جـــــــــــامـــعة بنـــهـــا

كـــــلية الهندســـــــة ببنـــــــــها

كلية الهندسة ببنها - جامعة بنها
اللائحة الموحدة لبرامج البكالوريوس بنظام الساعات المعتمدة

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رب زدني علما

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أولا: مقدمة

لقد بدأ التعليم الهندسى فى نهاية القرن التاسع عشر كإحدى الركائز المطلوبة للاستفادة من ثورة الاكتشافات العلمية التى صاحبت الثورة الصناعية. ومع التطور الذى حدث فى نهاية القرن التاسع عشر وبداية القرن العشرين وُضعت مهمتان رئيسيتان هما مهمة العلم والعالم ومهمة الهندسة والمهندس ، حيث تسعى الأولى إلى توسيع إطار المعرفة فى المجالات التى تفيد البشرية، فى حين تسعى المهمة الثانية إلى الاستفادة من المعرفة العلمية في ما ينفع الإنسان والمجتمع من خلال تطوير منتجات جديدة أو فتح مجالات جديدة تلبي احتياجات الإنسان والمجتمع.

ومن الواضح أن التعليم الهندسى يهدف إلى توفير الكوادر القادرة على الاستفادة من التقدم العلمى فى استنباط منتجات جديدة تلبي متطلبات المجتمع، إلا أن استفادة المجتمع من تلك المنتجات الجديدة لا تتحقق إلا بتصنيعها، الأمر الذي يتطلب توفير الطاقات الإنتاجية المناسبة وإعداد المستندات الفنية والهندسية وتوفير العدد والآلات ومعدات القياس وتخطيط ومتابعة الإنتاج ومراقبة الجودة والعناية بالصيانة وتصنيع قطع الغيار وغيرها من العناصر الإنتاجية.

إن احتياج سوق العمل لكوادر بشرية مدربة ومؤهلة للعمل في المجالات الهندسية المختلفة يتطلب إعداد مهندس على معرفة كافية بالعلوم الهندسية الحديثة إلى جانب القدرة على التطبيق والمزج بين فروع المعرفة المختلفة.

لقد أوضحت هذه الرؤية منذ سنوات عديدة لدى الدول المتقدمة والرائدة فى المجالات الصناعية والهندسية، وبعض دول العالم الثالث كفاءتها، وكان من أهم أثار ذلك ما نراه ونلمسه واضحا من تقدم علمى وصناعى وتكنولوجى جعل هذه الدول رائدة فى تلك المجالات.

إن مواكبة التقدم العلمي والتكنولوجي المتنامي يتطلب التطوير المستمر لبرامج التعليم الهندسي اللازمة لإعداد أجيال من المهندسين تساهم في التطوير والدعم الهندسي المطلوب للقطاعات الصناعية والمدنية وخدمة المجتمع.

الرؤية والرسالة وأوجه التميز

أ. الرؤية

تتطلع الكلية لتحقيق مكانة متميزة على المستوى القومي و الإقليمي و الدولي في التعليم الهندسي و البحث العلمي و الابتكار لتحقيق التنمية المستدامة للمجتمع.

ب. الرسالة

تلتزم الكلية بإعداد كوادر هندسية مزودة بالمعارف والمهارات اللازمة للمنافسة فى سوق العمل ، وقادرة على استخدام وتطوير التكنولوجيا الحديثة، وتقديم بحوث فى المجالات الهندسية بما يخدم المجتمع والبيئة.

ت. أوجه التميز في هذه الخطة

تتوجه الخطة الجديدة إلى التأكيد على أهمية الربط بين التعليم و التعلم، كذلك تعتمد على إدخال تكنولوجيات حديثة في أساليب التعليم مثل التعليم الإلكتروني و التعليم عن بعد بالإضافة إلى التوجه للتعليم المتكامل و ذلك من خلال:

1 ـ برامج دراسية حديثة تتوافق مع احتياجات سوق العمل.

2 ـ محتوى علمى يركز على الجوانب الهندسية والتطبيقية.

3 ـ برامج للتدريب الميدانى تصقل مهارات الطالب وتؤهله لمواكبة سوق العمل.

4 ـ التركيز على استخدام تطبيقات الحاسب الآلى فى الهندسة.

5 ـ إثراء الطالب باللغة الأجنبية الفنية.

6 ـ حزمة من المواد الاختيارية تحقق طموح الطلاب فى برامج دراسية مرنة.

تطور إنشاء الكلية وأقسامها العلمية

أُنشئت كلية هندسة بنها عام 1988م تحت مسمى المعهد العالى للتكنولوجيا ببنها التابع لوزارة التعليم العالى وكانت مدة الدراسة به خمس سنوات للحصول على درجة البكالوريوس في الهندسة. وفى عام 1993 م بدأت برامج الدراسات العليا في الكلية ببرنامجين لنيل درجة الماجستير والدبلوم. وانضم المعهد العالى للتكنولوجيا ببنها تحت مظلة جامعة بنها عام 2006 م، وتم تغيير مسمى المعهد العالى للتكنولوجيا ببنها إلى كلية الهندسة ببنها عام 2011 م. ومنذ بدايتها سارت الكلية على طريق النمو الكمي والتطور النوعي، ففي عام 2012 تم اعتماد وتطبيق اللائحة الجديدة لكلية الهندسة ببنها. وفى عام 2013 تم اعتماد وتطبيق اللائحة الجديدة للدراسات العليا لتشمل برنامجاً لنيل درجة الدكتوراه بالإضافة إلي برنامجي الماجستير و الدبلوم.
وتشهد الكلية زيادة مضطردة في أعداد طلابها وفي أعداد أعضاء هيئة التدريس فيها. ومنذ انشائها يتمتع خرجيها بمستوى فنى متميز وأكاديمي رفيع، كما أن إنتاجها العلمي والبحثي إنتاج متميز ومعروف على المستوى الدولي. وبدأت الكلية بثلاثة أقسام هي: الهندسة الميكانيكية و الهندسة الكهربائية والهندسة المدنية بالإضافة لقسم العلوم الهندسية الأساسية، ثم سعت ادارة الكلية مؤخرا لإنشاء قسم الهندسة المعمارية لسد عجز المجتمع المحيط بالكلية لهذا التخصص، وقد تم تحديث لائحة الكلية عام 2016 لتشمل قسم الهندسة المعمارية، وتم اعتمادها من لجنة قطاع الدراسات الهندسية والمجلس الأعلى للجامعات في نوفمبر 2016.

تضم الكلية العديد من المعامل والمختبرات المزودة بأحدث التقنيات والتجهيزات الحديثة التي تساعد الطالب والباحث في إجراء البحوث والدراسات. وتسعى الكلية ببذل كل جهد لخدمة المجتمع ومهنة الهندسة من خلال

تقديم برامج متخصصة متميزة وتقديم الاستشارات الهندسية للقطاع الخاص والحكومي وتقديم الدورات التدريبية وورش العمل المتخصصة وكذلك عقد المؤتمرات والمشاركة في الملتقيات العلمية محليا ودوليا.

وتضم الكلية الأقسام العلمية التالية :

1. قسم الهندسة الميكانيكية.
2. قسم الهندسة الكهربية.
3. قسم الهندسة المدنية.
4. قسم العلوم الهندسية الأساسية.
5. قسم الهندسة المعمارية .

النظرة المستقبلية

كانت كلية الهندسة ببنها - جامعة بنها دائما سبّاقة في إنشاء التخصصات الجديدة والتي يحتاجها المجتمع المحلى والإقليمي والدولي مثل شعبة الهندسة الطبية وشعبة هندسة الميكاترونيات، ومع التقدم الصناعي في المجالات المختلفة على المستوى المحلي والمستوى الإقليمي والدولي بالإضافة إلى النهضة التى تشهدها مصر للمشاريع القومية فلقد برزت الحاجة إلى إنشاء عدد من البرامج متعددة التخصصات (Inter-Disciplinary Programs) لمنح درجة بكالوريوس العلوم في الهندسة في التخصصات التالية :

- الهندسة الكهروميكانيكية.
- هندسة وإدارة التشييد.
- هندسة المرافق والبنية التحتية
- هندسة الميكاترونيات و الأتمتة

الأهداف الأستراتيجية للكلية

- تخريج مهندسين على معرفة بالأساليب الهندسية الحديثة.
- إعداد الكوادر القادرة على إيجاد حلول للمشاكل الهندسية واتخاذ القرارات.
- إعداد مهندسين قادرين على المنافسة في سوق العمل.
- تنمية القيم الأخلاقية والتربوية للخريجين بخلق مناخ تعليمي وتربوي متكامل.
- الإسهام في التطوير والدعم الهندسي اللازم للقطاعات الصناعية والخدمية وخدمة المجتمع.
- توفير دراسات عليا تتسم بمزج العلوم الهندسية بالتجريب والتطبيق لتنمية الفكر الابتكاري المتطور واللازم لتطور المجتمع.

- توفير دورات تعليم وتدريب مستمر تهدف إلى تطوير أداء المهندسين في المجالات الحديثة وغير التقليدية.
- استخدام إمكانيات الكلية بما يخدم المجتمع المحيط ويوفر فرصة لتدريب الطلاب.
- العمل كمركز للبحوث ودراسات الجدوى لحل المشاكل المرتبطة بالصناعة والإنتاج في البيئة المحيطة وتقديم الاستشارات الهندسية للمنشآت ولمشروعات البنية الأساسية بكافة أنواعها.

ثانيا: الأحكام العامة و الانتقالية و مواد اللائحة

مادة (1) أحكام عامة

1. تطبق أحكام قانون تنظيم الجامعات ولائحته التنفيذية واللائحة الداخلية للكلية وغيرها من اللوائح الجامعية فيما لم يرد فى شأنه نص فى هذه اللائحة
2. يخضع الطالب لقانون تنظيم الجامعات ولائحته التنفيذية و القواعد المنظمة الصادرة من الجامعة . أما مالم يذكر فيه نص فتطبق عليه أحكام هذه اللائحة.
3. يسمح للكلية بإضافة مقررات لقائمة المقررات الاختيارية وذلك بموافقة مجلس القسم العلمي ومجلسي الكلية والجامعة دون الرجوع للجنة القطاع الهندسى.
4. لمجلس الكلية بعد موافقة مجلس القسم العلمي المختص، الموافقة على تغيير جزئي للمحتوى العلمى للمقرر بما لايتعارض مع اسم المقرر وأهدافه بنسبة لاتتعدى 20%.

مادة (2) أحكام إنتقالية

1- تعقد المحاضرات لعدد لا يزيد عن مائة وعشرين طالبا ويلقيها أحد الأساتذة أو الأساتذة المساعدين أو المدرسين، وعلى القائم بالتدريس الإشراف على التمارين والتمارين التطبيقية وتحتسب ساعات إشراف بواقع عدد ساعات التمرين و التمرين التطبيقي المحددة للمقرر.

2- يقوم بتدريس التمارين عضو من هيئة التدريس وأحد معاونيه أو اثنان من معاونى أعضاء هيئة التدريس لكل مجموعة مكونة من 20 طالبا.

3- تعامل التمارين التطبيقية تعامل معاملة التمارين ويقوم بتدريس المواد التطبيقية للمجموعة المكونة من 10 طلاب عضو هيئة تدريس وأحد معاونيه أو اثنان من معاونى أعضاء هيئة التدريس بالإضافة إلى اثنين من القائمين بالتدريب العملى بالورش أو المعامل.

4- بالنسبة للتدريب الميدانى يتم فى المراكز الصناعية والشركات الهندسية ويشرف على التدريب عضو هيئة تدريس واحد وأحد معاونيه ويعاون فى تنظيم التدريب إدارى واحد من الكلية لما لايقل عن 5 طلاب في المجموعة الواحدة ، بالإضافة إلى مهندس من المصنع لكل خمسة طلاب على أن تصرف لكل منهم مكافأة بواقع 5 % من أساس المرتب عن كل يوم تدريب.

مادة (3) منح الدرجات العلمية

تقدم كلية الهندسة ببنها مجموعة من البرامج الهندسية. ويدير البرنامج مجلس إدارة للبرنامج. تنقسم البرامج إلى برامج تخصصية والبرامج متعددة التخصصات (Inter-Disciplinary Programs). يتم اختيارهم بعناية لتلبية احتياجات المجتمع والصناعة وكذلك الاحتياجات الإقليمية التي تستقطب العديد من الخريجين المصريين.

جدول (1) قائمة البرامج التي تقدمها كلية الهندسة ببنها – جامعة بنها

البرامج الهندسية	البرامج التخصصية	الهندسة الميكانيكية	1	هندسة التصميم والإنتاج الميكانيكي Mechanical Design and Production Engineering Program
			2	هندسة القوي الميكانيكية Mechanical Power Engineering Program
			3	هندسة الميكاترونيات Mechatronics Engineering Program
		الهندسة الكهربية	4	هندسة الإلكترونيات والاتصالات الكهربية Electronics and Electrical Communications Engineering Program
			5	الهندسة الطبية الحيوية Biomedical Engineering Program
			6	هندسة القوي والآلات الكهربية Electrical Power and Machines Engineering Program
			7	هندسة الحاسبات ونظم التحكم Computer and Control Systems Engineering Program
		الهندسة المدنية	8	الهندسة المدنية Civil Engineering Program
		الهندسة المعمارية	9	الهندسة المعمارية Architectural Engineering Program
	البرامج متعددة التخصصات (Inter-Disciplinary Programs)	الهندسة الكهروميكانيكية	10	Elctromechanical Engineering Program
		هندسة و إدارة التشييد	11	Construction Engineering and management Program
		هندسة المرافق و البنية التحتية	12	Infrastructure and Utilities Program
		هندسة الميكاترونيات و الأتمتة	13	Mechatronics Engineering and Automation Program

تمنح جامعة بنها بناء على طلب من مجلس كلية الهندسة ببنها درجة البكالوريوس فى التخصصات التالية :

1- بكالوريوس العلوم في الهندسة الميكانيكية

- برنامج هندسة التصميم والإنتاج الميكانيكي.
- برنامج هندسة القوي الميكانيكية.
- برنامج هندسة الميكاترونيات.
- برنامج الهندسة الكهروميكانيكية
- برنامج هندسة الميكاترونيات و الأتمتة

2- بكالوريوس العلوم في الهندسة الكهربية

- برنامج هندسة الإلكترونيات والاتصالات الكهربية.
- برنامج الهندسة الطبية الحيوية.
- برنامج هندسة القوي والآلات الكهربية.
- برنامج هندسة الحاسبات ونظم التحكم.

3- بكالوريوس العلوم في الهندسة المدنية

- برنامج الهندسة المدنية.
- برنامج هندسة و إدارة التشييد
- برنامج هندسة المرافق و البنية التحتية

4- بكالوريوس العلوم في الهندسة المعمارية

- برنامج الهندسة المعمارية.

ويشترط على الطالب إتمام المتطلبات الأكاديمية اللازمة لأحد تلك البرامج للحصول على الدرجة العلمية فى التخصص المطلوب وتكون الدراسة فى هذه البرامج بنظام الساعات المعتمدة وباللغة الإنجليزية.

مادة(4) الأقسام العلمية

تقدم المقررات في كلية الهندسة ببنها من خلال خمسة أقسام علمية جدول (2).

جدول (2) الأقسام العلمية – كلية الهندسة ببنها – جامعة بنها

م	القسم العلمي
1	قسم العلوم الهندسية الأساسية
2	قسم الهندسة الميكانيكية
3	قسم الهندسة الكهربية
4	قسم الهندسة المدنية
5	قسم الهندسة المعمارية

تقع مسؤولية القسم العلمي كالتالي:

- تدريس المقررات لجميع البرامج والتي تحتاج إلى مقررات في تخصص القسم و كذلك البحث العلمي.

- القسم العلمي هو المسؤول عن تدريس المحتوى العلمي للمقرر وترشيح أعضاء هيئة التدريس لكل مقرر سواء من القسم أو من قسم آخر أو من خارج الكلية.

- إقتراح انتداب أعضاء هيئة التدريس من خارج الكلية خاضع لموافقة مجلس الكلية إذا دعت الحاجة.

- القسم هو المسؤول عن التطوير المستمر لمناهج التدريس والمحتوى العلمي للمقررات.

الموضوعات التالية خاصة بالقسم العلمي المختص بالتدريس وإجراء البحوث فيها على النحو التالي:

1. قسم العلوم الهندسية الأساسية: الرياضيات والفيزياء والميكانيكا والكيمياء.
2. قسم الهندسة الميكانيكية:

- تخصص هندسة التصميم والإنتاج: تكنولوجيا السباكة واللحام، هندسة صناعية، هندسة مواد، ميكانيكا القياسات، ميكانيكا الآلات والتحكم الآلي، التصميم والرسم الهندسي، قطع المعادن، تشكيل المعادن، التصنيع الرقمي، تخطيط المصانع، هندسة الجودة.
- تخصص هندسة القوى الميكانيكية: الديناميكا الحرارية وديناميكا الغازات، انتقال الحرارة والكتلة، ميكانيكا الموائع، الاحتراق، أنظمة الطاقة الحرارية ومحركات الاحتراق الداخلي والتكييف والتبريد، التحكم الآلي والقياسات للنظم الحرارية، أنظمة الطاقة الجديدة و المتجددة.
- تخصص الميكاترونيات: الأتمتة والتحكم، التصميم المدمج، تصميم وتصنيع الميكاترونكس، الروبوتات وتطبيقات الميكاترونكس، الأنظمة الميكاترونية في الصناعة، الأنظمة الميكاترونية في السيارات.

3. قسم الهندسة الكهربية:

- تخصص هندسة القوى والآلات الكهربائية: أساسيات الهندسة الكهربائية، الآلات الكهربائية، أنظمة القوى الكهربائية، الجهد العالي، إلكترونيات القوى، هندسة القطع و الحماية ، القياسات الكهربائية والاختبار والتحكم في أنظمة الطاقة.
- تخصص هندسة الإلكترونيات والاتصالات الكهربائية: المواد الكهربائية، القياسات الإلكترونية، الهندسة الإلكترونية، الدوائر الإلكترونية، الاتصالات، الموجات الكهرومغناطيسية، الاختبارات الكهربائية، الدوائر المتكاملة.
- تخصص هندسة الحاسبات والنظم: هندسة البرمجيات ، شبكات الحاسوب، الأمن الرقمي، تنظيم الحاسوب، الرقمية، تصميم الدوائر والأنظمة المدمجة والذكاء الاصطناعي والتطبيقات والوسائط المتعددة، المعالجة وهندسة النظم وتطبيقات الكمبيوتر.

4. قسم الهندسة المدنية: التحليل الإنشائي، تصميم الهياكل الخرسانية، تصميم الهياكل الفولاذية، اختبار الخصائص وقوة المواد وضبط الجودة، والهندسة الجيوتقنية والأساسات، و هندسة التشييد وإدارة المشاريع، ميكانيكا الموائع، الهيدروليكا، المساحة والجيوديسيا، هندسة الري و الصرف، المسح التصويري والاستشعار عن بعد ، هندسة النقل المرور ، الصرف الصحي، الهندسة البيئية ، تخطيط النقل ، الطرق والمطارات.

5. قسم الهندسة المعمارية: التصميم المعماري، نظرية العمارة، تاريخ العمارة، تطبيقات الحاسب في الهندسة المعمارية والرسومات التنفيذية وتكنولوجيا البناء والتشريعات وإدارة المشاريع، الحفاظ على المباني وترميم التراث المعماري، التصميم الحضري ، التخطيط الحضري ، تخطيط المدن، الدراسات البيئية، وإعادة تأهيل المواقع التاريخية والتراثية.

ثالثا: لائحة الدراسة بنظام الساعات المعتمدة

مادة(5) نظام الدراسة بالبرامج الأكاديمية

يطبق نظام الساعات المعتمدة فى جميع المقررات الدراسية بالبرامج الأكاديمية وفقاً للقواعد التنفيذية للدراسة و التي يقرّها مجلس الجامعة ولجنة قطاع الدراسات الهندسية والتكنولوجية والصناعية بالمجلس الأعلى للجامعات.

مادة (6) معيار الساعة المعتمدة طبقا للإطار المرجعى (2020)

أولا: بالنسبة للمحاضرات: تحسب ساعة معتمدة واحدة لكل محاضرة مدتها ساعة واحدة أسبوعيا خلال الفصل الدراسى الواحد.

ثانيا : بالنسبة للتمارين التطبيقية والدروس العملية: تحسب ساعة معتمدة واحدة لكل 2-3 ساعة اتصال إسبوعيا خلال الفصل الدراسى الواحد.

ثالثاً : تنقسم ساعة الاتصال الواحدة إلي 50 دقيقة تدريس فعلي و10 دقائق راحة.

مادة(7) رئيس القسم العلمي

يقوم رئيس القسم العلمى بالمهام التالية:

1- تحقيق الأهداف والسياسات العليا في الكلية.
2- الإشراف على إدارة شؤون القسم التعليمية والبحثية والإدارية.
3- تنسيق مع رؤساء الأقسام العلمية الأخرى فى ترشيح السادة أعضاء هيئة التدريس للقيام بأعباء تدريس المقررات كل في مجال تخصصه.
4- .إعداد الخطط التشغيلية للقسم ومتابعة تنفيذها.
5- الإشراف على عملية التطوير الأكاديمي للبرامج بالقسم.
6- الإشراف على التدريب الميدانى.
7- الإشراف على المؤتمر العلمى للبرنامج.
8- الإشراف على تطوير البنية التحتية من مدرجات وقاعات ومعامل.
9- الإشراف على أعمال الجودة بالبرامج.

10- الإشراف على عملية معادلة المقررات الدراسية في القسم.

11- إعداد تقرير سنوي شامل عن سير الدراسة والأداء الأكاديمي والإداري والبحثي في القسم ورفعه إلى عميد الكلية.

مادة (8) منسق البرنامج

يتم اختيار منسق لكل برنامج بقرار من مجلس الكلية بناء على إقتراح من مجلس القسم العلمي المختص أو مجلسي القسمين بالنسبة للبرامج البينية لمدة عامين دراسيين قابلة للتجديد وفق المعايير التالية:

1- أن يكون أحد أعضاء هيئة التدريس العاملين بالقسم ذو كفاءة في مجال تخصصه.
2- أن يتمتع بمهارات القيادة والإدارة والقدرة علي العمل بمهارة مع الفريق.
3- أن يتمتع بمهارات الاتصال الفعال مع الزملاء، والقيادات الأكاديمية، والإدارية.
4- أن يكون لديه رؤية ويطرح حلول مبتكرة
5- أن يكون لديه خبرة في مجال جودة وتطوير التعليم.
6- أن يكون علي دراية بنماذج توصيف و تقارير البرامج والمقررات الدراسية.
7- أن يكون لديه خبرة في كيفية إجراء وصياغة دراسة التقييم الذاتي.
8- أن يشارك في الأنشطة الطلابية.
9- أن يكون لديه سيرة ذاتية تؤهله للتميز في إنجاز المهام المحددة، وسجل وتاريخ وظيفي يشهد له بالنزاهة والالتزام.

ويقوم منسق البرنامج بالمهام التالية :

1- متابعة تنفيذ البرنامج الدراسي من خلال:
   - التحقق من اكتساب الطلبة لمخرجات تعلم البرنامج الدراسي.
   - التحقق من تطبيق استراتيجيات التدريس الموصى بها في توصيف مقررات البرنامج الدراسي.
   - التحقق من تطبيق طرق تقييم الطلبة الموصى بها في توصيف مقررات البرنامج الدراسي.
   - متابعة تفسير النتائج غير الطبيعية لطلبة المقرر الدراسي مع مدرس المقرر.
2- دراسة الصعوبات التي تواجه تنفيذ البرنامج الدراسي، ورفع تقرير بذلك إلى رئيس القسم.
3- رفع المقترحات المتعلقة بتطوير المقررات الدراسية إلى رئيس القسم.
4- الإشراف على عمليات التسجيل الأكاديمى للطلاب و متابعة الخطة الدراسية للطلاب.
5- متابعة الإرشاد الأكاديمى للطلاب.

6- عرض معادلة المقررات للطلاب المحولين من برامج أخرى أو من كليات أخرى على رئيس القسم المختص.
7- متابعة العملية التعليمية ومراجعة التقارير الخاصة بالمقررات من السادة أعضاء هيئة التدريس لتحسين العملية التعليمية.
8- إعداد ومناقشة التقرير السنوي للبرنامج الدراسي مع أعضاء هيئة التدريس بالقسم، ورفع التقرير السنوي للبرنامج والتوصيات المتعلقة به إلى رئيس القسم.
9- عرض خطة المقررات في بداية كل فصل دراسي.
10- جمع البيانات الإحصائية المتعلقة بالبرنامج الدراسي، ورفع تقرير بذلك إلى رئيس القسم.
11- دراسة الاحتياجات التدريبية لأعضاء القسم، ورفع تقرير بذلك إلى رئيس القسم.
12- متابعة انتظام العملية التعليمية والجداول الدراسية.
13- .تطبيق نظم ولوائح الجودة والتقويم والاعتماد الأكاديمي .
14- المتابعة مع لجنة جودة البرنامج لعمل الدراسة الذاتية أو التقريرالسنوي للبرنامج.

مادة (9) لجنة شئون الطلاب

تشكل لجنة شئون التعليم و الطلاب برئاسة وكيل الكلية للتعليم و الطلاب و تختص لجنة شئون الطلاب بدراسة كل الشئون الخاصة بالطلاب طبقا للمادة (28) من قانون تنظيم الجامعات:

1- إبداء الرأي في قبول تحويل الطلاب و نقل ووقف القيد و قبول الأعذار.
2- تنظيم التدريب العملي للطلاب.
3- تتبع نتائج الامتحانات و دراسة الإحصاءات الخاصة بها، و تقارير لجان الامتحان عن مستوياتها، و تقديم التوصيات اللازمة في شأنها إلى مجلس الكلية.
4- تنظيم المكافأت و المنح الدراسية.
5- تتبع النشاط الثقافي و الرياضي و الاجتماعي للطلاب و تقديم الاقتراحات الكفيلة برفع مستواه.
6- تنظيم سياسة علمية للطلاب، بحيث يكون لكل مجموعة من طلاب الفرقة الدراسية رائد من أعضاء هيئة التدريس، يعاونه مدرس مساعد أو معيد للوقوف على مشاكلهم العلمية و توجيههم و العمل على حلها بمعرفة إدارة الكلية و أساتذتها.

يتم عرض جميع توصيات لجنة شئون التعليم والطلاب على مجلس الكلية للاعتماد. و يتم تصعيد الأمور المتعلقة بشؤون الطلاب على مستوى الجامعة في مسارين:

1. مجلس التعليم و الطلاب بجامعة بنها للطلبة الملتحقين بالبرامج التخصصية.
2. مجلس برامج جامعة بنها للطلاب المقيدين بالبرامج متعددة التخصصات.

مادة (10) المنسق العام للتحول الرقمى بالبرامج

يعين بقرار من السيد الأستاذ الدكتور عميد الكلية بعد ترشيح السيد الأستاذ الدكتور وكيل الكلية لشئون التعليم والطلاب بالكلية منسق عام للتحول الرقمى للبرامج من السادة أعضاء هيئة التدريس بالكلية من أصحاب الخبرات فى العمل بنظام الساعات المعتمدة لمدة عامين دراسيين قابلة للتجديد وعليه القيام بالمهام التالية:

1- الإشراف على تجهيز البنية التحتية للتحول الرقمى من شبكات و نقاط اتصال بشبكة الإنترنت.
2- مراجعة أعمال التسجيل للطلاب إلكترونيا.
3- مراجعة تصحيح الاختبارات الإلكترونية.
4- رفع نتائج الطلاب على المنصة الرقمية للجامعة.

مادة (11) مجلس إدارة البرامج

يقوم مجلس القسم العلمي المختص بدور مجلس الإدارة للبرامج التخصصية (المجانية)، أما البرامج متعددة التخصصات (غير المجانية) تشكل مجالس إدارتها طبقا للائحة الموحدة للبرامج بالجامعة. ويختص مجلس إدارة البرامج بالنظر في جميع الاجراءات العلمية والدراسية والإدارية والمالية المتعلقة بالبرامج متعددة التخصصات ، وبالأخص الإجراءات الآتية :

أ. التخطيط الاستراتيجي للبرامج.
ب. الأنشطة التسويقية للبرامج.
ت. إجراء دراسات الجدوى الخاصة بفتح وتجميد البرامج الأكاديمية.
ث. جميع المسائل المالية المتعلقة بتشغيل البرامج.
ج. دراسة الاستثناء من القواعد الواردة في لوائح وأنظمة الكلية.
ح. اقتراح السياسات للمحافظة على جودة التعليم والتعلم في البرامج.
د. مراجعة تقارير اللجان التوجيهية للبرامج وتقارير لجنة شئون التعليم والطلاب.
ذ. التعامل مع تظلمات الطلاب فيما يتعلق بمقررات معينة.
ر. أي مسائل أخرى تتعلق بتشغيل البرامج.

وترفع جميع توصيات مجلس إدارة البرامج إلى مجلس الكلية للاعتماد النهائي.

مادة (12) إجراءات إضافة / تجميد البرامج

- يمكن لأي قسم من أقسام الكلية اقتراح برنامج تخصصي جديد ضمن تخصص هذا القسم. كما يمكن أن يقترح أكثر من قسم برنامجًا جديدًا متعدد التخصصات.
- يجب تقديم مقترح البرنامج متضمنًا جميع معلومات البرنامج كما في هذه اللوائح بالإضافة إلى دراسة جدوى لاحتياجات الصناعة والمجتمع لخريجي البرنامج الجديد. ويجب أن يتضمن الاقتراح أيضًا مراجعة الموارد المتاحة داخل الكلية لتشغيل هذا البرنامج.
- يجب تقديم جميع المقترحات إلى مجلس إدارة البرامج الذي يقوم بدراسة الاقتراح ورفع التوصية إلى مجلس الكلية.
- بعد الموافقة عليها من قبل مجلس الكلية، يتم إحالتها إلى الجامعة لإحالتها إلى المجلس الأعلى للجامعات ومن ثم إضافتها إلى هذه اللوائح.
- يمكن لمجلس الكلية، بناءً على توصية مجلس القسم المختص أو المجالس المختصة، تجميد البرنامج إذا لزم الأمر.

مادة (13) شروط القيد ومتطلبات الإلتحاق

كلية الهندسة ببنها هي مؤسسة تعليمية حكومية تتبع جامعة بنها.و تتبع النظم و اللوائح الصادرة عن المجلس الأعلى للجامعات. كما أنها تقدم التعليم في البرامج المتخصصة مجانًا. و الطلاب الذين يستفيدون من هذا التعليم المجاني هم أولئك الذين أكملوا شهادة الثانوية المصرية (الثانوية العامة) أو ما يعادلها، والتحق بها من خلال مكتب التنسيق في نفس عام الحصول على هذه الشهادة أو ما يعادلها. يحافظ الطالب على تعليمه المجاني طالما أنجز الشروط المنصوص عليها في قانون تنظيم الجامعات و لائحته التنفيذية.

- يتم تقديم جميع البرامج في هذه اللوائح بنظام الساعات المعتمدة.
- تنقسم البرامج في هذه اللوائح إلى فئتين: تخصصية ومتعددة التخصصات.
- تضع الكلية من خلال مجلس الكلية القواعد العامة للالتحاق بالبرامج المختلفة بحيث تكون رغبة الطالب ومبدأ تكافؤ الفرص هي الأساس في قبول الطلاب بنظام الدراسة ببرامج الساعات المعتمدة بناء على القدرة الاستيعابية للكلية.
- يسمح لطلاب التعليم المجاني بالتسجيل في البرامج المتخصصة، بينما تخضع قواعد الالتحاق بالبرامج متعددة التخصصات (المعروفة سابقًا باسم البرامج المميزة) للوائح المنظمة في هذا الشأن طبقا لما تضعه الجامعة من شروط ولها رسوم دراسية منفصلة طبقا للائحة الأكاديمية الموحدة بالجامعة.

• الطلاب غير الملتحقين مباشرة بكلية الهندسة ببنها من خلال مكتب التنسيق ولكنهم حققوا الحد الأدنى للقطاع الهندسي يخضعون لقواعد التحويل الصادرة من المجلس الأعلى للجامعات في هذا الشأن سنة الالتحاق، أما طلاب السنوات السابقة يتم قبولهم شرط أن ينضم إلى البرامج متعددة التخصصات ذات الرسوم الدراسية المنفصلة التي يقررها مجلس الكلية كل عام.

• الطلاب المقيدين مباشرة بكلية الهندسة ببنها من خلال مكتب التنسيق، لهم الحق في الانضمام إلى البرامج متعددة التخصصات التي تدفع رسوم دراسية منفصلة.

• يمكن لمجلس الكلية تقديم منح دراسية إضافية بالبرامج متعددة التخصصات التي تدفع رسوم دراسية منفصلة للطلاب الذين حققوا الحد الأدنى من المعدل التراكمي، أو الطلاب ذوي القدرات المالية المحدودة، وفق القواعد التي يعلنها المجلس كل عام بناء على اقتراح مجلس إدارة البرامج.

• يتم إعفاء أعلى ثلاثون طالب من أوائل الثانوية العامة - القسم العلمي (شعبة الرياضيات إن وجدت) طبقا للترتيب التكراري من رسوم الدراسة عند الالتحاق بالبرامج متعددة التخصصات. ويستمرالإعفاء طيلة مدة الدراسة إذا حافظ الطالب على معدل تراكمي لا يقل عن 3.7 في كل فصل دراسي، وإلا فإن الطالب سيفقد هذا الامتياز وسيتم تطبيق القواعد الأخرى عليه.

- يتم إعفاء الطلاب الخمسة الأوائل في الفرقة الإعدادية في أي كلية هندسة حكومية من الرسوم الدراسية عند الإلتحاق بالبرامج متعددة التخصصات و يستمر الإعفاء إذا حافظ الطالب على معدل تراكمي 3.7 أو أكبر وإلا فإن الطالب سيفقد هذا الامتياز وسيتم تطبيق القواعد الأخرى عليه.
- يتم منح الطلاب المتفوقين دراسيا داخل البرامج متعددة التخصصات تخفيضات في الرسوم الدراسية كالتالي:
  - إذا كان $GPA \geq 3.7$ تخفيض يصل إلى 20 %
  - إذا كان $3.3 \leq GPA \leq 3.7$ تخفيض يصل إلى 10 %

• إذا لم يحقق طالب البرامج المتخصصة معدل تراكمي ≤ 2.0 لمدة 4 فصول دراسية رئيسية متتالية، يمكن السماح له بتسجيل مقررات لفصلين دراسيين لرفع معدله و في حالة عدم تحقيق ذلك يمكن للطالب الانتقال إلى البرامج متعددة التخصصات مع دفع الرسوم الدراسية المقررة.

• إذا رسب الطالب المسجّل في أي من البرامج المتعددة التخصصات- في مقرر ما مرتين، فيُسمح له بتسجيل هذا المقرر مرة أخرى لمدة 4 مرات أخرى مقابل رسوم إضافية يقررها مجلس الكلية كل عام في سنة تسجيل المقرر.

- يسمح لطلبة البرامج المتخصصة بالتسجيل في المقررات المطلوبة للحصول على الدرجة ضمن متطلبات برنامجه. وأي ساعات معتمدة مسجلة بعد الساعات المعتمدة المطلوبة للبرنامج لأي سبب من الأسباب غير المقبولة يتم تحصيل الرسوم الدراسية المنفصلة التي يقررها مجلس الكلية كل عام في سنة تسجيل المقرر.
- يمكن لطلاب البرامج المتخصصة فقط تسجيل المقررات في الفصول الدراسية الرئيسية. ومع ذلك فإنه يمكنهم ذلك تسجيل الدورات في الفصل الصيفي بدفع الرسوم الدراسية المنفصلة التي يقررها مجلس الكلية كل عام في سنة تسجيل المقرر.
- لكي يكون الطالب منتظما في البرنامج يجب أن يكون مسجلا ل12 ساعة معتمدة على الأقل (مالم يكون الطالب خريجا) بعد موافقة المرشد الأكاديمي ومنسق البرنامج وألا تزيد عدد الساعات المسجلة عن 21 ساعة معتمدة طبقا لقواعد التسجيل و المعدل العام للطالب.
- يمكن لأي طالب غير ملتحق بكلية الهندسة ببنها دراسة أي عدد من المقررات مع سداد الرسوم الدراسية التي يقررها مجلس الكلية كل عام في سنة تسجيل المقرر، و يحصل الطالب على بيان الدرجات طبقا للائحة.

مادة (14): الرسوم الدراسية للبرامج متعددة التخصصات (Inter-Disciplinary Programs)

- يتم تحديد الرسوم الدراسية ، المحددة لكل ساعة معتمدة ، طبقا للائحة الأكاديمية الموحدة بالجامعة. وعلى وكيل الكلية للتعليم و الطلاب الإعلان عن هذه الرسوم قبل بدء الدراسة بالسنة الأكاديمية.
- يتم دفع الرسوم الدراسية في كل فصل دراسي (الفصلين الأول والثاني) على أساس عدد الساعات المعتمدة التي يسجلها الطالب بحد أدنى 12 ساعة معتمدة لكل فصل دراسي ما لم يكن عدد الساعات المعتمدة المتبقي للحصول على الدرجة أقل من ذلك ، وفي هذه الحالة يجب على الطالب دفع مبلغ العدد الفعلي للساعات المعتمدة المسجلة.
- يدفع الطالب الرسوم المقررة كل فصل دراسي رئيسي مقابل الخدمات العامة و التدريب و الأنشطة اللاصفية داخل الحرم الجامعي.
- التسجيل في المقرر لايكون ساريا إلا بعد دفع الرسوم المقررة.

مادة (15) قواعد التحويل (تغيير البرنامج الدراسى) وإعادة القيد داخل الجامعة

- يجوز تحويل الطلاب من برنامج هندسى بنظام الساعات المعتمدة (من داخل الكلية) إلى أي من البرامج المدرجة فى لائحة الكلية وفقا للقواعد التى يحددها مجلس الكلية طالما لم يجتز الطالب 50% من متطلبات التخرج و بعد إجراء المقاصة اللازمة.
- على الطلاب الملتحقين ببرنامج و يرغبون فى الالتحاق للدراسة فى برنامج آخر، يجب عليهم أن يكونوا قد أنهوا مقررات المستوى العام بمتوسط تراكمى لايقل عن 2.0 وطبقا للقواعد التى يحددها مجلس الكلية ويقرها مجلس الجامعة بناء على القدرة الاستيعابية.
- إذا كان التحويل من كلية أخرى داخل الجامعة لايتم التحويل إلا عن طريق مكتب التحويلات المركزى بإدارة الجامعة ومع بداية العام الدراسى وبعد عمل المقاصات اللازمة .
- يستخدم الجدول رقم (3) لحساب التقديرات المكافئة عند تحويل الطالب من النظام الفصلى إلى نظام الساعات المعتمدة.
- يجوز قبول الطلاب الوافدين الحاصلين على الثانوية العامة أو مايعادلها وفقا للترشيحات التى ترد للكلية من الإدارة العامة للوافدين ويتولى مجلس الكلية اقتراح مقابل تكلفة الخدمات التعليمية بخلاف الرسوم الجامعية ويتم القبول طبقا للقواعد المنظمة.

مادة (16) قواعد التحويل من الجامعات الأخرى

يتم تقديم طلبات التحويل من جامعات أخرى طبقا للشروط التالية :

- يتم التحويل عن طريق مكتب التحويلات المركزى بإدارة الجامعة.
- أن يستوفى الطالب قواعد القبول بالكلية والشروط الأخرى التى يحددها المجلس الأعلى للجامعات.
- يجوز لمجلس الكلية قبول طلاب محولين من كليات هندسية حكومية تطبق النظام الفصلى فى بعض البرامج بالكلية بعد عمل المقاصات اللازمة للتحويل من النظام الفصلى إلى نظام الساعات المعتمدة طبقاً للأطر التى تضعها لجنة قطاع الدراسات الهندسية مع الالتزام بما نص عليه البند السابق .
- يجوز تحويل الطلاب من برامج ساعات معتمدة بجامعات أخري إلي البرامج متعددة التخصصات بالكلية بعد عمل المقاصات المطلوبة حيث لايتم احتساب أكثر من 50% من الساعات المعتمدة اللازمة لاجتياز البرنامج المحول إليه من الساعات التي أنهاها الطالب قبل التحويل بشرط عدم مرور أكثر من خمس سنوات دراسية على اجتيازها. و في جميع الأحوال يتم إجراء مقاصة لما درسه ليتم حسابه ضمن متطلبات الحصول على الدرجة دون احتسابها في حساب المعدل التراكمي للطالب.
- عدم احتساب أى ساعات معتمدة لمقررات مضى على دراستها خمس سنوات أكاديمية.
- لا يسمح بنقل الطلاب المفصولين من كليتهم بسبب تجاوزهم الحد الأقصى للفرص الأكاديمية أو الرسوب.

جدول رقم (3) التقديرات المكافئة عند التحويل من النظام الفصلى إلى نظام الساعات المعتمدة

النسبة المئوية	نظام الساعات المعتمدة	
	عدد النقاط	التقدير المناظر
95% فأكثر	4.0	A+
90% الى أقل من 95%		A
85% الى أقل من 90%	3.70	A-
80% الى أقل من 85%	3.30	B+
75% الى أقل من 80%	3.00	B
71% الى أقل من 75%	2.70	B-
68% الى أقل من 71%	2.30	C+
65% الى أقل من 68%	2.00	C
60% الى أقل من 65%	1.70	C-
55% الى أقل من 60%	1.30	D+
50% الى أقل من 55%	1.00	D
أقل من 50%	0.00	F

مادة (17) الدراسة فى جامعات اخرى

يسمح للطالب بدراسة ما لايزيد عن (40%) من الساعات المعتمدة للبرنامج الدراسي المقيد فيه الطالب فى جامعة أخرى معترف بها من المجلس الأعلى للجامعات وتحسب لهم هذه الساعات وفق الشروط التالية:

1- أن يكون الطالب أنهى بنجاح مالايقل عن 36 ساعة معتمدة بالبرنامج فى كلية الهندسة ببنها.
2- أن يحصل الطالب على توصية بالموافقة على المقررات التى سيقوم بدراستها فى الجامعة الأخرى من المرشد الأكاديمى وتعتمد من مجلس الكلية.
3- أن يتوافق المحتوي العلمي للمقرر فى حدود 80%.
4- أن يكون الطالب قد اجتاز كل المقررات المتطلبة للمقرر.

مادة (18) متطلبات الحصول على الدرجة

يشترط لحصول الطالب على درجة بكالوريوس العلوم في الهندسة:

1- اجتياز الساعات المعتمدة المطلوبة (160 ساعة معتمدة) بنجاح في أحد البرامج وفقًا للمتطلبات المنصوص عليها مع معدل تراكمي لا يقل عن 2.0.
2- النجاح فى جميع المقررات الدراسية التى لها (0) ساعة معتمدة .
3- مشروع التخرج هو جزء أساسي من متطلبات البرامج للتخرج. يمكن أن يكتمل مشروع التخرج على مدى فصلين دراسيين متتاليين حسب متطلبات البرنامج، ولن يتخرج الطالب ما لم يستوف متطلبات النجاح في المشروع.

4- يجب أن يقوم الطالب بالتدريب الميدانى مرتين علي الأقل بمدة لا تقل عن 4 أسابيع لكل تدريب خلال فترة دراسته.

5- يجب على الطالب أن يكون قد اجتاز 70% من الساعات المعتمدة على الأقل حتى يمكنه التسجيل فى مشروع التخرج .وإذا كان المشروع ينقسم إلى فصلين دراسيين فعلى الطالب أن يدرسهما وفقا لترتيبهما.ولايجوز التسجيل لمشروع التخرج خلال الفصل الدراسى الصيفى.

على أن يكون توزيع المقررات التى يحتوى عليها البرنامج (جدول 4)على النحو التالى:

جدول (4) توزيع المقررات الدراسية داخل البرنامج

المجموعات التخصصية	الحد الأدنى	الحد الأقصى	المكونات الأساسية
متطلبات الجامعة	%8	--	بناء شخصية الخريجين الثقافية ، وتنمية مهارتهم الشخصية ، والإدراك العام بقضايا المجتمع والتركيز على الهوية والإرتباط بالوطن
متطلبات الكلية	%20	--	الحد الأدنى للعلوم الأساسية والثقافة الهندسية والعلوم الهندسية الأساسية حول كافة التخصصات
متطلبات التخصص العام	%35	--	العلوم الهندسية الأساسية ومبادئ التصميم والتطبيقات فى التخصص العام (معلومات عن جميع التخصصات الدقيقة)
متطلبات التخصص الدقيق	--	%30	المهارات والعلوم الهندسية والتصميمات والتطبيقات الهندسة التخصصية

مع مراعاة أن تحقق الخطط الدراسية لكل برنامج المقررات والنسب الاسترشادية التى وضعتها الهيئة القومية لضمان جودة التعليم وتشمل المقررات التالية

1- العلوم الإجتماعية والإنسانية
2- إدارة الأعمال
3- العلوم الأساسية
4- الثقافة الهندسية
5- العلوم الهندسية الأساسية
6- التطبيقات الهندسية والتصميم
7- مشروع التخرج والتدريب الميدانى

مادة (19) مدة الدراسة

- تمنح الدرجة العلمية متى استوفى الطالب متطلبات الحصول عليها وفقا لما تحدده اللائحة الداخلية للبرنامج.

- يمكن أن يسمح للطالب المتفوق بالتخرج والحصول على درجة البكالوريوس فى الهندسة بنظام الدراسة بالساعات المعتمدة، فى مدة 4 سنوات دراسية، أو (ثمانية فصول دراسية رئيسية)، بعد اجتياز كافة متطلبات التخرج، هذا بالإضافة لمدة الدراسة العادية.
- الحد الأقصى للدراسة ضعف المدة المنصوص عليها والمقترحة فى البرنامج وهو ما لايشمل الفصول الدراسية المجمدة لأسباب مقبولة من مجلس الكلية وبعد هذه المدة يتم فصل الطالب من البرنامج.

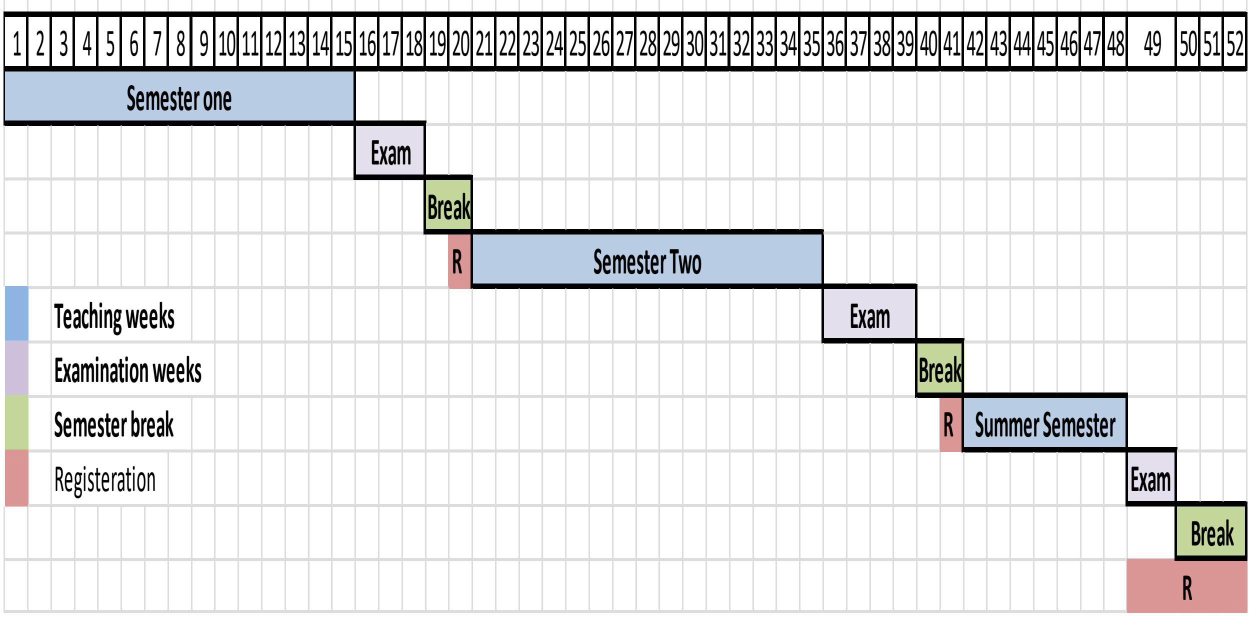
مادة(20) مواعيد الدراسة

تنقسم السنة الأكاديمية إلى ثلاثة فصول كالتالى:

1. **الفصل الدراسى الأول - فصل الخريف** (فصل رئيسى) ويبدأ مع بداية العام الدراسى الجامعى ولمدة 15 أسبوعا تدريسا.
2. **الفصل الدراسى الثانى- فصل الربيع** (فصل رئيسى) ويبدأ بعد إجازة منتصف العام الجامعى ولمدة 15 أسبوعا تدريسا.
3. **الفصل الدراسى الصيفى (فصل اختيارى)** ويبدأ فى شهر يوليو ولمدة 7 اسابيع تدريسية مع مضاعفة ساعات المقررات الدراسية.

يتم القيد والتسجيل قبل بداية كل فصل دراسى طبقا للتقويم الأكاديمي (شكل رقم 1)

Figure 1 Academic Calendar.



مادة (21) الأقسام العلمية المشتركة فى تنفيذ برامج الساعات المعتمدة

يشرف مجلس القسم المختص على تدريس جميع المقررات الدراسية (التخصصية) و القيام بكافة متطلبات الجودة و التقرير السنوي و الاستبيانات المقررة من قبل مجلس الكلية للبرنامج الذى يتبعه ويتم تدريس مقررات العلوم المختلفة من خلال الأقسام التالية كل فى تخصصه:

1- قسم الهندسة الميكانيكية .
2- قسم الهندسة الكهربية .
3- قسم الهندسة المدنية .
4- قسم الهندسة المعمارية.
5- قسم العلوم الهندسية الأساسية.
6- أقسام خارجية من كليات الطب فى برنامج الهندسة الطبية الحيوية.
7- أقسام خارجية من كليات الحقوق فى مجال التشريعات والقوانين والعقود والإنسانيات.
8- أقسام خارجية من كليات التجارة فى مجال اللوجستيات والإدارة .

لغة الدراسة و الاختبارات هى اللغة الإنجليزية ويجوز تدريس بعض المقررات باللغة العربية مثل الإنسانيات.

مادة (22) طرق التدريس والوسائل التعليمية

تعتمد الكلية على طرق التدريس التقليدية والحديثة على النحو التالى:

- **الطرق التقليدية** حيث تقوم على وسيلة يعرض بها المحاضر المادة العلمية وينقلها إلى طلابه بعد تبسيطها وتقوم هذه الطريقة فى الغالب على شرح المحاضر وفاعاليته.
- **الطرق الحديثة** تقوم على التفاعل بين المحاضر والطالب معا ، بمعنى أن يشترك كلاهما فى البحث عن المعلومة والتعلم الذاتى الذى يؤدى إلى إطلاق طاقات الطلاب وإبداعاتهم ويدفعهم للتعلم وتعتبر الوسائل الحديثة عنصرا من عناصر العملية التعليمية وتستخدم الكلية الوسائل التالية :
  - الوسائل البصرية (أجهزة العرض الضوئية المتصلة بالحاسب).
  - وسائل أخرى (الحاسب الألى – السبورات الذكية – المحاضرات عبر الإنترنت والفيديو).
  - دعوة الخبراء والمتخصصين من الصناعة أو ذوى الخبرة لعرض قصص النجاح والتطبيق العملي للدراسة.
  - يجوز لمجلس الكلية بعد أخذ رأى مجلس القسم المختص وحسب طبيعة المقررات الدراسية أن يقرر تدريس مقرر أو أكثر بنمط التعليم الهجين، بحيث تكون الدراسة فى المقرر بنسبة 60-70% وجهاً لوجه و30-40% بنظام التعليم عن بعد، وعلى أن يتم عرض ذلك على مجلس شئون التعليم والطلاب بالجامعة للموافقة عليه ورفعه إلى مجلس الجامعة لاعتماده.

مادة (23) قواعد الإنتظام فى الدراسة

الطلاب المسجلين بالبرامج عليهم الالتزام بالقواعد التالية:

(1) سداد الرسوم الدراسية

يتم دفع رسوم التسجيل والخدمات التعليمية طبقا لما يقرره مجلس الجامعة فى هذا الشأن.

(2) انتظام الحضور

يتولى أستاذ كل مقرر تسجيل حضور وغياب الطلاب عن المحاضرات أوالتمارين التطبيقية أو العملية ويخطر بذلك منسق البرنامج:

- يتم إنذار الطالب إنذارا أوليا عند تجاوزه نسبة غياب 10% من مجموع المحاضرات و التمارين.
- يتم إنذار الطالب إنذارا ثانيا عند تجاوزه نسبة غياب 20% من مجموع المحاضرات و التمارين.
- اذا زادت نسبة غياب الطالب عن 25% من مجموع المحاضرات و التمارين بدون عذر مقبول ومعتمد من مجلس الكلية يتم حرمان الطالب من دخول امتحان المقرر.
- إذا زادت نسبة الغياب للطالب عن 25% وكان غيابه بعذر مقبول يقبله مجلس الكلية يسجل للطالب تقدير غير مكتمل ولا تدخل فى حساب أيا من المعدل الفصلى أو التراكمى للطالب.

(3) إيقاف قيد الطالب

فى حالة قيام ولي أمر الطالب بتقديم طلب بإيقاف قيده فعليه سداد الرسوم الدراسية الإدارية الخاصة بذلك على أن يتم وقف القيد فى المواعيد المحددة من قبل مجلس الكلية.

(4) تغيير عنوان الطالب

على ولي أمر الطالب أن يخطر إدارة البرنامج بأى تغيير يحدث فى محل إقامته حتى تتم المراسلات للطالب على عنوانه الصحيح أو من خلال النظام الإلكتروني أو الإيميل الجامعي.

مادة (24) الفصل من الدراسة والإنذار الأكاديمى

- يحصل الطالب على إنذار أكاديمى إذا كان معدله التراكمى فى أى فصل دراسى رئيسى أقل من 2.0.
- يتم فصل الطالب من الدراسة إذا حصل على ستة إنذارات أكاديمية متتالية.
- إذا تجاوز المعدل الفصلى للطالب 2.0 فى أى فصل دراسى رئيسى ، فإنه يتم إعادة حساب عدد الإنذارات الأكاديمية المتتابعة.
- يتم فصل الطالب إذا لم يحقق متطلبات التخرج خلال المدة القصوى للدراسة (ضعف مدة البرنامج) طبقا للائحة.
- الطالب المعرض للفصل من الدراسة بسبب انخفاض معدله الفصلى إلى عن 2.0 تتاح له فرصة إضافية ونهائية للتسجيل بحد أقصى فصليين دراسيين رئيسيين متتالين بالإضافة إلى فصل الصيف لتحقيق متطلبات التخرج شريطة أن يكون أنجز بنجاح ما لايقل عن 80% من العدد الإجمالى للساعات المعتمدة اللازمة لتخرجه.

مادة (25) شروط تسجيل المقررات الدراسية

- يمكن للطالب أن يسجل مقررات دراسية فى الفصول الدراسية الرئيسية وفقا للقواعد التالية (بعد موافقة المرشد الأكاديمى للطالب)
  - حتى 21 ساعة معتمدة وذلك للطالب الحاصل على معدل تراكمى أكبر من أو يساوى 3.0
  - حتى 18 ساعة معتمدة وذلك عند التسجيل فى أول فصل دراسى للطالب أو للطالب الحاصل على معدل تراكمى أكبر من أو يساوى 2.0 .
  - حتى 14 ساعة معتمدة وذلك للطالب الحاصل على معدل تراكمى أقل من 2.0.
  - الحد الأدني لعدد الساعات المعتمدة المسجلة هو 12 ساعة معتمدة.
- يمكن للطالب تسجيل مقررات فى الفصل الدراسى الصيفى طبقا للقواعد التالية (بعد موافقة المرشد الأكاديمى)
  - حتى 9 ساعات معتمدة وذلك للطالب الحاصل على معدل تراكمى أكبر من أو يساوى 3.0 مالم يكن مسجلاً للتدريب الميداني.
  - حتى 8 ساعات معتمدة وذلك للطالب الحاصل على معدل تراكمى أقل من 3.0 مالم يكن مسجلاً للتدريب الميداني.
  - إذا كان الطالب مسجلاً للتدريب الميداني يمكنه تسجيل مقرر واحد بحد أقصي 3 ساعات معتمدة.
- يمكن للطالب تسجيل مقرر دراسى إضافى واحد عن الحدود المذكورة أعلاه إذا كان ذلك يؤدى إلى تخرجه وذلك بعد موافقة المرشد الأكاديمى.
- يسمح لإدارة البرنامج تحديد المقررات الدراسية التى يتم طرحها كل فصل دراسى عدا المقررات الضرورية للتخرج فيتم إتاحتها للتسجيل كل فصل دراسى.
- يمكن للطلاب التسجيل كمستمعين في بعض المقررات الدراسية وغير مسموح لهم دخول الامتحان النهائي للمقرر إلا بعد موافقة المرشد الأكاديمي و منسق البرنامج.

مادة (26) مستويات الدراسة

كلما استكمل الطالب نسبة محددة من متطلبات البرنامج سوف يتم نقله من مستوى للمستوى التالى ويوضح الجدول رقم (5) حالة الطالب استنادا إلى نسبة عدد الساعات المعتمدة التى تم اجتيازها بنجاح

جدول رقم (5) حالة الطالب استنادا إلى عدد الساعات المعتمدة المجتازة

المستوى الدراسى	تعريف موقع الطالب	نسبة عدد الساعات المعتمدة التى اجتازها الطالب بنجاح
الأول	المستوى العام (Freshman)	من 0 الى أقل من 25%
الثانى	المستوى الأول(sophomore)	من 25 الى أقل من 50%
الثالث	المستوى الثانى (Junior)	من 50 الى أقل من 75%
الرابع	المستوى الثالث(Senior)	من 75 الى 100%

مادة (27) التدريب الميداني

- يشمل كل برنامج تدريب ميداني لمدة لاتقل عن ثمانية أسابيع داخل القطاعات المتخصصة تحت إشراف أعضاء هيئة التدريس.
- يتولى متابعة التدريب مشرف معين من قبل إدارة البرنامج و يمنح بدل انتقال مرة واحدة أسبوعيا.

- يتم تحديد مسؤول الاتصال بجهة التدريب.
- يجب على الطالب تقديم تقرير فني إلى المشرف الأكاديمي في نهاية فترة التدريب.
- يجب على المنشأة تقديم تقييم للطالب إلى المشرف الأكاديمي في نهاية فترة التدريب.
- ينقسم التدريب إلى فترتين كل فترة 4 أسابيع على الأقل و يشترط اجتياز الطالب 65 ساعة للتدريب الأول، و 96 ساعة من الساعات المعتمدة للتدريب الثاني على الترتيب.
- يتم تقييم التدريب الميداني على أساس النجاح / الرسوب ولا يتم احتسابه في حساب المعدل التراكمي.

مادة(28) إضافة وحذف المقررات الدراسية

- يسمح للطالب أن يضيف مقرر دراسى فى الأسبوع الأول من الفصول الدراسية الرئيسية أو فى الأيام الثلاثة الأولى من الفصل الدراسى الصيفى .
- يمكن للطالب أن يحذف المقررات الدراسية المسجل بها حتى نهاية الأسبوع الثانى من الفصول الدراسية الرئيسية أو نهاية الأسبوع الأول من الفصل الدراسى الصيفى .
- لايجب أن يؤدى إضافة أو حذف المقررات الدراسية إلى مخالفة الحد الأدنى أو الحد الأقصى لعدد الساعات المعتمدة لكل فصل دراسى .

مادة(29) الانسحاب من المقررات الدراسية

- يمكن للطالب الانسحاب من المقرر الدراسى خلال الأسابيع العشرة الأولى من الفصول الدراسية الرئيسية أو خلال الأسابيع الخمسة الأولى للفصل الدراسى الصيفى .
- لايرسب الطالب فى المقرر المنسحب منه ، شريطة أن يتم الانتهاء من طلب الانسحاب والموافقة عليه خلال المدة الزمنية المحددة.
- يحصل الطالب على تقدير (W) للمقرر المنسحب منه ويسمح له بتسجيل هذا المقرر (الحضور الكامل وأداء جميع الأنشطة بما فى ذلك الامتحانات) فى الفصول الدراسية اللاحقة .
- بالنسبة للمقرر الاختيارى ، يسمح للطالب بتغييره فى الفصول الدراسية اللاحقة إذا رسب فى اجتيازه أو قام بالانسحاب منه . وهذا يخضع لموافقة المرشد الأكاديمى للطالب ومتطلبات تخرجه.

مادة(30) المقررات الدراسية غير المكتملة

- إذا لم يحضر الطالب الامتحان النهائى للمقرر الدراسى بعذر مقبول من قبل اللجنة المختصة بشئون البرنامج المسجل به ووافق عليه مجلس الكلية ، فإن المقرر يعتبر غير مكتمل (I) .
- يحصل الطالب على تقدير (I) فى المقرر غير المكتمل ولن يدخل فى حساب المعدل التراكمى للطالب، وذلك حتى يتم إجراء الامتحان فى هذا المقرر فى الموعد التالى المتاح لامتحان هذا المقرر.
- إذا لم يقم الطالب بإجراء الامتحان النهائى للمقرر غير المكتمل فى الموعد التالى المتاح لامتحان هذا المقرر فإنه يحصل على تقدير (F) فى المقرر الدراسى .
- إذا قام الطالب بإجراء الامتحان النهائى للمقرر غير المكتمل فى الموعد التالى المتاح لامتحان هذا المقرر تضاف درجات هذا الامتحان النهائى إلى درجات أعمال الفصل الدراسى وذلك لحساب التقدير الكلى لهذا المقرر الدراسى.

مادة(31) إعادة المقررات الدراسية

- يمكن للطالب إعادة مقرر دراسى دراسة وامتحانا لمرة واحدة بهدف التحسين إذا كان تقديره فى هذا المقرر يستوفى شرط الحد الأدنى من النجاح وفقا للقواعد التالية.
  - يحصل الطالب على التقدير الأعلى فى المقرر الدراسى بعد الإعادة . وهذا التقدير هو الذى سيتم احتسابه فى المعدل التراكمى للطالب . شريطه أن تظهر الإعادة فى شهادة الطالب.

- الحد الأقصى لعدد المرات التى يمكن للطالب تكرارها بهدف التحسين هو خمس مرات خلال مدة دراسته . ويستثنى من ذلك المقررات الدرسية التى يتم التحسين فيها تلبية لمتطلبات التخرج.
- فى حالة رسوب الطالب فى الإعادة إذا كان بغرض تحسين التقدير، فيلغى تقديره السابق للمقرر ولايعتد به بعد ذلك ويعتبر راسبا ويحصل على تقدير (F).
- إذا رسب الطالب فى مقرر دراسى (حاصل على تقدير F)، فإنه يطلب منه إعادة جميع متطلبات المقرر (الحضور الكامل وأداء جميع الأنشطة بما فى ذلك الامتحانات) وفقا للقواعد التالية:
  1- أقصى تقدير للمقرر الدراسى المعاد هو B^{+} .
  2- يحصل الطالب على تقدير المقرر الدراسى بعد الإعادة وهذا التقدير هو الذى سيتم احتسابه فى المعدل التراكمى للطالب شريطة أن تظهر الإعادة فى شهادة الطالب.
- إذا قام الطالب بإعادة مقرر دراسى، فإنه يطلب منه أن يعيد جميع متطلبات تقييم المقرر الدراسى حتى يعاد تقييمه بالكامل. حيث يعاد احتساب تقدير المقرر الدراسى.
- يجوز السماح للطالب إذا رسب فى مقرر دراسى (حصل على تقديرF)، بإعادة الامتحان النهائى (فى ذات الفصل الدراسى) خلال المدة التى تقرها اللائحة، ولمقرر دراسى واحد فقط للطالب، ووفقا للقواعد الأتية :
  - ألا تقل درجة الطالب فى الامتحان النهائى للمقرر عن 50% من درجة الامتحان، وألا تقل نتيجة الطالب فى المقرر عن 55% من إجمالى درجات المقرر.
  - ألا يزيد تقدير الطالب فى المقرر بعد الإعادة عن C^{-}.
  - فى حالة رسوب الطالب فى الامتحان التكميلى عليه إعادة المقرر دراسة وامتحان طبقا لقواعد الإعادة .
  - فى حالة الضرورة (عدم اكتمال عدد الساعات المعتمدة المصرح بها فى الفصل الدراسى) يجوز للطالب الراسب فى متطلب سابق، بتوصية المرشد الأكاديمى وموافقة لجنة التعليم بالكلية، التسجيل فى مقرر بالتزامن مع المتطلب السابق، ويعلق نجاح الطالب فى المقرر حتى يجتاز الطالب المتطلب السابق بنجاح.

مادة(32) الامتحانات والتقييم للمقررات الدراسية

- تحسب الدرجة لكل مقرر من مائة درجة.
- الدرجة الكلية لكل مقرر هى مجموع درجات الامتحان النهائى ودرجات الأعمال الفصلية موزعة طبقاً للجدول رقم (6) المرفق بالنسبة للبرامج التخصصية أما البرامج متعددة التخصصات فيتبع توزيع الدرجات الجدول رقم (7)، ويكون الامتحان النهائى تحريرياً ويستثنى من ذلك مشروع التخرج والمقررات التى يحدد وصف المقرر باللائحة (Course syllabus) أن الامتحان النهائى يكون شفهيا أو باستخدام الحاسب الآلى أو بأى طريقة أخرى.

جدول رقم (6) توزيع درجات المقرر للبرامج التخصصية

نوع الإمتحان	المقرر نظري/عملي	المقرر نظري فقط	المقرر عملي فقط	المشروع
الامتحان النهائي	%40	%40	%40	%50
امتحان فصلي	%30	%30	%30	–
امتحان شفوى/عملى	%20	-	-	
أعمال فصلية و خلافه	%10	%30	%30	%50

جدول رقم (7) توزيع درجات المقرر للبرامج متعددة التخصصات

نوع الامتحان	المقرر نظرى / عملى	المقرر نظري	المقرر عملي	المشروع
امتحان فصلى	30%	%30	%30	---
امتحان فصلى ثانى	--	%20	%20	---
أعمال السنة	%10	%10	%10	% 50
الامتحان العملي/الشفهي	%20	--	40%	--
الامتحان النهائى	%40	%40	--	%50

يعتبر الطالب راسبا ويحصل على تقدير (F) إذا حصل على أقل من 40% من درجات الاختبار النهائى وبغض النظر عن مجموع درجاته بالمقرر.

- يعتبر الطالب راسبا ويحصل على تقدير (F) إذا حصل على أقل من 60% من الدرجات الكلية للمقرر، أو تم حرمانه من حضور الامتحان النهائى بسبب تجاوز نسبة الغياب أو الغش..إلخ، أو لم يحضر الامتحان النهائى دون تقديم عذر مقبول من قبل مجلس الكلية .
- المقررات الدراسية التى لها (0) ساعة معتمدة يكون التقدير فيها راسب أو ناجح ويجب على الطالب الحصول على 60% من درجات المقرر ليعتبر ناجحا ولايدخل هذا المقرر فى حساب المعدل الفصلى، أو المعدل التراكمى.
- يكون الامتحان الفصلي للمقرر امتحانا واحدا على أن يعقد فى الأسبوع السابع من بداية كل من الفصليين الدراسيين الرئيسيين (الخريف والربيع) وفى الفصل الصيفى يعقد فى الأسبوع الرابع . وقد تشمل الأعمال الفصلية تقاريرا، أو بحوثا، أو مشاريع مصغرة .. إلخ طبقا لما هو موضح فى وصف المقرر (Course syllabus).
- يكون منسق المقرر(يحدده منسق البرنامج) من أحد المحاضرين القائمين بتدريس المقرر على أن يكون عضوا بلجنة تصحيح المقرر فى مراجعة التوزيع الإحصائى لتقديرات الطلاب بناء على الآليات التى يضعها مجلس الكلية . وبالنسبة لمقررات العلوم الإنسانية والاجتماعية ومقررات إدارة الأعمال ومقررات الثقافة الهندسية التى لاترتبط ببرنامج معين فيكون وكيل الكلية لشئون التعليم والطلاب، أو من يفوضه منسقا عليها.
- المقررات العملية أو المقررات التي لها شق عملي سيكون الامتحان النهائى لها هو امتحان عملي و يقسم الطلاب إلى مجموعات و كل مجموعة 5 طلاب و تكون لجنة الامتحان مكونة من 4 أعضاء هيئة تدريس.
- بالنسبة لمشروع التخرج-1 سيكون الامتحان النهائى له عبارة عن امتحان شفوى فى نهاية الفصل.
- بالنسبة لمشروع التخرج-2 يتم اقتراح تشكيل لجان من قبل منسق البرنامج لمناقشة المشاريع بنهاية الفصل و يفضل وجود عضو من خارج الكلية ضمن تشكيل اللجنة و يعتمد من مجلس إدارة البرامج.
- يحدد مجلس الكلية آلية تقديم ودراسة التظلمات والفترة الزمنية اللازمة لذلك.
- تحدد مدة الامتحان النهائى بساعتين لجميع المقررات ، ماعدا مقررات الرسم والتصميم والمقررات المشابهة لها فيجوز زيادتها إلى أكثر من ذلك ويصدر قرارا من مجلس الكلية بذلك لتحديد هذه المقررات.

- يجب أن ينص توصيف المقرر على توزيع الدرجات لطرق التقييم المختلفة. ويجوز لمجلس الكلية أن يعدل توزيع الدرجات لمقرر ما وذلك بناء على اقتراح مجلس القسم بعد التنسيق مع منسق البرنامج وإعلان ذلك التوزيع للطلاب قبل بدء الفصل الدراسى .
- يجوز لمجلس الكلية بعد أخذ رأى مجلس القسم المختص وحسب طبيعة المقررات الدراسية أن يقرر عقد الامتحانات إلكترونيا فى مقرر أو أكثر، كما يجوز عقد الامتحان فى كل المقرر أو جزء منه بما يسمح بتصحيحه إلكترونيا وعلى أن يتم عرض ذلك على مجلس شئون التعليم والطلاب بالجامعة للموافقة عليه ورفعه إلى مجلس الجامعة لاعتماده.

مادة(33) تقديرات المقررات الدراسية

- بالنسبة للمقررات التى يسجل الطالب فيها كمستمع أو أن يطلب منه فقط اجتياز المقرر (المقررات الدراسية ذات عدد الساعات المعتمدة الصفرية ، المقررت الدراسية غير المدرجة فى حساب المعدل التراكمى) ستكون تقديرات الطالب طبقا للجدول رقم (8).

جدول رقم (8) تقديرات المقررات الدراسية ذات عدد الساعات المعتمدة الصفرية

التقدير	المدلول	التفاصيل
Au	مستمع (Audience)	يرصد للطالب المسجل مستمع
P	ناجح (Pass)	يرصد للطالب الناجح
F	راسب (Fail)	يرصد للطالب الراسب
W	منسحب (Withdraw)	يرصد للطالب المنسحب من مقرر بناءً علي طلبه
I	مقرر غير مكتمل (Incomplete)	يرصد للطالب الذي تعذر عليه إستكمال متطلبات المقرر وتغيب في الإمتحان النهائي بعذر مقبول وقدم طلباً بذلك وتم قبوله طبقاً للقواعد.

- يتم حساب عدد النقاط لكل مقرر على أساس الدرجات التى يحصل عليها الطالب خلال دراسته لهذا المقرر (الأنشطة- امتحانات منتصف الفصل الدراسى – الامتحان العملى- الامتحان النهائى) ويوضح الجدول رقم (9) كيفية حساب عدد النقاط والتقدير من خلال الدرجات .
- يجب على الطالب الحصول على الحد الأدنى (D) لاجتياز أى مقرر دراسى والتى يتم استخدامه فى حساب المعدل التراكمى للطالب .

مادة (34) المرشد الأكاديمى

- يعين منسق البرنامج مرشد أكاديمى لكل طالب يتابع الطالب ويساعده فى اختيار المقررات الدراسية بكل فصل دراسى.
- المرشد الأكاديمى مسئول عن :
  - مساعدة الطالب فى تسجيل المقررات طبقا لمعدل الطالب.
  - مساعدة الطالب فى اختيار مساره الأكاديمى وكذلك فى اختيار المقررات بكل فصل دراسى .
  - مساعدة الطالب فى اختيار التدريب الميدانى.
  - مساعدة الطالب فى اختيار التخصص ومشروع التخرج

- يجوز للمرشد الأكاديمى أن يطلب من الطالب إعادة مقررات دراسية نجح فيها الطالب بالفعل أو أن يطلب منه التسجيل فى مقررات دراسية إضافية ، وذلك بهدف رفع المعدل التراكمى المطلوب لكى يحقق الطالب متطلبات التخرج.

مادة (35) حساب المعدل التراكمى (GPA)

- تحسب نقاط المقررات الدراسية التى حققها الطالب على أنها عدد الساعات المعتمدة لهذا المقرر مضروبة فى نقاط التقدير وفقا لجدول رقم (7)
- يتم احتساب إجمالى النقاط التى حققها الطالب فى أى فصل دراسى على أنها مجموع نقاط المقررات التى اجتازها الطالب فى هذا الفصل الدراسى

يحسب المعدل التراكمى للطالب فى نهاية أى فصل دراسى باعتباره إجمالى عدد النقاط التى حققها الطالب فى جميع المقررات الدراسية التى تمت دراستها مقسوما على العدد الإجمالى للساعات المعتمدة لهذه المقررات ، مع مراعاة القواعد المتعلقة بإعادة القيد وتحسين المقررات .

$$Cumulative\ GPA = \frac{\sum_{Courses} Grade\ points * Credit\ Hours}{\sum_{Courses} Credit\ Hours}$$

- يحسب متوسط النقاط فى الفصل الدراسى باعتبار إجمالى النقاط التى حققها الطالب فى المقررات الدراسية فى هذا الفصل الدراسى مقسوما على العدد الإجمالى للساعات المعتمدة لهذه المقررات.
- المعدل التراكمى للتخرج هو المعدل التراكمى عند التخرج وذلك بعد اجتياز جميع متطلبات التخرج ولايمكن للطالب الحصول على درجة البكالوريوس إلا إذا حقق معدل تراكمى 2.0 على الأقل.
- يتحدد ترتيب الخريجين على أساس المعدل التراكمى للتخرج . فى حالة التساوى فى المعدل التراكمي يتم الترتيب طبقا للمجموع التراكمى للدرجات.

يجب أن تتضمن شهادة الطالب جميع المقررات الدراسية التى تم تسجيلها خلال مدة الدراسة ، بما فى ذلك المقررات الدراسية التى رسب فيها أو انسحب منها أو تم تحسينها.

مادة (36) مرتبة الشرف لطلبة البكالوريوس

لكى يحصل الطالب على مرتبة الشرف فإن عليه أن يستوفى الشروط التالية:

1. الحفاظ على معدل تراكمى لايقل عن 3.3 خلال فترة دراسته فى البرنامج مع تحقيق هذا المعدل على الأقل خلال جميع فصول الدراسة .
2. ألا يكون قد حصل على تقدير(F) فى أى مقرر دراسى خلال فترة دراسته.
3. ألا يكون قد تم توقيع أى عقوبات تأديبية عليه خلال فترة دراسته فى الكلية .

مادة (37) تكليف خريجى البرامج فى وظيفة معيد

يتم تكليف المعيدين من خريجى البرامج بقرار من رئيس الجامعة بناء على طلب من مجلس الكلية طبقا للمادة (133) من قانون تنظيم الجامعات وبما لايخل بتطبيق المادتين 136،135 من ذات القانون ويشترط ألا يقل معدله التراكمي عند التخرج عن B^+.

جدول رقم (9) تقدير المقررات وعدد النقاط المناظر

النسبة المئوية	نظام الساعات المعتمدة	
	عدد النقاط	التقدير المناظر
أكثر من 97%	4.0	A+
93% الى أقل من 97%		A
89% الى أقل من 93%	3.70	A-
84% الى أقل من 89%	3.30	B+
80% الى أقل من 84%	3.00	B
76% الى أقل من 80%	2.70	B-
73% الى أقل من 76%	2.30	C+
70% الى أقل من 73%	2.00	C
67% الى أقل من 70%	1.70	C-
64% الى أقل من 67%	1.30	D+
60% الى أقل من 64%	1.00	D
أقل من 60%	0.00	F

مادة (38) الإدارة الإلكترونية

تقوم الكلية بتصميم برنامج لإدارة نظم المعلومات للبرامج أو تتعاقد عليه وذلك لميكنة العمل بالبرامج بنظام الساعات المعتمدة و يشرف عليها منسق التحول الرقمي ويشتمل هذا البرنامج على البنود التالية :

1- تسجيل المقررات الدراسية .
2- إضافة وحذف المقررات الدراسية.
3- أعمال الإرشاد الأكاديمى.
4- أعمال إدارة البرنامج فى تحقيق القواعد المنظمة للبرنامج.
5- أعمال الكنترولات.
6- أعمال الدراسة والامتحانات .
7- الأعمال الخاصة بشئون الطلاب.
8- بيانات الحالة.
9- تقارير عن أداء الطلاب.
10- تسجيل غياب الطلاب.
11- التواصل مع الطلاب.
12- الإمتحانات الإلكترونية.
13- أعمال الجودة.

ويجب مراعاة الحفاظ على سرية البيانات واستدعائها، وسهولة الاستخدام للطالب وعضو هيئة التدريس والفريق الإدارى وإتاحة الدعم الفنى.

رابعا: تفاصيل البرامج المقدمة

تمنح جامعة بنها بناءً على طلب مجلس كلية الهندسة ببنها درجة بكالوريوس العلوم في أحد البرامج التي تقدمها كلية الهندسة ببنها، و التي تنقسم إلى برامج متخصصة (Disciplinary programs) ومتعددة التخصصات (Inter-Disciplinary Programs).

وفقًا للشروط المرجعية لنظام الدراسة بنظام الساعات المعتمدة بكليات الهندسة (2020) - المجلس الأعلى للجامعات، تنقسم المقررات الدراسية في أي برنامج إلى المتطلبات التالية:

1. متطلبات الجامعة.
2. متطلبات الكلية.
3. متطلبات التخصص.
4. متطلبات البرنامج.

يوضح الجدول (10) توزيع الساعات المعتمدة بين المتطلبات المختلفة لكل من البرامج المتخصصة ومتعددة التخصصات. بالنسبة للبرامج متعددة التخصصات، يتم تقسيم **114** ساعة معتمدة بين التخصصات المختلفة التي يتكون منها هذا البرنامج.

يوضح الشكل (2) المستويات المختلفة للجدارات كما تم نشرها في المعايير المرجعية الأكاديمية الوطنية (NARS-2018). تحدد هذه الجدارات توزيع المقررات في مستويات الجدارات المختلفة وفقا و متطلبات المستوى الدراسي.

جدول (10) تقسيم الساعات المعتمدة بين المتطلبات الأربعة.

		متطلبات الجامعة	متطلبات الكلية	متطلبات التخصص	متطلبات البرنامج
البرامج التخصصية (Specialized Programs)	الهندسة الميكانيكية	14 CH 8.75%	32 CH 20%	66 41.25%	48 30%
	الهندسة الكهربية			67 41.88%	47 29.37%
	الهندسة المدنية			114 CH 71.25%	
	الهندسة المعمارية			114 CH 71.25%	
البرامج متعددة التخصصات (Inter-Disciplinary Programs)				114 CH 71.25%	

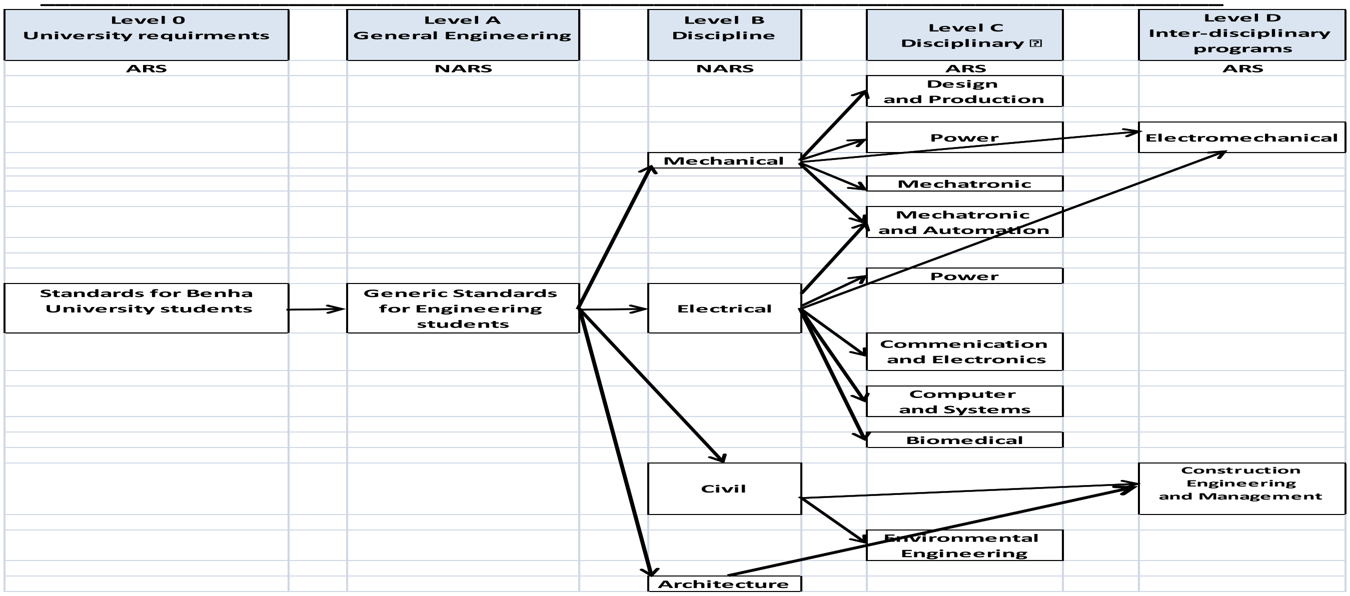


Figure 2 Different Levels of Competencies as per NARS 2018, as published by NAQAAE

ملخص البرامج الدراسية:

Table 11 List of overall data about the programs.

#	Program	NC	Credits and SWL			Total Contact Hours				4 Requirements %				BS %
			CH	ECTS	SWL	Lec	Tut	Lab	TT	UR	FR	DR	PR	
Specialized Programs														
1	Design and Production Engineering	**61**	160	267	6750	104	55	76	235	8.75	20	39.37	31.87	22.5
2	Mechanical Power Engineering	**61**	160	267	6750	106	55	74	235	8.75	20	41.25	30	18.75
3	Mechatronics Engineering Program	61	160	267	6750	104	55	76	235	8.75	20	39.375	31.875	22.5
4	Electrical Power and Machines Engineering	61	160	270	6750	110	102	73	285	8.75	20	41.87	29.4	18.125
5	Computer and Control Systems Engineering	58	160	270	6750	108	56	75	239	8.75	20	41.88	29.38	20.63
6	Electronics and Communications	58	160	270	6750	107	65	72	244	8.75	20	42.5	28.75	18.75
7	Biomedical Engineering	58	160	270	6750	108	89	97	294	8.75	20	41.7	29	18.75
8	Civil Engineering	62	160	270	6750	113	51	61	225	8.75	20	63.75	0	18.75
9	Architectural Engineering	**61**	160	267	6750	108	98	26	232	8.75	20	71.25	0	11.25
Interdisciplinary Programs														
10	Infrastructures and Utilities Engineering	62	160	267	6667	110	70	50	230	8.75	20	0	71.75	18.75
11	Construction Engineering and Management	62	160	267	6667	111	71	50	232	8.75	20	0	71.75	18.75
12	Elctromechanical Engineering	61	160	234	5850	113	82	31	226	9	20	0	71	21
13	Mechatronics and Automation Program	**61**	160	279.6	6990	106	56	71	233	8.75	27.5	0	63.75	22.5

NC	Total number of Courses	UR	University Requirement
CH	Credit Hour	FR	Faculty Requirement
ECTS	European Credit Transfer System	DR	Discipline Requirement
SWL	Student Workload	PR	Program Requirement
Lec	Lectures	TT	Total
Tut	Tutorials	BS	Basic Sciences Percentage
Lab	Laboratory		

Checklist for each program:

- The total number of credit hours should be between 144 and 165
- The percentage of the 4 requirements is calculated by credit hours and should follow the percentages in the Terms of Reference.
- The percentage of Basic Sciences is calculated by credit hours and should follow the percentages in the Terms of Reference.
- **The maximum number of courses is 60**
- The maximum number of weekly contact hours is 280 Contact Hours. The maximum number of Lecture Contact hours is 50% of total contact hours or 130 contact hours, whichever is less.

متطلبات الجامعة

تهتم جامعة بنها ببناء التفكير البشري ليكون في أعلى مستوياته ليكون مصدر مهم لتنمية الموارد البشرية، يهتم بالنهوض بالحضارة العربية و التراث التاريخي للمجتمع المصري وتقاليده. كما أنها تهتم بتعاليم الدين والأخلاق والقومية العربية. و من الأهمية بمكان الاهتمام بدراسة المشاكل المجتمعية المعاصرة و كيفية مواجهتها. لذلك يجب أن يكون خريج جامعة بنها مدرك تماما للقضايا الوطنية والإقليمية والدولية المعاصرة ، ليكون شخصية واعية و مؤهلة فكريا للتفاعل الفعال في المجتمع من خلال مختلف مهارات التواصل.

و لتحقيق هذا، صممت جامعة بنها عددًا من المقررات لبناء شخصية الطالب وتنمية مهاراته وتزيد من وعيه بالموضوعات المختلفة. هذه المقررات تسمى متطلبات الجامعة. اختارت كلية الهندسة ببنها بعض من هذه المقررات ضمن البرامج الهندسية. هذه المقررات تشتمل على:

جدول (11) قائمة مقررات متطلبات الجامعة

الكود	المقرر	الساعات المعتمدة	ساعات الإتصال			
			محاضرة	معمل	درس نظري	الإجمالي
UHS 101	لغة أجنبية	2	2	--	--	2
UHS 102	تكنولوجيا المعلومات و الإتصالات	2	2	--	--	2
UHS 103	القضايا المجتمعية	2	2	--	--	2
UHS 104	أخلاقيات المهنة	2	2	--	--	2
UHS XXX	مقرر إختياري 1	2	2	--	--	2
UHS XXX	مقرر إختياري 2	2	2	--	--	2
UHS XXX	مقرر إختياري 3	2	2	--	--	2
الإجمالي		14	14	--	--	14

Table 11 List of University Requirements Courses

Code	Course Title	Cr. Hrs.	Ct. Hr.			
			Lect.	Lab.	Tut.	Tot.
UHS 101	Foreign Language	2	2	0	0	2
UHS 102	Information and Communication Technology	2	2	0	0	2
UHS 103	Societal Issues	2	2	0	0	2
UHS 104	Professional Ethics	2	2	0	0	2
UHS XXX	Humanities Elective I	2	2	0	0	2
UHS XXX	Humanities Elective II	2	2	0	0	2
UHS XXX	Humanities Elective III	2	2	0	0	2
Total		14	14	0	0	14

جدول (12) قائمة المقررات الإختيارية لمتطلبات الجامعة

الكود	المقرر	الساعات المعتمدة	ساعات الإتصال: محاضرة	معمل	درس نظري	الإجمالي
مقررات ريادة الأعمال						
UHS 201	مبادىء ريادة الأعمال وإدارة المشروعات	2	2	--	--	2
UHS 203	إدارة الموارد البشرية	2	2	--	--	2
مقررات المهارات الشخصية والمكتسبة						
UHS 301	مهارات الإتصال والعرض	2	2	--	--	2
UHS 302	مهارات القيادة	2	2	--	--	2
مقررات البحث والتحليل العلمي						
UHS 801	مناهج البحث	2	2	--	--	2
UHS 803	مهارات التفكير	2	2	--	--	2

Table 12 List of Humanities Elective Courses

Humanities Elective	Code	Course Title	Cr. Hrs.
Entrepreneurship Courses	UHS 201	Principles of Entrepreneurship and Project Management	2
	UHS 203	Human Resources Management	2
Personal and acquired skills courses	UHS 301	Communication and Presentation Skills	2
	UHS 302	Leadership Skills	2
Scientific research and analysis courses	UHS 801	Research Methodologies	2
	UHS 803	Thinking Skills	2

University Requirements Compulsory Courses

Code	Course Title	Pre-req.	CH	Ct. Hr. Lec.	Lab.	Tut.	Sum	Assessment SA	MT	PE/OE	Final
UHS 101	Foreign Language	-	2	2	-	-	2	30%	30%	-	40%

Course Contents

خصائص اللغة الانجليزية، أو الألمانية، أو الفرنسية، أو أي لغة أخري يتم إقرارها من قبل مجلس القسم العلمي واعتمادها من مجلس الكلية والجامعة، مراجعه قواعد اللغة، بعض قواعد الاسلوب والجمل الفعالة وخصائصها، التعرف على بعض الأخطاء الشائعة في كتابه الجملة الفنية، بناء الفقرات الاساسية: أنواع الفقرات، قراءة وتحليل مقتطفات من الكتب في مختلف الفروع لتنمية مهارات الاتصال.

The characteristics of the foreign language (English, Deutsch, French, or any foreign language approved by the academic department council and both the faculty and university councils) - Revision of the language grammar – grammar style and effective sentences and their characteristics – Identification of common errors in writing technical sentences – Building basic paragraphs: types of paragraphs, reading and analysing of excerpts from books in varies disciplines to develop communication skills.

References

EManuel Alvarez-Sandoval, “The Importance of Learning a Foreign Language in a Changing Society”, 2005, Universe

Code	Course Title	Pre-req.	CH	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	SA	MT	PE/OE	Final
UHS 102	Information and Communication Technology	-	2	2	-	-	2	30%	30%	-	40%
Course Contents	مفاهيم ومصطلحات تكنولوجيا المعلومات، أنماط الاتصال في التعليم والتعلم، شبكة الانترنت والتعلم، نظم الوسائل المتعددة، قواعد البيانات، الواقع الافتراضي، الواقع المعزز، انترنت الأشياء، الروبوتات وتصنيفها، الذكاء الاصطناعي، البيانات الضخمة، الحوسبة السحابية. Concepts and terminologies of information technology – Communication styles in teaching and learning – The internet and learning – multimedia systems – databases – Virtual Reality – Augmented reality – Internet of Things – Robotics and its classification – Artificial Intelligence – Big data – Cloud Computing.										
References	ITL Limited ITL Education Solutions Limited, "Introduction to Information Technology", 2nd edition, 2012, Pearson Education, ISBN: 9789332525146 Floyd Fuller, Brain Larson, Lisa Bucki, Faithe Wempen, "Computers: Understanding Technology Comprehensive ", 6th edition, 2016, Kendall Hunt Publishing, ISBN-13 : 978-0763870089										

Code	Course Title	Pre-req.	CH	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	SA	MT	PE/OE	Final
UHS 103	Societal Issues	-	2	2	-	-	2	30%	30%	-	40%
Course Contents	توعية الطلاب بالعديد من القضايا الاجتماعية والبيئية والاقتصادية وغ ريه ا ي مصر مثل من القضايا المعاصرة ف قضايا الزيادة السكانية في مصر وأثره ا على الفرد والمجتمع، وقضايا مكافحة الفساد وأثره على الحقوق الاقتصادية والتنمية المستدامة، وقضايا حقوق الإنسان، وقضايا العنف ضد المرأة، وقضايا الصحة العامة والتلوث البيئي والتصحر وتغيير المناخ والمياه، قضايا الطاقة وغيرها من القضايا الهامة في مجتمعنا. The awareness of students on many social, environmental, economic, and other contemporary issues in Egypt such as issues of overpopulation in Egypt and its impact on the individual and society - issues of combatting venality and its impact on economic rights and sustainable development – human rights issues – issues of violence against women – public health issues – environmental pollution and desertification -Climate change, water and energy issues – Other important issues in our society.										
References	Enid Hill, "Discourses in Contemporary Egypt: Politics and Social Issues", 2000, American University in Cairo Press.										

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req.</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/ OE</th><th>Final</th></tr>
<tr><td>UHS 104</td><td>Professional Ethics</td><td>-</td><td>2</td><td>2</td><td>-</td><td>-</td><td>2</td><td>30%</td><td>30%</td><td>-</td><td>40%</td></tr>
<tr><td>Course Contents</td><td colspan="11">يقدم المقرر الخلفية اللازمة لمناقشة المواضيع الأساسية للأخلاقيات المهنية مع التركيز على الموضوعات الأخلاقية التي تواجه الخريجيين في مجال العمل. ويحتوي المقرر على التعريف بالمقومات العامة لأخلاقيات المهنة ومراعاة المصلحة العامة واللوائح والانظمة، الالتزامات تجاه المجتمع والحقوق والواجبات مع دراسة أمثلة من مجال عمل الخريج في كل كلية.
The course offers the background necessary to discuss the core issues of professional ethics facing graduates in their field of work. The course contains the definition of the general ingredients of professional ethics, and taking into account the public interest, rules and regulations, obligation towards society, rights and duties, with a study of example from the graduate’s field of work in each college.</td></tr>
<tr><td>References</td><td colspan="11">John Rowan & Samuel Zinaich, Jnr., “Ethics for the Professions”, 1st edition, 2002, ISBN-13 : 978-0155069992</td></tr>
</table>

University Requirements Elective Courses

<table>
<tr><th rowspan="3">Code</th><th rowspan="3">Course Title</th><th rowspan="3">Pre-req</th><th rowspan="3">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>2</td><td>-</td><td>-</td><td>2</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>UHS 201</td><td>Principles of Entrepreneurship and Project Management</td><td>-</td><td>2</td><td colspan="8"></td></tr>
<tr><td>Course Content</td><td colspan="11">مفاهيم في ريادة الأعمال، ريادة الأعمال والمنشآت الصغيرة، توليد الأفكار للمشاريع الريادية، الجامعة وريادة الأعمال فرص وتحديات، الخطة التسويقية، الخطة التشغيلية، الخطة المالية، كتابة خطة العمل، البيئة التكنولوجية للمشروع الريادي، بيئة الاعمال الخارجية للمشروعات الريادية، برامج دعم المشاريع الرائدة في الاقتصاد المصري، مهارات عرض المشروع الريادي، مقدمة في إدارة المشروعات، الهيكل التنظيمي للمشروعات، تقييم النجاح، التخطيط، قراءة البيانات، مخطط الشبكات، تحليل المسار الحرج للشبكات، تخصيص المصادر والقيود، إدارة التكلفة، إدارة المخاطر، قياس ومراقبة أداء المشروعات.
Concepts in entrepreneurship – entrepreneurship and small enterprises – Idea generation of entrepreneurial projects – The university and entrepreneurship opportunities and challenges – Marketing plan – operational plan – financial plan – Writing the business plan – The technological environment for entrepreneurship projects – External business environment for pioneering projects – Egyptian economy programs to support leading projects – entrepreneurial project presentation skills –
Introduction to project management – The organizational structure – Success assessment – Planning – data reading – network planning – critical path analysis of networks – resource allocation and constraints – cost management – risk management – measurement and control of project performance.</td></tr>
<tr><td>References</td><td colspan="11">• Alexander Osterwalder, Yves Pigneur, “Business model generation: A handbook for visionaries, game changers, and challengers”, 1st edition, 2010, ISBN-13 : 978-0470876411
• Eric Ries, “The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses”, 1st edition, 2011, ISBN-13 : 978-0307887894
• https://designthinking.ideo.com/</td></tr>
</table>

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
UHS 203	Human Resources Management		2	2	-	-	2	30	30	-	40

Course Content	مفهوم إدارة الموارد البشرية، التطور التاريخي لإدارة الموارد البشرية، الوظائف الرئيسية لإدارة الموارد البشرية، التخطيط للموارد البشرية، الحصول على الموارد البشرية، تدريب وتطوير الموارد البشرية، تعويض الموارد البشرية، الحفاظ على الموارد البشرية واستدامتها. The concept of human resources management – The historical development of human resource management – the main jobs of human resource management – planning for human resources – obtaining human resources – training and developing human resources – compensation for human resources – maintaining and sustaining human resources.
References	• Dessler, G., Chhinzer, N., & Gannon, G., « Management of human resources: The essentials”, 5th ed., 2019, Pearson Education, ISBN: 9780134882963. • A. DeNisi, R. Griffin, HR, “Human Resource Management“, 3rd edition, 2007, ISBN-13 : 978-0618794195

Code	Course Title	Pre-req.	CH	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	SA	MT	PE/OE	Final
UHS 301	Communication & Presentation Skills	-	2	2	-	-	2	30%	30%	-	40%

Course Contents	مدخل عام الى الاتصال، اهمية الاتصال، ا نواع الاتصال، معوقات الاتصال، مهارات الاتصال، سمات واساليب العرض الفعال، الاتصال اللفظي: مهارات التحدث، الاتصال غير اللفظي، مهارات الحوار واستراتيجيات الاقناع، الاتصال في بيئة العمل، كتابة السيرة الذاتية والتقارير والرسائل الرسمية. A general introduction to communication, the importance of communication, types of communication, communication obstacles, communication skills, features and methods of effective presentation, verbal communication: speaking skills – non-verbal communication – dialogue skills and persuasion strategies – communication in the work environment – writing resume – writing formal reports and letters.
References	Mike Markel; Stuart A. Selber, "Practical Strategies for Technical Communication", Macmillan Learning, 3rd edition, 2019 Mike Markel; Stuart Selber, "Technical Communication", Macmillan Learning, 13th edition, 2021

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req.</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>UHS 302</td><td>Leadership Skills</td><td>-</td><td>2</td><td>2</td><td>-</td><td>-</td><td>2</td><td>30%</td><td>30%</td><td>-</td><td>40%</td></tr>
<tr><td>Course Contents</td><td colspan="11">يهدف المقرر الى تنمية المهارات القيادية والإدارية لدى الطلاب، وتنمية فرص التم ر ي لديهم، من خلال تعريفهم بسمات الشخصية القيادية والإدارية، وأهم طرق وأساليب التحول من التعبئة الى القيادة، وتعريفهم بأهم استراتيجيات التميز والتفاعل القيادي، اضافة الى تنمية بعض المهارات وأخلاقيات القيادة والإدارة المتعلقة بالتخطيط وإدارة الذات والأخرين، وطرق وأساليب اتخاذ القرارات الفعالة، وأساليب التحف ر ي، ومهارة قيادة التغيير، وأخلاقيات الإدارة والقيادة.

The course aims to develop the students' leadership and management skills – Develop their opportunities for excellence, by introducing the leadership and administrative personality traits – The most important ways of transformation from mobility to leadership – The most important strategies of excellence and leadership interaction – developing some skills and ethics of leadership and management related to planning self and other management – Effective decision-making methods and techniques – motivational methods – the skill of change leadership – management and leadership ethics.</td></tr>
<tr><td>References</td><td colspan="11">Primal Leadership, "Unleashing the power of Emotional Intelligence", Daniel Goleman, Harvard Business Review Press</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>UHS 801</td><td>Research Methodology</td><td>-</td><td>2</td><td>2</td><td>-</td><td>-</td><td>2</td><td>30%</td><td>30%</td><td>-</td><td>40%</td></tr>
<tr><td>Course Contents</td><td colspan="11">التفكير العلمي وخصائصه، تعريف البحث العلمي وخصائصه، خطوات البحث العلمي وتصميم أدوات البحث وضبطها واختيار العينات (اختيار موضوع البحث، تحديد مشكلة البحث وعوامل اختيارها، تحديد إطار البحث، تحديد منهج البحث، تحليل البيانات). أنواع الدراسات العلمية: الدراسات الاستطلاعية، الدراسات الوصفية، الدراسات التجريبية. مناهج وطرق البحث العلمي: المنهج الوصفي، المسح الاجتماعي، دراسة المضمون، تحليل المضمون، أنواع التصميمات التجريبية، الأساليب الوصفية، الأساليب الاستنتاجية.

Scientific thinking and its specifications, definition of scientific research and its specifications, steps of scientific research and designing research tools and sample selection (choosing a research subject, defining the research problem and the principles of choice, setting the research frame and methodology and data analysis). Types of scientific studies: Descriptive, survey and experimental studies.

Scientific research methods: Descriptive method, social screening, content study, content analysis, types of experimental designs, descriptive methods, analytical methods.</td></tr>
<tr><td rowspan="2">References</td><td colspan="11">Ann Sloan Devlin, "The Research Experience: Planning, Conducting and Reporting Research", SAGE, 2nd Edition, 2020</td></tr>
<tr><td colspan="11">C.R. Kothari, "Research Methodology: Methods and Techniques", New Age, 2nd Edition, 2004, ISBN (13) : 978-81-224-2488-1</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req.</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>UHS 803</td><td>Thinking Skills</td><td>-</td><td>2</td><td>2</td><td>-</td><td>-</td><td>2</td><td>30%</td><td>30%</td><td>-</td><td>40%</td></tr>
<tr><td>Course Contents</td><td colspan="11">مفاهيم نظرية (الذاكرة -التفكير- الإبداع)، مدخل إلى تعليم مهارات التفكير، طبيعة التفكير (تعريفه – خصائصه – مستوياته)، أنواع التفكير (الإبداعي- الناقد- العلمي)، مهارات التفكير المعرفية، مهارات التفكير الميتا معرفية، أدوات قياس التفكير، أنماط التفكير المختلفة ومها راتها، الاستراتيجيات المستخدمة في تنمية مهارات التفكير، برامج تعليم مهارات التفكير، طرق تعليم مهارات التفكير.

Theoretical concepts (memory – thinking – creativity), an introduction to teaching thinking skills, the nature of thinking (definition – characteristics – levels) types of thinking (creative – critical – scientific), cognitive thinking skills, metacognitive thinking skills, thinking measurement tools, different thinking patterns, and skills, strategies used to develop thinking skills, thinking skills programs, ways to teach thinking skills</td></tr>
<tr><td>References</td><td colspan="11">John Butterworth, Geoff Thwaites, “Thinking Skills: Critical Thinking and Problem Solving”, 2nd edition, 2016, ISBN-13 : 978-1107606302</td></tr>
</table>

Faculty Requirements for Desplinary Programs متطلبات الكلية

All programs offered at Benha Faculty of Engineering, Benha University are Engineering Programs. The graduates have the opportunity of being Engineers and are registered in the Egyptian Engineering Syndicate.

According to the National Academic Reference Standards (NARS-2018), The Engineering Graduate must be able to (A-Level):

A1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science and mathematics.

A2. Develop and conduct appropriate experimentation and/or simulation, analyse and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

A3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

A4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.

A5. Practice research techniques and methods of investigation as an inherent part of learning.

A6. Plan, supervise and monitor implementation of engineering projects.

A7. Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural teams.

A8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.

A9. Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

A10. Acquire and apply new knowledge; and practice self, lifelong and other learning strategies.

To achieve these Learning Outcomes, a set of courses has to be completed as a Faculty Requirement. These courses are divided into Basic Science Courses and Basic Engineering Courses.

Table 12 List of Faculty requirements courses.

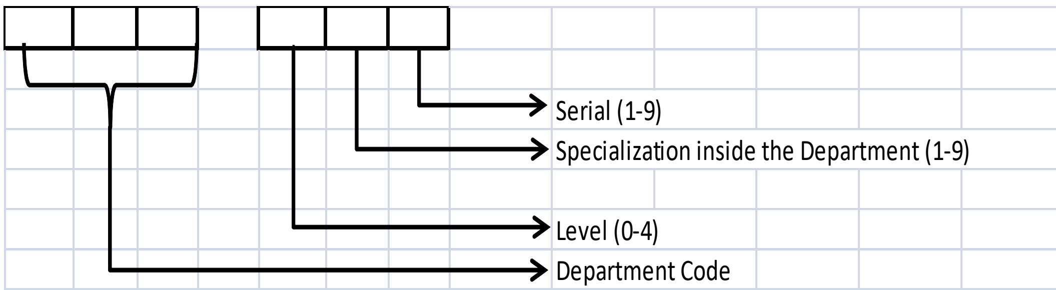
Code	Course	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
BES 011	Mathematics I	-----	3	2	0	2	4
BES 021	Mechanics I	-----	3	2	0	2	4
BES 031	Physics I	-----	3	2	2	1	5
BES 041	General Chemistry	-----	4	3	2	1	6
MEC 011	Engineering Graphics	-----	2	0	0	4	4
BES 012	Mathematics II	BES 011	3	2	0	2	4
BES 022	Mechanics II	BES 021	3	2	0	2	4
BES 032	Physics II	-----	3	2	2	1	5
MEC 012	Production Engineering	-----	2	1	3	0	4
MEC 014	Computer Aided Drafting	MEC 011	2	1	2	0	3
ELE 042	Computer Programming Fundamentals	-----	2	0	2	2	4
BES 141*	Pollution and Industrial Safety	BES 041	2	2	1	0	3
FTR 103	Field Training I	Completion of 65 Cr.Hrs	0	0	0	0	0
FTR 203	Field Training II	Completion of 96 Cr.Hrs	0	0	0	0	0
Total			32	19	14	17	50

* Course teaching is shared between the Basic Engineering Science Department and Displine Department.

Faculty Requirement Courses

The course coding is divided into two parts and follows the following convention:

1. Three Letters which are the Department code.
2. Three Numbers indicating the Level, the Specialization inside the department, and a counter inside the specialization.



BES x1x	Mathematics Courses offered by Basic Engineering Science Department
BES x2x	Mechanics Courses offered by Basic Engineering Science Department
BES x3x	Physics Courses offered by Basic Engineering Science Department
BES x4x	Chemistry Courses offered by Basic Engineering Science Department
MEC xxx	Course offered by Mechanical Engineering Department for Faculty Requirement
ELE xxx	Course offered by Electrical Engineering Department for Faculty Requirements

The following abbreviations are the legend for the courses:

CH Credit Hour
Ct. Hr. Contact Hour
Lec Lectures
Tut Tutorials
Lab Laboratory
Tot Total
MT Mid-Term Exam
SA Student Activity
PE Practical Exam

<table>
<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>CH</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><td rowspan="2">BES 011</td><td rowspan="2">Mathematics I</td><td rowspan="2">-</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Tot</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Differential Calculus: Real functions and their graphs (Algebraic functions, trigonometric functions and their inverses, exponential, hyperbolic and logarithmic functions). Limits and continuity. Differentiation of real functions of one variable. Applications of differentiation (maxima, minima and inflection points, curve tracing, optimization problems). The first mean value theorem and first order approximation of functions. Taylor’s and Maclaurin's expansions of functions.
Algebra: Elements of mathematical logic with applications, Matrix algebra and systems of linear equations (Gauss elimination, Gauss – Jordan elimination, LU factorization, matrix inversion). Applications (codes, matrix games). Eigenvalues and eigenvectors. Complex numbers.</td></tr>
<tr><td>References</td><td colspan="11">• Howard Anton, "Calculus with analytical geometry", John Wiley & Sons, Last Edition.
• Gilbert Strang, "Introduction to Linear Algebra", Wellesley-Cambridge Press, Last Edition.</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">CH</th><th colspan="4">Ct. Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>BES 012</td><td>Mathematics II</td><td>BES 011</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Integral Calculus: Indefinite integrals with applications. Methods of integration. Definite integrals with applications (areas, volumes of revolution, lengths of curves and surface area).

Multivariable Calculus (A): Surfaces and curves in three dimensions. Vector functions of one variable. Scalar functions of several variables, partial derivatives. Directional derivatives, total derivatives. Applications (tangent planes and normal lines. Taylor expansions, maxima and minima, Lagrange's multipliers).</td></tr>
<tr><td>References</td><td colspan="11">• Howard Anton, "Calculus with analytical geometry", John Wiley & Sons, Last Edition.
• George B. Thomas, Jr., Maurice D. Weir, Joel Hass, THOMAS' CALCULUS Multivariable (Twelfth Edition), 2010.
.</td></tr>
</table>

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">CH</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>BES 021</td><td>Mechanics I</td><td>-</td><td>3</td><td>2</td><td>-</td><td>2</td><td>4</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Fundamentals of statics, Types of supports, Vector algebra and applications to mechanics, Statics of particles, Moments of forces and couples, Equivalent systems of forces and moments. Equilibrium of rigid bodies, Centroides and centers of gravity, Analysis of structures (trusses and machines), Friction and its applications. Virtual Work for a System of Connected Rigid Bodies, Stability of Equilibrium Configuration.</td></tr>
<tr><td>References</td><td colspan="11">• F. P. Beer, E. R. Johnston, D. F. Mazurek, P. J. Cornwell, Vector Mechanics for Engineers: Statics and Dynamics, 10th edition (2013).
• Hibbeler, R. C. Engineering Mechanics: Statics and Dynamics, 10th Edition. Upper Saddle River, New Jersey: Prentice Hall, (2003).</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">CH</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>BES 022</td><td>Mechanics II</td><td>BES 021</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Kinematics of particles (rectilinear and curvilinear motion), Kinetics of particles (force and acceleration method – work and energy method – impulse and momentum method), Planar Kinematics of rigid bodies (translation – rotation about a fixed axis – general plane motion), planar kinetics of rigid bodies (force and acceleration method – work and energy method. – impulse and momentum method). Moment of area, mass moments of inertia for single body, product of inertia and principal moments of inertia.</td></tr>
<tr><td>References</td><td colspan="11">• F. P. Beer, E. R. Johnston, D. F. Mazurek, P. J. Cornwell, Vector Mechanics for Engineers: Statics and Dynamics, 10th edition (2013).
• Hibbeler, R. C. Engineering Mechanics: Statics and Dynamics, 10th Edition. Upper Saddle River, New Jersey: Prentice Hall, (2003).</td></tr>
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<table>
<tr><th rowspan="1">Code</th><th>Course Title</th><th>Pre-req</th><th>CH</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><td rowspan="2">BES 031</td><td rowspan="2">Physics I</td><td rowspan="2">-</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Tot</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Wave motion, Sound waves, Doppler effect, Superposition of waves: interference, standing waves and beats, Interference of light waves, Diffraction of light, Polarization of light, First law of thermodynamics, Kinetic theory of gases, specific heats of gases, thermodynamic processes: isochoric, isobaric, isothermal and adiabatic, Heat transfer: conduction, convection and radiation, Elasticity, Hooke’s law, Hydrostatics and surface tension, Hydrodynamics and Viscosity.</td></tr>
<tr><td>References</td><td colspan="11">• R. A. Serway and J. W. Jewett, Physics for scientists and engineers: Cengage learning, 2018.
• Tarek M. Abdolkader, Mohamed Elfaham, Mina Asham, Ibrahim Sayed, Walid Selmy, “Engineering Physics, Part I, Waves, Heat and Optics”, 1st edition, 2022.
• D. Halliday, et al., Fundamentals of physics: John Wiley & Sons, 2013.
• D. Giancoli, Physics for Scientists & Engineers with Modern Physics, 4th Edition ed. Pearson, 2008.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Simple harmonic motion
• Waves in stretched string,
• Sound waves,
• Interference and diffraction of light,
• Polarization of light,
• Specific heat,
Thermistor and thermal conductivity.</td></tr>
</table>

<table>
<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>CH</th><th colspan="4">Ct. Hrs</th><th colspan="4">Assessment</th></tr>
<tr><td rowspan="2">BES 032</td><td rowspan="2">Physics II</td><td rowspan="2">-</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Tot</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Electric force and electric field, Motion of charge in electric field, Electric dipole, Gauss law and applications, Electric potential, Capacitors and dielectrics, Current and resistance, Magnetic field and magnetic force, Sources of magnetic field, Bio-Savart law and Ampere’s laws, Electromagnetic induction and Faraday’s law, Self-induction and magnetic energy.</td></tr>
<tr><td>References</td><td colspan="11">• R. A. Serway and J. W. Jewett, Physics for scientists and engineers: Cengage learning, 2018.
• Tarek M. Abdolkader, Mohamed Elfaham, Mina Asham, Ibrahim Sayed, Walid Selmy, “Engineering Physics, Part II, Waves, Heat and Optics”, 1st edition, 2022.
• D. Halliday, et al., Fundamentals of physics: John Wiley & Sons, 2013.
• D. Giancoli, Physics for Scientists & Engineers with Modern Physics, 4th Edition ed. Pearson, 2008.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Ohm's Law
• Wheatstone bridge & Metric bridge
• Electric Field Mapping
• Capacitor Charging and Discharging
• The Electric Transformer
• Faraday’s Law</td></tr>
</table>

Code	Course Title	Pre-req	CH	Ct. Hrs.				Assessment			
BES 041	General Chemistry	-	4	Lec.	Lab	Tut	Tot	SA	MT	PE/OE	Final
				3	2	1	6	10	30	20	40

Course Content	Gases: ideal & real gas laws, kinetic molecular theory- Liquids and solutions - Solids: arrangement of atoms, metallic solids, alloys - Chemical kinetics: reaction rates & order, catalysis – Electrochemistry: electrochemical cells, corrosion– Cements – Polymers – lubricants.
References	- J. Brady, "General Chemistry, Principles and structures", Wiley Inc., Fifth Edition, 1990. - L. W. Fine, H. Beall, J. Stuehr, "Chemistry for Scientists and Engineering, Preliminary Edition, Brooks Cole; 1st edition, 1999. -Steven S. Zumdahl, "Chemistry Principles", Third Edition, Houghton Mifflin, 1998. -Prof. Elsayed Fouad, Engineering Chemistry I, II. -Steven S. Zumdahl, Susan A. Zumdahl "Chemistry" Seventh Edition, Houghton Mifflin, 2007. -P. Barnes, J. Bensted, Structure and Performance of Cements, CRC Press, 2nd Edition, 2019.
Laboratory	-Neutralization Reactions -Oxidation-Reduction Reactions -W/C Ratio -Precipitation Reactions

Code	Course Title	Pre-req	CH	Ct Hrs				Assessment			
BES 141	Pollution and Industrial Safety	BES 041	2	Lec.	Lab	Tut	Tot	SA	MT	PE/OE	Final
				2	1	-	3	10	30	20	40

Course Content	- Air pollution-sources and types of pollutants-Adverse effects -ozone depletion – green house effects- Acid rain and global warming -measurement and control methods. - Water pollution- sources and types- constituents of wastewater- primary treatment: various pre-treatment methods - Advanced Treatment: chemical oxidation, precipitation, air stripping, - heavy metals removal. **Civil and Architecture Engineering students:** Plan and manage construction health and safety, maintain safety issues for construction to introduce the foundations on which appropriate health and safety systems may be built. Occupation and health and safety affect all aspects of work. Legal framework for health and safety. **Mechanical Engineering students:** Hazards analysis-Hazards of pressure , uses of over pressure-hazards of temperature-HAZOP study regarding pressure, temperature & flow -static electricity & its control purging and inerting -relief valves and rupture disks-venting – flame arrester -flare system-alarms and types of alarms and its application-trips d interlock system-hot work permit , confined space vessel work permit & height work permit - personnel protective equipment-On-site &Off-site emergency plan. **Electrical Engineering students:** Electric shock and burns from live wire contact, Fires from faulty wiring, overloading circuits, leaving electrical parts exposed, Electrocution or burns from lack of PPE, Explosions and fires from explosive and flammable substances, Contact with overhead power lines Electrical exposure to water.
References	• Handbook of "Industrial Safety and Health, Trade and Technical Press Ltd. Morden, U.K.1980. • S.P. Mahajan, "Pollution Control in Process Industries" Tata McGraw Hill, NewDelhi1985.
Laboratory	• Air sampling • Water sampling • Adsorption • Precipitation

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
MEC 011	Engineering Graphics	-	2	0	0	4	4	30	30	-	40

Course Content	Engineering drawing techniques and skills. Conventional lettering and dimensioning. Geometric constructions. Theories of view derivation. Orthographic projection of engineering bodies. Derivation of views from isometric drawings and deducing of missing views. Sectioning views: (full, half, offset, partial, revolved, removed, and partial sectioning). Steel construction, Symbols of electrical circuits
References	William Chalk, Goetsch, "Technical Drawing", Delmar technical graphics series, 6th edition, 2010. Allbert W. Boundy, "Engineering Drawing", McGraw-Hill Australia, 2012
Laboratory	Student's engineering sketches and drawings carried out in the engineering drawing Labs.

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
MEC 012	Production Engineering	-	2	1	3	0	4	10	30	20	40

Course Content	Introduction, Types of industries, Casting processes: Main steps of sand casting, Pattern design, melting of metals, Cleaning and inspection of casting, Metal forming processes: Forging, Rolling, Extrusion, Drawing, Bending, Joining Processes: Temporary and permanent joints, welding techniques, Cutting Processes: Principles and elements of cutting processes, Basic cutting, and machining (Turning, Drilling, Milling, etc.,). Principles of production planning and control, Introduction to quality control.
References	• Jiangshan Li, Semyon M. Meerkov, 2008, “Production Systems Engineering”, Springer; 1st ed. 2009 edition, 2008 • M. P. Groover, 2011, "Principles of Modern Manufacturing", 4th Ed., john Wiley & Sons, Inc.
Laboratory	• Practicing the workshop measuring operations and tools • Practicing the sand-casting workshop • Practicing the welding workshop; electric arc welding, gas welding and cutting, and electric resistance welding • Practicing the machining workshop; turning, shaping, drilling, milling, and grinding • Practicing the metal forming workshop; rolling, bending, drawing, and extrusion • Practicing the carpentry workshop • Practicing the forging workshop

<table>
<tr><td rowspan="3">Code</td><td rowspan="3">Course Title</td><td rowspan="3">Pre-req</td><td rowspan="3">CH</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment Criteria</td></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>1</td><td>2</td><td>0</td><td>3</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>MEC 014</td><td>Computer Aided Drafting</td><td>MEC 011</td><td>2</td><td colspan="8"></td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to Computer Aided Drafting, history, advantages, and limitation. Graphics/CAD involves the visualization, sketching, and geometric construction of mechanical components. Layout and creation 2D working industrial drawings that adhere to industry standards. Illustrate CAD drawing construction techniques, implementation of graphical communication through the use of the alphabet of lines, orthographic projection, section views, auxiliary views and the creation of assembly and detail mechanical components</td></tr>
<tr><td>References</td><td colspan="11">• William Chalk, Goetsch, "Technical Drawing", Delmar technical graphics series, 6th edition, 2010.
• Allbert W. Boundy, "Engineering Drawing", McGraw-Hill Australia, 2012</td></tr>
<tr><td>Laboratory</td><td colspan="11">Student's engineering sketches and drawings carried out in the engineering Computer Labs</td></tr>
</table>

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<tr><td rowspan="2">Code</td><td rowspan="2">Course Name</td><td rowspan="2">Pre-req.</td><td rowspan="2">CH</td><td colspan="4">Ct Hrs</td><td colspan="4">Assessment</td></tr>
<tr><td>Lec.</td><td>Lab.</td><td>Tut.</td><td>Tot</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>FTR 103</td><td>Field Training I</td><td>Completion of 65 CH</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>**Course Contents**</td><td colspan="11">For 4 weeks interval as a minimum.
Field training conducted under the supervision of a faculty member and field mentor in the actual field practice. The student must submit a detailed technical report by the end of training period, explain what he learned during this training.
By the end of the training the student will be able to:
Apply the principles knowledge to execute practical engineering field works.
The students will have the opportunity to work with multidisciplinary teams during the training period.</td></tr>
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<tr><td rowspan="2">Code</td><td rowspan="2">Course Name</td><td rowspan="2">Pre-req.</td><td rowspan="2">CH</td><td colspan="4">Ct Hrs</td><td colspan="4">Assessment</td></tr>
<tr><td>Lec.</td><td>Lab.</td><td>Tut.</td><td>Tot</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>FTR 203</td><td>Field Training II</td><td>Completion of 96 CR</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>**Course Contents**</td><td colspan="11">For 4 week interval as a minimum.
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Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 042	Computer Programming Fundamentals	-	2	0	2	2	4	10	30	20	40

Course Content

Computer System: Hardware, Software - Introduction to software design - evolution and comparison of programming languages - types and characteristics of translators - Program Design Process - Software Life Cycle - structured programming - Variables, Constants - Input and Output - Data Types and Representation - Simple Flow - Flow of Control (Conditioning, Iteration) - Array - Functions (Predefined - Programmer Defined) - Pointers- Strings - program maintenance & testing – documentation.
Course topics are explained using a high-level language (as C, or C++).

References

- W. Savitch, "Problem Solving with C++", 10th Edition, Pearson, 2018, ISBN-13: 978-0134448282
- Jery Hanly, Elliot Koffman, “Problem Solving and Program Design in C”, 8th edition, Pearson, 2015, ISBN-13: 978-0134014890
- C.R. Severance, S. Blumenburg, "Python for Everybody: Exploring Data in Python 3", CreateSpace Independent Publishing Platform, 2016, ISBN-13: 978-1530051120
- R. Sedgweck, K. Wayne, "Introduction to Programming in Java: An Interdisciplinary Approach”, 2nd Edition, Addison-Wesley Professional, 2017, ISBN-13: 978-0672337840

Laboratory

Problem solving labs using high level language (C, or C++) to apply explained topics in each lecture including:

- Flowcharts
- Data Types, Variable, Constant declaration. Input and Output
- Sequence Flow program
- Conditioning Statements (if, nested if and switch case)
- Iteration Statements (for, while do while, Do Until, and nested loops)
- Arrays (1D and 2D arrays)
- Functions (predefined and user defined)
- Pointers
- Strings and string functions

* Project:
At the end of the course the student must provide a project emphasizing the course content

Programs Requirements

According to the National Academic Reference Standards (NARS-2018), each discipline graduate (Mechanical – Electrical – Civil – Architectural), has to meet specific Competencies.

Part A: Disciplinary programmes

Program # 1 Mechanical Design and Production Engineering Program

Program Description

The Design & Production Engineering program is one of the oldest engineering programs in Egypt. The program progressed with the growth in Egyptian industry during the sixties of the twentieth century. Recently, there has been an increasing need for the modernization of industry in Egypt to carry on with the global challenges of designing and fabricating cost-effective products that can compete with the international market. Consequently, the Design & Production Engineering program needs to be modernized as well. The program developed at Benha Faculty of Engineering - Benha University equips students with necessary competencies contemporary with the current industry. It also inspires graduates for self-learning to cope with the requirements of the ever-changing career path after their graduation.

The program offers a bachelor's degree in Mechanical Engineering where students can choose one of three tracks to specialize in. The three tracks offered are Product Design, Manufacturing &Materials, and Industrial & Management Engineering.

Basic Information

Program Mission

The Mechanical Design and Production Engineering Program aims to prepare an outstanding engineer to apply scientific methods to daily practical problems. The program deepens students' knowledge in mechanics, design, manufacturing processes, and material science. Graduates of this program are distinguished by their creativity, innovation, and scientific research, and they add a clear contribution to their industrial environment.

Program Objectives

The objectives of the B.Sc. in Mechanical Design and Production Engineering program are to enable its graduates to:

PO1. Apply a wide spectrum of engineering knowledge, science, and specialized skills with analytic, critical, and systematic thinking to identify and solve engineering problems in a real-life situation.

PO2. Behave professionally, adhere to engineering ethics and standards, and work to develop the profession and community and promote sustainability principles.

PO3. Work in and lead a heterogeneous team and display leadership qualities, business administration, and entrepreneurial skills.

PO4. Use techniques, skills, and modern engineering tools necessary for engineering practice.

PO5. Master self-learning and life-long learning strategies to communicate effectively in academic/professional fields.

PO6. Participate as leaders in addressing the social, economic, and environmental issues involved in mechanical design, material science, and manufacturing technologies.

PO7. Stimulate the graduate's scientific curiosity and passion for continuous research to participate in the evolution of the promising design and manufacturing of new and robust engineering innovative products with contemporary technology.

Graduate Attributes

By the completion of the MDP program of study, and according to NARS 2018, the graduate will be capable to:

GA1. Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real-life situations.

GA2. Apply analytic, critical, and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation.

GA3. Behave professionally and adhere to engineering ethics and standards.

GA4. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance.

GA5. Recognize his/her role in promoting the engineering field and contribute to the development of the profession and the community.

GA6. Value the importance of the environment, both physical and natural, and work to promote sustainability principles.

GA7. Use techniques, skills, and modern engineering tools necessary for engineering practice.

GA8. Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies.

GA9. Communicate effectively using different modes, tools, and languages with various audiences; to deal with academic/professional challenges critically and creatively.

GA10. Demonstrate leadership qualities, business administration, and entrepreneurial skills.

In addition to all engineering graduate attributes defined by NARS 2018, MDP graduates should be able to:

GA11. Handle professionally different engineering processes, including materials selection, design, analysis, synthesis, modern and classical fabrication techniques, nanotechnology, and experimental techniques.

GA12. Demonstrate the ability to design, develop, implement, and improve integrated systems, including people, materials, information, equipment, and energy.

GA13. Comprehend and handle the integration of management systems based on various industrial standards.

Program Learning Outcomes

The program courses fulfill the NARS 2018

Level A: The Engineering Graduate must be able to:

PLO1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics.

PLO2. Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess, and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

PLO3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical, and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

PLO4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues, and risk management principles.

PLO5. Practice research techniques and methods of investigation as an inherent part of learning.

PLO6. Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.
PLO7. Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural teams.
PLO8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.
PLO9. Use creative, innovative, and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.
PLO10. Acquire and apply new knowledge, and practice self, lifelong and other learning strategies.

Level B: The Engineering Graduate must be able to:

In addition to the Competencies for All Engineering Programs, the BASIC MECHANICAL Engineering graduate and similar programs must be able to:

PLO11. Model, analyze and design physical systems applicable to the specific discipline by applying the concepts of: Thermodynamics, Heat Transfer, Fluid Mechanics, solid Mechanics, Material Processing, Material Properties, Measurements, Instrumentation, Control Theory and Systems, Mechanical Design and Analysis, Dynamics, and Vibrations.
PLO12. Plan, manage and carry out mechanical systems and machine elements designs using appropriate materials, both traditional means and computer-aided tools and software contemporary to the mechanical engineering field.
PLO13. Select conventional mechanical equipment according to the required performance.
PLO14. Adopt suitable national and international standards and codes; and integrate legal, economic, and financial aspects to design, build, operate, inspect, and maintain mechanical equipment and systems.

Level C: The Engineering Graduate must be able to:

In addition to competencies for all engineering programs (Level A, NARS 2018), and Mechanical Engineering competencies (Level B, NARS 2018), Design & Production engineer must be able to:

PLO15. Implement new technologies in manufacturing to select suitable processes and their variables for specific products.
PLO16. Design machines, tools, and products with industrial standards and develop the necessary calculations, construction, and working drawings.
PLO17. Implement basics of industrial engineering to analyze, plan and design production systems.
PLO18. Demonstrate additional abilities to model, analyze, and design mechanical components and systems using advanced tools of integrated systems.
PLO19. Demonstrate additional abilities to select, prepare, analyze, treat, and test materials for specific applications.
PLO20. Demonstrate additional abilities to analyze, design, integrate, operate, evaluate, control, automate, and implement methods and techniques to manage industrial systems.

Benchmark:

Benha University	**Oregon State University** (https://mime.oregonstate.edu/student-outcomes-manufacturing-engineering-program)
PLO15. Implement new technologies in manufacturing to select suitable processes and their variables for specific products.	Ability to measure manufacturing process variables and develop technical inferences about the process.
PLO16. Design machines, tools, and products with industrial standards and develop the necessary calculations, construction and working drawings.	An ability to design products and the equipment, tooling, and environment necessary for their manufacture.

PLO17. Implement basics of industrial engineering to analyze, plan and design production systems.	An ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions.
PLO18: Demonstrate additional abilities to model, analyze, and design mechanical components and systems using advanced tools of integrated systems.	An ability to design products and the equipment, tooling, and environment necessary for their manufacture.
PLO19: Demonstrate additional abilities to select, prepare, analyze, treat, and test materials for specific applications.	An ability to design manufacturing processes that result in products that meet specific material and other requirements.
PLO20: Demonstrate additional abilities to analyze, design, integrate, operate, evaluate, control, automate, and implement methods and techniques to manage industrial systems.	An ability to analyze, synthesize, and control manufacturing operations using statistical methods. An ability to create competitive advantage through manufacturing planning, strategy, quality, and control.

Faculty Mission vs. Program Mission Matrix

<table>
<tr><td colspan="2" rowspan="3">Faculty Mission</td><td colspan="3">Program Mission</td></tr>
<tr><td colspan="3">The Mechanical Design and Production Engineering Program aims to prepare an outstanding engineer to apply scientific methods to daily practical problems. The program deepens students' knowledge in mechanics, design, manufacturing processes, and material science. Graduates of this program are distinguished by their creativity, innovation, and scientific research, and they add a clear contribution to their industrial environment.</td></tr>
<tr><td>Prepare an outstanding engineer to apply scientific methods to daily practical problems.</td><td>Deepens students' knowledge in mechanics, design, manufacturing processes, and material science.</td><td>contribution to their industrial environment.</td></tr>
<tr><td rowspan="3">Benha University is committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market, and capable of using and developing modern technology, and providing research in engineering fields to serve society and community.</td><td>Graduate well prepared engineers equipped with knowledge and skills</td><td>√</td><td></td><td></td></tr>
<tr><td>Compete in labor market capable of using and developing modern technology, and providing research in engineering fields</td><td></td><td>√</td><td></td></tr>
<tr><td>Serve society and community.</td><td></td><td></td><td>√</td></tr>
</table>

Program Mission vs. Program Objectives Matrix

<table>
<tr><td colspan="2" rowspan="2">Program Mission</td><td colspan="7">Program Objectives</td></tr>
<tr><td>PO1</td><td>PO2</td><td>PO3</td><td>PO4</td><td>PO5</td><td>PO6</td><td>PO7</td></tr>
<tr><td rowspan="3">The Mechanical Design and Production Engineering Program aims to prepare an outstanding engineer to apply scientific methods to daily practical problems. The program deepens students' knowledge in mechanics, design, manufacturing processes, and material science. Graduates of this program are distinguished by their creativity, innovation, and scientific research, and they add a clear contribution to their industrial environment.</td><td>Prepare an outstanding engineer to apply scientific methods to daily practical problems.</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td><td></td><td></td></tr>
<tr><td>Deepens students' knowledge in mechanics, design, manufacturing processes, and material science.</td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>contribution to their industrial environment.</td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td></tr>
</table>

Program Learning Outcomes vs. Program Objectives Matrix

Program Objectives	Program Competencies																			
	Level A										Level B				Level C					
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4	C1	C2	C3	C4	C5	C6
PO1	√	√	√								√	√	√	√	√	√				
PO2				√	√	√	√	√												
PO3					√	√	√	√	√											
PO4				√				√		√	√	√	√	√	√	√				
PO5													√	√	√	√	√	√	√	√
PO6															√	√	√	√	√	√
PO7															√	√	√	√	√	√

Program Objectives vs. Graduate Attributes Matrix

Program Objectives	Graduate Attributes												
	GA 1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA 10	GA 11	GA 12	GA 13
PO1	√	√											
PO2			√		√	√							
PO3				√						√			
PO4							√						
PO5								√	√				
PO6											√	√	√
PO7											√	√	√

Career Prospects

Design & Production Engineering is one of the most recognized disciplines in Egyptian industry. Design & Production engineers are needed in many industries intending to design and manufacture various products, machines and equipment. Graduates well serve in all industrial sectors, including metallurgical, petrochemical, textiles, furniture, etc. They can work as engineers in research and development, operations' management, quality control, tool design, work study, cost analysis, process control, heat treatment, etc. Graduates can be specialized in a specific field of the following concentrations: Manufacturing engineering, Mechanical design, Industrial engineering and operations' management, or Material engineering.

Program Concentrations

The graduate of the program can be specialized in one of the following three concentrations:

1. Product Design
2. Manufacturing & Materials Engineering
3. Industrial & Management Engineering

The concentration focus is achieved by 23 Cr. Hrs. including 18 Cr. Hrs. of elective courses and 5 Cr. Hrs. as the graduation project, all related to the specific concentration.

List of Design and Production Engineering Requirement Courses

Requirement	Cr. Hr.	Ct. Hr.			
		Lec.	Lab	Tut	Sum
Benha University Requirements	14	14	0	0	14
Benha Faculty of Engineering Requirements	32	21	33	46	50
Discipline Requirements	66	42	38	22	102
Major Mechanical Design & Production Program Requirements	30	17	25	3	45
Concentration of Product Design Requirements	18	12	0	12	24
Concentration of Manufacturing & Materials Requirements					
Concentration of Industrial & Management Requirements					
Total	160	106	96	83	235

Basic Science Requirements of Mechanical Design and Production Engineering

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec	Lab	Tut	Sum
BES 011	Mathematics I		3	2	0	2	4
BES 041	General Chemistry		4	3	2	1	6
BES 031	Physics I		3	2	2	1	5
BES 012	Mathematics II	BES 011	3	2	0	2	4
BES 032	Physics II		3	2	2	1	5
BES 111	Differential Equations	BES 012	3	2	0	2	4
BES 112	Numerical Analysis	BES 111	3	2	2	0	4
BES 113	Mathematics III	BES 012	3	2	0	2	4
*BES 141	Pollution and Industrial Safety	BES 041	2	2	1	0	3
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4
Total			**30**	**21**	**11**	**11**	**43**

* Course teaching is shared between the Basic Engineering Science Department and Mechanical Engineering Department.
** One credit hour from the Program courses (MEC314) has been encountered to the basic science courses. The total hours of basic sciences are 30 Hours.

Discipline Requirements of Mechanical Design and Production Engineering

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec.	Lab.	Tut.	Sum
BES 111	Differential Equations	BES 012	3	2	0	2	4
BES 112	Numerical Analysis	BES 111	3	2	2	0	4
BES 113	Mathematics III	BES 012	3	2	0	2	4
BES 211	Engineering Statistics and Probability		2	2	1	1	4
MEC 121	Fluid Mechanics	BES 031	3	2	2	1	5
MEC 111	Kinematics of Machines	BES 022	3	2	1	2	5
MEC 113	Mechanics and Testing of Materials	MEC 012	3	2	2	1	5
MEC 123	Materials Science and Engineering	BES 032	3	2	2	0	4
ELE 103	Electrical Circuits	BES 032	2	1	0	2	3
MEC 131	Computer Applications	ELE 042	2	1	2	0	3
MEC 122	Thermodynamics	BES 031	3	2	1	2	5
MEC 112	Design of Machine Elements	MEC 113	3	2	3	0	5
MEC 114	Measurement and Instrumentation	BES 032	2	1	2	1	4
MEC 116	Manufacturing Technology	MEC 012	2	1	3	0	4
ELE 104	Electronic Devices and Circuits	ELE 103	2	1	0	2	3
MEC 211	Project Management	BES 012	3	2	2	0	4
MEC 221	Heat Transfer	MEC 122	3	2	1	2	5
MEC 223	Fluid Power Systems	MEC 121	2	1	3	0	4
MEC 215	Mechanical Design	MEC 113	3	2	3	0	5
MEC 213	Mechanical Vibrations	BES 022	3	2	2	1	5
ELE 201	Electric Machinery	ELE 103	2	1	2	0	3
MEC 214	Automatic Control Systems	MEC 213	3	2	2	1	5
MEC 312	Engineering Economics		2	2	0	1	3
MEC 314	Advanced Topics in Control Engineering	MEC 314	3	2	2	0	4
MEC 301	Technical Reports		2	1	2	0	3
Total			**66**	**42**	**38**	**22**	**103**

*The student can register the Senior design Project course after passing 70% of the program cr. hrs., i.e., 112 Cr. Hr.

Major Requirements of Mechanical Design and Production Engineering

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec	Lab	Tut	Sum
MEC 212	Metal Cutting Processes	MEC 012	3	2	2	0	4
MEC 216	Computer Aided Design	MEC 112	3	2	2	0	4
MEC 218	Material Engineering	MEC 123	3	2	2	0	4
MEC 311	Advanced Machining Processes	MEC 214	3	2	2	0	4
MEC 313	Computer-Aided Manufacturing	MEC 212	3	2	2	0	4
MEC 31x1	Elective I		3	2	0	2	4
MEC 31x2	Elective II		3	2	0	2	4
MEC 416	Operations Research	MEC 311	3	2	2	0	4
MEC 316	Operations Researches	MEC 211	3	2	0	2	4
MEC 31x3	Elective III		3	2	0	2	4
MEC 31x4	Elective IV		3	2	0	2	4
MEC 411	Materials Handling	MEC 313	3	2	3	0	5
MEC 413	Production Aids Design	MEC 216	3	2	2	0	4
MEC 415	Machine Tool Design	MEC 311	2	1	2	0	3
MEC 43x5	Elective V		3	2	0	2	4
MEC 43x6	Elective VI		3	2	0	2	4
MEC 302	Senior Design Project I		2	2	0	0	2
MEC 401	Senior Design Project II	MEC 302	3	0	6	0	6
Total			**48**	**29**	**25**	**15**	**69**

* Elective courses are selected from three concentrations (x, y, and z)

Concentration Requirements of Product Design Engineering (concentration "x")

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec	Lab	Tut	Sum
Pool Courses for Elective I, Elective II							
MEC 31x1	Finite Element Analysis	MEC 216	3	2	0	2	4
MEC 31x2	Product Design & Development	MEC 215	3	2	0	2	4
Pool Courses for Elective III, Elective IV							
MEC 31x3	Failure Analysis	MEC 31x1 MEC 31x2	3	2	0	2	4
MEC 31x4	Design of Experiments	MEC 31x1 MEC 31x2	3	2	0	2	4
MEC 31x5	Tribology	MEC 31x1 MEC 31x2	3	2	0	2	4
Pool Courses for Elective V, Elective VI							
MEC 41x6	Special Topics in Mechanical Design	MEC 31x1 MEC 31x2	3	2	0	2	4
MEC 41x7	Pressure Vessels and Piping	MEC 31x1 MEC 31x2	3	2	0	2	4
MEC 41x8	Ergonomics and Human Factor	MEC 31x1 MEC 31x2	3	2	0	2	4
MEC 41x9	Computer Integrated Manufacturing	MEC 31x1 MEC 31x2	3	2	0	2	4
MEC 41x10	Process Control with applications	MEC 31x1	3	2	0	2	4

		MEC 31x2					
MEC 41x11	Sheet Metal processes and design	MEC 31x1 MEC 31x2	3	2	0	2	4
MEC 41x12	Material selection in Design	MEC 31x1 MEC 31x2	3	2	0	2	4
MEC 41x13	Design for Manufacture	MEC 31x1 MEC 31x2	3	2	0	2	4
MEC 41x14	Mechanism Design	MEC 31x1 MEC 31x2	3	2	0	2	4
MEC 41x15	Advanced Hydraulic and pneumatic control	MEC 31x1 MEC 31x2	3	2	0	2	4

* The course content must be approved by Mechanical Engineering Department Council before any student can register it.

Concentration Requirements of Manufacturing & Materials Engineering (concentration "y")

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec	Lab	Tut	Sum
Pool Courses for Elective I, Elective II							
MEC 31y1	Advanced Composite Materials	MEC 218	3	2	0	2	4
MEC 31y2	Manufacturing Systems	MEC 214	3	2	0	2	4
Pool Courses for Elective III, Elective IV							
MEC 31y3	Process Control with applications	MEC 31y1 MEC 31y2	3	2	0	2	4
MEC 31y4	Welding Technology	MEC 31y1 MEC 31y2	3	2	0	2	4
MEC 31y5	Casting Processes	MEC 31y1 MEC 31y2	3	2	0	2	4
Pool Courses for Elective V, Elective VI							
MEC 41y6	Powder Metallurgy	MEC 31y1 MEC 31y2	3	2	0	2	4
MEC 41y7	Polymers Engineering & Manufacturing	MEC 31y1 MEC 31y2	3	2	0	2	4
MEC 41y8	Special Topics in Materials Engineering	MEC 31y1 MEC 31y2	3	2	0	2	4
MEC 41y9	Computer Integrated Manufacturing	MEC 31y1 MEC 31y2	3	2	0	2	4
MEC 41y10	Special Topics in Manufacturing	MEC 31y1 MEC 31y2	3	2	0	2	4
MEC 41y11	Design for Manufacture	MEC 31y1 MEC 31y2	3	2	0	2	4
MEC 41y12	Sheet Metal processes	MEC 31y1 MEC 31y2	3	2	0	2	4
MEC 41y13	Design of Experiments	MEC 31y1 MEC 31y2	3	2	0	2	4
MEC 41y14	Ergonomics and Human Factor	MEC 31y1 MEC 31y2	3	2	0	2	4
MEC 41y15	Industrial Information systems	MEC 31y1 MEC 31y2	3	2	0	2	4

* The course content must be approved by Mechanical Engineering Department Council before any student can register it.

Concentration Requirements of Industrial & Management Engineering (concentration "z")

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec	Lab	Tut	Sum
Pool Courses for Elective I, Elective II							
MEC 31z1	Industrial Automation	MEC 214	3	2	0	2	4
MEC 31z2	Motion and Time Study	MEC 214	3	2	0	2	4
Pool Courses for Elective III, Elective IV							
MEC 31z3	Quality Control	MEC 31z1 MEC 31z2	3	2	0	2	4
MEC 31z4	Lean Manufacturing Systems	MEC 31z1 MEC 31z2	3	2	0	2	4
MEC 31z5	Industrial Market analysis	MEC 31z1 MEC 31z2	3	2	0	2	4
Pool Courses for Elective V, Elective VI							
MEC 41z6	Advanced Operations Research	MEC 31z1 MEC 31z2	3	2	0	2	4
MEC 41z7	Total Quality Management	MEC 31z1 MEC 31z2	3	2	0	2	4
MEC 41z8	Work & Work System	MEC 31z1 MEC 31z2	3	2	0	2	4
MEC 41z9	Computer Integrated Manufacturing	MEC 31z1 MEC 31z2	3	2	0	2	4
MEC 41z10	Process Control with applications	MEC 31z1 MEC 31z2	3	2	0	2	4
MEC 41z11	Special Topics in Industrial Engineering	MEC 31z1 MEC 31z2	3	2	0	2	4
MEC 41z12	Facilities Planning and Design	MEC 31z1 MEC 31z2	3	2	0	2	4
MEC 41z13	Ergonomics and Human Factor	MEC 31z1 MEC 31z2	3	2	0	2	4
MEC 41z14	Design of Experiments	MEC 31z1 MEC 31z2	3	2	0	2	4
MEC 41z15	Financial and accounting Management	MEC 31z1 MEC 31z2	3	2	0	2	4

* The course content must be approved by Mechanical Engineering Department Council before any student can register it.

Proposed Study Plan for Mechanical Design and Production Engineering

Level 0 - 1

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr. Lec	Ct. Hr. Lab	Ct. Hr. Tut	Ct. Hr. Sum	Final Exam Time HR.	Assessment SA	Assessment MT	Assessment PE/OE	Assessment Final Exam	Assessment Sum
BES 011	Mathematics I		3	2	0	2	4	2	30	30	-	40	100
BES 021	Mechanics I		3	2	0	2	4	2	30	30	-	40	100
BES 041	General Chemistry		4	3	2	1	6	2	10	30	20	40	100
BES 031	Physics I		3	2	2	1	5	2	10	30	20	40	100
MEC 011	Engineering Graphics		2	0	0	4	4	2	30	30	-	40	100
UHS 101	Foreign Language		2	2	0	0	2	2	30	30	-	40	100
UHS 102	Info. and Communication Tech.		2	2	0	0	2	2	30	30	-	40	100
Total			19										700

Level 0 - 2

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr. Lec	Ct. Hr. Lab	Ct. Hr. Tut	Ct. Hr. Sum	Final Exam Time HR.	Assessment SA	Assessment MT	Assessment PE/OE	Assessment Final Exam	Assessment Sum
BES 012	Mathematics II	BES 011	3	2	0	2	4	2	30	30	-	40	100
BES 022	Mechanics II	BES 021	3	2	0	2	4	2	30	30	-	40	100
MEC 012	Production Engineering		2	1	3	0	4	2	10	30	20	40	100
BES 032	Physics II		3	2	2	1	5	2	10	30	20	40	100
MEC 014	Computer Aided Drafting	MEC 011	2	1	2	0	3	2	10	30	20	40	100
ELE 042	Computer Programming Fundamentals		2	0	2	2	4	2	10	30	20	40	100
UHS 103	Societal Issues		2	2	0	0	2	2	30	30	-	40	100
Total			17										700

Level 1- 1														
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time HR.	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 111	Differential Equations	BES 012	3	2	0	2	4	2	30	30	-	40	100
MEC 121	Fluid Mechanics	BES 031	3	2	2	1	5	2	10	30	20	40	100
MEC 111	Kinematics of Machines	BES 022	3	2	0	2	4	2	30	30	-	40	100
MEC 113	Mechanics and Testing of Materials	MEC 012	3	2	2	1	5	2	10	30	20	40	100
MEC 123	Materials Science and Engineering	BES 032	3	2	2	0	4	2	10	30	20	40	100
ELE 103	Electrical Circuits	BES 032	2	1	0	2	3	2	30	30	-	40	100
MEC 131	Computer Applications	ELE 042	2	1	2	0	3	2	10	30	20	40	100
Total			19										700

Level 1- 2														
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time HR.	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 113	Mathematics III	BES 012	3	2	0	2	4	2	30	30	-	40	100
MEC 122	Thermodynamics	BES 031	3	2	1	2	5	2	10	30	20	40	100
MEC 112	Design of Machine Elements	MEC 113	3	2	3	0	5	2	10	30	20	40	100
MEC 114	Measurement and Instrumentation	BES 032	2	1	2	1	4	2	10	30	20	40	100
MEC 116	Manufacturing Technology	MEC 012	2	1	3	0	4	2	10	30	20	40	100
ELE 104	Electronic Devices and Circuits	ELE 103	2	1	0	2	3	2	30	30	-	40	100
UHS 104	Professional Ethics		2	2	0	0	2	2	30	30	-	40	100
Total			17										700

Field Training I														
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lect	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
FTR 103	Field Training I	Completion of 65 Cr. Hrs.	0	0	0	0	0	Oral	-	-	Pass or Fail	-	-

Level 2- 1													
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time HR.	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
MEC 211	Project Management	BES 012	3	2	2	0	4	2	10	30	20	40	100
MEC 221	Heat Transfer	MEC 122	3	2	1	2	5	2	10	30	20	40	100
MEC 223	Fluid Power Systems	MEC 121	2	1	3	0	4	2	10	30	20	40	100
MEC 215	Mechanical Design	MEC 113	3	2	3	0	5	2	10	30	20	40	100
MEC 213	Mechanical Vibrations	BES 022	3	2	2	1	5	2	10	30	20	40	100
ELE 201	Electric Machinery	ELE 103	2	1	2	0	3	2	10	30	20	40	100
UHS 3XX	Humanities - Elective I		2	2	0	0	2	2	30	30	-	40	100
Total			18										700

Level 2- 2														
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time HR	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 112	Numerical Analysis	BES 111	3	2	2	0	4	2	10	30	20	40	100
MEC 212	Metal Cutting Processes	MEC 012	3	2	2	0	4	2	10	30	20	40	100
MEC 216	Computer Aided Design	MEC 112	3	2	2	0	4	2	10	30	20	40	100
MEC 218	Material Engineering	MEC 123	3	2	2	0	4	2	10	30	20	40	100
MEC 214	Automatic Control Systems	MEC 213	3	2	2	1	5	2	10	30	20	40	100
BES 141	Pollution and Industrial Safety	BES 041	2	2	1	0	3	2	10	30	20	40	100
UHS 3XX	Humanities Elective II		2	2	0	0	2	2	30	30	-	40	100
Total			19										700

Field Training II														
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lect	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
FTR 203	Field Training I	Completion of 96 Cr. Hrs.	0	0	0	0	0	Oral	-	-	Pass or Fail	-	-

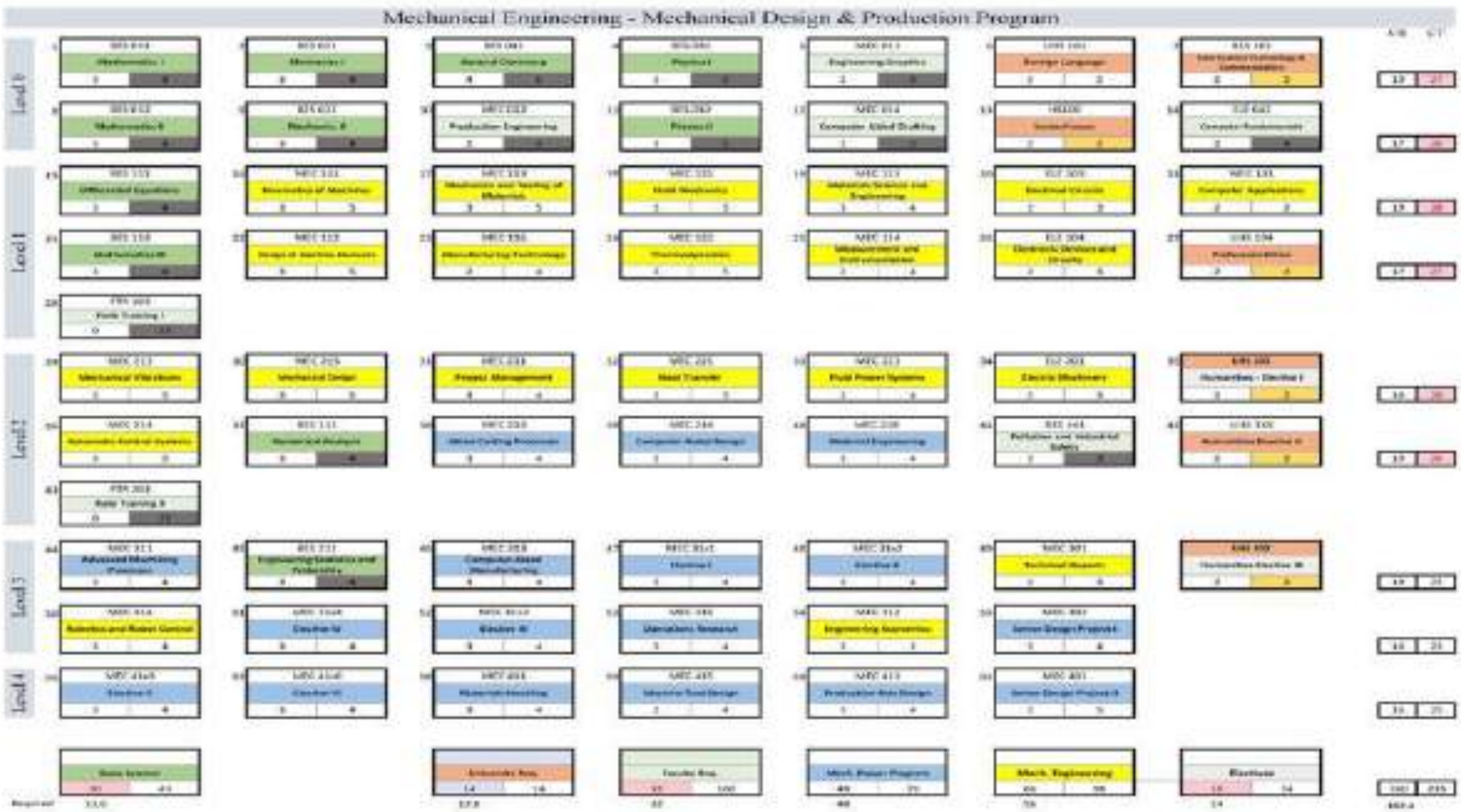
Level 3- 1														
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time HR	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4	2	10	30	20	40	100
MEC 31x1	Elective I		3	2	0	2	4	2	30	30	-	40	100
MEC 311	Advanced Machining Processes	MEC 214	3	2	2	0	4	2	10	30	20	40	100
MEC 313	Computer-Aided Manufacturing	MEC 212	3	2	2	0	4	2	10	30	20	40	100
MEC 31x2	Elective II		3	2	0	2	4	2	30	30	-	40	100
MEC 301	Technical Reports		2	1	2	0	3	2	50	-	50	--	100
UHS 4XX	Humanities Elective III		2	2	0	0	2	2	30	30	-	40	100
Total			19										700

Level 3- 2														
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time HR	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
MEC 314	Robotics and Robot Control	MEC 214	3	2	2	0	4	2	10	30	20	40	100
MEC 316	Operations Research	MEC 211	3	2	0	2	4	2	30	30	-	40	100
MEC 31x3	Elective III		3	2	0	2	4	2	30	30	-	40	100
MEC 31x4	Elective IV		3	2	0	2	4	2	30	30	-	40	100
MEC 302	Senior Design Project I		2	0	4	0	4	-	50	-	50	--	100
MEC 312	Engineering Economics		2	2	0	1	3	2	30	30	--	40	100
Total			16										600

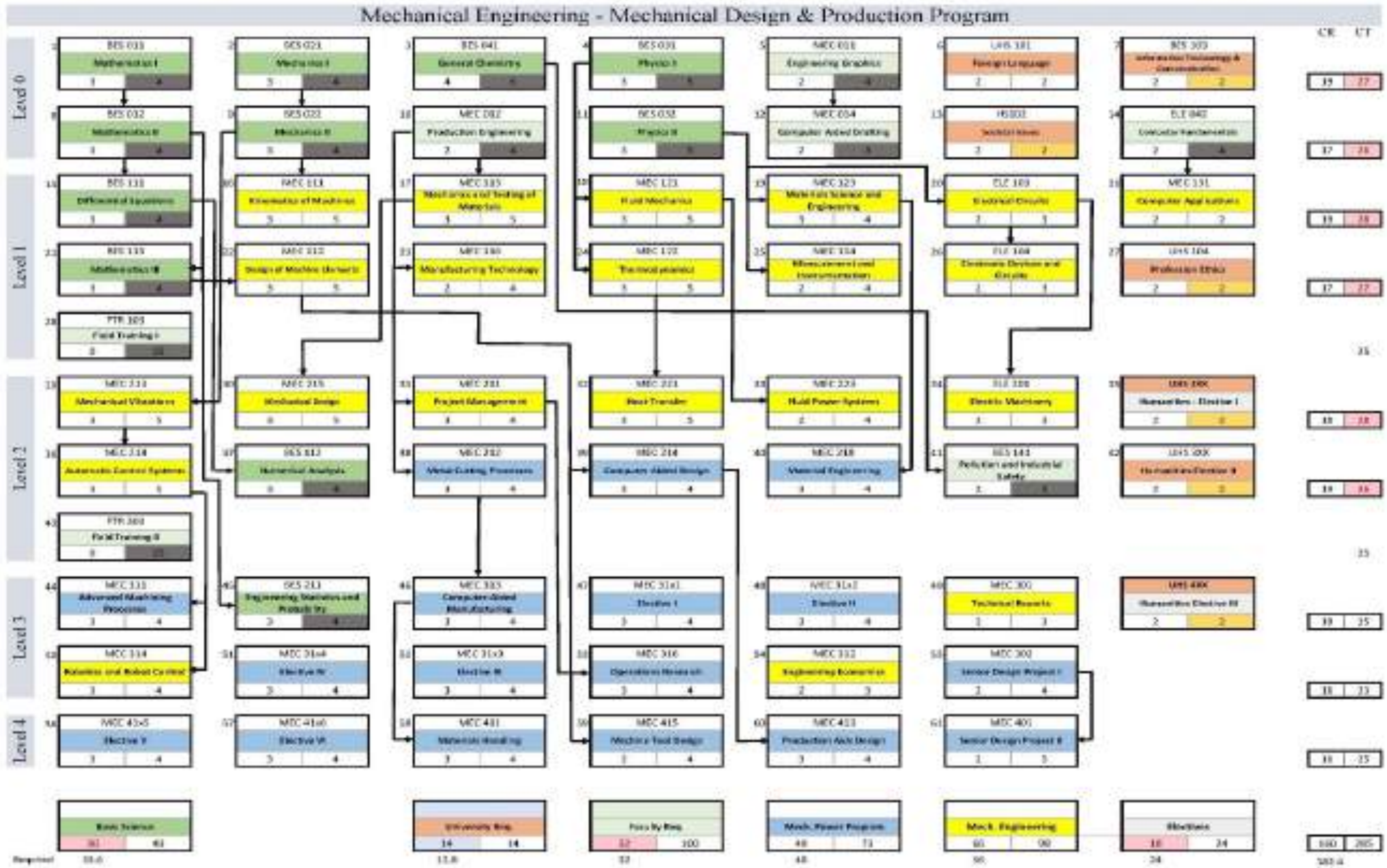
Level 4- 1														
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time HR	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
MEC 411	Materials Handling	MEC 313	3	2	2	0	4	2	10	30	20	40	100
MEC 413	Production Aids Design	MEC 216	3	2	2	0	4	2	10	30	20	40	100
MEC 41x5	Elective V		3	2	0	2	4	2	30	30	-	40	100
MEC 41x6	Elective VI		3	2	0	2	4	2	30	30	-	40	100
MEC 415	Machine Tool Design	MEC 311	2	1	2	1	4	2	10	30	20	40	100
MEC 401	Senior Design Project II	MEC 302	2	0	5	0	5	-	50	-	50	--	100
Total			16										600

Courses Plan and Matrix

Curriculum Plan for Mechanical Design and Production Engineering



Curriculum Plan for Mechanical Design and Production Engineering Program



Program Learning Outcomes to Program Courses Matrix

Level	Semester	Code	Competency	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18	PLO19	PLO20
Level 0	Semester 1	BES 011	Mathematics I	•		•																	
		BES 021	Mechanics I	•	•																		
		BES 041	General Chemistry	•	•																		
		BES 031	Physics I	•	•																		
		MEC 011	Engineering Graphics						•		•												
		UHS 101	Foreign Language								•		•										
		UHS 102	Information Technology & Communication				•		•				•										
	Semester 2	BES 012	Mathematics II	•		•																	
		BES 022	Mechanics II	•	•																		
		MEC 012	Production Engineering				•		•														
		BES 032	Physics II	•	•																		
		MEC 014	Computer Aided Drafting				•					•											
		ELE 042	Computer Fundamentals	•		•																	
		UHS 103	Societal Issues							•			•										
Level 1	Semester 3	BES 111	Differential Equations	•	•																		
		MEC 121	Fluid Mechanics											•		•							
		MEC 111	Kinematics of Machines											•	•	•							
		MEC 113	Mechanics and Testing of Materials		•									•									
		MEC 123	Materials Science and Engineering											•	•								
		ELE 103	Electrical Circuits											•	•								
		MEC 131	Computer Applications			•									•								
	Semester 4	BES 113	Mathematics III	•	•																		
		MEC 122	Thermodynamics											•	•								
		MEC 112	Design of Machine Elements			•	•								•		•						
		MEC 114	Measurement and Instrumentation		•		•							•									
		MEC 116	Manufacturing Technology											•	•		•						
		ELE 104	Electronic Devices and Circuits											•	•								
		UHS 201	Profession Ethics				•	•															
		FTR 103	Field Training I							•			•										

Level	Semester	Code	Competency	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18	PLO19	PLO20
Level 2	Semester 5	MEC 211	Project Management					•			•	•											
		MEC 221	Heat Transfer											•		•							
		MEC 225	Fluid Power Systems											•		•							
		MEC 215	Mechanical Design			•					•				•		•						
		MEC 213	Mechanical Vibrations											•	•		•						
		ELE 201	Electric Machinery																				
		HS 3XX	Humanities - Elective I			•	•																
	Semester 6	BES 112	Numerical Analysis	•	•																		
		MEC 212	Metal Cutting Processes													•		•				•	
		MEC 216	Computer Aided Design																•		•		
		MEC 218	Material Engineering																•			•	
		MEC 214	Automatic Control Systems			•								•			•						
		BES 141	Pollution and Industrial Safety	•		•	•																
		HS 304	Legalisation & Human Rights							•	•												
		FTR 203	Field Training III					•	•	•		•	•										
Level 3	Semester 7	BES 211	Engineering Statistics	•	•																		
		MEC 31x1	Elective I															•		•	•	•	•
		MEC 311	Advanced Machining Processes															•	•			•	
		MEC 313	Computer-Aided Manufacturing													•		•	•		•	•	
		MEC 31x2	Elective II															•		•	•	•	•
		MEC 301	Technical Reports					•		•	•												
		HS 4XX	Humanities Elective 2								•	•											
	Semester 8	MEC 314	Robotics and Robot Control											•	•		•				•		
		MEC 316	Operations Researches																	•			•
		MEC 31x3	Elective III																•		•	•	•
		MEC 31x4	Elective IV																•		•	•	•
		MEC 302	Senior Design Project I				•	•	•	•		•	•					•	•	•	•	•	•
		MEC 312	Engineering Economics			•				•													
Level 4	Semester 9	MEC 411	Materials Handling													•		•		•		•	•
		MEC 413	Production Aids Design													•		•	•		•	•	
		MEC 41x5	Elective V																•		•	•	•
		MEC 41x6	Elective VI																•		•	•	•
		MEC 415	Machine Tool Design																•		•	•	
		MEC 401	Senior Design Project II				•	•	•	•		•	•					•	•	•	•	•	•

Matching Mechanical Design and Production Engineering Program Courses with ABET Requirements

ABET Program Criteria for Mechanical and Similarly Named Engineering Programs
Lead Society: American Society of Mechanical Engineers

Mechanical Power Engineering Program Courses Required to Cover ABET Criteria

ABET Criteria		CODE	Course Name	Cr. Hrs.
A minimum of 30 semester credit hours (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program.	basic science, and mathematics (including multivariate calculus and differential equations);	BES 011	Mathematics I	3
		BES 012	Mathematics II	3
		BES 113	Mathematics III	3
		BES 111	Differential Equations	3
		BES 112	Numerical Analysis	3
		BES 211	Engineering Statistics and Probability	2
	principles of engineering	BES 041	General Chemistry	4
		BES 021	Mechanics I	3
		BES 022	Mechanics II	3
		BES 141	Pollution and Industrial Safety	2
		BES 031	Physics I	3
		BES 032	Physics II	3
Total				**35**
ABET Criteria		**CODE**	**Course Name**	**Cr. Hrs.**
A minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design and utilizing modern engineering tools.	applications of these topics to modeling, analysis, design, and realization of physical systems, components, or processes.	MEC 011	Engineering Graphics	2
		MEC 012	Production Engineering	2
		MEC 014	Computer Aided Drafting	2
		MEC 111	Kinematics of Machines	3
		MEC 112	Design of Machine Elements	3
		MEC 116	Manufacturing Technology	2
		MEC 123	Materials Science and Engineering	3
		MEC 215	Mechanical Design	3
		MEC 131	Computer Applications	2
	coverage of both Production and mechanical systems.	MEC 122	Thermodynamics	3
		MEC 223	Fluid Power Systems	2
		MEC 121	Fluid Mechanics	3
		MEC 221	Heat Transfer	3
		MEC 114	Measurement and Instrumentation	2
		MEC 213	Mechanical Vibrations	3
		MEC 214	Automatic Control Systems	3
	in-depth coverage of either Production or mechanical systems.	MEC 212	Metal Cutting Processes	3
		MEC 216	Computer Aided Design	3
		MEC 218	Material Engineering	3

		MEC 311	Advanced Machining Processes	3
		MEC 313	Computer-Aided Manufacturing	3
		MEC 31x1	Elective I	3
		MEC 31x2	Elective II	3
		MEC 314	Robotics and robot control	3
		MEC 316	Operation Research	3
		MEC 31x3	Elective III	3
		MEC 31x4	Elective IV	3
		MEC 411	Materials Handling	3
		MEC 413	Production Aids Design	3
		MEC 415	Machine Tool Design	2
		MEC 33x5	Elective V	3
		MEC 33x6	Elective VI	3
	Explain basic concepts in project management, business, public policy, and leadership.	MEC 301	Technical Reports	2
		MEC 312	Engineering Economics	2
		MEC 211	Project Management	3
		UHS 103	Societal Issues	2
		UHS 3XX	Humanities Elective I	2
		UHS 3XX	Humanities Elective II	2
		UHS 4XX	Humanities Elective III	2
	Analyze issues in professional ethics and explain the importance of professional licensure.	UHS 104	Professional Ethics	2
Total				**105**

Program #2 Mechanical Power Engineering Program

Program Description

The program aims to study both conventional energy and renewable sources energy. Energy's flows, constraints, generation, transmission, distribution, consumption, and management knowledge are acquired through the period of study. Students are provided with a deep knowledge of conventional and renewable energy technologies generation and applications. Thermal power plants, machine construction, design, and stability are topics covered. Solar photovoltaic, solar thermal, concentrated solar power, and others are studied. Renewable energy applications are illustrated and evaluated both theoretically and economically. Energy management is discussed in detail using demand side management, energy efficiency, and energy consumption and audit are explained. Finally, the program encourages problem identification and solving as well as critical thinking skills. All topics under study prepare the program graduates for the national, regional, and international energy job market.

Basic Information

Program Mission

Deliver high quality engineers equipped with the required skills in the various fields of mechanical power engineering, to engage in engineering professions and high-quality research and development of national and regional relevance, and to provide expert consultancy on energy issues.

Program Objectives

The objectives of the B.Sc. in mechanical power engineering program are to enable its graduates to:

- PO1. Apply a wide spectrum of engineering knowledge, science, and specialized skills with analytic, critical, and systematic thinking to identify and solve engineering problems in real life situation.
- PO2. Behave professionally and adhere to engineering ethics and standards and work to develop the profession and community and promote sustainability principles.
- PO3. Work in and lead a heterogeneous team and display leadership qualities, business administration, and entrepreneurial skills.
- PO4. Use techniques, skills, and modern engineering tools necessary for engineering practice.
- PO5. Master self-learning and life-long learning strategies to communicate effectively in academic/professional fields.
- PO6. Participate as leaders in addressing the social, economic, and environmental issues involved in energy technologies.
- PO7. Design and develop various types of mechanical power generation, energy transfer equipment and air-conditioning & refrigeration systems in addition to the automatic control devices involved in all such systems.

Graduate Attributes

By the completion of the MPE program of study, and according to NARS 2018, the graduate will be capable to:

- GA1. Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real life situations.
- GA2. Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation.
- GA3. Behave professionally and adhere to engineering ethics and standards.

GA4. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance.
GA5. Recognize his/her role in promoting the engineering field and contribute to the development of the profession and the community.
GA6. Value the importance of the environment, both physical and natural, and work to promote sustainability principles.
GA7. Use techniques, skills, and modern engineering tools necessary for engineering practice.
GA8. Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies.
GA9. Communicate effectively using different modes, tools, and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner.
GA10. Demonstrate leadership qualities, business administration and entrepreneurial skills.

In addition to all engineering graduate attributes defined by NARS 2018, MPE graduate should be able to:

GA11. Design, develop, operate and to maintain various types of mechanical power generation, energy transfer equipment and air-conditioning & refrigeration systems in addition to the automatic control devices involved in all such systems.
GA12. Describe the physical laws and resources that constrain energy systems.
GA13. Identify all aspects of the issues of environmental pollution problems concerning emissions of power generation, wastewater, and air pollution.

Program Learning Outcomes

The program courses fulfill the NARS 2018

Level A: The Engineering Graduate must be able to:

PLO1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics.
PLO2. Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess, and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.
PLO3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical, and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.
PLO4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues, and risk management principles.
PLO5. Practice research techniques and methods of investigation as an inherent part of learning.
PLO6. Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.
PLO7. Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural teams.
PLO8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.
PLO9. Use creative, innovative, and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.
PLO10. Acquire and apply new knowledge, and practice self, lifelong and other learning strategies.

Level B: The Engineering Graduate must be able to:

In addition to the Competencies for All Engineering Programs the BASIC MECHANICAL Engineering graduate and similar programs must be able to:

PLO11. Model, analyze and design physical systems applicable to the specific discipline by applying the concepts of: Thermodynamics, Heat Transfer, Fluid Mechanics, solid Mechanics, Material Processing, Material Properties, Measurements, Instrumentation, Control Theory and Systems, Mechanical Design and Analysis, Dynamics, and Vibrations.

PLO12. Plan, manage and carry out designs of mechanical systems and machine elements using appropriate materials both traditional means and computer-aided tools and software contemporary to the mechanical engineering field.

PLO13. Select conventional mechanical equipment according to the required performance.

PLO14. Adopt suitable national and international standards and codes; and integrate legal, economic, and financial aspects to design, build, operate, inspect, and maintain mechanical equipment and systems.

Level C: The Engineering Graduate must be able to:

In addition to competencies for all engineering programs (Level A, NARS 2018), and Mechanical Engineering competencies (Level B, NARS 2018), mechanical power engineer must be able to:

PLO15. Describe the physical laws and resources that constrain energy systems.

PLO16. Use Engineering software to simulate the flow field, predict the thermal behaviors, and analysis of conventional and non-conventional mechanical power systems.

PLO17. Identify the functional relationships of the mechanical system components installed to adopt the input/output of thermal power systems and equipment.

PLO18. Optimize the operating conditions and describe the performance parameters of energy absorbing/ producing machines, power stations, mechanical plants, and cells.

PLO19. Looking at ways of improving the design of wind turbines, improvements in solar and geothermal power, as well as every stage of renewable energy development.

PLO20. Design, develop, operate and to maintain various types of energy transfer equipment and air-conditioning & refrigeration systems in addition to the automatic control devices involved in all such systems.

PLO21. Identify all aspects of the issues of environmental pollution problems concerning emissions and air pollution. Design, develop and implement the appropriate vehicle and transport solutions.

Benchmark:

Benha University	Illinois state University https://tec.illinoisstate.edu/renewable-energy/curriculum/
PLO15. Describe the physical laws and resources that constrain energy systems.	- Describe the physical laws and resources that constrain our energy systems.
PLO16. Use Engineering software to simulate the flow field, predict the thermal behaviors, and analysis of conventional and non-	- Analyze wind data using professional software.

conventional mechanical power systems.	
PLO19. Looking at ways of improving the design of wind turbines, improvements in solar and geothermal power, as well as every stage of renewable energy development.	- Design residential and commercial solar photovoltaic (PV) systems using renewable energy software. - Optimize renewable energy business decision-making. - Develop a business case for a commercial renewable energy project.

Benha University	**Elgin Community College https://catalog.elgin.edu/degree-programs-certificates/career-technical/career-technical-degrees-certificates/energy-management/#learningoutcomestext**
PLO15. Describe the physical laws and resources that constrain energy systems. PLO16. Use Engineering software to simulate the flow field, predict the thermal behaviors, and analysis of conventional and non-conventional mechanical power systems. PLO17. Identify the functional relationships of the mechanical system components installed to adopt the input/output of thermal power systems and equipment.	- Evaluate the energy use patterns for residential and commercial structures and recommend energy efficiency and alternative energy solutions for optimization of evaluated buildings.
PLO18. Optimize the operating conditions and describe the performance parameters of energy absorbing/ producing machines, power stations, mechanical plants, and cells. PLO20. Design, develop, operate and to maintain various types of energy transfer equipment and air-conditioning & refrigeration systems in addition to the automatic control devices involved in all such systems.	- Program building automation systems for heating, ventilating, air conditioning, and exterior lighting service independently; and determine whether to dispatch appropriate staff or to resolve problems remotely via the energy management system.

Benha University	**Marathwada Mitra Mandal's Polytechnic.** **http://mmpolytechnic.edu.in/index.php/automobile-eng/automobile-engineering/learning-outcomes**

PLO21. Identify all aspects of the issues of environmental pollution problems concerning emissions and air pollution. Design, develop and implement the appropriate vehicle and transport solutions.	- Maintenance and Testing of automobile components: Make the use of Automobile equipment competently for vehicle maintenance, automotive Electronics, and testing. - Modern software usage: Use of latest software for simple design drafting, manufacturing, maintenance and documentation of automobile engineering components and processes. - Skill sets for entrepreneurs: Build the skill sets for entrepreneurs in Automobile service sectors.

Faculty Mission vs. Program Mission Matrix

Faculty Mission		Program Mission		
		The mission of the Mechanical Power Engineering Program is to deliver high quality engineers equipped with the required skills in the various fields of mechanical power engineering, to engage in engineering professions and high-quality research and development of national and regional relevance, and to provide expert consultancy on energy issues.		
		Deliver high quality engineers equipped with the required skills in the various fields of mechanical power engineering	Engage in engineering professions and high-quality research and development of national and regional relevance	Provide expert consultancy on energy issues
Benha University is committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market, and capable of using and developing modern technology, and providing research in engineering fields to serve society and community.	Graduate well prepared engineers equipped with knowledge and skills	√		
	Compete in labor market capable of using and developing modern technology, and providing research in engineering fields		√	
	Serve society and community.			√

Program Mission vs. Program Objectives Matrix

Program Mission		Program Objectives						
		PO1	PO2	PO3	PO4	PO5	PO6	PO7
The mission of the Mechanical Power Engineering Program is to deliver high quality engineers equipped with the required skills in the various fields of mechanical power engineering, to engage in engineering professions and high-quality research and development of national and regional relevance, and to provide expert consultancy on energy issues.	Deliver high quality engineers equipped with the required skills in the various fields of mechanical power engineering	√	√	√	√			
	Engage in engineering professions and high-quality research and development of national and regional relevance					√	√	√
	Provide expert consultancy on energy issues					√	√	√

Program Objectives vs. Graduate Attributes Matrix

Program Objectives	Graduate Attributes												
	GA 1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA 10	GA 11	GA 12	GA 13
PO1	√	√											
PO2			√		√	√							
PO3				√						√			
PO4							√						
PO5								√	√				
PO6											√	√	√
PO7											√	√	√

Program Outcomes vs. Program Objectives Matrix

Program Objectives	Program Competencies																				
	Level A										Level B				Level C						
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4	C1	C2	C3	C4	C5	C6	C7
PO1	√	√	√								√	√	√	√	√	√					
PO2				√	√	√	√	√													
PO3					√	√	√	√	√												
PO4				√				√		√	√	√	√	√	√	√					
PO5													√	√	√	√	√	√	√	√	√
PO6															√	√	√	√	√	√	√
PO7															√	√	√	√	√	√	√

Career Prospects

This program qualifies its graduates to work in mechanical power engineering, energy, and renewable energy engineering fields. Graduates can join electrical sector entities such as generation (conventional and renewable), public or private Power plants, control centers, petroleum industry, factories, maintenance applications, and energy management sectors can be a target for the program’s graduates. Distribution installations, refrigeration and air conditioning, water desalination and distillation applications, and solar pumping fields are candidate jobs for the energy graduates.

Program Concentrations

The graduate of the program can be specialized in one of the following three concentrations:

1. Sustainable & Renewable Energy
2. Energy management and HVAC Engineering
3. Vehicle Engineering

The concentration focus is achieved by 23 Credit Hours including 18 Cr. Hrs. of elective courses and 5 Cr. Hrs. as the graduation project, all related to the specific concentration.

List of Mechanical Power Engineering Requirement Courses

Requirement	Cr. Hr.	Ct. Hr.			
		Lec.	Lab	Tut	Sum
Benha University Requirements	14	14	0	0	14
Benha Faculty of Engineering Requirements	32	19	34	47	50
Discipline Requirements	66	42	38	22	102
Major Mechanical Power Program Requirements	30	17	27	1	45
Concentration of Sustainable & Renewable Energy Requirements	18	12	0	12	24
Concentration of Energy management and HVAC Requirements					
Concentration of Vehicle Engineering Requirements					
Total	**160**	**104**	**99**	**82**	**235**

Basic Science Requirements of Mechanical Power Engineering

Code	Course	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec	Lab	Tut	Sum
BES 011	Mathematics I		3	2	0	2	4
BES 041	General Chemistry		4	3	2	1	6
BES 031	Physics I		3	2	2	1	5
BES 012	Mathematics II	BES 011	3	2	0	2	4
BES 032	Physics II		3	2	2	1	5
BES 111	Differential Equations	BES 012	3	2	0	2	4
BES 112	Numerical Analysis	BES 111	3	2	2	0	4
BES 113	Mathematics III	BES 012	3	2	0	2	4
*BES 141	Pollution and Industrial Safety	BES 041	2	2	1	0	3
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4
Total			**30**	**21**	**11**	**11**	**43**

* Course teaching is shared between the Basic Engineering Science Department and Mechanical Engineering Department.

Mechanical Engineering Discipline Requirements

Code	Course	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec.	Lab.	Tut.	Sum
BES 113	Mathematics III	BES 012	3	2	0	2	4
BES 111	Differential Equations	BES 012	3	2	0	2	4
BES 112	Numerical Analysis	BES 111	3	2	2	0	4
BES 211	Engineering Statistics and Probability		3	2	2	0	4
MEC 121	Fluid Mechanics	BES 031	3	2	2	1	5
MEC 111	Kinematics of Machines	BES 022	3	2	0	2	4
MEC 113	Mechanics and Testing of Materials	MEC 012	3	2	2	1	5
MEC 123	Materials Science and Engineering	BES 032	3	2	2	0	4
ELE 103	Electrical Circuits	BES 032	2	1	0	2	3
MEC 131	Computer Applications	ELE 042	2	1	2	0	3
MEC 122	Thermodynamics	BES 031	3	2	1	2	5
MEC 112	Design of Machine Elements	MEC 113	3	2	3	0	5
MEC 114	Measurement and Instrumentation	BES 032	2	1	2	1	4
MEC 116	Manufacturing Technology	MEC 012	2	1	3	0	4
ELE 104	Electronic Devices and Circuits	ELE 103	2	1	0	2	3
MEC 211	Project Management	BES 012	3	2	2	0	4
MEC 221	Heat Transfer	MEC 122	3	2	1	2	5
MEC 223	Fluid Power Systems	MEC 121	2	1	3	0	4
MEC 215	Mechanical Design	MEC 113	3	2	3	0	5
MEC 213	Mechanical Vibrations	BES 022	3	2	2	1	5
ELE 201	Electric Machinery	ELE 103	2	1	2	0	3
MEC 214	Automatic Control Systems	MEC 213	3	2	2	1	5
MEC 312	Engineering Economics		2	2	0	1	3
MEC 421	Advanced Topics in Control Engineering	MEC 314	3	2	2	0	4
MEC 301	Technical Reports		2	1	2	0	3
Total			**66**	**42**	**38**	**22**	**102**

*The student can register the Senior design Project course after passing 70% of the program cr. hrs., i.e., 112 Cr. Hr.

Major Requirements of Mechanical Power Engineering

Code	Course	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec	Lab	Tut	Sum
MEC 222	Applied Thermodynamics	MEC 122	3	2	2	0	4
MEC 224	Fluid Dynamics	MEC 121	3	2	2	0	4
MEC 226	Refrigeration	MEC 122	3	2	2	0	4
MEC 323	Combustion	MEC 222	3	2	2	0	4
MEC 325	Air Conditioning	MEC 222	3	2	2	0	4
MEC 41x1	Elective I		3	2	0	2	4
MEC 41x2	Elective II		3	2	0	2	4
MEC 322	Internal Combustion Engines	MEC 222	3	2	2	0	4
MEC 324	Power System Components	MEC 222	3	2	2	0	4
MEC 41x3	Elective III		3	2	0	2	4
MEC 41x4	Elective IV		3	2	0	2	4
MEC 423	Turbomachinery	MEC 221	3	2	2	0	4
MEC 425	Power Stations	MEC 322	2	1	2	1	4
MEC 43x5	Elective V		3	2	0	2	4
MEC 43x6	Elective VI		3	2	0	2	4
MEC 302	Senior Design Project I		2	0	4	0	4
MEC 401	Senior Design Project II	MEC 302	2	0	5	0	5
Total			**48**	**29**	**27**	**13**	**69**

* Elective courses are selected from three concentrations (x, y, and z)

Concentration Requirements of Sustainable & Renewable Energy (concentration "x")

Code	Course	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec	Lab	Tut	Sum
Pool Courses for Elective I, Elective II							
MEC 32x1	Introduction to Renewable Energy	MEC 222	3	2	0	2	4
MEC 32x2	Hydroelectric Energy Systems	MEC 222	3	2	0	2	4
Pool Courses for Elective III, Elective IV							
MEC 32x3	Wind Energy System Design	MEC 32x1 MEC 32x2	3	2	0	2	4
MEC 32x4	Fundamentals and Applications of Solar Energy	MEC 32x1 MEC 32x2	3	2	0	2	4
MEC 32x5	Nuclear Power Stations	MEC 222	3	2	0	2	4
Pool Courses for Elective V, Elective VI							
MEC 42x5	Essentials of Energy Management	MEC 32x1 MEC 32x2	3	2	0	2	4
MEC 42x6	Biomass and waste Conversion Technology	MEC 221 , MEC 323	3	2	0	2	4
MEC 42x7	Design of Renewable Energy Equipment	MEC 32x1 MEC 32x2	3	2	0	2	4
MEC 42x8	Geothermal Energy Systems	MEC 32x1 MEC 32x2	3	2	0	2	4

*The course content must be approved by Mechanical Engineering Department Council before registration.

Concentration Requirements of Energy management and HVAC Engineering (concentration "y"

Code	Course	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec	Lab	Tut	Sum
Pool Courses for Elective I, Elective II							
MEC 32y1	Industrial Refrigeration	MEC 226	3	2	0	2	4
MEC 32y2	Fire Fighting & Water Distribution Systems	MEC 222	3	2	0	2	4
Pool Courses for Elective III, Elective IV							
MEC 32y3	Refrigeration & Air Conditioning Equipment	MEC 32y1	3	2	0	2	4
MEC 32y4	Fire Extinguishing Systems	MEC 32y2	3	2	0	2	4
MEC 32y5	Air Filtration	MEC 32y1 MEC 32y2	3	2	0	2	4
Pool Courses for Elective V, Elective VI							
MEC 42y6	Essentials of Energy Management	MEC 32y1 MEC 32y2	3	2	0	2	4
MEC 42y7	Special HVAC design applications	MEC 32y1 MEC 32y2	3	2	0	2	4
MEC 42y8	Energy Storage	MEC 222	3	2	0	2	4
MEC 42y9	Air-Conditioning Systems	MEC 32y1 MEC 32y2	3	2	0	2	4

*The course content must be approved by Mechanical Engineering Department Council before registration.

Concentration Requirements of Vehicle Engineering (concentration "z")

Code	Course	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec	Lab	Tut	Sum
Pool Courses for Elective I, Elective II							
MEC 32z1	Vehicle Dynamics	MEC 213	3	2	0	2	4
MEC 32z2	Automotive Engineering	MEC 214	3	2	0	2	4
Pool Courses for Elective III, Elective IV							
MEC 32z3	Electric vehicles	MEC 32z1 MEC 32z2	3	2	0	2	4
MEC 32z4	Vehicle design & Manufacturing	MEC 32z2	3	2	0	2	4
MEC 32z5	Vehicle maintenance Technology	MEC 32z1 MEC 32z2	3	2	0	2	4
Pool Courses for Elective V, Elective VI							
MEC 42z6	Engine Testing and Pollution Control	MEC 32z1 MEC 32z2	3	2	0	2	4
MEC 42z7	Fundamental of hybrid vehicles	MEC 32z1 MEC 32z2	3	2	0	2	4
MEC 42z8	Aerodynamics of Road Vehicles	MEC 32z1 MEC 32z2	3	2	0	2	4
MEC 42z9	Mechatronics for Automotive (Autotronics)	MEC 32z1 MEC 32z2	3	2	0	2	4

*The course content must be approved by Mechanical Engineering Department Council before registration.

Proposed Study Plan for Mechanical Power Engineering

Level 0 - 1

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time HR.	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 011	Mathematics I		3	2	0	2	4	2	30	30	-	40	100
BES 021	Mechanics I		3	2	0	2	4	2	30	30	-	40	100
BES 041	General Chemistry		4	3	2	1	6	2	10	30	20	40	100
BES 031	Physics I		3	2	2	1	5	2	10	30	20	40	100
MEC 011	Engineering Graphics		2	0	0	4	4	2	30	30	-	40	100
UHS 101	Foreign Language		2	2	0	0	2	2	30	30	-	40	100
UHS 102	Information and Communications Technology		2	2	0	0	2	2	30	30	-	40	100
Total			19										700

Level 0- 2

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time HR.	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 012	Mathematics II	BES 011	3	2	0	2	4	2	30	30	-	40	100
BES 022	Mechanics II	BES 021	3	2	0	2	4	2	30	30	-	40	100
MEC 012	Production Engineering		2	1	3	0	4	2	10	30	20	40	100
BES 032	Physics II		3	2	2	1	5	2	10	30	20	40	100
MEC 014	Computer Aided Drafting	MEC 011	2	1	2	0	3	2	10	30	20	40	100
ELE 042	Computer Programming fundamentals		2	0	2	2	4	2	10	30	20	40	100
UHS 103	Societal Issues		2	2	0	0	2	2	30	30	-	40	100
Total			17										700

Level 1- 1														
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time HR.	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 111	Differential Equations	BES 012	3	2	0	2	4	2	30	30	-	40	100
MEC 121	Fluid Mechanics	BES 031	3	2	2	1	5	2	10	30	20	40	100
MEC 111	Kinematics of Machines	BES 022	3	2	0	2	4	2	30	30	-	40	100
MEC 113	Mechanics and Testing of Materials	MEC 012	3	2	2	1	5	2	10	30	20	40	100
MEC 123	Materials Science and Engineering	BES 032	3	2	2	0	4	2	10	30	20	40	100
ELE 103	Electrical Circuits	BES 032	2	1	0	2	3	2	30	30	-	40	100
MEC 131	Computer Applications	ELE 042	2	1	2	0	3	2	10	30	20	40	100
Total			19										700

Level 1- 2													
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time HR.	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 113	Mathematics III	BES 012	3	2	0	2	4	2	30	30	-	40	100
MEC 122	Thermodynamics	BES 031	3	2	1	2	5	2	10	30	20	40	100
MEC 112	Design of Machine Elements	MEC 113	3	2	3	0	5	2	10	30	20	40	100
MEC 114	Measurement and Instrumentation	BES 032	2	1	2	1	4	2	10	30	20	40	100
MEC 116	Manufacturing Technology	MEC 012	2	1	3	0	4	2	10	30	20	40	100
ELE 104	Electronic Devices and Circuits	ELE 103	2	1	0	2	3	2	30	30	-	40	100
UHS 104	Profession Ethics		2	2	0	0	2	2	30	30	-	40	100
Total			19										700

Field Training I														
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lect	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
FTR 103	Field Training I	Completion of 65 Cr. Hrs.	0	0	0	0	0	Oral	-	-	Pass or Fail	-	-

Level 2- 1														
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time HR.	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
MEC 211	Project Management	BES 012	3	2	2	0	4	2	10	30	20	40	100
MEC 221	Heat Transfer	MEC 122	3	2	1	2	5	2	10	30	20	40	100
MEC 223	Fluid Power Systems	MEC 121	2	1	3	0	4	2	10	30	20	40	100
MEC 215	Mechanical Design	MEC 113	3	2	3	0	5	2	10	30	20	40	100
MEC 213	Mechanical Vibrations	BES 022	3	2	2	1	5	2	10	30	20	40	100
ELE 201	Electric Machinery	ELE 103	2	1	2	0	3	2	10	30	20	40	100
UHS 3XX	Humanities - Elective I		2	2	0	0	2	2	30	30	-	40	100
Total			18										700

Level 2- 2														
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time HR.	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 112	Numerical Analysis	BES 111	3	2	2	0	4	2	10	30	20	40	100
MEC 222	Applied Thermodynamics	MEC 122	3	2	2	0	4	2	10	30	20	40	100
MEC 224	Fluid Dynamics	MEC 121	3	2	2	0	4	2	10	30	20	40	100
MEC 226	Refrigeration	MEC 122	3	2	2	0	4	2	10	30	20	40	100
MEC 214	Automatic Control Systems	MEC 213	3	2	2	1	5	2	10	30	20	40	100
BES 141	Pollution and Industrial Safety	BES 041	2	2	1	0	3	2	10	30	20	40	100
UHS 3XX	Humanities Elective II		2	2	0	0	2	2	30	30	-	40	100
Total			19										700

Field Training II													
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lect	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
FTR 203	Field Training I	Completion of 96 Cr. Hrs.	0	0	0	0	0	Oral	-	-	Pass or Fail	-	-

Level 3- 1

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time HR.	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 211	Engineering Statistics and probability	BES 012	2	2	1	1	4	2	10	30	20	40	100
MEC 32x1	Elective I		3	2	0	2	4	2	30	30	-	40	100
MEC 323	Combustion	MEC 222	3	2	2	0	4	2	10	30	20	40	100
MEC 325	Air Conditioning	MEC 222	3	2	2	0	4	2	10	30	20	40	100
MEC 32x2	Elective II		3	2	0	2	4	2	30	30	-	40	100
MEC 301	Technical Reports		2	1	2	0	3	2	50	-	50	--	100
UHS 4XX	Humanities Elective III		2	2	0	0	2	2	30	30	-	40	100
Total			19										600

Level 3- 2

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time HR.	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
MEC 322	Internal Combustion Engines	MEC 222	3	2	2	0	4	2	10	30	20	40	100
MEC 324	Power System Components	MEC 222	3	2	2	0	4	2	10	30	20	40	100
MEC 32x3	Elective III		3	2	0	2	4	2	30	30	-	40	100
MEC 32x4	Elective IV		3	2	0	2	4	2	30	30	-	40	100
MEC 302	Senior Design Project I		2	2	0	0	2	-	50	-	50	--	100
MEC 312	Engineering Economics		2	2	0	1	3	2	30	30	-	40	100
Total			16										600

Level 4- 1														
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time HR.	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
MEC 421	Control Application for Energy Systems	MEC 214	3	2	1	2	5	2	10	30	20	40	100
MEC 423	Turbomachinery	MEC 121	3	2	2	0	4	2	10	30	20	40	100
MEC 42x5	Elective V		3	2	0	2	4	2	30	30	-	40	100
MEC 42x6	Elective VI		3	2	0	2	4	2	30	30	-	40	100
MEC 425	Power Stations	MEC 222	2	1	2	0	3	2	10	30	20	40	100
MEC 401	Senior Design Project II	MEC 302	3	0	6	0	6	-	50	-	50	--	100
Total			16										600

Courses Plan and Matrix

Curriculum Plan for Mechanical Power Engineering

Mechanical Engineering - Mechanical Power Engineering Program

Level 0

No.	Code	Course	CR	CT
1	BES 011	Mathematics I	3	4
2	BES 021	Mechanics I	3	4
3	BES 041	General Chemistry	4	6
4	BES 041	Physics I	3	5
5	BES 011	Engineering Graphics	2	4
6	UHS 101	Foreign Language	2	2
7	UHS 102	Information Technology & Communication	2	2
			19	27
8	BES 012	Mathematics II	3	4
9	BES 022	Mechanics II	3	4
10	MEC 012	Production Engineering	2	4
11	BES 032	Physics II	3	5
12	MEC 014	Computer Aided Drafting	2	3
13	ELE 042	Computer Fundamentals	2	4
14	UHS 103	Societal Issues	2	2
			17	26

Level 1

No.	Code	Course	CR	CT
15	BES 111	Differential Equations	3	4
16	MEC 121	Fluid Mechanics	3	5
17	MEC 111	Kinematics of Machines	3	5
18	MEC 113	Mechanics and Testing of Materials	3	5
19	MEC 123	Materials Science and Engineering	3	4
20	ELE 103	Electrical Circuits	2	3
21	MEC 131	Computer Applications	2	2
			19	28
21	BES 113	Mathematics III	3	4
22	MEC 122	Thermodynamics	3	5
23	MEC 114	Measurement and Instrumentation	2	4
24	MEC 112	Design of Machine Elements	3	5
25	MEC 116	Manufacturing Technology	2	4
26	ELE 104	Electronic Devices and Circuits	2	3
27	UHS 104	Profession Ethics	2	2
			17	27
28	FTR 103	Field Training I	0	25

Level 2

No.	Code	Course	CR	CT
29	MEC 211	Project Management	3	4
30	MEC 221	Heat Transfer	3	5
31	MEC 223	Fluid Power Systems	2	4
32	MEC 215	Mechanical Design	3	5
33	MEC 213	Mechanical Vibrations	3	5
34	ELE 201	Electric Machinery	2	3
35	UHS 3XX	Humanities - Elective I	2	2
			18	28
36	BES 112	Numerical Analysis	3	4
37	MEC 214	Automatic Control Systems	3	5
38	MEC 222	Applied Thermodynamics	3	4
39	MEC 226	Refrigeration	3	4
40	MEC 224	Fluid Dynamics	3	4
41	BES 141	Pollution and Industrial Safety	2	3
42	UHS 3XX	Humanities Elective II	2	2
			19	26
43	FTR 203	Field Training II	0	25

Level 3

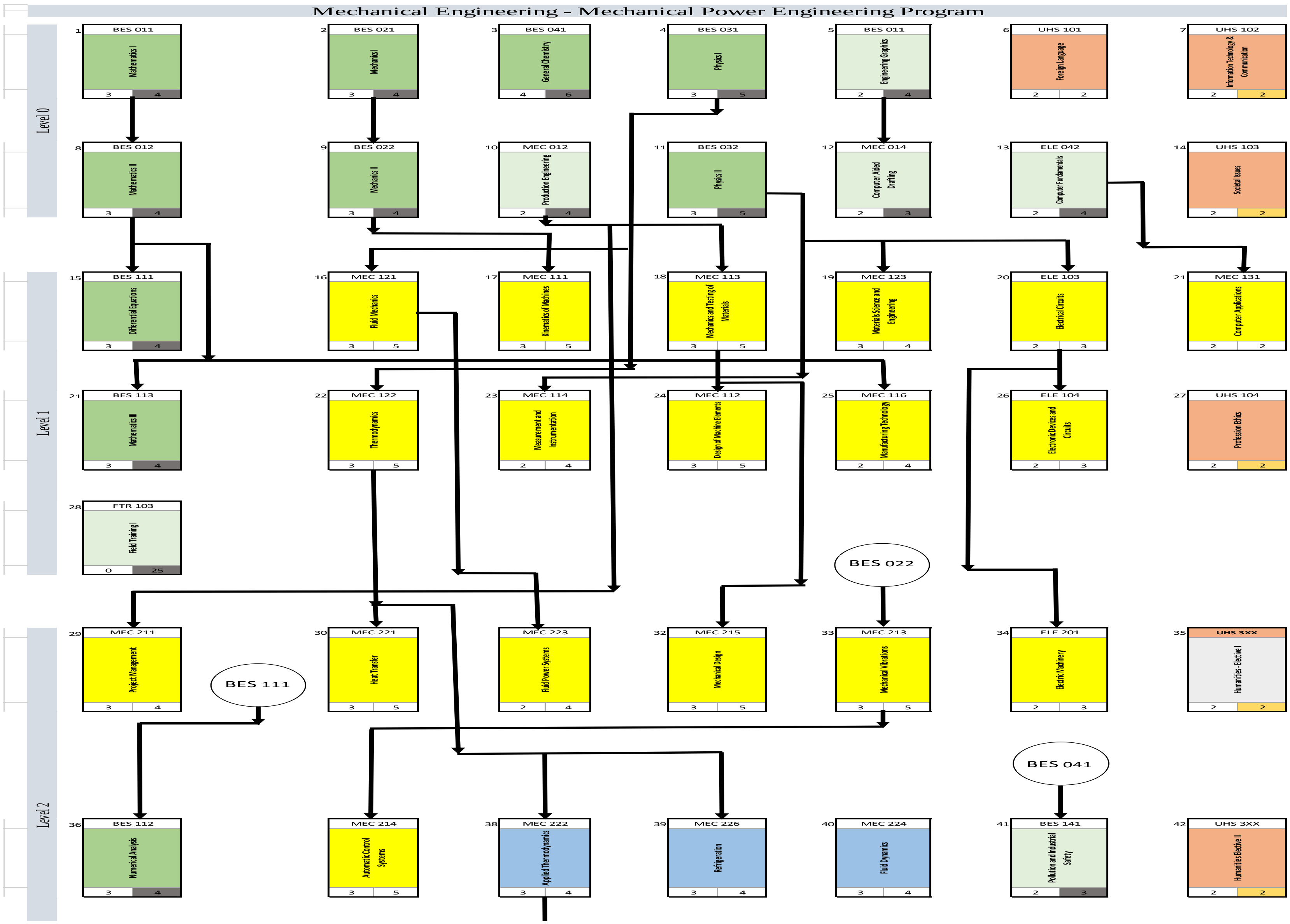
No.	Code	Course	CR	CT
44	BES 211	Engineering Statistics and Probability	3	4
45	MEC 32x1	Elective I	3	4
46	MEC 323	Combustion	3	4
47	MEC 325	Air Conditioning	3	4
48	MEC 32x2	Elective II	3	4
49	MEC 301	Technical Reports	2	3
50	UHS 4XX	Humanities Elective III	2	2
			19	25
52	MEC 322	Internal Combustion Engines	3	4
53	MEC 324	Power System Components	3	4
54	MEC 32x3	Elective III	3	4
55	MEC 32x4	Elective IV	3	4
56	MEC 312	Engineering Economics	2	3
57	MEC 302	Senior Design Project I	2	4
			16	23

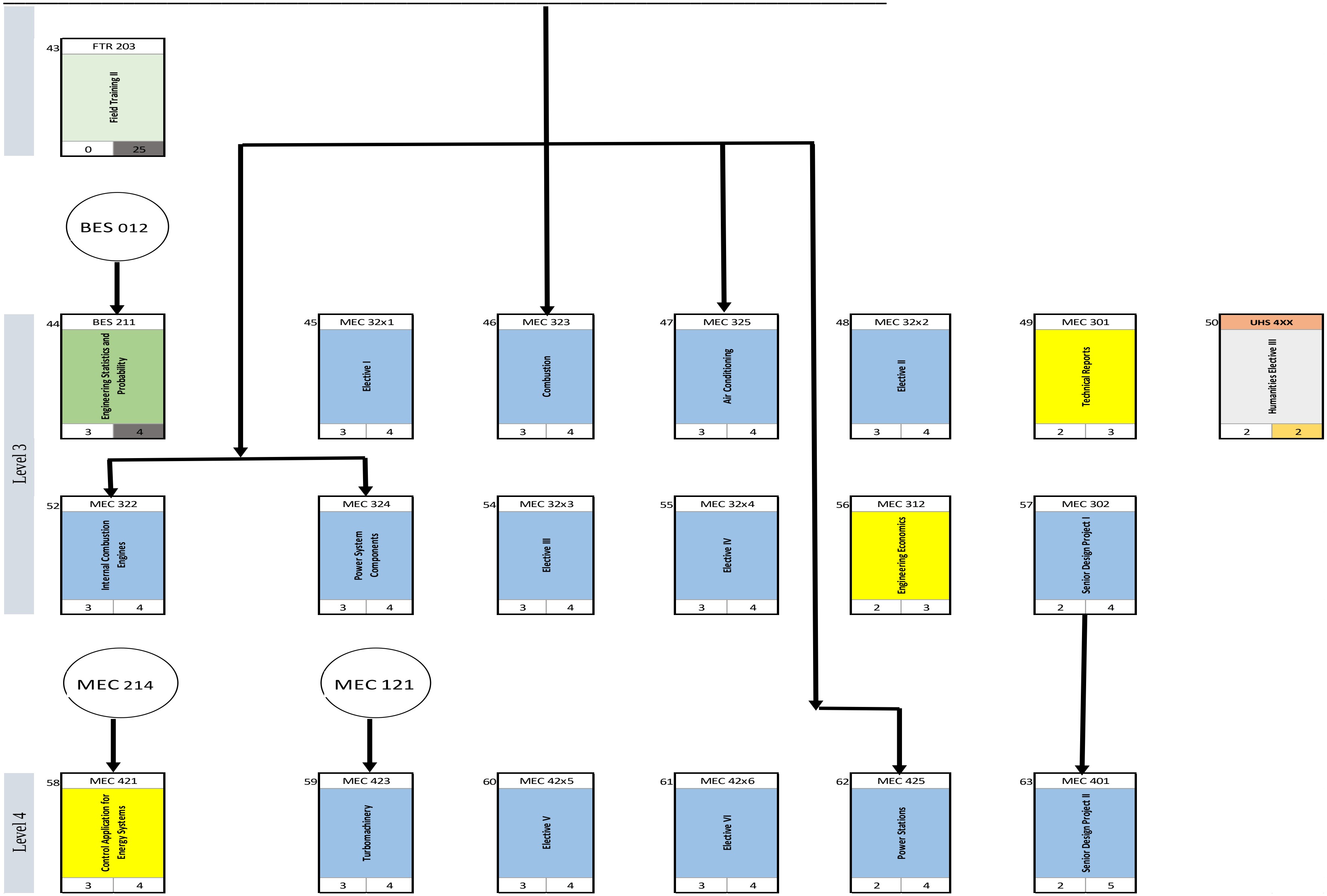
Level 4

No.	Code	Course	CR	CT
58	MEC 421	Control Application for Energy Systems	3	4
59	MEC 423	Turbomachinery	3	4
60	MEC 42x5	Elective V	3	4
61	MEC 42x6	Elective VI	3	4
62	MEC 425	Power Stations	2	4
63	MEC 401	Senior Design Project II	2	5
			16	25

Category	CR	CT
Basic Science	30	43
University Req.	14	14
Faculty Req.	32	100
Mech. Power Program	48	73
Mech. Engineering	66	98
Electives	18	24
Total	160	235

Curriculum Plan for Mechanical Power Engineering




Level 3
Level 4
43 FTR 203 Field Training II 0 25
BES 012
44 BES 211 Engineering Statistics and Probability 3 4
45 MEC 32x1 Elective I 3 4
46 MEC 323 Combustion 3 4
47 MEC 325 Air Conditioning 3 4
48 MEC 32x2 Elective II 3 4
49 MEC 301 Technical Reports 2 3
50 UHS 4XX Humanities Elective III 2 2
52 MEC 322 Internal Combustion Engines 3 4
53 MEC 324 Power System Components 3 4
54 MEC 32x3 Elective III 3 4
55 MEC 32x4 Elective IV 3 4
56 MEC 312 Engineering Economics 2 3
57 MEC 302 Senior Design Project I 2 4
MEC 214
MEC 121
58 MEC 421 Control Application for Energy Systems 3 4
59 MEC 423 Turbomachinery 3 4
60 MEC 42x5 Elective V 3 4
61 MEC 42x6 Elective VI 3 4
62 MEC 425 Power Stations 2 4
63 MEC 401 Senior Design Project II 2 5

Program Learning Outcomes to Program Courses Matrix

Courses				Program Learning Outcomes																				
Levels		Code	Title	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18	PLO19	PLO20	PLO21
Level 0	Level 0-1	BES 011	Mathematics I	●		●																		
		BES 021	Mechanics I	●	●																			
		BES 041	General Chemistry	●	●																			
		BES 031	Physics I	●	●																			
		MEC 011	Engineering Graphics						●		●													
		UHS 101	Foreign Language								●		●											
		UHS 102	Information Technology & Communication				●		●				●											
	Level 0-2	BES 012	Mathematics II	●		●																		
		BES 022	Mechanics II	●	●																			
		MEC 012	Production Engineering				●		●															
		BES 032	Physics II	●	●																			
		MEC 014	Computer Aided Drafting				●					●												
		ELE 042	Computer Programming Fundamentals	●		●																		

		UHS 103	Societal Issues							●			●											
Level 1	Level 1-1	BES 111	Differential Equations	●	●																			
		MEC 121	Fluid Mechanics											●		●								
		MEC 111	Kinematics of Machines											●	●	●								
		MEC 113	Mechanics and Testing of Materials		●									●										
		MEC 123	Materials Science and Engineering											●	●									
		ELE 103	Electrical Circuits											●	●									
		MEC 131	Computer Applications			●									●									
	Level 1-2	BES 113	Mathematics III	●	●																			
		MEC 122	Thermodynamics											●	●									
		MEC 112	Design of Machine Elements			●	●								●		●							
		MEC 114	Measurement and Instrumentation		●		●							●										
		MEC 116	Manufacturing Technology											●	●		●							
		ELE 104	Electronic Devices and Circuits											●	●									
		UHS 201	Profession Ethics				●	●																
		FTR 103	Field Training I							●			●											
Level 2	Level 2-1	MEC 211	Project Management					●			●	●												

		MEC 221	Heat Transfer											●		●								
		MEC 223	Fluid Power Systems											●		●								
		MEC 215	Mechanical Design			●					●				●		●							
		MEC 213	Mechanical Vibrations											●	●		●							
		ELE 201	Electric Machinery											●	●									
		UHS 3XX	Humanities - Elective I			●	●																	
	Level 2-2	BES 112	Numerical Analysis	●	●																			
	Level 2-2	MEC 222	Applied Thermodynamics																	●	●			●
	Level 2-2	MEC 224	Fluid Dynamics															●				●		●
	Level 2-2	MEC 226	Refrigeration																	●	●		●	
	Level 2-2	MEC 214	Automatic Control Systems			●								●			●							
	Level 2-2	BES 141	Pollution and Industrial Safety	●		●	●																	
	Level 2-2	UHS 304	Legalization & Human Rights							●	●													
	Level 2-2	FTR 203	Field Training II					●	●	●		●	●											
Level 3	Level 3-1	BES 211	Engineering Statistics	●	●																			
Level 3	Level 3-1	MEC 32x1	Elective I															●				●	●	●
Level 3	Level 3-1	MEC 323	Combustion																●	●				●

		MEC 325	Air Conditioning																●	●	●		●	
		MEC 32x2	Elective II															●				●	●	●
		UHS 4XX	Humanities Elective 2								●	●												
		MEC 301	Techincal Reports					●		●	●													
	Level 3-2	MEC 322	Internal Combustion Engines																	●				●
	Level 3-2	MEC 324	Power System Components															●	●	●	●			●
	Level 3-2	MEC 32x3	Elective III															●				●	●	●
	Level 3-2	MEC 32x4	Elective IV															●				●	●	●
	Level 3-2	MEC 302	Senior Design Project I				●	●	●	●		●	●					●	●	●	●	●	●	●
	Level 3-2	MEC 312	Engineering Economics			●				●														
Level 4	Level 4-1	MEC 421	Control Application for Energy Systems					●						●	●		●							
Level 4	Level 4-1	MEC 423	Turbomachinery															●		●				●
Level 4	Level 4-1	MEC 42x5	Elective V															●				●	●	●
Level 4	Level 4-1	MEC 42x6	Elective VI															●				●	●	●
Level 4	Level 4-1	MEC 425	Power Stations																●	●	●			
Level 4	Level 4-1	MEC 401	Senior Design Project II				●	●	●	●		●	●					●	●	●	●	●	●	●

Matching Mechanical Power Engineering Program Courses with ABET Requirements

ABET Program Criteria for Mechanical and Similarly Named Engineering Programs
Lead Society: American Society of Mechanical Engineers

Mechanical Power Engineering Program Courses Required to Cover ABET Criteria				
ABET Criteria		**CODE**	**Course Name**	**Cr. Hrs.**
A minimum of 30 semester Cr. Hrs. (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program.	basic science, and mathematics (including multivariate calculus and differential equations);	BES 011	Mathematics I	3
		BES 012	Mathematics II	3
		BES 113	Mathematics III	3
		BES 111	Differential Equations	3
		BES 112	Numerical Analysis	3
		BES 211	Engineering Statistics and Probability	2
	principles of engineering	BES 041	General Chemistry	4
		BES 021	Mechanics I	3
		BES 022	Mechanics II	3
		BES 141	Pollution and Industrial Safety	2
		BES 031	Physics I	3
		BES 032	Physics II	3
Total				**35**
ABET Criteria		**CODE**	**Course Name**	**Cr. Hrs.**
A minimum of 45 semester Cr. Hrs. (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design and utilizing modern engineering tools.	applications of these topics to modeling, analysis, design, and realization of physical systems, components, or processes.	MEC 011	Engineering Graphics	2
		MEC 012	Production Engineering	2
		MEC 014	Computer Aided Drafting	2
		MEC 111	Kinematics of Machines	3
		MEC 112	Design of Machine Elements	3
		MEC 116	Manufacturing Technology	2
		MEC 123	Materials Science and Engineering	3
		MEC 215	Mechanical Design	3
		MEC 131	Computer Applications	2
	coverage of both thermal and mechanical systems.	MEC 122	Thermodynamics	3
		MEC 223	Fluid Power Systems	2
		MEC 121	Fluid Mechanics	3
		MEC 221	Heat Transfer	3
		MEC 114	Measurement and Instrumentation	2
		MEC 213	Mechanical Vibrations	3
		MEC 214	Automatic Control Systems	3
	in-depth coverage of either thermal or mechanical systems.	MEC 222	Applied Thermodynamics	3
		MEC 224	Fluid Dynamics	3
		MEC 226	Refrigeration	3

		MEC 323	Combustion	3
		MEC 325	Air Conditioning	3
		MEC 31x1	Elective I	3
		MEC 31x2	Elective II	3
		MEC 322	Internal Combustion Engines	3
		MEC 324	Power System Components	3
		MEC 31x3	Elective III	3
		MEC 31x4	Elective IV	3
		MEC 421	Control Application for Energy Systems	3
		MEC 423	Turbomachinery	3
		MEC 425	Power Stations	2
		MEC 33x5	Elective V	3
		MEC 33x6	Elective VI	3
	Explain basic concepts in project management, business, public policy, and leadership.	MEC 301	Technical Reports	2
		MEC 312	Engineering Economics	2
		MEC 211	Project Management	3
		UHS 103	Societal Issues	2
		UHS 3XX	Humanities Elective I	2
		UHS 3XX	Humanities Elective II	2
		UHS 4XX	Humanities Elective III	2
	Analyze issues in professional ethics and explain the importance of professional licensure.	UHS 104	Professional Ethics	2
Total				**105**

Program# 3 Mechatronics Engineering Program

Program Description

Mechatronics engineering is considered recently the keystone of automation and technology all over the world. Mechatronics Engineering is a multidisciplinary science that blends mechanical engineering, electrical engineering, and computer science to develop intelligent systems and convert conventional machines into smart machines. The integration among these several sciences empowered the mechatronics engineering to be utilized in various applications like industrial automation, automotive, robotics, drones, 3d printers and more.

Basic Information

Program Mission

The mission of mechatronics program is to prepare a skillful engineer that possesses analytical and technical skills to fulfill the market needs and to provide innovative solutions for multidisciplinary engineering applications that serve the society and promote the scientific research.

Program Objectives (PO)

Upon completion of this program, mechatronics and automation engineering program graduates are expected to be able to:

- PO1 Apply a wide spectrum of engineering knowledge, science, and specialized skills with analytic, critical, and systematic thinking to identify and solve engineering problems in real life situation.
- PO2 Behave professionally and adhere to engineering ethics and standards and work to develop the profession and community and promote sustainability principles.
- PO3 Work in and lead a heterogeneous team and display leadership qualities, business administration, and entrepreneurial skills.
- PO4 Use techniques, skills, and modern engineering tools necessary for engineering practice.
- PO5 Master self-learning and life-long learning strategies to communicate effectively in academic/professional fields.
- PO6 Assist students in becoming acquainted with the foundations of modern technologies like as Artificial Intelligence, IoT, and Autotronics.
- PO7 Control Mechatronics applications using current engineering techniques, talents, and procedures.

Graduate Attributes (GA)

Graduate attributes are the academic abilities, personal qualities, and skills which mechatronics Engineering graduates should have. Mechatronics engineering graduates should be always aware of the everlasting updates in the field since that mechatronics engineering is one of the fast and non-stopping disciplines of engineering. The wide range of engineering fields that are integrated within the mechatronics engineering requires that mechatronics graduates should possess self-learning philosophy to keep up with the technology evolution.

According to NARS 2018, all engineering graduates must:

- GA1 Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real life situations.

GA2 Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation.
GA3 Behave professionally and adhere to engineering ethics and standards.
GA4 Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance.
GA5 Recognize his/her role in promoting the engineering field and contribute to the development of the profession and the community.
GA6 Value the importance of the environment, both physical and natural, and work to promote sustainability principles.
GA7 Use techniques, skills and modern engineering tools necessary for engineering practice.
GA8 Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies.
GA9 Communicate effectively using different modes, tools, and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner.
GA10 Demonstrate leadership qualities, business administration and entrepreneurial skills.

In addition to all engineering graduate attributes defined by NARS 2018, mechatronics engineering graduate should be able to:

GA11 Demonstrate the theoretical and practical knowledge of multi disciplines within mechatronics systems.
GA12 Use latest technologies and apply knowledge in various disciplines to identify and solve complex mechatronics problem.
GA13 Design, develop, and conduct experimental tests in the mechatronic engineering.
GA14 Work efficiently and integrally in a multidisciplinary team with leading skills.

Program Learning Outcomes

Level A

The Engineering Graduate must be able to:

PLO1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science and mathematics.
PLO2. Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.
PLO 3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.
PLO 4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.
PLO 5. Practice research techniques and methods of investigation as an inherent part of learning.
PLO 6. Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.
PLO 7. Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural teams.

PLO 8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.

PLO 9. Use creative, innovative, and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

PLO 10. Acquire and apply new knowledge, and practice self, lifelong and other learning strategies.

Level B

In addition to the Competencies for All Engineering Programs (Level A, NARS 2018), Mechatronics Engineering Program graduate must be able to (B-Level):

PLO 11. Model, analyze and design physical systems applicable to the specific discipline by applying the concepts of: Thermodynamics, Heat Transfer, Fluid Mechanics, solid Mechanics, Material Processing, Material Properties, Measurements, Instrumentation, Control Theory and Systems, Mechanical Design and Analysis, Dynamics, and Vibrations.

PLO 12. Plan, manage and carry out designs of mechanical systems and machine elements using appropriate materials both traditional means and computer-aided tools and software contemporary to the mechanical engineering field.

PLO 13. Select conventional mechanical equipment according to the required performance.

PLO 14. Adopt suitable national and international standards and codes; and integrate legal, economic, and financial aspects to design, build, operate, inspect, and maintain mechanical equipment and systems.

Level C

In addition to the Competencies for all Engineering Programs (Level A, NARS 2018) and the competencies for the Mechanical Discipline (Level B, NARS 2018), the Mechatronics Engineering Program graduate must be able to (C Level):

PLO 15. Determine the tools needed to maximize the design while designing, modelling, and analyzing an electrical, electronic, or digital system or component for a particular application.

PLO 16. Calculate and quantify an electrical, electronic, or digital system's performance under a certain input excitation, and assess the system's appropriateness for a given application.

PLO 17. Adopt suitable national and international standards and codes to design, build, operate, inspect, and maintain electrical / electronic / digital equipment, systems, and services.

PLO 18. Determine the design, production, interface, and software requirements for various Mechatronics system components at the appropriate level.

PLO 19. Create innovative solutions to mechatronics systems challenges, especially those involving production, maintenance, and interfaces, while taking into consideration industrial and commercial restrictions.

Benchmark:

Benha University	Heliopolis University at - https://www.hu.edu.eg/Competencies-of-mechatronics-engineers/
PLO 15. Determine the tools needed to maximize the design while designing, modelling, and analyzing an electrical, electronic, or digital system or component for a particular application.	Design, model and analyze an electrical/electronic/digital system or component for a specific application; and identify the tools required to optimize this design
PLO 16. Calculate and quantify an electrical, electronic, or digital system's performance under a certain input excitation, and assess the system's appropriateness for a given application	Estimate and measure the performance of an electrical/electronic/digital system and circuit under specific input excitation, and evaluate its suitability for a specific application ANU
Benha University	**NARS 2018**
PLO 17. Adopt suitable national and international standards and codes to design, build, operate, inspect, and maintain electrical / electronic / digital equipment, systems, and services	Adopt suitable national and international standards and codes to design, build, operate, inspect, and maintain electrical / electronic / digital equipment, systems, and services
Benha University	**College of Engineering and Technology | AASTMT at - https://aast.edu/en/colleges/coe/southValley /dept/contenttemp.php?page_id=64800008**
PLO 18. Determine the design, production, interface, and software requirements for various Mechatronics system components at the appropriate level.	Identify at an appropriate level the design, production, interfacing and software needs of different parts of Mechatronics systems
PLO 19. Create innovative solutions to mechatronics systems challenges, especially those involving production, maintenance, and interfaces, while taking into consideration industrial and commercial restrictions.	Create solutions to mechatronics systems especially to manufacturing, maintenance and interfacing Problems in a creative way, taking account of industrial and commercial constraints.

Faculty Mission vs. Program Mission Matrix

Faculty Mission		Program Mission		
		The mission of mechatronics program is to prepare a skillful engineer that possesses analytical and technical skills to fulfill the market needs and to provide innovative solutions for multidisciplinary engineering applications that serve the society and promote the scientific research.		
		prepare a skillful engineer that possesses analytical and technical skills	to fulfill the market needs and to provide innovative solutions for multidisciplinary engineering applications	that serve the society and promote the scientific research.
Benha University is committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market, and capable of using and developing modern technology, and providing research in engineering fields to serve society and community.	graduate well prepared engineers equipped with knowledge and skills	√		
	compete in labor market capable of using and developing modern technology, and providing research in engineering fields		√	
	serve society and community.			√

Program Mission vs. Program Objectives Matrix

Program Mission		Program Objectives						
		PO1	PO2	PO3	PO4	PO5	PO6	PO7
The mission of mechatronics program is to prepare a skillful engineer that possesses analytical and technical skills to fulfill the market needs and to provide innovative solutions for multidisciplinary engineering applications that serve the society and promote the scientific research.	prepare a skillful engineer that possesses analytical and technical skills	√	√	√			√	
	to fulfill the market needs and to provide innovative solutions for multidisciplinary engineering applications	√			√	√	√	
	that serve the society and promote the scientific research.					√		√

Program Competencies vs. Program Objectives Matrix

Program Objectives	Competencies																		
	Level A										Level B				Level C				
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4	C1	C2	C3	C4	C5
PO1	√	√								√	√	√				√			
PO2		√			√			√				√	√	√	√				
PO3			√			√	√		√			√							
PO4		√	√	√									√		√	√		√	
PO5	√				√			√		√									
PO6																	√	√	√
PO7															√		√	√	√

Program Objectives vs. Graduate Attributes Matrix

Program Objectives	Graduate Attributes													
	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12	GA13	GA14
PO1	√	√												
PO2			√		√	√								
PO3				√						√				
PO4							√							
PO5								√	√					
PO6											√	√	√	√
PO7											√	√	√	√

Career Prospects

Mechatronics engineering graduates of this program are expected to gain good experience in different scopes that enable them to be eligible to work in several fields including:

1- Automation and control field,
2- Maintenance field,
3- Robotics field,
4- CAD/CAM and 3D printing fields,
5- Embedded system field,
6- Intelligent control and machine learning fields,
7- Automotive field.

Program Concentrations

The graduates of mechatronics engineering program focus on two main concentrations including

1- Robotics and Control
   In this this concentration, students will study advanced topics on robotics and intelligent control.
2- Advanced Mechatronics and Automotive
   In this concentration, students will study foundations of automotive industry and Autotronics

The concentration focus is achieved by 23 Cr. Hrs. including 18 Cr. Hrs. of elective courses and 4 Cr. Hrs. as the graduation project, all related to the specific concentration.

List of Mechatronics Engineering Requirement Courses

Requirement	Cr. Hr.	Ct. Hr.			
		Lec.	Lab	Tut	Sum
Benha University Requirements	14	14	0	0	14
Benha Faculty of Engineering Requirements	32	19	34	47	50
Discipline Requirements	66	42	38	22	102
Major Mechatronics Program Requirements	30	17	25	3	45
Concentration of Sustainable & Renewable Energy Requirements Concentration of Energy management and HVAC Requirements Concentration of Vehicle Engineering Requirements	18	12	0	12	24
Total	**160**	**104**	**97**	**84**	**235**

Basic Science Requirements of Mechatronics Engineering

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec	Lab	Tut	Sum
BES 011	Mathematics I		3	2	0	2	4
BES 041	General Chemistry		4	3	2	1	6
BES 031	Physics I		3	2	2	1	5
BES 012	Mathematics II	BES 011	3	2	0	2	4
BES 032	Physics II		3	2	2	1	5
BES 111	Differential Equations	BES 012	3	2	0	2	4
BES 113	Mathematics III	BES 012	3	2	0	2	4
BES 112	Numerical Analysis	BES 111	3	2	2	0	4
*BES 141	Pollution and Industrial Safety	BES 041	2	2	1	0	3
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4
Total			**30**	**21**	**11**	**11**	**43**

* Course teaching is shared between the Basic Engineering Science Department and Mechanical Engineering Department.

Mechanical Engineering Discipline Requirements

Code	Course	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec.	Lab.	Tut.	Sum
BES 113	Mathematics III	BES 012	3	2	0	2	4
BES 111	Differential Equations	BES 012	3	2	0	2	4
BES 112	Numerical Analysis	BES 111	3	2	2	0	4
BES 211	Engineering Statistics and Probability		3	2	2	0	4
MEC 121	Fluid Mechanics	BES 031	3	2	2	1	5
MEC 111	Kinematics of Machines	BES 022	3	2	0	2	4
MEC 113	Mechanics and Testing of Materials	MEC 012	3	2	2	1	5
MEC 123	Materials Science and Engineering	BES 032	3	2	2	0	4
ELE 103	Electrical Circuits	BES 032	2	1	0	2	3
MEC 131	Computer Applications	ELE 042	2	1	2	0	3
MEC 122	Thermodynamics	BES 031	3	2	1	2	5
MEC 112	Design of Machine Elements	MEC 113	3	2	3	0	5
MEC 114	Measurement and Instrumentation	BES 032	2	1	2	1	4
MEC 116	Manufacturing Technology	MEC 012	2	1	3	0	4
ELE 104	Electronic Devices and Circuits	ELE 103	2	1	0	2	3
MEC 211	Project Management	BES 012	3	2	2	0	4
MEC 221	Heat Transfer	MEC 122	3	2	1	2	5
MEC 223	Fluid Power Systems	MEC 121	2	1	3	0	4
MEC 215	Mechanical Design	MEC 113	3	2	3	0	5
MEC 213	Mechanical Vibrations	BES 022	3	2	2	1	5
ELE 201	Electric Machinery	ELE 103	2	1	2	0	3
MEC 214	Automatic Control Systems	MEC 213	3	2	2	1	5
MEC 312	Engineering Economics		2	2	0	1	3
MEC 314	Advanced Topics in Control Engineering	MEC 314	3	2	2	0	4
MEC 301	Technical Reports		2	1	2	0	3
Total			**66**	**42**	**38**	**22**	**102**

*The student can register the Senior design Project course after passing 70% of the program cr. hrs., i.e., 112 Cr. Hr.

Major Requirements of Mechatronics Engineering

Code	Course	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec	Lab	Tut	Sum
MEC 232	Introduction to Mechatronics	ELE 104	3	2	2	0	4
ELE 204	Logic Circuits Design & Applications	ELE 104	3	2	2	0	4
MEC 236	Industrial Robots	MEC 121	3	2	2	0	4
MEC 331	Design of Mechatronic Systems	MEC 232	3	2	2	0	4
ELE 301	Power Electronics	ELE 204	3	2	2	0	4
MEC 31x1	Elective I		3	2	0	2	4
MEC 31x2	Elective II		3	2	0	2	4
MEC 332	CAD/CAM	MEC 215	3	2	2	0	4
ELE 404	Digital Control	MEC 214	3	2	0	2	4
MEC 31x3	Elective III		3	2	0	2	4
MEC 31x4	Elective IV		3	2	0	2	4
MEC 431	Embedded System Design	MEC 214	2	1	2	1	4
MEC 433	Programmable Logic Controllers	ELE 204	3	2	2	0	4
MEC 43x5	Elective V		3	2	0	2	4
MEC 43x6	Elective VI		3	2	0	2	4
MEC 302	Senior Design Project I		2	0	4	0	4
MEC 401	Senior Design Project II	MEC 302	2	0	5	0	5
Total			**48**	**29**	**25**	**15**	**69**

* Elective courses are selected from three concentrations (x, y, and z)

Concentration Requirements of Robotics and Control (concentration "x")

Code	Course	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec	Lab	Tut	Sum
Pool Courses for Elective I, Elective II							
MEC 33x1	Mobile Robots	MEC 236	3	2	0	2	4
MEC 33x2	Autonomous systems	MEC 236	3	2	0	2	4
Pool Courses for Elective III, Elective IV							
MEC 33x3	Robot Operating Systems (ROS)	MEC 33x1 MEC 33x2	3	2	0	2	4
MEC 33x4	Robust and Fault-tolerant Control	MEC 214 ELE 404	3	2	0	2	4
MEC 33x5	Computer Interfacing	ELE 404	3	2	0	2	4
Pool Courses for Elective V, Elective VI							
MEC 43x6	Rehabilitation Robotics	MEC 33x2	3	2	0	2	4
MEC 43x7	Medical Robotics	MEC 33x2	3	2	0	2	4
MEC 43x8	Machine Learning	MEC 232	3	2	0	2	4

*The course content must be approved by Mechanical Engineering Department Council before registration.

Concentration Requirements of Advanced Mechatronics and Autotronics Engineering (concentration "y")

Code	Course	Pre-Req	Cr. Hr.	Ct. Hr.			
				Lec	Lab	Tut	Sum
Pool Courses for Elective I, Elective II							
MEC 33y1	Autotronics	MEC 232	3	2	0	2	4
MEC 33y2	Machine Vision Systems	MEC 232	3	2	0	2	4
Pool Courses for Elective III, Elective IV							
MEC 33y3	Automotive Engineering	MEC 43y1	3	2	0	2	4
MEC 33y4	Micro Electromechanical Systems (MEMS)	MEC 43y2	3	2	0	2	4
MEC 33y5	Industrial Mechanisms and Robotics	MEC 236 MEC 33y2	3	2	0	2	4
Pool Courses for Elective V, Elective VI							
MEC 43y6	Vehicle System Dynamics and Control	MEC 32y1 MEC 32y2	3	2	0	2	4
MEC 43y7	Hydraulic Servo Control	MEC 32y1 MEC 32y2	3	2	0	2	4
MEC 43y8	Playware Technology	MEC 331	3	2	0	2	4

*The course content must be approved by Mechanical Engineering Department Council before registration.

Proposed Study Plan for Mechatronics Engineering

Level 0- 1

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 011	Mathematics I		3	2	0	2	4	2 Hr	30	30	-	40	100
BES 021	Mechanics I		3	2	0	2	4	2 Hr	30	30	-	40	100
BES 041	General Chemistry		4	3	2	1	6	2 Hr	10	30	20	40	100
BES 031	Physics I		3	2	2	1	5	2 Hr	10	30	20	40	100
MEC 011	Engineering Graphics		2	0	0	4	4	2 Hr	30	30	-	40	100
UHS 101	Foreign Language		2	2	0	0	2	2 Hr	30	30	-	40	100
UHS 102	Information and Communication Technology		2	2	0	0	2	2 Hr	30	30	-	40	100
Total			19										700

Level 0- 2

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 012	Mathematics II	BES 011	3	2	0	2	4	2 Hr	30	30	-	40	100
BES 022	Mechanics II	BES 021	3	2	0	2	4	2 Hr	30	30	-	40	100
MEC 012	Production Engineering		2	1	3	0	4	2 Hr	10	30	20	40	100
BES 032	Physics II		3	2	2	1	5	2 Hr	10	30	20	40	100
MEC 014	Computer Aided Drafting	MEC 011	2	1	2	0	3	2 Hr	10	30	20	40	100
ELE 042	Computer Programming Fundamentals		2	0	2	2	4	2 Hr	10	30	20	40	100
UHS 103	Societal Issues		2	2	0	0	2	2 Hr	30	30	-	40	100
Total			17	10	9	7	26						700

Level 1- 1														
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 111	Differential Equations	BES 012	3	2	0	2	4	2 Hr	30	30	-	40	100
MEC 121	Fluid Mechanics	BES 031	3	2	2	1	5	2 Hr	10	30	20	40	100
MEC 111	Kinematics of Machines	BES 022	3	2	1	2	5	2 Hr	30	30	-	40	100
MEC 113	Mechanics and Testing of Materials	MEC 012	3	2	2	1	5	2 Hr	10	30	20	40	100
MEC 123	Materials Science and Engineering	BES 032	3	2	2	0	4	2 Hr	10	30	20	40	100
ELE 103	Electrical Circuits	BES 032	2	1	0	2	3	2 Hr	30	30	-	40	100
MEC 131	Computer Applications	ELE 042	2	1	2	0	2	2 Hr	10	30	20	40	100
Total			19										700

Level 1-2														
Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 113	Mathematics III	BES 012	3	2	0	2	4	2 Hr	30	30	-	40	100
MEC 122	Thermodynamics	BES 031	3	2	1	2	5	2 Hr	10	30	20	40	100
MEC 112	Design of Machine Elements	MEC 113	3	2	3	0	5	2 Hr	10	30	20	40	100
MEC 114	Measurement and Instrumentation	BES 032	2	1	2	1	4	2 Hr	10	30	20	40	100
MEC 116	Manufacturing Technology	MEC 012	2	1	3	0	4	2 Hr	10	30	20	40	100
ELE 104	Electronic Devices and Circuits	ELE 103	2	1	0	2	3	2 Hr	30	30	-	40	100
UHS 104	Professional Ethics		2	2	0	0	2	2 Hr	30	30	-	40	100
Total			17	11	9	7	27						700

Field Training I														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lect.	Lab.	Tut.	Sum		St. Act.	Mids.	PE/ OE	Final Exam	Sum
FTR 103	Field Training I	Completion of 65 Cr. Hrs.	0	0	0	0	0	Oral	-	-	Pass or Fail	-	-

Level 2- 1

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
MEC 211	Project Management	BES 012	3	2	2	0	4	2 Hr	10	30	20	40	100
MEC 221	Heat Transfer	MEC 122	3	2	1	2	5	2 Hr	10	30	20	40	100
MEC 223	Fluid Power Systems	MEC 121	2	1	3	0	4	2 Hr	10	30	20	40	100
MEC 215	Mechanical Design	MEC 113	3	2	3	0	5	2 Hr	10	30	20	40	100
MEC 213	Mechanical Vibrations	BES 022	3	2	2	1	5	2 Hr	10	30	20	40	100
ELE 201	Electric Machinery	ELE 103	2	1	2	0	3	2 Hr	10	30	20	40	100
UHS 3XX	Humanities - Elective I		2	2	0	0	2	2 Hr	30	30	-	40	100
Total			18										700

Level 2- 2

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 112	Numerical Analysis	BES 111	3	2	2	0	4	2 Hr	10	30	20	40	100
MEC 232	Introduction to Mechatronics	ELE 104	3	2	2	0	4	2 Hr	10	30	20	40	100
ELE 204	Logic Circuits Design & Applications	ELE 104	3	2	2	0	4	2 Hr	10	30	20	40	100
MEC 236	Industrial Robots	MEC 121	3	2	2	0	4	2 Hr	10	30	20	40	100
MEC 214	Automatic Control Systems	MEC 213	3	2	2	1	5	2 Hr	10	30	20	40	100
BES 141	Pollution and Industrial Safety	BES 041	2	2	1	0	3	2 Hr	10	30	20	40	100
UHS 3XX	Humanities Elective II		2	2	0	0	2	2 Hr	30	30	-	40	100
Total			19										700

Field Training II

CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lect.	Lab.	Tut.	Sum		St. Act.	Mids.	PE/ OE	Final Exam	Sum
FTR 203	Field Training II	Completion of 96 Cr. Hrs.	0	0	0	0	0	Oral	-	-	Pass or Fail	-	-

Level 3- 1

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4	2 Hr	10	30	20	40	100
MEC 33x1	Elective I		3	2	0	2	4	2 Hr	30	30	-	40	100
MEC 331	Design of Mechatronic Systems	MEC 232	3	2	2	0	4	2 Hr	10	30	20	40	100
ELE 301	Power Electronics	ELE 204	3	2	2	0	4	2 Hr	10	30	20	40	100
MEC 33x2	Elective II		3	2	0	2	4	2 Hr	30	30	-	40	100
MEC 301	Technical Reports		2	1	2	0	3	2 Hr	50	-	50	-	100
UHS 4XX	Humanities Elective III		2	2	0	0	2	2 Hr	30	30	-	40	100
Total			19										700

Level 3- 2

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
MEC 332	CAD/CAM	MEC 215	3	2	2	0	4	2 Hr	10	30	20	40	100
ELE 404	Digital Control	MEC 214	3	2	0	2	4	2 Hr	30	30	-	40	100
MEC 33x3	Elective III		3	2	0	2	4	2 Hr	30	30	-	40	100
MEC 33x4	Elective IV		3	2	0	2	4	2 Hr	30	30	-	40	100
MEC 302	Senior Design Project I		2	0	4	0	4	-	50	-	50	--	100
MEC 312	Engineering Economics		2	2	0	1	3	2 Hr	30	30		40	100
Total			16										600

Level 4- 1

Code	Course Title	Pre-Req	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
MEC 431	Embedded System Design	MEC 214	2	1	2	1	4	2 Hr	10	30	20	40	100
MEC 433	Programmable Logic Controllers	ELE 204	3	2	2	0	4	2 Hr	10	30	20	40	100
MEC 43x5	Elective V		3	2	0	2	4	2 Hr	30	30	-	40	100
MEC 43x6	Elective VI		3	2	0	2	4	2 Hr	30	30	-	40	100
MEC 435	Artificial Intelligence	ELE 404	3	2	2	0	4	2 Hr	10	30	20	40	100
MEC 401	Senior Design Project II	MEC 302	2	0	5	0	5	-	50	-	50	--	100
Total			16										600

Courses Plan and Matrix

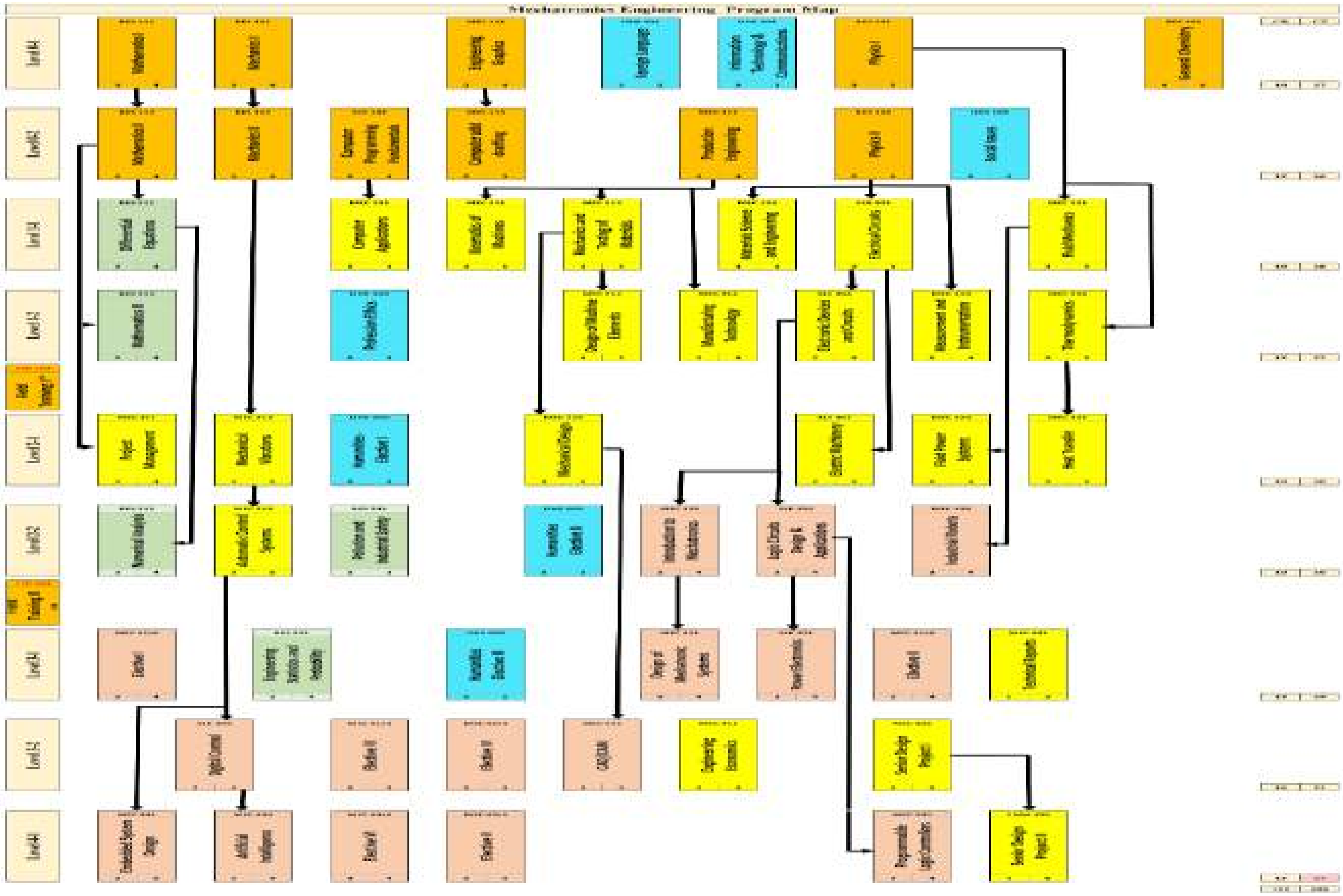
Curriculum Plan for Mechatronics Engineering

Mechanical Engineering - Mechatronics Engineering Program

Level	No.	Code	Course	CR	CT
Level 0	1	BES 011	Mathematics I	3	4
	2	BES 021	Mechanics I	3	4
	3	BES 041	General Chemistry	4	6
	4	BES 031	Physics I	3	5
	5	MEC 011	Engineering Graphics	2	4
	6	UHS 101	Foreign Language	2	2
	7	UHS 102	Information Technology & Communication	2	2
				19	27
	8	BES 012	Mathematics II	3	4
	9	BES 022	Mechanics II	3	4
	10	MEC 012	Production Engineering	2	4
	11	BES 032	Physics II	3	5
	12	MEC 014	Computer Aided Drafting	2	3
	13	ELE 042	Computer Fundamentals	2	4
	14	UHS 103	Societal Issues	2	2
				17	26
Level 1	15	BES 111	Differential Equations	3	4
	16	MEC 121	Fluid Mechanics	3	5
	17	MEC 111	Kinematics of Machines	3	4
	18	MEC 113	Mechanics and Testing of Materials	3	5
	19	MEC 123	Materials Science and Engineering	3	4
	20	ELE 103	Electrical Circuits	2	3
	21	MEC 131	Computer Applications	2	3
				19	28
	21	BES 113	Mathematics III	3	4
	22	MEC 122	Thermodynamics	3	5
	23	MEC 114	Measurement and Instrumentation	2	4
	24	MEC 112	Design of Machine Elements	3	5
	25	MEC 116	Manufacturing Technology	2	3
	26	ELE 104	Electronic Devices and Circuits	2	3
	27	UHS 104	Profession Ethics	2	2
				17	26
	28	FTR 103	Field Training I	0	25
Level 2	29	MEC 211	Project Management	3	4
	30	MEC 221	Heat Transfer	3	5
	31	MEC 223	Fluid Power Systems	2	4
	32	MEC 215	Mechanical Design	3	5
	33	MEC 213	Mechanical Vibrations	3	5
	34	ELE 201	Electric Machinery	2	3
	35	HS 3XX	Humanities - Elective 1	2	2
				18	28
	36	BES 112	Numerical Analysis	3	4
	37	MEC 214	Automatic Control Systems	3	5
	38	MEC 232	Introduction to Mechatronics	3	4
	39	ELE 204	Logic Circuits Design & Applications	3	4
	40	MEC 236	Industrial Robots	3	4
	41	BES 141	Pollution and Industrial Safety	2	3
	42	HS 304	Legalisation & Human Rights	2	2
				19	26
	43	FTR 203	Field Training II	0	25
Level 3	44	BES 211	Engineering Statistics and Probability	3	4
	45	MEC 33x1	Elective I	3	4
	46	MEC 331	Design of Mechatronic Systems	3	4
	47	ELE 301	Power Electronics	3	4
	48	MEC 33x2	Elective II	3	4
	49	MEC 301	Technical Reports	2	3
	50	HS 4XX	Humanities Elective 2	2	2
				19	25
	51	MEC 332	CAD/CAM	3	4
	52	ELE 404	Digital Control	3	4
	53	MEC 33x3	Elective III	3	4
	54	MEC 33x4	Elective IV	3	4
	55	MEC 312	Engineering Economics	2	3
	56	MEC 302	Senior Design Project I	2	4
				16	23
Level 4	57	MEC 431	Embedded System Design	2	4
	58	MEC 433	Programmable Logic Controllers	3	4
	59	MEC 43x5	Elective V	3	4
	60	MEC 43x6	Elective VI	3	4
	61	MEC 435	Artificial Intelligence	3	4
	62	MEC 401	Senior Design Project II	2	5
				16	25

Category	CR	CT	Required
Basic Science	30	43	33.6
University Req.	14	14	12.8
Faculty Req.	32	100	32
Mechatronics Program	48	72	48
Mech. Engineering	66	97	56
Electives	24	30	24
Total	160	234	182.4

Mechatronics Engineering Flowchart



Program Learning Outcomes to Program Courses Matrix

Courses				PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18	PLO19
Level 1	Semester 1	BES 111	Mathematics I	●		●																
		BES 121	Mechanics I	●	●																	
		BES 141	General Chemistry	●	●																	
		BES 131	Physics I	●	●																	
		MEC 111	Engineering Graphics						●		●											
		UHS 101	Foreign Language								●		●									
		UHS 102	Information and Communication Technology				●						●									
	Semester 2	BES 112	Mathematics II	●		●																
		BES 122	Mechanics II	●	●																	
		MEC 112	Production Engineering				●		●													
		BES 132	Physics II	●	●																	
		MEC 114	Computer Aided Drafting				●					●										
		ELE 142	Computer Programming Fundamentals	●		●																
		UHS 103	Societal Issues							●			●									
Level 2	Semester 1	BES 211	Differential Equations	●	●																	
		MEC 221	Fluid Mechanics	●	●									●		●						
		MEC 211	Kinematics of Machines											●	●	●						
		MEC 214	Mechanics and Testing of Materials		●									●								
		MEC 223	Materials Science and Engineering											●	●							
		ELE 203	Electrical Circuits	●														●	●			
		MEC 201	Computer Applications		●										●							
	Semester 2	BES 213	Mathematics III	●	●																	
		MEC 222	Thermodynamics	●	●									●	●							
		MEC 252	Design of Machine Elements			●					●				●	●	●					
		MEC 216	Measurement and Instrumentation		●										●		●					
		MEC 236	Manufacturing Technology	●										●		●						
		ELE 204	Electronic Devices and Circuits		●		●											●	●	●		
		UHS 104	Profession Ethics				●	●														
		FTR 101	Field Training I							●			●									

Level 3	Semester 5	MEC 311	Project Management								●	●				●						
		MEC 321	Heat Transfer	●	●									●		●						
		MEC 323	Fluid Power Systems	●	●									●		●						
		MEC 315	Mechanical Design			●					●			●	●		●					
		MEC 312	Mechanical Vibrations	●	●									●	●							
		ELE 381	Electric Machinery		●													●	●			
		UHS 3XX	Humanities - Elective I			●	●															
	Semester 6	BES 212	Numerical Analysis	●	●																	
		MEC 332	Introduction to Mechatronics																		●	●
		ELE 382	Logic Circuits Design & Applications															●		●		
		MEC 336	Industrial Robots																		●	●
		MEC 314	Automatic Control Systems											●	●							
		BES 241	Pollution and Industrial Safety	●		●	●															
		UHS 3XX	Humanities Elective II								●	●										
		FTR 202	Field Training II							●			●									
Level 4	Semester 7	BES 311	Engineering Statistics and Probability	●	●																	
		MEC 41x1	Elective I																		●	●
		MEC 451	Design of Mechatronic Systems														●			●	●	●
		ELE 401	Power Electronics															●		●		
		MEC 41x2	Elective II															●			●	
		MEC 401	Technical Reports							●		●	●									
		UHS 4XX	Humanities Elective III					●					●									
	Semester 8	MEC 432	CAD/CAM											●		●		●				
		ELE 494	Digital Control															●	●			
		MEC 41x3	Elective III																		●	●
		MEC 41x4	Elective IV											●				●			●	
		MEC 402	Senior Design Project I							●		●										
		MEC 412	Engineering Economics							●		●										
Level 5	Semester 9	MEC 431	Embedded System Design																		●	●
		MEC 531	Programmable Logic Controllers															●	●			
		MEC 41x5	Elective V															●			●	
		MEC 41x6	Elective VI																		●	●
		MEC 435	Artificial Intelligence																		●	●
		MEC 501	Senior Design Project II							●		●										

Matching Mechatronics Engineering Program Courses with ABET Requirements

Mechanical and Similarly Named Engineering Programs

Lead Society: American Society of Mechanical Engineers

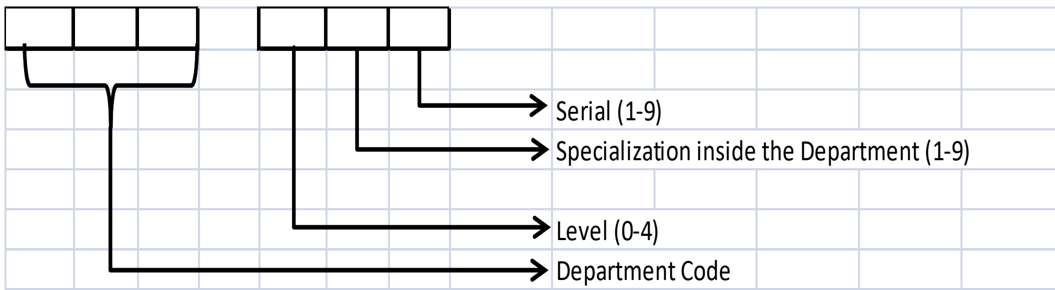
Mechatronics Engineering Program Courses Required to Cover ABET Criteria				
ABET Criteria		**CODE**	**Course Name**	**Cr. Hrs.**
A minimum of 30 semester credit hours (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program.	basic science, and mathematics (including multivariate calculus and differential equations);	BES 011	Mathematics I	3
		BES 012	Mathematics II	3
		BES 113	Mathematics III	3
		BES 111	Differential Equations	3
		BES 112	Numerical Analysis	3
		BES 211	Engineering Statistics and Probability	3
	principles of engineering	BES 041	General Chemistry	4
		BES 021	Mechanics I	3
		BES 022	Mechanics II	3
		BES 141	Pollution and Industrial Safety	2
		BES 031	Physics I	3
		BES 032	Physics II	3
Total				**36**
ABET Criteria		**CODE**	**Course Name**	**Cr. Hrs.**
A minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design and utilizing modern engineering tools.	applications of these topics to modeling, analysis, design, and realization of physical systems, components or processes.	MEC 011	Engineering Graphics	2
		MEC 012	Production Engineering	2
		MEC 014	Computer Aided Drafting	2
		MEC 111	Kinematics of Machines	3
		MEC 112	Design of Machine Elements	3
		MEC 116	Manufacturing Technology	2
		MEC 123	Materials Science and Engineering	3
		MEC 215	Mechanical Design	3
		MEC 131	Computer Applications	2
	coverage of both thermal	MEC 122	Thermodynamics	3

	and mechanical systems.	MEC 223	Fluid Power Systems	2
		MEC 121	Fluid Mechanics	3
		MEC 221	Heat Transfer	3
		MEC 114	Measurement and Instrumentation	2
		MEC 213	Mechanical Vibrations	3
		MEC 214	Automatic Control Systems	3
	in-depth coverage of either thermal or mechanical systems.	MEC 232	Introduction to Mechatronics	3
		MEC 236	Industrial Robots	3
		MEC 33x1	Elective I	3
		MEC 331	Design of Mechatronic Systems	3
		MEC 33x2	Elective II	3
		MEC 431	Embedded System Design	2
		MEC 332	CAD/CAM	3
		MEC 33x3	Elective III	3
		MEC 33x4	Elective IV	3
		MEC 43x5	Elective V	3
		MEC 43x6	Elective VI	3
		MEC 435	Artificial Intelligence	3
		MEC 433	Programmable Logic Controllers	3
	Explain basic concepts in project management, business, public policy, and leadership.	MEC 301	Technical Reports	2
		MEC 312	Engineering Economics	2
		MEC 211	Project Management	3
		UHS 103	Societal Issues	2
		UHS 3XX	Humanities Elective I	2
		UHS 3XX	Humanities Elective II	2
		UHS 4XX	Humanities Elective III	2
	Analyze issues in professional ethics and explain the importance of professional licensure.	UHS 104	Professional Ethics	2
Total				**96**

Courses offered to Mechanical Engineering Programs

The course coding is divided into two parts and follows the following convention:

1. Three Letters which are the Department code.
2. Three Numbers indicating the Level, the Specialization inside the department, and a counter inside the specialization.



The Mechanical Engineering Department is responsible for teaching courses that serve the following programs:

1. Design and Production Engineering Program.
4. Mechanical Power Engineering Program.
5. Mechatronic Engineering Program

code	Specialization
MEC x1x	Course offered by Mechanical Engineering Department/ Mechanical Design & Production Program
MEC x2x	Course offered by Mechanical Engineering Department/ Mechanical Power Program
MEC x3x	Course offered by Mechanical Engineering Department/ Mechatronics Program
MEC x0x	Technical Report and Graduation Project I & II

The following abbreviations are the legend for the courses:

CH Credit Hour
Lec Lectures
Tut Tutorials
Lab Laboratory
Tot Total
UHS University Requirement
MT Mid-Term Exam
SA Student Activity
PE /OE Practical Exam/ Oral Exam
Final Final Exam

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 111	Kinematics of Machines	BES 022	3	2	0	2	4	30	30	-	40

Course Content	Basic concepts of mobility and mechanisms – Graphical method of Kinematic analysis of mechanisms (displacement, velocity, and acceleration analysis). Computational method and computer utilization in kinematic analysis of mechanisms. Force Analysis of Mechanisms (Newton Euler formulation and principle of virtual work). Cams (types, follower types and motion, construction of cam profile, cam displacement, velocity, and acceleration diagrams). Gears, Gear trains, Balancing of rotating masses.		
References	• Norton, R.L., 2009, "Kinematics and Dynamics of Machinery", McGraw-Wiley • R. S. Khurmi, 2005, "Theory of Machines", 14th Ed., New Delhi. • H. Mabie, C. Reinholtz,"Mechanisms and Dynamics of Machinery", Wiley		
Used in Program	All Mechanical Department Programs	Semester	3

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 113	Mechanics and Testing of Materials	MEC 012	3	2	2	1	5	10	30	20	40

Course Content	Introduction, Concept of stress and strain, Axial loading, Stress-strain diagrams – Behavior of ductile and brittle metals. Area moments of Inertia. Torsion, Pure bending, Transverse shear, Analysis, and design of beams for bending and shearing stresses. Deflection of beams and shafts - Statically indeterminate beams and shafts. Transformations of stress and strain, Principal stresses under a given loading, Internal forces, and moments in beams (axial force – shear force bending moment), Deflection of beams. Destructive testing of materials (Tension, compression, bending, Torsion, and impact tests).		
References	• Russell C. Hibbeler, 2011, "Mechanics of Materials", 8E, Pearson. • E.P. Popov, S. Nagarajan and Z.A. Lu, Mechanics of Materials, 2nd Ed., Prentice-Hall, Inc., 1976.		
Laboratory	• Tension test, Stress-strain diagram • Compression test • Impact test • Bending test • Torsion test • Hardness test		
Used in Program	All Mechanical Department Programs	Semester	3

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 112	Design of Machine Elements	MEC 113	3	2	3	0	5	10	30	20	40

Course Content

Introduction to design process. Review of load and stress analysis, Mohr's circle for plane stress. Failures resulting from static loading, variable loading, and fatigue failure. Material selection for strength and rigidity.
Design of mechanical elements: Knuckle joint - screws, fasteners - shafts and shaft components - mechanical springs - welding joints, Bonding, and permanent joints.

References

- Robert L. Mott, " Machine elements in Mechanical Design", Pearson/Prentice Hall, 2004.
- J.E. Shigley and C. R. Mischke, "Mechanical Engineering Design", McGraw-Hill, Last Edition.

Laboratory

Term design projects:
- Working and assembly drawing of parts and machine elements
- Computer aided drafting of assembly drawings and machine elements

Used in Program	All Mechanical Department Programs	Semester	3

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 114	Measurement and Instrumentation	BES 032	2	1	2	1	4	10	30	20	40

Course Content

Introduction – operating principles of sensors and transducers – general considerations for selection and evaluation of measurement equipment – statistical treatment of data – temperature sensors – pressure transducers – fluid transducers – strain gauges – load cells and force measurement – position and level measurement – uncertainty analysis of complete measurement systems – introduction to signal conditioning and data processing – Opto-electronics. Laboratory experiments on the course topics.

References

- Richard S. Figliola and Clemson University, "Theory and Design for Mechanical Measurements", 5th edition, John Wiley & Sons, Inc., 2011.
- Alan S. Morris, "Measurement and Instrumentation Principles", 3rd edition, Alan S. Morris, 2001.

Laboratory

- Measuring Temperature (Mechanical Methods)
- Measuring Temperature (Electrical Methods)
- Measuring Pressure (Mechanical Methods)
- Measuring Pressure (Electrical Methods)
- Flow Measuring Instruments: Orifice Meter, Venturi Meter, Flow Nozzle, Pitot Tube, Movable Vane, ultrasonic

Used in Program	All Mechanical Department Programs	Semester	4

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>ST</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>MEC 116</td><td>Manufacturing Technology</td><td>MEC 012</td><td>2</td><td>1</td><td>2</td><td>0</td><td>3</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Metal Casting Technology: solidification process, metals and alloys, production of primary metals, production of shaped casting, sand casting (moulding, melting, pouring, solidification, cleaning, defects, and inspection). Contemporary casting processes (metallic mould, electro-slag, precision, and centrifugal casting).
Metal Forming Technology: Hot and cold working of metals, metal forming processes (rolling, forging, drawing, extrusion and spinning), pipe and tube manufacturing, joining technology (fastening, riveting, soldering, and brazing, welding, and adhesive bonding).
Welding: submerged arc welding, spot and seam welding, plasma welding, cold pressure welding, adhesive welding, testing of welded joints. Welding operations for ferrous metals – thermal welding – Oxy-Acy welding
Metal cutting technology: Cutting tools, metal cutting machine tools (turning, drilling, boring, milling, shaping, planning, broaching, grinding, special purpose, gear and thread cutting and super finishing machine tools).</td></tr>
<tr><td>References</td><td colspan="11">• Rajender Singh, 2006, " Introduction to basic manufacturing processes and workshop technology ", New age international publishers.</td></tr>
<tr><td>Laboratory</td><td colspan="11">Students make different mechanical models in all the following workshops:
• Casting workshop
• Metal forming technology
• Welding
• Metal cutting workshop</td></tr>
<tr><td colspan="2">Used in Program</td><td colspan="5">All Mechanical Department Programs</td><td colspan="2">Semester</td><td colspan="3">3</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>ST</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>MEC 121</td><td>Fluid Mechanics</td><td>BES 031</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Physical properties of fluids, Density, Viscosity, Surface tension. Continuum Hypothesis, Flow Classification, and Shear-Deformation Behavior of Fluids. Fluid statics (Buoyancy, Forces on submerged surfaces). Flow kinematics, Elementary fluid dynamics, Bernoulli equation. Control volume analysis (Mass conservation, Momentum conservation, Energy conservation, Practical applications). Differential fluid flow analysis (Continuity, Navier-Stokes equation). Flow in pipes (Laminar flow, turbulent flow, Frictional losses in pipes and pipe fittings). Dimensional analysis and similarity (Buckingham theorem, physical similarity). Classification of Turbomachines, Operation of centrifugal pumps, Series and Parallel Operation, Selection of Pumps.</td></tr>
<tr><td>Reference s</td><td colspan="11">• Munson, Young, and Okiishi, 2009, "Fundamentals of Fluid Mechanics", 7th Ed., Wiley.
• T. C. Clayton, F. E. Donald, and A. R. John, 2006,"Engineering Fluid Mechanics", John Wiley & Sons, Inc., 8th Ed.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Determination of fluid properties
• Hydrostatic pressure measurement
• Determination of pressure force on submerged surface
• Application of continuity equation for the flow through pipes
• Apparatus of impact water jet
• Satisfying of the Bernoulli’s theorem
• Demonstration of the flow through orifice and free jet
• Determination of the friction losses through pipes
• Determination of the minor losses through pipe connections</td></tr>
<tr><td colspan="2">Used in Program</td><td colspan="6">All Mechanical Department Programs</td><td colspan="2">Semester</td><td colspan="2">3</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>ST</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>MEC 122</td><td>Thermodynamics</td><td>BES 031</td><td>3</td><td>2</td><td>1</td><td>2</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Definitions and basic concepts of thermodynamic systems, Properties of pure substances, phase change process, ideal gas. Work and Heat, first law of thermodynamics (closed system, unsteady and steady flow open systems, applications). Second law of thermodynamics (Heat engines and refrigerators, reversible and irreversible process, Carnot cycle). Entropy (Clausis inequality, entropy, increase of entropy principles, entropy change of pure substances, solids and liquids, entropy changes of ideal gases, adiabatic efficiency of process). Refrigeration Cycles: Refrigerators and Heat Pumps, The Reversed Carnot Cycle.</td></tr>
<tr><td>References</td><td colspan="11">• Yunus A.Cengel Michael A.Boles, 2014, “Thermodynamics An Engineering Approach”, McGraw Hill Education; 8th edition.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Identification and recognition of the application of work and heat
• Identification and recognition of the application of the first law
• Identification and recognition of the application of the second law
• Computer controlled expansion processes of a perfect gas unit
• investigate the thermodynamics components such as turbine, compressor, pump, boiler, condenser, etc.</td></tr>
<tr><td colspan="2">Used in Program</td><td colspan="6">All Mechanical Department Programs</td><td colspan="2">Semester</td><td colspan="2">4</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>ST</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>MEC 123</td><td>Materials Science and Engineering</td><td>BES 032</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to engineering materials. Structure and structural defects of metals, Phase transformation of metals, Theory of alloying and constitutional diagrams. Plastic deformation machine of metals, Strengthening mechanisms, Heat treatment of metals and alloys. Deterioration of metallic materials, selection of alloys. Non-metallic materials. Non-destructive tests of materials (Hardness, Photo elasticity, X-ray, Acoustics, and Stain gages). Failure of materials due to creep and Fatigue.</td></tr>
<tr><td>References</td><td colspan="11">• William F. Smith,1996,"Principles of Materials Science and Engineering", McGraw-Hill.
• William D. Callister Jr., David G. Rethwisch, 2006, "Materials Science and Engineering: An Introduction", Wiley.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Optical microstructure
• Heat treatment of metals and alloys
• Hardness test
• Photo elasticity
• X-ray Test</td></tr>
<tr><td colspan="2">Used in Program</td><td colspan="6">All Mechanical Department Programs</td><td colspan="2">Semester</td><td colspan="2">3</td></tr>
</table>

Code	Course Name	Pre-req.	CH	Ct. Hr.				Assessment Criteria			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
MEC 128	Thermal Power Engineering		2	2	0	1	3	30	30	0	40
Course Contents	Definitions and basic concepts of thermodynamic systems, Properties of pure substances, phase change process, ideal gas. Work and Heat, first law of thermodynamics (closed system, unsteady and steady flow open systems, applications). Second law of thermodynamics (Heat engines and refrigerators, reversible and irreversible process, Carnot cycle). Entropy (Clausis inequality, entropy, increase of entropy principles, entropy change of pure substances, solids and liquids, entropy changes of ideal gases, adiabatic efficiency of process).										
References	• Yunus A.Cengel Michael A.Boles, 2014, “Thermodynamics An Engineering Approach”, McGrawHill Education; 8th edition.										

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 131	Computer Applications	ELE 042	2	1	2	0	3	10	30	20	40
Course Content	Developing basic concepts of algorithmic thinking to solve problems of relevance in engineering practice and implementing these algorithms MATLAB. Loops, control structures, functions, arrays. Create MATLAB programs that solve real-world problems in engineering and the sciences. Numerical methods, solution of nonlinear equations, plotting, logic operations, and graphical user interfaces to design, test, and debug numerical algorithms.										
References	• Simin Nasseri, “Solving Mechanical Engineering Problems with MATLAB”, Linus Publications										
Laboratory	Student's programs of tasks and problems are carried out in the engineering Computer Labs.										
Used in Program	All Mechanical Department Programs							Semester	3		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 211	Project Management	BES 012	3	2	2	0	4	10	30	20	40
Course Content	Introduction to Project planning and scheduling, Project charter, Scope statement, Work Breakdown Structure, Responsibility Chart. Network diagram, Schedule analysis and possibilities using the Critical Path Method (CPM) and the Program Evaluation and Review Technique (PERT). Resource levelingand allocation, Time-cost trade off (Crashing a schedule), Gantt Chart, Time overlaps, Time and cost control, Risk monitoring and control, Computer applications										
References	• Moder J., Phillips C., and Davis E., "Project Management with CPM, PERT and Precedence Diagramming", Last Edition. • Gail Freeman-Rue & James Balkwill, "Management in Engineering, Principles & Practice", Prentice Hall, Last Edition.										
Laboratory	Students will solve lecture problems and sheet problems in the computer Lab using Primavera software. Additionally at the end of the course, Each group of five students will plan and analyze a real life mini-project in the computer Lab using Primavera software and provide a Power Point presentation for oral discussion.										
Used in Program	All Mechanical Department Programs							Semester	5		

<table>
<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><td rowspan="2">MEC 212</td><td rowspan="2">Metal Cutting Processes</td><td rowspan="2">MEC 012</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Analysis of metal cutting, mechanism of chip formation, mechanics of metal cutting, experimental and theoretical determination of cutting forces, dynamometer, thermal aspects of metal cutting – tool materials, tool wear, tool life and machinability – mechanics of grinding, surface quality and dimensional control. Introduction to the theory of metal cutting, tool geometry (definitions, reference planes, geometry of single point tools, twist drills and milling cutters), Tool materials (types and applications), Chip formation (types of chips, built up edge BUE, chip compression ratio, determination of shear angle and shear strain), Mechanics of metal cutting (merchant's analysis, factors affecting cutting forces).</td></tr>
<tr><td>References</td><td colspan="11">• B. L. Juneja, “Fundamentals of Metal Cutting and Machine Tools”, New Age International, 2003</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Study of Tool Geometry
• Study of various conventional machining processes
• Experiment to Find Shear Angle
• Chip Thickness Analysis
• Cutting forces in orthogonal cutting
• Experiment on a Drilling Tool Dynamometer
• Study of Unconventional Forming</td></tr>
<tr><td>Used in Program</td><td colspan="6">Mechanical Design & Production Program</td><td colspan="2">Semester</td><td colspan="3">6</td></tr>
</table>

<table>
<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><td rowspan="2">MEC 213</td><td rowspan="2">Mechanical Vibrations</td><td rowspan="2">BES 022</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Foundation of mechanical systems, mathematical models of mechanical systems, systems modeling, electromechanical systems. Explore necessary algorithms to solve equations of motion, Laplace transform, matrix method, computer generated solutions. Dynamic response and evaluation of first and second order systems, oscillating motion with single DOF, measuring and analysis methods, damping of free motion. Isolation of vibration, vibration of two DOF, vibration of multi-degree of freedom system. Numerical methods for evaluation of natural frequency and patterns, design of frequency absorbers.</td></tr>
<tr><td>References</td><td colspan="11">• Ahmed A. Shabana, "Theory of Vibration, An Introduction", Springer, 3rd edition, 2019
• Rao, S.S., and A. Weiley, “Mechanical vibrations”, 4th edition, Prentice Hall, 1995</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Validation of a pendulum dynamics and estimation of gravitational acceleration.
• Verification of mass-spring system and estimation of spring stiffness.
• Estimation of the moment of inertia for a wheel and the damping condition.
• Vibration measurement methods, Double cantilever test.
• Computer-aided simulation and case studies, course project</td></tr>
<tr><td>Used in Program</td><td colspan="6">All Mechanical Department Programs</td><td colspan="2">Semester</td><td colspan="3">5</td></tr>
</table>

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 214	Automatic Control Systems	MEC 213	3	2	2	1	5	10	30	20	40
Course Content	Introduction to feedback control systems. Modeling of dynamic systems, Laplace transform, Block diagrams, State Space. Control system characteristics: time response, steady state error, Stability. Analyze control systems using root loci - Design of feedback control systems using root locus. Polar and Nyquist plot - small gain theory - Bode plots. Linear control systems analysis in State Space. PID Controllers and Tuning. Computer simulation and case studies.										
References	• K. Ogata, 1997, "Modern control engineering", Prentice Hall. • R. C. Dorf and R. H. Bishop, "Modern Control Systems", 10th Ed., Prentice Hall, 2004. • B. C. Kuo and F. Golnaraghi, "Automatic Control Systems", 8th Ed., John Wiley & Sons Inc, 2002.										
Laboratory	• Modeling of dynamic systems using MATLAB/LabVIEW • Block diagrams Using of MATLAB / SIMULINK/LabVIEW • Modeling and Control of liquid level system • Modeling and Control of DC motor • Controller design of inverted pendulum • Modeling and Control of liquid level system										
Used in Program	All Mechanical Department Programs							Semester	6		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 215	Mechanical Design	MEC 113	3	2	3	0	5	10	30	20	40
Course Content	Design methodology revision and creative problem solving, Design of chain drives selection, Belt drives, gear drives selection, shaft design, roller element bearing selection, Electric motor selection, structural issues, small collaborative project.										
References	• J.E. Shigley and C. R. Mischke, "Mechanical Engineering Design", McGraw-Hill, Last Edition. • George E. Dieter, Linda C. Schmidt, 2021, "Engineering design", 6th Edition.										
Laboratory	Students will use derived knowledge from MEC212 and MEC315, and work in groups to make an assigned projects in computer aided laboratories to demonstrate their capability of producing integrated system design, then oral discussion will be followed.										
Used in Program	All Mechanical Department Programs							Semester	5		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 216	Computer Aided Design	MEC 112	3	2	2	0	4	10	30	20	40

Course Content	Introduction to basic concepts of CAD/CAE – role of computers in synthesis and analysis – geometry description – parametric and feature-based design – geometric modeling: wireframe, surface and solid modeling (CSG & B-Rep) – curves and surfaces in modeling (Bezier and Splines interpolation curves) – computer graphics; transformations; constraints; clipping and windowing – design optimization – introduction to finite element method – application of FEA to stress analysis – applications of CAD – Individual projects.
References	• Chinyere Okechi Onwubiko, "Foundations of Computer-Aided Design", West Group; 21st edition (March 1, 1989).
Laboratory	The Laboratory has the following section: • Engineering graphics using C++/MATLAB or other programming language. • Transformation of objects in plane and space • Geometric Modeling • Finite Element Analysis • Rapid Prototyping

Used in Program	Mechanical Design & Production Program	Semester	6

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 218	Material Engineering	MEC 123	3	2	2	0	4	10	30	20	40

Course Content	Ceramics – composite materials – polymeric materials – quantitative material selection – materials for low temperature applications – selection of materials to satisfy mechanical requirements including the concept of cost per unit property – experimental methods for physical examination of metals – plastic deformation, work hardening and fracture – diffusion – precipitation – martensitic transformation – new trends in materials technology (Nanomaterials).
References	• William D. Callister, David G. Rethwisch, "Materials science and engineering: An introduction", 9th Ed. John Wiley and Sons, Inc., 2013.
Laboratory	The Laboratory has the following section: • Find out the hardenability of steels by Jominy End Quench Test. • Find out the hardness of various treated and untreated steels. • Study of Microstructure of Composite Material subjected to tensile testing • Study of the Composite Material • Join the sheets using Ultrasonic Joining process

Used in Program	Mechanical Design & Production Program	Semester	6

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 221	Heat Transfer	MEC 122	3	2	1	2	5	10	30	20	40

Course Content	Thermal Conduction: Steady 1D Conduction, Plane Wall, Composite Plane Wall, Convection, Overall Heat Transfer Coefficient, Cylindrical Shell, Spherical Shell, Extended Surfaces (Fins), Conduction with Variable Thermal Conductivity, Steady 2D Conduction, Transient Conduction, Periodic Conduction. Convection: Types of Convection, Dimensionless Groups, Dimensional Analyses and similitude, Natural Convection, Forced Convection. Heat Exchanger. Thermal Radiation: Setfan-Boltzmann Law, Planck’s Law, Radiation Properties of Real Surfaces, Emissivity and Absorptivity, Kirchoff’s Law, Emissivity of Real Surfaces, Gray Surfaces, Selective Surfaces, Heat Exchange by Radiation, Heat Exchange between Two Planes, Heat Exchange between Two Cylinders or Spheres.
References	• Incropera and De Witt, Fundamentals of heat and mass transfer, 7th Edition, 2012 • Yunus A. Cengel, "Heat Transfer: A Practical Approach", 2nd ed., McGraw-Hill, 2015
Laboratory	• Determination of the heat conductivity of solids • Steady heat conduction in bars • Steady convection in non-homogeneous bars • Steady convection in homogeneous bars • Steady conduction in homogeneous radial patterns • Heat exchangers: parallel and counter flow heat exchangers • Thermocouples calibration test rig • Combined forced convection and radiation

Used in Program	All Mechanical Department Programs	Semester	5

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 222	Applied Thermodynamics	MEC 122	3	2	2	0	4	10	30	20	40

Course Content	Vapor and Combined Power Cycles (The Carnot Vapor Cycle, Rankine Cycle). Gas power cycles (air standard assumptions, Otto and Diesel cycles, Striling and Ericsson cycles, Brayton cycle, Brayton cycle with intercooling, reheating and regeneration, ideal jet prolusion cycle). Gas Mixtures (Composition of a Gas Mixture: Mass and Mole Fractions, P-v-T Behavior of Gas Mixtures: Ideal and Real Gases). Chemical Reactions (Fuels and Combustion, Theoretical and Actual Combustion Processes, Enthalpy of Formation and Enthalpy of Combustion, First-Law Analysis of Reacting Systems, Adiabatic Flame Temperature. Heat of combustion, fuel heating values, constant volume combustion and constant pressure combustion,
References	• Yunus A.Cengel Michael A. Boles, 2014, “Thermodynamics An Engineering Approach”, McGraw-Hill Education; 8th edition.
Laboratory	• Simulation work and virtual laboratories of power plants and cycles.
Used in Program	Mechanical Power Engineering program — Semester: 6

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 223	Fluid Power Systems	MEC 121	2	1	3	0	4	10	30	20	40

Course Content	Thermal Properties of fluids, Bulk modulus, Types of Hydraulic fluids, Flow through conduits and orifices, Power losses, Pressure transients in hydraulic conduits. Hydraulic pumps, Analysis of ideal and practical pumps and motors, Performance curves. Hydraulic control valves, Spool valve analysis, Three-way spool valve, Flapper valve analysis. Hydraulic power elements, Valve controlled motors. Pump controlled motor. Pressure and flow control valves. Electro-Hydraulic operation of fluid power systems.
References	• Herbert E. Merritt, 1991, "Hydraulic Control Systems", John Wiley & Sons. • John Watton: Fundamentals of Fluid Power Control. Cambridge University Press, 2009
Laboratory	• Demonstrate basic hydraulic operation. • Build circuits with pumps, filters, flow and pressure-control valves and act • Analyze hydraulic systems using simulation software • Build control and automation of an application using fluid components
Used in Program	All Mechanical Department Programs — Semester: 5

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 224	Fluid Dynamics	MEC 121	3	2	2	0	4	10	30	20	40

Course Content	Compressible flow: Speed of sound, Wave propagation, Mach number and Mach angle, Isentropic flow with area change, Stagnation, and sonic conditions. Shock waves: Stationary normal shock waves, Moving normal shock waves, Oblique shock waves. Flow in converging - diverging nozzles. One dimensional adiabatic flow with friction (Fanno flow). One dimensionl flow with heat transfer (Raleigh flow).
References	• Robert D. Zucker, Oscar Biblarz, 2019, "Fundamentals of Gas Dynamics", 3rd Edition, Wiley.
Laboratory	• Determination of Mach number with supersonic flow using supersonic wind tunnel • Supersonic shock and flow visualization of normal and oblique shocks • Supersonic probes: measurement of internal wall losses

Used in Program	Mechanical Power Engineering program	Semester	6

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 226	Refrigeration	MEC 122	3	2	2	0	4	10	30	20	40

Course Content	Introduction to refrigeration and Refrigeration machines - Ideal and actual Vapor - compression refrigeration cycle - Refrigerants - Vapor refrigeration cycles (Single and multi-stage) - Vapor absorption systems - Gas refrigeration cycles - Thermoelectric refrigeration systems - Lubricants in refrigeration systems - Expansion devices.
References	R.S. Khurmi and J. K. Gupta, 1992, "A textbook of refrigeration and air conditioning ", Eurasia Publishing House. Wilbert F. Stoecker, 1998, "Industrial Refrigeration Handbook, 1st Edition", McGraw-Hill Companies, Inc.
Laboratory	• Refrigeration Components Instruments and Tools • Basic cycle performance, suction accumulator. Liquid receiver, different types of expansion device, oil separator, multi evaporators. • Simple Vapor Compression Refrigeration System • Performance Test General Cycle Refrigeration Trainer • Computer controlled refrigeration system

Used in Program	Mechanical Power Engineering program	Semester	**6**

Code	Course Name	Pre-req.	CH	Ct. Hr.				Assessment Criteria			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
MEC 228	Power Station	MEC 128	3	2	0	2	4	30	30	-	40
Course Contents	Introduction – classification of power stations – steam power stations (Improvement of Rankine cycle efficiency, main and auxiliary systems) – gas turbine power stations (theory, components, applications, water injection) – combined cycle power stations – cogeneration – hydraulic power stations – diesel stations. Load Frequency Characteristics, Speed Regulation, Parallel Operation, Lubrication Systems, Protection and Tripping Systems, Start-Up and Shut Down Procedures. Energy storage – Economics of power stations.										
References	• El-Wakil M. M., Power Plant Technology, McGraw Hill, 1984 • Gill A. B., Power Plant Performance, Butterworth, 1984										
Used in Program	Electrical Power and Machines Engineering Program							Semester			

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 232	Introduction to Mechatronics	ELE 104	3	2	2	0	4	10	30	20	40
Course Content	Mechatronics fundamentals, Electrical actuation systems, Digital logic, combinational and sequential logic circuits. Microprocessors & Microcontrollers. System performance, System Interfacing, Instrumentation, and Control Systems, Sensor technology (Proximity switches, Photoelectric sensors, Fiber optic sensors), signal acquisition, filtering, and conditioning – Device communications, Computer simulation and Practical training, Case studies and Applications.										
References	• Robert H. Bishop, 2010, “Mechatronics: An Introduction”, CRC Press. • David, G. and Michael, B., Introduction to Mechatronics and Measurement Systems, McGraw Hill, 2003.										
Laboratory	• Control, drives and real-time interaction with mechatronic system • Transducer calibration system for certain application • Sensors for condition monitoring • Transistor Operation, Passive filters, and an Op Amp circuit experiment. • Stepper Motor Motion Control • Barcode reader • DC Motor Speed Control Using PWM										
Used in Program	Mechatronics Engineering Program							Semester	6		

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>ST</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>MEC 236</td><td>Industrial Robots</td><td>MEC 121</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Definition of robot, areas of application, general structure of industrial robots. Geometrical Modeling of Industrial Robot Arms. Working space and working volume of industrial robots. Homogeneous Transformation Matrix (HTM), Position and Orientation of the robot arm end effector center. HTM between two adjacent links. Generalized HTMs of spatial robots. Direct Kinematic Modeling of Industrial Robot Arms. Direct kinematic position model (DKPM), direct kinematic velocity model (DKVM), robot arm Jacobian matrix, direct Kinematic acceleration Model (DKAM). Trajectory generation. Inverse Kinematic Modeling of Industrial Robot Arms. Dynamic Modeling of Industrial Robot Arms.</td></tr>
<tr><td>References</td><td colspan="11">• Megahed, S., 1993, "Principles of Robot Modelling and Simulation", John Wiley & Sons Ltd, England.
• Craig, J.,2005, "Introduction to Robotics: Mechanics and Control", 3rd edition, by Addison-Wesley Publishing Company, Inc.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Computer aided analysis of kinematics of robots
• Kinematic modeling of 5R articulated robot
• Kinematic modeling of SCARA robot
• Kinematic modeling of 6 DOFs robot
• Computer aided trajectory generation between several points
• Dynamic analysis of planar and spatial robots</td></tr>
<tr><td>Used in Program</td><td colspan="6">Mechatronics Engineering Program</td><td colspan="2">Semester</td><td colspan="3">6</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>ST</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>MEC 251</td><td>Mechanical Engineering</td><td>MEC 012</td><td>2</td><td>2</td><td>0</td><td>1</td><td>3</td><td>30</td><td>30</td><td>--</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Fluid Mechanics: Fluid properties and basic concepts - Fluid static (pressure at a point, basic equation for pressure field, measurement of pressure) - fluid flow rate and mass conservation.
Thermodynamics: Definitions and basic concepts - Properties of pure substances (pure substance, phase change process, properties diagram and tables, ideal gas) - First law of thermodynamics (closed system, open systems, applications) thermodynamics (Heat engines, heat pump air conditioning and refrigerators). Heat Transfer: Introduction to Heat Transfer- Modes of heat transfer (conduction, convection, radiation) - One dimensional steady heat conduction – Extended surfaces - Introduction to convection heat transfer (Free and forced)- Heat exchangers.</td></tr>
<tr><td>References</td><td colspan="11">• Frank M white, Fluid Mechanics, 8th edition 2015
• Yunus A.Cengel Michael A.Boles, 2014, “Thermodynamics An Engineering Approach”, McGraw Hill Education; 8th edition</td></tr>
<tr><td>Used in Program</td><td colspan="6">Biomedical Engineering Program</td><td colspan="2">Semester</td><td colspan="3">6</td></tr>
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<tr><td rowspan="2">Code</td><td rowspan="2">Course Title</td><td rowspan="2">Pre-req</td><td rowspan="2">CH</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment Criteria</td></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>MEC 301</td><td>Technical Reports</td><td>-</td><td>2</td><td>1</td><td>2</td><td>0</td><td>3</td><td>50</td><td>-</td><td>50</td><td>-</td></tr>
<tr><td>Course Content</td><td colspan="11">The student is assigned a practical problem to study and write a though report covering all its aspects. He is expected to do one or all the following: gather information, collect data, review literature, analyze or test in pursue of reliable results and solutions.</td></tr>
<tr><td>Laboratory</td><td colspan="11">Practical and Simulation experiment and data collection and writing concluding results with illustrative drawings in well-organized technical report.</td></tr>
<tr><td>Used in Program</td><td colspan="6">All Mechanical Department Programs</td><td colspan="2">Semester</td><td colspan="3">7</td></tr>
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<tr><td rowspan="2">Code</td><td rowspan="2">Course Title</td><td rowspan="2">Pre-req</td><td rowspan="2">CH</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment Criteria</td></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>MEC 311</td><td>Advanced Machining Processes</td><td>MEC 214</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction – processes classification – thermal nontraditional techniques (EDM, EBM & PAC) – mechanical processes (USM, WJM & AJM) – electrochemical machining (ECM, ECG & ECD) – chemical machining – laser industrial applications (cutting, welding & heat treatment) – combinations of various processes – process selection – competitive aspects and economics of manufacturing – modeling and optimization of non-traditional machining processes.</td></tr>
<tr><td>References</td><td colspan="11">Vijay Kumar Jain, "Advanced Machining Processes", Allied Publishers; 1st edition, 2009.</td></tr>
<tr><td>Laboratory</td><td colspan="11">The Laboratory has the following section:
• Computer Numerical Controlled (CNC) Milling Machine.
• Computer Numerical Controlled (CNC) lathe machine
• Weld-deposition based Additive Manufacturing Facility</td></tr>
<tr><td>Used in Program</td><td colspan="6">Mechanical Design & Production Program</td><td colspan="2">Semester</td><td colspan="3">7</td></tr>
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<tr><td rowspan="2">Code</td><td rowspan="2">Course Title</td><td rowspan="2">Pre-req</td><td rowspan="2">CH</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment Criteria</td></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>MEC 313</td><td>Computer-Aided Manufacturing</td><td>MEC 212</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Fundamentals of CAM – Introduction to NC Machine Tools – Specifications – Automated manufacturing Systems (NC, CNC, DNC, AC) – Classification of NC Machine Systems – Manual part Programming – Computer-Aided Part Programming & post-processors – trajectory interpolators – fundamentals of rapid prototyping and automated fabrication – CAPP – DFA & DFM – Applications programs will be written and interfaced to the CAD/CAM database.</td></tr>
<tr><td>References</td><td colspan="11">• Radhakrishnan.P, Subramanyan.S and Raju.V, "CAD/CAM/CIM", New Age International Publishers, 2nd edition 2008.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Students participate in a manufacturing project which utilizes CAD/CAM software to design and manufacture a component using CNC machining equipment.</td></tr>
<tr><td>Used in Program</td><td colspan="6">Mechanical Design & Production Program</td><td colspan="2">Semester</td><td colspan="3">8</td></tr>
</table>

Code	Course Title	Pre-req.	CH	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	SA	MT	PE/OE	Final
MEC 312	Engineering Economics	-	2	2	-	1	3	30	30	--	40
Course Contents	Principles of Economics, Economical Analysis, Cost estimation, Comparison between alternatives, Present worth method, Future worth, Depreciation, Taxes, Inflation, Risk and uncertainty, Introduction to Engineering cost analysis and budgeting.										
References	N. Gregory Mankiw, Euston Quah and Peter Wilson, "Principles of Economics", Delmar, Cengage Learning, - 2020, An Asian Edition, ISBN-13: 978-981-4227-87-2										

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 314	Robotics and Robot Control	MEC 214	3	2	2	0	4	10	30	20	40
Course Content	Introduction to control methods of robotics applications. Kinematics analysis of planar robotic arms. Spatial robots, rotation representations, Euler angles, homogeneous transformation, Denavit Hartenberg notations, forward and inverse kinematics, Jacobian matrix, singularities. Trajectory planning. Dynamics analysis of industrial robots: joint space dynamics, Newton-Euler algorithm, inertia tensor, Lagrange equations, inverse, and forward dynamics. Control: computed torque techniques, joint space control, PD control stability, trajectory tracking.										
References	• Jadran Lenarcic and Federico Thomas, Advances in Robot Kinematics: Theory and Applications, Kluwer Academic Publishers, 2002. • Craig, J.,2005, "Introduction to Robotics: Mechanics and Control", 3rd edition, by Addison-Wesley Publishing Company, Inc.										
Laboratory	• Determine the working space of planar robot using simulation tools • Kinematic modeling of various models of industrial robots. • Solve and implement the IKPM of educational robot in LAB. • Solve and implement the IKVM of educational robot. • Solve and implement the IDM of educational robot.										
Used in Program	Mechanical Design & Production Program							Semester	8		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 316	Operations Research	MEC 211	3	2	0	2	4	30	30	--	40
Course Content	An introduction to the philosophy of operations research – Formulation of linear programming models and their solution (graphical and simplex methods) – Duality theory – Transportation model – assignment – network models – critical path methods, projects evaluation review technique (PERT) – Sensitivity analysis – Integer programming, branch-and-bound – Use of LP and IP computer software programs.										
References	• Hamdy A. Taha, "Operations Research: An Introduction", 10th Edition, Pearson Inc.										
Used in Program	Mechanical Design & Production Program							Semester	8		

<table>
<tr><td>Code</td><td>Course Title</td><td>Pre-req</td><td>CH</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment Criteria</td></tr>
<tr><td rowspan="2">MEC 322</td><td rowspan="2">Internal Combustion Engines</td><td rowspan="2">MEC 222</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Fundamentals of Internal Combustion engines, engine types, configurations, and history of engines. Review of thermodynamics and combustion chemistry. Spark Ignition Engines, operating principle, standard cycles. Combustion in SI engines, knocking, SI engine emissions and emission control, Control of SI engines, effect of throttling. Compression ignition (Diesel) Engines: operating principle, cycles, combustion in diesel engines, diesel engine emissions and emission control, Control of CI engines. Turbo/supercharging, Alternative engine cycles (Homogeneous charge compression ignition (HCCI), gasoline direct injection (GDI), downsizing), Alternative fuels, Hybrid vehicles/Electric vehicles.</td></tr>
<tr><td>References</td><td colspan="11">• Chris Mi, M. Abul Masrur, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives (Automotive Series)", 2nd Edition, Wiley.
• H.N. Gupta, 2006,"Fundamentals of Internal Combustion Engines", 2nd edition, Prentice-Hall of India Pvt.Ltd.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Identification and recognition of different parts of four-stroke diesel engine,
• Identification and recognition of different parts gasoline engine (SI)
• Investigate the function of glow plug on a live diesel engine testbed
• Investigate the cooling system of a diesel engine
• Investigate the lubrication system of diesel engines
• Investigate the engine exhaust emissions such as CO2, CO, and Nox</td></tr>
<tr><td>Used in Program</td><td colspan="6">Mechanical Power Engineering Program</td><td colspan="2">Semester</td><td colspan="3">8</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>ST</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>MEC 323</td><td>Combustion</td><td>MEC 222</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Thermal properties of combustible gases (Air/fuel ratio, product of combustion, heat of combustion, fuel heating values) constant volume combustion constant pressure combustion, Hillums and Gibbs functions, combustion equilibrium, kinetic theory of combustion, flammability limit, combustion efficiency, flame velocity, burning velocity, flame stability, flame structure- premixed flame- diffusion flame- furnaces- gas turbine combustion- fuel properties (gas fuel-Liquid fuel gaseous fuel) - fuel nozzles design(gaseous, liquid fuel) - combustion in boiler- design of combustion chamber, Fuel cells and electrochemical fundamentals.</td></tr>
<tr><td>References</td><td colspan="11">• Stefan R. Turns, 2000, " An Introduction to combustion: Concepts and Applications", International Editions, by McGraw-Hill.
• Irvin Glassman, and Richard A. Yetter, 2008, "Combustion”, Fourth Edition, by Elsevier Inc.
• Shripad Revankar and Pradip Majumdar, 2014, "Fuel Cells Principles Design and Analysis", by Taylor & Francis Group, LLC
• John Newman and Karen E. Thomas-Alyea, 2004, "Electrochemical Systems", Third Edition, by Wiley Interscience</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Identification and recognition of different types of fuel sources
• Identification and recognition of different properties of liquid fuels, such as viscosity, density, heating value, flashand fire point, cetane number, octane number, etc.
• Investigate the Droplet Evaporation of liquid fuels
• Investigate the spray development of liquid fuel
• Investigate the laminar and diffusion flames</td></tr>
<tr><td colspan="2">Used in Program</td><td colspan="6">Mechanical Power Engineering program</td><td colspan="2">Semester</td><td colspan="2">7</td></tr>
</table>

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 324	Power System Components	MEC 222	3	2	2	0	4	10	30	20	40
Course Content	Introduction and overview, Energy system components and configuration, Thermal performance evaluation, Physical modeling of transport qualities and governing equations, Modeling methods and algorithms, Thermal design of: Steam generators, Heat exchangers, Compressors, Steam Turbines, Pumps, Facilities phase change, Computer-aided design software with application of energy facilities. References.										
References	• Pradip Majumdar, 2021, "Design of Thermal Energy Systems", Wiley. • Steven G Penoncello, 2018, "Thermal Energy Systems: Design and Analysis", CRC Press • Stultz S. C. and Kitto J. B., Steam: Its Generation and Use, 41 ST Edition										
Laboratory	• Design and simulation of Steam generation using EES Program • Design and simulation of Chilled Water-Cooling Coil using EES Program • Optimization Analysis Models • Parametric Representation of Thermal Parameters and Properties • Optimization process for Heat Exchanger Design										
Used in Program	Mechanical Power Engineering Program							Semester	8		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 325	Air Conditioning	MEC 222	3	2	2	0	4	10	30	20	40
Course Content	Introduction to air conditioning-Psychrometry-Psychrometric processes-Psychrometry of Air Conditioning Systems- Heating and cooling Load Calculations-Air distribution systems-Air duct design-Fundamentals of HVAC Control.										
References	Faye C. McQuiston, "HVAC Analysis and Design", 6th edition (2004) R.S. Khurmi and J. K. Gupta, "A textbook of refrigeration and air conditioning"										
Laboratory	Heating, cooling, humidification, dehumidification processes using practical software. Simulation of Controlling devices in air conditioning system.										
Used in Program	Mechanical Power Engineering program							Semester	**7**		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 331	Design of Mechatronic Systems	MEC 232	3	2	2	0	4	10	30	20	40

Course Content

Modeling hypothesis and mathematical models of complex mechatronics systems. Principle of operation of various sensors and transducers. Design of control strategies for vehicles and robotic systems. Adopting and designing different components of a mechatronics system. Microcontrollers and electrical components, Electromechanical actuators and control, Mechanical components and mechanisms, Programmable motion control and algorithm development, Closed loop control. Essential tools for the mechatronics system design using the V-model: MATLAB/SIMULINK, LabVIEW, PROTEUS VSM, SOLIDWORKS, etc. Case studies of various mechatronics systems. Control interface of mechatronic systems using MATLAB/LabVIEW.

References

- Clarence W. De Silva, 2005, "Mechatronics: An integrated approach", CRC Press, 2005.
- Alciatore, D. G. and Histand, M.B., Introduction to Mechatronics and Measurement Systems, McGraw Hill,2003.

Laboratory

- Demonstration and presentation of at least two mechatronic systems.
- Performing some experiments on some basic components.
- Using an ADDA card to control two types of systems through a PC, based system.
- Mechatronic control in automated manufacturing
- MATLAB/LabVIEW interface of mechatronic system.

Used in Program	Mechatronics Engineering Program	Semester	7

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 332	CAD/CAM	MEC 215	3	2	2	0	4	10	30	20	40

Course Content

CAD: Geometric modeling, data exchange and integration, mechanical assembly and drafting, mechanical tolerance, mechanical stress analysis. CAD/CAM: Process planning and Tool path generation, integration of CAD/CAM with the production machine. Programming for lathe, drilling and milling machines, canned cycles, subroutines, Loops, Computer assisted part programming, DNC, CNC. Group Technology: Part families, part classifications and coding systems, group technology machine. Computer Integrated Manufacturing: Types of manufacturing systems, types of CIMS, special manufacturing systems, Flexible Manufacturing Systems (FMS), Manufacturing Cells.

References

- M.P. Groover, E.w. Zimmers, "Computer- Aided Design & Manufacturing", Prentice-Hall, Inc, New Jersey, 1984.

Laboratory

- Make various subroutines/program of different workpieces machining operations in CNC machine.

Used in Program	Mechatronics Engineering Program	Semester	8

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 411	Materials Handling	MEC 313	3	2	3	0	5	10	30	20	40
Course Content	Introduction to tool and die design – Basic types and functions of jigs and fixtures (modular, assembly, welding, inspection, and machining fixtures) – Proper supporting, locating principles, and clamping features of jigs and fixtures – Conceptual design of jigs and fixtures (for drilling, reaming, milling, turning, boring etc.) – Different types of dies and their purpose – The steps to design a die – Different types of presses and press accessories – Considerations of design economics.										
References	• N. Rudenko, A. Troitsky,1970," Materials Handling Equipment", Central Books Ltd; 2Rev Ed edition.										
Laboratory	• Course project and training on design methodologies for the various components under study during the course in computer-aided design laboratories. • Developing and conducting a preventive maintenance program for materials handling equipment.										
Used in Program	Mechanical Design & Production Program							Semester	9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 413	Production Aids Design	MEC 216	3	2	2	0	4	10	30	20	40
Course Content	Introduction to tool and die design – Basic types and functions of jigs and fixtures (modular, assembly, welding, inspection, and machining fixtures) – Proper supporting, locating principles, and clamping features of jigs and fixtures – Conceptual design of jigs and fixtures (for drilling, reaming, milling, turning, boring etc.) – Different types of dies and their purpose – The steps to design a die – Different types of presses and press accessories – Considerations of design economics.										
References	• Joshi, Prakash Hiralal. 2010. Jigs and Fixtures. 3rd ed. New York: McGraw Hill Education Limited.										
Laboratory	Training on design methodologies for the various components under study during the course in computer-aided design laboratories.										
Used in Program	Mechanical Design & Production Program							Semester	9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 415	Machine Tool Design	MEC 311	2	1	2	1	4	10	30	20	40
Course Content	General requirements of machine tools and performance nomograms – Standardization of spindle speeds and feet rates – Layout of speed change gears (application for design of machine tools gear boxes) – Design of constructional elements (Frames, Sideways, Spindles and bearings, Cutting, Feed and Control drives) - Hydraulic drives – Vibrations in machine tools.										
References	• N. Acherkan, 2000,"Machine Tool Design", University Press of the Pacific.										
Laboratory	Training on design methodologies for the various components under study during the course, in computer-aided design laboratories										
Used in Program	Mechanical Design & Production Program							Semester	9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 421	Control Application for Energy Systems	MEC 214	3	2	2	1	5	10	30	20	40

Course Content

Process control principles and applications, sensors, and actuators. signal conditioning circuits: filters, instrumentation amplifiers and power circuits. Dynamics and control of real processes: heat exchangers, boilers, internal combustion engines, turbines, HVAC systems. Experimental and Industrial control system design, P, PI, PID control design of mechanical power systems. Experimental frequency response. Steam temperature control, Supervisory predictive control of a combined cycle thermal power plant. Multivariable power plant control.

References

- Damian Flynn, 2003, "Thermal Power Plant Simulation and Control", The Institution of Engineering and Technology.
- Karl J. Astrom, Tore Hagglund, 2009, "PID Controllers", Tech-lib.

Laboratory

- Steam temperature control
- Liquid level control
- Flow control
- HVAC control

Used in Program	Mechanical Power Engineering Program	Semester	9

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 423	Turbomachinery	MEC 221	3	2	2	0	4	10	30	20	40

Course Content

Introduction to turbo machines (definition, basic equation, similarity analysis)– Flow analysis (one-dimensional fluid flow in turbo machines, two dimensional cascades in turbo machinery, and three dimensional flow) –Types of pumps, fans, turbines and compressors: General selection criteria and charts - Machines in series, Machines in parallel –Thermal and hydraulic design and analysis of pumps, fans, turbines and compressors – Selection & Installation requirements as per Manufacturer’s Catalogues (air compressors, domestic water pumps, chilled water pumps, centrifugal fans, axial fans, etc.) - Vibration and Noise problems and solutions – control of turbomachinery in various application - best practices in operation - Maintenance – Troubleshooting.

References

- Fundamentals of Turbo machinery William W. Peng Wiley
- Hydraulic and compressible flow turbomachiners. A Sayers 1990.
- Basic Fluid Mechanics and Fluid Machines Husain el al, 2008

Laboratory

- Measuring the performance of pelton wheel at different deflection angle and flow rate
- Measuring the performance of the Frances turbine at different inlet angle and flow rate
- Measuring the pump performance
- Measuring the generated forces from moving fluid (impact of jet)

Used in Program	Mechanical Power Engineering program	Semester	9

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>ST</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>MEC 425</td><td>Power Stations</td><td>MEC 322</td><td>2</td><td>1</td><td>2</td><td>0</td><td>3</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Co-Generation Plants, Combined Cycles, Heat Recovery Boilers, Efficiency of Combined Cycles, Performance Characteristics of Power Stations, Heat Rate and Incremental Rate, Optimum Load Division Among Power Generation Units, Control of the Steam Generators, Convection and Radiant Type Superheaters, Governing of Steam Turbines, Steam Partial Admission and Full Admission, Load Frequency Characteristics, Speed Regulation, Parallel Operation, Lubrication Systems, Protection and Tripping Systems, Start-Up and Shut Down Procedures, Procedure of Meeting the Power Demands: Adding Peaking Load Units, Connection between Zones of Different Longitudes, Energy Storage.</td></tr>
<tr><td>References</td><td colspan="11">• El-Wakil M. M., Power Plant Technology, McGraw Hill, 1984
• Gill A. B., Power Plant Performance, Butterworth, 1984</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Simulation work and virtual laboratories of plants and cycles.</td></tr>
<tr><td>Used in Program</td><td colspan="5">Mechanical Power Engineering program</td><td colspan="2">Semester</td><td colspan="4">9</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>ST</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>MEC 431</td><td>Embedded System Design</td><td>MEC 214</td><td>2</td><td>1</td><td>2</td><td>1</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Fundamentals of embedded system hardware and firmware. Embedded processor selection, glue logic, circuit design, circuit layout, circuit debugging, development tools, firmware architecture, firmware design, and firmware debugging. Microcontrollers family, architecture of microcontroller, wire wrapped microcontroller board. Development of embedded software using C language. The students will be able to grasp the main principles of embedded system design and understand the concept of hardware-software co-design.</td></tr>
<tr><td>References</td><td colspan="11">• Embedded systems design with the Atmel AVR microcontroller, Barrett, Steven F., and Steven Frank Barrett, Morgan & Claypool Publishers, 2010.
• AVR Microcontroller and Embedded Systems, Mazidi, The. Pearson India, 2010.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Testing of microcontrollers IO pins
• Generation of different signals using Microcontroller.
• Microcontroller interface with sensors.
• Microcontroller interface with actuators and motors (DC and servo motors)
• Microcontroller interface with peripheral devices and communication.
• Digital function implementation using digital blocks</td></tr>
<tr><td>Used in Program</td><td colspan="5">Mechatronics Department</td><td colspan="2">Semester</td><td colspan="4">9</td></tr>
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<tr><td rowspan="2">Code</td><td rowspan="2">Course Title</td><td rowspan="2">Pre-req</td><td rowspan="2">CH</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment Criteria</td></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>MEC 433</td><td>Programmable Logic Controllers</td><td>ELE 204</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Basic theory and applications of programmable logic controllers (PLCs). Processor units, numbering systems, memory organization, relay type devices, timers, counters, data manipulators, and programming. Explain the architecture and operation of industrial PLC's. Integration of PLCs with electro-mechanical systems. Develop, troubleshoot, test, and optimize PLC programs. Use of industrial data monitoring and supervision systems. Networking, building simple supervisory control and data acquisition (SCADA) system integrated with a PLC for sequential control problems.</td></tr>
<tr><td>References</td><td colspan="11">• Dag H. Hanssen, Programmable Logic Controllers: A Practical Approach to IEC 61131-3 using CoDeSys, 2015, Wiley.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Program logic functions in PLC's using both graphical and text-based languages
• Use timers, counters, and shift-registers to achieve sequential functionality
• Monitoring and Control of filling a tank
• Case study project to solve problems encountered in industry
• Examine a communication protocol used with PLC's
• Hybrid boat control system</td></tr>
<tr><td colspan="2">Used in Program</td><td colspan="6">Mechatronics Department</td><td colspan="2">Semester</td><td colspan="2">9</td></tr>
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<tr><td rowspan="2">Code</td><td rowspan="2">Course Title</td><td rowspan="2">Pre-req</td><td rowspan="2">CH</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment Criteria</td></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>MEC 435</td><td>Artificial Intelligence</td><td>ELE 404</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to intelligent control methods. Design of simple intelligent controllers. Basics of Artificial intelligence, Fuzzy set theory, Fuzzy logic, Fuzzy reasoning, Fuzzy controllers, Fuzzy PID control. Introduction to Neural networks, perception model, classification problem, multilayer networks, Feed forward networks, back propagation learning algorithms, recurrent networks, radial basis networks, neural network control. Neuro-fuzzy systems, introduction to optimization methods such as swarm optimizations and colony.</td></tr>
<tr><td>References</td><td colspan="11">• Y. Sin and C. Xu, Intelligent Systems: Modeling, Optimization, and Control, CRC Press, 2008 Jinkun, Liu, “Intelligent Control Design and MATLAB Simulation”</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Design a fuzzy controller for the system using MATLAB/LabVIEW
• Design a neural controller for simple control system using MATLAB/LabVIEW
• Training a multilayer perceptron with the MATLAB/LabVIEW Neural Networks Toolbox
• Investigate the performance of a neural network on the 2D XOR problem
• Fuzzy model reference learning control for a tanker ship
• Train Convolutional Neural Network for Regression using MATLAB/LabVIEW</td></tr>
<tr><td colspan="2">Used in Program</td><td colspan="6">Mechatronics Department</td><td colspan="2">Semester</td><td colspan="2">9</td></tr>
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Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 31x1	Finite Element Analysis	MEC 216	3	2	0	2	4	30	30	0	40
Course Content	Basic principles of continuum mechanics and finite element methods, modern application to solution of practical problems in solid, structural, and fluid mechanics, heat and mass transfer, other field problems. Kinematics of deformation, strain and stress measures, constitutive relations, conservation laws, virtual work, and variation al principles. Discretization of governing equations using finite element methods. Solution of central problems using an existing general-purpose finite element analysis program, Course project.										
References	• Chandraputla T.R., and Belegundu A.D., “Introduction of Finite Element in Engineering”, Prentice Hall of India, Fourth Edition, 2012.										
Used in Program	Production Department (Product Design)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 31x2	Product Design and Development	MEC 215	3	2	0	2	4	30	30	0	40
Course Content	Product development and design processes and methods, including product specifications, concept development, engineering drawings, design for prototyping, and manufacturing.										
References	• Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011										
Used in Program	Production Department (Product Design)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 31x3	Failure Analysis	MEC 31x1 MEC 32x2	3	2	0	2	4	30	30	0	40
Course Content	Functional and structural failures. Tribological surface failure, abrasive, adhesive, fatigue wear, fretting and corrosive wear. Design against wear. Modes of bulk failures, excessive deformation, buckling, yielding, plastic instability, creep, and creep rupture. Incremental collapse, fracture mechanics and crack propagation. Damage-tolerant design. Identification and detection of failures. Applications to some mechanical components. Case studies. Course project.										
References	• W.F. Hosford, Mechanical Behavior of Materials, Cambridge University Press, 2009. • W.D. Callister, Jr., D.G. Rethwisch, Materials Science and Engineering: An Introduction, John Wiley & Sons, 2009.										
Used in Program	Production Department (Product Design)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 31x4	Design of Experiments	MEC 31x1 MEC 32x2	3	2	0	2	4	30	30	0	40
Course Content	Principles of experimental design. Randomized complete block designs. Latin square and Greco-Latin square designs. General factorial designs. 2k Factorial designs. Response surface methodology and robust design. Planning, performing, and analyzing industrial experiments										
References	Montgomery, Douglas C. *"Design and analysis of experiments"*, 8th Edition, John Wiley & Sons, 2017. George E. P. Box, J. Stuart Hunter and William G. Hunter. "Statistics for Experimenters: Design, Innovation and Discovery".										
Used in Program	Production Department (Product Design)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 31x5	Tribology	MEC 31x1 MEC 32x2	3	2	0	2	4	30	30	0	40
Course Content	Surface topography, Nature of surface and contacts, Viscosity and Rheology, Methods of fluid-film formation, Friction mechanism, Mechanisms of wear, Plain bearing materials, Bearing surface coatings and treatments, Wear resistant materials, Rolling bearing materials, Gear materials, Friction materials, Properties of friction materials, Mineral oils, Synthetic oils, Greases, Solid lubricants and coatings, Selection of lubricant types, Plain bearing lubrication, Rolling bearing lubrication, Gear and chain lubrication, Selection of bearing type and form, Selection of journal bearing, Selection of thrust bearing, Pressure-fed fluid film bearings, Grease, wick, and drip-fed lubricated journal bearings, Dry rubbing bearings, Plain-thrust bearings, Profiled-pad thrust bearings, Tilting-pad thrust bearing, Plain bearings form and installation, Mechanical seals, Selection of seals, Wear-resistant parts, (material selection), course project and computer applications										
References	Jamal, Takadoum, “Materials and Surface Engineering in Tribology”, Wiley Publications, 2008.										
Used in Program	Production Department (Product Design)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41x6	Special Topics in Mechanical Design	MEC 31x1 MEC 32x2	3	2	0	2	4	30	30	0	40
Course Content	Students study one or more topics in Mechanical Design Engineering that are not covered by other program courses and/or that present recent or advanced development of interest to mechanical engineers. Course project.										
References	Karl T. Ulrich and Steven D. Eppinger,"Product Design and Development”, (the third edition),, the McGraw-Hill Companies, Inc										
Used in Program	Production Department (Product Design)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41x7	Pressure Vessels and Piping	MEC 31x1 MEC 32x2	3	2	0	2	4	30	30	0	40
Course Content	Introduction to ASME Boiler, Pressure Vessels, and Piping Codes. Section VIII Divs. 1 and 2. B31 code series. Material selection. Basic principles in design. Types of loads. Failure theories. Design for internal and external pressure. Design of end closures with various geometries. Design of openings and nozzles. Fabrication requirements. Non-destructive examination and testing. Piping stress and flexibility analyses, design and selection of piping supports. Computer implementation of general-purpose software packages. Course project.										
References	Wingate, James A - Applying the ASME codes _ plant piping and pressure vessels (2007, ASME Press)										
Used in Program	Production Department (Product Design)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41x8	Ergonomics and Human Factor	MEC 313	3	2	0	2	4	30	30	0	40
Course Content	Introduction to Occupational Biomechanics. Review of kinematics and kinetics. Anthropometry. Mechanical work-capacity evaluation. Bioinstrumentation for Occupational Biomechanics. Biomechanical models. Methods of classifying and evaluating manual work. Manual material handling limits. Biomechanical considerations in machine control and workplace design. Hand tool design guidelines. Guidelines for seated work. **I**ntroduction to human factors engineering. Muscular work. Nervous control. Work efficiency. Body size and anthropometrics. Workstation design. Heavy work. Handling loads. Man-machine systems. Mental activity. Fatigue. Stress and boredom. Vision and lighting. Noise and vibration.										
References	Henry H Bednar, “Pressure vessel Design Hand book”, CBS publishers and distributors J. Phillip Ellenberger, “Pressure Vessels: ASME Code Simplified”, ASME. Smith P, “Fundamentals of Piping Design”, Elsevier										
Used in Program	Production Department (Product Design)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41x9	Computer Integrated Manufacturing	MEC 31x1 MEC 32x2	3	2	0	2	4	30	30	0	40
Course Content	CIM introduces the basic concepts and procedures of CIM production as well as the main components and devices in a CIM cell. Students learn about all the aspects of a CIM production cycle, from customer order and inventory control, through automated manufacturing of materials into finished parts, to quality inspection and final delivery. It covers the integration of: Computer Aided Design (CAD), Computer Aided Process Planning (CAPP), and Computer Aided Manufacturing (CAM); Integrating robotic systems such as Automated Guided Vehicles (AGV) and robotic arms into manufacturing systems and use of Flexible Manufacturing Systems (FMS). Use of CIM software										
References	• Radhakrishnan.P, Subramanyan.S and Raju.V, “CAD/CAM/CIM”, New Age International Publishers, 2nd edition 2008. • Alavudeen.A and Venkateshwaran. N, “Computer Integrated Manufacturing”, PHI Learning Private Limited, 2010.										
Used in Program	Production Department (Product Design)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41x10	Process Control	MEC 31x1 MEC 32x2	3	2	0	2	4	30	30	0	40
Course Content	Identification and control methods applicable to processes. Read P&I diagrams, identify control loops, and tune industrial controllers including robot arms. The cascade controllers, feed forward controllers, control design of time-delay processes, internal model control, two-degree of freedom controllers, hybrid controllers, introduction to model predictive control, implementation of industrial controllers, introduction to nonlinear controllers.										
References	Dumitru Popescu, Amira Gharbi, Dan Stefanoiu, Pierre Borne, 2017, "Process Control Design for Industrial Applications", John Wiley & Sons, Inc										
Used in Program	Production Department (Product Design)					Semester		7:9			

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41x11	Sheet Metal processes and design	MEC 31x1 MEC 32x2	3	2	0	2	4	30	30	0	40
Course Content	Review of Sheet metal industry applications, Sheet Metal Properties, Deformation of sheet metals, Simple Stamping Analysis, Deep Drawing Die design, Sheet metal shearing and bending, Non-Conventional Sheet metal processes. Die design: Standard parts, progressive and compound dies, Mechanical and Hydraulic Presses selection-CNC punch presses. Course project										
References	Vukota Boljanovic,2004, "Sheet Metal Forming Processes and Die Design", Industrial Press Inc.										
Used in Program	Production Department (Product Design)					Semester		7:9			

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41x12	Material selection in Design	MEC 31x1 MEC 32x2	3	2	0	2	4	30	30	0	40
Course Content	Classification of all engineering material; Materials properties; Performance indices; Materials selection charts; Performance indices with geometry factors; Case studies.										
References	M.F. Ashby, Materials Selection in Mechanical Design, Butterworth-Heinemann, 5th Ed., 2017 (ISBN-13: 978-0081005996) Engineering Design: A Materials and Processing Approach, George E. Dieter, McGraw-Hill										
Used in Program	Production Department (Product Design)					Semester		7:9			

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41x14	Mechanism Design	MEC 31x1 MEC 32x2	3	2	0	2	4	30	30	0	40
Course Content	Introduction and basic concepts, Mechanisms and structures, Number synthesis, Paradoxes, Isomers, Linkage transformation, Intermittent motion, Inversion, Function path and motion generation Graphical synthesis of planar mechanisms: Two-position synthesis, Three-position synthesis, Quick-return mechanisms, Coupler curves, Analytical synthesis of planar mechanisms, Optimal planar mechanism synthesis, Analytical synthesis of simple toggles, Introduction to spatial mechanism synthesis, simulation using Computer Graphics and Matlab Software and case studies. Course project.										
References	Tilman Börgers, 2015, "An Introduction to the Theory of Mechanism Design", Oxford										
Used in Program	Production Department (Product Design)			Semester	7:9						

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 31y1	Advanced Composite Materials	MEC 218	3	2	0	2	4	30	30	0	40
Course Content	Stress and strain analysis of continuous fiber composite materials. Orthotropic elasticity, lamination theory, failure criterion, fiber-matrix interfacial features and interactions. Manufacturing and processing techniques of metal-, polymer-, and ceramic-matrix composites; Design philosophies, as applied to structural polymeric composites. Design considerations related to manufacturing techniques; non-destructive testing of composite structures.										
References	LOUIS A PILATO, Michael J. Michno, 1994, "Advanced Composite Materials", Springer, Berlin, Heidelberg										
Used in Program	Production Department (Manufacturing & Materials)			Semester	7:9						

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 31y2	Manufacturing Systems	MEC 214	3	2	0	2	4	30	30	0	40
Course Content	Basic principles, NC machines, Numerical control, and industrial robotics. Group technology and flexible manufacturing systems. Production lines, Machining centers, High speed machining. Manufacturing engineering, Process planning, Problem solving and continuous improvement, Concurrent engineering design for manufacturability, Production planning and control, Introduction to Quality control.										
References	• George Chryssolouris, 2006, "Manufacturing Systems: Theory and Practice", Springer Science Inc.										
Used in Program	Production Department (Manufacturing & Materials)			Semester	7:9						

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 31y3	Process Control	MEC 31y1 MEC 31y2	3	2	0	2	4	30	30	0	40
Course Content	Identification and control methods applicable to processes. Read P&I diagrams, identify control loops, and tune industrial controllers including robot arms. The cascade controllers, feed forward controllers, control design of time-delay processes, internal model control, two-degree of freedom controllers, hybrid controllers, introduction to model predictive control, implementation of industrial controllers, introduction to nonlinear controllers.										
References	Dumitru Popescu, Amira Gharbi, Dan Stefanoiu, Pierre Borne, 2017, "Process Control Design for Industrial Applications", John Wiley & Sons, Inc										
Used in Program	Production Department (Manufacturing & Materials)			Semester	7:9						

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 31y4	Welding Technology	MEC 31y1 MEC 31y2	3	2	0	2	4	30	30	0	40
Course Content	Metal Welding Definition, Welding Joints, Welding Standards, Welding Symbols, Fusion Welding Processes, Solid State Welding Processes, High Energy Welding Processes, Heat Flow in Metal Welding, Chemical Reactions & Fluid Flow in Arc Welding, Solidification of Fusion Zone, Weldability & Cracking Susceptibility, Welding Defects, and Inspection of Welded Joints. Advanced welding operations: Laser welding, Electron beam welding, Friction stir welding of different alloys and post weld heat treatment and dissimilar materials, Ultrasonic welding (USW).										
References	J. Paulo Davim, 2021, Welding Technology, Springer Nature Switzerland										
Used in Program	Production Department (Manufacturing & Materials)			Semester	7:9						

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 31y5	Casting Processes	MEC 31y1 MEC 31y2	3	2	0	2	4	30	30	0	40
Course Content	Metal casting technology: Introduction, Solidification processing, Liquid metals, Principles of solidification, Primary (wrought) and casting, Metals and alloys, Production of primary metals, Production of shaped casting, Patterns, Molding techniques: Molding techniques and dynamics, Melting procedures and equipment, Design considerations, Structure, Properties and defects of casting, Casting process selection, Computer applications in metal casting, Quality control in casting, advanced casting processes.										
References	• Sahoo, Mahi, and Sudhari Sahu, 2014, "Principles of Metal Casting", 3rd ed. New York: McGraw-Hill Education.										
Used in Program	Production Department (Manufacturing & Materials)			Semester	7:9						

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41y6	Powder Metallurgy	MEC 31y1 MEC 31y2	3	2	0	2	4	30	30	0	40
Course Content	Powder preparation, rapid-solidification processing principles, powder characterization, theory of compaction, sintering, full-density processing, powder metallurgy component design, compact characterization, application of powder metallurgy processing to structural, electrical, magnetic, and biomedical components.										
References	Powder Metallurgy: Science, Technology, and Materials, Anish Upadhyaya, Gopal Shankar Upadhyaya, CRC Press,2011.										
Used in Program	Production Department (Manufacturing & Materials)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41y7	Polymers Engineering & Manufacturing	MEC 31y1 MEC 31y2	3	2	0	2	4	30	30	0	40
Course Content	Engineering analysis and design techniques for synthetic polymers. Treatment of materials properties selection, mechanical characterization, and processing in design of load bearing and environment-compatible structures are covered.										
References	Fundamentals of Composites manufacturing: Materials, Methods, and Applications by Dr. A. Brent Strong Society of manufacturing Engineers, 2nd Edition, 2007, ISBN 13: 978-087263854-9. Anil Kumar, Rakesh K. Gupta, Fundamentals of Polymer Engineering, Third Edition,20										
Used in Program	Production Department (Manufacturing & Materials)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41y8	Special Topics in Materials Engineering	MEC 31y1 MEC 31y2	3	2	0	2	4	30	30	0	40
Course Content	Nanomaterials (characteristics, fabrication, and application), Magnetic Materials (types, characteristics, fabrication and application), Coating materials (metallic, organic, ceramics and nanocomposite coating), Advanced and smart materials such as photovoltaic solar cells materials …etc.										
References	Some selected scientific research in the field.										
Used in Program	Production Department (Manufacturing & Materials)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41y9	Computer Integrated Manufacturing	MEC 31y1 MEC 31y2	3	2	0	2	4	30	30	0	40

Course Content	Product Cycle and CAD/CAM, Automation and CAD/CAM, Programming for lathe, drilling and milling machines. Computer assisted part programming, DNC, CNC. Industrial robotic applications. Computer aided process planning: Retrieval type process planning systems, generative process planning systems, machinability data systems, computer generated time standard. Types of manufacturing systems, types of CIMS, special manufacturing systems, Flexible Manufacturing Systems FMS, Manufacturing Cells, Course project.
References	• Alavudeen.A and Venkateshwaran.N, “Computer Integrated Manufacturing”, PHI Learning Private Limited, 2010.

Used in Program	Production Department (Manufacturing & Materials)	Semester	7:9

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41y10	Special Topics in Manufacturing	MEC 31y1 MEC 31y2		2	0	2	4	30	30	0	40

Course Content	The course covers advanced topics in manufacturing of relevance to emerging technologies. The topic may include flexible manufacturing systems, reverse engineering and prototyping, integrated manufacturing, manufacturing intelligence, 3-D printing, Additive manufacturing, The course includes independent research project on advanced manufacturing processes.
References	M.P. Groover, Fundamentals of Modern Manufacturing, 6th edition. John Wiley & Sons, Inc. ISBN: 978-1119128694.

Used in Program	Production Department (Manufacturing & Materials)	Semester	7:9

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41y12	Sheet Metal processes and design	MEC 31y1 MEC 31y2	3	2	0	2	4	30	30	0	40

Course Content	Review of Sheet metal industry applications, Sheet Metal Properties, Deformation of sheet metals, Simple Stamping Analysis, Deep Drawing Die design, Sheet metal shearing and bending, Non-Conventional Sheet metal processes. Die design: Standard parts, progressive and compound dies, Mechanical and Hydraulic Presses selection-CNC punch presses. Course project
Reference s	• Alan Weatherall, Computer Integrated Manufacturing From fundamentals to implementation, 1988 Elsevier Ltd.

Used in Program	Production Department (Manufacturing & Materials)	Semester	7:9

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41y13	Design of Experiments	MEC 31y1 MEC 31y2	3	2	0	2	4	30	30	0	40
Course Content	Principles of experimental design. Randomized complete block designs. Latin square and Greco-Latin square designs. General factorial designs. 2k Factorial designs. Response surface methodology and robust design. Planning, performing, and analyzing industrial experiments.										
References	Montgomery, Douglas C. *"Design and analysis of experiments"*, 8th Edition, John Wiley & Sons, 2017. George E. P. Box, J. Stuart Hunter and William G. Hunter. "Statistics for Experimenters: Design, Innovation and Discovery".										
Used in Program	Production Department (Manufacturing & Materials)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41y14	Ergonomics and Human Factor	MEC 313	3	2	0	2	4	30	30	0	40
Course Content	Introduction to Occupational Biomechanics. Review of kinematics and kinetics. Anthropometry. Mechanical work-capacity evaluation. Bioinstrumentation for Occupational Biomechanics. Biomechanical models. Methods of classifying and evaluating manual work. Manual material handling limits. Biomechanical considerations in machine control and workplace design. Hand tool design guidelines. Guidelines for seated work. Introduction to human factors engineering. Muscular work. Nervous control. Work efficiency. Body size and anthropometrics. Workstation design. Heavy work. Handling loads. Man-machine systems. Mental activity. Fatigue. Stress and boredom. Vision and lighting. Noise and vibration.										
References	Sanders and McCormick, Human Factors in Engineering and Design, 7th Edition, McGraw Hill, ISBN # 978-0070549012).										
Used in Program	Production Department (Manufacturing & Materials)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41y15	Industrial Information systems	MEC 31y1 MEC 31y2	3	2	0	2	4	30	30	0	40
Course Content	General concepts. Values and attributes of information. Different types of information systems. Concepts of managerial information systems. Emphasis on analysis, design, and development of industrial information systems. Developing information systems by using microcomputers.										
References	Thomas Boucher, Ali Yalcin - Design of Industrial Information Systems (2006, Elsevier)										
Used in Program	Production Department (Manufacturing & Materials)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41y16	Artificial Intelligence	ELE 434	3	2	0	2	4	30	30	0	40
Course Content	Basics of intelligent control. Design of simple intelligent controllers. Basics of Artificial intelligence, Fuzzy set theory, Fuzzy logic, Fuzzy reasoning, Fuzzy controllers, Fuzzy PID control. Introduction to Neural networks, perception model, classification problem, multilayer networks, Feed forward networks, back propagation learning algorithms, recurrent networks, radial basis networks, neural network control. Neuro-fuzzy systems, Introduction to optimization methods such as swarm optimizations and ants colony.										
References	Russell, Stuart, and Peter Norvig. "Artificial intelligence: a modern approach."4th Edition (2020).										
Used in Program	Production Department (Manufacturing & Materials)	Semester	7:9								

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 31z1	Industrial Automation	MEC 214	3	2	0	2	4	30	30	0	40
Course Content	Introduction to industrial automation: mechanization versus automation, advantages of automation, application of automation, types of automation, automation system structure. Sensor types and selection. Actuator types & selection, Programmable Logic Controllers (PLC): introduction, hardwired ladder diagram, PLC programming and hardware fundamentals. Supervisory control and data acquisition: introduction, fundamental principles, hardware and software, modern applications of SCADA systems. Distributed Control Systems (DCS): introduction, fundamental principles, modern applications of DCS.										
References	Chanchal Dey, Sunit Kumar Sen, 2020, "Industrial Automation Technologies", CRC Press.										
Used in Program	Production Department (Industrial & Management)	Semester	7:9								

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 31z2	Motion and time study	MEC 214	3	2	0	2	4	30	30	0	40
Course Content	Introduction to Productivity, Factors affecting on productivity, Productivity Measurements, Productivity Improvement Techniques, Work Study, Method Study, Motion Study, Work Measurement, Time Study										
References	• Benjamin w. Niebel, "motion and time study ".										
Used in Program	Production Department (Industrial & Management)	Semester	7:9								

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 31z3	Quality Control	MEC 31z1 MEC 31z2	3	2	0	2	4	30	30	0	40
Course Content	History of quality control Quality definitions and concepts, Process capability analysis, Theory of control charts, Statistical control charts for attributes, Statistical control charts for variables, Acceptance sampling: Principles and concepts, Acceptance sampling by attributes, Acceptance sampling by variables.										
References	Montgomery, Douglas C. *"Introduction to statistical quality control"*,8th Edition. John Wiley & Sons, 2020.										
Used in Program	Production Department (Industrial & Management)	Semester	7:9								

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 31z4	Lean Manufacturing Systems	MEC 31z1 MEC 31z2	3	2	0	2	4	30	30	0	40
Course Content	Fundamentals of lean manufacturing principles. Toyota house, seven wastes, Push verse Pull systems and JIT, Kanban system, Kanban size and number, CONWIP. Value stream mapping: How to construct the current state map, improvement tools Kaizen, Poka-a-Yoke, 5S. Takt /mealculations and production leveling.										
References	Lonnie Wilson, “How to Implement Lean Manufacturing”, McGraw-Hill Professional; 1 edition, 2009										
Used in Program	Production Department (Industrial & Management)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 31z5	Industrial Market analysis	MEC 31z1 MEC 31z2	3	2	0	2	4	30	30	0	40
Course Content	Supply chain metrics, primary tradeoffs in making supply chain decisions, and basic tools for effective and efficient supply chain management, production planning and inventory control, order fulfillment and supply chain coordination. It will also investigate topics such as global supply chain design, logistics, and outsourcing, several other recent supply chain innovations.										
References	Zimmerman, A. & Blythe, J , Business to Business Marketing Management: A Global Perspective, third edition.										
Used in Program	Production Department (Industrial & Management)							Semester	9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41z6	Advanced Operations Research	MEC 316	3	2	0	2	4	30	30	0	40
Course Content	Non-linear programming. Dynamic programming. Inventory models. Waiting line models. Markov analysis. Introduction to Game theory. Applications in industrial, service and public systems										
References	Hamdy A. Taha, “Operations Research – An Introduction” 10th Edition, 2017.										
Used in Program	Production Department (Industrial & Management)							Semester	9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41z9	Computer Integrated Manufacturing	MEC 31z1 MEC 31z2	3	2	0	2	4	30	30	0	40
Course Content	Product Cycle and CAD/CAM, Automation and CAD/CAM, Programming for lathe, drilling and milling machines. Computer assisted part programming, DNC, CNC. Industrial robotic applications. Computer aided process planning: Retrieval type process planning systems, generative process planning systems, machinability data systems, computer generated time standard. Types of manufacturing systems, types of CIMS, special manufacturing systems, Flexible Manufacturing Systems FMS, Manufacturing Cells, Course project.										
References	Alavudeen.A and Venkateshwaran.N, "Computer Integrated Manufacturing", PHI Learning Private Limited, 2010.										
Used in Program	Production Department (Industrial & Management)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41z12	Facilities Planning and Design	MEC 31z1 MEC 31z2	3	2	0	2	4	30	30	0	40
Course Content	Fundamentals of facilities planning. Facilities design. Flow, space, and activity relationships. Material handling systems. Layout planning models. Warehouse operations. Quantitative facilities planning models. Preparing, presenting, implementing and maintaining facilities plan.										
References	Tompkins, J. A, Facilities Planning (4th ed.). Hoboken, NJ: John Wiley & Sons, Inc., 2010										
Used in Program	Production Department (Industrial & Management)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41z13	Ergonomics and Human Factor	MEC 313	3	2	0	2	4	30	30	0	40
Course Content	Introduction to Occupational Biomechanics. Review of kinematics and kinetics. Anthropometry. Mechanical work-capacity evaluation. Bioinstrumentation for Occupational Biomechanics. Biomechanical models. Methods of classifying and evaluating manual work. Manual material handling limits. Biomechanical considerations in machine control and workplace design. Hand tool design guidelines. Guidelines for seated work. Introduction to human factors engineering. Muscular work. Nervous control. Work efficiency. Body size and anthropometrics. Workstation design. Heavy work. Handling loads. Man-machine systems. Mental activity. Fatigue. Stress and boredom. Vision and lighting. Noise and vibration.										
References	Sanders and McCormick, Human Factors in Engineering and Design, 7th Edition, McGraw Hill, ISBN # 978-0070549012).										
Used in Program	Production Department (Industrial & Management)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 41z14	Design of Experiments	MEC 31z1 MEC 31z2	3	2	0	2	4	30	30	0	40
Course Content	Principles of experimental design. Randomized complete block designs. Latin square and Greco-Latin square designs. General factorial designs. 2k Factorial designs. Response surface methodology and robust design. Planning, performing, and analyzing industrial experiments.										
References	Montgomery, Douglas C. *"Design and analysis of experiments"*, 8th Edition, John Wiley & Sons, 2017. George E. P. Box, J. Stuart Hunter and William G. Hunter. "Statistics for Experimenters: Design, Innovation and Discovery".										
Used in Program	Production Department (Industrial & Management)							Semester	7:9		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 32x1	Introduction to Renewable Energy	MEC 222	3	2	0	2	4	30	30	0	40
Course Content	Introduction. Different Sources of Energy - Solar Energy. Availability of Solar Energy Collection of Solar Energy. Solar Energy Systems. Wind Energy. Characteristics of Wind. Wind Turbine Theory. Wind Energy Conversion Systems. Biomass Energy. Production of Biomass Gases. Systems and Tools for Energy Production from Biomass - Geothermal Energy: types of geothermal energy, vapor dominated system, liquid dominated system, petro-thermal system. Systems Design of Energy Saving systems.										
References	Kaltschmitt M., Streicher W., Wiese A., Renewable Energy, Springer London, Limited, Jun 1, 2007. Tiwari G. N., and Ghosal M. K., Renewable Energy Resources: Basic Principles And Applications - Morgan & Claypool, 2005										
Used in Program	Mechanical Power Engineering - Sustainable & Renewable Energy							Semester	7		

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 32x2	Hydroelectric Energy Systems	MEC 221	3	2	0	2	4	30	30	0	40
Course Content	Introduction and Status of Hydropower, Physical and Technical Basics of Hydropower, Hydropower Resource, Categories of hydropower Plant, Components of Hydropower Plants, Large Hydropower Plants: Dams and Barrages, Hydraulic Turbines: Types and Operational Aspects. Generators. Small Hydropower. Use of Ocean Energies, Economics of Hydropower Plants, Outlook for Hydropower										
References	• Hermann-Josef Wagner, Jyotirmay Mathur, 2011, "Introduction to Hydro Energy Systems", Springer Nature Switzerland • Paul Breeze, 2018, "Hydropower", Academic Press										
Used in Program	Mechanical Power Engineering - Sustainable & Renewable Energy							Semester	7		

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>ST</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>MEC 32x3</td><td>Wind Energy System Design</td><td>MEC 32x1
MEC 32x2</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Geophysics of wind resources; aerodynamics of horizontal-axis wind turbines; wind turbine performance; design loads; conceptual design of horizontal-axis wind turbines; blade design and its optimization; materials properties and materials selection; mechanical design and safety factors; wind turbine control; installation; wind farms; electrical systems for wind turbines, Wind Turbine Acoustics.</td></tr>
<tr><td>References</td><td colspan="11">• Gary L. Johnson, 1985, "Wind Energy Systems", Prentice-Hall</td></tr>
<tr><td>Used in Program</td><td colspan="5">Mechanical Power Engineering - Sustainable & Renewable Energy</td><td colspan="2">Semester</td><td colspan="4">8</td></tr>
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<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>ST</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>MEC 32x4</td><td>Fundamentals and Applications of Solar Energy</td><td>MEC 32x1
MEC 32x2</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Solar energy potential in Egypt- resource assessment measurements - solar geometry-solar thermal applications- flat plate collectors(water-air)- efficiency and Sankey diagram-assessment of yield and solar fraction evacuated tube collectors- medium temperature concentration of solar energy-high temperature concentration application-solar cooling- solar desalination- poly-generation applications-certification.</td></tr>
<tr><td>References</td><td colspan="11">• Garg & Prakash, H. P. Garg, 2000, " Solar Energy: Fundamentals and Applications ", McGraw-Hill Education</td></tr>
<tr><td>Used in Program</td><td colspan="5">Mechanical Power Engineering - Sustainable & Renewable Energy</td><td colspan="2">Semester</td><td colspan="4">8</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>ST</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>MEC 32x5</td><td>Nuclear Power Stations</td><td>MEC 222</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Thermodynamics of Balance-of-Plant Systems, Nuclear Boilers. Different types of nuclear power stations (boiling water, pressurized water, gas-cooled, fast-breeders). Cycle Isolation and the Mass Balance, Heat Rejection Systems, Cooling Towers. Simulation of different types – methods of choosing nuclear power Station type – choosing the materials used in different reactors.</td></tr>
<tr><td>References</td><td colspan="11">• Charles F. Bowman, Seth N. Bowman, 2020, " Thermal Engineering of Nuclear Power Stations - Balance-of-Plant Systems", CRC Press.</td></tr>
<tr><td>Used in Program</td><td colspan="5">Mechanical Power Engineering - Sustainable & Renewable Energy</td><td colspan="2">Semester</td><td colspan="4">8</td></tr>
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Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 42x5	Essentials of Energy Management	MEC 32x1 MEC 32x2	3	2	0	2	4	30	30	0	40
Course Content	Energy Resources, energy efficiency technologies, integration of renewable Energy with energy efficiency measures. Supply and demand side management. Industrial energy efficiency. Energy efficiency in residential, commercial, tourist and transport sectors. Energy efficiency policies, standards, codes, and benchmarking. Energy auditing and accounting, life cycle Assessment, Economics, and financing of Energy Efficiency options. Environmental impact of energy efficiency.										
References	• Craig B. Smith, Kelly Parmenter, 1981, "Energy, Management, Principles - Applications, Benefits, Savings", Pergamon.										
Used in Program	Mechanical Power Engineering - Sustainable & Renewable Energy			Semester	9						

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 42x6	Biomass and waste Conversion Technology	MEC 221, MEC 323	3	2	0	2	4	30	30	0	40
Course Content	Characterization of Waste, Types of Biomass, Biomass Properties, Pre-Treatment of Biomass, Thermo-Chemical Processes, Fast and Slow Pyrolysis, Gasification, Transesterification, Design of Gasifiers, Drying and Devolatilization, Heat and Mass Transfer across Small and Large Biomass Particles, Combustion, Chemical Kinetics, Types of Reactors, Incinerators, Bio-Chemical Conversion, Anaerobic Digestion and Fermentation, Operation of Biomass Boilers and Stoves, Use of Bio-Fuels in Internal Combustion Engines and Gas Turbines, Emissions, Cost Considerations.										
References	• Pratima Bajpai, 2019, "Biomass to Energy Conversion Technologies - The Road to Commercialization", Elsevier.										
Used in Program	Mechanical Power Engineering - Sustainable & Renewable Energy			Semester	9						

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 42x7	Design of Renewable Energy Equipment	MEC 32x1 MEC 32x2	3	2	0	2	4	30	30	0	40
Course Content	Factors Promoting Renewable Energy Applications. Photovoltaic. Engineering principles of electrical storage technologies: electrical vs. chemical energy storage; batteries; double layer capacitors; superconducting magnetic energy storage; flywheels; demand-side issues: electrical load curve; periodicity; electricity tariff structure and time-of-use tariff. Emerging Renewable energy sources, Fundamentals of demand-side management; efficiency improvements; load management; electricity market basic, integration of renewable generation into the grid, regulatory policy aspects.										
References	• Ziyad Salameh, 2011, "Renewable energy system design", Academic Press.										
Used in Program	Mechanical Power Engineering - Sustainable & Renewable Energy			Semester	9						

<table>
<tr><td>Code</td><td>Course Title</td><td>Pre-req</td><td>CH</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment Criteria</td></tr>
<tr><td rowspan="2">MEC 42x8</td><td rowspan="2">Geothermal Energy Systems</td><td rowspan="2">MEC 32x1
MEC 32x2</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Basic concepts, Earth's structure, thermal structure of earth. Temperature estimates in some simple geological situations. Geothermal systems and resources, Types of Geothermal Systems. Geological and Hydrological Considerations, Exploration techniques: Geochemical techniques, Geophysical techniques, Airborne surveys, Exploratory drilling.</td></tr>
<tr><td>References</td><td colspan="11">• Harsh Gupta, Sukanta Roy, 2006, "Geothermal Energy - An Alternative Resource for the 21st Century", Elsevier Science.</td></tr>
<tr><td>Used in Program</td><td colspan="5">Mechanical Power Engineering - Sustainable & Renewable Energy</td><td colspan="2">Semester</td><td colspan="4">9</td></tr>
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<table>
<tr><td>Code</td><td>Course Title</td><td>Pre-req</td><td>CH</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment Criteria</td></tr>
<tr><td rowspan="2">MEC 32y1</td><td rowspan="2">Industrial Refrigeration</td><td rowspan="2">MEC 226</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Food Storage and Equipment (Thermal properties of foods, cooling and freezing time of foods, commodity storage requirements, Food microbiology and refrigeration, refrigeration load, refrigerated facility design, methods of precooling fruits, vegetables and cut flowers) – Food refrigeration (Industrial food freezing systems, meat products, poultry products, fishery products, others products) – Industrial applications (Ice manufacture ice rinks, refrigeration in the chemical industries) – Low temperature applications (Cryogenics, Ultralow temperature refrigeration, biomedical applications of cryogenic refrigeration)..</td></tr>
<tr><td>References</td><td colspan="11">P. C. Koelet, T. B. Gray, 1992, "Industrial Refrigeration: Principles, Design and Applications", Macmillan Education. UK.</td></tr>
<tr><td>Used in Program</td><td colspan="5">Mechanical Power Engineering - Energy management and HVAC Engineering</td><td colspan="2">Semester</td><td colspan="4">**7**</td></tr>
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<table>
<tr><td>Code</td><td>Course Title</td><td>Pre-req</td><td>CH</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment Criteria</td></tr>
<tr><td rowspan="2">MEC 32y2</td><td rowspan="2">Fire Fighting & Water Distribution Systems</td><td rowspan="2">MEC 222</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Fire Fighting System: Introduction and Classification of firefighting system. Sprinkler system – Fire Hose Cabinet – clean agents 200 suppression system – Special firefighting systems- NFPA and firefighting codes.
Hydronic system: Domestic cold and hot water system (Demand – systems of circulations – sizing of domestic water piping system – heating capacity) – Sanitary Drainage system (single pipe system, two pipes system, fixture units of plumbing fixtures, sizing of drainage water piping system, sump pits and sump pumps) – Rainwater drainage system – Ventilation system.</td></tr>
<tr><td>References</td><td colspan="11">Dennis P. Nolan, 2011, "Fire Fighting Pumping Systems at Industrial Facilities", Elsevier.</td></tr>
<tr><td>Used in Program</td><td colspan="5">Mechanical Power Engineering - Energy management and HVAC Engineering</td><td colspan="2">Semester</td><td colspan="4">**7**</td></tr>
</table>

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 32y3	Refrigeration & Air Conditioning Equipment	MEC 32y1	3	2	0	2	4	30	30	0	40
Course Content	Air handling equipment (duct construction, room air distribution equipment, fans, evaporative air cooling equipment, humidifiers, air-cooling and dehumidifying coils, desiccant dehumidification, air heating coils, air cleaners for particulate contaminants) – General equipment (compressors, condensers, evaporators, cooling towers, liquid coolers, liquid-chilling systems, air to air energy recovery system, expansion devices, pipes, valves and fittings) – Unitary equipment (unitary air conditioners and heat pumps, room air conditioner, packaged terminal air conditioner).										
References	Miller, Rex; Miller, Mark R, 2011, "Air Conditioning and Refrigeration", McGraw-Hill Education.										
Used in Program	Mechanical Power Engineering - Energy management and HVAC Engineering					Semester		8			

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 32y4	Fire Extinguishing Systems	MEC 32y2	3	2	0	2	4	30	30	0	40
Course Content	Fundamental of Fire Science - Explosions - Fire Models - Fire and Smoke Spread - Fire Safety Equipment-Design of hydrants – Fire Pumps – Sprinkler Systems Design – Inert Gas Systems – Foam Systems – Fire Codes.										
References	• "NFPA 2001 : standard on clean agent fire extinguishing systems 2018", National Fire Protection Association										
Used in Program	Mechanical Power Engineering - Energy management and HVAC Engineering					Semester		8			

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 42y5	Air Filtration	MEC 32y1, MEC 32y2	3	2	0	2	4	30	30	0	40
Course Content	Macroscopic Behavior of Filters, Surface filtration and depth filtration, Layer efficiency, Single fibre efficiency. Filter Structure: Paper, Carded, porous and model filters. Flow Patterns and Pressure Drop. Particle Capture by Mechanical Means. Electrically Charged Filter Material. Particle Capture by Electric Forces. Particle Adhesion and Particle Bounce. Filter Testing.										
References	• R.C. Brown, 1993, "Air Filtration: An Integrated Approach to the Theory and Applications of Fibrous Filters", Pergamon Press.										
Used in Program	Mechanical Power Engineering - Energy management and HVAC Engineering					Semester		8			

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 32y6	Essentials of Energy Management	MEC 32y1 MEC 32y2	3	2	0	2	4	30	30	0	40

Course Content	Energy Resources, energy efficiency technologies, integration of renewable Energy with energy efficiency measures. Supply and demand side management. Industrial energy efficiency. Energy efficiency in residential, commercial, tourist and transport sectors. Energy efficiency policies, standards, codes, and benchmarking. Energy auditing and accounting, life cycle Assessment, Economics, and financing of Energy Efficiency options. Environmental impact of energy efficiency.		
References	• Craig B. Smith, Kelly Parmenter, 1981, "Energy, Management, Principles - Applications, Benefits, Savings", Pergamon.		
Used in Program	Mechanical Power Engineering - Energy management and HVAC Engineering	Semester	9

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 42y7	Special HVAC design applications	MEC 32y1 MEC 32y2	3	2	0	2	4	30	30	0	40

Course Content	Design requirements-design phases-design concept and different alternatives-schematic design stage and its deliverable-design development stage and its deliverables-tender documents stage and its deliverable-bid analysis and awarding-work shop drawings stage and submittals approval-construction supervision and handover.		
References	R.S. Khurmi, A Textbook of Refrigeration and Air Conditioning,2006		
Used in Program	Mechanical Power Engineering - Energy management and HVAC Engineering	Semester	9

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 42y8	Energy Storage	MEC 222	3	2	0	2	4	30	30	0	40

Course Content	Introduction to the need for storage- storage efficiency- storage density thermal energy storage technology- sensible heat storage- latent heat storage- phase change materials-thermal mass storage-chilled water/ice storage-thermochemical storage- compressed air storage-hydroelectric storage-batteries- super conducting magnetic storage- super capacitors hydrogen as a storage medium-comparison of storage technologies.		
References	• Robert A. Huggins, 2010, "Energy Storage", Springer US.		
Used in Program	Mechanical Power Engineering - Energy management and HVAC Engineering	Semester	9

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
MEC 42y9	Air-Conditioning Systems	MEC 42y1 MEC 42y2	3	Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
				2	0	2	4	30	30	0	40
Course Content	HVAC system classification – HVAC system analysis and selection – Building air distribution – In-room terminal system – Central cooling and heating – Decentralized cooling and heating – District heating and cooling – Hydronic heating and cooling system design – Applied heat pumps and heat recovery systems – Air conditioning system comfort application (Residences, retail facilities, commercial and public system, hotels, motels and dormitories, educational spaces, health care facilities) – Industrial air conditioning system (industrial drying system, ventilation of the industrial environment, kitchen ventilation) – Air conditioning systems for clean spaces.										
References	• Spach, Adam F.; Stanford III, Herbert W, 2019, "Analysis and Design of Heating, Ventilating, and Air-Conditioning Systems", Chapman and Hall/CRC.										
Used in Program	Mechanical Power Engineering - Energy management and HVAC Engineering					Semester	9				

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
MEC 32z1	Vehicle Dynamics	MEC 213	3	Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
				2	0	2	4	30	30	0	40
Course Content	One-Dimensional Vehicle Dynamics, Tire Dynamics, Tire Stiffness, Tireprint Forces. Driveline Dynamics, Engine Dynamics, Driveline and Efficiency, Gearbox and Clutch Dynamics. Vehicle Applied Kinematics. Steering Dynamics: Steering linkages, steering systems design, Vehicle steering properties: neutral, oversteer and understeer, vehicle directional stability. Suspension Mechanisms: Solid Axle Suspension, Independent Suspension. Vehicle Applied Dynamics: Two-wheel Rigid Vehicle Dynamics, Steady-State Turning. Vehicle Vibration: Mechanical Vibration Elements, Lagrange Method, and Dissipation Function.										
References	• G. Nakhaie Jazar, 2008, "Vehicle Dynamics. Theory and Application", Springer. • Georg Rill, Abel Arrieta Castro, 2020, "Road Vehicle Dynamics-Fundamentals and Modeling with MATLAB", CRC Press										
Used in Program	Mechanical Power Engineering - Vehicle Engineering					Semester	**7**				

Code	Course Title	Pre-req	CH	Ct. Hr.				Assessment Criteria			
MEC 32z2	Automotive Engineering	MEC 214	3	Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
				2	0	2	4	30	30	0	40
Course Content	Characteristics of Ground Vehicle, Classification of Motor Vehicle. Manual and automatic Transmission Systems, Propeller Shaft and Drive Shaft. Tires, Construction of Tire, Tire Dynamics. Types of Suspension System: Mechanical, Pneumatic and Hydraulic suspension systems. Design Analysis of Suspension System, Braking System, Steering System, introduction of hybrid cars, autonomous cars.										
References	• Abubakar, S.; Alammari, Youssef; Kaisan, M. U.; Mahroogi, Faisal O.; Narayan, S.; Sakthivel, R, 2019, " An introduction to automotive engineering", John Wiley & Sons & Scrivener Publishing										
Used in Program	Mechanical Power Engineering - Vehicle Engineering					Semester	8				

<table>
<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><td rowspan="2">MEC 32z3</td><td rowspan="2">Electric vehicles</td><td rowspan="2">MEC 32z1
MEC 32z2</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to Electric Vehicles, Electric Vehicles Advantages: Efficiency Comparison, Pollution Comparison, Capital, and Operating Cost Comparison. Vehicle Kinetics, Dynamics of Vehicle Motion, Propulsion Power. Energy Source: Battery, Battery Basics, Lead-Acid Battery, Nickel-Cadmium Battery, Nickel-Metal-Hydride (NiMH) Battery. Battery Parameters: Battery Capacity, Discharge Rate, State of Charge, State of Discharge, Depth of Discharge. Alternative Energy Sources: Fuel Cells, Supercapacitors and Ultracapacitors, Flywheels. Hybrid Electric Vehicles: Types of Hybrids, Internal Combustion Engines, Gas Turbine Engine.</td></tr>
<tr><td>References</td><td colspan="11">• James H. Harlow, 2005, "Electric and Hybrid Vehicles Design Fundamentals – Design Fundamentals", CRC Press.</td></tr>
<tr><td>Used in Program</td><td colspan="6">Mechanical Power Engineering - Vehicle Engineering</td><td colspan="2">Semester</td><td colspan="3">8</td></tr>
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<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><td rowspan="2">MEC 32z4</td><td rowspan="2">Vehicle design & Manufacturing</td><td rowspan="2">MEC 32z2</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to chassis design, Chassis types. Body design: The styling process, Body design: Aerodynamics. Suspension systems and components, classification of springs, design of coil springs. Leaf springs, Spring capacity. Transmissions and driveline. Design of rigid axle beam and king pin independent suspensions, Design of double wishbone and Macpherson suspensions, Bearings. Drum and disc brakes: Mechanical advantage, Assisted brake systems. Modern materials and their incorporation into vehicle design. The manufacturing challenge for automotive designers.</td></tr>
<tr><td>References</td><td colspan="11">• HAPPIN SMITH, 2001, " An Introduction to Modern Vehicle Design", Elsevier Limited.</td></tr>
<tr><td>Used in Program</td><td colspan="6">Mechanical Power Engineering - Vehicle Engineering</td><td colspan="2">Semester</td><td colspan="3">7</td></tr>
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<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><td rowspan="2">MEC 32z5</td><td rowspan="2">Vehicle maintenance Technology</td><td rowspan="2">MEC 32y1, MEC 32y2</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Fundamentals of vehicle systems and components, diagnostic principles, latest techniques employed in effective vehicle maintenance and repair. Diagnostics, or fault finding, Mechanical diagnostic techniques, Electrical diagnostic techniques, Data sources. On-board diagnostics, Petrol/Gasoline on-board diagnostic monitors, Misfire detection. Engine systems, Engine operation, Diagnostics of engines, Test equipment, Engine fault diagnosis table. Fuel system, Carburation, Diagnostics of fuel system. Diagnostics of ignition system. Diagnostics of diesel injection systems. Diagnostics of cooling and lubrication.</td></tr>
<tr><td>References</td><td colspan="11">• Tom Denton, 2016, " Advanced Automotive Fault Diagnosis: Automotive Technology: Vehicle Maintenance and Repair ", Routledge Press.</td></tr>
<tr><td>Used in Program</td><td colspan="6">Mechanical Power Engineering - Vehicle Engineering</td><td colspan="2">Semester</td><td colspan="3">8</td></tr>
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<tr><td>Code</td><td>Course Title</td><td>Pre-req</td><td>CH</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment Criteria</td></tr>
<tr><td rowspan="2">MEC 42z6</td><td rowspan="2">Engine Testing and Pollution Control</td><td rowspan="2">MEC 32z1
MEC 32z2</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Available technologies to overcome the limitations of conventional prime movers. Important terminology associated with engine. Engine performance parameters. Formulation of hydrocarbons. Engine modifications to limit harmful emissions, Development of new combustion concepts. Adoption of alternative fuels in existing engines. Switching over to electrics: advantages and limitations. Specifications of highly marketed automobiles. Emission measurement methods.</td></tr>
<tr><td>References</td><td colspan="11">• G. Amba Prasad Rao, T. Karthikeya Sharma, 2020, "Engine Emission Control Technologies - Design Modifications and Pollution Mitigation Techniques", Apple Academic Press.</td></tr>
<tr><td>Used in Program</td><td colspan="6">Mechanical Power Engineering - Vehicle Engineering</td><td colspan="2">Semester</td><td colspan="3">9</td></tr>
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<tr><td>Code</td><td>Course Title</td><td>Pre-req</td><td>Cr. Hrs.</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment Criteria</td></tr>
<tr><td rowspan="2">MEC 42z7</td><td rowspan="2">Fundamental of hybrid vehicles</td><td rowspan="2">MEC 32z1
MEC 32z2</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Hybrid Vehicles (HV): History Overview and Modern Applications; Power Flow and Power Management Strategies in HV; Vehicle Dynamics Fundamentals for HV Modeling and Computer Simulation (MATLAB/Simulink); Mechanical Drivetrain Engineering; Electric Drives; Wheel-Electric Drive, Suspension System Design; Batteries and Energy Storages: Battery characterization, math modeling and designs, Battery sizing for various vehicle applications; Fuel cells: principles of operation, design, modeling; Power Electronics in Hybrid Electric Vehicles; Plug-in Hybrid Electric Vehicles; Electric Unmanned Ground Vehicle: Computer Modeling and Physical Tests.</td></tr>
<tr><td>References</td><td colspan="11">• Chris Mi, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives” 2nd Edition, Automotive Series.
• Allen Fuhs, 2009, “Hybrid Vehicles and the Future of Personal Transportation” CRC press.</td></tr>
<tr><td>Used in Program</td><td colspan="6">Mechanical Power Engineering - Vehicle Engineering</td><td colspan="2">Semester</td><td colspan="3">9</td></tr>
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<tr><td>Code</td><td>Course Title</td><td>Pre-req</td><td>Cr. Hrs.</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment Criteria</td></tr>
<tr><td rowspan="2">MEC 42z8</td><td rowspan="2">Aerodynamics of Road Vehicles</td><td rowspan="2">MEC 32z1
MEC 32z2</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to Automobile Aerodynamics, Physical Principles of Aerodynamics. Aerodynamic Forces and influence on passenger vehicles, aerodynamic drag of passenger cars. Aerodynamics and driving stability, safety, and comfort. Cooling and Internal Flow. Aeroacoustics. Numerical methods for computation of flow around road vehicles.</td></tr>
<tr><td>References</td><td colspan="11">• Wolf-Heinrich Hucho, 1987, " Aerodynamics of Road Vehicles. From Fluid Mechanics to Vehicle Engineering", Butterworth-Heinemann Ltd.</td></tr>
<tr><td>Used in Program</td><td colspan="6">Mechanical Power Engineering - Vehicle Engineering</td><td colspan="2">Semester</td><td colspan="3">9</td></tr>
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Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 42z9	Mechatronics for Automotive (Autotronics)	MEC 32z1 MEC 32z2	3	2	0	2	4	30	30	0	40

Course Content	Basics of mechatronics, electronic control unit, Automotive networking, Automotive sensors, Electric Actuators, Electrohydraulic Actuators, Electronic Transmission Control, Modules for Transmission Control, Antilock Braking System (ABS). Traction Control System (TCS). Electronic Stability Program. Automatic brake functions. Electronic Diesel Control. Active steering, Drive, and adjustment systems. Heating, ventilation, and air conditioning. Vehicle security systems.
References	• Konrad Reif, 2019, " Automotive Mechatronics: Automotive Networking, Driving Stability Systems, Electronics", Bosch Professional Automotive Information.
Used in Program	Mechanical Power Engineering - Vehicle Engineering
Semester	9

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 33x1	Mobile Robots	MEC 236	3	2	0	2	4	30	30	0	40

Course Content	Introduction to mobile robots, Mobile robot hardware: locomotion, Mobile robot hardware: sensors, Mobile robot control system: hardware and software, Navigation I: localization and mapping, Navigation II: reasoning and motion planning, Wireless communication for mobile robots, Advanced topics: multiple robots' coordination. Design software structures and user interfaces for mobile robots.
References	• Introduction to Autonomous Mobile Robots", Seigwart et al, 2004.
Laboratory	• Select and implement planning algorithms • Design and implement a robot or autonomous system • Design navigation algorithms for a specific selection of sensors • Design and implement user interfaces • Path Planning and Navigation for Autonomous Robots
Used in Program	Mechatronics Engineering - Robotics and Control
Semester	7

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 33x2	Autonomous systems	MEC 236	3	2	0	2	4	30	30	0	40

Course Content	Autonomous versus automatic systems, Advanced topics in autonomous systems, including filters for localization, probabilistic map-based localization and mapping, motion planning and navigation algorithms. Design exception handling systems for autonomous systems. Select and implement planning algorithms. Knowledge-base: facts and procedures, acquisition, exploration, skill transfer, learning. Autonomous systems architecture: behavioral principles, expert systems, knowledge-bases, multi-level control concepts. Applications of autonomous systems.
References	Seigwart et al, 2004, Introduction to Autonomous Mobile Robots", Wiley.
Used in Program	Mechatronics Engineering - Robotics and Control
Semester	7

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 33x3	Robot Operating Systems (ROS)	MEC 33x1 MEC 33x2	3	2	0	2	4	30	30	0	40
Course Content	An introduction to the Robot Operating System (ROS), ROS architecture: master, nodes, topics, messages, services, parameters, and actions. ROS time, ROS bags. Navigating and analyzing ROS system. Debugging strategies. ROS web services. Software Engineering with ROS. ROS Simulation Frameworks. Interfaces for Interaction with robots, Interface with sensors and actuators. Path planning plugins in ROS.										
References	• Robot Operating System (ROS), Anis Koubaa, Springer, 2016.										
Used in Program	Mechatronics Engineering - Robotics and Control							Semester	8		

Code	Course Title	Pre-req	CR. HRS.	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 33x4	Robust and Fault-tolerant Control	MEC 214 ELE 404	3	2	0	2	4	30	30	0	40
Course Content	Robust and Fault-tolerant Control: Robust and optimal control methods for uncertain physical systems. H2/H_inf control of parametric uncertainty. Structural model of a dynamical system. Design a residual generator from structural and analytical results, Detectability and isolability of faults. Formulate models with uncertainty for a dynamical system. Sensitivity and performance for a feedback system. Algorithms for change detection. Design of control system for a faulty control object.										
References	• M. Blanke, M. Kinnaert, J. Lunze and M. Staroswiecki: Diagnosis and fault-tolerant control, 3nd ed., Springer 2015. • S. Skogestad and I. Postlethwaite, Multivariable feedback control - analysis and design, 2nd ed. Wile.										
Used in Program	Mechatronics Engineering - Robotics and Control							Semester	8		

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr. Lec.	Lab	Tut	Sum	Assessment Criteria ST	MT	PE/OE	Final
MEC 33x5	Computer Interfacing	ELE 404	3	2	0	2	4	30	30	0	40

Course Content	Computer Interfacing: Architecture of a virtual instrument, data-flow techniques, graphical programming. Development of Virtual Instruments (VIs) using GUI, Real-time systems. Loops, charts, arrays, clusters and graphs, structures, formula nodes, local and global variables, string and file I/O. Instrument Drivers, Introduction to data acquisition on PC, Sampling fundamentals, Input/ Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements. Common Instrument Interfaces.
References	• Wells, L.K. and Travis, J., LabVIEW for Everyone, Prentice Hall Inc. (1996). • Sokoloft, L., Basic Concepts of LabVIEW 4, Prentice Hall Inc. (2004).
Used in Program	Mechatronics Engineering - Robotics and Control — Semester: 8

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr. Lec.	Lab	Tut	Sum	Assessment Criteria ST	MT	PE/OE	Final
MEC 43x6	Rehabilitation Robotics	MEC 33x2	3	2	0	2	4	30	30	0	40

Course Content	Framework for neurorehabilitation robotics: implications for recovery. Biomechatronic design criteria of systems for robot-mediated rehabilitation therapy. Actuators and sensors for rehabilitation and prosthetic robots. Assistive controllers and modalities for robot-aided neurorehabilitation. Exoskeletons for upper limb rehabilitation. Exoskeletons for lower limb rehabilitation. Performance measures in robot-assisted assessment of sensorimotor functions.
References	John J. Craig, Introduction to Robotics: Mechanics and Control (3rd Edition) 3rd Edition.
Used in Program	Mechatronics Engineering - Robotics and Control — Semester: 9

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr. Lec.	Lab	Tut	Sum	Assessment Criteria ST	MT	PE/OE	Final
MEC 43x7	Medical Robotics	MEC 33x2	3	2	0	2	4	30	30	0	40

Course Content	Study of the design and control of robots for medical applications. Focus is on robotics in surgery and Interventional radiology, with introduction to other healthcare robots.
References	• AchimSchweikard, Floris Ernst, “Medical Robotics”, Springer, 2015. • Paula Gomes, "Medical robotics- Minimally Invasive surgery", Woodhead, 2012.
Used in Program	Mechatronics Engineering - Robotics and Control — Semester: 9

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>ST</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>MEC 43x8</td><td>Machine Learning</td><td>MEC 232</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Logistic regression, Non-parametric methods, Decision trees, classification, mixture models, neural networks, deep learning, ensemble methods and reinforcement learning.</td></tr>
<tr><td>References</td><td colspan="11">• Gareth, James, et al. An introduction to statistical learning: with applications in R. Spinger, 2013.
• Bishop, Christopher M., and Nasser M. Nasrabadi. Pattern recognition and machine learning. Vol. 4. No. 4. New York: springer, 2006.</td></tr>
<tr><td>Used in Program</td><td colspan="7">Mechatronics Engineering - Robotics and Control</td><td colspan="2">Semester</td><td colspan="2">9</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>ST</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>MEC 33y1</td><td>Autotronics</td><td>MEC 232</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Basics of control and electronic systems. Introduction to Autotronics, Vehicle main components and subsystems: propulsion systems, suspension systems, braking systems, steering systems, Engine starting system, fuel supply system and ignition system. Advanced vehicle systems: Anti-lock Braking system, Brake-By-Wire system, semi-active and active suspension systems, driving assistance systems, drive-By-Wire system, passive and active driving safety systems, and Steering-By-Wire systems. Electric vehicles and hybrid vehicles.</td></tr>
<tr><td>Refere nces</td><td colspan="11">• Konrad Reif, 2019, " Automotive Mechatronics: Automotive Networking, Driving Stability Systems, Electronics", Bosch Professional Automotive Information.</td></tr>
<tr><td>Used in Program</td><td colspan="7">Mechatronics Engineering - Advanced Mechatronics and Autotronics</td><td colspan="2">Semester</td><td colspan="2">7</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>ST</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>MEC 33y2</td><td>Machine Vision Systems</td><td>MEC 232</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Machine Vision Systems: Image understanding and image representation, feature extraction, segmentation, optical flow, and structure from motion. Image processing algorithms and traditional computer vision approaches. Use of image information to control a robot. Camera calibration, Artificial vision, Motion detection, Object tracking, Motion capture. Three-dimensional imaging, Epipolar geometry, Stereoscopic vision, Active range imaging, structured lighting. Visual servoing, target tracking, Mapping and robot guidance, activity monitoring, motion estimation, autonomous systems, biomedical imaging devices.</td></tr>
<tr><td>References</td><td colspan="11">• “Robotics, Vision and Control, Fundamental Algorithms in MATLAB”, By Peter Corke, Springer</td></tr>
<tr><td>Used in Program</td><td colspan="7">Mechatronics Engineering - Advanced Mechatronics and Autotronics</td><td colspan="2">Semester</td><td colspan="2">7</td></tr>
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Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 33y3	Automotive Engineering	MEC 33y1	3	2	0	2	4	30	30	0	40
Course Content	Characteristics of Ground Vehicle, Classification of Motor Vehicle. Manual and automatic Transmission Systems, Propeller Shaft and Drive Shaft. Tires, Construction of Tire, Tire Dynamics. Types of Suspension System: Mechanical, Pneumatic and Hydraulic suspension systems. Design Analysis of Suspension System, Braking System, Steering System, introduction of hybrid cars, autonomous cars										
References	• Abubakar, S.; Alammari, Youssef; Kaisan, M. U.; Mahroogi, Faisal O.; Narayan, S.; Sakthivel, R, 2019, " An introduction to automotive engineering", John Wiley & Sons & Scrivener Publishing.										
Used in Program	Mechatronics Engineering - Advanced Mechatronics and Autotronics						Semester	9			

*The course listed in electives of Mechanical Power Engineering – MEC42z2

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 33y4	Micro Electromechanical Systems (MEMS)	MEC 43y2	3	2	0	2	4	30	30	0	40
Course Content	Introduction to Micro and Nano-Electromechanical Systems (MEMS/NEMS). Design of MEMS/NEMS; Fabrication of MEMS/NEMS; Principles of sensing and actuation in MEMS/NEMS: Electrostatic – Piezoresistive - Magnetic; Applications of MEMS/NEMS; Computer Simulations and Course Project.										
References	• Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012. • Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000. • Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.										
Used in Program	Mechatronics Engineering - Advanced Mechatronics and Autotronics						Semester	9			

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 33y5	Industrial Mechanisms and Robotics	MEC 236 MEC 33y2	3	2	0	2	4	30	30	0	40
Course Content	Two-position synthesis, Three-position synthesis, Quick-return mechanisms, Coupler curves, Analytical synthesis of planar mechanisms, Optimal planar mechanism synthesis, Analytical synthesis of simple toggles, Introduction to spatial mechanism synthesis. Screw Motion: Plücker coordinates, Motion invariants, Pose, Instantaneous Screw axis (Screw Velocity): screw, twist, Acceleration, Dynamics: wrench, wrench axis, mass, center of mass, 1st moment of mass, Inertia, Kinetic energy, Newton Euler equations, Dynamics canonical equation. Simulation using Computer Graphics and MATLAB Software and case studies. Course project.										
References	• Mikell P. Groover, Mitchell Weiss, Roger N Nagel, Nicholas G Odrey, "Industrial Robotics Technology, Programming and Applications", Tata –McGraw Hill Pub. Co., 2008. • Gupta, Ashwani K., and Satish K. Arora. Industrial automation and robotics. Laxmi publications, 2009.										
Used in Program	Mechatronics Engineering - Advanced Mechatronics and Autotronics						Semester	9			

<table>
<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><td rowspan="2">MEC 43y6</td><td rowspan="2">Vehicle System Dynamics and Control</td><td rowspan="2">MEC 32y1
MEC 32y2</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction – vehicle body motion – Tires – Suspension systems – Equations of motion of passenger cars – vehicle stability - Simulation of motion of passenger cars - Fundamentals of Hybrid Electric Vehicles and Electric Vehicles, Course Project.</td></tr>
<tr><td>References</td><td colspan="11">• G. Nakhaie Jazar, 2008, "Vehicle Dynamics. Theory and Application", Springer.
• Georg Rill, Abel Arrieta Castro, 2020, "Road Vehicle Dynamics-Fundamentals and Modeling with MATLAB", CRC Press</td></tr>
<tr><td colspan="2">Used in Program</td><td colspan="5">Mechatronics Engineering - Advanced Mechatronics and Autotronics</td><td colspan="2">Semester</td><td colspan="3">9</td></tr>
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<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><td rowspan="2">MEC 43y7</td><td rowspan="2">Hydraulic Servo Control</td><td rowspan="2">MEC 32y1
MEC 32y2</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Fields of applications of hydraulic servo systems –Hydraulic servo systems versus proportional systems and electric servo systems – Hydraulic servo valves; types, static characteristics, valves coefficients, lapping conditions – Transient and steady state flow forces acting on spools and flappers – Pilot operated servo valves and types of feedback – Dynamic characteristics of servo valves and fluid lines – Hydro mechanical and electro-hydraulic servo systems; loop gain, stability, dynamics – Course project</td></tr>
<tr><td>References</td><td colspan="11">• John Watton, 2009, “Fundamentals of Fluid Power Control”, Cambridge University Press.</td></tr>
<tr><td colspan="2">Used in Program</td><td colspan="5">Mechatronics Engineering - Advanced Mechatronics and Autotronics</td><td colspan="2">Semester</td><td colspan="3">9</td></tr>
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<table>
<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment Criteria</th></tr>
<tr><td rowspan="2">MEC 43y8</td><td rowspan="2">Playware Technology</td><td rowspan="2">MEC 331</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>ST</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Fundamental principles and tools for the development of entertainment and educational robotics. Adaptivity, embodied artificial intelligence, hardware and software adaptivity, modularity, distributed processing, tangible interfaces, man-machine interaction, human-robot interaction, interaction design, play and play dynamics. Integrate knowledge on play and interaction in synthesis. Design of a modular robotic playware platform. Playful interaction with voice sensing modular robots. Adaptivity and implementations of adaptivity in playware.</td></tr>
<tr><td>References</td><td colspan="11">• S. Papert. Mindstorms: children, computers, and powerful ideas. New York, NY, USA: Basic Books, Inc., 1980.
• Standard Guide for Rapid Prototyping of Information Systems, ASTM, 2010.</td></tr>
<tr><td colspan="2">Used in Program</td><td colspan="5">Mechatronics Engineering - Advanced Mechatronics and Autotronics</td><td colspan="2">Semester</td><td colspan="3">9</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct Hrs				Assessment			
				Lec	Lab	Tut	Tot	SA	MT	PE/OE	Final
BES 111	Differential Equations	BES 012	3	2	0	2	4	30	30	-	40

Course Content

Ordinary differential equations (ODEs): Classification and types of solutions of ODEs. Solution of first order ODEs - Applications of ODEs (Newtons law of cooling, electric circuits) - Solution of nth order ODEs (homogeneous and non-homogeneous) - System of first order linear differential equations - Series solution of differential equations- Laplace transforms and inverse Laplace transforms with applications - Fourier series with applications. Gamma and Beta functions

Partial Differential Equations (PDEs): Classification and types of solutions of PDEs. Applications of PDEs. Solution of linear PDEs with constant coefficients, solution of some initial-boundary value problems. Solution of PDEs by Laplace Transforms.

References

- Morris Tenenbaum, Harry Pollard, "Ordinary Differential Equations: An Elementary Textbook for Students of Mathematics, Engineering, and the Sciences", Dover Publications, Last Edition.
- Wei-Chau Xie, Differential Equations for Engineers, CAMBRIDGE UNIVERSITY PRESS, 2010.

Code	Course Title	Pre-req	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab	Tut	Tot	SA	MT	PE/OE	Final
BES 112	Numerical Analysis	BES 111	3	2	2	0	4	10	30	20	40

Course Content

Numerical in general: Errors, norms, Numerical solution of a system of linear and nonlinear equations. matrix eigenvalues, least square method (Curve fitting), Interpolations, Numerical differentiation and integration.
Numerical ODEs and PDEs: methods for the solution of initial value problems in 1st order ODEs and higher order ODEs, Finite difference methods for boundary value problems in ODEs and initial-boundary value problems for PDEs (Elliptic and parabolic PDEs)- Lab simulations of engineering applications

References

- R W Hamming, "Numerical Methods for Scientists and Engineers", Courier Dover Publications, Last Edition.
- Steven C. Chapra, “Applied Numerical Methods with MATLAB for Engineers and Scientists”, Mcgraw-Hill, 3rd edition.
- Nita H. Shah, Numerical Methods with C++ Programming, PHI Learning, 2008.

Laboratory

Lab simulations by software’s as (C++, Matlab, Python,…)- Simulating practical technical problems- linear equations due to electric circuits , truss and spring mass systems. - Electric charge calculations- Nonlinear structural problems- Deflection of nonlinear springs- Calculating the shrinkage of a trunnion- Finding the longitudinal Young’s modulus -Estimating voltage drop on a resistor- Calculating the work done by stretching a string- Simulating equations due to the fluid continuum problems, DC motor speed control problems- interpolation and fitting for signals and voltage current relations- population growth calculations- Fluid flow rate calculations- Distributed wind force problems

Code	Course Title	Pre-req	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab	Tut	Tot	SA	MT	PE/OE	Final
BES 113	Mathematics III	BES 012	3	2	0	2	4	30	30	-	40
Course Content	Complex Functions: Complex plane, Polar form of complex number, Powers and roots, Cauchy-Riemann equations, Conformal transformations. Some elementary transformations (linear function, rational and bilinear functions, irrational functions, the exponential function, trigonometric functions). Complex integration. Multivariable Calculus (B): Multiple integrals: double integrals, areas, moments, double integrals in polar form, triple integrals, masses and moments in three dimensions, triple integrals in cylindrical and spherical coordinates, substitution in multiple integrals, line and surface integrals, Green, Gauss and Stock's theorems.										
References	• Erwin Kreyszig, "Advanced Engineering Mathematics", / Paperback / Wiley, John & Sons, Last Edition. George B. Thomas, Jr., Maurice D. Weir, Joel Hass, THOMAS' CALCULUS Multivariable (Twelfth Edition), 2010.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct Hrs				Assessment			
				Lec	Lab	Tut	Tot	SA	MT	PE/OE	Final
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4	10	30	20	40
Course Content	Probability: Obtaining Data - Probability models: mathematical, deterministic model. Probability theory concepts. - Discrete Distributions: Binomial and Poisson distribution. Continuous Distributions: Normal and Exponential Distribution. - Joint distributions. Statistics and Estimation: central point theorem, Single and multiple confidence interval, Prediction interval, tolerance interval - Hypothesis testing, - Inferences on the mean and variance of Normal distribution, Inference of two samples. – Simple and multiple Linear Regression and Correlation. - Applications involving uniform, Gaussian. Markov chains - Queueing Theory - Course examples are drawn from signal processing, system reliability, data science, wireless communications, civil engineering, and mechanical engineering - Lab simulations of engineering applications.										
References	• R. E Walpole, R. H. Myers, "Probability and Statistics for Engineers and Scientists", Macmillan Publishing, Last Edition. • David Levine, Patricia Ramsey , Robert Smidt, "Applied Statistics for Engineers and Scientists: Using Microsoft Excel & Minitab", First Edition, 2000.										
Laboratory	Lab simulations by software's as (Excel, Matlab, Python,…)- Exploratory data analysis and data transformation (Tabulated data summaries and statistics, Histograms, Box and Correlation plots, Computation of means, variances, etc, Missing data imputation)- Simple random sampling with and without replacement- Stratified random sampling- Simulating Bernoulli process and Poisson distribution - Simulating Markov chains applications-Binary and sequential hypothesis testing and gambler's ruin -Gaussian Mixture Models, clustering and anomaly detection- Regression models and inference- Time series forecasting and ARIMA models.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
ELE 103	Electrical Circuits	BES 032	2	1	0	2	3	30	30	0	40

Course Content	DC circuit analysis: Circuit Variables, Kirchhoff's Laws, Simple Resistive Circuits,The Wheatstone Bridge, Δ to-Y (or π -to-) EquivalentCircuits,TheNode-Voltage Method and Dependent Sources,TheMesh-Current Method and Dependent Sources,TheVenin and Norton Equivalents, Maximum Power Transfer, Superposition, Topology in Circuit Analysis,TheOperational Amplifier circuits,Inductance and Capacitance, The Natural Response of RL and RC Circuits, Step Response of First-Order RL and RC Circuits.
References	• Nilsson, J. W., & Riedel, S. A., "Electric circuits", 12th Edition, Pearson Education Limited, 2020.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
ELE 104	Electronic Devices and Circuits	ELE 103	2	1	0	2	3	30%	30%	0%	40%

Course Content	Semiconductor physics, Structure of diodes, Diode circuits and rectifiers, Structure of BJT, Biasing and operation modes of transistors, DC and small signal analysis of transistor circuits, Amplifiers circuits using BJT, Power amplifiers, Field effect transistors, Biasing of FET, Small signal model of FET. Amplifier circuits using FET, Design of amplifier circuits, Frequency response of amplifier circuits, Active filters, Feedback in electronic circuits,Different feedback configuration in electronic circuits, Oscillators circuits.
References	• Sedra / Smith, Microelectronic Circuits, 8th Edition, Oxford University Press, 2019.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
ELE 201	Electric Machinery	ELE 103	2	1	2	0	3	10%	30%	20%	40%

Course Content	Rotating electrical machines, operating principles, mainterminology, and industrial standards. Static conversion of electrical energy: three-phase inverter and current control. DC motor: principle of operation, main characteristics and construction, electrical drives with DC motor, sizing of real application examples. Synchronous motor ("brushless") : principle of operation, main characteristics and construction, electrical drives with synchronous motor. A synchronous motor: principle of operation, main characteristics and construction, electrical drives with a synchronous motor. Stepper motors.
References	"Electric machines and drives", By G.R. Slemon, Addison Wesley, MA, 1992
Laboratory	Polarity-test for single-phase Transformer, Open-circuit test for single-phase Transformer, Short-circuit test for single-phase Transformer, Parallel-operation for single-phase Transformer, Three-phase Transformer's connections, Magnetization curve or Open circuit characteristic of DC Machine (plot of Ea vs. Ia), Armature Control of DC Machine Drives., Field Control of DC Machine Drives. Voltage Regulation and Speed Regulation of DC Machine, Starting a DC Motor with DC Manual Starter, Principles of Induction Motor, Star Delta Starter of Induction Motor, Speed Control of Induction Motor Drives, Speed Regulation of Induction motor, Parameters determinations, Starting of Synchronous Machine, Connection of Synchronous Machines in Parallel or with the Grid, The effect of changes in field currents on Power-factor, Speed Control of Synchronous Machines Drives Speed Control of Stepper motor Drives

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
ELE 204	Logic Circuits Design & Applications	ELE 104	3	2	2	0	4	20	20	20	40
Course Content	Number systems and data representation - Boolean algebra - simplification of Boolean functions - logic gates - combinational and sequential logic circuits. Registers, counters, and adders – Memory. Digital electronics. Performance of analogue and digital transducers; selecting a proper transducer for a given application. Digital transducers: optical encoders, ultrasonic sensors. Data acquisition systems (A/D and D/A converters). Stepper motors: microprocessors: structure, programming, applications.										
References	• Charles H. Roth Jr., Larry L Kinney, 2009, "Fundamentals of Logic Design", 6th Edition, Publisher: CL Engineering • Sajjan G. Shiva, 1998, "Introduction to logic design", M. Dekker, New York										
Laboratory	• Project: At the end of the course the student must provide a project emphasizing the course content										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
ELE 301	Power Electronics	ELE 234	3	2	2	0	4	15%	20%	15%	50%
Course Content	Power semiconductor devices, diodes, thyristors, MOSFETS, and other insulated gate devices such as the IGBT, MCT and the FCT. Static and switching characteristics, gate drive and protection techniques. Drive circuit design and protection techniques. Power converter circuits Applications of AC-DC, DC-DC, and DC-AC power converter circuits. Analyses of input and output waveforms of these circuits, harmonic performance. A basic understanding of devices, circuit principles and implications in input/output waveform quality. Application considerations for remote and un-interruptible power supplies, and for computer systems, telecommunications, automobiles, traction and other industrial processes; Utility interaction, harmonic distortion.										
References	• Adel S. Sedra and Kenneth C. Smith, “Microelectronic Circuits”, by Oxford University press.										
Laboratory	• Characteristic of silicon-controlled rectifier • Triggering of IGBT, MOSFET & Power Transistor • Experimental study Bridge inverter using IGBT • Experimental study Series Inverter using MOSFET										
Used in Program	Mechatronics Engineering Program							Semester	7		

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
ELE 404	Digital Control	MEC 314	3	2	0	2	4	30%	30%	-	40%
Course Content	Introduction to digital control systems, AD/DA conversion. Conversion of linear time invariant systems from continuous-time to discrete-time. Identification of unknown systems. Design of digital controllers and filters. Sampling continuous-time systems, time-delay systems, transfer functions in z-domain, block diagram simplification, stability analysis of digital systems, transformation techniques, compensator designs, PID controllers, digital filters, state space models, controllability, observability, state feedback, output feedback, and introduction to system identification. Laboratory experiments on the course topics.										
References	• Ioan D. Landau and GianlucaZito, Digital Control Systems Design, Identification and Implementation, springer, 2006.										
Used in Program	Mechatronics Engineering Program							Semester	8		

Program # 4 Electrical Power and Machines Engineering Program

Program Description

The Electrical Power and Machines Engineering Program is designed to qualify its graduates for both fundamental and modern trends in electrical power systems, design, operation and control. The program is structured in a hierarchical manner based on strong mathematical and physics background while moving gradually up to the fundamental electrical engineering subjects. Then, reaching to the major specialty courses of power systems design, operation, installation, control and economics. The program pays significant attention to the renewable electrical energy resources as well as the smart grid operation and control with the objective of environmental conservation and economical aspects. The program adapts the updated approaches and methodology in teaching and learning activities and assessment with focus on achieving balance between academic background and professional skills of the graduates. Students in the program are centered of focus by implanting self-learning attitude, peer discussions, and courses embedded engineering skills. The assessment techniques are devised in a way to avoid passing the courses unless the student gets the intended learning outcomes.

Basic Information

Program Mission

The program seeks to achieve a high level of competitiveness through the preparation of a distinguished and innovative engineer in the field of electrical power engineering and its applications, be able to use advanced scientific knowledge and communication skills and its tools while adhering to the ethics of the profession by keeping pace with the needs of the market and achieve sustainable economic development and community service, and armed with the skills of performing scientific research. The program also urges students to engage in fundamentals of entrepreneurship

Program Objectives

Electrical Power and Machines Engineering Program is planned to: -

1. Qualify graduates for fundamental and modern trends in electrical power systems, design, operation, and control.
2. Prepare graduates to compete for the best jobs in several electrical power and machines engineering areas.
3. Qualify graduates to design a system, experiment, component, and process to meet the required needs of energy generation, transmission and distribution within realistic constraints, and data analysis and interpretation.
4. Prepare graduates to implement science, mathematics, and computational technology knowledge to investigate and solve problems encountered in the electrical power industry.
5. Qualify graduates to follow lifelong learning and continuously improve their knowledge in the electrical power engineering practice and contribute to the advancement of the engineering profession.
6. Prepare graduates to communicate effectively through speaking, writing, and using graphics, functioning collaboratively within multi-disciplinary problem-solving teams.

Graduate Attributes

The general engineering graduates' attributes as NARS 2018, the graduate would be able to:

Graduate attributes are the academic abilities, personal qualities, and skills which electronics and electrical communications engineering graduates should have. In addition to all engineering graduate attributes defined by NARS 2018, Electronics and Electrical Communications Engineering graduate should be able to:

1. Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real life situations
2. Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation.
3. Behave professionally and adhere to engineering ethics and standards.
4. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance.
5. Recognize his/her role in promoting the engineering field and contribute to the development of the profession and the community.
6. Value the importance of the environment, both physical and natural, and work to promote sustainability principles.
7. Use techniques, skills, and modern engineering tools necessary for engineering practice.
8. Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies.
9. Communicate effectively using different modes, tools, and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner.
10. Demonstrate leadership qualities, business administration and entrepreneurial skills.
11. Design, operate, analyze, and maintain different electric power and electrical machines engineering systems.
12. Use modern software tools to design, simulate, and implement different parts of electric power and machines engineering systems.

Program Learning Outcomes

The program courses fulfill the NARS 2018

Level A

The Engineering Graduate must be able to:

PLO1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science and mathematics.

PLO2. Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

PLO3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

PLO4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.

PLO5. Practice research techniques and methods of investigation as an inherent part of learning.

PLO6. Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.

PLO7. Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural teams.

PLO8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.

PLO9. Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

PLO10. Acquire and apply new knowledge, and practice self, lifelong and other learning strategies.

Level B

In addition to the program learning outcomes for All Engineering Programs the BASIC ELECTRICAL Engineering graduate and similar programs must be able to:

PLO11. Select, model, and analyze electrical power systems applicable to the specific discipline by applying the concepts of generation, transmission, distribution, protection, control, and high voltage of electrical power systems.

PLO12. Design, model, and analyze an electrical system or component for a specific application; and identify the tools required to optimize this design.

PLO13. Design and implement elements, modules, sub-systems or systems in electrical engineering using technological and professional tools.

PLO14. Estimate and measure the performance of an electrical power system under specific input excitation and evaluate its suitability for a particular application.

PLO15. Adopt suitable national and international standards and codes to: design, build, operate, inspect and maintain electrical/electronic/digital equipment, systems and services.

Level C

In addition to program learning outcomes for all engineering programs (Level A, NARS 2018), and Electric Engineering program learning outcomes (Level B, NARS 2018), the Electrical Power and Machines Engineering Program graduate must be able to (C-Level):

PLO16. Analyze the performance of electric power generation, control and distribution systems.

PLO17. Design and perform experiments, as well as analyses and interpret experimental results related to electrical power and machines system.

PLO18. Test and examine components, equipment and systems of electrical power and machines.

PLO19. Integrate electrical, electronic and mechanical components and equipment with transducers, actuators and controllers in creatively computer-controlled systems.

PLO20. Apply modern techniques, skills and engineering tools to electrical power and machines engineering systems.

Faculty Mission vs. Program Mission Matrix

<table>
<tr><td colspan="2" rowspan="3">**Faculty Mission**</td><td colspan="3">**Program Mission**</td></tr>
<tr><td colspan="3">The Electrical Power and Machines Engineering program at Benha Faculty of Engineering aims focuses on both the theoretical and practical aspects of electrical power and machines engineering. This is achieved by addressing the fundamental concepts of engineering mathematics, physical sciences, electrical machines and drives, power electronics, energy conversion, high voltage engineering, power system analysis, distribution, control, and protection. The program study plan aims at qualifying the graduates to have the ability to apply engineering principles needed for solving problems that arise in the field of electrical power engineering, and it qualifies them to compete for the best jobs in Egypt and the advanced countries. Also, the program is committed to providing continuing education, outreach activities, consulting, and scientific research.</td></tr>
<tr><td>Qualify the graduates to have the ability to apply engineering principles needed for solving problems that arise in the field of electrical power engineering</td><td>Qualify the graduates to compete for the best jobs in Egypt and the advanced countries. Also, the program is committed to providing continuing education, outreach activities, consulting, and scientific research</td><td>Participate effectively and ethically in serving their professional and societal communities</td></tr>
<tr><td rowspan="3">Benha University is committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market, and capable of using and developing modern technology, and providing research in engineering fields to serve society and community.</td><td>graduate well prepared engineers equipped with knowledge and skills</td><td>√</td><td></td><td></td></tr>
<tr><td>compete in labor market capable of using and developing modern technology, and providing research in engineering fields</td><td></td><td>√</td><td></td></tr>
<tr><td>serve society and community.</td><td></td><td></td><td>√</td></tr>
</table>

Program Mission vs. Program Objectives Matrix

<table>
<tr><th colspan="2" rowspan="2">Program Mission</th><th colspan="6">Program Objectives</th></tr>
<tr><th>PO1</th><th>PO2</th><th>PO3</th><th>PO4</th><th>PO5</th><th>PO6</th></tr>
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</table>

Program Objectives vs. Graduate Attributes Matrix

Program Objectives	Graduate Attributes											
	GA 1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA 10	GA 11	GA 12
PO1	√											
PO2		√	√									
PO3							√				√	
PO4								√	√			
PO5					√	√					√	√
PO6				√						√		√

Program Competencies vs. Program Objectives Matrix

Program Objectives	Program Competencies																			
	Level A										Level B					Level C				
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
PO1	√		√								√	√	√							
PO2										√						√				
PO3		√	√							√	√	√	√			√	√	√		
PO4				√	√	√							√		√					√
PO5									√	√				√					√	
PO6					√	√	√	√						√	√				√	√

Career Prospects

The prospect market of the Electrical Power and Machines Engineering Program graduate is widespread. Electrical power networks planning, design, and installation in urban areas, hospitals, touristic, educational and administrative buildings is a sizable market for the graduates in engineering contracting, and manufacturing firms. Industrial control and maintenance of electrical motors, traction, escalators, and elevators are covered within the program profession. Electrical power utilities; distribution, transmission, and generation are as well as major market labour for the graduals.

List of Electrical Power and Machines Engineering Program Requirement Courses

Requirement	Cr. Hrs.	Ct. Hr			
		Lec	Lab	Tut	Tot
Benha University Requirements	14	14	0	0	14
Benha Faculty of Engineering Requirements	32	20	37	43	50
Discipline Requirements	67	45	22	35	102
Major Power and Machines Engineering Program Requirements	29	19	14	12	45
Concentration of Power and Machines Engineering Requirements	18	12	6	12	30
Total	160	110	78	102	241

Basic Science Requirements of Electrical Power and Machines Program

Basic Science Requirements of Electrical Power and Machines Program

Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
BES 011	Mathematics I		3	2	0	2	4
BES 041	General Chemistry		4	3	1	2	6
BES 031	Physics I		3	2	2	1	5
BES 012	Mathematics II	BES 011	3	2	0	2	4
BES 032	Physics II		3	2	2	1	5
BES 111	Differential Equations	BES 012	3	2	0	2	4
BES 113	Mathematics III	BES 012	3	2	0	2	4
BES 112	Numerical Analysis	BES 111	3	2	2	0	4
BES 141	Pollution and Industrial Safety	BES 041	2	2	1	0	3
BES 131	Modern Physics	BES 031 BES 032	2	2	0	2	4
Total			29	21	8	14	43

One credit Hour Has been added to the Basic Science Courses from ELE 371
One credit Hour Has been added to the Basic Science Courses from ELE 271

Discipline Requirements of Electrical Power and Machines Program

Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
BES 111	Differential Equations	BES 012	3	2	0	2	4
BES 113	Mathematics III	BES 012	3	2	0	2	4
ELE 111	Electric Circuits I	BES 032	3	2	1	2	5
ELE 112	Electric Circuits II	ELE 111	3	2	1	2	5
ELE 141	Digital Logic Circuits		3	2	1	2	5
ELE 213	Electronic Circuits I	BES 131	3	2	1	2	5
MEC 128	Thermal Power Engineering		2	2	0	1	3
BES 131	Modern Physics	BES 031 BES 032	3	2	0	2	4
ELE 173	Electrical Applications		2	1	3	0	4
BES 112	Numerical Analysis	BES 111	3	2	2	0	4
ELE 132	Measurements and Instrumentations I	ELE 111 or ELE 179	3	2	2	1	5
ELE 237	Measurements and Instrumentations II	ELE 132	3	2	1	2	5
ELE 216	Electromagnetic Field	BES 113	3	2	0	2	4
ELE 231	Control Theory	BES 111	3	2	1	2	5
ELE 245	Computer Applications	ELE 042	3	2	2	0	4
MEC 228	Power Station	MEC 128	3	2	0	2	4
*ELE 271	Electrical Power System I	ELE 112	3	2	0	2	4
ELE 273	Power Electronics I	ELE 213	3	2	1	2	5
ELE 277	Electrical Machine I	ELE 112	3	2	1	2	5
ELE 232	Modern Control System	ELE 231	3	2	2	1	5
ELE 373	Renewable Energy	ELE 278	3	2	0	2	4
ELE 335	Industrial Automation Systems	ELE 232& ELE 132	3	2	2	1	5
ELE 347	Microcontroller Embedded Systems	ELE 141	3	2	2	0	4
Total			67	45	22	35	102

Major Requirements of Electrical Power and Machines Program

Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
*ELE 371	Power System Analysis	ELE 272	3	2	0	2	4
ELE 372	Power System Protection	ELE 371	3	2	0	2	4
ELE 375	Electrical Drive	ELE 278	3	2	0	2	4
ELE 377	Special Machines	ELE 278	2	2	1	0	3
ELE 376	Power Systems Distribution	ELE 272	2	2	1	0	3
ELE 471	High Voltage Engineering	ELE 272	3	2	0	2	4
ELE 272	Electrical Power System II	ELE 271	3	2	0	2	4
ELE 274	Power Electronics II	ELE 273	3	2	1	2	5
ELE 278	Electrical Machine II	ELE 277	3	2	1	2	5
ELE 392	Senior Design Project I	70 % of Total Hrs.	2	0	4	0	4
ELE 491	Senior Design Project II	ELE 392	3	1	4	0	5
ELE 4xx	Elective I		3	2	0	2	4
ELE 4xx	Elective II		3	2	0	2	4
ELE 4xx	Elective III		3	2	0	2	4
ELE 4xx	Elective V		3	2	0	2	4
ELE 4xx	Elective IV		3	2	0	2	4
ELE 4xx	Elective VI		3	2	0	2	4
Total			47	31	14	24	69

*One credit Hour Has been added to the Basic Science Courses

Concentration Requirements of Electrical Power and Machines Program

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
Pool Courses for Elective I, Elective II, Elective III							
ELE 472	Advanced Power Electronics	ELE 274	3	2	0	2	4
ELE 474	Power System Control	ELE 272	3	2	0	2	4
ELE 476	Power System Operation	ELE 371	3	2	0	2	4
ELE 478	Smart Grid Technology	ELE 373	3	2	0	2	4
ELE 480	Grid Integration of Renewable Energy Systems	ELE 373	3	2	0	2	4
ELE 482	Advanced Electric Machines	ELE 278	2	2	0	2	4
Pool Courses for Elective IV, Elective V, Elective VI							
ELE 473	Electrical Power Quality	ELE 272	3	2	0	2	4
ELE 475	Industrial Instrumentation	ELE 132	3	2	0	2	4
ELE 477	Advanced Power Systems	ELE 272	3	2	0	2	4
ELE 479	HVDC and Flexible AC Transmission Systems	ELE 274	3	2	0	2	4
ELE 481	Switchgear Engineering and substation	ELE 372	3	2	0	2	4
ELE 485	Electrical Installations and Energy Utilization	ELE 376	3	2	0	2	4

Proposed Study Plan for Electrical Power and Machines Program

Level 0-1														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 011	Mathematics I		3	2	0	2	4	2	30	30	-	40	100
BES 021	Mechanics I		3	2	0	2	4	2	30	30	-	40	100
BES 041	General Chemistry		4	3	2	1	6	2	10	30	20	40	100
BES 031	Physics I		3	2	2	1	5	2	10	30	20	40	100
MEC 011	Engineering Graphics		2	0	0	4	4	2	30	30	-	40	100
UHS 101	Foreign Language		2	2	0	0	2	2	30	30	-	40	100
UHS 102	Information and Communication Technology		2	2	0	0	2	2	30	30	-	40	100
Total			19	13	4	10	27						700

Level 0-2														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 012	Mathematics II	BES 011	3	2	0	2	4	2	30	30	-	40	100
BES 022	Mechanics II	BES 021	3	2	0	2	4	2	30	30	-	40	100
MEC 012	Production Engineering		2	1	3	0	4	2	10	30	20	40	100
BES 032	Physics II		3	2	2	1	5	2	10	30	20	40	100
MEC 014	Computer Aided Drafting	MEC 011	2	1	2	0	3	2	10	30	20	40	100
ELE 042	Computer Programming Fundamentals		2	0	2	2	4	2	10	30	20	40	100
UHS 103	Societal Issues		2	2	0	0	2	2	30	30	-	40	100
Total			17	10	9	7	26						700

Level 1-1														
Code	Course Name	Pre-Req.	Cr, Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 111	Differential Equations	BES 012	3	2	0	2	4	**2**	**30**	**30**	**-**	**40**	**100**
ELE 111	Electric Circuits I	BES 032	3	2	1	2	5	**2**	**10**	**30**	**20**	**40**	**100**
ELE 141	Digital Logic Circuits		3	2	1	2	5	**2**	**10**	**30**	**20**	**40**	**100**
BES 131	Modern Physics	BES 031 BES 032	3	2	0	2	4	**2**	**30**	**30**	**-**	**40**	**100**
ELE 173	Electrical Application		2	1	3	0	4	**2**	**10**	**30**	**20**	**40**	**100**
BES 113	Mathematics III	BES 012	3	2	0	2	4	**2**	**30**	**30**	**-**	**40**	**100**
UHS XXX	Humanities – Elective I		2	2	0	0	2	**2**	**30**	**30**	**-**	**40**	**100**
Total			19										**700**

Level 1-2													
Code	Course Name	Pre - Req.	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut			SA	MT	PE/ OE	Final Exam	Sum
BES 112	Numerical Analysis	BES 111	3	2	2	0	4	**2**	**10**	**30**	**20**	**40**	**100**
ELE 112	Electric Circuits II	ELE 111	3	2	1	2	5	**2**	**10**	**30**	**20**	**40**	**100**
ELE 213	Electronic Circuit I	BES 131	3	2	1	2	5	**2**	**10**	**30**	**20**	**40**	**100**
ELE 132	Measurments and Instrumentation I	ELE 111 or ELE 179	3	2	2	1	5	**2**	**10**	**30**	**20**	**40**	**100**
MEC 128	Thermal Power Engineering		2	2	0	1	3	**2**	**30**	**30**	**-**	**40**	**100**
UHS104	Professional Ethics		2	2	0	0	2	**2**	**30**	**30**	**-**	**40**	**100**
UHS XXX	Humanities Elective II		2	2	0	0	2	**2**	**30**	**30**	**-**	**40**	**100**
Total			18										**700**

Field Training I														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
FTR 103	Field Training I	Completion of 65 Cr. Hr	0	0	0	0	0	Oral	-	-	-	Pass or Fail	-

Level 2-1														
Code	Course Name	Pre - Req.	Cr. Hr.	Ct. Hr.				**Final Exam Time**	**Assessment**				
				Lec	Lab	Tut			SA	MT	**PE/ OE**	**Final Exam**	**Sum**
ELE 271	Electrical Power System I	ELE 112	3	2	0	2	4	**2**	**30**	**30**	**-**	**40**	**100**
ELE 273	Power Electronics I	ELE 213	3	2	1	2	5	**2**	**10**	**30**	**20**	**40**	**100**
ELE 216	Electromagnetic Field	BES 113	3	2	0	2	4	**2**	**30**	**30**	**-**	**40**	**100**
ELE 277	Electrical Machine I	ELE 112	3	2	1	2	5	**2**	**10**	**30**	**20**	**40**	**100**
ELE 231	Control Theory	BES 111	3	2	1	2	4	**2**	**10**	**30**	**20**	**40**	**100**
ELE 237	Measurements and Instruments II	ELE 132	3	2	1	2	5	**2**	**10**	**30**	**20**	**40**	**100**
Total			18										**600**

Level 2-2														
Code	Course Name	Pre - Req.	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lec.	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
ELE 272	Electrical Power System II	ELE 271	3	2	0	2	4	**2**	**30**	**30**	**-**	**40**	**100**
ELE 274	Power Electronics II	ELE 273	3	2	1	2	5	**2**	**10**	**30**	**20**	**40**	**100**
MEC 228	Power Station	MEC 128	3	2	0	2	4	**2**	**30**	**30**	**-**	**40**	**100**
ELE 278	Electrical Machine II	ELE 277	3	2	1	2	5	**2**	**10**	**30**	**20**	**40**	**100**
ELE 232	Modern Control Systems	ELE 231	3	2	2	1	5	**2**	**10**	**30**	**20**	**40**	**100**
ELE 245	Computer Applications	ELE 042	3	2	2	0	4	**2**	**10**	**30**	**20**	**40**	**100**
Total			18										**600**

Field Training II														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
FTR 203	Field Training I	Completion of 96 Cr. Hr	0	0	0	0	0	Oral	-	-	-	Pass or Fail	-

Level 3-1														
Code	Course Name	Pre-Req.	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
ELE 373	Renewable Energy	ELE 278	3	2	0	2	4	2	30	30	-	40	100
ELE 371	Power System Analysis	ELE 272	3	2	0	2	4	2	30	30	-	40	100
ELE 376	Power Systems Distribution	ELE 272	2	2	1	0	3	2	10	30	20	40	100
ELE 347	Microcontroller Embedded Systems	ELE 141	3	2	2	0	4	2	10	30	20	40	100
ELE 375	Electrical Drive	ELE 278	3	2	0	2	4	2	30	30	-	40	100
ELE 377	Special Machines	ELE 278	2	2	1	0	3	2	10	30	20	40	100
UHS 4XX	Humanities – Elective III		2	2	0	0	2	2	30	30	-	40	100
Total			18										700

Level 3-2													
Code	Course Name	Pre - Req.	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
ELE 372	Power System Protection	ELE 371	3	2	0	2	4	2	30	30	-	40	100
ELE 4XX	Elective I		3	2	0	2	4	2	30	30	-	40	100
ELE 4XX	Elective II		3	2	0	2	4	2	30	30	-	40	100
ELE 335	Industrial Automation Systems	ELE232 & ELE132	3	2	2	1	5	2	10	30	20	40	100
ELE 392	Senior Design Project I	70% of total CH	2	0	4	0	4	2	50	-	50	--	100
ELE 4XX	Elective III		3	2	0	2	4	2	30	30	-	40	100
Total			17										600

Level 4-1														
Code	Course Name	Pre - Req.	Cr. Hr.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 141	Pollution and Industrial Safety	BES 041	2	2	1	0	3	**2**	**10**	**30**	**20**	**40**	**100**
ELE 4XX	Elective IV		3	2	0	2	5	**2**	**10**	**30**	**-**	**40**	**100**
ELE 471	High Voltage Engineering	ELE 272	3	2	0	2	4	**2**	**30**	**30**	**-**	**40**	**100**
ELE 491	Senior Design Project II	ELE 392	3	1	4	0	5	2	**50**	**-**	**50**	**--**	**100**
ELE 4XX	Elective V		3	2	0	2	4	**2**	**10**	**30**	**20**	**40**	**100**
ELE 4XX	Elective VI		3	2	0	2	4	**2**	**10**	**30**	**20**	**40**	**100**
Total			17										**600**

Matching Electrical power and machines engineering Program Courses with ABET Requirements

ABET Program Criteria for Electrical power and machines engineering Program and Similarly Named Engineering Programs Lead Society: American Society of Electrical Engineers.

ABET Criteria		Electrical power and machines engineering Program Courses Required to Cover ABET Criteria		
		CODE	Course Name	Cr. Hrs.
A minimum of 30 semester Cr. Hrs. (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program.	The curriculum must prepare graduates to apply knowledge of mathematics through differential equations.	BES 011	Mathematics I	3
		BES 012	Mathematics II	3
		BES 111	Differential Equations	3
		BES 113	Mathematics III	3
		BES 112	Numerical Analysis	3
	Chemistry	BES 041	General Chemistry	4
		BES 141	Pollution and Industrial Safety	2
	Calculus-based physics	BES 031	Physics I	3
		BES 131	Modern Physics	3
		BES 032	Physics II	3
Total				**30**
A minimum of 45 semester Cr. Hrs. (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design and utilizing modern engineering tools.	The basic Courses of electrical power and machines engineering program.	ELE 111	Electric Circuits I	3
		ELE 112	Electric Circuits II	3
		ELE 141	Digital Logic Circuits	3
		ELE 213	Electronic Circuits I	3
		BES 131	Modern Physics	3
		ELE 173	Electrical Applications	2
		ELE 216	Electromagnetic Field	3
	Discuss the principle of control and automation system	ELE 131	Control Systems	3
		ELE 335	Industrial Automation Systems	3

		ELE 232	Modern Control System	3
A minimum of 45 semester Cr. Hrs. (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design and utilizing modern engineering tools.	Discuss the basic concepts of measurement and instrumentation	ELE 132	Measurements and Instrumentations I	3
		ELE 237	Measurements and Instrumentations II	3
	Discuss the principle of power electronics engineering	ELE 273	Power Electronics I	3
		ELE 274	Power Electronics II	3
		ELE 375	Electrical Drive	3
	Discuss the principle of electrical machines	ELE 277	Electrical Machine I	3
		ELE 278	Electrical Machine II	3
		ELE 377	Special Machines	2
	Considers the systems or processes from other electrical power and machines engineering curricular areas	ELE 392	Senior Design Project I	2
		ELE 491	Senior Design Project II	3
	Includes communication and collaboration with other design or construction team members	UHS 103	Societal Issues	2
		UHS 102	Information and Communication Technology	2
		UHS 104	Professional Ethics	2
	Include principles of electrical power system	ELE 271	Electrical Power System I	3
		ELE 272	Electrical Power System II	3
		ELE 371	Power System Analysis	3
		ELE 373	Renewable Energy	3
		ELE 372	Power System Protection	3
		ELE 379	Power Systems Distribution	2

		ELE 471	High Voltage Engineering	3
	Includes computer-based technology and considers applicable codes and standards.	ELE 042	Computer Programming Fundamentals	2
		ELE 245	Computer Applications	3
		ELE 347	Microcontroller Embedded Systems	3
Total				**91**

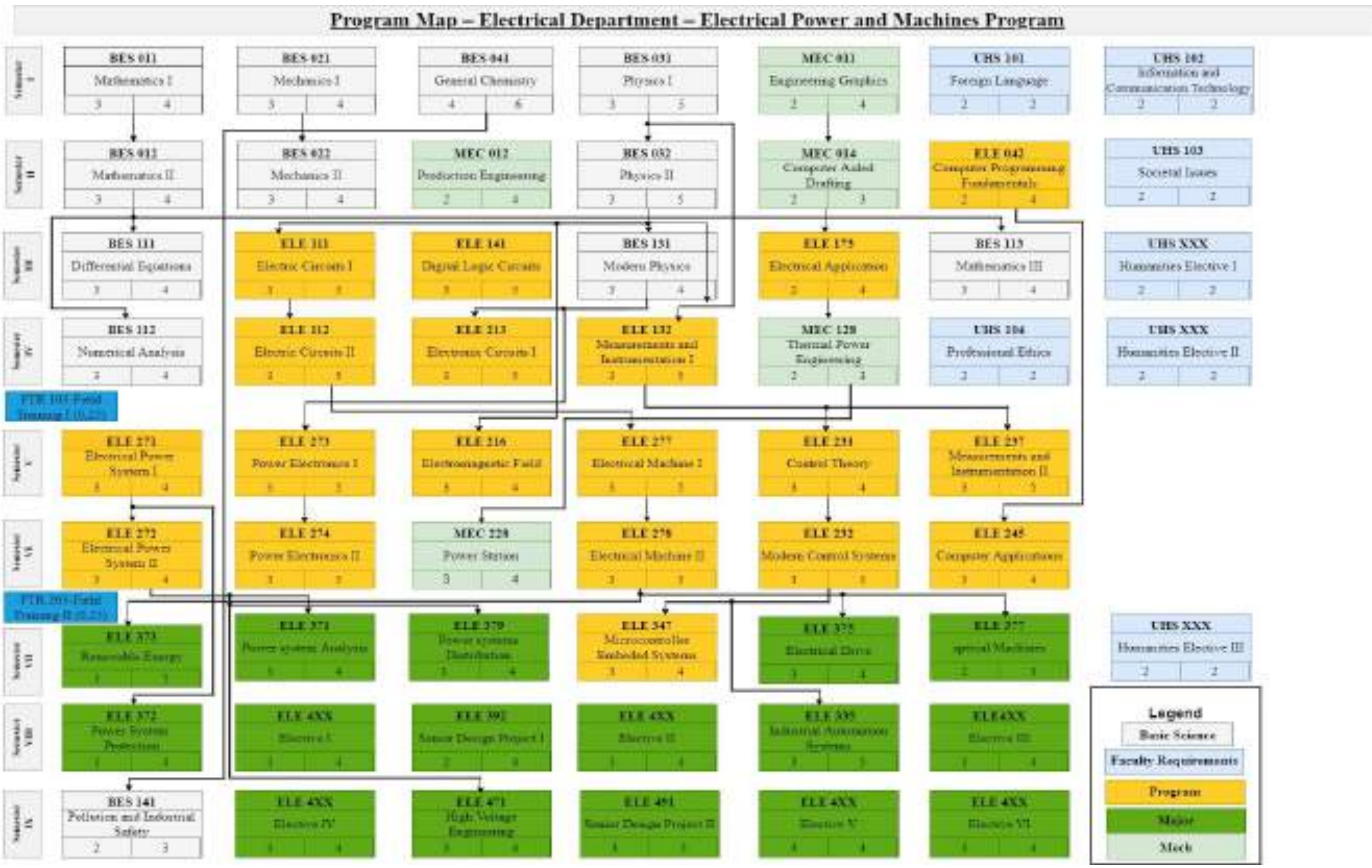
Courses Plan and Matrix

Program Map - Electrical Dept - Electrical Power & Machines

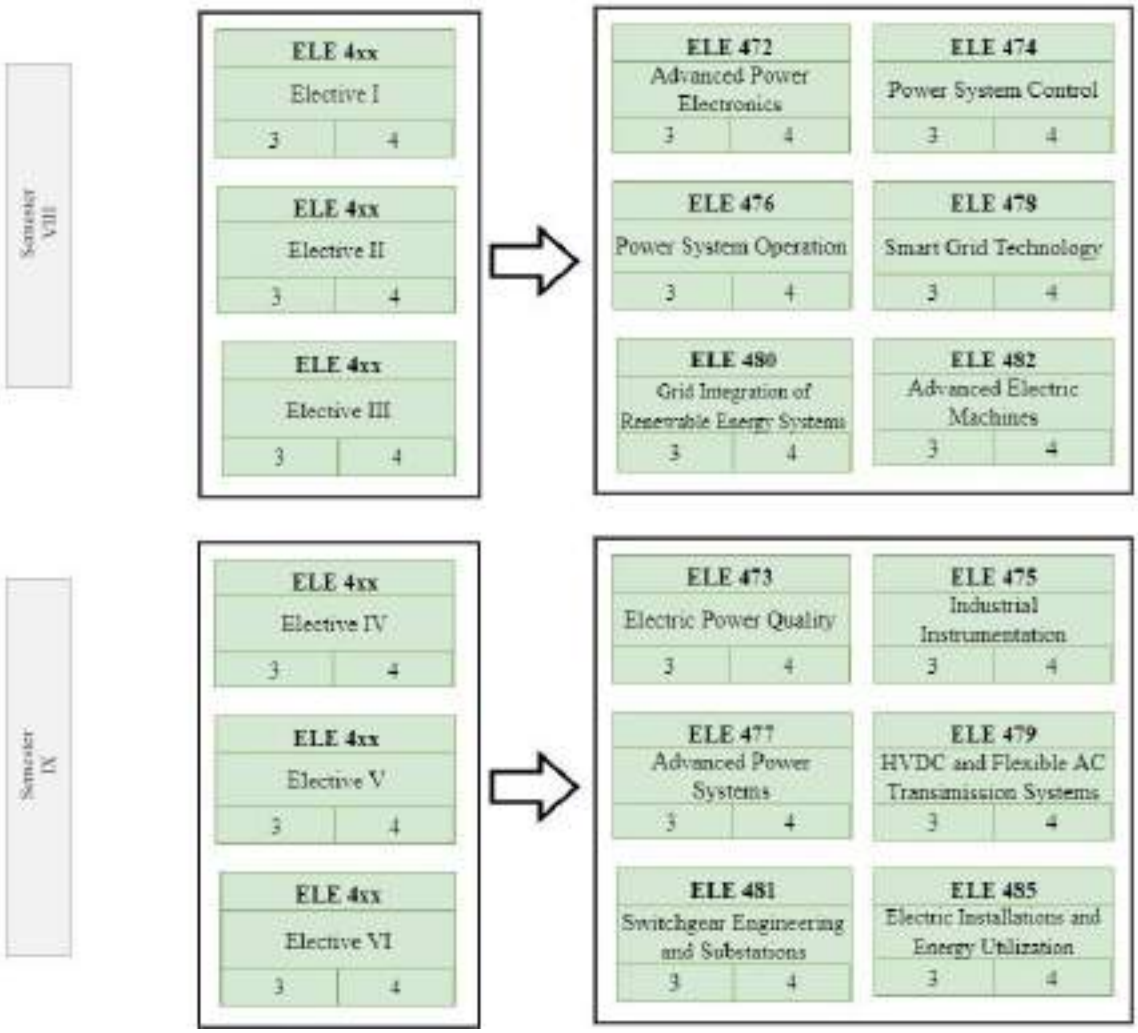
Level								CR	CT
Level 1	BES 011 Mathematics I (3 / 4)	BES 021 Mechanics I (3 / 4)	BES 041 General Chemistry (4 / 6)	BES 031 Physics I (3 / 5)	MEC 011 Engineering Graphics I (2 / 4)	UHS 101 English Language (2 / 2)	UHS 102 Information and (2 / 2)	19	27
	BES 012 Mathematics II (3 / 4)	BES 022 Mechanics II (3 / 4)	MEC 012 Production Engineering (2 / 4)	BES 032 Physics II (3 / 5)	MEC 014 Computer Aided Drafting (2 / 3)	ELE 042 Computer Programming (2 / 4)	UHS 103 Societal Issues (2 / 2)	17	26
Level 2	BES 111 Diferential Equations (3 / 4)	ELE 111 Electric Circuits I (3 / 5)	ELE 141 Digital Logic Circuits (3 / 5)	BES 131 Modern Physics (3 / 4)	ELE 173 Electrical Application (2 / 4)	BES 113 Mathematics III (2 / 4)	UHS XXX Humanities – Elective I (2 / 2)	18	28
	BES 112 Numerical Analysis (3 / 4)	ELE 112 Electric Circuits II (3 / 5)	ELE 213 Electronic Circuits I (3 / 5)	ELE 132 Measurments and Instrumentation I (3 / 5)	MEC 128 Thermal Power Engineering (2 / 3)	UHS 104 Professional Ethics (2 / 2)	UHS XXX Humanities Elective II (2 / 2)	18	26
	FTR 103 – Field Traning I [0,25]								
Level 3	ELE 271 Electrical Power System I (3 / 4)	ELE 273 Power Electronics I (3 / 5)	ELE 216 Electromagnetic Field (3 / 4)	ELE 277 Electrical Machine I (3 / 5)	ELE 231 Control Theory (3 / 5)	ELE 237 Measurments and Instrumentation II (3 / 5)		18	28
	ELE 272 Electrical Power System II (3 / 4)	ELE 274 Power Electronics II (3 / 5)	MEC 228 Power Station (3 / 4)	ELE 278 Electrical Machine II (3 / 5)	ELE 232 Modern Control Systems (3 / 5)	ELE 245 Computer Applications (3 / 4)		18	27
	FTR 203 – Field Traning II [0,25]								
Level 4	ELE 371 Power System Analysis (3 / 4)	ELE 373 Renewable Energy (3 / 4)	ELE 375 Electrical Drive (3 / 4)	ELE 377 Special Machines (2 / 3)	ELE 379 Power Systems Distribution (2 / 3)	ELE 347 Microcontroller Embedded (3 / 4)	UHS XXX Humanities – Elective III (2 / 2)	18	24
	ELE 372 Power System Protection (3 / 4)	ELE 335 Industrial Automation (3 / 5)	ELE 392 Senior Design Project I (2 / 4)	ELE 4xx Elective I (3 / 4)	ELE 4xx Elective II (3 / 4)	ELE 4xx Elective III (3 / 4)		17	25
Level 5	BES 141 Pollution and Industrial Safty (2 / 3)	ELE 471 High Voltage Engineering (3 / 4)	ELE 491 Senior Design Project II (3 / 5)	ELE 4xx Elective IV (3 / 4)	ELE 4xx Elective V (3 / 4)	ELE 4xx Elective VI (3 / 4)		17	24
								160	235

	University Req.		Faculty Req.		Discipline Req.		Major Req.	
Min. Requirements	Min 8%		Min 20%		Min 41%		Min 30%	
	CR	CT	CR	CT	CR	CT	CR	CT
Min. Hours	12.80	23.76	32.00	59.40	65.60	121.77	48.00	89.10
Satisfied Hours	14	14	32	99	66	104	48	80

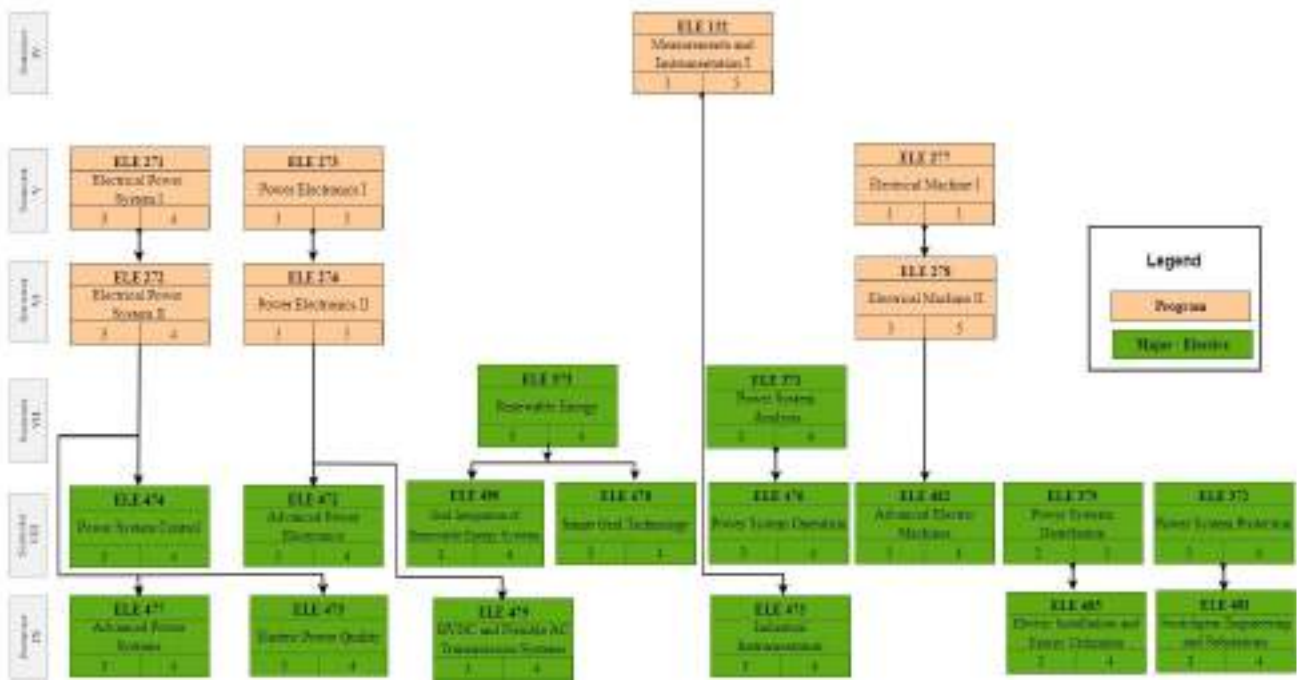
Curriculum Plan for Electrical Power and Machines Program



Map of Elective Courses



Flowchart of Elective Map



Program Learning Outcoms to Courses Matrix

	Course		PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18	PLO19	PLO20
	Code	Name																				
Semester I	BES 011	Mathematics I	√		√																	
	BES 021	Mechanics I	√	√																		
	BES 041	General Chemistry	√	√																		
	BES 031	Physics I	√	√																		
	MEC 011	Engineering Graphics						√		√												
	UHS 101	Foreign Language								√		√										
	UHS 102	Information and Communication Technology				√						√										
Semester II	BES 012	Mathematics II	√		√																	
	BES 022	Mechanics II	√	√																		
	MEC 012	Production Engineering				√		√														
	BES 032	Physics II	√	√																		
	MEC 014	Computer Aided Drafting				√				√												
	ELE 042	Computer Programming Fundamentals	√		√																	
	UHS 103	Societal Issues							√			√										
Semester III	BES 111	Differential Equations	√	√																		
	ELE 111	Electric Circuits I		√										√	√							
	ELE 141	Digital Logic Circuits	√	√	√									√								
	BES 113	Mathematics III	√	√																		

	Course		PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18	PLO19	PLO20
	Code	Name																				
	ELE 173	Electrical Application				√	√										√					
	BES 131	Modern Physics	√	√																		
	UHS 2xx	Humanities - Elective I			√	√																
Semester IV	BES 112	Numerical Analysis	√	√																		
	ELE 112	Electric Circuits II			√	√	√							√	√							
	ELE 213	Electronic Circuits I		√										√	√							
	ELE 132	Measurements and Instrumentation I		√										√		√						
	MEC 128	Thermal Power Engineering	√						√													
	UHS 104	Professional Ethics				√	√															
	UHS 4xx	Humanities - Elective II					√					√	√									
	FTR 103	Field Training I							√			√										
	ELE 271	Electrical Power System I								√			√	√				√				
	ELE 273	Power Electronics I							√				√		√	√						
	ELE 216	Electromagnetic Field	√											√	√							
	ELE 277	Electrical Machine I											√				√					
	ELE 231	Control Theory													√	√		√	√			
	ELE 237	Measurements and Instrumentation II		√							√					√						
	ELE 272	Electrical Power System II			√								√	√	√			√	√			

	Course		PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18	PLO19	PLO20
	Code	Name																				
	ELE 274	Power Electronics II						√						√	√							
	MEC 228	Power Station	√							√					√	√		√	√			√
	ELE 278	Electrical Machine II									√		√							√		√
	ELE 232	Modern Control Systems															√	√			√	
	ELE 245	Computer Applications		√										√		√						
	FTR 203	Field Training II							√			√										
	ELE 371	Power System Analysis			√									√	√		√	√	√			√
	ELE 373	Renewable Energy															√				√	
	ELE 375	Electrical Drive						√													√	√
	ELE 377	Special Machines								√								√		√		
	ELE 379	Power Systems Distribution							√									√	√			√
	ELE 347	Microcontroller Embedded												√	√	√						
	UHS 5xx	Humanities - Elective III					√					√										
Semester VIII	ELE 4xx	Elective I	Refer to electrical power and machines engineering electives																			
	ELE 4xx	Elective II																				
	ELE 4xx	Elective III																				
	ELE 372	Power System Protection																	√	√		
	ELE 335	Industrial Automation Systems															√				√	√

	Course		PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18	PLO19	PLO20
	Code	Name																				
	ELE 392	Senior Design Project I					√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
Semester IX	BES 141	Pollution and Industrial Safety				√		√														
	ELE 471	High Voltage Engineering																		√	√	√
	ELE 491	Senior Design Project II					√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	ELE 4xx	Elective IV	Refer to electrical power and machines engineering electives																			
	ELE 4xx	Elective V																				
	ELE 4xx	Elective VI																				
Electrical Power and Machines Engineering Electives	ELE 473	Electric Power Quality								√						√		√	√		√	
	ELE 475	Industrial Instrumentation							√		√	√	√					√		√		
	ELE 472	Advanced Power Electronics			√			√							√		√					√
	ELE 474	Power System Control										√		√		√		√	√			
	ELE 477	Advanced Power Systems							√		√				√		√		√		√	
	ELE 479	HVAC and Flexible AC Transmission Systems								√			√		√			√	√	√		
	ELE 476	Power System Operation			√						√						√				√	√
	ELE 478	Smart Grid Technology								√				√		√		√		√		
	ELE 480	Grid Integration of Renewable Energy Systems						√					√		√				√	√		
	ELE 481	Switchgear Engineering and Substations			√		√								√				√	√	√	
	ELE 482	Advanced Electric Machines						√						√		√		√				
	ELE 485	Electrical Installations and Energy Utilization							√		√		√		√		√				√	√

Program # 5 Computer and Control Systems Engineering Program

Program Description

Computer and control systems engineering is a discipline that integrates the science and technology of design, implementation, controlling and maintenance of software and hardware components of computing systems, computer-controlled equipment, and networks of intelligent devices. Generally, computer and control systems engineering is some combination of both electrical engineering and computer science.

Because of the breadth of the computer and control systems engineering field, computer-related coursework typically comes from computer organization and architecture, networks, algorithms, programming, databases, software engineering, automation, and intelligent systems. Electrical engineering related coursework typically comes from circuits, digital logic, microelectronics, signal processing, control systems, and integrated circuit design. Foundational areas typically include basic sciences, mathematics for both discrete and continuous domains, and applications of probability and statistics.

Basic Information

Program Mission

The mission of Computer and control systems is to provide students with the competencies and skills for successful featured careers, characterized by creativity, innovation, research and lifelong learning, to participate effectively and ethically in serving their professional and societal communities.

Program Objectives

Computer and Control Systems Engineering program is planned to:

1- Qualify graduates to apply principles, knowledge, skills, and current techniques of computer and control systems in their careers
2- Prepare graduates to be contributors and responsible in making professional and personal decisions
3- Enable graduates to synthesize and analyze the efficacy solutions to complex problems
4- Prepare graduates engage successfully and productively in their careers
5- Qualify graduates to work in areas across the breadth and depth of the discipline and diverse career paths including leadership and entrepreneurship
6- Program graduates would communicate and act in a creative, responsible, respectful, and ethical manner to serve their career and society
7- Program graduates would continue improve and develop professionally by learning new techniques, directions, and other creative pursuits in the field of computer and control systems
8- Stimulate the graduate scientific curiosity, and passion for continuous research, to be able to participate in the evolution of the promising computer and control systems field.

Graduate Attributes

Graduate attributes are the academic abilities, personal qualities, and skills which computer and control systems Engineering graduates should have.

With the ubiquity of computers, computer-based systems, and networks in the world today, computer engineers must be versatile in the knowledge drawn from standard study areas in computer science and electrical engineering as well as the foundations in mathematics and sciences. The rapid pace of change in the computing field requires that computer engineers be lifelong learners to maintain their knowledge and skills within their chosen discipline.

According to NARS 2018 all engineering graduates must:

1. Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real life situations.
2. Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation.
3. Behave professionally and adhere to engineering ethics and standards.
4. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance.
5. Recognize his/her role in promoting the engineering field and contribute to the development of the profession and the community.
6. Value the importance of the environment, both physical and natural, and work to promote sustainability principles.
7. Use techniques, skills and modern engineering tools necessary for engineering practice.
8. Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies.
9. Communicate effectively using different modes, tools and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner.
10. Demonstrate leadership qualities, business administration and entrepreneurial skills.

In addition to all engineering graduate attributes defined by NARS 2018, Computer and Control Systems Engineering graduate should be able to:

1. Use the existing computing tools professionally and can develop neoteric tools
2. Develop and manage projects related to computer and control systems in diverse fields of applications
3. Design and manage computer, computer-based systems, networks, and control and intelligent systems to solve novel problems including both hardware and software designs and extend their applications to diversity of real-life systems
4. Demonstrate the breadth and depth competencies of the computer and control systems engineering

Program Learning Outcomes

- **Level A Competencies**

According to NARS 2018, the competencies of the Engineering Graduate must be able to:

PLO1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science and mathematics.

PLO2. Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

PLO3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

PLO4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.

PLO5. Practice research techniques and methods of investigation as an inherent part of learning.

PLO6. Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.

PLO7. Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural teams.

PLO8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.

PLO9. Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

PLO10. Acquire and apply new knowledge, and practice self, lifelong and other learning strategies.

- **Level B Competencies**

In addition to the Program learning outcomes for All Engineering Programs the BASIC ELECTRICAL Engineering graduate and similar programs must be able to:

PLO11. Design, model and analyze an electrical/electronic/digital system or component for a specific application; and identify the tools required to optimize this design.

PLO12. Design and implement elements, modules, sub-systems or systems in electrical/electronic/digital engineering using technological and professional tools.

PLO13. Estimate and measure the performance of an electrical/electronic/digital system and circuit under specific input excitation and evaluate its suitability for a specific application.

PLO14. Adopt suitable national and international standards and codes to design, build, operate, inspect and maintain electrical/electronic/digital equipment, systems and services.

- **Level C Competencies**

In addition to the previous program learning outcomes for all engineering programs (Level A, NARS 2018), and Electric Engineering program learning outcomes (Level B, NARS 2018), computer and control systems engineers must be able to:

PLO15. Determine the characteristics of a given problem, choose the appropriate method to solve, analyze, design, and apply programming paradigm in Algorithm design/software design problems/intelligent systems design/ software engineering and testing

PLO16. Design and Implement Embedded Systems/ Image and Signal Processing Systems/ Systems Using Programmable Devices/Systems Using ASIC Design, taking into account relevant system design constraints (time, interrupts, reliability, reducing failure, bridging the analog and digital domains,…)

PLO17. Develop, deploy, manage, maintain, and evaluate the performance and security of wireless and wired networking principles in the context of relevant standards.

PLO18. Analyze, design, model, and evaluate basic control systems, multivariable systems, and dynamic nonlinear systems for real-world systems

PLO19. Formulate and describe different types of Industrial robots: structure and applications, robot kinematics, dynamics, and control systems, apply robot software tools, formulate solutions to solve problems related to robotics, industry, and automation, apply principles and techniques in varied application domains related to industry and artificial intelligence.

PLO20. Consolidate electrical, electronic, and digital components and equipment, and apply modern techniques, skills, and engineering tools to electrical, power, machines, and intelligent engineering systems.

Faculty Mission vs. Program Mission Matrix

<table>
<tr><th colspan="2" rowspan="3">Faculty Mission</th><th colspan="3">Program Mission</th></tr>
<tr><td colspan="3">The mission of Computer and control systems is to provide students with the competencies and skills for successful featured careers, characterized by creativity, innovation, research, and lifelong learning, to participate effectively and ethically in serving their professional and societal communities</td></tr>
<tr><td>provide students with the competencies and skills for successful featured careers</td><td>characterized by creativity, innovation, research, and lifelong learning</td><td>to participate effectively and ethically in serving their professional and societal communities</td></tr>
<tr><td rowspan="3">Benha Faculty of Engineering - Benha University is committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market, and capable of using and developing modern technology, and providing research in engineering fields to serve society and community.</td><td>graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market, and capable of using and developing modern technology</td><td>√</td><td></td><td></td></tr>
<tr><td>providing research in engineering fields</td><td></td><td>√</td><td></td></tr>
<tr><td>to serve society and community</td><td></td><td></td><td>√</td></tr>
</table>

Program Objectives Vs Graduate Attributes

Program Objectives	Graduate Attribute													
	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12	GA13	GA14
PO1	√										√			
PO2			√		√									
PO3		√											√	
PO4				√			√					√		
PO5										√				√
PO6						√			√					
PO7								√						
PO8								√						

Program Competencies vs. Program Objectives Matrix

Program Objectives	Program Competencies																			
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B14	C1	C2	C3	C4	C5	C6
PO1	√		√	√																
PO2		√				√			√											
PO3	√	√	√	√		√														
PO4							√	√	√	√										
PO5						√			√		√	√	√	√	√	√	√	√	√	√
PO6			√				√	√												
PO7					√				√	√	√	√	√	√	√	√	√	√	√	√
PO8					√					√										

Career Prospects

Computer and control systems engineers work in most industries, including the computer, automobile, aerospace, telecommunications, power production, manufacturing, defense, and electronics industries. They design high-tech devices ranging from tiny microelectronic integrated-circuit chips to powerful systems that utilize those chips and efficient telecommunication systems that interconnect those systems. Computer and control systems engineers also work on distributed computing environments—local and wide area networks, wireless networks, internets, intranets—and embedded computer systems—such as in aircraft, spacecraft, and automobile control systems where they perform various functions. A wide array of complex technological systems, such as power generation and distribution systems and modern processing and manufacturing plants, rely on computer systems developed and designed by computer and control systems engineers

Program Concentrations

The graduate of the program can be specialized in one of the following two concentrations:

1. Computer Engineering
2. Control Systems Engineering

The concentration focus is achieved by 23 Cr. Hrs. including 18 Cr. Hrs. of elective courses and 5 Cr. Hrs. as the graduation project, all related to the specific concentration.

List of Computer and Control Systems Engineering Requirement Courses

Requirement	Cr. Hrs.	Ct. Hr.			
		Lec	Lab	Tut	Sum
Benha University Requirements	14	14	0	0	14
Benha Faculty of Engineering Requirements	32	19	34	47	50
Discipline Requirements	67	45	31	25	101
Program Computer and Control Systems Program Requirements	29	18	18	8	44
Concentration of Computer Engineering Requirements	18	12	12	6	30
Concentration of Control Systems Engineering Requirements					
Total	160	108	95	86	239

Basic Science Requirements of Computer and Control Systems Engineering

Code	Course Title	Pre-Req	Cr. Hrs.	Contact Hrs			
				Lec	Lab	Tut	Tot
BES 011	Mathematics I		3	2	0	2	4
BES 041	General Chemistry		4	3	2	1	6
BES 031	Physics I		3	2	2	1	5
BES 012	Mathematics II	BES 011	3	2	0	2	4
BES 032	Physics II		3	2	2	1	5
BES 111	Differential Equations	BES 012	3	2	0	2	4
BES 113	Mathematics III	BES 012	3	2	0	2	4
BES 112	Numerical Analysis	BES 111	3	2	2	0	4
BES 114	Discrete Mathematics and Linear Programming	BES 012	3	2	0	2	4
*BES 141	Pollution and Industrial Safety	BES 041	2	2	1	0	3
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4
Total			33	23	11	13	47

* Course teaching is shared between the Basic Engineering Science Department and Electrical Engineering Department.

Discipline Requirements of Computer and Control Systems Engineering

Code	Course Title	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
BES 111	Differential Equations	BES 012	3	2	0	2	4
BES 113	Mathematics III	BES 012	3	2	0	2	4
ELE 179	Electric Circuits Analysis	BES 032	3	2	1	2	5
ELE 141	Digital Logic Circuits		3	2	1	2	5
ELE 143	Object Oriented Programming	ELE 042	3	2	2	0	4
ELE 173	Electrical Applications		2	1	3	0	4
BES 112	Numerical Analysis	BES 111	3	2	2	0	4
ELE 132	Measurements and Instrumentations I	ELE 179 or ELE 111	3	2	2	1	5
ELE 142	Digital System Design	ELE 141	3	2	2	1	5
ELE 144	Data Structures and Algorithms	ELE 143	3	2	2	0	4
ELE 211	Signals and Systems	BES 111	3	2	0	2	4
ELE 213	Electronic Circuits I	BES 131 or ELE 114	3	2	1	2	5
ELE 231	Control Theory	BES 111	3	2	1	2	4
ELE 241	Computer Architecture	ELE 142	3	2	2	1	5
ELE 245	Computer Applications	ELE 042	3	2	2	0	4
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	5
ELE 276	Electric Machines	ELE 179	3	2	1	1	4
ELE 232	Modern Control Systems	ELE 231	3	2	2	1	5
ELE 242	Computer Organization	ELE 241	3	2	2	1	5
ELE 246	Computer Network		3	2	2	1	5
ELE 341	Microprocessor Based Systems	ELE 242	3	2	1	2	5
Total			67	44	33	25	102

Program Requirements of Computer and Control Systems Engineering

Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
BES 114	Discrete Mathematics and Linear Programming	BES 012	3	2	0	2	4
ELE 243	Algorithms Analysis and Design	BES 114, ELE 144	3	2	1	1	4
ELE 244	Operating Systems	ELE 241	3	2	1	1	4
ELE 343	Database Systems	ELE 144	3	2	2	1	5
ELE 331	Machine Learning	ELE 243, BES 211	3	2	2	1	5
ELE 333	Digital Control	ELE 211, ELE 232	3	2	1	1	4
ELE 335	Industrial Automation Systems	ELE 132, ELE 232	3	2	2	1	5
ELE 342	Embedded Systems	ELE 141	3	2	2	0	4
ELE 3XX	Elective I		3	2	2	1	5
ELE 3XX	Elective II		3	2	2	1	5
ELE 3XX	Elective III		3	2	2	1	5
ELE 4XX	Elective IV		3	2	2	1	5
ELE 4XX	Elective V		3	2	2	1	5
ELE 4XX	Elective VI		3	2	2	1	5
*ELE 392	Senior Design Project I	70% of total CH	2	0	4	0	4
ELE 491	Senior Design Project II	ELE 392	3	1	4	0	5
Total			47	30	30	14	74

*The student can register the Senior design Project course after passing 70% of the program cr. hrs., i.e., 112 Cr. Hr.

Concentration Requirements of Control Systems Engineering

Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
Pool Courses for Elective I, Elective II, Elective III							
ELE 3302	Robotics	ELE 232, ELE 245	3	2	2	1	5
ELE 3304	Intelligent Control	ELE 232	3	2	2	1	5
ELE 484	Special Electric Machines	ELE 276	3	2	2	1	5
ELE 3306	Modelling and Simulation	ELE 245	3	2	2	1	5
ELE 3308	System Identification and Parameter Estimation	ELE 231	3	2	2	1	5
ELE 483	Power Electronics	ELE 213	3	2	2	1	5
Pool Courses for Elective IV, Elective V, Elective VI							
ELE 4301	Advanced Robotics	ELE 3302	3	2	2	1	5
ELE 4303	Autonomous Systems	ELE 3302	3	2	2	1	5
ELE 4305	Advanced Control Systems	ELE 333	3	2	2	1	5
ELE 4307	Advanced Industrial Automation Systems	ELE 331	3	2	2	1	5
ELE 4409	Internet of Things	ELE 342	3	2	2	1	5
*ELE 4309	Selected Topics in Control Systems		3	2	2	1	5

* The course content must be approved by Electric Engineering Department Council before any student can register it.

Concentration Requirements of Computer Engineering

Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
Pool Courses for Elective I, Elective II, Elective III							
ELE 3402	Advanced Topics in Computer Networks	ELE 246	3	2	2	1	5
ELE 3404	Computer and Network Security	ELE 246	3	2	2	1	5
ELE 3406	Software Engineering	ELE 144	3	2	2	1	5
ELE 3408	Data Analytics	BES 211	3	2	2	1	5
ELE 3118	Digital Electronics	ELE 213	3	2	2	1	5
ELE 3410	Web Engineering	ELE 143	3	2	2	1	5
ELE 3412	Fault-Tolerant Computing	ELE 242, BES 211	3	2	2	1	5
ELE 3414	Cloud Computing	ELE 246	3	2	2	1	5
Pool Courses for Elective IV, Elective V, Elective VI							
ELE 441	Image Processing	ELE 211, ELE 245	3	2	2	1	5
ELE 4401	Parallel and Distributed Systems	ELE 3402	3	2	2	1	5
ELE 4403	Digital Forensics	ELE 3404	3	2	2	1	5
ELE 4405	Software Project Management	ELE 3406	3	2	2	1	5
ELE 4407	Compilers	ELE 144	3	2	2	1	5
ELE 4409	Internet of Things	ELE 342	3	2	2	1	5
ELE 4411	RTL Design	ELE 242	3	2	2	1	5
*ELE 4413	Selected Topics in Computer Engineering		3	2	2	1	5

* The course content must be approved by Electric Engineering Department Council before any student can register it.

Proposed Study Plan for Computer and Control Systems Engineering

Level 0-1														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 011	Mathematics I		3	2	0	2	4	2	30	30	-	40	100
BES 021	Mechanics I		3	2	0	2	4	2	30	30	-	40	100
BES 041	General Chemistry		4	3	2	1	6	2	10	30	20	40	100
BES 031	Physics I		3	2	2	1	5	2	10	30	20	40	100
MEC 011	Engineering Graphics		2	0	0	4	4	2	30	30	-	40	100
UHS 101	Foreign Language		2	2	0	0	2	2	30	30	-	40	100
UHS 102	Information and Communication Technology		2	2	0	0	2	2	30	30	-	40	100
Total			19	13	4	10	27						700

Level 0-2														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 012	Mathematics II	BES 011	3	2	0	2	4	2	30	30	-	40	100
BES 022	Mechanics II	BES 021	3	2	0	2	4	2	30	30	-	40	100
MEC 012	Production Engineering		2	1	3	0	4	2	10	30	20	40	100
BES 032	Physics II		3	2	2	1	5	2	10	30	20	40	100
MEC 014	Computer Aided Drafting	MEC 011	2	1	2	0	3	2	10	30	20	40	100
ELE 042	Computer Programming Fundamentals		2	0	2	2	4	2	10	30	20	40	100
UHS 103	Societal Issues		2	2	0	0	2	2	30	30	-	40	100
Total			17	10	9	7	26						700

Level 1-1

Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 111	Differential Equations	BES 012	3	2	0	2	4	2	30	30	-	40	100
BES 113	Mathematics III	BES 012	3	2	0	2	4	2	30	30	-	40	100
ELE 179	Electric Circuits Analysis	BES 032	3	2	1	2	5	2	10	30	20	40	100
ELE 141	Digital Logic Circuits		3	2	1	2	5	2	10	30	20	40	100
ELE 143	Object Oriented Programming	ELE 042	3	2	2	0	4	2	10	30	20	40	100
ELE 173	Electrical Applications		2	1	3	0	4	2	10	30	20	40	100
UHS XXX	Humanities Elective I		2	2	0	0	2	2	30	30	-	40	100
Total			19	13	7	8	28						700

Level 1-2

Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 112	Numerical Analysis	BES 111	3	2	2	0	4	2	10	30	20	40	100
BES 114	Discrete Mathematics and Linear Programming	BES 012	3	2	0	2	4	2	30	30	-	40	100
ELE 132	Measurements and Instrumentations I	ELE 179 or ELE 111	3	2	2	1	5	2	10	30	20	40	100
ELE 142	Digital System Design	ELE 141	3	2	2	1	5	2	10	30	20	40	100
ELE 144	Data Structure and Algorithms	ELE 143	3	2	2	0	4	2	10	30	20	40	100
ELE 114	Semiconductor Physics	BES 032	3	2	0	2	4	2	30	30	-	40	100
Total			18	12	8	6	26						600

1st Field Training														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
FTR 103	Field Training, I	Completed 65 CH	0	0	0	0	0	-	-	-	-	Pass/ Fail	-

Level 2-1														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
ELE 211	Signals and Systems	BES 111	3	2	0	2	4	2	30	30	-	40	100
ELE 213	Electronic Circuits I	ELE 114	3	2	1	2	5	2	10	30	20	40	100
ELE 231	Control Theory	BES 111	3	2	1	2	5	2	10	30	20	40	100
ELE 241	Computer Architecture	ELE 142	3	2	2	1	5	2	10	30	20	40	100
ELE 243	Algorithms Analysis and Design	BES 114, ELE 144	3	2	1	1	4	2	10	30	20	40	100
ELE 245	Computer Applications	ELE 042	3	2	2	0	4	2	10	30	20	40	100
Total			18	12	7	8	27						600

Level 2-2														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4	2	10	30	20	40	100
ELE 276	Electric Machines	ELE 179	3	2	1	1	4	2	10	30	20	40	100
ELE 232	Modern Control Systems	ELE 231	3	2	2	1	5	2	10	30	20	40	100
ELE 242	Computer Organization	ELE 241	3	2	2	1	5	2	10	30	20	40	100
ELE 244	Operating Systems	ELE 241	3	2	1	1	4	2	10	30	20	40	100
ELE 246	Computer Network		3	2	2	1	5	2	10	30	20	40	100
Total			18	12	10	5	27						600

2nd Field Training														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
FTR 203	Field Training, II	Completed 96CH	0	0	0	0	0	-	-	-	-	Pass/Fail	-

Level 3-1

Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
ELE 341	Microprocessor Based Systems	ELE 242	3	2	1	2	5	2	10	30	20	40	100
ELE 331	Machine Learning	ELE 243, BES 211	3	2	2	1	5	2	10	30	20	40	100
ELE 333	Digital Control	ELE 211, ELE 232	3	2	1	1	4	2	10	30	20	40	100
ELE 335	Industrial Automation Systems	ELE 132, ELE 232	3	2	2	1	5	2	10	30	20	40	100
ELE 343	Database Systems	ELE 144	3	2	2	1	5	2	10	30	20	40	100
UHS XXX	Humanities - Elective II		2	2	0	0	2	2	30	30	-	40	100
Total			17	12	8	6	26						600

Level 3-2

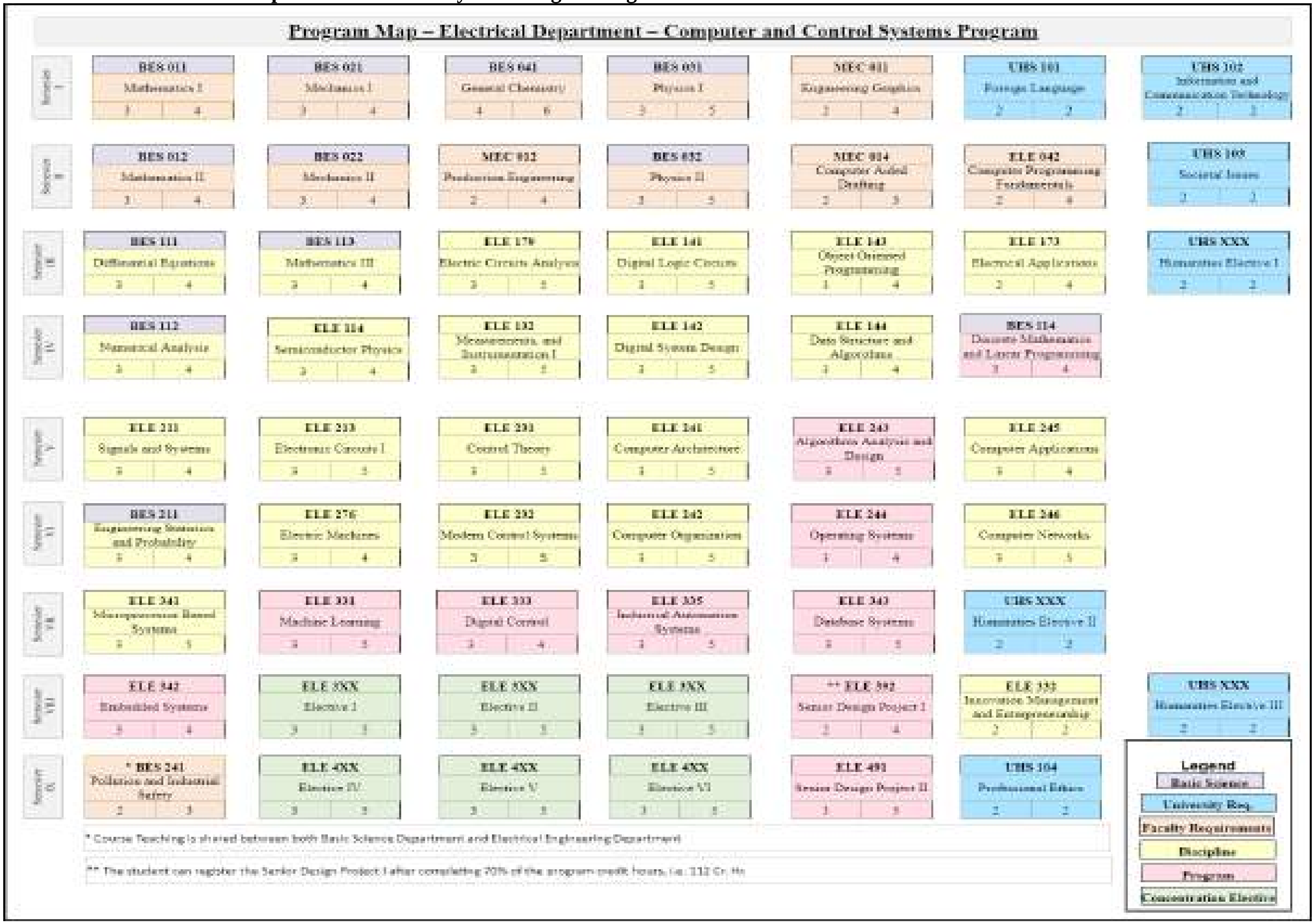
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
ELE 342	Embedded Systems	ELE 141	3	2	2	0	4	2	10	30	20	40	100
ELE 3XX	Elective I		3	2	2	1	5	2	10	30	20	40	100
ELE 3XX	Elective II		3	2	2	1	5	2	10	30	20	40	100
ELE 3XX	Elective III		3	2	2	1	5	2	10	30	20	40	100
ELE 332	Innovation Management and Entrepreneurship		2	2	0	0	2	2	30	30	-	40	100
ELE 392	Senior Design Project I	70% of total CH	2	0	4	0	4	2	50	-	50	--	100
UHS XXX	Humanities - Elective III		2	2	0	0	2	2	30	30	-	40	100
Total			18	13	11	3	27						700

Level 4-1

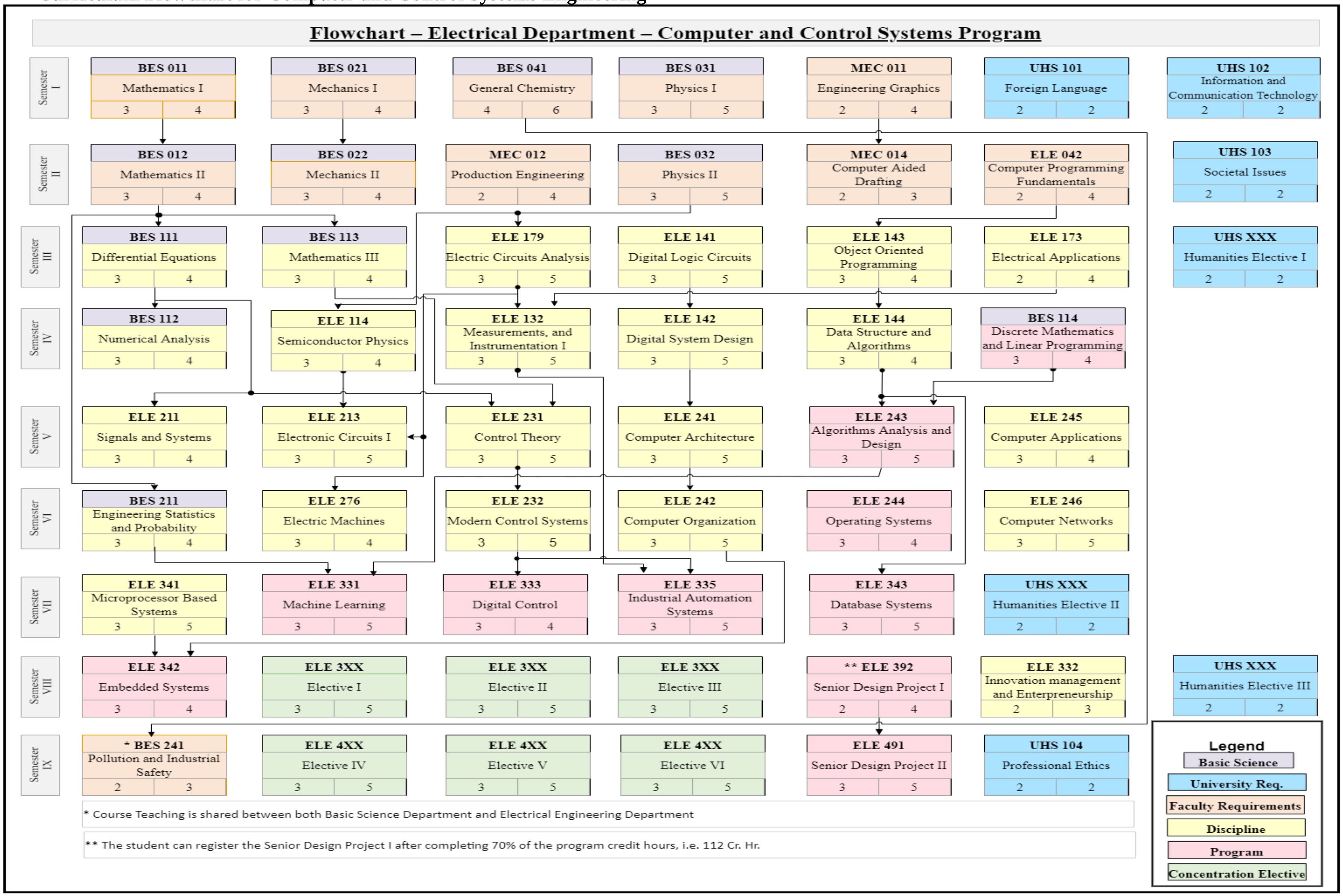
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 141	Pollution and Industrial Safety	BES 041	2	2	1	0	3	2	10	30	20	40	100
ELE 4XX	Elective IV		3	2	2	1	5	2	10	30	20	40	100
ELE 4XX	Elective V		3	2	2	1	5	2	10	30	20	40	100
ELE 4XX	Elective VI		3	2	2	1	5	2	10	30	20	40	100
ELE 491	Senior Design Project II	ELE 392	3	1	4	0	5	2	50	-	50	--	100
UHS 104	Professional Ethics		2	2	0	0	2	2	30	30	-	40	100
Total			16	11	11	3	25						600

Courses Plan and Matrix

Curriculum Plan for Computer and Control Systems Engineering



Curriculum Flowchart for Computer and Control Systems Engineering



Map of Elective Courses

Computer and Control Systems Program - Elective Courses Map

Elective slots

	ELE 3XX	Elective I	3	5
	ELE 3XX	Elective II	3	5
	ELE 3XX	Elective III	3	5
Semester IX	ELE 4XX	Elective IV	3	5
Semester IX	ELE 4XX	Elective V	3	5
Semester IX	ELE 4XX	Elective VI	3	5

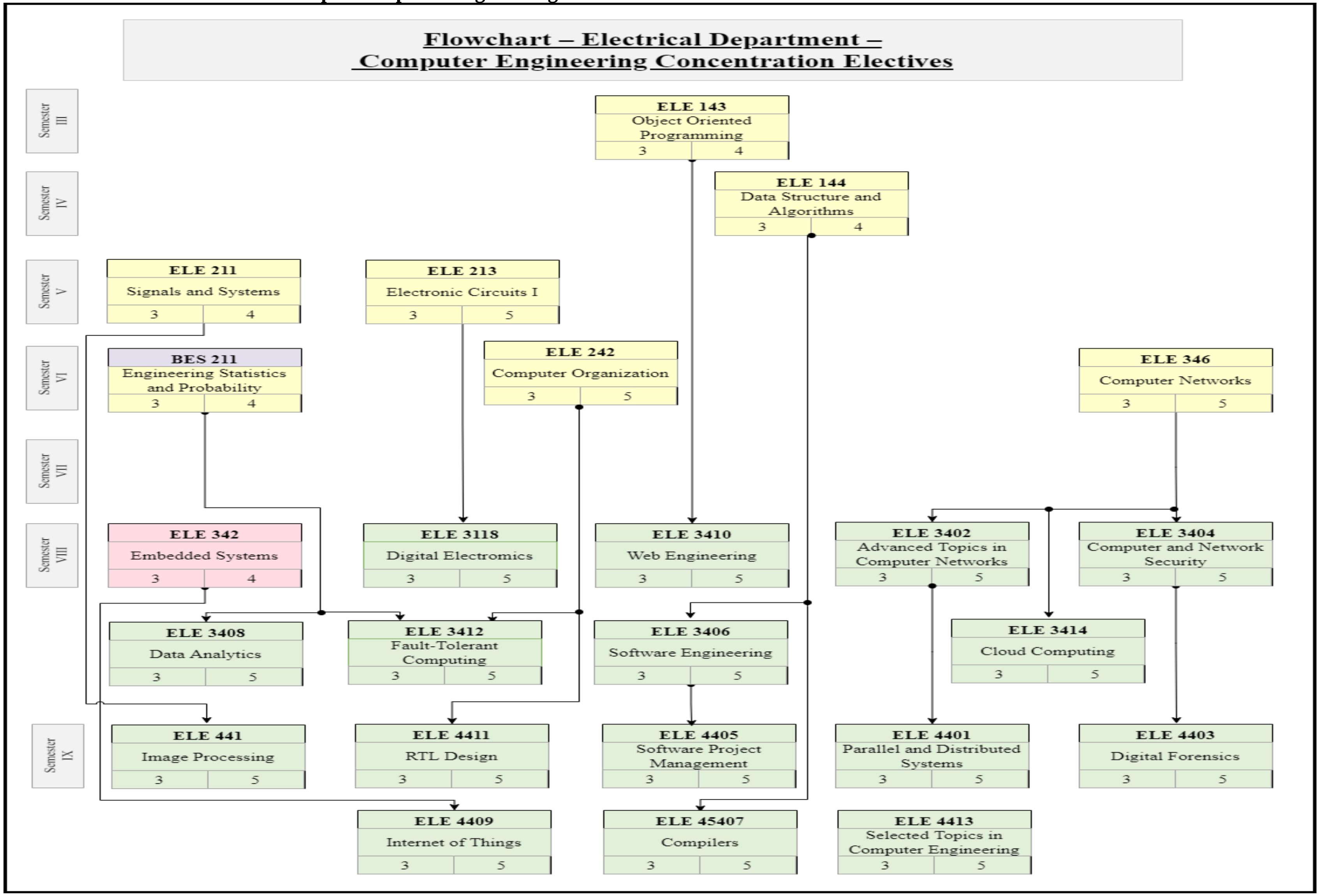
Computer Engineering Concentration Electives

ELE 3402	Advanced Topics in Computer Networks	3	5
ELE 3404	Computer and Network Security	3	5
ELE 3406	Software Engineering	3	5
ELE 3408	Data Analytics	3	5
ELE 3118	Digital Electronics	3	5
ELE 3410	Web Engineering	3	5
ELE 3412	Fault-Tolerant Computing	3	5
ELE 3414	Cloud Computing	3	5
ELE 4401	Parallel and Distributed Systems	3	5
ELE 4403	Digital Forensics	3	5
ELE 4405	Software Project Management	3	5
ELE 4407	Compilers	3	5
ELE 4411	RTL Design	3	5
ELE 4409	Internet of Things	3	5
ELE 441	Image Processing	3	5
ELE 4415	Selected Topics in Computer	3	5

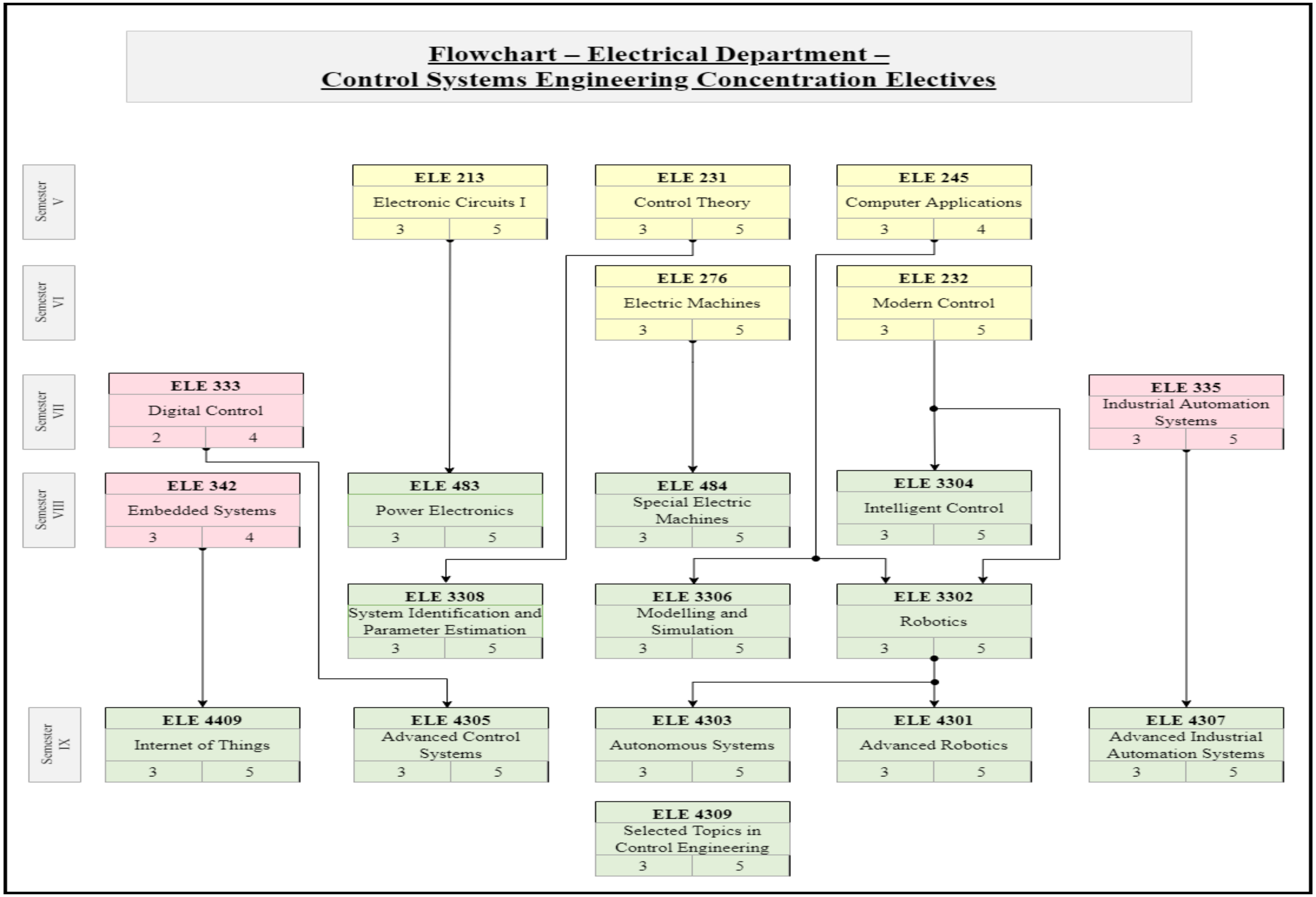
Control Systems Engineering Concentration Electives

ELE 3302	Robotics	3	5
ELE 3304	Intelligent Control	3	5
ELE 484	Special Electric Machines	3	5
ELE 3306	Modelling and Simulation	3	5
ELE 3308	System Identification and Parameter Estimation	3	5
ELE 483	Power Electronics	3	5
ELE 4301	Advanced Robotics	3	5
ELE 4303	Autonomous Systems	3	5
ELE 4305	Advanced Control Systems	3	5
ELE 4307	Advanced Industrial Automation Systems	3	5
ELE 4409	Internet of Things	3	5
ELE 4309	Selected Topics in Control Systems	3	5

Flowchart of Elective Courses Map – Computer Engineering Concentration



Flowchart of Elective Map – Control Systems Engineering Concentration



Study of External Reference with the Program (Benchmark)

- **Program Learning Outcomes Benchmark**

In addition to NARS2018, the program learning outcomes benchmarks are:

1. ACM, IEEE CC2020, Computing Curricula 2020, Paradigm for Global Computing Education, ISBN: 978-1-4503-9059-0.
2. Lac Hong University, Control and Automation Engineering Technology Program, Bien Hoa, Vietnam
3. Faculty of Electrical Engineering and Information Technologies, Computer Systems Engineering, Automation and Robotics, Skopje

The mapping of the benchmark to the program is shown below:

<table>
<tr><th>BM</th><th>Benchmark Outcome</th><th>Computer and Control Systems Program Outcomes</th></tr>
<tr><td rowspan="7">1</td><td>Evaluate and apply programming paradigms and languages to solve a wide variety of software design problems being mindful of trade-offs including maintainability, efficiency, and intellectual property constraints.</td><td rowspan="2">Determine the characteristics of a given problem, choose the appropriate method to solve, analyze, design and apply programming paradigm in Algorithm design/software design problems/intelligent systems design/ software engineering and testing</td></tr>
<tr><td>Determine the characteristics of a given problem that an intelligent system must solve and present the results to a project team</td></tr>
<tr><td>Design and/or implement basic and advanced I/O techniques, both synchronous and asynchronous and serial/parallel, including interrupts and time considerations</td><td rowspan="4">Design and Implement Embedded Systems/ Image and Signal Processing Systems/ Systems Using Programmable Devices/Systems Using ASIC Design, taking into account relevant system design constraint (time, interrupts, reliability, reducing failure, bridging the analog and digital domains,....)</td></tr>
<tr><td>Design and implement an example of an embedded system in a non-electronic device, including sensor feedback, low-power, and mobility.</td></tr>
<tr><td>Design signal processing systems applying knowledge of sampling and quantization to bridge the analog and digital domains.</td></tr>
<tr><td>Design a control or datapath circuit using programmable logic and considering relevant system design constraints and testability concerns.</td></tr>
<tr><td>Develop, deploy, maintain, and evaluate the performance of wireless and wired networking solutions in the context of relevant standards</td><td>Develop, deploy, manage, maintain, and evaluate the performance and security of wireless and wired networking principles in the context of relevant standards.</td></tr>
<tr><td>2</td><td>an ability to identify, formulate, and solve control and automation engineering problems</td><td>Analyze, design, model and evaluate basic control systems, multivariable systems and dynamic nonlinear systems for real world systems</td></tr>
<tr><td rowspan="2">3</td><td>Demonstrates knowledge and understanding of research, development, and application of knowledge in computer system engineering, automation and robotics, as well as engineering design in industrial processes.</td><td rowspan="2">Formulate and describe different types of Industrial robots: structure and applications, robot kinematics, dynamics, control systems, apply robot software tools, formulate solutions to solve problems related to robotics, industry and automation, apply principles and techniques in varied application domains related to industry and artificial intelligence.</td></tr>
<tr><td>An ability to identify, analyze and solve problems related to computer system engineering, automation and robotics.</td></tr>
</table>

	An ability to provide answers to both theoretical and practical issues, in order to give explanations and choose the appropriate solution.	
2	an ability to use the techniques, skills, and modern engineering tools necessary for control and automation engineering practice	Consolidate electrical, electronic, and digital components and equipment, and apply modern techniques, skills and engineering tools to electrical, power, machines, and intelligent engineering systems.
	a knowledge of electrical, electronics & communication, computer and other applied engineering necessary to analyze and design complex systems containing hardware and software components used in control and automation engineering applications.	

▪ Curriculum Courses Benchmark:

The benchmark of computer engineering is:

1- ACM, IEEE CC2020, Computing Curricula 2020, Paradigm for Global Computing Education, ISBN: 978-1-4503-9059-0.
2- ACM, IEEE CE2016, Computer Engineering Curricula 2016, Curriculum Guidelines for Undergraduate Degree Programs in Computer Engineering, ISBN: 978 – 1- 4503 – 4875 – 1, DOI: 10.1145/3025098.

The benchmark divides the Computer Engineering body of knowledge into 12 knowledge areas; each of them contains from 8 to 14 knowledge unit as shown in the following table:

CE-CAE Circuits and Electronics CE-CAE-1 History and overview CE-CAE-2 Relevant tools, standards, and/or engineering constraints CE-CAE-3 Electrical quantities and basic elements CE-CAE-4 Electrical circuits [11] CE-CAE-5 Electronic materials, diodes, and bipolar transistors CE-CAE-6 MOS transistor circuits, timing, and power [12] CE-CAE-7 Storage cell architecture CE-CAE-8 Interfacing logic families CE-CAE-9 Operational amplifiers CE-CAE-10 Mixed-signal circuit design CE-CAE-11 Design parameters and issues CE-CAE-12 Circuit modeling and simulation methods	**CE-CAL Computing Algorithms** CE-CAL-1 History and overview CE-CAL-2 Relevant tools, standards and/or engineering constraints CE-CAL-3 Basic algorithmic analysis CE-CAL-4 Algorithmic strategies CE-CAL-5 Classic algorithms for common tasks CE-CAL-6 Analysis and design of application-specific algorithms CE-CAL-7 Parallel algorithms and multi-threading CE-CAL-8 Algorithmic complexity CE-CAL-9 Scheduling algorithms CE-CAL-10 Basic computability theory
CE-CAO Computer Architecture and Organization CE-CAO-1 History and overview CE-CAO-2 Relevant tools, standards and/or engineering constraints CE-CAO-3 Instruction set architecture CE-CAO-4 Measuring performance CE-CAO-5 Computer arithmetic	**CE-DIG Digital Design** CE-DIG-1 History and overview CE-DIG-2 Relevant tools, standards, and/or engineering constraints CE-DIG-3 Number systems and data encoding CE-DIG-4 Boolean algebra applications CE-DIG-5 Basic logic circuits CE-DIG-6 Modular design of combinational circuits

CE-CAO-6 Processor organization CE-CAO-7 Memory system organization and architectures CE-CAO-8 Input/Output interfacing and communication CE-CAO-9 Peripheral subsystems CE-CAO-10 Multi/Many-core architectures CE-CAO-11 Distributed system architectures	CE-DIG-7 Modular design of sequential circuits CE-DIG-8 Control and datapath design CE-DIG-9 Design with programmable logic CE-DIG-10 System design constraints CE-DIG-11 Fault models, testing, and design for testability
CE-ESY Embedded Systems CE-ESY-1 History and overview CE-ESY-2 Relevant tools, standards, and/or engineering constraints CE-ESY-3 Characteristics of embedded systems CE-ESY-4 Basic software techniques for embedded applications CE-ESY-5 Parallel input and output CE-ESY-6 Asynchronous and synchronous serial communication CE-ESY-7 Periodic interrupts, waveform generation, time measurement CE-ESY-8 Data acquisition, control, sensors, actuators CE-ESY-9 Implementation strategies for complex embedded systems CE-ESY-10 Techniques for low-power operation CE-ESY-11 Mobile and networked embedded systems CE-ESY-12 Advanced input/output issues CE-ESY-13 Computing platforms for embedded systems	**CE-NWK Computer Networks** CE-NWK-1 History and overview CE-NWK-2 Relevant tools, standards, and/or engineering constraints CE-NWK-3 Network architecture CE-NWK-4 Local and wide area networks CE-NWK-5 Wireless and mobile networks CE-NWK-6 Network protocols CE-NWK-7 Network applications CE-NWK-8 Network management CE-NWK-9 Data communications CE-NWK-10 Performance evaluation CE-NWK-11 Wireless sensor networks
CE-PPP Preparation for Professional Practice CE-PPP-1 History and overview CE-PPP-2 Relevant tools, standards, and/or engineering constraints CE-PPP-3 Effective communication strategies CE-PPP-4 Interdisciplinary team approaches CE-PPP-5 Philosophical frameworks and cultural issues CE-PPP-6 Engineering solutions and societal effects CE-PPP-7 Professional and ethical responsibilities CE-PPP-8 Intellectual property and legal issues CE-PPP-9 Contemporary issues CE-PPP-10 Business and management issues CE-PPP-11 Tradeoffs in professional practice	**CE-SEC Information Security** CE-SEC-1 History and overview CE-SEC-2 Relevant tools, standards, and/or engineering constraints CE-SEC-3 Data security and integrity CE-SEC-4 Vulnerabilities: technical and human factors CE-SEC-5 Resource protection models CE-SEC-6 Secret and public key cryptography CE-SEC-7 Message authentication codes CE-SEC-8 Network and web security CE-SEC-9 Authentication CE-SEC-10 Trusted computing CE-SEC-11 Side-channel attacks
CE-SGP Signal Processing CE-SGP-1 History and overview CE-SGP-2 Relevant tools, standards, and/or	**CE-SPE Systems and Project Engineering** CE-SPE-1 History and overview CE-SPE-2 Relevant tools, standards and/or

engineering constraints CE-SGP-3 Convolution CE-SGP-4 Transform analysis CE-SGP-5 Frequency response CE-SGP-6 Sampling and aliasing CE-SGP-7 Digital spectra and discrete transforms CE-SGP-8 Finite and infinite impulse response filter design CE-SGP-9 Window functions CE-SGP-10 Multimedia processing CE-SGP-11 Control system theory and applications	engineering constraints CE-SPE-3 Project management principles CE-SPE-4 User experience* CE-SPE-5 Risk, dependability, safety and fault tolerance CE-SPE-6 Hardware and software processes CE-SPE-7 Requirements analysis and elicitation CE-SPE-8 System specifications CE-SPE-9 System architectural design and evaluation CE-SPE-10 Concurrent hardware and software design CE-SPE-11 System integration, testing and validation CE-SPE-12 Maintainability, sustainability, manufacturability
CE-SRM Systems Resource Management CE-SRM-1 History and overview CE-SRM-2 Relevant tools, standards, and/or engineering constraints CE-SRM-3 Managing system resources CE-SRM-4 Real-time operating system design CE-SRM-5 Operating systems for mobile devices CE-SRM-6 Support for concurrent processing CE-SRM-7 System performance evaluation CE-SRM-8 Support for virtualization	**CE-SWD Software Design** CE-SWD-1 History and overview CE-SWD-2 Relevant tools, standards, and/or engineering constraints CE-SWD-3 Programming constructs and paradigms CE-SWD-4 Problem-solving strategies CE-SWD-5 Data structures CE-SWD-6 Recursion CE-SWD-7 Object-oriented design CE-SWD-8 Software testing and quality CE-SWD-9 Data modeling CE-SWD-10 Database systems CE-SWD-11 Event-driven and concurrent programming CE-SWD-12 Using application programming interfaces CE-SWD-13 Data mining CE-SWD-14 Data visualization

In addition to these knowledge areas, there are 4 related computer engineering mathematics as shown in the following table:

CE-ACF Analysis of Continuous Functions CE-ACF-1 History and overview CE-ACF-2 Relevant tools and engineering applications CE-ACF-3 Differentiation methods CE-ACF-4 Integration methods CE-ACF-5 Linear differential equations CE-ACF-6 Non-linear differential equations CE-ACF-7 Partial differential equations CE-ACF-8 Functional series	**CE-DSC Discrete Structures** CE-DSC-1 History and overview CE-DSC-2 Relevant tools and engineering applications CE-DSC-3 Functions, relations, and sets CE-DSC-4 Boolean algebra principles CE-DSC-5 First-order logic CE-DSC-6 Proof techniques CE-DSC-7 Basics of counting CE-DSC-8 Graph and tree representations and properties CE-DSC-9 Iteration and recursion
CE-LAL Linear Algebra CE-LAL-1 History and overview	**CE-PRS Probability and Statistics** CE-PRS-1 History and overview

CE-LAL-2 Relevant tools and engineering applications CE-LAL-3 Bases, vector spaces, and orthogonality CE-LAL-4 Matrix representations of linear systems CE-LAL-5 Matrix inversion CE-LAL-6 Linear transformations CE-LAL-7 Solution of linear systems CE-LAL-8 Numerical solution of non-linear systems CE-LAL-9 System transformations CE-LAL-10 Eigensystems	CE-PRS-2 Relevant tools and engineering applications CE-PRS-3 Discrete probability CE-PRS-4 Continuous probability CE-PRS-5 Expectation and deviation CE-PRS-6 Stochastic Processes CE-PRS-7 Sampling distributions CE-PRS-8 Estimation CE-PRS-9 Hypothesis tests CE-PRS-10 Correlation and regression

The knowledge areas' units are covered by the Computer and Control Systems Engineering Program as shown in the following table:

Computer Engineering Courses/Benchmark Knowledge Area

	Course		Knowledge Area												
	Code	Title	CE-CAE	CE-SGP	CE-DIG	CE-CAO	CE-ESY	CE-SPE	CE-NWK	CE-SEC	CE-SWD	CE-CAL	CE-PPP	CE-SRM	Related Mathematic
Semester I	BES 011	Mathematics I													CE-ACF
	BES 021	Mechanics I													
	BES 041	General Chemistry													
	BES 031	Physics I													
	MEC 011	Engineering Graphics I													
	UHS 101	Foreign Language											3		
	UHS 102	Information and Communication Technology											1-2, 8		
Semester II	BES 012	Mathematics II													CE-LAL
	BES 022	Mechanics II													
	MEC 012	Production Engineering													
	BES 032	Physics II	1-3												
	MEC 014	Computer Aided Drafting													
	ELE 042	Fundamentals									1-3				
	UHS 103	Societal Issues													
Semester III	BES 111	Differential Equations													CE-ACF
	BES 113	Mathematics III													CE-ACF
	ELE 179	Electric Circuits Analysis	1-4, 9, 12												
	ELE 141	Digital Logic Circuits			1-5										
	ELE 143	Object Oriented Programming									3-4,7				
	ELE 173	Electrical Applications													
	UHS XXX	Humanities Elective I	Refer to Humanities Electives												
Semester IV	BES 112	Numerical Analysis													CE-LAL
	BES 114	Discrete Mathematics and Linear Programming													CE-DSC
	ELE 132	Measurements and Instrumentations I					8								
	ELE 142	Digital System Design			2, 6-7, 9										
	ELE 144	Data Structure and Algorithms									4-6	1-2,5			
	ELE 114	Semiconductor Physics	1-2, 5												
Semester V	ELE 211	Signals and Systems		1-7											
	ELE 213	Electronic Circuits I	5-6, 9, 12												
	ELE 231	Control Theory		5,11											
	ELE 241	Computer Architecture			8, 9	1-3, 5-6									
	ELE 243	Algorithms Analysis and Design									4	1-6,8			
	ELE 245	Computer Applications	12												
Semester VI	BES 211	Engineering Statistics and Probability													CE-PRS
	ELE 276	Electric Machines													
	ELE 232	Modern Control Systems		5,11											
	ELE 242	Computer Organization			8,10	1, 4,6-8, 10									
	ELE 244	Operating Systems				7						9		1-4,8	
	ELE 246	Computer Network							1-6						

	Course		Knowledge Area												
	Code	Title	CE-CAE	CE-SGP	CE-DIG	CE-CAO	CE-ESY	CE-SPE	CE-NWK	CE-SEC	CE-SWD	CE-CAL	CE-PPP	CE-SRM	Related Mathematic
Semester VII	ELE 244	Microprocessor Based Systems				3,8-9	7								
	ELE 331	Machine Learning									13				
	ELE 333	Digital Control		5,11											
	ELE 336	Industrial Automation Systems					8								
	ELE 343	Database Systems									9-10				
	UHS XXX	Humanities Elective II	Refer to Humanities Electives												
Semester VIII	ELE 342	Embedded Systems					1-9								
	ELE 3XX	Elective I	Refer to Computer Engineering Electives												
	ELE 3XX	Elective II													
	ELE 3XX	Elective III													
	ELE 392	Senior Design Project I						6-12							
	UHS XXX	Humanities Elective III	Refer to Humanities Electives												
Semester IX	BES 241	Pollution and Industrial Safety													
	ELE 4XX	Elective IV	Refer to Computer Engineering Electives												
	ELE 4XX	Elective V													
	ELE 4XX	Elective VI													
	ELE 491	Senior Design Project II						6-12							
	UHS 104	Professional Ethics											1-2, 7		
Humanities Elective I	UHS 201	Principles of Enterpreneurship and Project Management											6, 10		
	UHS 202	Introduction to Economics and Accounting											10		
	UHS 203	Human Resources Management													
	UHS 301	Communication and Presentation Skills											3		
	UHS 302	Leadership Skills											4		
	UHS 801	Research Methodologies													
	UHS 803	Thinking Skills													
Computer Engineering Electives	ELE 3402	Advanced Topics in Computer Networks							6-11						
	ELE 3404	Computer and Nework Security								1-8					
	ELE 3406	Software Engineering									8-9, 11-12				
	ELE 3408	Data Analysis									13-14				
	ELE 3118	Digital Electronics	1-2, 6-8, 11, 12												
	ELE 3410	Web Development							7						
	ELE 3412	Fault-Tolerant Computing			10-11			8							
	ELE 3414	Cloud Computing				11			7						
	ELE 441	Image Processing		10											
	ELE 4401	Parallel and Distributed Systems				10-11						7			
	ELE 4403	Digital Forensics								4, 8-11			9		
	ELE 4405	Software Project Management						1-5							
	ELE 4407	Compilers										10			
	ELE 4409	Internet of Things					10-13								
	ELE 4411	RTL Design			8-10	5									

The Matching of the Computer and Control Engineering with ABET Requirements

Curriculum Criteria

	Computer and Control Systems Engineering	ABET
Mathematics and Basic Science	33 cr. Hrs.	>=30 Cr.Hrs.
Discipline	67 Cr.Hrs.	>=45 Cr.Hrs.

- **ABET Program Criteria for Electrical/ Computer Engineering**

ABET Criteria	Computer and Control Systems Engineering to Cover the Criteria
Probability and Statistics	ELE 211 Engineering Statistics and Probability
Mathematics	BES 011 Mathematics I – BES 012 Mathematics II – BES 111 Differential Equations – BES 113 Mathematics III – BES 112 Numerical Analysis -
Sciences	BES 021 Mechanics I – BES 041 General Chemistry – BES 031 Physics I – BES 022 Mechanics II – BES 032 Physics II -
Discrete Mathematics	BES 114 Discrete Mathematics and Linear Programming
Topics to analyze and design complex electrical and electronic devices	ELE 179 Electric Circuits Analysis – ELE 141 Digital Logic Circuits – ELE 173 Electrical Applications –ELE 114 Semiconductor Physics – ELE 211 Signals and Systems – ELE 213 Electronic Circuits I – ELE 245 Computer Applications – ELE 276 Electric Machines – ELE 346 Computer Simulation Methods – ELE 3118 Digital Electronics – ELE 484 Special Electric Machines – ELE 3306 Modelling and Simulation – ELE 483 Power Electronics
Topics to analyze and design complex software	ELE 042 Computer Programming Fundamentals – ELE 143 Object Oriented Programming – ELE 144 Data Structure and Algorithms – ELE 243 Algorithms Analysis and Design – ELE 343 Database Systems –ELE 3406 Software Engineering – ELE 4405 Software Project Management – ELE 4407 Compilers -
Topics to analyze and design complex hardware systems	ELE 142 Digital System Design – ELE 241 Computer Architecture – ELE 242 Computer Organization – ELE 341 Microprocessor Based Systems – ELE 342 Embedded Systems – ELE 4411 RTL Design
Operating Systems and Networks	ELE 244 Operating Systems – ELE 246 Computer Networks – ELE 3402 Advanced Topics in Computer Networks
Apply Concepts of automatic control	ELE 231 Control Theory – ELE 232 Modern Control Systems – ELE 333 Digital Control – ELE 3304 Intelligent Control – ELE 4305 Advanced Control Systems
Apply concepts of measurements and sensor selection	ELE 132 Measurements and Instrumentations I – ELE 335 Industrial Automation Systems
Utilize programmable logic controllers	ELE 335 Industrial Automation Systems – ELE 4307 Advanced Industrial Automation Systems
Robotic and Automation Fields	ELE 3302 Robotics – ELE 4301 Advanced Robotics – ELE 4303 Autonomous Systems -
Topics to demonstrate the breadth and depth of the program	ELE 331 Machine Learning – ELE 3404 Computer and Network Security – ELE 3408 Data Analytics – ELE 3410 Web Engineering – ELE 3412 Fault-Tolerant Computing – ELE 3414 Cloud Computing – ELE 441 Image Processing – ELE 4401 Parallel and Distributed Systems – ELE 4401 Digital Forensics – ELE 4409 Internet of Things -

Program # 6 Electronics and Electrical Communications Engineering Program

Program Description

The Electronics and Electrical Communications Engineering program offers a specialization for those who want to combine the specialty of Electronics and Communications Engineering as it provides a balanced mix of electronics and communications. This mix has become necessary for the presence of modern electronics, digital systems, and communication systems. This is also in line with the knowledge economy and the dynamic nature of specialization. Each branch has become a stand-alone industry such as the electronics industry, digital systems industry, and the telecommunications technology industry. This specialization is considered one of the modern specializations on the international level, where the department grants a bachelor's degree to graduates in electronics and communications engineering after preparing them with a comprehensive curriculum according to NARS 2018 standards. It also explores new areas in electronics and electrical communications engineering where the program integrates knowledge in different areas of electronic circuits design, digital systems design, communication systems design, electronic systems' applications, digital systems applications, communication networks' connections, information theory and channel coding, modern wireless communication basics, satellites communications, and cellular communications, as well as areas of digital signal processing.

Basic Information

Program Mission

The Electronics and Electrical Communications Engineering program at Benha Faculty of Engineering aims to prepare scientifically qualified and professional engineers in the fields of communications and electronics engineering, able to compete in the local and regional labor market and conduct scientific research to serve the community and develop the environment.

Program Objectives

Program Objectives

The Electronics and Electrical Communications Engineering program is planned to:

1. Apply a wide spectrum of engineering knowledge, science, and specialized skills with analytic, critical, and systemic thinking to design systems, conduct experiments, analyze data, manage projects, identify, and solve engineering problems in real life situation.
2. Enhance the engineering skills by using modern engineering software programs and engineering tools for engineering practice.
3. Behave professionally and adhere to engineering ethics, standards, and work to develop the profession and the community and promote sustainability principles.
4. Work in and lead a heterogeneous team of professionals from different engineering specialties and display leadership qualities, business administration, and entrepreneurial skills.
5. Identify communication, presentation, and language skills to ensure effective communication, demonstrate professional and ethical responsibilities, and engage in lifelong self-learning so that graduates are prepared for post-graduate and research studies beside working in modern and complex work environments in a creative manner.
6. Design, operate, analyze, and maintain different electronic circuits and communication systems.
7. Use modern software tools to design, simulate, and implement different parts of electronics and communication system.

Graduate Attributes

Graduate attributes are the academic abilities, personal qualities, and skills which electronics and electrical communications engineering graduates should have. In addition to all engineering graduate attributes defined by NARS 2018, Electronics and Electrical Communications Engineering graduate should be able to:

1. Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real life situations
2. Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation.
3. Behave professionally and adhere to engineering ethics and standards.
4. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance.
5. Recognize his/her role in promoting the engineering field and contribute to the development of the profession and the community.
6. Value the importance of the environment, both physical and natural, and work to promote sustainability principles.
7. Use techniques, skills, and modern engineering tools necessary for engineering practice.
8. Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies.
9. Communicate effectively using different modes, tools, and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner.
10. Demonstrate leadership qualities, business administration and entrepreneurial skills.
11. Design, operate, analyze, and maintain different electronic circuits and systems.
12. Design, operate, analyze, and maintain different communication systems.
13. Use modern software tools to design, simulate, and implement different parts of electronics and communication system.

Program Learning Outcomes

The program courses fulfill the NARS 2018. A graduate must be able to:

Level A:

The Engineering Graduate must be able to:

PLO1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics.

PLO2. Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess, and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

PLO3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical, and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

PLO4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues, and risk management principles.

PLO5. Practice research techniques and methods of investigation as an inherent part of learning.

PLO6. Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.

PLO7. Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural teams.

PLO8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.

PLO9. Use creative, innovative, and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

PLO10. Acquire and apply new knowledge, and practice self, lifelong and other learning strategies.

Level B:

In addition to the competencies for all engineering programs, the BASIC ELECTRICAL Engineering graduate and similar programs must be able to:

PLO11. Design, model and analyze an electrical/electronic/digital system or component for a specific application; and identify the tools required to optimize this design.

PLO12. Design and implement elements, modules, sub-systems, or systems in electrical/electronic/digital engineering using technological and professional tools.

PLO13. Estimate and measure the performance of an electrical/electronic/digital system and circuit under specific input excitation and evaluate its suitability for a specific application.

PLO14. Adopt suitable national and international standards and codes to design, build, operate, inspect and maintain electrical/electronic/digital equipment, systems and services.

Level C:

In addition to competencies for all engineering programs (Level A, NARS 2018), and specific Electric Engineering competencies (Level B, NARS 2018), electronics and electrical communications engineer must be able to:

PLO15. Understand the underlying physical phenomena and limitations of the performance of components and systems in electronics and communications engineering.

PLO16. Design, model and analyze of elements, modules, and sub-systems in communication and electronics systems for specific applications using technological and professional tools and identify the software tools required to optimize this design.

PLO17. Design and compare between alternative components and systems in electronics and communications Engineering; Demonstrate the knowledge about state of the art of circuits and systems in electronics and communications engineering.

PLO18. Estimate and measure the performance of sub-block in a communication system or the whole communication and electronics system under specific working conditions and evaluate its suitability for a specific application.

PLO19. Design and Implement Embedded Systems/ Image and Signal Processing Systems/ Systems Using Programmable Devices/Systems Using ASIC Design, taking into account relevant system design constraints (time, interrupts, reliability, reducing failure, bridging the analog and digital domains, ...).

Faculty Mission vs. Program Mission Matrix

Faculty Mission		Program Mission		
		The Electronics and Electrical Communications Engineering program at Benha Faculty of Engineering aims to prepare scientifically qualified and professional engineers in the fields of communications and electronics engineering, able to compete in the local and regional labor market and conduct scientific research to serve the community and develop the environment.		
		prepare scientifically qualified and professional engineers in the fields of communications and electronics engineering	able to compete in the local and regional labor market and conduct scientific research	participate effectively and ethically in serving their professional and societal communities
Benha University is committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market, and capable of using and developing modern technology, and providing research in engineering fields to serve society and community.	graduate well prepared engineers equipped with knowledge and skills	√		
	compete in labor market capable of using and developing modern technology, and providing research in engineering fields		√	
	serve society and community.			√

Program Mission vs. Program Objectives Matrix

Program Mission		Program Objectives						
		PO1	PO2	PO3	PO4	PO5	PO6	PO7
The Electrical Communications and Electronics Engineering program at Benha Faculty of Engineering aims to prepare scientifically qualified and professional engineers in the fields of communications and electronics engineering, able to compete in the local and regional labor market and conduct scientific research to serve the community and develop the environment.	prepare scientifically qualified and professional engineers in the fields of communications and electronics engineering	√	√				√	√
	able to compete in the local and regional labor market and conduct scientific research			√	√	√		
	participate effectively and ethically in serving their professional and societal communities			√	√	√		

Program Objectives vs. Graduate Attributes Matrix

Program Objectives	Graduate Attributes												
	G.A 1	G.A 2	G.A 3	G.A 4	G.A 5	G.A 6	G.A 7	G.A 8	G.A 9	G.A 10	G.A 11	G.A 12	G.A 13
PO1	√	√											
PO2							√						
PO3			√		√	√							
PO4				√						√			
PO5								√	√				
PO6											√	√	
PO7													√

Program Competencies vs. Program Objectives Matrix

Program Objectives	Program Competencies																		
	Level A										Level B				Level C				
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4	C1	C2	C3	C4	C5
PO1	√	√	√								√	√	√						
PO2					√						√	√				√			
PO3				√	√									√					
PO4						√	√	√											
PO5					√			√	√	√									
PO6			√	√							√	√	√	√	√	√	√	√	√
PO7		√		√								√				√			√

Career Prospects

Electronics engineers work in most industries, including the digital computer, automobile, aerospace, wired and wireless communications, manufacturing, defense, and electronics industries. They design high-tech devices ranging from tiny microelectronic integrated-circuit chips to powerful systems that utilize those chips and efficient communication systems that interconnect those systems. Communications engineers analysis, design, and develop communications equipment and systems. They are also involved in the production of these systems. As a communication engineer you could work within several industries, including internet and computing technologies, networking and telecommunications, and radio transmission. Many posts include elements of both managerial and technical responsibilities but it's also possible for you to focus on just one of these areas.

List of Electronics and Electrical Communications Engineering Requirement Courses

Requirement	Cr. Hrs.	Ct. Hr			
		Lec	Lab	Tut	Tot
Benha University Requirements	14	14	0	0	14
Benha Faculty of Engineering Requirements	32	19	34	47	50
Discipline Requirements	68	45	30	29	104
Electronics and Electrical Communications Program Requirements	46	29	28	19	76
Total	**160**	**107**	**92**	**95**	**244**

Basic Science Requirements of Electronics and Electrical Communications Engineering

Code	Course Title	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
BES 011	Mathematics I		3	2	0	2	4
BES 041	General Chemistry		4	3	2	1	6
BES 031	Physics I		3	2	2	1	5
BES 012	Mathematics II	BES 011	3	2	0	2	4
BES 032	Physics II		3	2	2	1	5
BES 111	Differential Equations	BES 012	3	2	0	2	4
BES 112	Numerical Analysis	BES 111	3	2	2	0	4
*BES 141	Pollution and Industrial Safety	BES 041	2	2	1	0	3
BES 113	Mathematics III	BES 012	3	2	0	2	4
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4
**ELE 114	Semiconductors Physics	BES 032	3	2	0	2	4
Total			**30**	**21**	**3**	**17**	**41**

* Course teaching is shared between the Basic Engineering Science Department and Electrical Engineering Department.

** One credit hour is considered as Basic Engineering Science topics and two Cr. Hrs. are Electrical Engineering topics.

Program Requirements of Electronics and Electrical Communications Engineering

Code	Course Title	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
BES 111	Differential Equations	BES 012	3	2	0	2	4
BES 112	Numerical Analysis	BES 111	3	2	2	0	4
ELE 111	Electric Circuits I	BES 032	3	2	1	2	5
ELE 112	Electric Circuits II	ELE 111	3	2	1	2	5
ELE 114	Semiconductor Physics	BES 032	3	2	0	2	4
ELE 141	Digital Logic Circuits		3	2	1	2	5
ELE 142	Digital System Design	ELE 141	3	2	2	1	5
ELE 143	Object Oriented Programming	ELE 042	3	2	2	0	4
ELE 144	Data Structure and Algorithms	ELE 143	3	2	2	0	4
ELE 173	Electrical Applications		2	1	3	0	4
ELE 132	Measurements and Instrumentations I	ELE 179 or ELE 111	3	2	2	1	5
BES 113	Mathematics III	BES 012	3	2	0	2	4
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4
ELE 211	Signals and Systems	BES 111	3	2	0	2	4
ELE 213	Electronic Circuits I	BES 131 or ELE 114	3	2	1	2	5
ELE 214	Electronic Circuits II	ELE 213	3	2	1	2	5
ELE 245	Computer Applications	ELE 042	3	2	2	0	4
ELE 216	Electromagnetic Field	BES 113	3	2	0	2	4
ELE 241	Computer Architecture	ELE 142	3	2	2	1	5
ELE 242	Computer Organization	ELE 241	3	2	2	1	5
ELE 231	Control Theory	BES 111	3	2	1	2	5
ELE 2xx	Elective I		3	2	2	1	5
ELE 341	Microprocessor Based Systems	ELE 242	3	2	1	2	5
Total			**68**	**45**	**30**	**29**	**104**

Pool of Electives of Discipline Requirements of Electronics and Electrical Communications Engineering

Elective	Code	Course	Pre-Req
Elective I	ELE 246	Computer Network	
	ELE 232	Modern Control	ELE 231

Major Requirements of Electronics and Electrical Communications Engineering

Code	Course Title	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Tot
ELE 212	Analog Communication Systems	ELE 211	3	2	1	2	5
ELE 311	Digital Communication Systems	ELE 212	3	2	1	2	5
ELE 312	Wireless Communication Systems	ELE 211	3	2	1	2	5
ELE 313	Information Theory	BES 211	2	2	1	1	4
ELE 314	Digital Signal Processing I	ELE 211	3	2	1	2	5
ELE 315	Transmission Lines	ELE 216	3	2	1	2	5
ELE 316	Antenna Theory and Wave Propagation I	ELE 315	3	2	1	2	5
ELE 317	Electronic Circuit Design	ELE 214	3	2	1	2	5
ELE 4411	RTL design	ELE 242	3	2	2	1	5
ELE 411x	Elective II		3	2	2	1	5
ELE 412x	Elective III		3	2	2	1	5
ELE 413x	Elective IV		3	2	2	0	4
ELE 442x	Elective V		3	2	2	1	5
ELE 415x	Elective VI		3	2	2	0	4
*ELE 392	Senior Design Project I		2	0	4	0	4
ELE 491	Senior Design Project II	ELE 392	3	1	4	0	5
Total			**46**	**29**	**28**	**19**	**76**

*The student can register the Senior Design Project course after passing 70% of the program cr. hrs, i.e., 105 Cr. Hr.

Pool of Electives of Electronics and Electrical Communications Engineering

Elective	Code	Course Title	Pre-Req
Elective II	ELE 4111	Satellite Communication	ELE 312
	ELE 4112	Cellular Communication	ELE 312
Elective III	ELE 4121	Antenna Theory and Wave Propagation II	ELE 316
	ELE 4122	Microwave Circuits and Devices	ELE 316
Elective IV	ELE 4131	Forward Error Correction Codes	ELE 313
	ELE 4132	Embedded Systems	ELE 341
Elective V	ELE 4425	VLSI Design	ELE 4411
	ELE 4427	ASIC Design	ELE 4411
Elective VI	ELE 4151	Digital Signal Processing II	ELE 314
	ELE 4152	Detection and Estimation Theory	ELE 211

Proposed Study Plan for Electronics and Electrical Communications Engineering

Level 0-1														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
BES 011	Mathematics I		3	2	0	2	4	2	30	30	-	40	100
BES 021	Mechanics I		3	2	0	2	4	2	30	30	-	40	100
BES 041	General Chemistry		4	3	2	1	6	2	10	30	20	40	100
BES 031	Physics I		3	2	2	1	5	2	10	30	20	40	100
MEC 011	Engineering Graphics		2	0	0	4	4	2	30	30	-	40	100
UHS 101	Foreign Language		2	2	0	0	2	2	30	30	-	40	100
UHS 102	Information and Communication technology		2	2	0	0	2	2	30	30	-	40	100
Total			**19**	**13**	**4**	**10**	**27**						**700**

Level 0-2														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
BES 012	Mathematics II	BES 011	3	2	0	2	4	2	30	30	-	40	100
BES 022	Mechanics II	BES 021	3	2	0	2	4	2	30	30	-	40	100
BES 032	Physics II		3	2	2	1	5	2	10	30	20	40	100
MEC 012	Production Engineering		2	1	3	0	4	2	10	30	20	40	100
MEC 014	Computer Aided Drafting	MEC 011	2	1	2	0	3	2	10	30	20	40	100
ELE 042	Computer Programming Fundamentals		2	0	2	2	4	2	10	30	20	40	100
UHS 103	Societal Issues		2	2	0	0	2	2	30	30	-	40	100
Total			**17**	**10**	**9**	**7**	**26**						**700**

Level 1-1														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
ELE 111	Electric Circuits I	BES 032	3	2	1	2	5	2	10	30	20	40	100
ELE 141	Digital Logic Circuits		3	2	1	2	5	2	10	30	20	40	100
ELE 143	Object Oriented Programming	ELE 042	3	2	2	0	4	2	10	30	20	40	100
ELE 173	Electrical Application		2	1	3	0	4	2	10	30	20	40	100
BES 111	Differential Equations	BES 012	3	2	0	2	4	2	30	30	-	40	100
BES 141	Pollution and Industrial Safety	BES 041	2	2	1	0	3	2	10	30	20	40	100
UHS 2XX	Humanities Elective I		2	2	0	0	2	2	30	30	-	40	100
Total			**18**	**13**	**8**	**6**	**27**						**700**

Level 1-2													
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
ELE 112	Electric Circuits II	ELE 111	3	2	1	2	5	2	10	30	20	40	100
ELE 142	Digital System Design	ELE 141	3	2	2	1	5	2	10	30	20	40	100
ELE 144	Data Structure and Algorithms	ELE 143	3	2	2	0	4	2	10	30	20	40	100
ELE 132	Measurements and Instrumentations I	ELE 111 or ELE 179	3	2	2	1	5	2	10	30	20	40	100
BES 112	Numerical Analysis	BES 111	3	2	2	0	4	2	10	30	20	40	100
ELE 114	Semiconductors Physics	BES 032	3	2	0	2	4	2	30	30	-	40	100
Total			**18**	**12**	**9**	**6**	**27**						**600**

Field Training I														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
FTR 103	Field Training I	Completion of 65 Cr. Hr	0	0	0	0	0	Oral	-	-	-	Pass or Fail	-

Level 2-1													
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
ELE 211	Signals and Systems	BES 111	3	2	0	2	4	2	30	30	-	40	100
ELE 213	Electronic Circuits I	ELE 114	3	2	1	2	5	2	10	30	20	40	100
ELE 245	Computer Applications	ELE 042	3	2	2	0	4	2	10	30	20	40	100
ELE 241	Computer Architecture	ELE 142	3	2	2	1	5	2	10	30	20	40	100
ELE 231	Control Theory	BES 111	3	2	1	2	5	2	10	30	20	40	100
BES 113	Mathematics III	BES 012	3	2	0	2	4	2	30	30	-	40	100
Total			**18**	**12**	**6**	**9**	**27**						**600**

Level 2-2													
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
ELE 212	Analog Communication Systems	ELE 211	3	2	1	2	5	2	10	30	20	40	100
ELE 214	Electronic Circuits II	ELE 213	3	2	1	2	5	2	10	30	20	40	100
ELE 216	Electromagnetic Fields	BES 113	3	2	0	2	4	2	30	30	-	40	100
ELE 242	Computer Organization	ELE 241	3	2	2	1	5	2	10	30	20	40	100
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4	2	10	30	20	40	100
ELE 2xx	Elective I		3	2	2	1	5	2	10	30	20	40	100
Total			**18**	**12**	**8**	**8**	**28**						**600**

Field Training II														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam time	Assessment					
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
FTR 203	Field Training II	Completion of 96 Cr. Hr	0	0	0	0	0	Oral	-	-	-	Pass or Fail	-

Level 3-1														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
ELE 311	Digital Communication Systems	ELE 212	3	2	1	2	5	2	10	30	20	40	100
ELE 313	Information Theory	BES 211	2	2	1	1	4	2	10	30	20	40	100
ELE 315	Transmission Lines	ELE 216	3	2	1	2	5	2	10	30	20	40	100
ELE 317	Electronic Circuit Design	ELE 214	3	2	1	2	5	2	10	30	20	40	100
ELE 341	Microprocessor Based Systems	ELE 242	3	2	1	2	5	2	10	30	20	40	100
UHS 104	Professional Ethics		2	2	0	0	2	2	30	30	-	40	100
UHS 3XX	Humanities Elective II		2	2	0	0	2	2	30	30	-	40	100
Total			**18**	**14**	**5**	**9**	**28**						**700**

Level 3-2													
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
ELE 312	Wireless Communication Systems	ELE 311	3	2	1	2	5	2	10	30	20	40	100
ELE 314	Digital Signal Processing I	ELE 211	3	2	1	2	5	2	10	30	20	40	100
ELE 316	Antenna Theory and Wave Propagation I	ELE 315	3	2	1	2	5	2	10	30	20	40	100
ELE 4411	RTL design	ELE 242	3	2	2	1	5	2	10	30	20	40	100
ELE 392	Senior Design Project I		2	0	4	0	4	2	50	-	50	--	100
UHS 8XX	Humanities Elective III		2	2	0	0	2	2	30	30	-	40	100
Total			**16**	**10**	**9**	**7**	**26**						**600**

Level 4-1														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
ELE 411x	Elective II		3	2	2	1	5	2	10	30	20	40	100
ELE 412x	Elective III		3	2	2	1	5	2	10	30	20	40	100
ELE 413x	Elective IV		3	2	2	0	4	2	10	30	20	40	100
ELE 442x	Elective V		3	2	2	1	5	2	10	30	20	40	100
ELE 415x	Elective VI		3	2	2	0	4	2	10	30	20	40	100
ELE 491	Senior Design Project II	ELE 392	3	1	4	0	5	2	50	-	50	--	100
Total			**18**	**11**	**14**	**3**	**28**						**600**

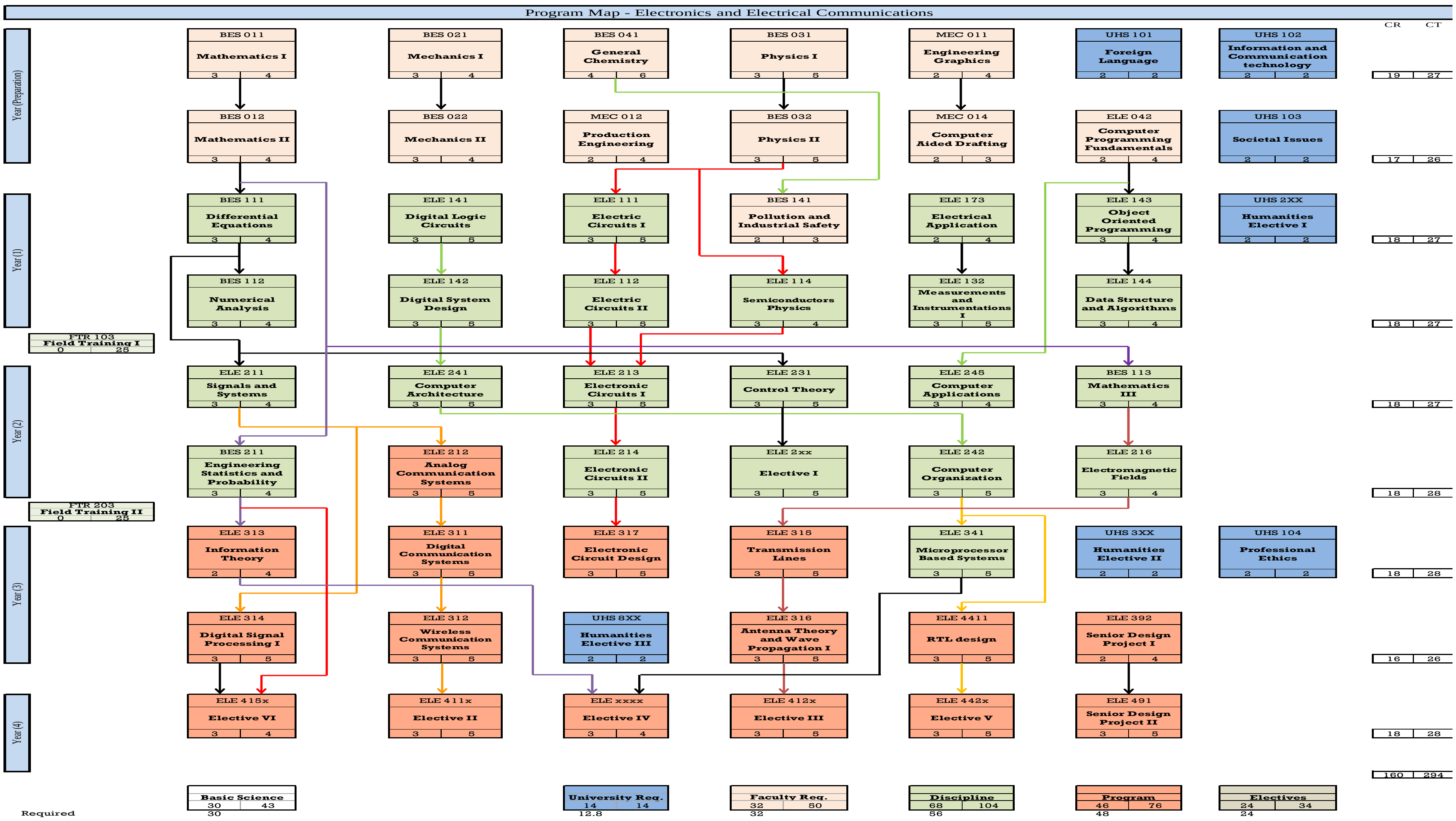
Curriculum Plan

Program Map - Electronics and Electrical Communications

Year								CR	CT
Year (Preparation)	BES 011 Mathematics I 3 4	BES 021 Mechanics I 3 4	BES 041 General Chemistry 4 6	BES 031 Physics I 3 5	MEC 011 Engineering Graphics 2 4	UHS 101 Foreign Language 2 2	UHS 102 Information and Communication technology 2 2	19	27
	BES 012 Mathematics II 3 4	BES 022 Mechanics II 3 4	MEC 012 Production Engineering 2 4	BES 032 Physics II 3 5	MEC 014 Computer Aided Drafting 2 3	ELE 042 Computer Programming Fundamentals 2 4	UHS 103 Societal Issues 2 2	17	26
Year (1)	BES 111 Differential Equations 3 4	ELE 111 Electric Circuits I 3 5	ELE 141 Digital Logic Circuits 3 5	ELE 143 Object Oriented Programming 3 4	ELE 173 Electrical Application 2 4	BES 141 Pollution and Industrial Safety 2 3	UHS 2XX Humanities Elective I 2 2	18	27
	BES 112 Numerical Analysis 3 4	ELE 112 Electric Circuits II 3 5	ELE 142 Digital System Design 3 5	ELE 144 Data Structure and Algorithms 3 4	ELE 132 Measurements and Instrumentations I 3 5	ELE 114 Semiconductors Physics 3 4		18	27
	FTR 103 Field Training I 0 25								
Year (2)	BES 113 Mathematics III 3 4	ELE 211 Signals and Systems 3 4	ELE 213 Electronic Circuits I 3 5	ELE 245 Computer Applications 3 4	ELE 241 Computer Architecture 3 5	ELE 231 Control Theory 3 5		18	27
	BES 211 Engineering Statistics and Probability 3 4	ELE 212 Analog Communication Systems 3 5	ELE 214 Electronic Circuits II 3 5	ELE 216 Electromagnetic Fields 3 4	ELE 242 Computer Organization 3 5	ELE 2xx Elective I 3 5		18	28
	FTR 203 Field Training II 0 25								
Year (3)	ELE 311 Digital Communication Systems 3 5	ELE 313 Information Theory 2 4	ELE 315 Transmission Lines 3 5	ELE 317 Electronic Circuit Design 3 5	ELE 341 Microprocessor Based Systems 3 5	UHS 3XX Humanities Elective II 2 2	UHS 104 Professional Ethics 2 2	18	28
	ELE 312 Wireless Communication Systems 3 5	ELE 314 Digital Signal Processing I 3 5	ELE 316 Antenna Theory and Wave Propagation I 3 5	ELE 4411 RTL design 3 5	UHS 8XX Humanities Elective III 2 2	ELE 392 Senior Design Project I 2 4		16	26
Year (4)	ELE 411x Elective II 3 5	ELE 412x Elective III 3 5	ELE xxxx Elective IV 3 4	ELE 442x Elective V 3 5	ELE 415x Elective VI 3 4	ELE 491 Senior Design Project II 3 5		18	28
								160	244

	Basic Science	University Req.	Faculty Req.	Discipline	Program	Electives
	30 43	14	32 50	68 104	46 76	24 34
Required	30	12.8	32	56	48	24

Curriculum Flowchart



Program Learning Outcomes to Program Courses Matrix

Level	CODE	Course Name	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12	PLO 13	PLO 14	PLO 15	PLO 16	PLO 17	PLO 18	PLO 19
Level-1	BES 011	Mathematics I	√		√																
	BES 021	Mechanics I	√	√																	
	BES 041	General Chemistry	√	√																	
	BES 031	Physics I	√	√																	
	MEC 011	Engineering Graphics						√		√											
	UHS 101	Foreign Language								√		√									
	UHS 102	Information and Communication technology				√						√									
Level-2	BES 012	Mathematics II	√		√																
	BES 022	Mechanics II	√	√																	
	BES 032	Physics II	√	√																	
	MEC 012	Production Engineering				√		√													
	MEC 014	Computer Aided Drafting				√				√											
	ELE 042	Computer Programming Fundamentals	√		√																
	UHS 103	Societal Issues							√			√									
Level-3	ELE 111	Electric Circuits I		√									√								
	ELE 141	Digital Logic Circuits	√	√	√								√								
	ELE 143	Object Oriented Programming			√						√			√							
	ELE 173	Electrical Application				√	√						√			√					
	BES 111	Differential Equations	√	√																	
	BES 141	Pollution and Industrial Safety	√		√	√															
	UHS 2XX	Humanities Elective I									√										
Level-4	ELE 112	Electric Circuits II		√	√	√									√						
	ELE 142	Digital System Design		√	√									√							
	ELE 144	Data Structure and Algorithms			√			√													
	ELE 132	Measurements and Instrumentations I											√		√	√					
	BES 112	Numerical Analysis	√	√																	
	ELE 114	Semiconductors Physics											√		√						
	FTR 103	Field Training I							√			√									
Le vel 5	ELE 211	Signals and Systems											√		√						

	ELE 213	Electronic Circuits I												√	√						
	ELE 245	Computer Applications		√									√		√						
	ELE 241	Computer Architecture		√									√	√							
	ELE 231	Control Theory		√	√									√	√						
	BES 113	Mathematics III	√	√																	
Level-6	ELE 212	Analog Communication Systems					√			√							√	√	√	√	
	ELE 214	Electronic Circuits II		√										√	√						
	ELE 216	Electromagnetic Fields											√		√						
	ELE 242	Computer Organization								√	√		√		√						
	BES 211	Engineering Probability and Statistics	√	√																	
	ELE 2xx	Elective I		√	√										√	√					
	FTR 203	Field Training II							√			√									
Level-7	ELE 311	Digital Communication Systems					√			√								√	√	√	
	ELE 313	Information Theory	√		√		√										√	√	√	√	
	ELE 315	Transmission Lines	√				√									√	√	√	√	√	
	ELE 317	Electronic Circuit Design			√							√	√				√	√	√		
	ELE 341	Microprocessor Based Systems												√	√						
	UHS 104	Professional Ethics				√															
	UHS 3XX	Humanities Elective II							√		√										
Level-8	ELE 312	Wireless Communication Systems					√		√	√	√							√	√	√	√
	ELE 314	Digital Signal Processing I	√	√							√						√	√	√		√
	ELE 316	Antenna Theory and Wave Propagation I	√	√	√								√			√		√	√	√	
	ELE 4411	RTL design						√	√		√							√	√		√
	ELE 392	Senior Design Project I					√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	UHS 8XX	Humanities Elective III					√					√									
Level-9	ELE 411x	Elective II					√			√						√	√	√	√	√	
	ELE 412x	Elective III											√			√		√	√	√	
	ELE 413x	Elective IV						√										√	√		√
	ELE 442x	Elective V							√		√							√	√	√	√
	ELE 415x	Elective VI											√					√	√	√	√
	ELE 491	Senior Design Project II			√		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

The Matching of the Electronics and Electrical Communications Engineering Program with ABET Requirements

Curriculum Criteria

	Electronics and Electrical Communications Engineering Program	ABET
Mathematics and Basic Science	30 cr. Hrs.	>=30 Cr.Hrs.
Discipline	68 Cr.Hrs.	>=45 Cr.Hrs.

ABET Program Criteria for Electronics and Electrical Communications Engineering

ABET Criteria	Electronics and Electrical Communications Engineering to Cover the Criteria
Probability and Statistics	ELE 211 Engineering Statistics and Probability.
Mathematics	BES 011 Mathematics I, BES 012 Mathematics II, BES 111 Differential Equations, BES 113 Mathematics III, BES 112 Numerical Analysis.
Sciences	BES 021 Mechanics I, BES 022 Mechanics II, BES 031 Physics I, BES 032 Physics II, ELE 114 Semiconductors Physics, BES 041 General Chemistry, BES 141 Pollution and Industrial Safety.
Topics to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components.	ELE 111 Electric Circuits I, ELE 112, Electric circuits II, ELE 141 Digital Logic Circuits, ELE 142 Digital System Design, ELE 143 Object Oriented Programming, ELE 144 Data Structure and Algorithms, ELE 173 Electrical Applications, ELE 245 Computer Applications, ELE 132 Measurements and Instrumentations I, ELE 211 Signals and Systems, ELE 213 Electronic Circuits I, ELE 214 Electronic Circuits II, ELE 216 Electromagnetic Fields, ELE 241Computer Architecture, ELE 242 Computer Organization, ELE 231 Control Theory, ELE 232 Modern Control, ELE 341Microprocessor Based Systems, ELE 246 Computer Network, ELE 317 Electronic Circuit Design, ELE 4411 RTL design, ELE 4425 VLSI Design, ELE 4427 ASIC Design.
advanced mathematics, such as differential equations, linear algebra, complex variables, and discrete mathematics.	BES 111 Differential Equations, BES 113 Mathematics III, ELE 211 Signals and Systems, ELE 314 Digital Signal Processing I.
topics in communication theory and systems.	ELE 212 Analog Communication Systems, ELE 311 Digital Communication Systems, ELE 312 Wireless Communication Systems, ELE 313 Information Theory, ELE 314 Digital Signal Processing I, ELE 315 Transmission Lines, ELE 316 Antenna Theory and Wave Propagation I, ELE 4111Satellite Communication, ELE 4112 Cellular Communication, ELE 4121Antenna Theory and Wave Propagation II, ELE 4122 Microwave Circuits and Devices, ELE 4131 Forward Error Correction Codes, ELE 4151 Digital Signal Processing II, ELE 4152 Detection and Estimation Theory.

Program# 7 Biomedical Engineering Program

Program Description

Biomedical Engineering is a discipline that integrates the science and technology of design, implementation, controlling and maintenance of software and hardware components of computing systems, computer-controlled equipment, and networks of intelligent devices. Generally, Biomedical Engineering is some combination of both electrical engineering and computer science.

Because of the breadth of the Biomedical Engineering field, computer-related coursework typically comes from computer organization and architecture, networks, algorithms, programming, databases, software engineering, automation, and intelligent systems. Electrical engineering related coursework typically comes from circuits, digital logic, microelectronics, signal processing, control systems, and integrated circuit design. Foundational areas typically include basic sciences, mathematics for both discrete and continuous domains, and applications of probability and statistics.

Basic Information

Program Mission

The mission of the Biomedical Engineering program is to provide the highest standard of excellence in higher education and to pursue continuous quality improvement of various engineering and management aspects in Biomedical Engineering and healthcare field. And to provide the community with graduates capable of effectively using relevant scientific and technical knowledge in digital healthcare. Problem-solving capabilities, teamwork, and communications skills developed by the graduates of the program will contribute to qualify the healthcare facilities for accreditation.

Program Objectives

Biomedical Engineering program is planned to:

1. Providing fundamental knowledge required for practicing high quality medical engineering .
2. Scientific principles, rigorous analysis, and creative design necessary for advanced study to serve healthcare systems.
3. Providing knowledge of important current issues, that are necessary for productive careers in both public and private sectors, and for the pursuit of graduate education .
4. Qualifying graduates for local, regional (particularly, in the Arab and African regions) and international markets .
5. Developing high communication skills, and emphasizing professional attitudes and ethics, so that graduates are prepared for complex modern work environments and lifelong learning .
6. Providing an environment that enables students to pursue their goals in an innovative program that is rigorous, challenging, open, and supportive .
7. To realize the impact of multidisciplinary engineering and scientific technologies in healthcare.

Graduate Attributes

Graduate attributes are the academic abilities, personal qualities, and skills which Biomedical Engineering graduates should have.
According to NARS 2018 all engineering graduates must:

1. Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real life situations.
2. Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation.
3. Behave professionally and adhere to engineering ethics and standards.
4. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance.
5. Recognize his/her role in promoting the engineering field and contribute in the development of the profession and the community;
6. Value the importance of the environment, both physical and natural, and work to promote sustainability principles.
7. Use techniques, skills, and modern engineering tools necessary for engineering practice.
8. Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies.
9. Communicate effectively using different modes, tools, and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner.
10. Demonstrate leadership qualities, business administration and entrepreneurial skills.

In addition to all engineering graduate attributes defined by NARS 2018, Biomedical Engineering graduate should be able to:

11. Apply knowledge of mathematics, science, and engineering concepts to the solution of engineering problems.
12. Design a system; component and process to meet the required needs within realistic constraints.
13. Consider the impacts of engineering solutions on society and environment.

Program Learning outcomes

- **Level A learning outcomes**

The Engineering Graduate must be able to:

PLO1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics

PLO2. Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess, and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions

PLO3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical, and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development

PLO4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues, and risk management principles

PLO5. Practice research techniques and methods of investigation as an inherent part of learning.

PLO6. Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements

PLO7. Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural teams

PLO8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools

PLO9. Use creative, innovative, and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations

PLO10. Acquire and apply new knowledge, and practice self, lifelong and other learning strategies

Level D learning outcomes

In addition to the program learning outcomes for All Engineering Programs the BASIC ELECTRICAL Engineering graduate and similar programs must be considered as: NARS 2018 & https://www.sydney.edu.au/handbooks/engineering/engineering_combined/combined_biomedical.shtml (Bench Mark (BM))

PLO11. Design, model and analyze an electrical/electronic/digital system or component for a specific application; and identify the tools required to optimize this design.

PLO12. Design and implement elements, modules, sub-systems or systems in electrical/electronic/digital engineering using technological and professional tools.

PLO13. Estimate and measure the performance of an electrical/electronic/digital system and circuit under specific input excitation and evaluate its suitability for a specific application.

PLO14. Adopt suitable national and international standards and codes to design, build, operate, inspect and maintain electrical/electronic/digital equipment, systems and services.

PLO15. Determine the characteristics of a given problem, choose the appropriate method to solve, analyze, design, and apply programming paradigm in Algorithm design/software design problems/intelligent systems design/ software engineering and testing

PLO16. Design and Implement Embedded Systems/ Image and Signal Processing Systems/ Systems Using Programmable Devices/Systems Using ASIC Design, taking into account relevant system design constraints (time, interrupts, reliability, reducing failure, bridging the analog and digital domains,…)

PLO17 Effectively address non-routine design and troubleshooting problems in biomedical engineering, and apply diverse strategies to develop and implement innovative ideas in biomedical engineering.

PLO18 Plan, design, and review biomedical systems, services, embedded system in a medical device and policies to support biomedical engineering decision making.

PLO19 Contribute as an individual to multidisciplinary and multicultural teams to deliver projects related to biomedical engineering, and apply relevant values, standards and judgement to contribute to the economic, social and environmental sustainability of biomedical engineering systems.

Faculty Mission vs. Program Mission Matrix

<table>
<tr><th colspan="2" rowspan="3">Faculty Mission</th><th colspan="3">Program Mission</th></tr>
<tr><td colspan="3">The mission of the Biomedical Engineering program is to provide the highest standard of excellence in higher education and to pursue continuous quality improvement of various engineering and management aspects in Biomedical Engineering and healthcare field. And to provide the community with graduates capable of effectively using relevant scientific and technical knowledge in digital healthcare. Problem-solving capabilities, teamwork, and communications skills developed by the graduates of the program will contribute to qualify the healthcare facilities for accreditation.</td></tr>
<tr><td>provide the highest standard of excellence in higher education and to pursue continuous quality improvement of various engineering and management aspects in Biomedical Engineering and healthcare field</td><td>provide the community with graduates capable of effectively using relevant scientific and technical knowledge in digital healthcare</td><td>Problem-solving capabilities, teamwork, and communications skills developed by the graduates of the program will contribute to qualify the healthcare facilities for accreditation.</td></tr>
<tr><td rowspan="3">Benha Faculty of Engineering - Benha University is committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market, and capable of using and developing modern technology, and providing research in engineering fields to serve society and community.</td><td>committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market</td><td>√</td><td></td><td></td></tr>
<tr><td>capable of using and developing modern technology, and providing research in engineering fields</td><td></td><td>√</td><td></td></tr>
<tr><td>serve society and community</td><td></td><td></td><td>√</td></tr>
</table>

Program Mission vs. Program Objectives Matrix

<table>
<tr><th colspan="2" rowspan="2">Program Mission</th><th colspan="7">Program Objectives</th></tr>
<tr><th>PO1</th><th>PO2</th><th>PO3</th><th>PO4</th><th>PO5</th><th>PO6</th><th>PO7</th></tr>
<tr><td rowspan="3">The mission of the Biomedical Engineering program is to provide the highest standard of excellence in higher education and to pursue continuous quality improvement of various engineering and management aspects in Biomedical Engineering and healthcare field. And to provide the community with graduates capable of effectively using relevant scientific and technical knowledge in digital healthcare. Problem-solving capabilities, teamwork, and communications skills developed by the graduates of the program will contribute to qualify the healthcare facilities for accreditation.</td><td>provide the highest standard of excellence in higher education and to pursue continuous quality improvement of various engineering and management aspects in Biomedical Engineering and healthcare field</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td><td></td><td>√</td></tr>
<tr><td>provide the community with graduates capable of effectively using relevant scientific and technical knowledge in digital healthcare</td><td></td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Problem-solving capabilities, teamwork, and communications skills developed by the graduates of the program will contribute to qualify the healthcare facilities for accreditation.</td><td></td><td></td><td>√</td><td>√</td><td></td><td>√</td><td>√</td></tr>
</table>

Program Objectives Vs Graduate Attributes

Program Objectives	Graduate Attribute												
	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12	GA13
PO1	√												
PO2		√									√		
PO3	√	√			√								
PO4			√	√			√						
PO5						√				√			
PO6						√			√			√	√
PO7								√					

Program Competencies vs. Program Objectives Matrix

Program Objectives	Competencies																		
	Level A									Level D									
	A1	A2	A 3	A4	A5	A6	A7	A8	A9	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
PO1	√	√	√	√	√														
PO2		√		√		√		√		√									
PO3	√		√	√				√	√	√									
PO4	√				√		√			√		√							
PO5		√	√	√	√		√			√									
PO6			√		√			√			√	√	√	√		√	√		√
PO7												√			√		√	√	√

Career Prospects

Based on multidiscipline knowledge and learned courses, Biomedical engineers can work in many functions related to healthcare facilities. They start from designing high-tech devices ranging from tiny microelectronic integrated-circuit chips reaching for smart systems. Biomedical engineers also work as Biomedical Engineer, clinical engineer, medical planning and hospital design, technical support for medical equipment and clinical applications, medical equipment manufacture, integrated systems and healthcare operation. In addition to implement advanced software application to serve and facilitate medical signal and image processing.

List of Biomedical Engineering Requirement Courses

Requirement	Cr. Hrs.	Ct. Hr			
		Lec	Lab	Tut	Sum
University Requirements	14	14	0	0	14
Faculty of Engineering Requirements	32	19	34	47	100
Discipline Requirements	67	45	31	26	102
Biomedical Engineering Program Requirements	47	30	30	14	74
Total	160	108	95	87	288

Basic Science Requirements of Biomedical Engineering

Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
BES 011	Mathematics I		3	2	0	2	4
BES 041	General Chemistry		4	3	2	1	6
BES 031	Physics I		3	2	2	1	5
BES 012	Mathematics II	BES 011	3	2	0	2	4
BES 032	Physics II		3	2	2	1	5
BES 111	Differential Equations	BES 012	3	2	0	2	4
BES 113	Mathematics III	BES 012	3	2	0	2	4
BES 112	Numerical Analysis	BES 111	3	2	2	0	4
BES 114	Discrete Mathematics and Linear Programming	BES 012	3	2	0	2	4
*BES 141	Pollution and Industrial Safety	BES 041	2	2	1	0	3
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4
Total			33	23	11	13	47

* Course teaching is shared between the Basic Engineering Science Department and Electrical Engineering Dep

Discipline Requirements of Biomedical Engineering

Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
BES 111	Differential Equations	BES 012	3	2	0	2	4
BES 113	Mathematics III	BES 012	3	2	0	2	4
ELE 179	Electric Circuits Analysis	BES 032	3	2	1	2	5
ELE 141	Digital Logic Circuits		3	2	1	2	5
ELE 143	Object Oriented Programming	ELE 042	3	2	2	0	4
ELE 173	Electrical Applications		2	1	3	0	4
BES 112	Numerical Analysis	BES 111	3	2	2	0	4
ELE 132	Measurements and Instrumentations I	ELE 179 or ELE 111	3	2	2	1	5
ELE 142	Digital System Design	ELE 141	3	2	2	1	5
ELE 144	Data Structures and Algorithms	ELE 143	3	2	2	0	4
ELE 114	Semiconductor Physics	BES 032	3	2	0	2	4
ELE 211	Signals and Systems	BES 111	3	2	0	2	4
ELE 213	Electronic Circuits I	ELE 114	3	2	1	2	5
ELE 231	Control Theory	BES 111	3	2	1	2	4
ELE 241	Computer Architecture	ELE 142	3	2	2	1	5
ELE 245	Computer Applications	ELE 042	3	2	2	0	4
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	5
ELE 276	Electric Machines	ELE 179	3	2	1	1	4
MEC 251	Mechanical Engineering	MEC 012	2	2	0	1	3
ELE 214	Electronic Circuits II	ELE 213	3	2	2	1	5
ELE 218	Digital Signal Processing	ELE 211	3	2	2	1	5
ELE 254	AI and advanced algorithms	ELE 144, BES 111	3	2	1	2	5
ELE 342	Embedded Systems	ELE 141	3	2	2	1	5
Total			67	45	31	26	102

Biomedical Engineering Program Requirements

Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
ELE 255	Anatomy and Physiology		2	2	0	0	2
ELE 256	Introduction to Biomedical Engineering	ELE 142	3	2	1	2	4
ELE 351	Hospital Instrumentation	ELE 241	3	2	0	1	4
ELE 353	Biomedical Modeling and Simulation	ELE 211, BES 112	3	2	2	1	5
ELE 355	Medical Imaging, I		3	2	2	1	5
ELE 357	Bioinformatics	ELE 211, ELE 254	3	2	2	1	5
ELE 359	Image Processing for Biomedical	ELE 245	3	2	2	1	5
ELE 356	Medical Imaging II	ELE 355	3	2	2	1	5
ELE 3XX	Elective I		3	2	2	1	5
ELE 3XX	Elective II		3	2	2	1	5
ELE 4XX	Elective III		3	2	2	1	5
ELE 4XX	Elective IV		3	2	2	1	5
ELE 4XX	Elective V		3	2	2	1	5
ELE 4XX	Elective VI		3	2	2	1	5
ELE 392	Senior Design Project I	70% of total CH	2	0	4	0	4
ELE 491	Senior Design Project II	ELE 392	3	1	4	0	5
Total			46	30	30	14	74

*The student can register the senior design Project I course after passing 70% of the program cr. hrs, i.e., 112 Cr. Hr

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Pool Courses for Elective I, II, III, IV, and V							
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
ELE 350	Biomechanics	BES 022	3	2	2	1	5
ELE 352	Rehabilitation Engineering and Assistive Technology	BES 022	3	2	2	1	5
ELE 354	Cardiovascular Biomechanics	BES 022	3	2	2	1	5
ELE 358	Introduction to Information Theory	BES 114	3	2	2	1	5
ELE 360	Biometrics	BES 114	3	2	2	1	5
ELE 361	Pattern Recognition	ELE 451	3	2	2	1	5
ELE 362	Medical Robotics	BES 022	3	2	2	1	5
ELE 363	Advanced Human Biodynamics	BES 022	3	2	2	1	5
ELE 364	Artificial Organs	BES 022	3	2	2	1	5
ELE 365	Kinematics and Kinetics of Human Movement	BES 022	3	2	2	1	5
ELE 331	Machine Learning	ELE 254	3	2	2	1	5
ELE 367	Deep Learning in Medicine	ELE 254	3	2	2	1	5
ELE 368	Medical Image Computing	ELE 355 &BES 114	3	2	2	1	5
ELE 450	Computational Methods for Medical Image Analysis	ELE 355	3	2	2	1	5
ELE 451	Advanced Image Processing Techniques	ELE 359	3	2	2	1	5
ELE 452	RF (Radiofrequency) Medical Devices	ELE 256	3	2	2	1	5
ELE 453	Biomedical Optical Microscopy	ELE 141	3	2	2	1	5
ELE 454	Bioinstrumentation: Bio-signals and Biosensors	ELE 256	3	2	2	1	5
ELE 455	Clinical Engineering Fundamentals	ELE 256	3	2	2	1	5
ELE 456	Clinical Equipment Management	ELE 256	3	2	2	1	5
ELE 457	Medical Instrumentation in the Hospital	ELE 256	3	2	2	1	5
ELE 458	Engineering Problems in the Hospital	ELE 256	3	2	2	1	5
ELE 459	Clinical Systems Engineering	ELE 256	3	2	2	1	5
ELE 460	Medical Device Cybersecurity	ELE 256	3	2	2	1	5
ELE 461	Computer Applications in Bioengineering	ELE 143	3	2	2	1	5
ELE 462	Biomedical Applications of Signal Processing	ELE 354	3	2	2	1	5
ELE 464	Digital Communication Systems	ELE 352	3	2	2	1	5
ELE 465	Digital and Analog Filters Design	ELE 352	3	2	2	1	5
ELE 466	Vision Sensors	ELE 256	3	2	2	1	5
ELE 467	Advanced Random Signals and Information Technology	BES 114	3	2	2	1	5
ELE 468	Neural Networks in Medical Fields	BES 114	3	2	2	1	5
ELE 469	Quantum for Information and Encoding	BES 114	3	2	2	1	5

* The course content must be approved by Electric Engineering Department Council before any student can register it.

Proposed Study Plan for Biomedical Engineering

Level 0-1														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 011	Mathematics I		3	2	0	2	4	2	30	30	-	40	100
BES 021	Mechanics I		3	2	0	2	4	2	30	30	-	40	100
BES 041	General Chemistry		4	3	2	1	6	2	10	30	20	40	100
BES 031	Physics I		3	2	2	1	5	2	10	30	20	40	100
MEC 011	Engineering Graphics		2	0	0	4	4	2	30	30	-	40	100
UHS 101	Foreign Language		2	2	0	0	2	2	30	30	-	40	100
UHS 102	Information and Communication Technology		2	2	0	0	2	2	30	30	-	40	100
Total			19	13	4	10	27						700

Level 0-2													
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 012	Mathematics II	BES 011	3	2	0	2	4	2	30	30	-	40	100
BES 022	Mechanics II	BES 021	3	2	0	2	4	2	30	30	-	40	100
MEC 012	Production Engineering		2	1	3	0	4	2	10	30	20	40	100
BES 032	Physics II		3	2	2	1	5	2	10	30	20	40	100
MEC 014	Computer Aided Drafting	MEC 011	2	1	2	0	3	2	10	30	20	40	100
ELE 042	Computer Programming Fundamentals		2	0	2	2	4	2	10	30	20	40	100
UHS 103	Societal Issues		2	2	0	0	2	2	30	30	-	40	100
Total			17	10	9	7	26						700

Level 1-1														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 111	Differential Equations	BES 012	3	2	0	2	4	2	30	30	-	40	100
BES 113	Mathematics III	BES 012	3	2	0	2	4	2	30	30	-	40	100
ELE 179	Electric Circuits Analysis	BES 032	3	2	1	2	5	2	10	30	20	40	100
ELE 141	Digital Logic Circuits		3	2	1	2	5	2	10	30	20	40	100
ELE 143	Object Oriented Programming	ELE 042	3	2	2	0	4	2	10	30	20	40	100
ELE 173	Electrical Applications		2	1	3	0	4	2	10	30	20	40	100
UHS XXX	Humanities Elective I		2	2	0	0	2	2	30	30	-	40	100
Total			19	13	7	8	28						700

Level 1-2														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 112	Numerical Analysis	BES 111	3	2	2	0	4	2	10	30	20	40	100
BES 114	Discrete Mathematics and Linear Programming	BES 012	3	2	0	2	4	2	30	30	-	40	100
ELE 132	Measurements and Instrumentations I	ELE 179 or ELE 111	3	2	2	1	5	2	10	30	20	40	100
ELE 142	Digital System Design	ELE 141	3	2	2	1	5	2	10	30	20	40	100
ELE 144	Data Structure and Algorithms	ELE 143	3	2	2	0	4	2	10	30	20	40	100
ELE 114	Semiconductor Physics	BES 032	3	2	0	2	4	2	30	30	-	40	100
Total			18	12	8	6	26						600

1st Field Training														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
FTR 103	Field Training, I	Completed 65 CH	0	0	0	0	0	-	-	-	-	-	Pass or fail

Level 2-1													
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
ELE 211	Signals and Systems	BES 111	3	2	0	2	4	2	30	30	-	40	100
ELE 213	Electronic Circuits I	ELE 114	3	2	1	2	5	2	10	30	20	40	100
ELE 231	Control Theory	BES 111	3	2	1	2	5	2	10	30	20	40	100
ELE 241	Computer Architecture	ELE 142	3	2	2	1	5	2	10	30	20	40	100
ELE 255	Anatomy and Physiology		2	2	0	0	2	2	30	30	-	40	100
ELE 245	Computer Applications	ELE 042	3	2	2	0	4	2	10	30	20	40	100
Total			17	12	6	7	25						600

Level 2-2														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4	2	10	30	20	40	100
ELE 276	Electric Machines	ELE 179	3	2	1	1	4	2	10	30	20	40	100
ELE 214	Electronic Circuits II	ELE 213	3	2	2	1	5	2	10	30	20	40	100
ELE 218	Digital Signal Processing	ELE 211	3	2	1	2	5	2	10	30	20	40	100
ELE 254	AI and advanced algorithms	ELE 144, BES 111	3	2	2	1	5	2	10	30	20	40	100
ELE 256	Introduction to Biomedical Engineering		3	2	1	1	4	2	10	30	20	40	100
Total			18	12	9	6	27						600

2nd Field Training													
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
FTR 203	Field Training, II	Completed 96 CH	0	0	0	0	0	-	-	-	-	-	Pass or Fail

Level 3-1														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
ELE 351	Hospital Instrumentation	ELE 256	3	2	1	1	4	2	10	30	20	40	100
ELE 353	Biomedical Modeling and Simulation	ELE 256, BES 112	3	2	2	1	5	2	10	30	20	40	100
ELE 355	Medical Imaging I		3	2	2	1	5	2	10	30	20	40	100
ELE 357	Bioinformatics	ELE 256, ELE 254	3	2	2	1	5	2	10	30	20	40	100
ELE 359	Image Processing for biomedical	ELE 245	3	2	2	1	5	2	10	30	20	40	100
UHS XXX	Humanities - Elective II		2	2	0	0	2	2	30	30	-	40	100
Total			17	12	9	5	26						600

Level 3-2													
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
ELE 342	Embedded Systems	ELE 141	3	2	2	0	4	2	10	30	20	40	100
ELE 356	Medical Imaging II	ELE 355	3	2	2	1	5	2	10	30	20	40	100
ELE 3XX	Elective I		3	2	2	1	5	2	10	30	20	40	100
UHS 104	Professional Ethics		2	2	0	0	2	2	30	30	-	40	100
ELE 3XX	Elective II		3	2	2	1	5	2	10	30	20	40	100
ELE 392	Senior Design Project I	70% of total CH	2	0	4	0	4	2	50	-	50	--	100
ELE 332	Innovation Management and Entrepreneurship		2	2	0	0	2	2	30	30	-	40	100
Total			18	13	11	3	27						

Level 4-1														
Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 141	Pollution and Industrial Safety	BES 041	2	2	1	0	3	2	10	30	20	40	100
ELE 4XX	Elective III		3	2	2	1	5	2	10	30	20	40	100
ELE 4XX	Elective IV		3	2	2	1	5	2	10	30	20	40	100
ELE 4XX	Elective V		3	2	2	1	5	2	10	30	20	40	100
ELE 491	Senior Design Project II	ELE 392	3	1	4	0	5	2	50	-	50	--	100
UHS XXX	Humanities Elective III		2	2	0	0	2	2	30	30	-	40	100
Total			18	11	11	3	25						600

Courses Plan and Matrix

Curriculum Plan for Biomedical Engineering

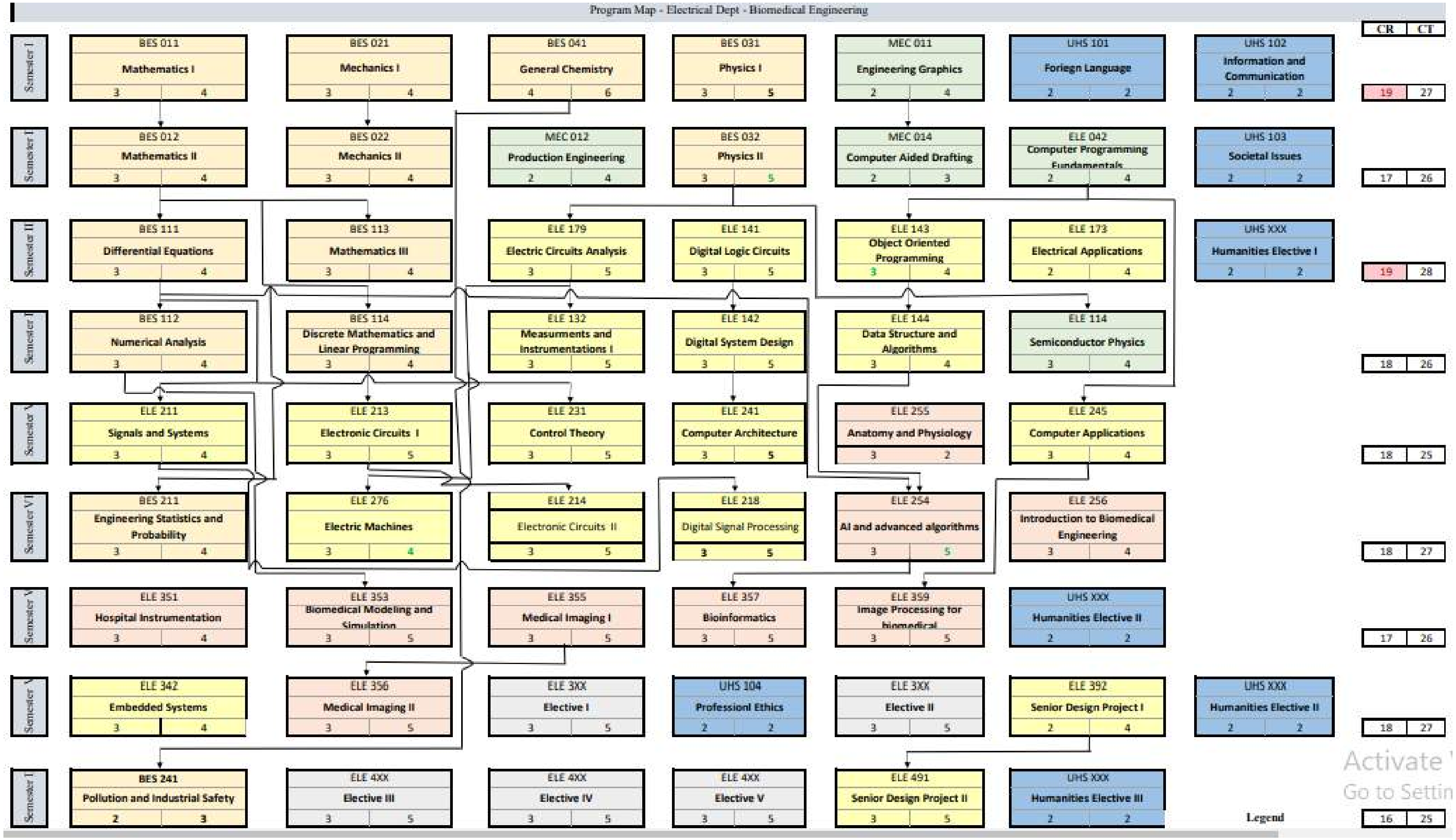
Program Map - Electrical Dept - Biomedical Engineering

Semester								CR	CT
Semester I	BES 011 Mathematics I 3 | 4	BES 021 Mechanics I 3 | 4	BES 041 General Chemistry 4 | 6	BES 031 Physics I 3 | 5	MEC 011 Engineering Graphics 2 | 4	UHS 101 Foriegn Language 2 | 2	UHS 102 Information and Communication Technology 2 | 2	19	27
Semester II	BES 012 Mathematics II 3 | 4	BES 022 Mechanics II 3 | 4	MEC 012 Production Engineering 2 | 4	BES 032 Physics II 3 | 5	MEC 014 Computer Aided Drafting 2 | 3	ELE 042 Computer Programming Fundamentals 2 | 4	UHS 103 Societal Issues 2 | 2	17	26
Semester III	BES 111 Differential Equations 3 | 4	BES 113 Mathematics III 3 | 4	ELE 179 Electric Circuits Analysis 3 | 5	ELE 141 Digital Logic Circuits 3 | 5	ELE 143 Object Oriented Programming 3 | 4	ELE 173 Electrical Applications 2 | 4	UHS XXX Humanities Elective I 2 | 2	19	28
Semester IV	BES 112 Numerical Analysis 3 | 4	BES 114 Discrete Mathematics and Linear Programming 3 | 4	ELE 132 Measurments and Instrumentations I 3 | 5	ELE 142 Digital System Design 3 | 5	ELE 144 Data Structure and Algorithms 3 | 4	ELE 114 Semiconductor Physics 3 | 4		18	26
Semester V	ELE 211 Signals and Systems 3 | 4	ELE 213 Electronic Circuits I 3 | 5	ELE 231 Control Theory 3 | 5	ELE 241 Computer Architecture 3 | 5	ELE 255 Anatomy and Physiology 3 | 2	ELE 245 Computer Applications 3 | 4		18	25
Semester VI	BES 211 Engineering Statistics and Probability 3 | 4	ELE 276 Electric Machines 3 | 4	ELE 214 Electronic Circuits II 3 | 5	ELE 218 Digital Signal Processing 3 | 5	ELE 254 AI and advanced algorithms 3 | 5	ELE 256 Introduction to Biomedical Engineering 3 | 4		18	27
Semester VII	ELE 351 Hospital Instrumentation 3 | 4	ELE 353 Biomedical Modeling and Simulation 3 | 5	ELE 355 Medical Imaging I 3 | 5	ELE 357 Bioinformatics 3 | 5	ELE 359 Image Processing for biomedical 3 | 5	UHS XXX Humanities Elective II 2 | 2		17	26
Semester VIII	ELE 342 Embedded Systems 3 | 4	ELE 356 Medical Imaging II 3 | 5	ELE 3XX Elective I 3 | 5	UHS 104 Professionl Ethics 2 | 2	ELE 3XX Elective II 3 | 5	ELE 392 Senior Design Project I 2 | 4	UHS XXX Humanities Elective II 2 | 2	18	27
Semester IX	BES 241 Pollution and Industrial Safety 2 | 3	ELE 4XX Elective III 3 | 5	ELE 4XX Elective IV 3 | 5	ELE 4XX Elective V 3 | 5	ELE 491 Senior Design Project II 3 | 5	UHS XXX Humanities Elective III 2 | 2		16	25

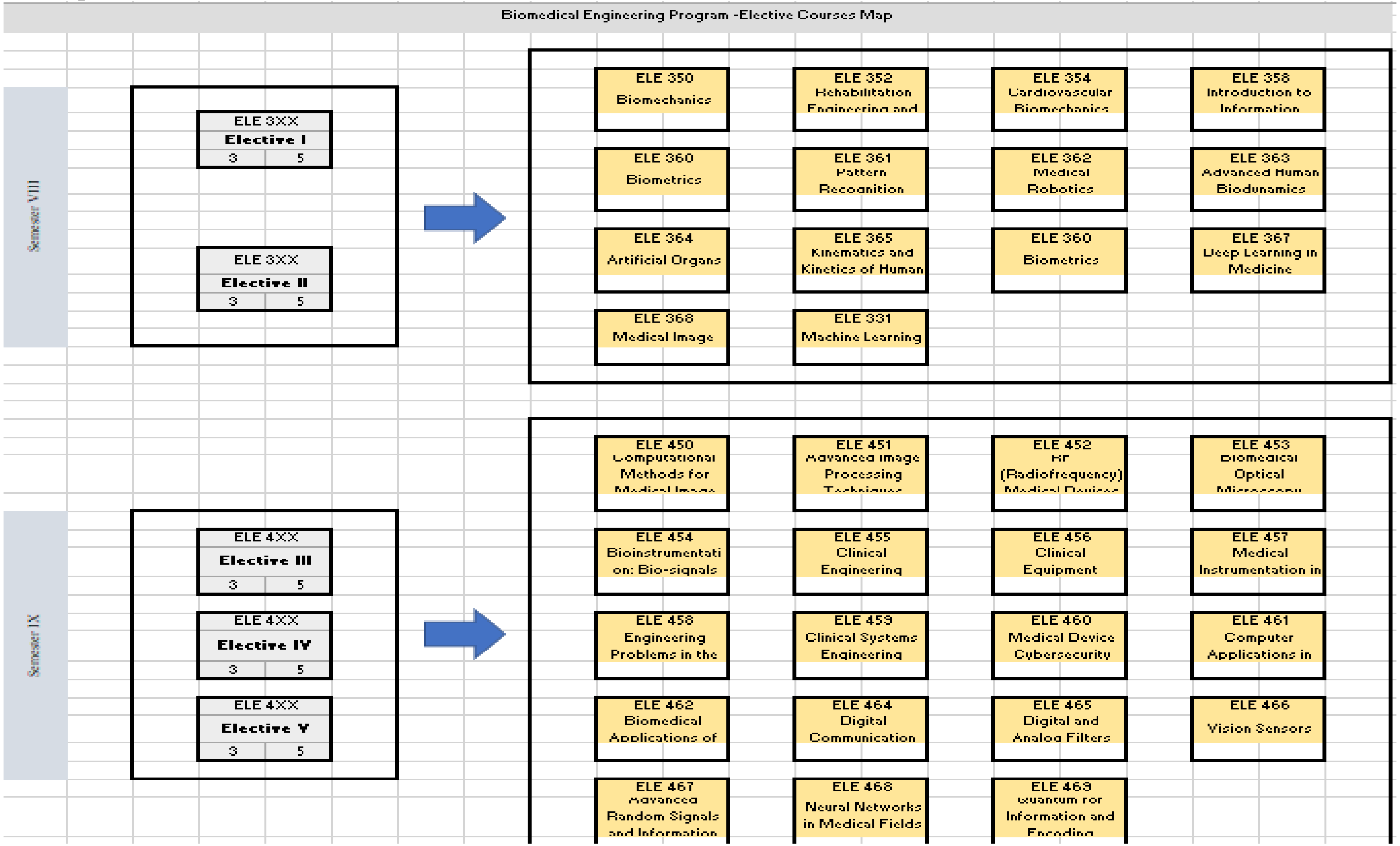
Legend

- Basic Science
- Faculty Req.
- University Req.
- Major
- Electives
- Program

Curriculum Flowchart for Biomedical



Map of Elective Courses



Program Learning Objectives to Biomedical Engineering Courses Matrix

	Code	Title	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	D1	D2	D3	D4	D5	D6	D7	D8	D9
Semester I	BES 011	Mathematics I	*		*																
	BES 021	Mechanics I	*	*																	
	BES 041	General Chemistry	*	*																	
	BES 031	Physics I	*	*																	
	MEC 011	Engineering Graphics						*		*											
	UHS 101	Foreign Language								*		*									
	UHS 102	Information and Communication Technology				*						*									
Semester II	BES 012	Mathematics II	*		*																
	BES 022	Mechanics II	*	*																	
	MEC 012	Production Engineering				*		*													
	BES 032	Physics II	*	*																	
	MEC 014	Computer Aided Drafting							*	*											
	ELE 042	Computer Programming Fundamentals	*		*																
	UHS 103	Societal Issues							*			*									

	Code	Title	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	D1	D2	D3	D4	D5	D6	D7	D8	D9
Semester III	BES 111	Differential Equations	*	*																	
	BES 113	Mathematics III	*	*																	
	ELE 179	Electric Circuits Analysis		*									*								
	ELE 141	Digital Logic Circuits	*	*	*								*								
	ELE 143	Object Oriented Programming			*						*			*							
	ELE 173	Electrical Applications				*	*						*			*					
	UHS XXX	Humanities Elective I	Refer to the Next Three Courses																		
	UHS 201	Principles of Enterpreneurship and Project Management						*			*										
	UHS 202	Introduction to Economics and Accounting						*			*										
	UHS 203	Human Resources Management						*			*										
Semester IV	BES 112	Numerical Analysis	*	*																	
	BES 114	Discrete Mathematics and Linear Programming	*		*																
	ELE 132	Measurments and Instrumentations I											*		*	*					
	ELE 142	Digital System Design		*	*									*							
	ELE 144	Data Structure and Algorithms			*			*													
	ELE 114	Semiconductor Physics											*		*						
	FTR 203	Field Training I							*			*									

	Code	Title	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	D1	D2	D3	D4	D5	D6	D7	D8	D9
Semester V	ELE 211	Signals and Systems											*		*						
	ELE 213	Electronic Circuits I												*	*						
	ELE 231	Control Theory		*	*									*	*						
	ELE 241	Computer Architecture		*									*	*							
	ELE 243	Anatomy and physiology																	*		*
	ELE 245	Computer Applications		*									*		*						
Semester VI	BES 211	Engineering Statistics and Probability	*	*																	
	ELE 276	Electric Machines					*						*								
	ELE 214	Electronic Circuits II												*	*						
	ELE 218	Digital Signal Processing	*	*										*	*						
	ELE 254	AI and advanced algorithms	*		*							*								*	*
	ELE 256	Introduction to Biomedical Engineering						*							*		*	*			
	FTR 303	Field Training II							*			*									

	Code	Title	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	D1	D2	D3	D4	D5	D6	D7	D8	D9
Semester VII	ELE 351	Hospital Instrumentation						*		*						*	*	*	*		*
	ELE 353	Biomedical Modeling and Simulation	*	*	*								*						*	*	*
	ELE 355	Medical Imaging I			*													*		*	
	ELE 357	Bioinformatics							*	*									*	*	*
	ELE 359	Image Processing for biomedical		*																*	*
	UHS XXX	Humanities - Elective II	Refer to the Next Two Courses																		
	UHS 301	Communication and Presentation Skills								*	*										
	UHS 302	Leadership Skills								*	*										
Semester VIII	ELE 342	Embedded Systems												*				*			
	ELE 356	Medical Imaging II			*							*						*		*	
	UHS 104	Professional Ethics				*	*														
	ELE 3XX	Elective I	Refer to Biomedical Engineering Elective Courses																		
	ELE 3XX	Elective II																			
	ELE 392	Senior Design Project I					*	*	*	*	*	*									
	UHS XXX	Humanities - Elective III	Refer to the Next Two Courses																		
	UHS 801	Research Methodologies					*					*									
	UHS 803	Thinking Skills					*					*									

	Code	Title	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	D1	D2	D3	D4	D5	D6	D7	D8	D9
Semester IX	BES 241	Pollution and Industrial Safety	*		*	*															
	ELE 4XX	Elective III	Refer to Biomedical Engineering Elective Courses																		
	ELE 4XX	Elective IV																			
	ELE 4XX	Elective V																			
	ELE 491	Senior Design Project II					*	*	*	*	*	*							*	*	*
	UHS XXX	Humanities - Elective III					*					*									

	Code	Title	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	D1	D2	D3	D4	D5	D6	D7	D8	D9
Biomedical Engineering Electives	ELE 352	Rehabilitation Engineering and Assistive Technology																			*
	ELE 354	Cardiovascular Biomechanics																	*		*
	ELE 358	Introduction to Information Theory																			*
	ELE 360	Biometrics															*	*			
	ELE 361	Pattern Recognition																		*	
	ELE 362	Medical Robotics												*					*		*
	ELE 363	Advanced Human Biodynamics								*											*
	ELE 364	Artificial Organs								*				*							*
	ELE 365	Kinematics and Kinetics of Human Movement								*											
	ELE 331	Machine Learning																		*	
	ELE 367	Deep Learning in Medicine	*	*								*								*	*
	ELE 368	Medical Image Computing		*								*								*	
	ELE 450	Computational Methods for Medical Image Analysis	*																	*	
	ELE 451	Advanced Image Processing Techniques																		*	*
	ELE 452	RF (Radiofrequency) Medical Devices		*									*	*			*	*		*	*
	ELE 453	Biomedical Optical Microscopy			*								*			*	*	*		*	
	ELE 454	Bioinstrumentation: Bio-signals and Biosensors			*								*		*		*	*	*	*	
	ELE 455	Clinical Engineering Fundamentals				*		*	*	*				*	*						
	ELE 456	Clinical Equipment Management				*		*	*	*						*	*	*	*		
	ELE 457	Medical Instrumentation in the Hospital			*	*							*		*	*	*	*	*	*	
	ELE 458	Engineering Problems in the Hospital											*						*	*	
	ELE 459	Clinical Systems Engineering														*			*		*
	ELE 460	Medical Device Cybersecurity															*		*		
	ELE 461	Computer Applications in Bioengineering								*			*							*	
	ELE 462	Biomedical Applications of Signal Processing								*				*						*	*

Matching Biomedical Engineering Program Courses with ABET Requirements

ABET criteria for Bioengineering and Biomedical and Similarly Named Engineering Programs.
Lead Society: Biomedical Engineering Society Cooperating Societies: American Ceramic Society, American Institute of Chemical Engineers, American Society of Agricultural and Biological Engineers, American Society of Mechanical Engineers, and Institute of Electrical and Electronics Engineers

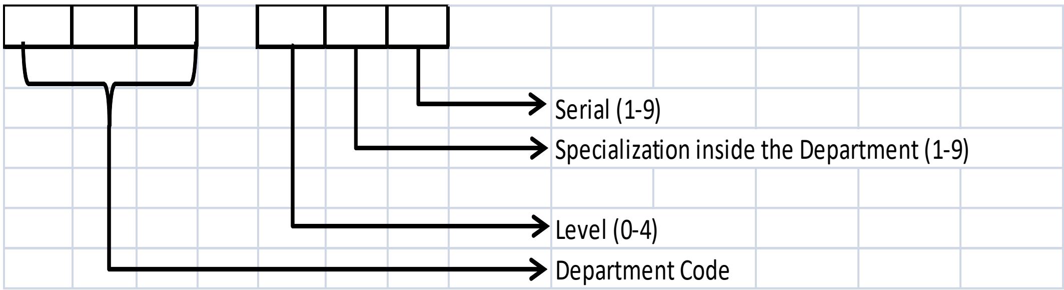
<table>
<tr><th colspan="5">Biomedical Engineering Program Courses Required to Cover ABET Criteria</th></tr>
<tr><th colspan="2">ABET Criteria</th><th>CODE</th><th>Course Name</th><th>Cr. Hrs.</th></tr>
<tr><td rowspan="12">A minimum of 30 semester Cr. Hrs. (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program.</td><td rowspan="4">The curriculum must prepare graduates to apply knowledge of mathematics through differential equations.</td><td>BES 011</td><td>Mathematics I</td><td>3</td></tr>
<tr><td>BES 012</td><td>Mathematics II</td><td>3</td></tr>
<tr><td>BES 111</td><td>Differential Equations</td><td>3</td></tr>
<tr><td>BES 113</td><td>Mathematics III</td><td>3</td></tr>
<tr><td rowspan="2">At least one additional area of basic science; apply probability and statistics to address uncertainty</td><td>BES 112</td><td>Numerical Analysis</td><td>3</td></tr>
<tr><td>BES 211</td><td>Engineering Statistics and Probability</td><td>3</td></tr>
<tr><td rowspan="2">Chemistry</td><td>BES 041</td><td>General Chemistry</td><td>4</td></tr>
<tr><td>BES 141</td><td>Pollution and Industrial Safety</td><td>2</td></tr>
<tr><td rowspan="2">Calculus-based physics</td><td>BES 031</td><td>Physics I</td><td>3</td></tr>
<tr><td>BES 032</td><td>Physics II</td><td>3</td></tr>
<tr><th colspan="4">Total</th><th>30</th></tr>
<tr><th colspan="2">ABET Criteria</th><th>CODE</th><th>Course Name</th><th>Cr. Hrs.</th></tr>
<tr><td rowspan="13">A minimum of 45 semester Cr. Hrs. (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design and utilizing modern engineering tools.</td><td rowspan="7">Analyze and design electrical and medical processes and systems in a biomedical engineering specialty field.</td><td>ELE 173</td><td>Electrical Applications</td><td>3</td></tr>
<tr><td>ELE 142</td><td>Digital System Design</td><td>3</td></tr>
<tr><td>ELE 245</td><td>Computer Applications</td><td>3</td></tr>
<tr><td>ELE 276</td><td>Electric Machines</td><td>3</td></tr>
<tr><td>ELE 254</td><td>AI and advanced algorithms</td><td>3</td></tr>
<tr><td>ELE 342</td><td>Embedded Systems</td><td>3</td></tr>
<tr><td>ELE 353</td><td>Biomedical Modeling and Simulation</td><td>3</td></tr>
<tr><td rowspan="6">Apply knowledge of methods, materials, equipment, planning, scheduling, safety, and cost analysis; to explain basic legal and ethical concepts and the importance of professional engineering licensure in the biomedical industry</td><td>ELE 042</td><td>Computer Programming Fundamentals</td><td>3</td></tr>
<tr><td>ELE 179</td><td>Electric Circuits Analysis</td><td>3</td></tr>
<tr><td>ELE 141</td><td>Digital Logic Circuits</td><td>3</td></tr>
<tr><td>ELE 114</td><td>Semiconductor Physics</td><td>3</td></tr>
<tr><td>ELE 231</td><td>Control Theory</td><td>3</td></tr>
<tr><td>ELE 255</td><td>Anatomy and Physiology</td><td>2</td></tr>
</table>

	Explain basic concepts of economics, business, accounting, communications, leadership, decision and optimization methods, engineering economics	UHS XXX	Humanities Elective II	2
	the engineering relationships between the management tasks of planning, organization, leadership, control, and the human element in production, research, and service organizations;	UHS XXX	Humanities Elective I	2
		UHS XXX	Humanities Elective III	2
	The stochastic nature of management systems	ELE 351	Hospital Instrumentation	3
	Integrating management systems into a series of different technological environments	ELE 456	Clinical Equipment Management	3
		ELE 457	Medical Instrumentation in the Hospital	3
		ELE 458	Engineering Problems in the Hospital	3
		ELE 459	Clinical Systems Engineering	3
Total				**55**

Courses offered to Electrical Engineering Programs

The course coding is divided into two parts and follows the following convention:

1. Three Letters which are the Department code.
2. Three Numbers indicating the Level, the Specialization inside the department, and a counter inside the specialization.



The Electrical Engineering Department is responsible for teaching courses that serve the following programs:

1. Power and Electrical Machines Program.
2. Computers and Control Systems Program.
3. Electrical Communication and Electronics Program

4- Biomedical Program

The coding system is demonstrated in the following table:

ELE x1x ELE x2x	Course offered by Electrical Engineering Department/ Electrical Communication and Electronics Program
ELE x3x ELE x4x	Course offered by Electrical Engineering Department/ Computers and Control Systems Program
ELE x5x ELE x6x	Course offered by Electrical Engineering Department/ Biomedical Program
ELE x7x ELE x8x	Course offered by Electrical Engineering Department/ Power and Electrical Machines Program
ELE x9x	Graduation Project

The following Abbreviation are used in the contents table:

Pre-req	Prerequisite	**CH**	Credit Hour	**SA**	Student Activity
MT	Midterm Exam	**PE**	Practical Exam	**OE**	Oral Exam

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
ELE 103	Electrical Circuits	BES 032	2	1	0	2	3	30	30	0	40
Course Content	DC circuit analysis: Circuit Variables, Kirchhoff's Laws, Simple Resistive Circuits,The Wheatstone Bridge, Δ to-Y (or π -to-) EquivalentCircuits,TheNode-Voltage Method and Dependent Sources,TheMesh-Current Method and Dependent Sources,TheVenin and Norton Equivalents, Maximum Power Transfer, Superposition, Topology in Circuit Analysis,TheOperational Amplifier circuits,Inductance and Capacitance, The Natural Response of RL and RC Circuits, Step Response of First-Order RL and RC Circuits.										
References	• Nilsson, J. W., & Riedel, S. A., "Electric circuits", 12th Edition, Pearson Education Limited, 2020.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
ELE104	Electronic DevicesandCircuits	ELE 103	2	1	0	2	3	30%	20%	0%	50%
Course Content	Semiconductorphysics,Structureofdiodes,Diodecircuitsandrectifiers,StructureofBJT,Biasingandoperationmodesoftransistors,DCandsmallsignalanalysisoftransistorcircuits,AmplifierscircuitsusingBJT, Poweramplifiers,Fieldeffecttransistors,BiasingofFET,SmallsignalmodelofFET.AmplifiercircuitsusingFET,Designofamplifiercircuits,Frequency response ofamplifiercircuits,Active filters, Feedbackinelectronic circuits,Differentfeedbackconfigurationinelectroniccircuits,Oscillators circuits.										
References	• Sedra / Smith, Microelectronic Circuits, 8th Edition, Oxford University Press, 2019.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 111	Electric Circuits I	BES 032	3	2	1	2	5	10	30	20	40
Course Content	The concepts of current, voltage, power and energy. Circuit Variables - Ohm's Low. Kirchhoff's Laws - Simple Resistive Circuits - Δ to-Y Equivalent Circuits - The Node-Voltage Method and Dependent Sources - The Mesh-Current Method and Dependent Sources - Thevenin and Norton Equivalents - Maximum Power Transfer - Superposition, Topology in Circuit Analysis - The Operational Amplifier circuits - Inductance and Capacitance - The Natural Response of RL and RC Circuits - Step Response of First Order RL and RC Circuits - Natural and Step Responses of RLC Circuits. Sinusoidal Steady-State Analysis - The Phasor - The Passive Circuit Elements – circuit theorems and Laws in the Frequency Domain.										
References	• Nilsson and Riedel, Electric Circuits, 11th Edition, Pearson, 2018, ISBN-13:978-0134746968.										
Laboratory	• Ohm's Low. • Kirchhoff's Laws • Series and Parallel Connection of Resistors • Voltage Divider in No-load Operation • Superposition's and Thevenin's Theorems • Ohmic Resistance in AC Circuits. • R-C And R-L Circuits in AC.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 112	Electric Circuits II	ELE 111	3	2	1	2	5	10	30	20	40
Course Content	Sinusoidal Steady-State Power Calculations Appliance Ratings. Balanced Three-Phase Circuits - Power Calculations - Mutual Inductance - The Dot Convention - Energy Calculations - The Linear and Ideal Transformer - Series and Parallel Resonance - The Laplace Transform - The Step and Impulse Functions - Functional and Operational Transforms - The Inverse Laplace Transform - Circuit Elements and Circuit Analysis in the s-Domain - The Transfer Function - Two-Port Circuits.										
References	• Nilsson and Riedel, Electric Circuits, 11th Edition, Pearson, 2018, ISBN-13:978-0134746968.										
Laboratory	• Power calculations in AC circuits • RC circuits, RL circuits • Ideal transformer circuits • Series resonance circuit • Parallel resonance circuit • OP-AMP circuits										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 114	Semiconductors Physics	BES 032	3	2	0	2	4	30	30	-	40
Course Content	Crystal structure of solid, Miller indices, Types of bonding. Semiconductor in Equilibrium: Bonding model and energy band model, Fermi-Dirac distribution, Intrinsic carrier concentration, Doped semiconductors, Charge-neutrality Equation and Mass action law. Carrier transport phenomena: mobility, drift current, diffusion current and the Einstein relation. Nonequilibrium excess carrier in semiconductors: carrier generation and recombination, carrier lifetime and continuity equation. Dielectrics: Electric dipoles, Capacitors without and with dielectrics, Losses in dielectrics, Polarization vector and susceptibility, Local fields, Clausius-Mosotti relation, microscopic models for polarization, Time and frequency response of dielectric materials										
References	• S.M. Sze, Kwok K. Ng, "Physics of Semiconductor Devices", John Wiley & Sons, 2007. • Marius Grundmann, "The Physics of Semiconductors", Springer, 2016										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 132	Measurements and Instrumentations I	ELE 179 or ELE 111	3	2	2	1	5	10	30	20	40

Course Content	Introduction, Error analysis and accuracy, operating principles of sensors and transducers. Analog measuring instruments. - Consideration for selection and evaluation of measurement equipment. - Measurement of current, voltage, resistance, power, energy, frequency, and power factor DC bridges – AC bridges. - Measurements of nonelectrical quantities (Speed, Displacement, Level, Velocity, Temperature, pressure, …etc. - Transducers: classification, Strain gauge, Displacement, Capacitive, Inductive, Piezoelectric, Temperature, and Photoelectric Transducers. Data acquisition system, Signal conditioning circuit. Digital to Analog and Analog to Digital converters. Data acquisition system and computerized control. - The relevance of the sensed and processed signals, Analogue/Digital and Digital/Analogue conversion
References	Alan S Morris, "Measurement and Instrumentation Principles", Third Edition, Publisher: Butterworth-Heinemann; 2001.
Laboratory	• Basic principles of electronics measurements and calibration. • Error analysis and accuracy on DC circuit. • Simple DC Circuits using a Digital Multi-Meter and Analogue Multi-Meter to measure voltage, current, and resistance, power, an oscilloscope to display time-varying voltages; a power supply to produce constant (DC) voltages; and a function generator to produce time varying (AC) voltages. • AC Measurements. Characterization and measurement of waveforms using an oscilloscope • Different type of transducers, calibration, connection, and measurements. • Introduction to signal processing

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 237	Measurements and Instruments II	ELE 132	3	2	1	2	5	10	30	20	40

Course Content	Cathode ray Oscilloscopes (CRO): Block diagram - Vertical Deflection Circuit - Horizontal Deflection Circuit - Trigger Circuits - Multiple trace Oscilloscopes -Analog storage oscilloscopes - Digital storage oscilloscopes. Transducers: Strain Gauges - Temperature Transducers - Displacement, velocity and acceleration Transducers - Force and Pressure Transducers - Light Transducers Digital Instruments: Data Converters - Voltage to Frequency Converters - A/D and D/A Converters - Basics of digital instruments: Time base - Amplified DC Meter - Digital Voltmeters - Digital Frequency Meters
References	• John G. Webster, HalitEren, “Measurement, Instrumentation, and Sensors Handbook”, 2nd Edition, CRC Press, 2016 • K. Lal Kishore, “Electronic Measurements and Instrumentation”, Pearson India, 2009, ISBN-13: 978-8131721995. • Alan S Morris, “Measurement and Instrumentation Principles”, 3rd Edition Butterworth-Heinemann; 2001.
Laboratory	• Using Photoelectric transducer in designing small control circuit • Basic Oscilloscope Operation and Measurements • Measuring frequency and phase shift with oscilloscope • Designing Simple A/D converter applied in digital meters

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 141</td><td>Digital Logic Circuits</td><td>-</td><td>3</td><td>2</td><td>1</td><td>2</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to Digital Concepts with emphasis on the difference between analog and digital system and the need for digital system design – Number systems - number-based conversion – The binary arithmetic operations on the signed and unsigned binary numbers – Coding systems – Boolean Algebra - Logic Gates – logic minimization techniques (Karnaugh maps, Quine-McCluskey)
Combinational circuits: Gate level design, Multiplexer, decoder, encoder, decoder, and adder.
Sequential circuits: Flip-flops, latches, analysis and design of simple sequential circuits, state tables and state diagrams, counters, registers</td></tr>
<tr><td>References</td><td colspan="11">• John Wakerly, "Digital Design: Principles and Practices", 5th Edition, Pearson, 2018, ISBN-13: 978-0134460093
• M. Morris Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog", 6th Edition, Pearson, 2017, ISBN-13: 978-0134549897.
• Floyd, Thomas L, "Digital Fundamentals", 11th Edition, Pearson Education, 2014, ISBN-13: 978-0132737968</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Logic Trainer Familiarization
• Breadboards and Building Digital Circuits.
• adders, subtractors, encoders and decoders, multiplexers and demultiplexers.
• Flip-flops
• design and analysis of combinational circuit
• design and analysis of simple sequential circuit</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 142</td><td>Digital System Design</td><td>ELE 141</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Modular design of combinational circuits – synchronous circuit designs using discrete gates and flip-flops (Registers, Counters, ...) – Moore and Mealy machines Finite State Machines analysis and design – Top-down digital systems design approach – Timing aspects of digital systems – ASM charts – Digital circuit representation formats including high level hardware description languages such as Verilog-HDL – Design methodologies using current computer aided design tools – Synthesis and modern digital circuit design – Modern programmable devices (PLDs) including ROMs, CPLDs and FPGAs – Mapping the designs to programmable logic devices in the form of FPGAs and CPLDS.</td></tr>
<tr><td>References</td><td colspan="11">• John Wakerly, "Digital Design: Principles and Practices", 5th Edition, Pearson, 2018, ISBN-13: 978-0134460093
• M. Morris Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog", 6th Edition, Pearson, 2017, ISBN-13: 978-0134549897.
• Charles H. Roth, Jr., Lizy K. John, "Digital Systems Design Using VHDL" 3rd Edition, Cengage Learning, 2017, ISBN-13: 978-1305635142
• F. P. Processor, D. E. Wiskel, "The art of digital Design and introduction to top- Down Design", 3rd Edition., Prentice Hall</td></tr>
<tr><td>Laboratory</td><td colspan="11">• implement combinational circuit using HDL
• implement sequential circuit using HDL
• structural design
• Interfacing with FPGA/CPLD boards
• mapping designs on FPGA</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 143	Object Oriented Programming	ELE 042	3	2	2	0	4	10	30	20	40

Course Content

Revision on Structured Programming - Fundamentals of Object Oriented Programming, necessity and advantages - Unified Modelling Language (UML) -Objects and Classes - Encapsulation - data and method binding - access specification - modularity based encapsulation - Inheritance: passing knowledge down, single versus multiple inheritance, sub- and super-classes - Code reuse - Polymorphism: Simple polymorphism, method overloading, subtype polymorphism through method overriding, 'virtual' methods - abstraction through polymorphism - Exception Handling - Templates - Comparison of Popular OOPLs, OOPL varieties. Comparing C++, Java, C#, and Python

References

- W. Savitch, "Problem Solving with C++" 10th Edition, Pearson, 2018, ISBN-13: 978-0134448282
- Reema Thareja, "Python Programming Using Problem Solving Approach", Oxford University Press, 2017, ISBN-13: 978-0199480173
- R. Sedgweck, K. Wayne, "Introduction to Programming in Java: An Interdisciplinary Approach", 2nd Edition, Addison-Wesley Professional, 2017, ISBN-13: 978-0672337840

Laboratory

The laboratory includes solving problems and implementing programs focusing on OOP to cover the lecture topics along with the course including:

- Programs to create classes and objects (Classes with primitive data members, arrays, pointers, and constants as data members)
- Constructors and Destructors
- Programs to illustrate Access Specifiers (public, private and protected)
- Operator Overloading
- Inheritance (single, hierarchical, multiple, multi-level and hybrid)
- Polymorphism (Compile and Run Time)
- Virtual Functions and classes
- Exception Handling
- Templates (template class, member function templates)

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 144	Data Structure and Algorithms	ELE 143	3	2	2	0	4	10	30	20	40

Course Content

Pointers - Dynamic Memory allocation - Abstract Data types and representation – Stacks: Representation, elementary operations, and applications. - Queues: Simple queue, circular queue, dequeue, elementary operations and applications - Linked lists: Linear, circular, and doubly linked lists, elementary operations, and applications - Trees: Binary tree, tree traversal, complete binary tree, other operations, and applications of trees - Hashing: hash tables, hash functions, open addressing - File structures: Introduction, data file types, file organization, file access methods.
Algorithms: Searching algorithms – Sorting Algorithms (Bubble, selection, insertion, quick)

References

- W. Savitch, "Problem Solving with C++" 10th Edition, Pearson, 2018, ISBN-13: 978-0134448282
- M.J. Augenstein, A.M. Tenenbaum, Y. Langsam, “Data Structure Using C & C++”, 2nd edition, Prentice Hall of India, 2007, ISBN-13: 978-0387202778.
- M. Goodrich, R. Tammasia, M. Goldwasser, "Data Structure and Algorithms in Python", Willey, 2013, ISBN-13: 978-1118290279
- M. T. Goodrich, R. Tamassia and M. H. Goldwasser, “Data Structures and Algorithms in Java”, 6th Edition, Wiley 2014, ISBN-13: 978-1118771334

Laboratory

Laboratory includes writing programs to implement the basic operations with different data structures using a high-level language as (C, C++, Java, Python, …. etc.)

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 173	Electrical Application		2	1	3	0	4	10	30	20	40

Course Content	Laboratory Safety, Familiarization with electronic components(resistors, capacitors, inductors, Diodes, Transistors, ICs, ...etc. Principals of layout of electrical and electronic circuits - modern representation for modern block diagrams - Designation, abbreviations and standards - wiring and cabling - PCB design process and issues – Etching - Electrical drawing and diagrams - Printed circuit board - Introduction to CAD- Simple electronic projects - Assembly of complete electronic project- Electrical Power System Elements- Relays and contactors types - Control and power circuits - 3 phase motor direction reversal - Star- Delta starting of 3 phase Induction Moto
References	• Lecture Notes • Electrical Engineering: Principles and Applications (Allan R. Hambley).
Laboratory	Monostable circuit • astable circuit • power supply • Digit BCD Counter • start stop induction motor • reverse induction motor

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 179	Electric Circuits Analysis	BES 032	3	2	1	2	5	10	30	20	40

Course Content	Circuit Topologies and DC Analysis: Concepts, resistive network. Network laws and theorems: The Node-Voltage Method and Dependent Sources - The Mesh-Current Method and Dependent Sources - Thevenin and Norton Equivalents - Maximum Power Transfer - Superposition, Topology in Circuit Analysis - Inductance and capacitance. The Operational Amplifier circuits - Transient Response: RC circuits, RL circuits, RLC circuits. The Natural Response of RL and RC Circuits - Step Response of First Order RL and RC Circuits - Natural and Step Responses of RLC Circuits -Sinusoidal Steady-State Analysis - The Phasor - The Passive Circuit Elements – circuit theorems and Laws in the Frequency Domain - Sinusoidal Steady-State Power Calculations Appliance Ratings.
References	• Nilsson, J. W., & Riedel, S. A., “Electric circuits”, 12th Edition, Pearson Education Limited, 2020.
Laboratory	Verify laws and theorems in the course using experiments, project construction and simulation, the topics include: Series/parallel connection circuit for resistance, Capacitance Circuit, Inductance Circuit, RC & RL Circuit, LC Resonance Circuit

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>ST</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 201</td><td>Electric Machinery</td><td>ELE 103</td><td>2</td><td>1</td><td>2</td><td>0</td><td>3</td><td>10%</td><td>30%</td><td>20%</td><td>40%</td></tr>
<tr><td>Course Content</td><td colspan="11">Rotatingelectricalmachines,operating principles, main terminology, and industrial standards. Static conversion of electrical energy: three- phase inverter and current control. DCmotor: principle of operation, main characteristics and construction, electrical drives with DC motor,sizingofrealapplicationexamples.Synchronousmotor(“brushless”):principleofoperation,maincharacteristicsandconstruction,electricaldriveswithsynchronousmotor.Asynchronousmotor:principle ofoperation,maincharacteristicsandconstruction,electricaldriveswithasynchronousmotor.Stepper motors.</td></tr>
<tr><td>References</td><td colspan="11">"Electric machines and drives", By G.R. Slemon, Addison Wesley, MA, 1992</td></tr>
<tr><td>Laboratory</td><td colspan="11">Polarity-test for single-phase Transformer
Open-circuit test for single-phase Transformer
Short-circuit test for single-phase Transformer
Parallel-operation for single-phase Transformer
Three-phase Transformer’s connections
Magnetization curve or Open circuit characteristic of DC Machine (plot of Ea vs. Ia).
Armature Control of DC Machine Drives.
Field Control of DC Machine Drives.
Voltage Regulation and Speed Regulation of DC Machine.
Starting a DC Motor with DC Manual Starter.
Principles of Induction Motor
Star Delta Starter of Induction Motor
Speed Control of Induction Motor Drives
Speed Regulation of Induction motor
Parameters determinations
Starting of Synchronous Machine
Connection of Synchronous Machines in Parallel or with the Grid
The effect of changes in field currents on Power-factor
Speed Control of Synchronous Machines Drives
Speed Control of Stepper motor Drives</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
ELE 204	Logic Circuits Design & Applications	ELE 104	3	2	2	0	4	20	20	20	40
Course Content	Number systems and data representation - Boolean algebra - simplification of Boolean functions - logic gates - combinational and sequential logic circuits. Registers, counters, and adders – Memory. Digital electronics. Performance of analogue and digital transducers; selecting a proper transducer for a given application. Digital transducers: optical encoders, ultrasonic sensors. Data acquisition systems (A/D and D/A converters). Stepper motors: microprocessors: structure, programming, applications.										
References	• Charles H. Roth Jr., Larry L Kinney, 2009, "Fundamentals of Logic Design", 6th Edition, Publisher: CL Engineering • Sajjan G. Shiva, 1998, "Introduction to logic design", M. Dekker, New York										
Laboratory	• Project: At the end of the course the student must provide a project emphasizing the course content										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 211	Signals and Systems	BES 111	3	2	0	2	4	30	30	-	40
Course Content	Signals and systems: Continuous time and discrete-time signals - Exponential and sinusoidal signals - The unit Impulse and unit step functions - Basic system properties -Linear time invariant systems: Discrete-time LTI systems: The convolution sum - Continuous-time LTI systems - Properties of LTI systems - Causal LTI systems described by differential and difference equations - Filters described by differential equations and filters described by difference equations - The continuous-time Fourier Analysis – Discrete Fourier Transform -Energy and power spectral densities.										
References	• B.P. Lathi, “Signal Processing and Linear Systems”, 2nd Edition, Oxford University, 2021. • Oppenheim, Alan V., Willsky, Alan S. with Nawab, S. Hamid, “Signals & Systems”, 2nd Edition, Pearson, 2014.										

<table>
<tr><td rowspan="2">Code</td><td rowspan="2">Course Title</td><td rowspan="2">Pre-req</td><td rowspan="2">Cr. Hrs.</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment</td></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>ELE 212</td><td>Analog Communication Systems</td><td>ELE 211</td><td>3</td><td>2</td><td>1</td><td>2</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Review on Fourier analysis, Canonical representation of Band-Pass signals, Band-pass systems, Phase and Group delay, Amplitude Modulation, DSB-SC modulation, Filtering of Sidebands, Vestigial Sideband Modulation, Single Sideband Modulation, Frequency Translation, Frequency-Division Multiplexing, Angle Modulation, Frequency Modulation, Phase-Locked Loop, Nonlinear Effects in FM systems, Superheterodyne receiver, Noise in DSB-SC receiver, Noise in SSB receiver, Noise in AM receiver, Noise in FM receiver, Pre-emphasis and De-emphasis in FM</td></tr>
<tr><td>References</td><td colspan="11">• "Simon Haykin, ""Communication Systems"", Wiley, 4th edition
• Lathi, ""Modern Digital and Analog Communication System"", Oxford University Press, 5th edition"</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Generation of AM signal
• Generation of DSB-SC signal
• Coherent detector receiver
• Generation of SSB signal
• Generation of narrowband and wideband FM signal
• FM detection using frequency discrimination
• FM detection using PPL</td></tr>
</table>

<table>
<tr><td rowspan="2">Code</td><td rowspan="2">Course Title</td><td rowspan="2">Pre-req</td><td rowspan="2">Cr. Hrs.</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment</td></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>ELE 213</td><td>Electronic Circuits I</td><td>BES 131 or ELE 114</td><td>3</td><td>2</td><td>1</td><td>2</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">The course offers the specific materials pertain to analog electronics including review on PN junction physics, diode circuits analysis, bipolar-junction transistors (BJT), Metal Oxide Semiconductor Field Effect Transistors (MOSFET), and basic amplifier configurations. Design and analyze single stage and multistage amplifier circuits. Analyze the frequency response of small signal amplifiers. Analysis of the basic logic gates: the DTL, TTL, ECL, P-MOS, N-MOS and CMOS gates Circuit simulation. Circuit performance is predicted by means of both hand calculations and computer simulations.</td></tr>
<tr><td>References</td><td colspan="11">• Sedra / Smith, Microelectronic Circuits, 8th Edition, Oxford University Press, 2019.
• Jacob Baker, CMOS Circuit Design, Layout, and Simulation, 3rd Edition, Institute of Electrical and Electronics Engineers, 2010.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• PN Junction diode characteristics: Forward bias and Reverse bias.
• Zener diode characteristics and voltage regulator.
• Clipper, Clamping and doubler circuits.
• Halfwave and Full wave Rectifiers with and without filter.
• Design the transistor circuit as Switch.
• Transistor CB, CC, CE characteristics (Input and Output).
• Frequency response of Amplifiers.</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 214	Electronic Circuits II	ELE 213	3	2	1	2	5	10	30	20	40

Course Content	This course will enable the students to learn about the use of transistors in analog circuits like BJT differential amplifiers, MOS differential amplifiers, multistage amplifier, DC and AC analysis of multistage amplifiers, current sources and sinks, current mirrors, voltage and current references, feedback amplifiers, and the frequency response of amplifier circuits. Circuit performance is predicted by means of both hand calculations and computer simulations.
References	• Sedra / Smith, Microelectronic Circuits, 7th Edition, Oxford University Press, 2015. • Jacob Baker, CMOS Circuit Design, Layout, and Simulation, 3rd Edition, Institute of Electrical and Electronics Engineers, 2010. • James M. Fiore, Operational Amplifiers & Linear Integrated Circuits: Theory and Application / 3E, West Group, Version 3.2.1, 20 February 2020.
Laboratory	• Design and test operational amplifier application, Inverting amplifier, non-inverting, summer, voltage follower, integrator, and differentiator. • Plot the frequency response of two stage RC coupled amplifier and calculate the bandwidth and compare it with single stage amplifier. • Design and test using operational amplifiers for performance zero crossing detector, Schmitt trigger for different hysteresis values. • Design and test using operational amplifiers for performance of full wave precision rectifier. • Current Sources and Voltage Source.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 216	Electromagnetic Field	BES 113	3	2	0	2	4	30	30	-	40

Course Content	Review of vector analysis. Repetition of the electrostatic and magnetostatic fields, including the polarization field in dielectrics and the magnetization field in magnetizable media. Potential theory with applications in electrostatics, magnetostatics and stationary current distributions. Induction law and displacement current. Transformation of the electromagnetic field. Maxwells equations. Pointing theorem
References	• Engineering electromagnetics by William Hyat, McGraw-Hill Education; 8th edition

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 218	Digital Signal Processing	ELE 211	3	2	1	2	5	10	30	20	40

Course Content

Introduces the fundamental theoretical concepts of digital signal processing. It covers quick review on discrete-time signals and systems, LTI systems, Z-Transform, digital filter design, filter realization, and frequency domain analysis using discrete and fast Fourier transforms.

References

- Fundamentals of digital signal processing, Lonnie C. Ludeman, Wiley 1986.
- Digital Signal Processing: Principles, Algorithms and Applications, J. Proakis, D. Manolakis, Prentice-Hall, 2006 (4-th edition)

Laboratory

- Generation of common discrete-time signals using MATLAB.
- Evaluation of impulse response and frequency response of LTI system with different ROC's.
- Digital filter design using MATLAB.
- Evaluation of DFT and FFT algorithms without using inherent MATLAB functions and compare algorithm complexity.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 231	Control Theory	BES111	3	2	1	2	4	10	30	20	40

Course Content

Transfer function - Block diagrams - Signal-flow graphs - State diagram. Mathematical modeling of physical systems - DC motors - linearization of nonlinear systems. State-variable analysis: Matrix representation of state equations, state-transition matrix - state-transition equation - relationship between state equations and transfer functions - characteristic equation Stability of linear control systems: methods of determining stability - Time-domain analysis of control systems - Transient and steady state response analysis - Root locus plots - Bode Diagrams - Polar plots and frequency response analysis

References

- Nise, N. S., "Control Systems Engineering", 8^{th} Edition, Wiley, 2019
- Katsuhiko, Ogata, "Modern Control Engineering", 5^{th} Edition, Pearson, 2009.

Laboratory

MATLAB SIMULINK Programming LAB 1:
- Differential Equation representation by SIMULINK
- Time Response of Transfer Function to different inputs
- State space representation in MATLAB
- Root Locus Plots - Bode Plots
- Frequency Response

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 232	Modern Control Systems	ELE 231	3	2	2	1	5	10	30	20	40

Course Content	PID controller design and tuning (Ziegler and Nichols and other advanced techniques). Nyquist stability criterion. State space modeling. Controllability and Observability. State feedback controller and observer design. Application of state-space method to the analysis and synthesis of feedback control systems. Pole Placement Using State Feedback. linear control systems with time delays – data control systems: PI – PID – Phase-Lead – Phase-Lag, Lead-Lag (Lag-Lead) – PID controller design using amplitude optimization methods. Case studies applied to Inverted Pendulum and Magnetic levitation using MATLAB.
References	• Dorf, Richard C., and Robert H. Bishop, "Modern Control Systems", 13th Edition, Pearson, 2016. • Katsuhiko, Ogata. "Modern Control Engineering" 5th Edition, Pearson, 2009.
Laboratory	• Time response for transfer function including P, PI, PD and PID Controllers • Lag-Lead compensators and overall system time and frequency response • State space representation for different systems (Benchmark-inverted pendulum, ball-beam system) • State feedback controller and observer design and Pole Placement techniques applications using MATLAB

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 241	Computer Architecture	ELE 142	3	2	2	1	5	10	30	20	40

Course Content	Basics of Computer Architecture, Computer arithmetic: Fixed-point arithmetic operations, Floating-point Arithmetic Operations, multiplication techniques, Instruction Set Architecture: introduction to ISA, Instruction formats- Instruction types and addressing modes, instruction cycle, Assembly language programming, Single cycle Data path design, RISC and CISC architecture.
References	• Linda Null, "Essentials of Computer Organization and Architecture", 5th Edition, Jones & Bartlett Learning, 2018. • David A. Patterson and John L. Hennessy, "Computer Organization and Design MIPS Edition: The Hardware/Software Interface", 5th Edition, Morgan Kaufmann, 2013. • William Stallings, "Computer Organization and Architecture", 11th Edition, Pearson, 2018M. Morris R. Mano, "Computer System Architecture", 3rd edition, Prentice-Hall of India, 2003.
Laboratory	• Processor simulators • Design single cycle or multi-cycle data path processor using VHDL • Assembly Programming

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr></tr>
<tr><td rowspan="2">ELE 242</td><td rowspan="2">Computer Organization</td><td rowspan="2">ELE 241</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Performance analysis - Building single cycle Datapath processor - Pipelining: examples of some pipeline in modern processors, pipeline hazards (Structure, data, and control hazards) - Techniques to handle hazards, performance improvement with pipelines and effect of hazards on the performance. - Superscalar and VLIW processors - Memory Hierarchy Design: A Top-Level View, Cache Memory, Main Memory. - Input/Output organization - Classification of models, Flynn’s taxonomy of machine models (SISD, SIMD, MISD, MIMD). - Cache Coherency</td></tr>
<tr><td>References</td><td colspan="11">• Linda Null, “Essentials of Computer Organization and Architecture”, 5th Edition, Jones & Bartlett Learning, 2018.
• David A. Patterson and John L. Hennessy, “Computer Organization and Design MIPS Edition: The Hardware/Software Interface”, 5th Edition, Morgan Kaufmann, 2013.
• William Stallings, “Computer Organization and Architecture”, 11th Edition, Pearson, 2018.
• John L. Hennessy and David A. Patterson, “Computer Architecture: A Quantitative Approach” 5th Edition, Morgan Koffman, 2011</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Design processor Datapath and control
• Design pipelined processor using VHDL
• Pipelined processor simulator</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr></tr>
<tr><td rowspan="2">ELE 243</td><td rowspan="2">Algorithms Analysis and Design</td><td rowspan="2">BES 114, ELE 144</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Algorithms Design and analysis- examples - Techniques for designing efficient algorithms - analysis of complexity - Decrease and conquer - Divide-and Conquer paradigm - Greedy Algorithms - Branch-and-bound - Dynamic Programming - Fundamentals of parallel algorithms - Scheduling Algorithms - Applications (approximate string matching, data compression, computational geometry) - NP-Hard and NP complete problems, Introduction to approximation algorithms.</td></tr>
<tr><td>References</td><td colspan="11">• Douglas R. Stinson, “Techniques for Designing and Analyzing Algorithms”, Routledge, 2021, ISBN-13: 978-0367228897
• T. Cormen, C.E. Leiserson, R. Rivest, "Introduction to Algorithms" 3rd Edition, MIT Press, 2009
• Anany Levitin, "Introduction to the Design and Analysis of Algorithms" 3rd Edition, Pearson, 2011
• R. Sedgweck, K. Wayne, "Algorithms" 4th Edition, Addison-Wesley Professional, 2011</td></tr>
<tr><td>Laboratory</td><td colspan="11">Laboratory experiments will be set based on the course topics. It includes programming problems for practicing, designing, and comparing different algorithm design paradigms.</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 244</td><td>Operating Systems</td><td>ELE 241</td><td>3</td><td>2</td><td>1</td><td>1</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to Operating Systems, Operating System Structure, Process: Operation, structure, and Management - CPU Scheduling: Context Switching, Algorithms - Process Synchronization: hardware, Semaphore – Deadlock - Memory Management: address binding, logical and physical address, swapping, Paging and Virtual Memory – Storage: files, file systems. – OS interfaces – LINUX, Android, IOS.</td></tr>
<tr><td>References</td><td colspan="11">• Abraham Silberschatz Peter B. Galvin and Greg Gagne, “Operating System Concepts”,10th Edition, Wiley, 2018.
• Andrew S. Tanenbaum and Herbert Bros, “Modern Operating Systems”, 4th Edition, Pearson, 2016.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Working with Linux, Shell script, System calls, Scheduling algorithms, Producer consumer problems, System Process, System Log</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 245	Computer Applications	ELE 042	3	2	2	0	4	10	30	20	40

Course Content	Computer Programming with MATLAB : Introduction to MATLAB – MATLAB Desktop tools -Data Representation in MATLAB - M files - Control Statements – Loops - Functions (Rules for writing MATLAB functions, function arguments, MATLAB function and Debugging) - Importing and exporting Data - Getting Help - MATLAB and algebra : Vectors and Matrices (operations and functions) - Solving Linear Equations – Polynomials - Differential Equations - MATLAB Graphic: Two-Dimensional Plots -Three-dimensional plots - MATLAB GUI - MATLAB Simulink.
References	• Holly Moore, "MATLAB for Engineers", 3rd Edition, Salt Lake Community College, 2011, ISBN-13: 978-0-13-210325-1 • Amos Gilate, "MATLAB: An Introduction with Applications", 5th Edition, John Wiley &Sons, Ic., 2015. ISBN 978-1-118-62986-4 (paper) • "SIMULINK Dynamic System Simulation for MATLAB", Version 4, COPYRIGHT 1990 - 1999 by The MathWorks, Inc.
Laboratory	Problem solving labs to apply explained topics in each lecture including: • Input to a Script File, Output Commands • The Save and Load Commands, Importing and Exporting Data • Relational and Logical Operators, Conditional Statements. • Loops: for-end loops, and while-end loops • User-Defined Functions and Function Files: Creating a Function File, Structure of a Function File. • Local And Global Variables. Saving A Function File. Using A User-Defined Function • Controlling the Simulation, Simulation Time, Solver Parameters, Solving Differential Equations. • Plotting in two dimension and three dimensions. • Modeling Equations in MATLAB Simulink. Simplification of Simulink Systems. The Function Block. Construction of Subsystems in Simulation. Link M file with Simulink file. Interface GUI with Simulink. * Project: At the end of the course, the student must provide a project emphasizing the course content.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 246	Computer Network		3	2	2	1	5	10	30	20	40

Course Content

Network applications, hardware, software, reference models: OSI and TCP/IP reference model - Internet Control Message Protocol - Address Resolution Protocol - Describe switching concepts (MAC learning , Frame switching, Frame flooding, MAC address table) - The difference between the router, switch and the rest of the linking devices - Network Device Domains (Collision, Broadcast Domains) - IPv4 Addressing - Subnetting - Variable length subnet mask - Route summarization - Router components - Router Configuration - Remote Access Telnet - Dynamic Host Configuration Protocol Operation - Configuring a Router as a DHCP Server - DHCP Relay Agent.

References

- A.S. Tanenbaum, “Computer Networks”, 6th Edition, Pearson Education, 2021.
- James F. Kurose, Keith W. Ross, "Computer Networking a Top-Down Approach", Pearson, 8th edition, 2021, ISBN-13: 978-0-13-285620-1
- Peter L Dordal, "An Introduction to Computer Networks", 2020 available in: https://intronetworks.cs.luc.edu/current2/html/
- "CCNA-200-301-Official-Cert-Guide - volume 1 and 2", WENDELL ODOM, 2020, ISBN-10: 0-13-579273-8, Published by: Cisco Press

Laboratory

- Network cables (How to prepare a UTP cable and testing a UTP cable using RJ45/RJ11 Cable Tester)
- IP Addresses, Network Communications and Share Files between Two Computers Using LAN Cable
- Viewing the Switch MAC Address Table
- Identifying IPv4 Addresses
- Configuring Basic Router Settings
- Router configuration on real cisco devices
- Designing and Implementing a Sub netted IPv4 Addressing Scheme
- Design and Implement a VLSM Addressing Scheme
- Configuring DHCP service on a generic server in Packet Tracer
- Configure real Cisco router as DHCP server

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<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 254</td><td>AI and advanced algorithms</td><td>ELE 144, BES 111</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to decision theory, artificial intelligence, heuristic search, uncertain reasoning, classification, and machine learning. Acquisition and representation of clinical expertise in the computer. Example applications of using AI in medical diagnosis.</td></tr>
<tr><td>References</td><td colspan="11">• Artificial Intelligence: A Modern Approach (3rdedition) by Stuart Russell and Peter Norvig, a.k.a AIMA(3e)
• Introduction to Artificial Intelligence, Shinji Araya, KYORITSU SHUPPAN, ISBN4-320-12116-3 (in Japanese)
• New Artificial Intelligence (Fundamental), Takashi Maeda and Fumio Aoki, Ohmsha, ISBN4-274-13179 (in Japanese)
• New Artificial Intelligence (Advanced), Takashi Maeda and Fumio Aoki, Ohmsha, ISBN4-274-13198-X (in Japanese)
• Artificial Intelligence: a modern approach, S. Russell and P. Norvig, Prentice Hall, ISBN0-13-080302-2</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Introduction to Python, Searching problem, CSPs Problem, Game Trees, Markov Decision process, Reinforcement learning, Probability model, Bayes' Net, Decision Diagrams, ML: Perceptron's</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>St. Act.</th><th>Mids</th><th>Exp.</th><th>Final</th></tr>
<tr><td>ELE 255</td><td>Anatomy and Physiology</td><td>---</td><td>2</td><td>2</td><td>0</td><td>0</td><td>2</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Application of statics to the musculoskeletal system: Systems in equilibrium, joints, muscle forces, joint reaction forces, indeterminate problems. Application of dynamics to study human motion: Linear and angular kinematics, linear and angular kinetics, impulse and momentum, work, and energy. Strength of materials: stress and strain, elastic and viscoelastic materials, linear and nonlinear constitutive equations. Material properties of biological tissues: bone, muscle, cartilage, tendons, and ligaments. Assessment of failure of bone under different loading conditions. Selected advanced topics: prosthetics design, total hip joint replacement.</td></tr>
<tr><td>References</td><td colspan="11">Science of Yoga: Understand the Anatomy and Physiology to Perfect Your Practice
Dorling Kindersley
DK, Ann Swanson, 2019

Anatomy & Physiology: The Unity of Form and Function
McGraw-Hill Science/Engineering/Math
Kenneth Saladin, 2003</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 256	Introduction to Biomedical Engineering	ELE 142	3	2	0	2	4	10	30	20	40
CourseContents	Analog signals, Digital signals, Analog to digital conversion, low power consuming circuits digital signal processing, biological instrumentation, and biomedical applications.										
References	John Enderle, Joseph Bronzino, 2011, Introduction to Biomedical Engineering, 3rd Edition, Academic Press										
	Street, Laurence J, 2011, Introduction to Biomedical Engineering Technology, Second EditionCRC Press										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 271	Electrical Power System I	ELE 112	3	2	0	2	4	30	30	0	40
Course Contents	Representation of power systems, Generating stations, Parameters of transmission lines: series impedance, inductance and electrical capacitance, Electrical design of transmission lines, Models of transmission lines, Analysis of short, medium and long transmission lines, Performance of transmission lines, Mechanical design, Overhead transmission lines insulators, Corona, Distribution systems-general, DC distribution, AC distribution, underground cables.										
References	• Stevenson, W. D., Elements of Power System Analysis, McGraw Hill, 1995. • Mehta, V. K. and Mehta, R., Principles of Power System, AMIE and Other Engineering Examinations. S. Chand Publishing, 2005. • Glover, J. D., Sarma, M. S., &Overbye, T., Power system analysis &design,Cengage Learning, 2012.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 272	Electrical Power System II	ELE 271	3	2	0	2	4	30	30	0	2
Course Contents	Power factor improvement, Essential features of switchgear, Basic elements of switchgear, substations and circuit breakers, Voltage control in AC power systems, Transients and dynamics of over voltages in high-voltage systems, DC power transmission systems, Introduction to FACTS, Introduction to power system planning.										
References	• Stevenson, W.D., Elements of Power System Analysis, McGraw Hill, 1995. • Mehta, V. K. and Mehta, R., Principles of Power System, AMIE and Other Engineering Examinations. S. Chand Publishing, 2005. • Glover, J. D.; Sarma, M. S., and Overbye, T., Power system analysis and design, SI version. Cengage Learning, 2012.										

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<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 273</td><td>Power Electronics I</td><td>ELE 213</td><td>3</td><td>2</td><td>1</td><td>2</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Introduction of power electronics devices- circuits, and applications- Power semiconductors: types, construction and performance of switching states of Power Diodes, Power Transistors and Thyristors- Characteristics, ratings, and types of power diodes, power transistors, and Thyristors- Protection of power semiconductors switches and their circuits against temperature rise, over current and over voltage - Uncontrolled and controlled rectifier: operation, performance analysis and Design - Design of output Voltage with LC Filter- Dual ,series and parallel controlled rectifier -Thyristors commutation- Firing and drive circuit.</td></tr>
<tr><td>References</td><td colspan="11">• Bose, B.K., Power Electronics and AC Drives, Prentice Hall, 1986
• Mohan, N., Undeland, T.M. and Robbines, W.P., Power Electronics: Converters,Applications and Design, John Wiley and Sons Inc., 1990
• Rashid, M.H., Power Electronics, Circuits, Devices And Applications, Prentice Hall, 1995.</td></tr>
<tr><td>Laboratory</td><td colspan="11">Characteristics of the switching devices (diode, thyristor, BJT, IGBT,)
Single phase half wave uncontrolled and controlled rectifiers with different loads (resistive, inductive, battery,..)
Single phase full wave uncontrolled and controlled rectifiers with different loads (resistive, inductive, battery ,..)</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 274</td><td>Power Electronics II</td><td>ELE 273</td><td>3</td><td>2</td><td>1</td><td>2</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">DC–AC inverters: operation, performance analysis and design- harmonic Reductions- AC Voltage Controllers: operation, performance analysis and design- DC–DC converters (DC choppers): operation, performance analysis and design. Update of power electronic circuit and system.</td></tr>
<tr><td>References</td><td colspan="11">•Bose, B.K., Power Electronics and AC Drives, Prentice Hall, 1986
•Mohan, N., Undeland, T.M. and Robbines, W.P., Power Electronics: Converters,Applications and Design, John Wiley and Sons Inc., 1990
•Rashid, M.H., Power Electronics, Circuits, Devices And Applications, Prentice Hall, 1995.</td></tr>
<tr><td>Laboratory</td><td colspan="11">Single phase inverter with different loads (resistive, inductive)
Three- phase square wave inverter (120°- 180°) with different loads (resistive, inductive)
DC chopper (buck)
Boost (DC chopper)
Single phase AC voltage controller with different loads (resistive, inductive)</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 276	Electric Machines	ELE 179	3	2	2	1	5	10	30	20	40
Course Content	Magnetics, electromagnetic forces, generated voltage, and energy conversion - Motor action, and generator action - Transformer principles, construction, transformer action, ideal transformer, equivalent impedance of transformer, voltage regulation, per-unit impedance of transformer, transformer losses and efficiency. Transformer polarity and standard markings, transformer nameplates, autotransformers. Overview on Generation, Transmission and Distribution of Electrical Energy. Principles of DC machines, armature winding, developed torque. Principles of three phase induction motors - Synchronous Motors - Principles of DC machines.										
References	• Charles I. Hubert, “Electric Machines Theory, Operating Applications, and Control”, 2nd Edition, Pearson 2020, ISBN-13: 978-0130612106. • Sen, P.C., “Principles of Electrical Machines and Power Electronics”,3rd edition, Wiley, 2013										
Laboratory	• Experiments on magnetics and electromagnetic forces and generated voltage • Transformer Polarity Experiment, Loading and Unloading Exp. • Voltage Regulation Exp. • Open-Circuit Test and Short-Circuit Test Exp. • Instrument Transformers • Armature Control of DC Machines • Field Control of DC Machines. • Measure voltage, current and frequency of I.M. at starting and running. • Measuring of synchronous speed, rotor speed, and slip of I.M. • Speed reversing of I.M. • I.M. Starting Methods • Speed Control of I.M.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 277	Electrical Machine I	ELE 112	3	2	1	2	5	10	30	20	40
Course Contents	Magnetics, Electromagnetic Forces, Generated Voltage, and Energy Conversion; Motor Action, and Generator Action. Single-Phase Transformer Principles, construction, Transformer Action, Ideal Transformer, Equivalent Impedance of Transformer, Voltage Regulation, Per-Unit Impedance of Transformer, Transformer Losses and Efficiency. and Determination of Transformer Parameters. Transformer Polarity and Standerd Terminal Markings, Transformer Nameplates, Autotransformers.										
References	• Say, M.G., Theory and Performance of ac Machines- Third Edition, Pitman.										
Laboratory	• Some Experiments Belongs to Magnetcs and Electromagnetc Forces and generated Voltage • Transformer Polarity Experiment • Transformer Loading and Unloading Exp. • Voltage Regulation Exp. • Open-Circuit Test and Short-Circuit Test Exp. • Parallel Operation of Transformers • Three-Phase connections of Single Phase Transformers • Three-Phase Transformers										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr. Lec	Lab	Tut	Sum	Assessment SA	MT	PE/OE	Final
ELE 278	Electrical Machine II	ELE 277	3	2	1	2	5	10	30	20	40
Course Contents	Principles of Three-Phase Induction Motors, Introduction, I.M. Action, Reversal of Rotation, Construction, Synchronous Speed, Slip and its effect on Rotor frequency, and Voltage, Equivalent Circuit of an I.M., Air Gap power, Mechanical Power and Developed Torque, Torque-Speed Characteristics, Losses, Efficiency and Power Factor, Classification, Equivalent Circuits of I.M., Performance, Applications, and Operations of Induction Machines, Squirrel-cage I.M. NEMA design, NEMA Tables, Wound-Rotor I.M., Motor Nameplate Data, per-Unit values of I.M. Parameters, Determination of I.M. Parameters, Induction Generators, I.G., I.M. Starting. Synchronous Motors, S.M., Introduction, construction, Types; (Cylindrical and Sailent Poles); Starting of S.M., Shaft Load, Power Angle and Developed Torque, Counter-EMF and Armature Reaction Voltage, Equivalent Circuit and Phasor Diagram of S.M., Power Equation (Magnet Power), V-Curves, S.M. losses and Efficiency, Sailent-Pole S.M., pull-In Torque, Speed Control of S.M. Synchronous Generators (Alternators), Introduction, Motor to Generator Transition, S.G. Power Equation, paralleling of S.G., Motoring of Alternators, Safe Shutdown of AC Generators in Parallel with other Machines, Accidental Loss of Field Excitation, Per-Unit Values of S.M. Parameters, Voltage-Regulations, Determination of S.M. Parameters, Losses and Efficiency, and Some Applications.										
References	•Say, M.G., Theory and Performance of ac Machines- Third Edition, Pitman. •Sen, P.C., Introduction to Electrical Machines and Power Electronics - First edition, Pitman •Lecture Notes •Fitzgerald, A.E.; Kingsley, C. and Umans, S.D., Electric Machinery - Fifth edition, McGraw Hill Co •Charles I. Hubert , Electric machines Theory, Operation, Applications, Adjustment, and Control-Second Edition,2002										
Laboratory	•Some Exps. To measue Voltage, Current and frequency of Wound Rotor I.M. at starting and Running. •Measuring of Synchronous Speed,Rotor Speed, and Slip of I.M. •Speed reversing of I.M. •Determination of I.M. Parameters (DC-Test, Blocked Rotor Test, and No-Load Test). •I.M. Starting Methods •Speed Control of I.M. •Starting of S.M. •Reversing the Rotation of S.M. •Determination of S.G. Parameters (DC-Test, Open-Circuit Test, Short-Circuit Test).										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr. Lec.	Lab	Tut	Sum	Assessment ST	MT	PE/OE	Final
ELE 301	Power Electronics	ELE 234	3	2	2	0	4	15%	20%	15%	50%
Course Content	Power semiconductor devices, diodes, thyristors, MOSFETS, and other insulated gate devices such as the IGBT, MCT and the FCT. Static and switching characteristics, gate drive and protection techniques. Drive circuit design and protection techniques. Power converter circuits Applications of AC-DC, DC-DC, and DC-AC power converter circuits. Analyses of input and output waveforms of these circuits, harmonic performance. A basic understanding of devices, circuit principles and implications in input/output waveform quality. Application considerations for remote and un-interruptible power supplies, and for computer systems, telecommunications, automobiles, traction and other industrial processes; Utility interaction, harmonic distortion.										
References	• Adel S. Sedra and Kenneth C. Smith, “Microelectronic Circuits”, by Oxford University press.										
Laboratory	• Characteristic of silicon-controlled rectifier • Triggering of IGBT, MOSFET & Power Transistor • Experimental study Bridge inverter using IGBT • Experimental study Series Inverter using MOSFET										
Used in Program	Mechatronics Engineering Program						Semester	7			

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 311</td><td>Digital Communication Systems</td><td>ELE 212</td><td>3</td><td>2</td><td>1</td><td>2</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Review Sampling Theory, Pulse Amplitude Modulation, Time-Division Multiplexing, Pulse-Position Modulation, Quantization Process, Pulse-Code Modulation, Noise Considerations in PCM systems, Delta Modulation, Differential Pulse-Code Modulation. Matched filter, Error Rate due to Noise, Intersymbol interference, Nyquest's Criterion for Distortionless Baseband Binary transmission, Correlative-Level coding, Baseband M-ary PAM transmission, Taped-Delay line Equalization, Eye Pattern, Passband transmission model, Gram-Schmidt Orthogonaliztion procedure, Gemotric interpretation of Signals, Response of Bank of Correlators to Noisy Input.</td></tr>
<tr><td>References</td><td colspan="11">• Simon Haykin, Communication Systems, Wiley, 4th edition
• Lathi, Modern Digital and Analog Communication System, Oxford University Press, 5th edition</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Sampling of band-limited signal
• Pulse Amplitude Modulation
• Pulse Position Modulation
• Time-Division multiplexing
• Pulse Code Modulation
• Delta Modulation
• Intersymbol Interference and Eye Pattern</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 312</td><td>Wireless Communication Systems</td><td>ELE 311</td><td>3</td><td>2</td><td>1</td><td>2</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Coherent Detection of Signals in Noise, Probability of Error, Correlation receiver, Detection of signals with unknown phase, Coherent Binary PSK, Coherent Binary FSK, Coherent QPSK, Coherent Minimum Shift Keying, Noncoherent Orthogonal Modulation, Noncoherent FSK, Differential PSK, Comparison of Binary and Quaternary Modulation Schemes, M-ary Modulation Techniques, Power Spectrum Density and Bandwidth Efficiency, Synchronization in Digital receivers, Time Varying Channel Models, characteristics of Time varying Channel, Signal transmission through frequency non-selective slow fading channel, Signal transmission through frequency selective slow fading channel, signal transmission through fast fading channel, Diversity transmission in wireless communication.</td></tr>
<tr><td>References</td><td colspan="11">• Simon Haykin, Communication Systems, Wiley, 4th edition
• Lathi, Modern Digital and Analog Communication System, Oxford University Press, 5th edition</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Binay PSK modulation.
• Binary FSK modulation.
• Binary ASK modulation.
• QPSK modulation.
• Differential PSK modulation.
• Non-coherent FSK modulation.
• Carrier and symbols synchronization in digital receiver.
• Simulation of Fading Channel.</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 313	Information Theory	BES 211	2	2	1	1	4	10	30	20	40

Course Content: Uncertainty, Information, and Entropy. Source coding theory. Data Compaction. Discrete memoryless channels. Mutual information. Channel capacity. Channel Coding theory. Implications of the information capacity theory. Rate distortion theory. Linear block Codes.

References:
- Simon Haykin, Communication Systems, Wiley, 4th edition
- Shu Lin, Daniel Castello, Error Control Coding, Pearson, 2nd

Laboratory:
- Simulation of Huffman source encoder and decoder.
- Simulation of Limpel-Ziv source encoder and decoder.
- Simulation of BPSK system with repetition code.
- Simulation of BPSK system with Hamming block code.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 314	Digital Signal Processing I	ELE 211	3	2	1	2	5	10	30	20	40

Course Content: Introduces the fundamental theoretical concepts of digital signal processing. It covers quick review on discrete-time signals and systems, LTI systems, Z-Transform, digital filter design, filter realization, and frequency domain analysis using discrete and fast Fourier transforms.

References:
- Fundamentals of digital signal processing, Lonnie C. Ludeman, Wiley 1986.
- Digital Signal Processing: Principles, Algorithms and Applications, J. Proakis, D. Manolakis, Prentice-Hall, 2006 (4-th edition)

Laboratory:
- Generation of common discrete-time signals using MATLAB.
- Evaluation of impulse response and frequency response of LTI system with different ROC's.
- Digital filter design using MATLAB.
- Evaluation of DFT and FFT algorithms without using inherent MATLAB functions and compare algorithm complexity.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 315	Transmission Lines	ELE 216	3	2	1	2	5	10	30	20	40

Course Content: Understanding of RF microwaves transmission line theory. Uniform Plane Wave propagated in several medias and power consideration. Reflection of uniform plane waves at normal incident and standing wave ratio phenomena. Infinite and terminated transmission line. Phase and group velocity. Impedance matching. Graphical Methods (Smith Chart). Microstrip line and Waveguides.

References:
- Engineering Electromagnetics, William Hayt, 6th edition.
- Elements of Power System Analysis, Fourth Edition, William D. Stevenson, Jr., McGraw-Hill Book Company, 1982, Chapter 5.

Laboratory:
- Steady-state performance characteristics of power transmission lines.
- Open, short, and matched loaded transmission line.
- Measurements under Transient Conditions (Characteristic Impedance & Velocity of Propagation.
- Microstrip line transmission line.
- Matching circuits.

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 316</td><td>Antenna Theory and Wave Propagation I</td><td>ELE 315</td><td>3</td><td>2</td><td>1</td><td>2</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Theory of radiation, fundamental antenna parameters and concepts. Influence of earth on antenna radiation pattern and impedance. Radiation from several types of wire antennas like dipoles and loop antennas. Antenna matching from lumped elements and baluns. Antenna arrays and the general array formula.</td></tr>
<tr><td>References</td><td colspan="11">• Antenna Theory, Wiley, 3th edition, C. Balanis
• Antenna Theory and Design, Wiley,2nd Edition, Warren L. Stutzman, Gary A. Thiele.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Radiation Pattern of a λ/2 Dipole at 1 GHz.
• Half Wave Folded Dipole Antennas and Impedance Balun Transformation.
• Loop Antennas.
• Circular Polarization and Helical Antennas.
• Vertical dipole mounted on Metallic Printed Strip Disk.
• Antenna polarization.</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 317</td><td>Electronic Circuit Design</td><td>ELE 214</td><td>3</td><td>2</td><td>1</td><td>2</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">This course cover power amplifiers (Class A, Class B, Class A-B and C amplifiers), Passive filters (low-pass, high-pass, band-pass and band-reject). Passive filters frequency response characteristics. Active filters, Design and analyze higher order active filters. active filters frequency response characteristics. Oscillators, Different oscillator circuits RC and LC- phase shift, Wien’s bridge, Hartley, Colpitts, and crystal oscillator. Relaxation oscillator. VCO. Phase locked loop. switched-capacitor circuits. Circuit performance is predicted by means of both hand calculations and computer simulations.</td></tr>
<tr><td>References</td><td colspan="11">• Sedra / Smith, Microelectronic Circuits, 7th Edition, Oxford University Press, 2015.
• Jacob Baker, CMOS Circuit Design, Layout, and Simulation, 3rd Edition, Institute of Electrical and Electronics Engineers, 2010.
• Peter D. Hiscocks, Analog Circuit Design, 2nd Edition, Department of Electrical and Computer Engineering Ryerson University, 2010.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Design and test the class A, B, class B complementary symmetry power amplifiers.
• Design active filters: LPF, HPF, BPF and BRF.
• Plot the frequency response curve of Hartley and Colpitts Oscillator.
• Plot the frequency response curve of phase shift and Wein bridge Oscillator.
• Design passive filters: LPF, HPF, BPF and BRF.</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 331</td><td>Machine Learning</td><td>ELE 243, BES 211</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Supervised learning (generative/discriminative learning, parametric/ nonparametric learning, neural networks, and support vector machines)-Unsupervised learning (clustering, dimensionality reduction, kernel methods)- Learning theory (bias/variance tradeoffs - Reinforcement learning and adaptive control.</td></tr>
<tr><td>References</td><td colspan="11">• Ethem Alpaydin, “Introduction to Machine Learning”, 2nd edition, MIT Press, 2009, ISBN-13: 978-0262012430
• Theobald, Oliver, “Machine learning for absolute beginners”. 3rd Edition, Scatterplot Press, 2020, ISBN-13: 978-1520951409.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Linear and Logistic Regression.
• Build and evaluate machine learning models for classification and regression.
• Multi-class Classification and Neural Networks.
• Perform automatic hyperparameter tuning and feature selection to optimize model performance.
• K-Means Clustering and PCA.</td></tr>
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<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 332</td><td>Innovation Management and Entrepreneurship</td><td></td><td>2</td><td>2</td><td>0</td><td>0</td><td>2</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">What is Innovation, Technological Innovation and Innovation Management? Invention, Creativity and Innovation: What is the difference? Why innovation is necessary? What causes innovation to fail? Sources and types of innovation; Diffusion of innovation S-curves and the best timing to introduce new products / service. Introduction to Design Thinking Mindsets, and characteristics of good solutions Problem selection and team creation Empathize Stage of Design Thinking Define Stage of Design Thinking Ideation Stage of Design Thinking Prototyping Stage of Design Thinking Validation and Testing Stage of Design Thinking and What is Next Steps? Entrepreneurship mindset and characteristic of successful entrepreneur Difference between startup, Small Business. Business Model Canvas Business Model Innovation. Pitching</td></tr>
<tr><td>References</td><td colspan="11">• Alexander Osterwalder, Yves Pigneur, “Business model generation: A handbook for visionaries, game changers, and challengers”, 1st edition, 2010, ISBN-13: 978-0470876411
• Eric Ries, “The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses”, 1st edition, 2011, ISBN-13: 978-0307887894
• https://designthinking.ideo.com/</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 333	Digital Control	ELE 211, ELE 232	3	2	1	1	4	10	30	20	40
Course Content	Introduction to digital control, Discrete time systems, Modeling of digital controls systems, Stability of digital control systems, Digital control systems design, State space representation of digital control systems, Properties of discrete state-space models, State feedback digital control, Proportional, derivative, and integral control, Introduction to optimal digital control, Practical issues.										
References	• M. Sami Fadali, Antonio Visioli, “Digital Control Engineering: Analysis and Design”, 3rd Edition, Academic Press,2019, ISBN-13: 978-0128144336										
Laboratory	Using MATLAB Program: • Explores the process of digital control representation in MATLAB, followed by a review of Z-transforms. • Demonstrates state-space representations and the construction of transfer functions and their corresponding discrete equivalents • Explores steady-state and transient response analysis using root locus, as well as frequency response plots and digital controller design using bode plots • Employs test cases and real-life examples to provide students with hands-on experience suitable for the industry										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 335	Industrial Automation Systems	ELE 232	3	2	2	1	5	10	30	20	40
Course Content	Automation versus mechanization - Programmable controller at the heart of the automated system - Study of different software package used in industrial field - Ladder diagram programming language: (bit logic, counter, timer, special functions, analog input and analog output), Sequential Function Charts (sequential functions, alternative processes and exclusive processes,) - Functional blocks diagram (PLC software and common applications) - Statement list - Structured Text- Supervisory control and data acquisition- Distributed Control Systems (DCS) and SCADA Applications										
References	• Hugh Jack, “Automating Manufacturing Systems with PLCs”,7th Edition, Lulu.com, 2009. • W. Bolton, 'Programmable Logic Controllers', 6th Edition, Newnes, 2015. • Dag H. Hanssen,” Programmable logic controllers a Practical approach to IEC 61131-3 Using CoDeSys”, Wiley, 2015.										
Laboratory	• Classical Control Lab • PLC Bit Logic lab. • Timer and Counter lab • Function Block Diagram (FBD) • HMI/SCADA lab.										

<table>
<tr><td>Code</td><td>Course Title</td><td>Pre-req</td><td>Cr. Hrs.</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment</td></tr>
<tr><td rowspan="2">ELE 341</td><td rowspan="2">Microprocessor Based Systems</td><td rowspan="2">ELE 242</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>1</td><td>2</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Microprocessor-based digital system basic architecture.; Microprocessor basic architecture. Intel 8x86 Programming Model.; 80x86 family as a particular case.; Internal registers and 80x86 architecture.; Memory access and organization.; Addressing modes. Directives and operators of the 80x86 assembler.; Assembly program structure. Assembly Instructions: data transfer, arithmetic and logic operations, control, interruptions, etc.; PC Memory Map.; Interruptions: mechanism and interruption vectors.; Input/output programming techniques (I/O). (Pulling, Interruptions, DMA); Management and programming of 80x86 interruptions: the 8259A programmable controller.; PC hardware resources programming (Keyboard, Timer, Real-Time Clock (RTC)).</td></tr>
<tr><td>References</td><td colspan="11">• Giuliano Donzellini, Andrea Mattia Garavagno, Luca Oneto, “Introduction to Microprocessor-Based Systems Design”, Springer, 2021, ISBN-13: 978-3030873431.
• Barry B. Brey- “The Intel microprocessors 8086, 8088, 80186, 80188, 80286, 80386, 80486, The Architecture, Programming, and Interfacing”, 8th Edition-Prentice Hall,2008.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Addressing modes
• Arithmetic operations
• Logic Operations
• Memory and data transfer
• Interrupts
• IO mapping</td></tr>
</table>

<table>
<tr><td>Code</td><td>Course Title</td><td>Pre-req</td><td>Cr. Hrs.</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment</td></tr>
<tr><td rowspan="2">ELE 342</td><td rowspan="2">Embedded Systems</td><td rowspan="2">ELE 141</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to Embedded systems, Basic Hardware foundations, - architecture of computer-controlled real time control system - Real time interfacing - IO types, Delays, Driving DC loads, Driving AC loads, adding structure to your code, meeting real time constraints, Creating an Embedded OS, Multi-State systems and function sequences, Using Serial interfaces (RS-232, I2C and SPI), ADC and DAC interfaces (PWM), Multi-Processor Arch., Different Case studies</td></tr>
<tr><td>References</td><td colspan="11">• M.J. Pont, “Patterns for Time-Triggered Embedded Systems: Building Reliable Applications with the 8051 Family of Microcontrollers”,Addison-Wesley, 2001, ISBN 0201331381.
• Daniele Lacamera, “Embedded Systems Architecture: Explore architectural concepts, pragmatic design patterns, and best practices to produce robust systems”, Packt Publishing, 2018.
• Xiaocong Fan, “Real-Time Embedded Systems: Design Principles and Engineering Practices”, Newnes, 2015.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Reading Keypad
• 7-Segment display
• Real Time clock
• Serial Interface
• ADC and DAC interfaces</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 343	Database Systems	ELE 144	3	2	2	1	5	10	30	20	40

Course Content

Fundamental database concepts - data structures and operations - data modeling (ER - Relational) - database system architecture - Functional dependencies and normal forms. - implementation techniques of database management systems (index structures, concurrency control, recovery, and query processing) - data definition and data manipulation languages - query languages including Algebra and SQL - management of semi structured and complex data - security and integrity; concurrency control, distributed and NoSQL databases.

References

- Hector Garcia, J. Ullman, and J. Widom, "Database Systems: The Complete Book",2nd edition, Pearson Prentice Hall, 2009, ISBN 978-0131873254.
- R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems",7th Edition, Pearson, 2015, ISBN: 978-0133970777
- T. Connolly, C. Begg, "Database Systems: A Practical Approach to Design, Implementation, and Management", 6th Edition, Pearson 2014

Laboratory

Project based laboratory, to design a database project, the lab work includes:

- ER Modelling
- Schema Designing, creating Tables
- Writing SQL Queries

Creating Reports

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 347	Microcontroller Embedded Systems	ELE 141	3	2	2	0	4	10	30	20	40

Course Content

Introduction to Embedded systems, Basic Hardware foundations, - architecture of computer-controlled real time control system - Data Acquisition Systems (DAS) - examples of DAS cards and digital signal processing chips (DSP)- Real time interfacing - IO types, Delays, Driving DC loads, Driving AC loads, Adding structure to your code , Meeting real time constraints, Creating an Embedded OS, Multi-State systems and function sequences, Using Serial interfaces(RS-232,I2C and SPI), ADC and DAC interfaces (PWM), Multi-Processor Arch., Different Case studies .

References

- M.J. Pont, "Patterns for Time-Triggered Embedded Systems: Building Reliable Applications with the 8051 Family of Microcontrollers", ISBN 0201331381, Addison-Wesley, 2001

Laboratory

- • Reading K4eypad, 7-Segment display, Real Time clock, Serial Interface, ADC and DAC interfaces

Code	Course Title	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 350	Biomechanics	BES 022	3	2	2	1	5	10	30	20	40
Course Contents	Application of statics to the musculoskeletal system: Systems in equilibrium, joints, muscle forces, joint reaction forces, indeterminate problems. Application of dynamics to study human motion: Linear and angular kinematics, linear and angular kinetics, impulse and momentum, work, and energy. Strength of materials: stress and strain, elastic and viscoelastic materials, linear and nonlinear constitutive equations. Material properties of biological tissues: bone, muscle, cartilage, tendons, and ligaments. Assessment of failure of bone under different loading conditions. Selected advanced topics: prosthetics design, total hip joint replacement.										
References	Susan Jean Hall, 8th edition, 2019, Basic biomechanics, McGraw-Hill Education										
Laboratory	Anthropometry and Body Segment Parameters: Motion Capture and Analysis: Force and Torque Measurements: Muscle Activity and Electromyography (EMG): Ergonomic Assessment and Design: Gait Analysis and Rehabilitation: Computational Modeling in Biomechanics:										

Code	Course Title	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 351	Hospital Instrumentation	ELE 241	3	2	0	1	4	10	30	20	40
Course Contents	Hospital design basics, Hospital Planning, Hospital departments, Hospital department equipment lists, Medical instrumentation pre installation requirements, critical technical specs of medical equipment										
References	John G. Webster “Medical Instrumentation Application and Design”, 4th Edition, 2009										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 352	Rehabilitation Engineering and Assistive Technology	BES 022	3	2	2	1	5	10	30	20	40
Course Contents	Seminar in musculoskeletal rehabilitation: gait analysis, kinetic and kinematic measurement systems. Design of orthotic and prosthetic devices, design of robotic rehabilitation devices, functional electrical stimulation (FES), BCI for rehabilitation, evaluation of rehabilitation and orthotic devices, neural engineering. Current research will be reviewed and discussed.										
References	Andrew Y. J. Szeto, “Assistive Technology and Rehabilitation Engineering”, 2014										
Laboratory	Assistive Device Evaluation and Assessment: Wheelchair and Seating Simulation: Assistive Technology Prototyping: Accessible Software and Web Design: Sensory Aids and Assistive Devices: Rehabilitation Engineering Design Project										

<table>
<tr><td rowspan="2">Code</td><td rowspan="2">Course Title</td><td rowspan="2">Pre-req</td><td rowspan="2">Cr. Hrs.</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment</td></tr>
<tr></tr>
<tr><td rowspan="2">ELE 353</td><td rowspan="2">Biomedical Modeling and Simulation</td><td rowspan="2">ELE 211, BES 112</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to Modeling – Definitions – Types of Models – Purposes of Models – Modeling Methodology – Mathematical Modeling – Parameter Estimation – Basic Model Forms
Basic Simulation Approaches - Handling Stepped and Event-based Time in Simulations
Discrete versus Continuous Modelling - Sources and Propagation of Error - Models of Population Dynamics – Compartmental Modeling – Model from the Human Physiology – Models of Human Movement –Application of Modeling and Simulation in Biomedical Fields.</td></tr>
<tr><td>References</td><td colspan="11">• Kojic, Milos &Filipovic, Nenad&Stojanovic, Boban & Kojic, Nikola. (2009). Computer Modeling in Bioengineering: Theoretical Background, Examples and Software. Computer Modeling in Bioengineering: Theoretical Background, Examples and Software. 1-446. 10.1002/9780470751763.
• Jensen, Christopher. (2009). Biological Modeling and Simulation: A Survey of Practical Models, Algorithms, and Numerical Methods. Computational Molecular Biology . By Russell Schwartz . Cambridge (Massachusetts) : MIT Press . $45.00. xii + 389 p.; ill.; index. 978-0-262-19584-3 . 2008 .. The Quarterly Review of Biology. 84. 284-284. 10.1086/644661.
• Hill, Raymond. (2007). Discrete-Event Simulation: A First Course. Journal of Simulation. 1. 10.1057/palgrave.jos.4250012.</td></tr>
<tr><td>Laboratory</td><td colspan="11">- Introduction to Matlap and Simulink , RNG algorithms, Statstical model “data analysis”
- DTMC/CTMC, Queueing Theory model, Montecarlo simulation, Output Analysis</td></tr>
</table>

<table>
<tr><td rowspan="2">Code</td><td rowspan="2">Course Name</td><td rowspan="2">Pre-req.</td><td rowspan="2">Cr. Hrs.</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment</td></tr>
<tr><td>Lec.</td><td>Lab.</td><td>Tut.</td><td>Sum</td><td>St. Act.</td><td>Mids</td><td>Exp.</td><td>Final</td></tr>
<tr><td>ELE 354</td><td>Cardiovascular Biomechanics</td><td>BES 022</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Review of relevant theories in Fluid Mechanics, followed by anatomy and physiology of the cardiovascular system, including blood rheology and vessel tissue mechanics. Cardiovascular anatomy using state-of-the-art Virtual Reality equipment. Modelling, analytical and experimental methods applied to several parts of the cardiovascular system. Application of modelling techniques to investigate correlations with disease.</td></tr>
<tr><td>References</td><td colspan="11">Peter R. Hoskins, Patricia V. Lawford, Barry J. Doyle , “Cardiovascular Biomechanics”, Springer International Publishing, 2017</td></tr>
<tr><td>Laboratory</td><td colspan="11">Cardiovascular Anatomy and Physiology:
Hemodynamic Measurements:
Cardiovascular Imaging Techniques:
Cardiovascular Stress Testing:
Cardiovascular Tissue Mechanics:
Computational Modeling of Cardiovascular Biomechanics:
Cardiovascular Device Design and Evaluation</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 355	Medical Imaging I		3	2	2	1	5	10	30	20	40

Course Content	Computed Imaging: CT, PET, and SPECT – Magnetic Resonance Imaging. Radiation and Matter – Absorption of Radiation in Ultraviolet and Visible Regions: Sources and Detectors – Visual Colorimeters – Filter Photometers – Spectrophotometers – Spectrophotometry– Absorption of Radiation in Infrared Region: Sources and Detectors – Infrared Spectrophotometers – Molecular Luminescence – Fluorescence and Phosphorescence – Spectrofluorometry – Spectropolarimetry – Flame Photometery - Atomic Absorption - Chromatography (HPLC & GC) – Water Purification - Balances – Centrifuges - Electrophorosis - Molecular Biology Technique - Scattering of Radiation – Laser: Sources, and Applications in Chemistry and Spectroscopy - Chromatography - Automation - Performance Evaluation - Calibration of Analytical Instrumentation - Analytical Laboratory Skills - Practical Training in Clinical Sites.
References	- Jerry L. Prince, Jonathan, Medical Imaging Signals and Systems - Bushberg, J. T., The essential physics of medical imaging, 2nd edition 2002, Philadelphia: Lippincott Williams and Wilkins. - Cho, Z-H., J. Jones, and M. Singh. Foundations of Medical Imaging. - Cherry, S. R., Sorensen, J. A. and Phelps, M. E., Physics in nuclear medicine, 3rd edition 2003, Philadelphia, PA: Saunders.
Laboratory	- Introduction to Matlab - Image filtration and noise analysis - CT image reconstruction

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 356	Medical Imaging II	ELE 355	3	2	2	1	5	10	30	20	40

Course Content	Computed Imaging: CT, PET, and SPECT – Magnetic Resonance Imaging. Radiation and Matter – Absorption of Radiation in Ultraviolet and Visible Regions: Sources and Detectors – Visual Colorimeters – Filter Photometers – Spectrophotometers – Spectrophotometry– Absorption of Radiation in Infrared Region: Sources and Detectors – Infrared Spectrophotometers – Molecular Luminescence – Fluorescence and Phosphorescence – Spectrofluorometry – Spectropolarimetry – Flame Photometery - Atomic Absorption - Chromatography (HPLC & GC) – Water Purification - Balances – Centrifuges - Electrophorosis - Molecular Biology Technique - Scattering of Radiation – Laser: Sources, and Applications in Chemistry and Spectroscopy - Chromatography - Automation - Performance Evaluation - Calibration of Analytical Instrumentation - Analytical Laboratory Skills - Practical Training in Clinical Sites.
References	- Jerry L. Prince, Jonathan, Medical Imaging Signals and Systems - Bushberg, J. T., The essential physics of medical imaging, 2nd edition 2002, Philadelphia: Lippincott Williams and Wilkins. - Cho, Z-H., J. Jones, and M. Singh. Foundations of Medical Imaging. - Cherry, S. R., Sorensen, J. A. and Phelps, M. E., Physics in nuclear medicine, 3rd edition 2003, Philadelphia, PA: Saunders.
Laboratory	- Ultrasound image reconstruction from RF data to image, - Signal Analysis - Image Analysis - Doppler ultrasound spectrogram reconstruction - Hospital visit

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>St. Act.</th><th>Mids</th><th>Exp.</th><th>Final</th></tr>
<tr><td>ELE 357</td><td>Bioinformatics</td><td>ELE 211, ELE 254</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Biology background – types of cells (animal / plant) – DNA- RNA-Proteins – genomes – proteome – web base & biology database – Exons, Introns, and Genes - sequence alignment – Similarity – Homology - Paralogs – Orthologs - proteins function prediction – proteins structure prediction – PPI prediction - Genes and Proteins application and algorithms</td></tr>
<tr><td>References</td><td colspan="11">SupratimChoudhuri, Michael Kotewicz, Bioinformatics for beginners : genes, genomes, molecular evolution, databases and analytical tools, Elsevier/AP, Academic Press, 2014</td></tr>
<tr><td>Laboratory</td><td colspan="11">Amino Acid prediction , Sequence Alignment, Phylogenetic Analysis: , Gene Prediction and , Annotation, Protein Structure Prediction: , Omics Data Analysis:, Database Searching and Retrieval: , Programming and Scripting</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req.</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>St. Act.</th><th>Mids</th><th>Exp.</th><th>Final</th></tr>
<tr><td>ELE 358</td><td>Introduction to Information Theory</td><td>BES 114</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Entropy – Conditional Entropy – Relative Entropy – Common Information – Jensen Sequences for Inequalities – Logarithmic Sum for Inequalities – Data Processing – Fano Rule for Inequalities – Data Storage – Constant Rate Encoding – Linear Encoding – Kraft Rule for Inequalities – Variable Rate Data Compression Hufmann Coding - General Rules for Information Theory – Encoding by Shanon Noiseless Theory – Modeling Information Sources – Markov Models – Loss of Memory – Modeling Information Channels – Constructing a Code for Limited Sources.</td></tr>
<tr><td>References</td><td colspan="11">Jr. Johnson, Greg A. Harris, D.C. Hankerson ,Introduction to Information Theory and Data Compression,
2nd edition, 2003</td></tr>
<tr><td>Laboratory</td><td colspan="11">Entropy Estimation and Source Coding, Channel Capacity and Error Correction, Markov Chain Modeling and Memory Loss, Information Source Modeling and Common Information.</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 359</td><td>Image Processing for Biomedical</td><td>ELE 245</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction-digital image representation-mathematical tools for image processing-image enhancement-image processing in frequency domain-image denoising-image segmentation - Image formation-image processing-feature detection-segmentation-feature based alignment-structure from motion-stereo correspondence-3D reconstruction- Image Enhancement, Image Restoration, Wavelets and Multiresolution Processing, Image Compression, Morphological Image Processing, Image Segmentation, Representation and Description, and Object Recognition</td></tr>
<tr><td>References</td><td colspan="11">• H. Singh, “Practical Machine Learning and Image Processing: For Facial Recognition, Object Detection, and Pattern Recognition Using Python,” New York, A press, 2019</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Handling Image File input and Outputs.
• Viewing and Printing Image Numbers.
• Implementation of image Histogram and Equalization
• Simulation of Edge Detections
• Realization of Special Frequency Filtering.
• Realization of Image Operations.</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>St. Act.</th><th>Mids</th><th>Exp.</th><th>Final</th></tr>
<tr><td>ELE 360</td><td>Biometrics</td><td>BES 114</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Introduction to Biometry – Feature Vector and Feature Space – Classification and Recognition Principles – Template & Shape Matching – Recognition of Fingerprint, Hand, Vein Tree, Iris, Retina, Thermograph, Speech, Keystroke, and Multimodal – Performance of Recognition Devices</td></tr>
<tr><td>References</td><td colspan="11">Biometrics: A Very Short Introduction (Very Short Introductions), Oxford University Press, Michael Fairhurst, 2019
Mayank Vatsa, Richa Singh, Angshul Majumdar, 2018, Deep Learning in Biometrics, CRC Press</td></tr>
<tr><td>Laboratory</td><td colspan="11">Image processing: , Features & segmentation, Fingerprint Recognition, Facial Recognition, Iris Recognition, Speaker Recognition, Multimodal Biometrics.</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">CH</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>St. Act.</th><th>Mids</th><th>Exp.</th><th>Final</th></tr>
<tr><td>ELE 361</td><td>Pattern Recognition</td><td>ELE 451</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Basics of Pattern Classification – Bayesian Decision Framework – Maximum Likelihood Estimation – Nonparametric Techniques – Linear Discriminate Analysis – Neural Networks – Fuzzy Classifiers – Unsupervised Learning and Clustering – Bi-clustering.</td></tr>
<tr><td>References</td><td colspan="11">• Christopher M. Bishop , “Pattern Recognition and Machine Learning”, Springer, 2006
• Himanshu Singh, “Practical Machine Learning and Image Processing: For Facial Recognition, Object Detection, and Pattern Recognition Using Python”, Apress, 2019</td></tr>
<tr><td>Laboratory</td><td colspan="11">SVM, Markov random field, Image Classification., Speech Recognition, Handwritten Digit Recognition, Text Classification, Clustering, Anomaly Detection .</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>St. Act.</th><th>Mids</th><th>Exp.</th><th>Final</th></tr>
<tr><td>ELE 362</td><td>Medical Robotics</td><td>BES 022</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">An introduction to the kinematics, dynamics, and control of robot manipulators, robotic vision, sensing, and the programming of robots. Inverse kinematics of serial chain manipulators. The manipulator Jacobian, force relations, dynamics and control-position, and force control. Trajectory generation, collision avoidance, automatic planning of the gross motion strategies, robot programming languages. Proximity, tactile, and force sensing. Network modeling, stability are fidelity in tele-surgery. Biological analogies and medical applications of robotics.</td></tr>
<tr><td>References</td><td colspan="11">Ikuo Yamamoto, 2016, Practical Robotics and Mechatronics: Marine, Space and Medical Applications The Institution of Engineering and Technology
Achim Schweikard, Floris Ernst (auth.), 2015, Medical Robotics, Springer International Publishing</td></tr>
<tr><td>Laboratory</td><td colspan="11">1. Robot Kinematics and Control.
2. Image-Guided Robotic Surgery.
3.Integrate medical imaging data (e.g. CT, MRI)
4. Teleoperation and Haptics.
5. Sensor Fusion and Navigation.
6. Robotic Assistive Devices.
7. Surgical Simulation and Training.</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 363	Advanced Human Biodynamics	BES 022	3	2	2	1	5	10	30	20	40

Course Contents

Human muscular-skeletal system explored in relation to engineering principles, focusing on torso, back, hip, neck and shoulder, hand, wrist, elbow, and knee. Emphasis is placed on function, biomechanics, biodynamics and modeling. Basic principles of human physiology presented from the engineering perspective. Bodily functions, their regulation and control discussed in quantitative terms and illustrated by mathematical models where feasible.

References

Erich Blechschmidt M.D., R.F. Gasser Ph.D., Biokinetics and Biodynamics of Human Differentiation: Principles and Applications, 2015.
Manish Arora, Paul Curtin, 2021, Environmental Biodynamics: A New Science of How the Environment Interacts with Human Health, Oxford University Press.

Laboratory

1. Kinematics and Kinetics.
2. Musculoskeletal Modeling.
3. Gait Analysis.
4. Ergonomics and Workplace Design.
5. Injury Biomechanics.
6. Rehabilitation Engineering.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 364	Artificial Organs	BES 022	3	2	2	1	5	10	30	20	40

Course Contents

Introduction of existing artificial organs, prostheses, and rehabilitation systems, focusing on their goals, working principles, and limitations. It further stimulates the student's innovation skills through the deep understanding of the global problem of interfacing a human with such a device.

References

Hasan, Anwarul, 2017, Tissue engineering for artificial organs : regenerative medicine, smart diagnostics and personalized medicine, Wiley VCH

Laboratory

1. Biomaterials.
2. Tissue Engineering.
3. Bioreactor Design.
4. Artificial Heart.
5. Artificial Kidney.
6. Organ Perfusion.

Code	Course Name ‘/ bhGV	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 365	Kinematics and Kinetics of Human Movement	BES 022	3	2	2	1	5	10	30	20	40

Course Contents

Basic mechanical principles of physical activity and exercise. Quantitative and qualitative biomechanical analyses of human movement. The structure, composition, and behavior of basic skeletal and muscular tissue, pathomechanics of injury, adaptation to load and degenerative changes associated with aging are discussed within the scope of scholarly literature

References

Smarter Workouts: The Science of Exercise Made Simple, Human Kinetics, Pete McCall, 2019.
Latash, Mark L., Zatsiorsky, Vladimir M, 2016, Biomechanics and motor control : defining central concepts, Elsevier Academic Press

Laboratory

1. Motion Capture.
2. Force Plate Analysis.
3. Inverse Dynamics.
4. Gait Analysis.
5. Ergonomics and Injury Biomechanics.
6. Modeling and Simulation.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 367	Deep Learning in Medicine	ELE 254	3	2	2	1	5	10	30	20	40

Course Content

Foundations of Deep Learning, how to build neural networks, and how to lead successful machine learning projects. How to drive performance, effectively use the common neural network, including initialization, L2 and dropout regularization, Batch normalization, gradient checking.

Laboratory

- Introduction to python/notebook and platforms like Tensor Flow, Keras, Pytorch and Colab
- Data exploration, preparation, and analysis
- Build data augmentation
- Building DL model for 1D data set “forecasting models”
- Building DL models computer vision
- Diabetes classifier
- Breast Cancer Classifier
- Model validation
- Model deployment

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 368	Medical Image Computing	ELE 355 &BES 114	3	2	2	1	5	10	30	20	40

Course Content

Application of new parallel processing platforms in solving biomedical engineering problems: introduction to programming parallel processing platform such as multi-core processors and GPUs; pitfalls in parallel computing; developing parallel algorithms for different biomedical applications such as image reconstruction, visualization, in silico methods in genomics and proteomics; advanced topics and applications.

References

- Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar."Introduction to Parallel Computing", University of Oregon - Intel Parallel Computing Curriculum
- https://ipcc.cs.uoregon.edu/curriculum.html
- Norm Matloff, UC Davis"Programming on Parallel Machines"
- Victor Eijkhout, TACC, Introduction to High Performance Scientific Computing"

Laboratory

- Analyzing Parallel Program Performance on a Quad-Core CPU
- Scheduling Task Graphs on a Multi-Core CPU
- A Simple Renderer in CUDA
- Big Graph Processing in OpenMP
- Implement Matrix Multiplication as Fast as You Can
- Biomedical projects , reconstruction of medical images{ CT, Ultrasound, Doppler ultrasound or 3d reconstruction}
- Distrusted computing project {Jolia, MPA, ….}

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 371	Power System Analysis	ELE 272	3	2	0	2	4	30	30	0	40
Course Contents	Equivalent circuits of power system elements, Per unit representation, Formulation of network matrices, Symmetrical fault analyses, Symmetrical components and unsymmetrical fault analyses, Load flow solutions and control: Load flow equations, The Gauss-Seidel method, Newton-Raphson method and approximations, De-coupled methods, Regulating transformers, Optimal dispatch of generation, Power system stability, Control in voltage stabilizers, Generatorspeedcontrol.										
References	• Hadi Saadat, Power System Analysis, PSA Publishing, Third Edition, 2010. • J. D. Glover, M. S. Sarma and T. J. Overbye, Power System Analysis and Design, • Cengage Learning, Fifth Edition, 2012. • Gross, C.A., Power System Analysis, John Wiley, 1980. • Elgerd, O., Electric Energy System Theory: An Introduction, McGraw Hill, 1991.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 373	Renewable Energy	ELE 278	3	2	0	2	4	30	30	-	40
Course Contents	Sources of renewable energy - solar thermal energy - Solar radiation measurements - photovoltaic sources - Applications of solar energy - Energy from oceans, wind energy, tidal wave energy ,geothermal energy - Biomass and bio-fuels - Power from satellite stations - Hydrogen energy, hydro and other common electrical renewable generation schemes - Selection and sizing of systems components - Detailed design of a typical photovoltaic inverter battery system - Renewable energy integration with existing grid connected power.										
References	•A.A.M. Saigh (Ed): Solar Energy Engineering, Academic Press, 1977 •Abbasi S. A. and N. Abbasi, Renewable Energy Sources and Their Environmental Impact,Prentice Hall of India, 2001.. •G.N. Tiwari: Solar Energy-Fundamentals, Design, Modelling and Applications, arosaPublishers, 2002 •Sawhney G. S., Non-Conventional Energy Resources, PHI Learning, 2012. •Tiwari G. N., Solar Energy- Fundamentals, Design, Modelling and Applications, CRC Press, 2002. •Khan B. H., Non-Conventional Energy Resources, Tata McGraw Hill, 2009. •Earnest J. and T. Wizelius, Wind Power Plants and Project Development, PHI Learning, 2011.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 375	Electrical Drive	ELE 278	3	2	0	2	4	30	30	-	40
Course Contents	Criteria for selecting drive components, DC motor drives, regenerative braking and four quadrantoperation, Induction motor drives, slip power recovery, Doubly Fed Induction Motor drive (DFIM),synchronous motor drives, Permanent Magnet Synchronous Machine drive (PMSM): motor andgenerator applications, Stepper motor drives.										
References	• Dave Polka, "Motors and Drives A Practical Technology Guide", The Instrumentation, Systems, and Automation Society, 2003. • R. Krishnan, " Electric Motor Drives modeling analysis and control", Virginia Tech. Blacksburg. VA, 2001. • Phipps, Clarence A., Variable Speed Drive Fundamentals, The Fairmont Press, Inc., Lilburn, GA, p. 22–28, 1994.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 376	Power Systems Distribution	ELE 272	3	2	1	1	4	10	30	20	40
Course Contents	Power handling equipment: Medium voltage switchgear, Ring main unit, Automatic transfer switch, Distribution boards; Wiring and raceways: Cables, Conductors, Bus duct, Cable trays, Conduits, Ducts; Protective devices of distribution system: Circuit breakers, fuses, Overcurrent relays, Differentional Relays, Ground fault circuit beakers; Control and utilization equipment: Static and dynamic loads, Contactors, Dimmers, Sockets, Different types of switches, Light current; Load estimation methods, Interior and exterior lighting design based on codes and standards, Sizing of cables, protection devices, Distribution transformer, etc; Calculations of short circuit, losses, voltage drop.										
References	• Stokes, G. (Ed.), Handbook of electrical installation practice, John Wiley & Sons, 2008. •Egyptian Building Codes and Regulations; International Electrotechnical Commission (IEC); Egyptian Standard Specifications (ES); National Electrical Code (NEC). • Atkinson, B., Lovegrove, R., & Gundry, G., Electrical Installation Designs, John Wiley & Sons, 2012.										
Laboratory	Design and implement automatic transfer switches. Design, implementation and testing of protection circuits for different loads. Design and implementation of ground protection circuits. Designing lighting circuits using the Deluxe program Designing socket circuits using AutoCAD analysis of short circuit and voltage drop for power circuit ETAP program										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 377	Special Machines	ELE 278	2	2	1	0	3	10	30	20	40
Course Contents	• introduction , universal motor, Two phase induction motors, Single phase induction motors, Linear induction motor, Stepper motor, DC and AC servo motors, Sensors and actuators										
References	• Vinott., Fractional Horsepower Motors, McGraw Hill. 1980. -- • Fitzgerald, A.E.; Kingsley, C. and Umans, S.D., Electrical Machinery-fifth edition, • McGraw Hill Co, 1990. -Chapman, S. J., Electrical Machinery fundamentals, • Nagrth Kothari "electric machine"										
Laboratory	• Test and examine components, equipment and systems of electrical power and control • Designing components in electric power systems such as: electric machines, transmission and distribution system, power electronic circuits, control systems, measuring instruments, insulators, relays, circuit breakers, ...etc										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
ELE 372	Power System Protection	ELE 371	3	2	0	2	4	30	30	-	40
Course Content	Effects of short-circuits on power systems, Basic elements of protective gear, Current and potential transformers, Protective relays, Electromechanical and static relays, Different types of electromechanical relays, Microprocessor-based relays, Differential protection of power systems, Protection of transmission lines (carrier protection), Impedance Relays, Types of circuit breakers, Bus-bars protection, Transformers protection, Generators protection, AC motors protection, Design the primary and backup protection systems, Coordination of protective devices										
References	Horowitz, S. H. and Phadke, A. G., Power system relaying, John Wiley & Sons, 2014. • Ravindranath, B. and Chander, M., Power system protection and switchgear, New Age International, 1977. • Bakshi, U. A. and Bakshi, M. V, Switchgear and Protection, Technical Publications, 2020. • Deshpande, M. V., Switchgear and Protection, Tata McGraw Hill Co., 1991.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 392	Senior Design Project I	70 % of Total Hrs.	2	0	4	0	4	50	--	50	--
Course Content	The student is assigned, among a team of students and one or more faculty professors, the design of an applied project which simulates the real working condition to which the student will be exposed after graduation. The project should be comprehensive and includes all the necessary preliminary studies. At the end of the semester, there will be a seminar held for the working team of students to present the details of the project. The working team will be orally examined and evaluated based on the presentation.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 441	Image Processing	ELE 211, ELE 245	3	2	2	1	5	10	30	20	40
Course Content	Introduction-digital image representation-mathematical tools for image processing-image enhancement-image processing in frequency domain-image denoising-image segmentation - Image formation-image processing-feature detection-segmentation-feature based alignment-structure from motion-stereo correspondence-3D reconstruction- Image Enhancement, Image Restoration, Wavelets and Multiresolution Processing, Image Compression, Morphological Image Processing, Image Segmentation, Representation and Description, and Object Recognition										
References	• H. Singh, "Practical Machine Learning and Image Processing: For Facial Recognition, Object Detection, and Pattern Recognition Using Python," New York, A press, 2019										
Laboratory	• Handling Image File input and Outputs. • Viewing and Printing Image Numbers. • Implementation of image Histogram and Equalization • Simulation of Edge Detections • Realization of Special Frequency Filtering. • Realization of Image Operations.										

<table>
<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><td rowspan="2">ELE 450</td><td rowspan="2">Computational Methods for Medical Image Analysis</td><td rowspan="2">ELE 355</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
</table>

Course Content

Comprehensive overview on the mathematical techniques and methods used in the image processing science. Inverse problems in image processing, regularization methods for ill-posed problems and solutions to large scale inverse problems. Stochastic image analysis, modeling of image intensity distribution, local smoothing filters, wiener filters, image segmentation, and shape analysis. Practical implementation and numerical case studies of real image processing problems.

References

- Solutions of Ill-posed Problems, Tikhonov, A.N. ,Tkhonov, A.N. and Tikhonov, A.N.
- Stochastic Image Processing, Chee Sun WonRobert M. Gray
- Advanced Techniques for Image Segmentation: Image Processing, Sultan H. Aljahdali, Mohammad Junedul Haque.

Laboratory

- Image deblurring as and example of ill-posed problem
- Stochastic image denoising
- Segmentation based on greyscale, CT/MRI images
- Segmentation based on texture, ultrasound images
- Clustering Segmentation

<table>
<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><td rowspan="2">ELE 451</td><td rowspan="2">Advanced Image Processing Techniques</td><td rowspan="2">ELE 359</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
</table>

Course Content

This course explores a few major areas of digital image processing at an advanced level, with primary emphasis on medical applications. Discussing the treatment of geometrical correction of common distortions. Covering ways of classifying different areas and textures in images. Image segmentation, image registration, and image processing using Image Processing Toolbox in MATLAB, Python, and 3D Slicer.

References

- M. Haidekker, “Advanced Biomedical Image Analysis,” John Wiley & Sons, 2011.
- G. Shengrong et al., “Advanced Image and Video Processing Using MATLAB,” Springer
- International Publishing, 2018.
- J. Hajnal et al., “Medical Image Registration,” CRC Press, Boca Raton, 2001.

Laboratory

- Image restoration
- Image distortion correction
- Texture based classification
- Segmentation with different techniques
- Image registration

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 452	RF (Radiofrequency) Medical Devices	ELE 256	3	2	2	1	5	10	30	20	40
Course Content	Applications of electromagnetics and RF in medicine and in other devices that can cause thermal safety hazards. Topics such as Maxwell Equations, Wave Equations, Transmission Lines, Electromagnetic Theorems, Introduction to Antennas, and Introduction to Computational Electromagnetics will be presented. The class will include analyses of several RF devices used in medical applications and/or have electromagnetic safety implications such as magnetic resonance imaging (MRI), biological sensors (brain machine interface), RF ablation, and cell phones. Upon completing the course, the student should be able to describe how to apply fundamental electromagnetic principles to set up and solve problems in RF devices used in medical applications.										
References	Bijan Elahi, Safety Risk Management for Medical Devices D. Smith, Electromagnetic Theory for Complete Idiots (Electrical Engineering for Complete Idiots) Constantine A. Balanis, Antenna Theory: Analysis and Design, 4th Edition Amira S. Ashour, Yanhui Guo and Waleed S. Mohamed, Thermal Ablation Therapy										
Laboratory	- Using modeling/simulation tools Ex:Comsol, Electromagnetic field simulation, Antenna simulation, Tissue Electrical effect simulation, Simulation driven modeling of radiofrequency, Ablation modeling										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 453	Biomedical Optical Microscopy	ELE 141	3	2	2	1	5	10	30	20	40
Course Content	Fundamental background of tissue optics; Understanding of physics, strengths, and limitations of various existing bio-optical imaging technologies. Optical properties of tissue, and photon-tissue interactions. Monte Carlo simulation. Sensing of optical properties and spectroscopy. Ballistic imaging. Wide-field and dark-field microscopy. Polarization, phase contrast, and differential interference contract microscopy (DIC) microscopy. Fluorescence microscopy. Confocal microscopy. Two-photon microscopy. Optical coherence tomography. Super-resolution imaging										
References	Fundamentals of Light Microscopy and Electronic Imaging, Douglas B. Murphy, Wiley-Liss, ISBN: 0-471-25391-X										
Laboratory	Comsol simulation, Tissue optical characterization, Wide/dark Field power calculation, OCT model										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 454	Bioinstrumentation: Bio-signals and Biosensors	ELE 256	3	2	2	1	5	10	30	20	40
Course Content	Measurement principles of sensors found in health technologies, ranging from medical devices used in hospitals to wearables for fitness monitoring. Bio-potential amplifiers, record and interpret bioelectrical data (e.g. heart activity, muscle activity). Principles underlying the instrumentation for measuring respiratory and cardiovascular function such as blood pressure, blood flow as well as biochemical sensors and neuro-stimulators.										
References	- Webster, Medical Instrumentation Application and Design, Wiley, 4th edition, 2009 - Schreiner, Bronzino, Peterson, Medical Instruments and Devices: Principles and Practices, CRC Press, 1st Edition, 2015										
Laboratory	- Instrumentation amplifier, ECG amplifier circuits and simulation - Ground loops., EEG , EMG - Blood pressure instrument - Respiratory measurements										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
ELE 455	Clinical Engineering Fundamentals	ELE 256	3	Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
				2	2	1	5	10	30	20	40
Course Content	Equipment control concepts and techniques and their application in hospitals and in the medical profession; device evaluation specifications; codes & standards; preventive maintenance and service; calibration and medical product liability.										
References	- WORLD HEALTH ORGANIZATION, MEDICAL DEVICE REGULATIONS Global overview and guiding principles - P. Derrico, M. Ritrovato, F. Nocchi, Clinical Engineering - FDA Report on the Quality, Safety, and Effectiveness of Servicing of Medical Devices										
Laboratory	- Hospital design model - ICU design considerations - Hemodialysis unit design										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
ELE 456	Clinical Equipment Management	ELE 256	3	Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
				2	2	1	5	10	30	20	40
Course Content	Structure within a Hospital: Clinical Departments, Administration and Accounting, Nursing, Information Handling, Support Services - Quality Control: Equipment Acquisition and Maintenance, Codes, Regulations and Standards -Biomedical Engineering Department: Interaction with Administration, Physicians, Nursing and Plant Services, Responsibilities, Equipment Specifications, Preventive-Maintenance and Maintenance, Equipment Calibration, Training -Clinical Engineering Program Functions, Structure, Personnel Facilities for Implementing a Program - Equipment Control Programs: Inventory Control, Hazard Control, Cost Control, Quality Assurance and Management - Equipment Acquisition: Clinical Requirements, Survey of Environment and Equipment, Specifications, Equipment Evaluation, Contracts, Requisition and Control of Acquisition Process - Medical Gases System Design.										
References	- Stuart Showalter, The Law of Healthcare Administration, Ninth Edition, National Safety and Quality Health Service Standards - Ronda G. Hughes.Tools and Strategies for Quality Improvement and Patient Safety										
Laboratory	- Hospital visit “biomedical department” - Design of medical gasses from real hospital - Egypt standard, FDA and CE - Interview with hospital management administration - Interview with biomedical device company management. - Review of actual medical devices contracts and tender process										

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 457</td><td>Medical Instrumentation in the Hospital</td><td>ELE 256</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Basics of Therapeutic and Prosthetic Devices – Implementable Devices – Lithotripsy Types and Instrumentation – Artificial Kidney and Dialysis Machines – Heart-Lung Machines – Surgical Instrumentation – Electrical Safety in Medical Devices.
Data Acquisition and Distribution System: Principles, Review of Sampling Theory, Analog to Digital Converters, Digital to Analog Converters, Sample and Hold Circuits, and Analog Multiplexers, Biomedical Measurements: Respiratory System Measurements (Air Flow and Flow Rate), Cardiac Measurements (Blood Flow, Blood Pressure and Cardiac Output).
Ultrasound Imaging Instrumentation – X-Ray Instrumentation. Computed Imaging: CT, PET, and SPECT – Magnetic Resonance Imaging.</td></tr>
<tr><td>References</td><td colspan="11">- R. S. Khandpur, HANDBOOK OF BIOMEDICAL INSTRUMENTATION, 3rd Edition
- Emilio, Data Acquisition Systems 2013th Edition
- Signal Conditioning and Pc-Based Data Acquisition Handbook: A Reference on Analog and Digital Signal Conditioning for Pc-Based Data Acquisition” by Steve Lekas
- Peter Hoskins BA, MSc, PhD, DSc, FIPEM, FInstP , Diagnostic Ultrasound Physics and Equipment
- Handbook on calibration of radiation protection monitoring instruments. (=Technical reports series / International Atomic Energy Agency ; 133)</td></tr>
<tr><td>Laboratory</td><td colspan="11">- Understand the full functionality of digital Oscilloscope as an example
- Data acquisition design board, lab test boards
- Hands-on lab for blood pressure, spo2, icu,
- Hands-on lab for respiratory system measurements. Air flow meter</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>St. Act.</th><th>Mids</th><th>Exp.</th><th>Final</th></tr>
<tr><td>ELE 458</td><td>Engineering Problems in the Hospital</td><td>ELE 256</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Covers engineering solutions to problems that are found in the healthcare environment. Includes a wide variety of topics such as electrical power quality of and the reliable operation of high tech medical equipment, electrical safety in the patient care environment, electromagnetic compatibility of various medical devices and electromagnetic interference, radiation shielding and radiation protection, medical gas systems, medical ventilation systems and indoor air quality, fire protection systems required in the hospital, project management, functionality and design implications of emerging technologies, and hospital architecture and the design of patient care facilities.</td></tr>
<tr><td>References</td><td colspan="11">Clinical Engineering. A Handbook for Clinical and Biomedical Engineers, Academic Press
Azzam Taktak, Paul Ganney, David Long and Paul White (Eds.), 2014</td></tr>
<tr><td>Laboratory</td><td colspan="11">1. Hospital Workflow Analysis Lab:
2. Medical Device Usability Lab:
3. Hospital Information Systems Lab:
4. Lean Six Sigma for Healthcare Lab:
5. Medical Instrumentation and Sensor Integration Lab:
6. Hospital Facility Design Lab:</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 459	Clinical Systems Engineering	ELE 256	3	2	2	1	5	10	30	20	40
Course Contents	Introduction to clinical Engineering – ethical issue related to clinical research – medical devices regulations & standard – hospital risk management – types of hospital hazards - Purchasing methods- technical specs – technical evaluation of offered equipment. Medical engineering processes and plans- Preventive maintenance plan and procedures.										
References	Clinical Engineering. A Handbook for Clinical and Biomedical Engineers, Academic Press Azzam Taktak, Paul Ganney, David Long and Paul White (Eds.), 2014										
Laboratory	1. Medical Device Integration Lab: Implement communication protocols (e.g., HL7, DICOM, IEEE 11073) for data exchange 2. Clinical Workflow Optimization Lab: 3. Biomedical Sensor Development Lab: 4. Medical Imaging and Visualization Lab: 5. Health Information Systems Integration Lab: 6. Privacy in Healthcare Lab:										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 460	Medical Device Cybersecurity	ELE 256	3	2	2	1	5	10	30	20	40
Course Contents	Introduction to cybersecurity primitives and algorithms. Key requirements for marketing medical device software, medical device software life cycle processes, vulnerabilities, Software Safety Classification. Cybersecurity requirements. Software life cycle process with cybersecurity. State-of-the-Art of Cybersecurity for IoT applied to medical industry. Threat Analysis and Risk Assessment (TARA). Demonstrating Confor										
References	Arnab Ray, 2021, Cybersecurity for Connected Medical Devices, Academic Press										
Laboratory	1. Vulnerability Assessment Lab: 2. Secure Communication Lab: 3. Access Control and Authentication Lab: 4. Incident Response and Forensics Lab: 5. Threat Modeling and Risk Assessment Lab: 6. Secure Software Development Lab:										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 461	Computer Applications in Bioengineering	ELE 143	3	2	2	1	5	10	30	20	40
Course Contents	LabVIEW programming is taught in the context of real-world tasks that engineering students will likely encounter in future academic or industrial work. Practical applications of signal processing tools and software design specification development are especially relevant. The fundamentals of LabVIEW, data flow programming concepts, programming with graphical user interfaces, modular programming structures, and data acquisition and control concepts are covered.										
References	Computer Applications in Engineering and Management, CRC Press, Taylor & Francis Group, 2022 Computer Applications in Engineering and Management, CRC Press, Taylor & Francis Group, 2022 Milos Kojic, Nenad Filipovic, Boban Stojanovic, Nikola Kojic, 2008, Computer modeling in bioengineering: theoretical background, examples and software, John Wiley & Sons Andreas Öchsner, Holm Altenbach (eds.), 2015, Applications of Computational Tools in Biosciences and Medical Engineering, Springer International Publishing										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 462	Biomedical Applications of Signal Processing	ELE 354	3	2	2	1	5	10	30	20	40
Course Contents	The fundamentals of digital signal processing of time series are developed, via applied exercises and projects with a focus on medical and biological signal analysis and interpretation. Biomedical applications are selected from a variety of areas, such as cardiovascular, gait and balance, electrophysiological (EEG, EKG, EOG, etc.) and neural signal processing, among others.										
References	Falk, Tiago H., Sejdic, Ervin, Signal processing and machine learning for biomedical big data, Taylor & Francis, 2018										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 464	Digital Communication Systems	ELE 352	3	2	2	1	5	10	30	20	40
Course Contents	Introduction of digital communication systems. Mathematical foundation of decomposing the systems into separately designed source codes and channel codes. Principles of commonly used algorithms to convert continuous time waveforms into bits, and vice versa. Comprehensive introduction to the basics of information theory, treatment of Fourier transforms and the sampling theorem, and an overview of the use of vector spaces in signal processing.										
References	• B. P. Lathi, Zhi Ding , "Modern Digital and Analog Communication Systems", Oxford University Press, 2009. • Krzysztof Wesolowski , "Introduction to Digital Communication Systems", John Wiley and Sons, 2009										
Laboratory	Amplitude Modulation (AM) and Demodulation, Frequency Modulation (FM) and Demodulation, Pulse Amplitude Modulation (PAM) and Demodulation, Fourier Transform and Signal Processing										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 465	Digital and Analog Filters Design	ELE 352	3	2	2	1	5	10	30	20	40
Course Contents	Analysis, design, and realization of digital filters. Discrete Fourier Transform algorithms, digital filter design procedures, coefficient quantization. Design of Infinite Impulse Response (IIR) digital filters by transformation from analog filters: Impulse Invariance, Bilinear Transformation. Design of Finite Impulse Response (FIR) digital filters by Windowing, Frequency Sampling. Computer Aided Design of FIR and IIR digital filters by Criterion Minimization. Implementation aspects: quantization of parameters, finite word length, and filter structure.										
References	• Les Thede, "Practical Analog And Digital Filter Design", Artech House Publishers, 2004. • Steve Winder, "Analog and Digital Filter Design" Second Edition, 2011										
Laboratory	Design of IIR Filters using Impulse Invariance and Bilinear Transformation, Design of FIR Filters using Windowing and Frequency Sampling, Computer-Aided Design of FIR and IIR Filters: Criterion Minimization, Implementation Aspects of Digital Filters: Quantization and Finite Word Length.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 466	Vision Sensors	ELE 256	3	2	2	1	5	10	30	20	40
Course Contents	Fundamentals of vision cameras and other sensors. Mirror-based and solid-state devices (CCD, CMOS). Use of sensors and understand, model and deal with the uncertainty (noise) in measurements. Conventional "single viewpoint" or "perspective" cameras. Recent "multi-viewpoint" or "multi-perspective" cameras that includes a host of lenses and mirrors.										
References	Ling Shao, Jungong Han, Pushmeet Kohli, Zhengyou Zhang (eds.), 2014, Computer Vision and Machine Learning with RGB-D Sensors, Springer International Publishing. Kevin Ashley, 2020, Applied Machine Learning for Health and Fitness: A Practical Guide to Machine Learning with Deep Vision, Sensors and IoT A press.										
Laboratory	Camera Calibration and Lens Distortion Correction, Object Detection and Tracking, Depth Sensing with Stereo Vision, Multi-Viewpoint Imaging and 3D Scene Reconstruction										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 467	Advanced Random Signals and Information Technology	BES 114	3	2	2	1	5	10	30	20	40
Course Contents	Signal Analysis – Review of Probability Theory – Characterization of Random Signals – Transmission and Filtering of Random Signals – Analog Data Communication: Modulation – Digital Data Communication: Signal Detection – Introduction to Information Theory and Coding.										
References	Boaz Porat, 2008, Digital Processing of Random Signals: Theory and Methods										
Laboratory	Histogram and Probability Density Estimation, Autocorrelation Function Analysis, Power Spectral Density Estimation, Digital Modulation and Signal Detection.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 468	Neural Networks in Medical Fields	BES 114	3	2	2	1	5	10	30	20	40
Course Contents	Brief Introduction to Neural Networks – Historical Background – How Neural Networks Work – How Neural Networks Learn – Linear Separability – Back propagation of Errors – Interpretation of Neural Network Results – Supervised Learning – Unsupervised Learning – Hybrid Models – Divide-and-Conquer in Neural Networks – Hierarchical Architectures – Bottom-up Hierarchical Architectures and Top-down Hierarchical Architectures. Application of Neural Networks for Medical Research: Applications in Clinical Medicine – Applications in Signal Processing and Interpretation – Applications in Image Processing – Evaluating Neural Network Applications in Medicine – Neural Networks as Diagnostic Tests – Hierarchical Neural Networks for Diagnosis.										
References	R. N. G. Naguib, G. V. Sherbet, 2001, Artificial Neural Networks in Cancer Diagnosis, Prognosis, and Patient Management (Biomedical Engineering), CRC Press										
Laboratory	1. Medical Image Analysis Lab: Implement convolutional neural networks (CNNs) for tasks such as image classification, segmentation, or detection 2. Apply CNNs to analyze medical images (e.g., X-rays, CT scans, MRI) for disease diagnosis or tissue identification 3. Predictive Modeling Lab: 4. Time Series Analysis Lab: Explore the use of recurrent neural networks (RNNs), such as LSTMs or GRUs, for analyzing time-series medical data 5. Clinical Decision Support Lab: 6. Medical Natural Language Processing Lab: 7. Generative Modeling Lab:										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids	Exp.	Final
ELE 469	Quantum for Information and Encoding	BES 114	3	2	2	1	5	10	30	20	40
Course Contents	Quantum Theory for Information and Computation – Review of Classical Information Theory – Quantum Information Transmission through Noisy Channels – Classical Complex Theory Quantum of Complex Components – Efficient Quantum Algorithm – Correction Code for Error Quantum.										
References	Mark M. Wilde, 2017, Quantum Information Theory, 2nd Edition										
Laboratory	Qubit Manipulation, Quantum Arithmetic, Quantum Error Correction, Quantum Cryptography, Quantum Algorithm Design, Quantum Simulation.										

Code	Course Name	Pre-req.	CH	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 471	High Voltage Engineering	ELE 272	3	2	0	2	4	30	30	0	40
Course Contents	Electric fields, Electrical breakdown in gases, solid materials and dielectric fluids, Corona discharge, Generation of high voltages and high currents, Measurement of high voltages and currents, Wave propagation over lines and equipment, Theory of travelling waves and standing waves, Electrical overvoltages, testing procedures and insulation coordination, Single and three-core cables, Electrical stresses in cables, Thermal properties of cables, Grounding systems.										
References	•Wadhwa, C. L., High voltage engineering, New Age International, 2006. •Kuffel, J. and Kuffel, E., High voltage engineering fundamentals, Elsevier, 2000. •Naidu, M. S., High voltage engineering, Tata McGraw-Hill Education, 2013. •Abdel Salam, M.; Anis, H.; El-Morshedy, A. and Radwan, R., High-voltage engineering: theory and practice, revised and expanded, CRC Press, 2018.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 472	Advanced Power Electronics	ELE 274	3	2	0	2	4	30	30	-	40
Course Contents	Advanced Switch Mode Power Converters: Cuk dc-dc converter, Full bridge dc-dc converter, Half-bridge converter Forward converter, Flyback converter, Push-pull converter, Resonant Converters: Introduction, classification of resonant converters, series and parallel resonant inverters, load resonant converters, resonant switch converters, zero voltage and zero current switching resonant converters, Multilevel Inverters: Concept, types of multilevel inverters, diode-clamped, flying-capacitor, and cascaded multilevel inverters, applications, comparison; FACTS: Principles of shunt and series compensation, compensators: TCR, TCS, SVC, TSSC, TCSC, UFC, comparison, Matrix converters: Basic principles and analysis, applications.										
References	•M. H. Rashid, "Power Electronics: Circuits, Device and Applications", 2nd Ed. 1993, Prentice-Hall, Inc. •N. Mohan, T. M. Undeland, and W. P. Robbins, "Power Electronics: Converters, Application and Design", 3rd. Ed., John Wiley, 2003 • A. M. Trzynadlowski, "Introduction to Modern Power Electronics" John Wiley, 1998.										

Code	Course Name	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 473	Electrical Power Quality	ELE 272	3	2	0	2	4	30	30	-	40
Course Contents	Brief review of various power quality (PQ) problems: Source of generation and their impacts on equipment and systems, need of monitoring, international power quality standards, Passive Filters: Control of harmonics using passive L-C filters, tuned and de-tuned filters, their design criterion and implementation, Active Power Filters: Power factor improvement, reactive power compensation, mitigation of harmonics and voltage sag compensation using active power filters. Study of various active power filters viz., static shunt compensators (STATCOM), dynamic voltage restorer (DVR), unified power quality conditioner (UPQC), etc. Suitability of type of active filters for mitigation of various power quality problems, Design of active power filters, various topologies and control schemes.										
References	• A. Ghosh and Gerard Ledwich 'Power Quality Enhancement Using Custom Power Devices (Power Electronics and Power Systems)', Springer; 2002. •S. Santoso, H. W. Beaty, R. C. Dugan, and M. F. McGranaghan, 'Electrical Power Systems Quality', McGraw-Hill Professional, 2002. • B33 M. H. Bollen 'Understanding Power Quality Problems: Voltage Sags and Interruptions', Wiley-IEEE Press, 1999. • N. G. Hingorani and L. Gyugy 'Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems', Wiley-IEEE Press, 1999.										

Code	Course Name	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 475	Industrial Instrumentation	ELE 132	3	2	0	2	4	30	30	-	40
Course Contents	Introduction to Instrumentation system; Static and Dynamic characteristics of Instrument; Pressure measurement: Elastic transducers (Bourdon Gauge, Bellow and Diaphragm Gauge); Temperature measurement: Thermocouple, Resistance Temperature Detector (RTD), Thermistor, Radiation Pyrometer; Flow and pressure measurements: Differential Pressure flow meter, Variable area flow meter, Variable reluctance transducer, Turbine flow meter, Ultrasonic flow meter (Both transit time and Doppler Shift), Electromagnetic flow meter and Mass flow meter; Measurement of level: Capacitance based and Float based method; Measurement of strain: Strain Gauge; Position sensor: Linear Variable Differential Transformer (LVDT), Synchro; Load and torque cell; pH probe and viscosity measurement; Piezoelectric sensors; Ultrasonic sensors; Pollution measurement; Smart sensors; Actuators and Control valves; Signal conditioning; Pneumatic and Hydraulic Instrumentation system.										
References	•D. Patranabis, 'Principles of Industrial Instrumentation', Tata Mcgraw-Hill, 2001. •W. C. Dunn, 'Fundamentals of Industrial Instrumentation and Process Control', Mcgraw-Hill, 2005. •N. A. Anderson, 'Instrumentation for process measurement and control', CRC press, 1998. •E. Doebelin 'Measurement Systems: Application and Design', Mcgraw-Hill, 2003.										

Code	Course Name	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 476	Power System Operation	ELE 371	3	2	0	2	4	30	30	-	40

Course Contents

Load Flow Studies in power systems, Network model formulation, Bus-Admittance Matrix, Gauss-Siedel, Newton Raphson and decoupled load flow studies, Line Flow and Losses, Load flow with power electronics control, AC-DC analysis; State estimation: static and dynamic. Optimal system operation: Optimal operation of generators on bus bar, optimal unit commitment, optimal generation scheduling, Unit commitment and Scheduling of Hydro thermal systems, Power system security: System state classification, security analysis, contingency analysis, sensitivity factors; State estimation of power system: LSQ, static state estimation and tracking state estimation of power systems, computational considerations, Reliability considerations in power system operation; Load forecasting : forecasting methodology, time series and Kalman filter based approach, long term load forecasting; Introduction to power system restructuring, deregulation and market operations.

References

•D. P. Kothari, I J Nagrath ‘Modern Power System Analysis’, Tata McGraw-Hill Education, 2011.
• H. Sadat ‘Power system analysis’, Tata Mcgraw Hill Education, 2002.
• Grainmger and Stevenson ‘Modern Power system Analysis’, Tata McGraw-Hill Education, 1994.
• L. L. Lai, ‘Power System Restructuring and Deregulation: Trading, Performance and Information Technology’, John Wiley & Sons, 2001.

Code	Course Name	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 477	Advanced Power Systems	ELE 272	3	2	0	2	4	30	30	-	40

Course Contents

Load Flow Studies: Introduction, Network model formulation and Bus Impedance matrix, Power flow Equations, Gauss Siedel Power flow solution, Line-Flow and losses, Newton Raphson power flow solution, Fast decoupled power flow solution, Economic Dispatch of Generation: Non-linear function optimization: constrained parameter optimization, equality and inequality constraints, Operating cost of a thermal plant, Economic dispatch neglecting losses without and with generator limit, Economic dispatch including losses, Economic dispatch of Hydro-thermal system, Compensation in Power system: Loading capability, compensation, Flexible AC transmission systems, Shunt Compensators: SVC and STATCOM, Series Compensator: TCSC and SSSC, Combined series and shunt controller: UPFC, Comparison between STATCOM and SVC, Performance of FACTs devices.
Power System Security & Reliability: System state classification, security analysis, contingency analysis, sensitivity factors. Basic reliability concepts, reliability function, Reliability models generating capacity, loss of load and loss of energy indices, Transmission systems reliability evaluation.

References

•H. Sadat, “Power System Analysis”, TATA-McGraw Hill Edition.
•G. Grainger and W. D. Stevenson, Jr. “Power System Analysis”, TATA- McGraw Hill Edition.
•Roy Billinton, “Reliability Evaluation of Power Systems”, Advanced Publications.

Code	Course Name	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 478	Smart Grid Technology	ELE 373	3	2	0	2	4	30	30	-	40
Course Contents	Review of basic elements of electrical power systems, desirable traits of a modern grid, principal characteristics of the smart grid, key technology areas; Smart grid communication: Two way digital communication paradigm, network architectures, IP-based systems, Power line communications, advanced metering infrastructure; Renewable Generation: Renewable Resources: Wind and Solar, Microgrid Architecture, Tackling Intermittency, Distributed Storage and Reserves; Wide Area Measurement: Sensor Networks, Phasor Measurement Units, Communications Infrastructure, Fault Detection and Self-Healing Systems, Application and Challenges; Security and Privacy: Cyber Security Challenges in Smart Grid, Defense Mechanism, Privacy Challenges.										
References	•J. Momoh ‘Smart Grid: Fundamentals of Design and Analysis’ Wiley-IEEE Press, 2012. •P. F. Schewe ‘The Grid: A Journey through the Heart of our Electrified World’ Joseph Henry Press, 2006.										

Code	Course Name	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 479	HVDC and Flexible AC Transimission Systems	ELE 274	3	2	0	2	4	30	30	-	40
Course Contents	Description and application of HVDC transmission, DC System components and their functions, Converter configuration, Principles of DC Link control and Converter control characteristics, Firing angle, Current and extinction angle control, DC link power control, Reactive power control and VAR sources, MTDC system types; Power flow in AC Systems, Definition of FACTS, Constraints of maximum transmission line loading. Benefits of FACTS, Uncompensated line, shunt and series compensation, Phase angle control. SVC and STATCOM, Operation and Control of TSC, TRC and STATCOM, Compensator Control; TSSC, SSSC, Static voltage and phase angle regulators TCVR and TCPAR. Operation and Control applications, Unified Power Flow Controller, Circuit Arrangement, Basic Principle of P and Q Control, independent real and reactive power flow control, Applications; Introduction to interline power flow controller, Compensation Devices, STS, SSC, SVR, Backup energy supply devices, Special purpose FACTS controllers, Thyristor controlled voltage limiter and voltage regulator, Thyristor controlled braking resistor and current limiter.										
References	• N.G Hingorani, L. Gyugyi, “Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems”, IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001. Padiyar K.R., “HVDC Power Transmission System”, Wiely Eastern PVT Limited.										

Code	Course Name	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 480	Grid Integration of Renewable Energy Systems	ELE 373	3	2	0	2	4	30	30	-	40

Course Contents	Control of frequency and voltage of distributed generation in Stand-alone and Grid-connected mode, use of energy storage and power electronics interfaces for the connection to grid and loads. Design and optimization of size of renewable sources and storages. Concept of microgrid, operation of microgrid in grid-connected as well as isolated mode, power quality problems and fault-ride through capability of microgrid. Integration of large capacity renewable sources to grid: Operation and control, present trends, challenges, future technological needs viz., advanced characteristics of renewable energy generating units and plants, improved flexibility in conventional generation, transmission technology.
References	• M. J. Bollen, F. Hassan ‘Integration of Distributed Generation in the Power System’, IEEE Press, 2011. • S. Heier and R. Waddington ‘Grid Intergration of Wind Energy Conversion Systems’, Wiley, 2006. • L. Lei Lai and T. Fun Chan ‘Distributed Generation: Induction and Permanent Magnet Generators’, Wiley-IEEE Press, 2007.

Code	Course Name	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 481	Switchgear Engineering and substations	ELE 272	3	2	0	2	4	30	30	-	40

Course Contents	Switchgear equipment, Main switchgear schemes, Circuit Interrupters: Fuses: Types and Applications, Circuit breakers: Types (Air, Air-blast, Oil, SF6 and Vacuum), Construction, Performance and ratings, Interruption of fault currents and arcs in circuit breakers. Switching transients and their control.Functions of substation. Voltage levels in HVAC and HVDC substations. Types and essential features of substations. Substation equipment, Substation layout, Busbar schemes, Busbar materials and ratings, Busbar clamp and connectors, Substation structure, Insulators and surge arresters. Protective systems in substations. Clearances and creepage distance, power line carrier. Substation earthing system. Special requirement of EHVAC and HVDC substations, Testing and commissioning at site, Protection, monitoring and control by microprocessors and computers.
References	1. BAKSHI, Uday A.; BAKSHI, Mayuresh V. Switchgear & Protection. Technical Publications, 2020. 2. RAVINDRANATH, B.; CHANDER, M. Power system protection and switchgear. New Age International, 1977. 3. STEWART, Stan. Distribution switchgear. IET, 2004. 4. RAM, Badri. Power system protection and switchgear. Tata McGraw-Hill Education, 2011.

Code	Course Name	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 482	Advanced Electric Machines	ELE 278	3	2	0	2	4	30	30	-	40
Course Contents	Analysis of electrical machines using reference frame theory; two axial-model; Transient models and behaviors of DC, Induction machines and synchronous machines, wind generators, self-excited induction generators, doubly fed induction generators, permanent magnet synchronous generators, field-oriented control, and direct torque control techniques. Simulation of different types of electric machines										
References	1. D. P. Kothari and I. J. Nagrth, Electric machines, 4th edition, 2010. 2. Chee-MUN ONJ, Dynamic simulation of electric machinery using Matlab/Simulink, 1998. 3. J. F. Gieras , Advancements in electric machines										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 483	Power Electronics	ELE 213	3	2	2	1	5	10	30	20	40
Course Content	Introduction; Overview of power semiconductor devices, characteristics. Diode (Uncontrolled) rectifiers. Controlled AC-DC rectifiers. Non-Isolated and isolated DC - DC converters, Control issues. DC - AC Converters (Inverters). Device losses and thermal design. Computer simulation of the given topics										
References	• R. Erickson and W. Maksimovic, “Fundamentals of Power Electronics”, 3rd edition, Springer, 2020, ISBN No. 978-3-030-43881-4. • Mohan, Undeland, Robbins: “Power Electronics: Converters, Applications and Design.” 3rd Edition. John Wiley & Sons, 2003. Lecture notes.										
Laboratory	• Buck DC-DC Converter • Boost DC-DC Converter • Single-phase Inverter • Three-phase inverter • Switching Characteristics: Diodes, MOSFETs and IGBTs										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 484	Special Electric Machines	ELE 276	3	2	2	1	5	10	30	20	40
Course Content	Construction, principle of operation, control and performance of stepping motors. Construction, principle of operation, control and performance of switched reluctance motors. Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors. Construction, principle of operation and performance of permanent magnet synchronous motors.										
References	• Janardanan, E. G. “Special Electrical Machines”. PHI Learning Pvt. Ltd., 2014. • K. Venkataratnam, “Special Electrical Machines”, Universities Press (India) Private Limited, 2019. • Ratnam, K. Venkata. "Special Electrical Machine”, 2008.										
Laboratory	• Experimental setup of hybrid stepper motor. • Speed control of brushless D.C motors. • Control of Switched Reluctance Motor. • Experimental setup of permanent Magnet Synchronous Machine.										

Code	Course Name	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 485	Electrical Installations and Energy Utilization	ELE 376	3	2	0	2	4	30	30	-	40
Course Contents	Codes and standards of electrical installations, Installation of electrical components, Electrical hazards, Inspection and testing, Electrical maintenance, Earth leakage detection, Installation planning, Electromagnetic field compatibility, Illumination technologies, Industrial heating; Conduction, Convection, Forced Convection and radiation, resistance, arc, dielectric, induction, H.F eddy current heating. Ventilation.										
References	1. LINSLEY, Trevor. Basic electrical installation work. Routledge, 2013. 2. NEIDLE, Michael. Electrical installation technology. Elsevier, 2016. 3. DONNELLY, Eugene Lawrence. Electrical installation: Theory and practice. Nelson Thornes, 2014. 4. ATKINSON, Bill; LOVEGROVE, Roger; GUNDRY, Gary. Electrical Installation Designs. John Wiley & Sons, 2012.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/ OE	Final
ELE 491	Senior Design Project II	ELE 392	3	1	4	0	5	50	-	50	--
Course Content	The second design experience course for the students. The students build\implement\ fabricate their design. They test and evaluate their design against the design specification. The students are asked to demonstrate a functional project to the discussion committee, make an oral presentation and deliver their final report that documents the project										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Su m	SA	MT	PE/O E	Final
ELE 3118	Digital Electronics	ELE 213	3	2	2	1	5	10	30	20	40
Course Content	Analysis of CMOS digital circuits: The CMOS logic gates (inverter, NAND, NOR, XOR, compound gates) - CMOS inverter and its dynamic operation - Delay (Timing optimization, delay models) - Effect of transistor sizing - Power dissipation (static and dynamics) - Digital Ices technologies and logic circuits families - NMOS, dynamic, bipolar logic circuits- Sequential circuit design (delay constraint, clock skew) CMOS implementation of Latches and flip-flop - semiconductor memories - Random access memory both SRAM and DRAM - Read only Memory. CMOS Fabrication process technology and Layout										
References	• David Money Harris, Neil Weste, "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson, 2011 • Jacob Baker, CMOS Circuit Design, Layout, and Simulation, 3rd Edition, Institute of Electrical and Electronics Engineers, 2010. • H. Kaeslin, “Top-Down Digital VLSI Design”, 2015										
Laboratory	PSPICE and HSPICE simulation for the course topics										

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 3302</td><td>Robotics</td><td>ELE 232, ELE 245</td><td>ELE 3302</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Rigid Motions and Homogeneous Transformations, forward(configuration) Kinematics, Inverse Kinematics, Velocity Kinematics, Jacobian, Singularities, and Manipulability, Path planning, Trajectory Planning, Euler-Lagrange Method, Newton-Euler Formulation.</td></tr>
<tr><td>References</td><td colspan="11">Mark W. Spong, “Robot Modeling and Control”, 2nd Edition, Wiley, 2020, ISBN-13: 978-1119523994</td></tr>
<tr><td>Laboratory</td><td colspan="11">Using MATLAB Robotics toolbox:
• Rigid Motions and Homogeneous Transformations using MATLAB command
• Get forward kinematics for Common serial robotics configuration
• Get Jacobian and inverse Jacobian for Common serial robotics configuration
• Trajectory generation using Robotics toolbox (half circle, straight line, quintic polynomial)
In the sense of project-based learning, each student should submit a complete project that cover most of the intended outcomes</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 3304</td><td>Intelligent Control</td><td>ELE 232</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Concept of Artificial Intelligence. Foundations of Fuzzy Logic. Foundations of Fuzzy Control. Types of Fuzzy Controllers. Fuzzy Logic Toolbox. Creation of Fuzzy Inference System with Fuzzy Logic Toolbox. Creation of Fuzzy Controllers. Neural Networks. Neuron Model. Perceptron Model. Modeling of Basic Logic Functions using the Perceptron. Feedforward Neural Network with Backpropagation Error. Approximation of Functions by a Two-layer Feedforward Neural Network. Creation of a Neural Networks with Neural Network Toolbox.</td></tr>
<tr><td>References</td><td colspan="11">• Jinkun Liu, “Intelligent Control Design and MATLAB Simulation”, Springer, 2018.
• Li Xin Wang, ‘A Course in Fuzzy Systems and Control,’ 1st Edition, Pearson, 1997
• J. M. Zurada, ‘Introduction to Artificial Neural Systems,’ 1st edition, 1992.
• Thrishantha Nanayakkara, Ferat Sahin, “Intelligent Control Systems with an Introduction to System of Systems Engineering “, CRC Press, 2009, ISBN-13: 978-1420079241</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Fuzzy Logic toolbox in MATLAB
• Neural network toolbox in MATLAB</td></tr>
</table>

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<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><td rowspan="2">ELE 3306</td><td rowspan="2">Modelling and Simulation</td><td rowspan="2">ELE 245</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Basic Concepts of Modeling. Two magnetically coupled coils. Reference Frame Theory. Small Signal Modeling. Modeling of Induction machines. Modeling of Synchronous Machine. Dynamic Analysis of Synchronous Machine.</td></tr>
<tr><td>References</td><td colspan="11">• Ahmed Masmoudi, “Control Oriented Modelling of AC Electric Machines”, Springer, 2018.
• Asif Mahmood Mughal, “Real Time Modeling, Simulation and Control of Dynamical Systems”, Springer, 2016.
• R. Krishnan, “Electric Motor Drives - Modeling, Analysis& control”, Pearson Publications, First edition, 2002.
• P.C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, “Analysis of Electrical Machinery and Drive systems”, 2^{nd} Edition, IEEE Press, 2002.</td></tr>
<tr><td>Laboratory</td><td colspan="11">MATLAB/SIMULINK lab for
• two magnetically coupled coils
• three phase induction machines
• three phase Synchronous machines
• DC machines</td></tr>
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<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><td rowspan="2">ELE 3308</td><td rowspan="2">System Identification and Parameter Estimation</td><td rowspan="2">ELE 231</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>3</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to Estimation theory. Parameter estimation (online and offline). Minimum variance unbiased Estimation. Cramer- Rao lower bound. Linear estimators. Maximum likelihood. Least squares estimation. The method of moments. Bayesian Methods. Extension to Complex Data. Linear Kalman Filtering. Extended Kalman Filter.</td></tr>
<tr><td>References</td><td colspan="11">• Steven M. Kay, “Fundamentals of Statistical Signal Processing:Practical Algorithm Development”, Pearson College Div, 2013, ISBN 13: 978-0132808033
• P. R. Kumar, Pravin Varaiya, “Stochastic Systems: Estimation, Identification, and Adaptive Control “, Society for Industrial and Applied Mathematics, 2016.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Computer labs with MATLAB.
• State space Representation in MATLAB
• Kalman Filters in MATLAB</td></tr>
</table>

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 3402</td><td>Advanced Topics in Computer Networks</td><td>ELE 246</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Spanning Tree Protocol(STP) - Spanning tree enhancements - PortFast technology - virtual LANs (VLANs) - 802.1Q Native VLAN - Dynamic trunking protocol - Implement VLAN trunking protocol - Implement Inter-VLAN Routing - Per VLAN Spanning Tree (PVST+) - IPv4 Static Routing - Dynamic Routing Protocols - Distance Vector Routing Protocols (RIP V1, RIP V2) - Network management: goals, standards, protocols including SNMP (v1,2,3), Remote Monitoring - Network Automation (Telnet Python Automation on Routers) - Network Programming (Sockets, IPv4, and Simple Client/Server Programming) - Software Defined Networking (SDN) - Wireless and Mobile Networks: (Wi-Fi, WiMAX, LTE Wireless LAN)</td></tr>
<tr><td>References</td><td colspan="11">
A.S. Tanenbaum, “Computer Networks”, 6th Edition, Pearson Education, 2021.
James F. Kurose, Keith W. Ross, "Computer Networking a Top-Down Approach", Pearson, 8th edition, 2021, ISBN-13: 978-0-13-285620-1
Peter L Dordal, "An Introduction to Computer Networks", 2020 available in: https://intronetworks.cs.luc.edu/current2/html/
PradeebanKathiravelu, Dr. M. O. FaruqueSarker, "Python Network Programming Cookbook", Packt Publishing, 2nd edition, 2017, ISBN 978-1-78646-399-9
"'CCNP Enterprise Advanced Routing ENARSI 300-410 Official Cert Guide", Raymond Lacoste, Brad Edgeworth, 2020, ISBN-13: 978-1-58714-525-4, Published by: Cisco Press
</td></tr>
<tr><td>Laboratory</td><td colspan="11">
Implementing Spanning Tree Protocol
Implementing VLANS
Inter-VLAN Routing
Static Route Configuration
RIP Configuration
Virtualization & VMware Installation & Windows Server 2019 Installation & Windows 10 Installation - Active Directory
Join Domain & Create Domain Users & User Automation
Remote access on server & NTFS Permissions &Sharing Permissions
DHCP server & DNS server on Windows Server
Telnet Python Automation on Cisco Routers
Network Simulation Tools (ex. Mininet, Omnet)
Preparing network for practical implementation SDN (Software Defined Network)
Configuring Wireless LAN Access
</td></tr>
</table>

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<tr><td rowspan="2">Code</td><td rowspan="2">Course Title</td><td rowspan="2">Pre-req</td><td rowspan="2">Cr. Hrs.</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment</td></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>ELE 3404</td><td>Computer and Network Security</td><td>ELE 246</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
</table>

Course Content

Networking Security Concepts: (Attacks - Mitigation Techniques- Vulnerability - Threats - Risk - Exposure) - Cryptographic Technologies: Symmetric key, public key- DHCP Starvation Attack - DHCP Spoofing Attack - Mitigating DHCP Attacks - MAC Spoofing Attack - MAC Flood Attack - Switch Port Security - IP Spoofing Attack - IP Source Guard - ARP Spoofing Attack - Dynamic ARP Inspection - Mitigating STP Attacks - VLAN Switch spoofing Attack - VLAN Double Tagging Attack- Mitigating VLAN Attacks - Securing Routing Protocols - RIPv2 Authentication Keychain - Securing Devices Access - Secure Shell (SSH) - Securing wireless LAN - Router Password Recovery - Backup and Restore Configuration Files - Understanding Firewall Fundamentals

References

- William Stallings, “Cryptography and Network Security: Principles and Practice”, 6th Edition, Pearson, 2013, ISBN-13: 978-0133354690
- James F. Kurose, Keith W. Ross, "Computer Networking a Top-Down Approach", Pearson, 8th edition, 2021, ISBN-13: 978-0-13-285620-1
- Jose Manuel Ortega, "Mastering Python for Networking and Security", Packt Publishing, 2018, ISBN-13: 978-1788992510
- "'CCNP and CCIE Security Core SCOR 350-701 Official Cert Guide", Omar Santos, 2020, ISBN: 9780135971833, Published by: Cisco Press
- "'CCNA Security 210-260 Official Cert Guide", Omar Santos, John Stuppi, 2015, ISBN-13: 978-1-58720-566-8, Published by: Cisco Press

Laboratory

- Installing Wireshark & Installing Kali Linux
- DHCP Starvation Attack using Kali Linux
- Mitigating DHCP Attacks (Configure DHCP Snooping on real Cisco Switches)
- MAC Flood ATTACK On Kali Linux
- configure port-security on real Cisco Switch
- IP Source Guard & Integration Between IP Source Guard & Port Security on real Cisco Switch
- Detect Fake packets from attackers & Detect ARP Spoof Attack by Duplicate Address Filter
- Configuring Dynamic ARP Inspection on real Cisco Switch
- Configuring Root Guard &Configuring BDPU Guard
- RIPv2 Authentication Keychain
- Securing Devices Access & Configure SSH
- HTTP Protocol Sniffing & Sniffing File Transfer Protocol & Sniffing Email Protocols
- Wireless security & python security (port scanner - network scanner - network sniffer)

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 3406	Software Engineering	ELE 144	3	2	2	1	5	10	30	20	40

Course Content	The principles and theory of programming-in-the-large. The phases of software development, requirements development, software design software coding, and module testing, and software verification and validation - Documents, rapid phototyping, top down, bottom up, successive refinement, functional and data abstraction. - Black and white box testing methods. Software quality. Hierarchical and democratic term organization structures and the effects of personalizing and group dynamics.
References	• David Farley, "Modern Software Engineering", Addison-Wesley Professional, 2021. • Rajib Mall, "Fundamentals of Software Engineering", 4th Edition, PHI Learning, 2014 • Ian Sommerville, "Software Engineering", 10th edition, Pearson, 2015, ISBN-13: 978-013703515
Laboratory	Phases of the software development life cycle: • Identify the Requirements and prepare the problem statement • Analysis and design • Implementation, testing (Integration testing, Performance testing, regression testing, metrics) • Delivery, and maintenance • The Git environment

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 3408	Data Analytics	BES 211	3	2	2	1	5	10	30	20	40

Course Content	Project-based course focused on exploring and understanding how data are collected, represented, and stored, and computed/analyzed upon to arrive at appropriate and meaningful interpretation (gathering and wrangling the data), the ETL process - Set of algorithms for data analytics which include: hashing, indexes, caching; algorithms for structured datasets; streaming data modes; clustering algorithms; and case studies. Introduction to data mining: Concepts, techniques, and systems of data warehousing and data mining. Data visualization tools
References	• Anil K. Maheshwari, "Data Analytics Made Accessible", 2021 • Mr Benjamin Smith, "DATA ANALYTICS: A Comprehensive Beginner's Guide to Learn About the Realms Of Data Analytics From A-Z", 2020, ISBN-13: 979-8640455267
Laboratory	• Descriptive Statistics • Reading and writing different datasets • Visualization • Correlation and Covariance • Using Hadoop for Big data

<table>
<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><td rowspan="2">ELE 3410</td><td rowspan="2">Web Engineering</td><td rowspan="2">ELE 143</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Web developing basics - Website structure and hosting - HTML basics - HTML linking - HTML Forms- JavaScript programming - website with styles: CSS properties - Media specific styles - Layout Methods - Web design with Bootstrap - Typography - React - Database Integration - PHP Hypertext Processor - data interchange languages (JSON/XML)</td></tr>
<tr><td>References</td><td colspan="11">• Terry Felke-Morris, "Basics of Web Design: HTML5 & CSS3", Pearson, 3rd edition, 2016, ISBN-13: 978-0133970746
• Marty Stepp, Jessica Miller, and Victoria Kirst, "Web Programming Step by Step", LULU ENTERPRISES, 2nd Edition, 2012, ISBN13: 9781105578786
• Jon Ducket, "HTML and CSS: Design and Build Websites", Willey, 2011, ISBN: 978-1-118-00818-8
• Jon Ducket, "JavaScript and JQuery: Interactive Front-End Web Development", Willey, 2014, ISBN: 978-1-118-53164-8</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Git Environment, Design using HTML, Design using CSS, Program using JavaScript, JSON/XML, Web Application</td></tr>
</table>

<table>
<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><td rowspan="2">ELE 3412</td><td rowspan="2">Fault-Tolerant Computing</td><td rowspan="2">ELE 242, BES 211</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to fault tolerant systems - Fault Models - Stuck-at Faults - Error Detection - Fault Tolerant Design Techniques Based on Hardware Redundancy, software, information Redundancy - Measures of Fault Tolerance and Reliability– Case Studies</td></tr>
<tr><td>References</td><td colspan="11">• Shooman, Martin, "Reliability of Computer Systems and Networks: Fault Tolerance, Analysis, and Design", Wiley Interscience, 2002. ISBN 9780471293422
• Israel Koren C. Mani Krishna, "Fault-Tolerant Systems" 2nd Edition, Morgan Kaufmann, 2020, ISBN: 9780128181058.
• Parag K. Lala, "Fault Tolerant & Fault Testable Hardware Design", 2020, BSP Books, ISBN: 9789386819062</td></tr>
<tr><td>Laboratory</td><td colspan="11">Project based laboratory where the student along with the course will:
• Design and implement a system
• Apply Fault Tolerant Techniques to the system
• implement fault injection techniques
• Test and verify the design reliability</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 3414	Cloud Computing	ELE 246	3	2	2	1	5	10	30	20	40

Course Content	Essential characteristics of cloud computing, the evolution of cloud computing, the emerging technologies supported by cloud, the different types of service and deployment models- Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS). the three main deployment models available on the cloud—Public, Private, and Hybrid. various components of a cloud computing architecture: virtualization virtual machines, bare metal servers, and the difference between virtual machines and bare metal servers. the emergent trends in cloud computing: Hybrid Multi-cloud, Serverless Computing, and Microservices. Cloud Security and Monitoring.
References	• Anand Nayyar , "Handbook of Cloud Computing", BPB Publication, 2019 • Lizhe Wang, Rajiv Ranjan, Jinjun Chen, Boualem Benatallah , "Cloud Computing", 2017
Laboratory	• Building a Cloud using OwnCloud and WAMPServer • Transferring Cloud Data Using Secure Channel • Harvesting Cloud Credientials by Exploiting Java Vulnerability • Performing Cloud Vulnerability Assessment Using Mobile-Based Security Scanner

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 4111	Satellite Communication	ELE 312	3	2	2	1	5	10	30	20	40

Course Content	Orbital Mechanics and Launchers, Satellites, Satellite Link Design, Modulation and Multiplexing Techniques for Satellite Links, Multiple Access Techniques, Error Control for Digital Satellite Links, Propagation Effects and their Impact on Satellite–Earth Links, VSAT SYSTEMS, Low Earth Orbit and Non-Geostationary Satellite Systems, Direct Broadcast Satellite Television and Radio, Satellite Navigation and the Global Positioning System.
References	• Timothy Pratt, Charles W. Bostian and Jeremy E. Allnutt, Satellite Communications, John Wiley & Sons, second edition, 2003
Laboratory	• Set up a Satellite Communication Link. • Study the generation of a Frequency Hopping Spread Spectrum Modulated signal. • To study radiation pattern & calculate beam width for Yagi uda& folded dipole antenna. • To study radiation pattern & calculate beam width for circular & triangular patch antenna. • To study GPS data like longitude, latitude using GPS receiver • Study of Minimum Shift Keying (MSK) Modulation and de-modulation Process

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 4112	Cellular Communication	ELE 312	3	2	2	1	5	10	30	20	40

Course Content

Elements of cellular radio system design, Different Specifications of world's cellular systems, Cell Coverage for Signal and Traffic, Cell-Site Antennas and Mobile Antenna. Co-channel Interference reduction, Frequency Management and Channel Assignment, Handoffs, Switching and Traffic, Data Links and Microwaves, Spectrum Efficiency Evaluation.

References

- William C. Y. Lee, "Mobile Cellular Telecommunications Systems", McGraw-Hill Inc.

Laboratory

- To study and analyze the behavior of the PSTN TST switch on Trainer kit.
- To study and analyze the behavior of the CDMA Trainer kit designed to provide experimental knowledge of CDMA Direct Sequence Spread Spectrum Modulation/Demodulation technique.
- To study and analyze the Mobile phone on its trainer kit.
- To study and analyze the behavior of 3G network using cellular phone on the 3G mobile trainer kit.
- To study and use the AT commands using GSM trainer kit to make voice call and send messages.
- To study the VoIP implementation on VOIP Trainer kit.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 4121	Antenna Theory and Wave Propagation II	ELE 316	3	2	2	1	5	10	30	20	40

Course Content

Aperture antennas. Horn antennas. Microstrip antennas. Parabolic antennas. Reflect array antennas. Base-station antennas. Propagation effects.

References

- Antenna Theory, Wiley, 3th edition, C. Balanis.
- Antenna Theory and Design, Wiley,2nd Edition, Warren L. Stutzman, Gary A. Thiele.

Laboratory

- Aperture Antennas.
- Horn Antennas.
- The Rectangular Patch Antenna.
- Microstrip Planar Array Antennas.
- Parabolic Antennas.
- Antenna Pattern Plotting.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 4122	Microwave Circuits and Devices	ELE 316	3	2	2	1	5	10	30	20	40

Course Content

Electromagnetic and plane waves review, rectangular and cylindrical waveguides, Microstrip and strip line, Microwave Network analysis (Z, Y, S, ABCD matrices), Microwave resonators (cavities, dielectric), Misc. components (attenuators, terminations), Microwave Filters LPF and BPF, Active Microwave elements.

References

- Microwave Engineering, David M.Pozar, Wiley, 4th edition.

Laboratory

- Microstrip Impedance calculations. Microwave Network by Matlab.
- Microstrip Coupler. Microstrip LPF. Microstrip BPF.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 4131	Forward Error Correction Codes	ELE 313	3	2	2	0	4	10	30	20	40

Course Content	Cyclic Codes, Encoding of Cyclic Codes, Decoding of cyclic Codes, Shortened Cyclic Codes, Binary BCH Codes, Decoding of BCH codes, RS Codes, Majority-Logic decodable and finite geometry codes, Convolutional Code, Viterbi decoder, Soft-output Viterbi algorithm, BCJR algorithm, Turbo-codes, LDPC codes, Reliability based soft-decision decoding algorithm for linear block codes.
References	• Simon Haykin, Communication Systems, Wiley, 4th edition • Shu Lin, Daniel Castello, Error Control Coding, Pearson, 2nd edition
Laboratory	• Simulation of the encoder and decoder of cyclic code. • Simulation of the encoder and decoder of BCH code. • Simulation of the encoder and decoder of RS code. • Simulation of the encoder of Convolutional code. • Simulation of the Viterbi decoder. • Simulation of the soft-output Viterbi decoder. • Simulation of the BCJR decoder. • Simulation of LDPC decoder.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 4151	Digital Signal Processing II	ELE 314	3	2	2	0	4	10	30	20	40

Course Content	course covers advanced topics of DSP that provide the student solid theoretical and practical understanding of: system solution with initial conditions using UZT, multi-rate signal processing, quadrature-mirror filters, LTI system analysis, advanced filter design and spectral analysis.
References	• Discrete-Time Signal Processing, Oppenhiem, Schafer Pearson, 3rd edition • Digital Signal Processing: Principles, Algorithms and Applications, J. Proakis, D. Manolakis, Prentice-Hall, 2006 (4-th edition) • Applied Digital Signal Processing, Theory and Practice. Dimitris G. Manolakis, Vinay K. Ingle, Cambridge University Press, 1st edition.
Laboratory	• Discrete-Time Convolution using MATLAB. • Sample rate conversion of audio files using MATLAB. • Design of IIR and FIR digital filters using "Filter Design and Analysis" tool of MATLAB. Evaluation of finite-word precision on filter response and stability. • DTMF Generation and Detection using IFFT and FFT. • Project: Voice Compression using double-band multi-rate Quadrature Mirror Filters.

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 4152</td><td>Detection and Estimation Theory</td><td>ELE 311</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Fundamentals of detection theory, Single sample detection of binary hypotheses, Bays criterion, Minimax criterion, Neyman-Pearson criterion, Receiver operating characteristics, Multiple sample detection of binary hypotheses, Fundamentals of estimation theory, relation between detection and estimation theory, Types of estimation problems, Properties of estimators, Bayes estimation, Maximum-likelihood estimation, Cramer-Rao inequality.</td></tr>
<tr><td>References</td><td colspan="11">• Harry L. Van Trees, Detection, Estimation, and Modulation Theory, Part I.
• Thomas A. Schonhoff, Detection and Estimation Theory and its Applications, Pearson Prentice Hall, 2006</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Simulation of M-ary PSK receiver.
• Simulation of M-ary FSK receiver.
• Frequency offset estimation in digital receivers.
• Symbol time estimation in digital receivers.
• Simulation of Radar transmitter and receiver.</td></tr>
</table>

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 4301</td><td>Advanced Robotics</td><td>ELE 3302</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course</td><td colspan="11">Introduction to parallel robots, Flying robots (construction, dynamic, and control), Mobile robotics (construction, dynamic, and control), Static force and compliance, trajectory planning, robot control, robot sensing. Environmental perception applying sensors and computer vision</td></tr>
<tr><td>References</td><td colspan="11">• Siciliano, Bruno, Khatib, Oussama, “Springer Handbook of Robotics”, (Eds.),2016
• Mark W. Spong, “Robot Modeling and Control”, 2nd Edition, Wiley, 2020, ISBN-13: 978-1119523994</td></tr>
<tr><td>Laboratory</td><td colspan="11">Using MATLAB Robotics toolbox:
• use MATLAB Robotics toolbox for flying robot modeling and control
• use MATLAB Robotics toolbox for mobile robot modeling and control
• Trajectory generation for prespecified tasks (case study)
• Getting start with computer vision in robotics field.
In the sense of project-based learning, each student should submit a complete project that cover most of the intended outcomes</td></tr>
</table>

<table>
<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><td rowspan="2">ELE 4303</td><td rowspan="2">Autonomous Systems</td><td rowspan="2">ELE 3302</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">This course introduces autonomous systems including the architecture of autonomous systems. The Basics of Autonomy (Motion and Vision), design of agents, models and knowledge representations, robot navigation (localization and mapping. The lectures and exercises of this course introduce several types of robots such as wheeled, flight, and underwater robots, self-deriving cars).</td></tr>
<tr><td>References</td><td colspan="11">• R.Seigwart, I. R.Nourbakhsh, D. Scaramuzza, "Introduction to Autonomous Mobile Robots", 2nd Edition, MIT Press, 2011.
• Gerardus Blokdyk, “Autonomous System AS”, 2nd Edition, 5STARCooks, 2022, ISBN-13: 978-0655342304.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• MATLAB virtual lab: Modelling and simulating autonomous robotics systems
• Using different computer's program such as V-REP for simulating the dynamics of different robots.
• Other useful simulating programs may be included (GACEEPO, MSC ADAMS).
• Laboratory experiments will be set based on the course selected topics and robots.</td></tr>
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<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><td rowspan="2">ELE 4305</td><td rowspan="2">Advanced Control Systems</td><td rowspan="2">ELE 333</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>SA</td><td>MT</td><td>PE/OE</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>1</td><td>1</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Basic principles of control systems engineering, Modeling of sampled-data systems, sampling rate selection, Controller design with continuous systems, Direct digital design, Design considerations for robust control, Feedforward control, State space methods for control and estimation, Optimal feedback, and long-range predictive control, Adaptive, learning, fuzzy, and variable structure control</td></tr>
<tr><td>References</td><td colspan="11">• Eduardo Garcia Jaimes,”Advanced Control Systems: Theory and Practice”,Our Knowledge Publishing, 2021, ISBN-13: 978-6202831758
• Hassan K. Khalil, “Nonlinear Control”, 1st edition, Pearson, 2014, ISBN: 978-0133499261
• K. Ogata, “Modern Control Engineering”, 5th edition, Pearson, 2009, ISBN: 978-0136156734
• G. F. Franklin, J. David Powel, M.L. Workman, “Digital Control of Dynamic Systems”, 3rd edition, Adison Wesley, 1997, ISBN: 978-0201820546</td></tr>
<tr><td>Laboratory</td><td colspan="11">Project based laboratory where the student along with the course will:
• Design, build, simulate, and test control systems and strategies using both MATLAB and Simulink
• Work on a controls-based project related to graduate thesis work. If graduate thesis is not controls-related, a relevant project will be assigned</td></tr>
</table>

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 4307</td><td>Advanced Industrial Automation Systems</td><td>ELE 331</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to industry 4.0. Sensors and transducers: Temperature, displacement, force, pressure, displacement sensors – Actuators: Hydraulic, Pneumatic, and Electric actuators – Digital PI, PID controller – Industrial Process Control examples: Continuous Casting process, rolling process, Winding, and unwinding process, drawing process, Mixing Process, basics of machine safety, process safety. Industrial Communications, Protocols, networks. Examples on media converters. Protocol converters.</td></tr>
<tr><td>References</td><td colspan="11">• Geoffrey Williamson, “Industrial Automation: Systems and Engineering”, States Academic Press, 2022
• L. A. Bryan, E. A. Bryan, 'programmable controllers’ theory and implementation', 2nd Edition, Amer Technical Pub, 2003.
• Dag H. Hanssen,” Programmable logic controllers a Practical approach to IEC 61131-3 Using CoDeSys”, Wiley, 2015.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Process Simulator labs
• Drive Control through network
• Protocol Examples
• WinCC SCADA</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 4309</td><td>Selected Topics in Control Systems</td><td></td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">This course would cover selected contemporary topics in control systems engineering. The course content must take approval from the Electrical Engineering Department Council before students’ registration.</td></tr>
</table>

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 4401</td><td>Parallel and Distributed Systems</td><td>ELE 3402</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">The use of parallelism to achieve high performance - parallelism within the central processing unit – parallel processing in multiprocessors environment - physical components of the data flow machines – new parallel architectures - the new advances in parallel processing - models and structures parallel data - examples of applications of the current in parallel and distributed systems- Distributed Systems, MapReduce, Clusters - Distributed File Systems, Security - Distributed Shared Memory, Peer-to-Peer</td></tr>
<tr><td>References</td><td colspan="11">• Arun Kulkarni, Nupur Prasad Giri, Nikhilesh Joshi, Bhushan Jadhav, “Parallel and Distributed Systems “,Wiley, 2016, ISBN: 9788126565825
• Peter Kacsuk, Thomas Fahringer, “Distributed and Parallel Systems: From Cluster to Grid Computing”, Springer 2007, ISBN-13: 978-0387698571
• F. Xhafa, F. Leu, M. Ficco, and C. Yang, “Advances on P2P, Parallel, Grid, Cloud and Internet Computing,” Proceedings of the 13th International Conference on P2P, Parallel, Grid, Cloud, and Internet Computing (3PGCIC-2018).</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Virtual Machines and Virtualization of Clusters and Data Centers
• Implementation of Service Oriented Architecture for Distributed Computing.
• Cloud Programming and Software Environment
• grid Computing, Systems, and Resource Management.</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 4403</td><td>Digital Forensics</td><td>ELE 3404</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to Digital Forensics, Types of cybercrimes, electronic evidence and handling, electronic media, collection, searching and storage of electronic media, internet crimes, hacking and cracking. Data Acquisition and Authentication Process, Windows Systems, UNIX file Systems, mac file systems, computer artifacts, Internet Artifacts, OS Artifacts, and their forensic applications. Forensic Tools, Usage of Slack space, tools for Disk Imaging, Data Recovery, Vulnerability Assessment Tools, FTK tools, Anti Forensics and probable counters, process of computer forensics and digital investigations, processing of digital and multimedia evidence.</td></tr>
<tr><td>References</td><td colspan="11">• C. Altheide and H. Carvey, “Digital Forensics with Open-Source Tools”, Syngress, 2011. ISBN: 9781597495868.
• Rama Chandra Malayanur, “Forensics2022: Digital Forensics and Cyber Crime", 2022
• Preston Miller, Chapin Bryce, “Python Digital Forensics Cookbook: Effective Python recipes for digital investigations, Packt Publishing, 2017.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Live Case Studies
• Open-Source Forensic Tools
• Disk Forensics and Data Recovery
• Steganography
• Key loggers
• Network monitors</td></tr>
<tr><td>Used in Program</td><td colspan="7">Computer and Control Systems (Computer Concentration)</td><td>Semester</td><td colspan="3">9</td></tr>
</table>

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ELE 4405</td><td>Software Project Management</td><td>ELE 3406</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to Software Project Management - Project Analysis: strategic assessment, technical assessment, economic analysis - Activity Planning and Scheduling: Objectives of activity planning, Work breakdown structure, Bar chart, Network planning model: Critical path method, Program evaluation and review technique, Precedence diagramming method, shortening project duration, Identifying critical activities. - Risk Management - Resource allocation - Monitoring and control - Software quality assurance and testing - Software Configuration Management</td></tr>
<tr><td>References</td><td colspan="11">• Adolfo Villafiorita, "Introduction to Software Project Management", Auerbach Publications, 2014,ISBN 9781466559530
• Robert K. Wysocki, "Effective Software Project Management", Wiley, 2006,ISBN: 978-0-470-44653-9</td></tr>
<tr><td>Laboratory</td><td colspan="11">Students should prepare a project report using different concepts of software project management. The project can be done in groups. Each group can select a case study and apply the concepts of software project management focusing on project analysis, scheduling, risk analysis, resource allocation, testing.</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
ELE 4407	Compilers	ELE 144	3	Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
				2	2	1	5	10	30	20	40

Course Content	Introduction to Compiling; Lexical analysis: specification and recognition of tokens, finite automata; Syntax analysis: grammars, top-down and bottom-up passing; Syntax-directed translation; Semantic routines; Storage-allocation strategies; Code generation; Error recovery.
References	• Keith D. Cooper, Linda Torczon, “Engineering a Compiler”, 3rd Edition, Morgan Kaufmann, 2022. • AlfredAho, et al, “Compilers. Principles, Techniques and Tools”, Addison Wesley,2006.
Laboratory	• Lexical Analysis • Symbol Table • Type Checking and Semantic Analysis • Optimization

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
ELE 4409	Internet of Things	ELE 342	3	Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
				2	2	1	5	10	30	20	40

Course Content	Overview of IoT and High-level Architecture, Setting up IoT workflow. Programming with Advanced C / Embedded C. Micro-controller programming using Arduino. Programming with Python. Building IoT Applications using Raspberry Pi IoT Protocols: HTTP, CoAP, MQTT, AMQP, 6LoWPAN. IoT Cloud Infrastructure Performance and Security in IoT
References	• John Soldatos, “Building Blocks for IOT Analytics”, River Publishers, 2017, ISBN: 978-87-93519-03-9. • Marco Schwartz, “Internet of Things with Arduino Cookbook”, Packt Publishing, 2016, ISBN-13: 978-1785286582 • Othmar Kyas, “How to Smart Home a Step-by-Step Guide to Your Personal Internet of Things”, 3rd edition, Key concept Press
Laboratory	• reading digital input through Wi-Fi • Reading analog input through Wi-Fi • NodeRed platform intro • Using MQTT broker in sending messages • Raspberry Pi interface for IoT

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 4411	RTL design	ELE 242	3	2	2	1	5	10	30	20	40
Course Content	Introduction - FPGA Architecture - Overview of FPGA/ASIC Design Flow- RTL Coding - Digital Design with HDL (VHDL/Verilog) - Design modelling with examples - Test Bench Development - Simulation and Synthesis- Timing Analysis - Chip Scope - RTL Optimization - System Design with Finite and Algorithmic State Machine.										
References	• Frank Vahid, " Digital Design with RTL Design, VHDL and Verilog", Second Edition A John Willey Sons Publications, 2011 • Sanjay Churiwala · Sapan Garg, "Principles of VLSI RTL Design a Practical Guide", Springer New York Dordrecht Heidelberg London, ISBN 978-1-4419-9295-6, 2011 • A. Arockia Bazil Raj, "FPGA-Based Embedded System Developer's Guide",Taylor & Francis Group, LLC, 2018										
Laboratory	• Arithmetic Operations: Adders/ Subtractors - Multipliers – Dividers • Trigonometric Computations: CORDIC • Memory Design and Implementation: ROM - RAM • Peripheral Interfacing										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 4413	Selected Topics in Computer Engineering		3	2	2	1	5	10	30	20	40
Course Content	As the development of computer engineering is fast, this course would cover selected contemporary topics in computer engineering. The course content must take approval from the Electrical Engineering Department Council before students' registration.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 4425	VLSI Design	ELE 4411	3	2	2	1	5	10	30	20	40
Course Content	This course covers Principles, analysis, and design of CMOS Radio frequency (RF) integrated circuits for wireless communication systems. Noise performance and limitations of devices, RF Circuits, Design of RF Filter design. Basic blocks in RF systems and their VLSI implementation, Low noise Amplifier design, Design of Mixers, Various mixers working and implementation. VCO and definition of phase noise, Noise power and trade off. PLL frequency Synthesizers. Frequency dividers. Cadence SpectreRF for circuit simulations.										
References	• Thomas H. Lee , Design of CMOS RF Integrated Circuits, Cambridge University press, June 2012. • Jacob Baker, CMOS Circuit Design, Layout, and Simulation, 3rd Edition, Institute of Electrical and Electronics Engineers, 2010. • Razavi, PHI, RF Microelectronics, Pearson, 2nd edition.										
Laboratory	• Gilbert Mixer Simulation (Cadence SpectreRF). • LNA simulation using Cadence SpectreRF.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
ELE 4427	ASIC Design	ELE 4411	3	2	2	1	5	10	30	20	40

Course Content	Course covers Fundamentals of ASIC digital Design Flow, Advanced register-transfer level RTL design using HDL language. RTL Verification, Synopsys design compiler, logic synthesis tool for mapping RTL onto Gate-Level, Netlist Generation, Essential Level system on chip SOC designing, ASIC physical design flow, Floor planning, Automatic Place the Functional blocks, Optimization and timing analysis techniques, Clock tree synthesis CTS, and Routing Algorithms, ASIC verification and post Synthesis Algorithms. virtuoso GDS file. DRC & LVS calibration.
References	• Digital ASIC Group, Digital ASIC Design, A Tutorial on the Design Flow, Lund Institute of Technology, October 20, 2005. • Michael John Sebastian Smith, Application-Specific Integrated Circuits, 1997. • Golshan, Khosrow, Physical Design Essentials, springer, 2007.
Laboratory	• Design and implement a FIR filter by VHDL and perform the following steps: • Verification from your code. • Logic synthesis. • Import Design to SOC Encounter. • Floor Planning. • Placement. • Optimization and timing analysis. • Pre-CTC Timing. • Clock Tree Synthesis. • Post-CTS timing. • Routing the Design. • Post synthesis gate level simulation. • Generating final GDS File.

Code	Course Title	Pre-req	Cr. Hrs.	Ct Hrs				Assessment			
				Lec	Lab	Tut	Tot	SA	MT	PE/OE	Final
BES 111	Differential Equations	BES 012	3	2	0	2	4	30	30	-	40

Course Content	Ordinary differential equations (ODEs): Classification and types of solutions of ODEs. Solution of first order ODEs - Applications of ODEs (Newtons law of cooling, electric circuits) - Solution of nth order ODEs (homogeneous and non-homogeneous) - System of first order linear differential equations - Series solution of differential equations- Laplace transforms and inverse Laplace transforms with applications - Fourier series with applications. Gamma and Beta functions Partial Differential Equations (PDEs): Classification and types of solutions of PDEs. Applications of PDEs. Solution of linear PDEs with constant coefficients, solution of some initial-boundary value problems. Solution of PDEs by Laplace Transforms.
References	• Morris Tenenbaum, Harry Pollard, "Ordinary Differential Equations: An Elementary Textbook for Students of Mathematics, Engineering, and the Sciences", Dover Publications, Last Edition. • Wei-Chau Xie, Differential Equations for Engineers, CAMBRIDGE UNIVERSITY PRESS, 2010.

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>BES 112</td><td>Numerical Analysis</td><td>BES 111</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Numerical in general: Errors, norms, Numerical solution of a system of linear and nonlinear equations. matrix eigenvalues, least square method (Curve fitting), Interpolations, Numerical differentiation and integration.
Numerical ODEs and PDEs: methods for the solution of initial value problems in 1st order ODEs and higher order ODEs, Finite difference methods for boundary value problems in ODEs and initial-boundary value problems for PDEs (Elliptic and parabolic PDEs)- Lab simulations of engineering applications</td></tr>
<tr><td>References</td><td colspan="11">• R W Hamming, "Numerical Methods for Scientists and Engineers", Courier Dover Publications, Last Edition.
• Steven C. Chapra, “Applied Numerical Methods with MATLAB for Engineers and Scientists”, Mcgraw-Hill, 3rd edition.
• Nita H. Shah, Numerical Methods with C++ Programming, PHI Learning, 2008.</td></tr>
<tr><td>Laboratory</td><td colspan="11">Lab simulations by software’s as (C++, Matlab, Python,…)- Simulating practical technical problems- linear equations due to electric circuits , truss and spring mass systems. - Electric charge calculations- Nonlinear structural problems- Deflection of nonlinear springs- Calculating the shrinkage of a trunnion- Finding the longitudinal Young’s modulus -Estimating voltage drop on a resistor- Calculating the work done by stretching a string- Simulating equations due to the fluid continuum problems, DC motor speed control problems- interpolation and fitting for signals and voltage current relations- population growth calculations- Fluid flow rate calculations- Distributed wind force problems</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>BES 113</td><td>Mathematics III</td><td>BES 012</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Complex Functions: Complex plane, Polar form of complex number, Powers and roots, Cauchy-Riemann equations, Conformal transformations. Some elementary transformations (linear function, rational and bilinear functions, irrational functions, the exponential function, trigonometric functions). Complex integration.
Multivariable Calculus (B): Multiple integrals: double integrals, areas, moments, double integrals in polar form, triple integrals, masses and moments in three dimensions, triple integrals in cylindrical and spherical coordinates, substitution in multiple integrals, line and surface integrals, Green, Gauss and Stock’s theorems.</td></tr>
<tr><td>References</td><td colspan="11">• Erwin Kreyszig, "Advanced Engineering Mathematics", / Paperback / Wiley, John & Sons, Last Edition. George B. Thomas, Jr., Maurice D. Weir, Joel Hass, THOMAS' CALCULUS Multivariable (Twelfth Edition), 2010.</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
BES 214	Discrete Mathematics and Linear Algebra	BES 011	3	2	0	2	3	30	30	-	40

Course Content

Discrete Mathematics: Proofs - Recursion - Sets - Combinatorics - Number theory - Relations - Functions and matrices - Graphs and Trees - Algebraic structures (Groups-Rings-Fields)- Introduction to modelling computations.
Linear Programming: Definitions, Maximization and Minimization problems, Graphical solutions of linear programming problems, Simplex and Big – M method. - Graphs and Digraphs: shortest path, spanning tree.

References

- Susanna S. EPP, Discrete mathematics with application, Fourth Edition, 2011, Brooks/Cole Cengage Learning.
- Gass, S. I. Linear Programming: Methods and Applications, 5th ed. McGraw-Hill, 1985, New York

Code	Course Title	Pre-req	Cr. Hrs.	Ct Hrs				Assessment			
				Lec	Lab	Tut	Tot	SA	MT	PE/OE	Final
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4	10	30	20	40

Course Content

Probability: Obtaining Data - Probability models: mathematical, deterministic model. Probability theory concepts. - Discrete Distributions: Binomial and Poisson distribution. Continuous Distributions: Normal and Exponential Distribution. - Joint distributions.
Statistics and Estimation: central point theorem, Single and multiple confidence interval, Prediction interval, tolerance interval - Hypothesis testing, - Inferences on the mean and variance of Normal distribution, Inference of two samples. – Simple and multiple Linear Regression and Correlation. - Applications involving uniform, Gaussian. Markov chains - Queueing Theory - Course examples are drawn from signal processing, system reliability, data science, wireless communications, civil engineering, and mechanical engineering - Lab simulations of engineering applications.

References

- R. E Walpole, R. H. Myers, “Probability and Statistics for Engineers and Scientists", Macmillan Publishing, Last Edition.
- David Levine, Patricia Ramsey , Robert Smidt, “Applied Statistics for Engineers and Scientists: Using Microsoft Excel & Minitab”, First Edition, 2000.

Laboratory

Lab simulations by software’s as (Excel, Matlab, Python,…)- Exploratory data analysis and data transformation (Tabulated data summaries and statistics, Histograms, Box and Correlation plots, Computation of means, variances, etc, Missing data imputation)- Simple random sampling with and without replacement- Stratified random sampling- Simulating Bernoulli process and Poisson distribution - Simulating Markov chains applications-Binary and sequential hypothesis testing and gambler's ruin -Gaussian Mixture Models, clustering and anomaly detection- Regression models and inference- Time series forecasting and ARIMA models.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
BES 131	Modern physics	BES 031 BES 032	2	2	1	1	4	10	30	20	40
Course Content	Quantization theory and photoelectric effect and, Wave-particle duality, Schrodinger equation, Particle in a box, Quantum tunneling, Band theory of solids, intrinsic and extrinsic semiconductors, energy band diagrams, drift and diffusion currents, Carrier generation and recombination, continuity equations, pn junction, Bipolar Junction Transistor, Field-Effect Transistors, solar cells, properties of dielectric materials.										
References	• R. A. Serway and J. W. Jewett, Physics for scientists and engineers: Cengage learning, 2018. • Neamen, *Semiconductor Physics and Devices-Basic Principles*, 4th Ed, McGraw-Hill, 2012. • Robert F. Pierret, *Semiconductor Device Fundamentals*, 2nd Ed, Addison Wisely, 1996.										
Laboratory	• Photoelectric effect, • Line spectrum, • Hall Effect, • p-n junction diode characteristics, • Solar cell characteristics										
Used in Program	Electrical power Engineering							Semester	3		

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment Criteria			
				Lec.	Lab	Tut	Sum	ST	MT	PE/OE	Final
MEC 131	Computer Applications	ELE 042	2	1	2	0	3	10	30	20	40
Course Content	Developing basic concepts of algorithmic thinking to solve problems of relevance in engineering practice and implementing these algorithms MATLAB. Loops, control structures, functions, arrays. Create MATLAB programs that solve real-world problems in engineering and the sciences. Numerical methods, solution of nonlinear equations, plotting, logic operations, and graphical user interfaces to design, test, and debug numerical algorithms.										
References	• Simin Nasseri, “Solving Mechanical Engineering Problems with MATLAB”, Linus Publications										
Laboratory	Student's programs of tasks and problems are carried out in the engineering Computer Labs.										
Used in Program	All Mechanical Department Programs							Semester	3		

Program# 8 Civil Engineering Program

Program Description

Students completing the Civil Engineering program at Benha faculty of engineering are awarded with a Bachelor of Science in Civil Engineering degree. Civil Engineering Program provides the undergraduate education and the necessary skills required for a career as a civil engineer or to pursue graduate studies in relevant fields. Students awarded with Bachelor of Science in Civil Engineering can qualify and practice as Professional Civil Engineer (PE) after fulfilling the experience and exam requirements of the licensure. Our well-rounded curriculum emphasizes the fundamentals that integrate both established and cutting-edge civil engineering principles, methods, tools, and materials. The engineering courses are designed around real-life examples in connection with the practices in the industry so that students can easily relate the theories with practice. The humanity courses at Benha faculty of engineering helps our students to supplement their engineering education and training with communication skills, ethic values, and social and environmental awareness. The small class sizes within the Engineering Program allows student-centric and individualized learning environment.

Basic Information

Program Vision

The Civil Engineering Program strives to graduate qualified engineers, produce recognized research, and provide professional societal service locally and internationally.

Program Mission

The mission of the civil engineering program is to develop highly competent professionals, preparing them for positions in civil engineering, continuing education in graduate school, life-long learning, and societal leadership. The program aims to provide undergraduates with outstanding education opportunities founded on comprehensive engineering fundamentals and coupled with modern engineering tools. The program focuses on professional practices in civil engineering preparing its graduates for the labor market, societal needs, while equipping them with lifelong learning skills.

Program Objectives

The objectives of the Civil Engineering Program are to enable its graduates to:

- **PO1.** Apply a wide spectrum of engineering knowledge, science and specialized skills with analytic, critical and systemic thinking to identify and solve engineering problems in real life situation.
- **PO2.** Behave professionally and adhere to engineering ethics and standards and work to develop the profession and the community and promote sustainability principles.
- **PO3.** Work in and lead a heterogeneous team and display leadership qualities, business administration, and entrepreneurial skills.
- **PO4.** Use techniques, skills, and modern engineering tools necessary for engineering practice.
- **PO5.** Master self-learning and life-long learning strategies to communicate effectively in academic/professional fields.
- **PO6.** Design of constructions that meet specified needs with appropriate attention to health and safety risks, applicable standards, economic, environmental, cultural, and societal considerations.
- **PO7.** Incorporate economics and business practices including project risk and change management into the practice of engineering and to understand their limitations.

Graduates Attributes

According to NARS 2018 the graduate attributes of civil engineering are:

GA1. Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real life situations.

GA2. Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation.

GA3. Behave professionally and adhere to engineering ethics and standards.

GA4. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance.

GA5. Recognize his/her role in promoting the engineering field and contribute in the development of the profession and the community;

GA6. Value the importance of the environment, both physical and natural, and work to promote sustainability principles.

GA7. Use techniques, skills and modern engineering tools necessary for engineering practice.

GA8. Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies.

GA9. Communicate effectively using different modes, tools, and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner.

GA10. Demonstrate leadership qualities, business administration and entrepreneurial skills.

In addition to all engineering graduate attributes defined by NARS 2018, Civil Engineering graduates should be able to:

GA11. Design of constructions systems that meet specified needs with applicable standards.

GA12. Understand the concept of quality control during design and construction, field verification, and review

GA13. Incorporate economic and business practices into engineering projects.

Program Learning Outcomes

According to NARS 2018 the graduate of civil engineering program must be able to:

Level A: General Competencies of Engineering Graduate

PLO1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics.

PLO2. Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess, and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

PLO3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical, and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

PLO4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues, and risk management principles.

PLO5. Practice research techniques and methods of investigation as an inherent part of learning.

PLO6. Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.

PLO7. Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural teams.

PLO8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.

PLO9. Use creative, innovative, and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

PLO10. Acquire and apply new knowledge, and practice self, lifelong and other learning strategies.

Level B: Competencies of Civil Engineering Graduate

PLO11. Select appropriate and sustainable technologies for construction of buildings, infrastructures and water structures; using either numerical techniques or physical measurements and/or testing by applying a full range of civil engineering concepts and techniques of: Structural Analysis and Mechanics, Properties and Strength of Materials, Surveying, Soil Mechanics, Hydrology and Fluid Mechanics.

PLO12. Achieve an optimum design of Reinforced Concrete and Steel Structures, Foundations and Earth Retaining Structures; and at least three of the following civil engineering topics: Transportation and Traffic, Roadways and Airports, Railways, Sanitary Works, Irrigation, Water Resources and Harbors; or any other emerging field relevant to the discipline.

PLO13. Plan and manage construction processes; address construction defects, instability and quality issues; maintain safety measures in construction and materials; and assess environmental impacts of projects.

PLO14. Deal with biddings, contracts and financial issues including project insurance and guarantees.

Faculty Mission vs. Program Mission Matrix

<table>
<tr><td colspan="2" rowspan="3">Faculty Mission</td><td colspan="3">Program Mission</td></tr>
<tr><td colspan="3">The mission of the civil engineering program is to develop highly competent professionals, preparing them for positions in civil engineering, continuing education in graduate school, life-long learning, and societal leadership. The program aims to provide undergraduates with outstanding education opportunities founded on comprehensive engineering fundamentals and coupled with modern engineering tools. The program focuses on professional practices in civil engineering preparing its graduates for the labor market, societal needs, while equipping them with lifelong learning skills.</td></tr>
<tr><td>The program aims to provide undergraduates with outstanding education opportunities founded on comprehensive engineering fundamentals and coupled with modern engineering tools.</td><td>The program focuses on professional practices in civil engineering preparing its graduates for the labor market</td><td>Develop highly competent professionals, preparing them for positions in civil engineering, continuing education in graduate school, life-long learning, and societal leadership.</td></tr>
<tr><td rowspan="3">Benha Faculty of Engineering - Benha University is committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market, and capable of using and developing modern technology, and providing research in engineering fields to serve society and community.</td><td>Benha Faculty of Engineering - Benha University is committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market</td><td></td><td>√</td><td></td></tr>
<tr><td>Capable of using and developing modern technology</td><td>√</td><td></td><td></td></tr>
<tr><td>Providing research in engineering fields to serve society and community</td><td></td><td></td><td>√</td></tr>
</table>

Program Mission vs. Program Objectives Matrix

Program Mission		Program Objectives						
		PO1	PO2	PO3	PO4	PO5	PO6	PO7
The mission of the civil engineering program is to develop highly competent professionals, preparing them for positions in civil engineering, continuing education in graduate school, life-long learning, and societal leadership. The program aims to provide undergraduates with outstanding education opportunities founded on comprehensive engineering fundamentals and coupled with modern engineering tools. The program focuses on professional practices in civil engineering preparing its graduates for the labor market, societal needs, while equipping them with lifelong learning skills.	The program aims to provide undergraduates with outstanding education opportunities founded on comprehensive engineering fundamentals and coupled with modern engineering tools.	√			√			√
	The program focuses on professional practices in civil engineering preparing its graduates for the labor market		√	√		√	√	
	Develop highly competent professionals, preparing them for positions in civil engineering, continuing education in graduate school, life-long learning, and societal leadership.		√	√		√		

Program Objectives vs. Program Competencies Matrix

Program Objectives	Program Competencies													
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4
PO1	√	√							√					
PO2			√				√							
PO3							√	√	√					
PO4				√				√		√				
PO5					√			√		√				
PO6						√					√	√	√	
PO7			√						√					√

Program Objectives vs. Graduate Attributes Matrix

Program Objectives	Graduate Attributes												
	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12	GA13
PO1	√	√											
PO2			√		√	√							
PO3				√						√			
PO4							√						
PO5								√	√				
PO6											√	√	
PO7													√

Career Prospects

Graduates of the Civil Engineering Program would apply their knowledge and interpersonal skills in careers, both in private and public sectors, to conceive, plan, design, implement, operate and maintain the systems needed to support the physical infrastructure.

Building, construction and maintenance will always be necessary for every country. Civil Engineers with computer skills will be particularly in demand because of the growing usage of computers in areas such as structural analysis and design, transportation system planning and construction management.

Graduates will be able to pursue a variety of career options in worldwide locations due to demands for improvements to civil infrastructure that are ever-present, because of population growth and deterioration of existing systems over time. Several career options include, but not limited to, the following:

1. Survey Engineering
2. Geotechnical Engineering
3. Structural Engineering
4. Hydraulics and Irrigation Engineering
5. Environmental Engineering
6. Transportation, Traffic and Highway Engineering
7. Construction Management Engineering

Requirements of Program Courses

Program Requirements

Requirement		Cr. Hrs.	Ct. Hr.			
			Lec	Lab	Tut	Sum
Benha University Requirements		14	14	0	0	14
Benha Faculty of Engineering Requirements		32	19	14	17	50
Program Requirements	From Basic science	12	8	6	2	16
	Compulsory Courses	84	60	37	24	121
	Elective courses	18	12	4	8	24
Total		160	113	61	51	225

University Requirements of Civil Engineering Program

Lists of Humanities Courses of Civil Engineering Program

Code	Course	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
UHS 101	Foreign Language	-----	2	2	0	0	2
UHS 102	Information and Communication Technology	-----	2	2	0	0	2
UHS 103	Societal Issues	-----	2	2	0	0	2
UHS 104	Professional Ethics	-----	2	2	0	0	2
UHS XXX	Humanities Elective I	-----	2	2	0	0	2
UHS XXX	Humanities Elective II	-----	2	2	0	0	2
UHS XXX	Humanities Elective III	-----	2	2	0	0	2
Total			14	14	0	0	14

Lists of Electives Humanities Courses of Civil Engineering Program

Humanities Elective		Code	Course
I	Entrepreneurship Courses	UHS 201	Principles of Entrepreneurship and Project Management
		UHS 203	Human Resources Management
II	Personal and acquired skills courses	UHS 301	Communication and Presentation Skills
		UHS 302	Leadership Skills
III	Scientific research and analysis courses	UHS 801	Research Methodologies
		UHS 803	Thinking Skills

Basic Science Requirements of Civil Engineering Program

CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
BES 011	Mathematics I	-----	3	2	0	2	4
BES 012	Mathematics II	BES 011	3	2	0	2	4
BES 111	Differential Equations	BES 012	3	2	0	2	4
BES 112	Numerical Analysis	BES 111	3	2	2	0	4
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4
BES 041	General Chemistry	-----	4	3	2	1	6
BES 148	Water Chemistry	BES 041	3	2	2	0	4
BES 141*	Pollution and Industrial Safety	BES 041	2	2	1	0	3
BES 031	Physics I	-----	3	2	2	1	5
BES 032	Physics II	-----	3	2	2	1	5
Total			30	21	13	9	43

* Course teaching is shared between the Basic Engineering Science Department and Civil Engineering Department.

Program Requirements

Lists of Compulsory Courses (96 Cr. Hrs.)

CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
BES 111	Differential Equations	BES 012	3	2	0	2	4
BES 112	Numerical Analysis	BES 111	3	2	2	0	4
BES 148	Water Chemistry	BES 041	3	2	2	0	4
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4
Total from Basic Science			12	8	6	2	16
CIV 101	CAD for Civil Engineering	MEC 014	2	1	3	0	4
CIV 111	Properties and Testing of Materials	BES 022	3	2	2	0	4
CIV 113	Technology of Building Materials	BES 041	2	2	1	0	3
CIV 114	Concrete Technology	CIV 113	3	2	2	0	4
CIV 121	Structure Analysis I	BES 021	3	2	0	2	4
CIV 122	Structure Analysis II	CIV 121	3	2	0	2	4
CIV 142	Surveying for Engineers I	BES 012	3	2	2	0	4
CIV 161	Fluid Mechanics	BES 031	2	2	1	0	3
CIV 162	Hydraulics	CIV 161	2	2	1	0	3
ARC 217	Architectural Engineering	CIV 101	2	1	0	2	3
CIV 221	Structure Analysis III	CIV 122	3	2	0	2	4
CIV 222	Design of Metallic Structures I	CIV 122	3	2	0	2	4
CIV 231	Soil Mechanics	CIV 111	3	2	2	0	4
CIV 232	Geotechnical Engineering and Foundations	CIV 231, CIV 251	3	2	2	0	4
CIV 241	Surveying for Engineers II	CIV 142	3	2	2	0	4
CIV 251	Design of R.C. Structures I	CIV 114, CIV 122	3	2	0	2	4
CIV 252	Design of R.C. Structures II	CIV 251	3	2	0	2	4
CIV 261	Hydrology	CIV 162	2	2	0	1	3
CIV 272	Water Supply Engineering	CIV 162	3	2	2	0	4
CIV 282	Traffic and Transportation Engineering	BES 112, BES 211	3	2	2	0	4
CIV 300	Contracts and Legalizations	CIV 222, CIV 252	2	2	0	1	3
CIV 302	Computer Applications in Civil Engineering	ELE 042, CIV 122	2	1	3	0	4
CIV 304	Quality Control and Fundamentals of Repair and Strengthening of Structures	CIV 252, CIV 321	2	2	0	1	3
CIV 306	Engineering Economy	-----	2	2	0	1	3
CIV 321	Design of Metallic Structures II	CIV 222	3	2	0	2	4
CIV 331	Design of Foundations and Earth Retaining Structures	CIV 232	2	2	0	1	3
CIV 351	Design of R.C. Structures III	CIV 252	2	2	0	1	3
CIV 361	Irrigation and Drainage Engineering	CIV 161	2	2	0	1	3
CIV 371	Sanitary Engineering	CIV 272	3	2	2	0	4
CIV 381	Highway Engineering I	CIV 142, CIV 231, CIV 282	3	2	2	0	4
CIV 398	Senior Design Project I	*	2	0	4	0	4
CIV 401	Construction Project & Management	CIV 300	2	2	0	1	3
CIV 499	Senior Design Project II	CIV 398	3	1	4	0	5
Total from Civil Courses			84	60	37	24	121
Total			96	68	43	26	137

* The student can register the senior design project course after passing 70% of the program Cr. Hrs., i.e., 112 Cr. Hrs. + completion of the prerequisite courses of the project.

Lists of Elective Courses (18 Cr. Hrs.)

CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr. Lec	Lab	Tut	Sum
Elective I							
CIV 200	Civil Engineering Application I	Completion of 70 Cr. Hrs.	3	2	2	0	4
CIV 202	Civil Engineering Application II		3	2	2	0	4
Elective II							
CIV 312	Modern Construction Materials	CIV 114	3	2	0	2	4
CIV 322	Structure Analysis IV	CIV 221	3	2	0	2	4
CIV 332	Special Topics in Geotechnical Engineering	CIV 331	3	2	0	2	4
CIV 342	Satellite Geodesy	CIV 241	3	2	0	2	4
CIV 344	Underground Utility Survey	CIV 241	3	2	0	2	4
CIV 346	Hydrographic Survey	CIV 241	3	2	0	2	4
Elective III							
CIV 324	Metallic Structures Design III	CIV 222	3	2	0	2	4
CIV 334	Special Topics in Foundations Engineering	CIV 331	3	2	0	2	4
CIV 352	R.C. Structures Design IV	CIV 351	3	2	0	2	4
CIV 362	Design of Irrigation Structure	CIV 162	3	2	0	2	4
CIV 364	Costal Engineering	CIV 162	3	2	0	2	4
CIV 372	Advanced Sanitary Engineering	CIV 371	3	2	0	2	4
CIV 382	Airport Engineering	CIV 381	3	2	0	2	4
CIV 384	Railway Engineering	CIV 282	3	2	0	2	4
Elective IV							
CIV 403	Construction project specifications, bids, and contracts	CIV 300	3	2	0	2	4
CIV 405	Value Engineering in the Construction Industry	CIV 300	3	2	0	2	4
Elective V							
CIV 407	Repair and Strengthening of Concrete Structures	CIV 304	3	2	0	2	4
CIV 461	Inland Navigation	CIV 162	3	2	0	2	4
CIV 471	Environmental Engineering	-----	3	2	0	2	4
CIV 481	Highway Engineering II	CIV 381	3	2	0	2	4
Elective VI							
CIV 421	Modelling of structures	CIV 322	3	2	2	0	4
CIV 431	Computer Application in Geotechnical Engineering and Foundations	CIV 331	3	2	2	0	4
CIV 441	Remote Sensing and Geographical Information Systems	CIV 241	3	2	2	0	4
CIV 443	Photogrammetry by Drones	CIV 241	3	2	2	0	4
CIV 451	R.C. structures Modelling	CIV 352	3	2	2	0	4
CIV 463	Hydraulic Modelling	CIV 162	3	2	2	0	4
CIV 473	Modeling of Water & Wastewater Networks	CIV 371	3	2	2	0	4
CIV 483	Computer Application in Transportation Engineering	CIV 381	3	2	2	0	4
Total			18	12	4	8	24

Proposed Study Plan

Level 0-1														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
UHS 101	Foreign Language	-----	2	2	0	0	2	2	30	30	0	40	100
UHS 102	Information and Communication Technology	-----	2	2	0	0	2	2	30	30	0	40	100
MEC 011	Engineering Graphics	-----	2	0	0	4	4	2	30	30	0	40	100
BES 011	Mathematics I	-----	3	2	0	2	4	2	30	30	0	40	100
BES 021	Mechanics I	-----	3	2	0	2	4	2	30	30	0	40	100
BES 031	Physics I	-----	3	2	2	1	5	2	10	30	20	40	100
BES 041	General Chemistry	-----	4	3	2	1	6	2	10	30	20	40	100
Sum			19	13	4	10	27						700

Level 0-2													
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
UHS 103	Societal Issues	-----	2	2	0	0	2	2	30	30	0	40	100
MEC 012	Production Engineering	-----	2	1	3	0	4	2	10	30	20	40	100
MEC 014	Computer Aided Drafting	MEC 011	2	1	2	0	3	2	10	30	20	40	100
BES 012	Mathematics II	BES 011	3	2	0	2	4	2	30	30	0	40	100
BES 022	Mechanics II	BES 021	3	2	0	2	4	2	30	30	0	40	100
BES 032	Physics II	-----	3	2	2	1	5	2	10	30	20	40	100
ELE 042	Computer Programming Fundamentals	-----	2	0	2	2	4	2	10	30	20	40	100
Sum			17	10	9	7	26						700

Level 1-1

CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr. Lec	Ct. Hr. Lab	Ct. Hr. Tut	Ct. Hr. Sum	Final Exam Time	Assessment SA	Assessment MT	Assessment PE/OE	Assessment Final Exam	Assessment Sum
BES 141	Pollution and Industrial Safety	BES 041	2	2	1	0	3	2	10	30	20	40	100
BES 111	Differential Equations	BES 012	3	2	0	2	4	2	30	30	0	40	100
CIV 101	CAD for Civil Engineering	MEC 014	2	1	3	0	4	2	30	30	40	--	100
CIV 111	Properties and Testing of Materials	BES 022	3	2	2	0	4	2	10	30	20	40	100
CIV 113	Technology of Building Materials	BES 041	2	2	1	0	3	2	10	30	20	40	100
CIV 121	Structure Analysis I	BES 021	3	2	0	2	4	2	30	30	0	40	100
CIV 161	Fluid Mechanics	BES 031	2	2	1	0	3	2	10	30	20	40	100
Sum			17	13	8	4	25						700

Level 1-2

CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr. Lec	Ct. Hr. Lab	Ct. Hr. Tut	Ct. Hr. Sum	Final Exam Time	Assessment SA	Assessment MT	Assessment PE/OE	Assessment Final Exam	Assessment Sum
UHS 104	Professional Ethics	-----	2	2	0	0	2	2	30	30	0	40	100
BES 112	Numerical Analysis	BES 111	3	2	2	0	4	2	10	30	20	40	100
BES 148	Water Chemistry	BES 041	3	2	2	0	4	2	10	30	20	40	100
CIV 114	Concrete Technology	CIV 113	3	2	2	0	4	2	10	30	20	40	100
CIV 122	Structure Analysis II	CIV 121	3	2	0	2	4	2	30	30	0	40	100
CIV 142	Surveying for Engineers I	BES 012	3	2	2	0	4	2	10	30	20	40	100
CIV 162	Hydraulics	CIV 161	2	2	1	0	3	2	10	30	20	40	100
Sum			19	14	9	2	25						700

Field Training I														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
FTR 103	Field Training I	Completion of 65 Cr. Hrs.	0	0	0	0	0	Oral	-	-	Pass or fail	-	-

Level 2-1													
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4	2	10	30	20	40	100
ARC 217	Architectural Engineering	CIV 101	2	1	0	2	3	2	30	30	40	--	100
CIV 221	Structure Analysis III	CIV 122	3	2	0	2	4	2	30	30	0	40	100
CIV 231	Soil Mechanics	CIV 111	3	2	2	0	4	2	10	30	20	40	100
CIV 241	Surveying for Engineers II	CIV 142	3	2	2	0	4	2	10	30	20	40	100
CIV 251	Design of R.C. Structures I	CIV 114, CIV 122	3	2	0	2	4	2	30	30	0	40	100
CIV 261	Hydrology	CIV 162	2	2	0	1	3	2	30	30	0	40	100
Sum			19	13	6	7	26						700

Level 2-2														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
CIV 2XX	Elective I	*	3	2	2	0	4	2	10	30	20	40	100
CIV 222	Design of Metallic Structures I	CIV 122	3	2	0	2	4	2	30	30	0	40	100
CIV 232	Geotechnical Engineering and Foundations	CIV 231, CIV 251	3	2	2	0	4	2	10	30	20	40	100
CIV 252	Design of R.C. Structures II	CIV 251	3	2	0	2	4	2	30	30	0	40	100
CIV 272	Water Supply Engineering	CIV 162	3	2	2	0	4	2	10	30	20	40	100
CIV 282	Traffic and Transportation Engineering	BES 112, BES 211	3	2	2	0	4	2	10	30	20	40	100
Sum			18	12	6	6	24						600

* According to the Course Name

Field Training II													
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
FTR 203	Field Training II	Completion of 96 Cr. Hrs.	0	0	0	0	0	Oral	-	-	Pass or Fail	-	-

Level 3-1														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
UHS XXX	Humanities Elective I	-----	2	2	0	0	2	2	30	30	0	40	100
CIV 321	Design of Metallic Structures II	CIV 222	3	2	0	2	4	2	30	30	0	40	100
CIV 331	Design of Foundations and Earth Retaining Structures	CIV 232	2	2	0	1	3	2	30	30	0	40	100
CIV 351	Design of R.C. Structures III	CIV 252	2	2	0	1	3	2	30	30	0	40	100
CIV 361	Irrigation and Drainage Engineering	CIV 161	2	2	0	1	3	2	30	30	0	40	100
CIV 371	Sanitary Engineering	CIV 272	3	2	2	0	4	2	10	30	20	40	100
CIV 381	Highway Engineering I	CIV 142 CIV 231 CIV 282	3	2	2	0	4	2	10	30	20	40	100
Sum			17	14	4	5	23						700

Level 3-2														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/OE	Final Exam	Sum
CIV 300	Contracts and Legalizations	CIV 222 CIV 252	2	2	0	1	3	2	30	30	0	40	100
CIV 302	Computer Applications in Civil Engineering	ELE 042 CIV 122	2	1	3	0	4	2	10	30	20	40	100
CIV 304	Quality Control and Fundamentals of Repair and Strengthening of Structures	CIV 252 CIV 321	2	2	0	1	3	2	30	30	0	40	100
CIV 306	Engineering Economy	-----	2	2	0	1	3	2	30	30	0	40	100
CIV 3XX	Elective II	*	3	2	0	2	4	2	30	30	0	40	100
CIV 3XX	Elective III	*	3	2	0	2	4	2	30	30	0	40	100
CIV 398	Senior Design Project I	**	2	0	4	0	4	Oral	50	0	50	--	100
Sum			16	11	7	7	25						700

* According to the Course Name

** The student can register the senior design project course after passing 70% of the program cr. hrs, i.e., 112 Cr. Hrs. + completion of the prerequisite courses of the project.

Level 4-1														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		SA	MT	PE/ OE	Final Exam	Sum
UHS XXX	Humanities Elective II	-----	2	2	0	0	2	2	30	30	0	40	100
UHS XXX	Humanities Elective III	-----	2	2	0	0	2	2	30	30	0	40	100
CIV 401	Construction Project & Management	CIV 300	2	2	0	1	3	2	30	30	0	40	100
CIV 4XX	Elective IV	*	3	2	0	2	4	2	30	30	0	40	100
CIV 4XX	Elective V	*	3	2	0	2	4	2	30	30	0	40	100
CIV 4XX	Elective VI	*	3	2	0	2	4	2	30	30	0	40	100
CIV 499	Senior Design Project II	CIV 398	3	1	4	0	5	Oral	50	0	50	--	100
Sum			18	13	4	7	24						700

* According to the Course Name

Matching Civil Engineering Program Courses with ABET Requirements

ABET Program Criteria for Civil and Similarly Named Engineering Programs
Lead Society: American Society of Civil Engineers

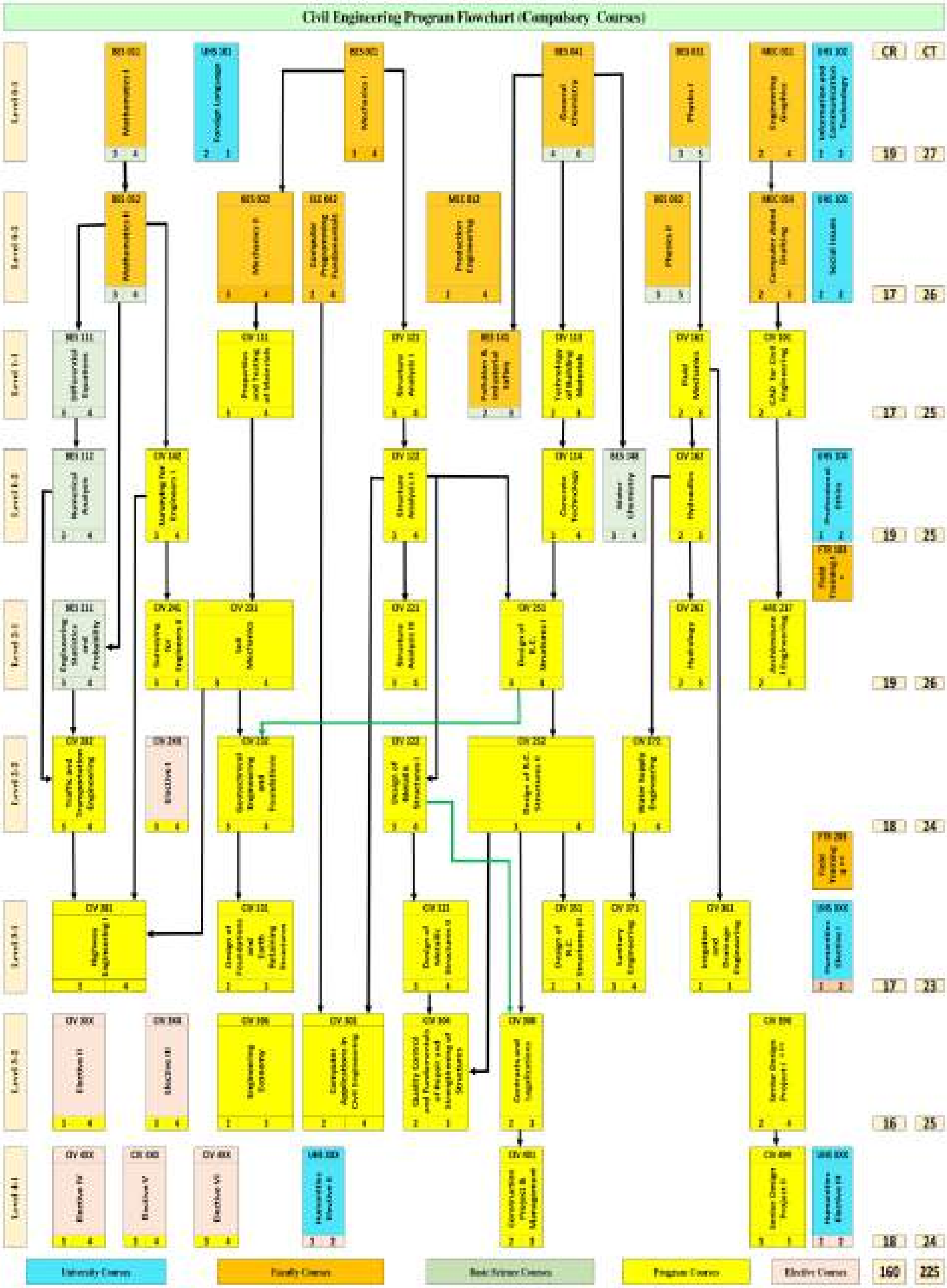
Civil Engineering Program Courses Required to Cover ABET Criteria				
ABET Criteria		CODE	Course Name	Cr. Hrs.
A minimum of 30 semester credit hours (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program.	The curriculum must prepare graduates to apply knowledge of mathematics through differential equations.	BES 011	Mathematics I	3
		BES 012	Mathematics II	3
		BES 111	Differential Equations	3
	At least one additional area of basic science; apply probability and statistics to address uncertainty	BES 112	Numerical Analysis	3
		BES 211	Engineering Statistics and Probability	3
	Chemistry	BES 041	General Chemistry	4
		BES 249	Water Chemistry	3
		BES 141	Pollution and Industrial Safety	2
	Calculus-based physics	BES 031	Physics I	3
		BES 032	Physics II	3
Total				**30**
ABET Criteria		**CODE**	**Course Name**	**Cr. Hrs.**
A minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design and utilizing modern engineering tools.	Analyze and solve problems in at least four technical areas appropriate to civil engineering.	CIV 121	Structure Analysis I	3
		CIV 122	Structure Analysis II	3
		CIV 221	Structure Analysis III	3
		CIV 261	Hydrology	2
		CIV 361	Irrigation and Drainage Engineering	2
		CIV 302	Computer Applications in Civil Engineering	2
		CIV 282	Traffic and Transportation Engineering	3
	Conduct experiments in at least two technical areas of civil engineering and analyze and interpret the resulting data.	CIV 111	Properties and Testing of Materials	3
		CIV 113	Technology of Building Materials	2
		CIV 114	Concrete Technology	3
		CIV 142	Surveying for Engineers I	3
		CIV 241	Surveying for Engineers II	3
		CIV 231	Soil Mechanics	3
		CIV 232	Geotechnical Engineering and	3

			Foundations	
		CIV 161	Fluid Mechanics	2
		CIV 162	Hydraulics	2
	Design a system, component, or process in at least two civil engineering contexts;	CIV 331	Design of Foundations and Earth Retaining Structures	3
		CIV 251	Design of R.C. Structures I	3
		CIV 252	Design of R.C. Structures II	3
		CIV 351	Design of R.C. Structures III	3
		CIV 222	Design of Metallic Structures I	3
		CIV 321	Design of Metallic Structures II	3
		CIV 381	Highway Engineering I	3
		CIV 272	Water Supply Engineering	3
		CIV 371	Sanitary Engineering	3
	Include principles of sustainability in design.	CIV 304	Quality Control and Fundamentals of Repair and Strengthening of Structures	2
		CIV 4XX	Elective V	3
	Explain basic concepts in project management, business, public policy, and leadership.	CIV 300	Contracts and Legalizations	2
		CIV 306	Engineering Economy	2
		CIV 401	Construction Project & Management	2
		CIV 4XX	Elective IV	3
		UHS 103	Societal Issues	2
		UHS XXX	Humanities Elective I	2
		UHS XXX	Humanities Elective II	2
	Analyze issues in professional ethics and explain the importance of professional licensure.	UHS 104	Professional Ethics	2
Total				**91**

Courses Plan and Matrix

Civil Engineering Program Map

Level								CR	CT
Level 0	UHS 101 Foreign Language 2 2	UHS 102 Information and Communication Technology 2 2	MEC 011 Engineering Graphics 2 4	BES 011 Mathematics I 3 4	BES 021 Mechanics I 3 4	BES 031 Physics I 3 5	BES 041 General Chemistry 4 6	19	27
Level 0	UHS 103 Social Issues 2 2	MEC 012 Production Engineering 2 4	MEC 014 Computer Aided Drafting 2 3	BES 012 Mathematics II 3 4	BES 022 Mechanics II 3 4	BES 032 Physics II 3 5	ELE 042 Computer Programming Fundamentals 2 4	17	26
Level 1	BES 141 Pollution & Industrial Safety 2 3	BES 111 Differential Equations 3 4	CIV 101 CAD for Civil Engineering 2 4	CIV 111 Properties and Testing of Materials 3 4	CIV 113 Technology of Building Materials 2 3	CIV 121 Structure Analysis I 3 4	CIV 161 Fluid Mechanics 2 3	17	25
Level 1	UHS 104 Professional Ethics 2 2	BES 112 Numerical Analysis 3 4	BES 148 Water Chemistry 3 4	CIV 114 Concrete Technology 3 4	CIV 122 Structure Analysis II 3 4	CIV 142 Surveying for Engineers I 3 4	CIV 162 Hydraulics 2 3	19	25
	FTR 103 Field Training I								
Level 2	BES 211 Engineering Statistics and Probability 3 4	ARC 117 Architectural Engineering 2 3	CIV 221 Structure Analysis III 3 4	CIV 231 Soil Mechanics 3 4	CIV 241 Surveying for Engineers II 3 4	CIV 251 Design of R.C. Structures I 3 4	CIV 261 Hydrology 2 3	19	26
Level 2	CIV 29X Elective I 3 4	CIV 222 Design of Metallic Structures I 3 4	CIV 232 Geotechnical Engineering and Foundations 3 4	CIV 252 Design of R.C. Structures II 3 4	CIV 272 Water Supply Engineering 3 4	CIV 282 Traffic and Transportation Engineering 3 4		18	24
	FTR 203 Field Training II								
Level 3	UHS XXX Humanities Elective I 2 2	CIV 321 Design of Metallic Structures II 3 4	CIV 331 Design of Foundations and Earth Retaining Structures 2 3	CIV 351 Design of R.C. Structures III 2 3	CIV 361 Irrigation and Drainage Engineering 2 3	CIV 371 Sanitary Engineering 3 4	CIV 381 Highway Engineering I 3 4	17	23
Level 3	CIV 300 Contracts and Legalizations 2 3	CIV 302 Computer Applications in Civil Engineering 2 4	CIV 304 Quality Control and Fundamentals of Repair and Strengthening of Structures 2 3	CIV 306 Engineering Economy 2 3	CIV 3XX Elective II 3 4	CIV 3XX Elective III 3 4	CIV 398 Senior Design Project I 2 4	16	25
Level 4	UHS XXX Humanities Elective II 2 2	UHS XXX Humanities Elective III 2 2	CIV 401 Construction Engineering & Management 2 3	CIV 4XX Elective IV 3 4	CIV 4XX Elective V 3 4	CIV 4XX Elective VI 3 4	CIV 499 Senior Design Project II 3 5	18	24
	University Req.	Faculty Req.	Basic Science Req.	Program Req.	Elective Req.	CR : Credit Hour CT : Contact Hour		CR 160	CT 225



* 65 Credit hours are required as a minimum for registration.

** 96 Credit hours are required as a minimum for registration.

*** The student can register the senior design project course after passing 70% of the program Credit hours, i.e., 112 credit hours + completion of the prerequisite courses of the project.

Civil Engineering Program - Elective Courses

Level 2

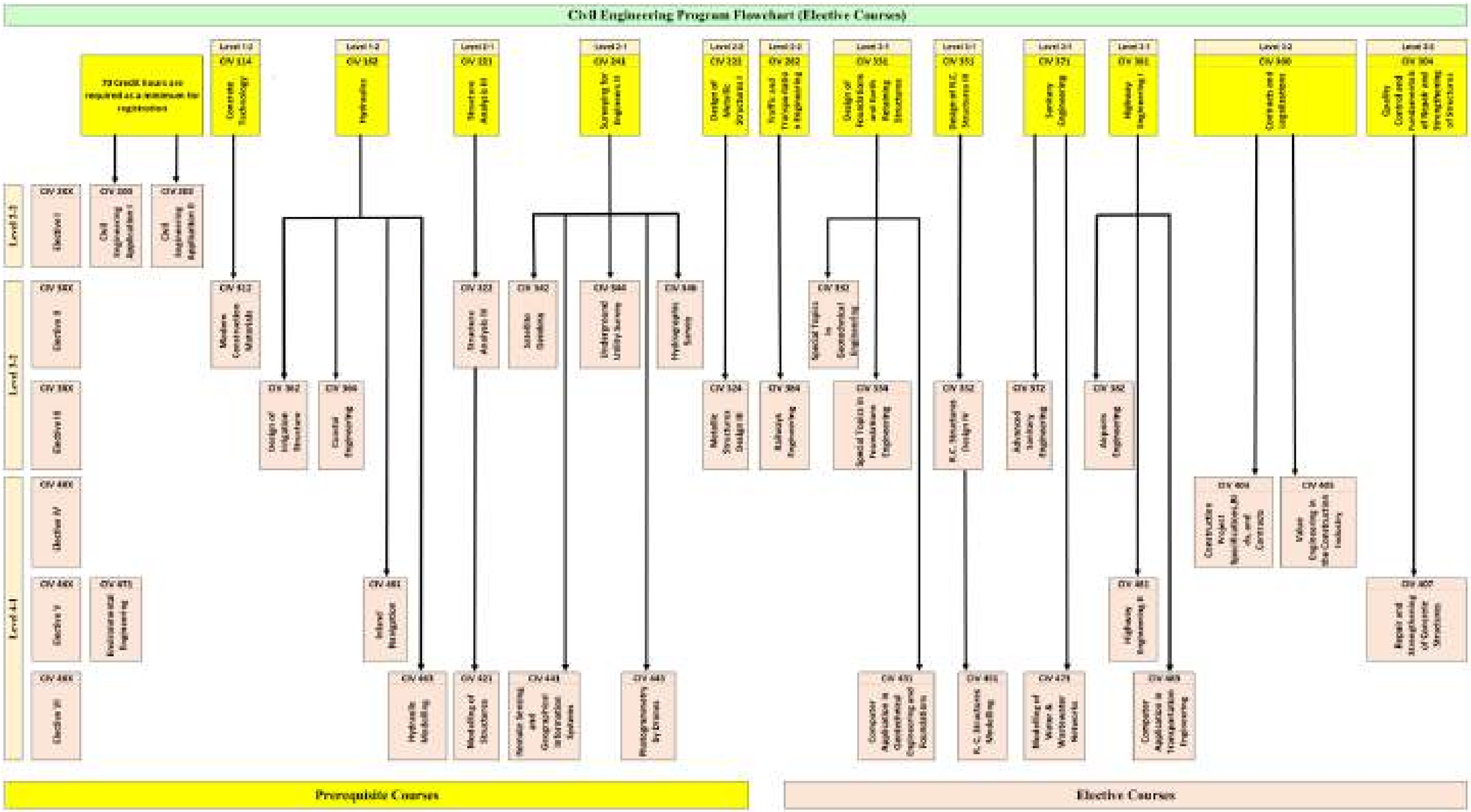
Elective	Code	Course		
CIV 2XX Elective I (3, 4)	CIV 200	Civil Engineering Application I	3	4
	CIV 202	Civil Engineering Application II	3	4

Level 3

Elective	Code	Course		
CIV 3XX Elective II (3, 4)	CIV 312	Modern Construction Materials	3	4
	CIV 322	Structure Analysis IV	3	4
	CIV 332	Special Topics in Geotechnical Engineering	3	4
	CIV 342	Satellite Geodesy	3	4
	CIV 344	Underground Utility Survey	3	4
	CIV 346	Hydrographic Survey	3	4
CIV 3XX Elective III (3, 4)	CIV 324	Metallic Structures Design III	3	4
	CIV 334	Special Topics in Foundations Engineering	3	4
	CIV 352	R.C. Structures Design IV	3	4
	CIV 362	Design of Irrigation Structure	3	4
	CIV 364	Coastal Engineering	3	4
	CIV 372	Advanced Sanitary Engineering	3	4
	CIV 382	Airports Engineering	3	4
	CIV 384	Railways Engineering	3	4

Level 4

Elective	Code	Course		
CIV 4XX Elective IV (2, 4)	CIV 403	Construction project specifications, bids, and contracts	3	4
	CIV 405	Value Engineering in the Construction Industry	3	4
CIV 4XX Elective V (3, 4)	CIV 407	Repair and Strengthening of Concrete Structures	3	4
	CIV 461	Inland Navigation	3	4
	CIV 471	Environmental Engineering	3	4
	CIV 481	Highway Engineering II	3	4
CIV 4XX Elective VI (3, 4)	CIV 421	Modelling of Structures	3	4
	CIV 431	Computer Application in Geotechnical Engineering and Foundations	3	4
	CIV 441	Remote Sensing and Geographical Information Systems	3	4
	CIV 443	Photogrammetry by Drones	3	4
	CIV 451	R.C. Structures Modelling	3	4
	CIV 463	Hydraulic Modelling	3	4
	CIV 473	Modelling of Water & Wastewater Networks	3	4
	CIV 483	Computer Application in Transportation Engineering	3	4


Civil Engineering Program Flowchart (Elective Courses)
Prerequisite Courses
Elective Courses

Program Learning Objectives to Courses Matrix

Code	Title	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	Total
Compulsory Humanities Courses																
UHS 101	Foreign Language								1		1					2
UHS 102	Information and Communication Technology				1						1					2
UHS 103	Societal Issues							1			1					2
UHS 104	Professional Ethics				1	1										2
Elective Humanities Courses																
UHS XXX	Humanities Elective I			1	1											2
UHS XXX	Humanities Elective II								1	1						2
UHS XXX	Humanities Elective III					1					1					2
Basic Science Courses																
BES 011	Mathematics I	1		1												2
BES 012	Mathematics II	1		1												2
BES 111	Differential Equations	1	1													2
BES 112	Numerical Analysis	1	1													2
BES 211	Engineering Statistics and Probability	1	1													2
BES 041	General Chemistry	1	1													2
BES 249	Water Chemistry	1	1		1											3
BES 141*	Pollution and Industrial Safety	1		1	1											3
BES 031	Physics I	1	1													2
BES 032	Physics II	1	1													2
Faculty Requirements Courses																
MEC 011	Engineering Graphics						1		1							2
MEC 012	Production Engineering				1		1									2
MEC 014	Computer Aided Drafting				1				1							2
ELE 042	Computer Programming Fundamentals	1		1												2
BES 021	Mechanics I	1	1													2

BES 022	Mechanics II	1	1													2
FTR 103	Field Training I							1			1					2
FTR 203	Field Training II							1			1					2
Civil Program Compulsory Courses																
		PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**	**PLO13**	**PLO14**	**Total**
CIV 101	CAD for Civil Engineering				1								1			2
CIV 111	Properties and Testing of Materials		1									1				2
CIV 113	Technology of Building Materials		1									1				2
CIV 114	Concrete Technology		1									1		1		3
CIV 121	Structure Analysis I	1										1				2
CIV 122	Structure Analysis II	1										1				2
CIV 142	Surveying for Engineers I		1			1						1				3
CIV 161	Fluid Mechanics		1									1				2
CIV 162	Hydraulics		1							1		1				3
ARC 217	Architectural Engineering					1			1							2
CIV 221	Structure Analysis III	1										1				2
CIV 222	Design of Metallic Structures I			1	1								1			3
CIV 231	Soil Mechanics		1			1						1				3
CIV 232	Geotechnical Engineering and Foundations			1								1	1			3
CIV 241	Surveying for Engineers II		1			1						1				3
CIV 251	Design of R.C. Structures I			1	1								1			3
CIV 252	Design of R.C. Structures II			1	1								1			3
CIV 261	Hydrology	1										1				2
CIV 272	Water Supply Engineering		1										1			2
CIV 282	Traffic and Transportation Engineering					1							1	1		3
CIV 300	Contracts and Legalizations								1	1				1	1	4
CIV 302	Computer Applications in Civil Engineering		1										1			2
CIV 304	Quality Control and Fundamentals of				1	1				1	1			1		5

	Repair and Strengthening of Structures															
CIV 306	Engineering Economy									1					1	2
CIV 321	Design of Metallic Structures II			1	1								1			3
CIV 331	Design of Foundations and Earth Retaining Structures			1									1			2
CIV 351	Design of R.C. Structures III			1	1								1			3
CIV 361	Irrigation and Drainage Engineering	1											1			2
CIV 371	Sanitary Engineering		1										1			2
CIV 381	Highway Engineering I			1	1								1			3
CIV 398	Senior Design Project I			1	1		1	1	1	1	1	1	1	1	1	11
CIV 401	Construction Project & Management						1			1				1	1	4
CIV 499	Senior Design Project II			1	1		1	1	1	1	1	1	1	1	1	11
Civil Program Elective Courses																
		PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**	**PLO13**	**PLO14**	**Total**
CIV 2XX	Elective I						1					1				2
CIV 3XX	Elective II					1						1				2
CIV 3XX	Elective II												1	1		2
CIV 4XX	Elective IV						1							1	1	3
CIV 4XX	Elective V					1								1		2
CIV 4XX	Elective VI		1									1				2
Total		18	21	15	17	10	7	5	8	8	9	18	17	10	6	170

Courses offered to Civil Engineering Program

The coding system is demonstrated in the following table:

BES X1X	Mathematics Courses offered by Basic Engineering Science Department
BES X4X	Chemistry Courses offered by Basic Engineering Science Department
ARC XXX	Course offered by Architecture Engineering Department
CIV XXX	Course offered by Civil Engineering Department
CIV X0X	Cad, Management, Quality Control, Repair, and Civil Application Courses
CIV X1X	Material courses
CIV X2X	Structural and Metallic courses
CIV X3X	Soil and Foundation Courses
CIV X4X	Surveying Courses
CIV X5X	Reinforced Concrete Courses
CIV X6X	Water Courses
CIV X7X	Environmental Courses
CIV X8X	Transportation Courses
CIV X9X	Graduation Project

The following abbreviations are the legend for the courses:

The following abbreviations are the legend for the courses:	
Lec	Lectures
Lab	Laboratory
Tut	Tutorials
SA	Student Activity
MT	Mid-Term Exam
PE	Practical Exam
OE	Oral Exam

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 101	CAD for Civil Engineering	MEC 014	2	1	3	0	4	30	30	40	--
Course Contents	Application of AutoCAD Program in drawing different types of civil structures (Irrigation structures – Reinforced concrete structures – Steel structures- urban transportation systems).										
References	A Textbook of Engineering Drawing: Along with an Introduction to AutoCAD, International Publishing House, 2015. ISBN 9789384588687										
Laboratory	• Irrigation structures drawing. • Reinforced concrete structures drawing. • Steel structures drawing. • Transportation systems drawing.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 111	Properties and Testing of Materials	BES 022	3	2	2	0	4	10	30	20	40

Course Contents

Stress and strain - Types of tests - Testing machines - Strain gauge devices - Static tension test - Static compression test - Bending test - Shear test - Torsion test - Hardness test - Fatigue test - Impact test - Metals creep teSA

References

- Mechanics of Materials, James M. Kere & Barry J. Goodno, CENGAGE Learning, ISBN-13: 978-1111577735 / ISBN-10: 1111577730.
- Strength of Materials, S. S. Bhavikatti,Vikas, Vicas, ISBN-13: 978-9325971578, ISBN-10: 9325971577.
- A Textbook of Strength of Materials, Dr R.K. Bansal, LAXMI PUBLICATIONS (P) LTD, ISBN-10: 9788131808146 / ISBN-13: 978-8131808146.
- المواد الهندسية مقاومتها واختبارها (الجزء الأول والجزء الثاني)، ا.د. احمد العريان - ا.د. عبد الكريم عطا
- مقاومة واختبار المواد، د. عبد الوهاب محمد عوض - د. إبراهيم على درويش.
- المواصفات القياسية المصرية.

Laboratory

- Static tension teSA
- Static compression teSA
- Bending teSA
- Hardness teSA
- Impact teSA

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 113	Technology of Building Materials	BES 041	2	2	1	0	3	10	30	20	40

Course Contents

Specifications and standard specifications of materials and products - Main properties of engineering materials - Building Rocks - Mineral binding materials (Lime, Gypsum & Cement) - Concrete aggregates - Steel reinforcement - Timber - Bricks – Introduction to fibre reinforced polymers.

References

- للكود المصري لتصميم وتنفيذ المنشآت الخرسانية – 203.
- الملحق الثالث للكود المصري لتصميم وتنفيذ المنشآت الخرسانية (دليل الاختبارات المعملية لمواد الخرسانة).
- Building Materials, S. K. Duggal, Routledge, ISBN-10: 8122433790 / ISBN-13: 978-8122433791.
- Materials of construction, R.C. Smith, McGraw-Hill, ISBN-10: 0070584761, ISBN-13: 978-0070584761.

Laboratory

- Specific surface area of cement – Setting time of cement - compressive strength of cement
- Sieve analysis of coarse and fine aggregate – bulk density of aggregate – specific
- Coarse aggregate crushing value – Los Angles abrasion value of coarse aggregate.
- Compression test of bricks.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 114	Concrete Technology	CIV 113	3	2	2	0	4	10	30	20	40
Course Contents	Introduction to concrete as a structural material - Mixing water - Concrete manufacture (Batching - Mixing - Transportation - Placing - Compacting - Surface finishing, Repair and curing) - Properties of fresh concrete (Consistency - Workability - Segregation and bleeding) - Properties of hardened concrete (Strength - Shrinkage - Elasticity - creep) - Durability of concrete - Mix design - Non-destructive testing (Rebound hammer - Ultrasonic Pulse velocity and core) - Concrete admixtures - Special concretes.										
References	• Concrete Technology, AM Neville, JJ Brooks, Longman, ISBN-10: 0273732196, ISBN-13: 978-0273732198. • Properties of Concrete and Structures, P.K. Mehta, Prentice Hall, ISBN-10: 0131671154, ISBN-13: 978-0131671157. • تكنولوجيا الخرسانة" (الجزء الأول والجزء الثاني)، أ.د. أحمد العريان - أ.د. عبد الكريم عطا. • الكود المصري لتصميم وتنفيذ المنشآت الخرسانية- 203. • الملحق الثالث للكود المصري لتصميم وتنفيذ المنشآت الخرسانية (دليل الاختبارات المعملية لمواد الخرسانة).										
Laboratory	• Compacting factor test - Slump teSA • Compressive strength test - Splitting tensile strength test – Modulus of rupture teSA • Rebound hammer test - Ultrasonic Pulse velocity teSA										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 121	Structure Analysis I	BES 021	3	2	0	2	4	30	30	0	40
Course Contents	Loads and reactions – Stability of structures (external and internal) – Straining actions in Statically determinate structures- Normal stresses – Shear stresses (pure shear, torsional) – Combined stresses.										
References	• Structural Analysis by Russell C. Hibbeler, Pearson, 9th Edition, 2014, ISBN-13:978-0-13-394284-2. • Kenneth M. Leet, Chia-Ming Uang, Joel T. Lanning, Anne M. Gilbert. “Fundamentals of Structural Analysis”. McGraw-Hill Education, 2018. ISBN-13: 978-0073398006 • George, N. Frantziskonis. “Essentials of the Mechanics of Materials, Second Edition”. USA: Destech Publications, Inc. 2013. ISBN 13: 9781605950983 • Pytel, A. and Kiusalaas, J. “Mechanics of Materials Second Edition”. Cengage Learning2012. ISBN-13: 978-0-495-66775-9										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 122	Structure Analysis II	CIV 121	3	2	0	2	4	30	30	0	40
Course Contents	Buckling of Column, Elastic deflection of determinate structures (double Integration method and virtual work method). Influence line for determinate beam- Analysis of statically indeterminate structures (Three moment equations).										
References	• Aslam Kassimali , "Structural Analysis" Stamford USA: Cengage Learning, 4th Si Edition, 2011, ISBN-13: 978-0-495-29567-9 • Aslam Kassimali, "Structural Analysis", Stamford USA: Cengage Learning, 6th Si Edition, 2019, ISBN-13 : 978-1337630948 • Jack C. McCormac, "Structural Analysis Using Classical and Matrix Methods", John Wiley & Sons, Inc, 4th Edition, 2007, ISBN-13: 978-0470036082.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 123	Structure Analysis	BES 021	3	2	-	2	4	30	30	-	40
Course Contents	The course is an introduction to the basic tools of structural analysis and design. It contributes to the knowledge and skills required by the civil engineers in the following topics: Loads and reactions, stability of structures (external and internal), straining actions in statically determinate structures, normal stresses, shear stresses (pure shear, torsional), combined stresses, elastic deformations, and introduction to the analysis of statically indeterminate structures through 3-moment equation.										
References	• Structural Analysis by Russell C. Hibbeler, Pearson, 9th Edition, 2014, ISBN-13:978-0-13-394284-2. • Kenneth M. Leet, Chia-Ming Uang, Joel T. Lanning, Anne M. Gilbert. "Fundamentals of Structural Analysis". McGraw-Hill Education, 2018. ISBN-13: 978-0073398006										
Used in Program	Architecture Engineering Program									Semester	3

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 142	Survey for Engineers I	BES 012	3	2	2	0	4	10	30	20	40

Course Contents	Basics of surveying and mapping (Definitions - Units - Scales- Reconnaissance - Sketch drawing)- Distance measurement (principles - optical measurements- EDM) - Angle and direction measurement (Vertical & Horizontal angle measurements) -Traverse (Traverse computation & adjustment) - Intersection and Resection - Area & volume computation - Vertical control & Leveling (Definitions - Methods of determining relative heights - Topographic maps - Precise leveling - Trigonometric leveling).
References	• Elementary surveying. An introduction to geomatics by Ghilani C.D., Wolf P.R., PH 2011, ISBN 0132554348 • Engineering Surveying. W. Schofield& M. Breach, CRC Press, 2007, ISBN 9780750669498. • Surveying Problem Solving with Theory and Objective Type Questions *Dr /* A M Chandra - ISBN (13): 978-81-224-2532-1
Laboratory	• Linear surveying measurements • Theodolite parts and calibration • Vertical and Horizontal angle measurements • Tacheometric surveying • Survey levelling instruments and height determination

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 143	Construction Survey	BES 012	3	2	2	0	4	10	30	20	40

Course Contents	To introduce the student to basic elements of surveying and their architectural applications. Plotting scales. Vertical and horizontal angle measurement, levelling & theodolites. Map drawing. Traverse computations and adjustment. Area and Volume calculations. Photogrammetry and its architectural applications. Remote sensing.		
References	• Engineering Surveying. W. Schofield& M. Breach - Sixth Edition 2007- ISBN–13: 978-0-7506-6949-8 • Surveying Problem Solving with Theory and Objective Type Questions Dr / A M Chandra- 2005- ISBN (13) : 978-81-224-2532-1		
Laboratory	• Linear surveying measurements • Theodolite parts and calibration • Vertical and Horizontal angle measurements • Survey levelling instruments and height determination		
Used in Program	Architecture Engineering Program	Semester	3

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 259	Design of RC Structures	CIV 123	2	2	0	1	3	30	30	0	40
Course Contents	The course presents the fundamentals of reinforced concrete structures such as reinforcement details of beams, solid slabs, columns, and stairs. It focuses on loads and load distribution. The course contributes to the knowledge and skills in the following topics: Statically determinate frames, ribbed and hollow block slabs, paneled beam slabs, flats slabs, and openings in slabs.										
References	• Egyptian Code of Practice – ECP 201-2018 • Structural design for architecture – Angus j macdonald, ISBN 0 7506 3090 6										
Used in Program	Architecture Engineering Program							Semester	4		

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 161	Fluid Mechanics	BES 031	2	2	1	0	3	10	30	20	40
Course Contents	Dimensions and Units - Fluid Properties - Fluid Statics (Pressure distribution - Pressure measurements - Forces on submerged surfaces) - Buoyancy and Floatation - Fluids in Relative Equilibrium - Fluid Kinematics (Description of Fluids motion - Continuity Equation - Velocity and Acceleration) - Fluid Dynamics (Energy Equation - Applications of Bernoulli's Equation) - Impulse-Momentum Equation - Application of the Momentum Equation - Flow in Pipes – Pipes Systems.										
References	• A Brief Introduction to Fluid Mechanics, sixth Edition by Donald F. Young, Bruce R. Munson, Theodore H. Okiishi, Wade W. Huebsch, Wiley 2010, ISBN: 0470596791, 9780470596791 • E. Shashi Menon, "Liquid Pipeline Hydraulics", Marcel Dekker, 2004.										
Laboratory	• Determine Densities, Specific Gravities, Weights and Viscosity. • Bernoulli's Theorem Demonstration. • Flow through sharp edged Orifice. • Flow over Rectangular and Triangular Weirs. • Friction in a smooth bore pipe, Minor loss Experiment.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 162	Hydraulics	CIV 161	2	2	1	0	3	10	30	20	40

Course Contents: Basic Principles (open channel flow) - Uniform Flow (Basic equations for steady uniform flow - Velocity and shear stress distributions in open channels) – Non-Uniform Flow (Specific energy - Hydraulics of channel bed transition) - Hydraulic Jumps - Gradually Varied Flow - Open Channel Design (Rigid boundary and erodible channel) - Dimensional analysis and Similarity (Methods of dimensional analysis - Model analysis and similarity) – Hydraulics Machinery (Pumps and Turbines) – Unsteady Flow.

References:
- Fundamentals of Hydraulic Engineering, by Prasuhn, Alan L., Oxford University Press 1992, ISBN 978-1-61344-141-1, 978-0-19-510732-6
- Strum, W. T., (2001). Open Channels Hydraulics, McGraw-Hill Higher Education, USA.
- Chow, V.T (ed.): "Handbook of Hydrology," McGraw-Hill, New York, 1964.
- Novak, P., Moffat, A. I. B., Nalluri, C., Narayanan, R. (2001) Hydraulic Structures, Third Ed, Spon, London

Laboratory:
- Open Channel Flow
- Hydraulic Jump
- Pump Characteristics

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 200	Civil Engineering Application I	Completion of 70 CR	3	2	2	0	4	10	30	20	40

Course Contents: The main elements of structures - Construction techniques - Types of Formworks (wooden forms -metallic forms - tunnel formwork - climbing formwork - slip formwork - lift slabs system) - Formwork design, implementation and receiving - Steel reinforcement works and receiving - bricks works.

References:
- Construction Technology Paperback English by Mr Roy Chudley, Roger Greeno ISBN-13 9780131286429
- Fundamentals of Building Construction : Materials and Methods, By Edward Allen, Joseph Iano, ISBN13 9781119446194

Laboratory:
- Construction techniques
- Wooden formwork
- Metallic formwork
- Bricks works

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 202	Civil Engineering Application II	Completion of 70 CR	3	2	2	0	4	10	30	20	40
Course Contents	Thermal insulation - Water proofing - Water supply and sanitary works - Flooring - Doors and windows - Internal and External Finishes (Plastering and Painting). Construction of Steel Structures (Cutting - Drilling- Shaping - Welding - Bolts - Erection – Cladding).										
References	• Construction Technology Paperback English by Mr Roy Chudley, Roger Greeno, ISBN-13 9780131286429 • Structural steel fabrication and erection by s.k.saxena, r.b.asthana, isbn-13 : 978-8170392071										
Laboratory	• Thermal insulation works, Water proofing works, Water supply and sanitary works, Flooring works, Wood works, Painting works, Steel welding works										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 221	Structure Analysis III	CIV 122	3	2	0	2	4	30	30	0	40
Course Contents	Analysis of statically indeterminate structures:1-Force approach (Consistent deformation method), 2- Displacement approach (Slope deflection Method, Moment distribution method). Introduction to Matrix Structural Analysis for 1-D element using Stiffness method (Truss, Beam, and frame elements).										
References	Aslam Kassimali, “Structural Analysis”, Cengage Learning, Fifth Edition, 2015. ISBN-13: 978-1133943891										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 222	Design of Metallic Structures I	CIV 122	3	2	0	2	4	30	30	0	40
Course Contents	Steel as a construction material - Material properties and steel sections - Allowable Stress Design method - Design of tension members - Design of compression members - Columns in braced and unbraced frames - Design of flexural members - Types and classification of beam cross sections - Design of laterally supported and unsupported beams - Design of beam-columns (axial and flexural forces) - Design of bolted connections - Design of welded connections.										
References	• Egyptian code for design of steel structure. • Steel structures design by Prof Dr. Abdulrahim Khalil Dessouki. • Advanced Steel Design Of Structures, by Prof. Srinivasan Chandrasekaran, Indian Institute of Technology, India. ISBN-13 9780367232900 • Steel Designers' Manual, By (Steel Construction Institute), Edited by Buick Davison and Graham W. Owens, ISBN-13 9781119249863										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 231	Soil Mechanics	CIV 111	3	2	2	0	4	10	30	20	40

Course Contents	Introduction to Geotechnical Engineering - Definitions and Relationships - Index Properties of Soil - Soil Classification Systems (Unified – British) - Permeability and Seepage of Soil (Darcy's Law - Capillarity in Soils - Flow Net Analysis) - Stress Distribution in Soil (Point load – Uniform Load (Newmark – Fadum - Approximation)) - Shear Strength of Soil (Direct Shear Box - Triaxial– Unconfined Compression) - Lateral Earth Pressure (Active and Passive) - Soil Compaction (Standard Proctor - Modified Proctor).
References	• El-Kasaby, E. A., Soil Mechanics, Dar Al-Kutub Al-Almia, Cairo, 5th Ed., (21371/2013), ISBN 978 – 977 – 726 – 041 – 1, 2014. • Das, B. M, Soil Mechanics Laboratory Manual, Oxford University Press, 9th. Ed., ISBN 978 – 019 – 020 – 966 – 7, 2016.
Laboratory	• Specific Gravity Determination. • Atterberg Limits (Liquid Limit – Plastic Limit – Shrinkage Limit). • Grain Size Distribution - Coarse Grained Soils. (Sieve Analysis). • Grain Size Distribution - Fine Grained Soils (Hydrometer Analysis). • Determination of Natural Unit Weight of Soil (Sand Bottle Test - Core Cutter Test). • Constant Head Permeability TeSA • Falling Head Permeability TeSA • Direct Shear Box TeSA • Tri-axial Shear TeSA • Unconfined Shear TeSA • Standard Proctor TeSA • Modified Proctor TeSA

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 232	Geotechnical Engineering and Foundations	CIV 231 CIV 251	3	2	2	0	4	10	30	20	40

Course Contents

Soil Consolidation and Settlement (Soil Consolidation Theory - Primary and Secondary Settlement - Oedometer Test) - Bearing Capacity of Soil (Terzaghi Eq. - Mayerhof Eq. – Egyptian Code Eq.) - Shallow Foundations (Construction Considerations - Design Considerations) - Design of Isolated Footings (Square and Rectangular Footings – Footing with Moment) - Design of Strip Footings - Design of Combined Footings - Design of Strap Beam Footings - Design of Rafts (Conventional Method – Ribbed Raft).

References

- El-Kasaby, E. A., Soil Mechanics, Dar Al-Kutub Al-Almia, Cairo, 5th Ed., (21371/2013), ISBN 978 – 977 – 726 – 041 – 1, 2014.
- El-Kasaby, E. A., Engineering of Surface Foundations, Dar Al-Kutub Al-Almia, Cairo, 5th Ed., (19440/2015), ISBN 978 – 977 – 726 – 139 – 5, 2015.
- Das, B. M, Principles of Foundation Engineering, Brooks - Cole, 9th. Ed., ISBN 978 – 133 – 770 – 502 – 8, 2017.
- Das, B. M, Soil Mechanics Laboratory Manual, Oxford University Press, 9th. Ed., ISBN 978 – 019 – 020 – 966 – 7, 2016.

Laboratory

- One Dimensional Consolidation Test (Oedometer Test).
- SPT: Standard Penetration TeSA
- CPT: Cone Penetration TeSA
- Plate Loading TeSA

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 241	Survey for Engineers II	CIV 142	3	2	2	0	4	10	30	20	40

Course Contents

Basics of geodesy- Geodetic datum – Reference Ellipsoid- Geoid determination –Terrestrial Coordinate systems and associated transformations – Geodetic position computations on the reference Ellipsoid (2 D approach for horizontal control)- Geodetic position computations in Space (3 D approach) – direct Geodetic problem – Inverse Geodetic problem – (GNSS) Global Navigation Satellite System - Satellite orbits - Satellite signals – Observables - Mathematical models for positioning - Data processing - Data transformation.

References

- Elementary surveying. An introduction to geomatics by Ghilani C.D., Wolf P.R., PH 2011, ISBN 0132554348
- Engineering Surveying. W. Schofield& M. Breach, CRC Press, 2007, ISBN 9780750669498.
- Surveying Problem Solving with Theory and Objective Type Questions Dr / A M Chandra - ISBN (13): 978-81-224-2532-1

Laboratory

- Total station parts
- Total Station software
- Coordinates by Total Station
- Lay out and setting out by Total Station

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 251	Design of R.C. Structures I	CIV 114 CIV 122	3	2	0	2	4	30	30	0	40
Course Contents	Properties of concrete materials - Ultimate limit states design method - Design of sections under pure bending moment (Rectangular, L & T - sections) - Load distribution – Design of section under shear – Design simple and continuous beams - Design of one-way and two-ways solid slabs - Design of hollow block slabs - Design of panelled beams.										
References	• Egyptian Code for Design & Construction of Reinforced Concrete Structures – ECOP 203-2018 • Design of Concrete Structures, Arthur H Nilson, D.Darwin, Charles W. Fifteenth Edition,2016. • Design of reinforced concrete structures, Mashhour Ghoneim, Mahmoud Elmihilmy, Volume I, second edition, 2012. • Design of reinforced concrete structures, Mashhour Ghoneim, Mahmoud Elmihilmy, Volume 2, Third edition, 2012. • Fundamentals of Reinforcement Concrete and Prestressed concrete, M.Hilal, 1987.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 252	Design of R.C. Structures II	CIV 251	3	2	0	2	4	30	30	0	40
Course Contents	Design of flat slabs - Design of sections subjected to bending moment and axial force - Analysis and design of columns – Design of RC frames -Design of Sections under Torsion-Serviceability limit states (deflection - crack width).										
References	• Egyptian Code for Design & Construction of Reinforced Concrete Structures – ECOP 203-2018 • Design of Concrete Structures, Arthur H Nilson, D.Darwin, Charles W. Fifteenth Edition,2016. • Fundamentals of Reinforcement Concrete and Prestressed concrete, M.Hilal, 1987. • Design of reinforced concrete structures, Mashhour Ghoneim, Mahmoud Elmihilmy, Volume 2, Third edition, 2012. • Design of reinforced concrete structures, Mashhour Ghoneim, Mahmoud Elmihilmy, Volume 3, First edition, 2011.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 261	Hydrology	CIV 162	2	2	0	1	3	30	30	0	40
Course Contents	Introduction to water balance and hydrological cycle – Precipitation – Evaporation – Transpiration – Infiltration – Runoff – Hydrograph – Hydrology of the Nile basin – Flood routing – Storage and reservoir operation – Groundwater hydrology (Aquifers and groundwater reservoirs – confined and unconfined flow – design of wells – Groundwater management) – Application of computer programs in hydrology such as HEC-RAS.										
References	• Mays, L.W., Ground and surface water hydrology. John Wiley & Sons, Inc., 2012. ISBN: 978-0-470-16987-2 • Subramanya, K., Engineering Hydrology. 4th Edition 2017.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 272	Water Supply Engineering	CIV 162	3	2	2	0	4	10	30	20	40

Course Contents

Introduction, Preliminary studies for water supply projects, sources of water, water quality and standards, design flow rates, water collection, Design of water treatment plants using conventional processes (Sedimentation - Coagulation and Flocculation - Filtration - Disinfection), water pumping and transportation works, water storage, water distribution networks.

References

- Water and Wastewater Technology: Pearson New International Edition, ISBN-13: 9781292021041
- Water supply, prof. Dr. M. Basiouny
- Lectures presentations
- شبكات المياه - الكود المصرى
- محطات تنقية مياه الشرب - الكود المصرى

Laboratory

Determine Turbidity, PH, Temperature, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Volatile Solids (VS), Chloride, Iron and Manganese, Arsenic, Fluorides and total bacteria account

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 282	Traffic and Transportation Engineering	BES 112 BES 211	3	2	2	0	4	10	30	20	40

Course Contents

Transportation Planning:
Introduction to transportation planning - Study area - Transportation planning surveys - Travel demand forecasting (Trip generation - Trip distribution - Modal split (Mode Choice) - Traffic assignment) - Transportation evaluation
Traffic Engineering:
Introduction (Road user characteristics - Vehicle characteristics) - Traffic volume - Traffic speed - Traffic density - Travel time and delay studies - Traffic Flow characteristics - Parking studies - Traffic control devices - Intersection control - Traffic signals design.

References

- Traffic and Highway Engineering, Nicholas Garber and Lester Hoel, Fifth Enhanced SI Edition, CENGAG Learning, 2020, ISBN-13: 978-1-337-63104-4.
- الكود المصرى للطرق – 2020 .

Laboratory

- Traffic surveys (traffic volume count)
- Speed & delay study
- Parking study
- Roadside and household interviews.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 300	Contracts and Legalizations	CIV 222 CIV 252	2	2	0	1	3	30	30	0	40

Course Contents

Define contract documents, define priority of contract documents, regulations, construction law Plan and manage construction documents, deal with biddings and financial issues including project insurances, disputes. Acquire knowledge and understanding the ability to prepare and analyze the bill of quantities for any specified project. The preparation and calculation of the on-going works quantities. The ability to manage construction project.

References

- law no 89 issue year 1998, civil law
- law no 82/2018, civil law
- Fidic contracts forms 2017 red book edition, ISBN: 978-2-88432-084-9

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 302	Computer Applications in Civil Engineering	CIV 122 ELE 042	2	1	3	0	4	10	30	20	40

Course Contents

Introduction to analyzing structures using the computer - Choosing appropriate models for analyzing different structures - Applications to internal forces and deformations in space structures (Beams, Frames, and Trusses) - Applications to represent supports in the frames including the interaction between the structures and the soil - Structural deformations - Thermal effect on structures - Computer Applications for Design of Reinforced Concrete Structures (Design of columns and beams) - Data Base Forming - Curves and Charts Drawing - Optimization.

References

Computer Application in Civil Engineering, dsmbooks, Liverpool, United Kingdom, ISBN 13: 9789382174202.

Laboratory

- Modelling of space structures (Beams, Frames, and Trusses).
- Modelling of supports in the structures including the interaction between the structures and the soil.
- Thermal effect on structures.
- Applications for Design of Reinforced Concrete Structures (Design of columns and beams).
- Data Base Forming, Optimization

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 304	Quality Control and fundamentals of Repair and Strengthening of Structures	CIV 252 CIV 321	2	2	0	1	3	30	30	0	40

Course Contents

Definition of quality control and assurance - Quality control requirements – Quality control of concrete materials – Quality control before concreting - Quality control during concreting - Quality control after concreting – Assessment of hardened concrete results – Quality control levels – Statistical quality control – Assessment of reinforced concrete structures - Defects of Reinforced concrete structures – Fundamentals of strengthening and repair of reinforced concrete structures – Assessment of steel structures - Defects of steel structures – Fundamentals of strengthening and repair of steel structures.

References

- 203 - الكود المصري لتصميم وتنفيذ المنشآت الخرسانية.
- El-Kasaby, E. A., Repair of concrete structures, Dar Al-Kutub Al-Almia, Cairo, 2nd Ed., (19441/2015), ISBN 978-977-726-140-1, 2016.
- Quality Management in Construction Projects by Abdul Razzak Rumane, ISBN-13: 978-0367890032, ISBN-10: 0367890038.
- Concrete Structures: Protection, Repair and Rehabilitation by R. Dodge Woodson, ISBN-13: 978-1856175494, ISBN-10: 1856175499.
- Egyptian codes for design of steel structure.
- Steel Designers' Manual, By (Steel Construction Institute), Edited by Buick Davison and Graham W. Owens, ISBN-13 9781119249863
- Strengthening of Steel Structures: Performance of Steel Beams Bonded with FRP by LAP LAMBERT Academic Publishing, ISBN-10 : 9783844384192 ISBN-13 : 978-3844384192

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 306	Engineering Economy	-	2	2	0	1	3	30	30	0	40

Course Contents

Foundations of Engineering Economy, Interest Factors, Nominal and Effective Interest Rates, Present Worth Analysis, Annual Worth Analysis, Rate of Return Analysis, Benefit/Cost Analysis, Breakeven and Payback Analysis, Replacement and Retention Decisions, Effects of Inflation, Estimating Costs, Depreciation Methods, After-Tax Economic Analysis, Multiple Attributes and Risk.

References

- Basics of Engineering Economy, Leland Blank & Anthony Tarquim, McGraw HILL, Third Edition, 2020, ISBN-13 : 978-1260571141
- Engineering Economy, William G. Sullivan, Elin M. Wicks, & C. Patrick Koelling, Seventeenth Global Edition, Pearson, 2020, ISBN 13: 978-1-292-26490-5.
- Engineering Economy, Leland Blank & Anthony Tarquim, McGraw HILL, Eighth Edition, 2018, ISBN: 978-0-07-352343-9

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 312	Modern Construction Materials	CIV 114	3	2	0	2	4	30	30	0	40
Course Contents	Different types of new construction materials (for examples, fiber reinforced polymer & Geopolymer concrete) – Constituents of new construction materials - Properties of the new construction materials (Physical, Chemical & Mechanical properties) - Fabrication technology - Comparison with conventional construction materials - Structural applications - Testing - Economical point of view.										
References	• الكود المصري لأسس تصميم وإشتراطات تنفيذ استخدام البوليمرات المسلحة بالألياف في مجالات التشييد – 205. • Construction Materials, their Nature and Behavior, Marios Soutsos, Edited by Peter Domone and John Illston, ISBN-13: 978-1498741101 / ISBN-10: 9781498741101. • Fundamentals of Materials Science and Engineering, William D. Callister Jr., David G. Rethwisch, Wiley Abridged Print Companion, ISBN-13: 978-1119498926, ISBN-10: 1119498929.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 321	Design of Metallic Structures II	CIV 222	3	2	0	2	4	30	30	0	40
Course Contents	Classical bridge types - Different bridge systems - loads (Roadway - Railway - Other loads) - Design of floor beams systems - plate girder bridges (Preliminary proportioning - Design for bending - Design for shear - Combined shear and moment - Buckling of plates - Longitudinal and transversal stiffeners - Load bearing stiffeners - Splices - Curtailment of flange plates - Details) - Wind bracing systems - bridge bearings.										
References	• Egyptian code for design of steel structure. • Steel bridges by Prof. Metwally Abu-Hamd, Cairo University • Planning and Design of Bridges, by Prof. M.S. Troitsky, ISBN-13 9780471028536										

.	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 322	Structure Analysis IV	CIV 221	3	2	0	2	4	30	30	0	40
Course Contents	Dynamic equilibrium; Dynamic equations of motion for single-degree-of-freedom systems; Analysis of free and forced vibration. Damping in structures. Numerical evaluation of dynamic response. Dynamic equations of motion for two and multi degrees of freedom structures; Natural vibration properties of structures and Mode Shapes. Modal superposition method; Introduction to response history analysis; Response spectrum for elastic structures. Seismological Background (Earthquakes, causes, effects, and scales) - Egyptian Code applications (Earthquake analysis using equivalent static method- Response spectrum analysis).										
References	• Aggarwal P., Shrikhande, M., "Earthquake Resistant Design of Structures", Prentice Hall India Learning, Private Limited; 1 edition, 2006, ISBN-13: 978-8120328921. • Anil K. Chopra, " DYNAMICS OF STRUCTURES", Prentice Hall, United States of America; 4th edition, 2012, ISBN-13: 978-0132858038. • Ray W. Clough, Joseph Penzien " DYNAMICS OF STRUCTURES", Computers & Structures, Inc, United States of America; 3rd edition, 2003.										

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 229</td><td>Design of Steel Structures</td><td>CIV 123</td><td>2</td><td>2</td><td>0</td><td>1</td><td>3</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">The course presents the fundamentals of steel structures and materials through the following topics: such as material properties and steel sections, allowable Stress Design method - Concept of tension members, compression members, and flexural members, the different Types and classification of beam cross sections, Concept of beam-columns (axial and flexural forces), bolted and welded connections.</td></tr>
<tr><td>References</td><td colspan="11">• Egyptian code for design of steel structure.
• Advanced Steel Design Of Structures, by Prof. Srinivasan Chandrasekaran, Indian Institute of Technology, India. ISBN-13 9780367232900
• Steel Designers' Manual, By (Steel Construction Institute), Edited by Buick Davison and Graham W. Owens, ISBN-13 9781119249863</td></tr>
<tr><td colspan="2">Used in Program</td><td colspan="5">Architecture Engineering Program</td><td colspan="2">Semester</td><td colspan="3">7</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 324</td><td>Metallic Structures Design III</td><td>CIV 222</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Composite construction - composite floor beams (Strength requirement - shear connectors - formed metal deck) - Design of composite columns - Flexural design of slender sections - Connection classification and design (Flexible - Rigid – Semi rigid) - Design of base plates and anchor bolts – Introduction of Load and Resistance Factor Design (LRFD) - Identification of Limit states (Strength limit state and Serviceability limit state) - Design of tension, compression and flexure members using LRFD approach.</td></tr>
<tr><td>References</td><td colspan="11">• Egyptian Code of Practice for Steel Construction and Bridges (LRFD).
• Steel structures design by Prof Dr. Abdulrahim Khalil Dessouki.
• Steel Design for Engineers and Architects, by David A. Fanella, Rene Amon, Bruce Knobloch, Atanu Mazumder, United States of America ISBN-13: 978-1-4615-9731-5</td></tr>
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Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 331	Design of Foundations and Earth Retaining Structures	CIV 232	3	2	0	1	3	30	30	0	40
Course Contents	Pile Foundations (Types of Piles - Load Transfer Mechanisms - Static Capacity for Piles - Field Load Tests – Pile Group – Elastic Centre Method - Design of Pile Caps) - Introduction to Earth Retaining Structures - Pile wall (Secant piles - Tangent Piles - Bored Pile Wall) - Construction Techniques and Design of Retaining Walls (Cantilever RW – Counterfort RW) – Introduction to Reinforced Soil RW - SPW.										
References	• El-Kasaby, E. A., Design and Construction of Deep and Special Foundations, Dar Al-Kutub Al-Almia, Cairo, 4th Ed., (10651/2016), ISBN 978 – 977 – 726 – 168 – 5, 2016. • Das, B. M, Principles of Foundation Engineering, Brooks - Cole, 9th. Ed., ISBN 978 – 133 – 770 – 502 – 8, 2017. • Bowles, J., Foundation Analysis and Design, McGraw - Hill, 5th. Ed., ISBN 978 – 007 - 912 – 247 – 7, 2009.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 332	Special Topics in Geotechnical Engineering	CIV 331	3	2	0	2	4	30	30	0	40
Course Contents	Soil Exploration and Site Investigation (Field Exploration - Geological Surveys - Borings and Soil Boring Reports) - Stability of Slopes (Slope Failures Causes - Wedge - Friction Circle - Slices Method) - Difficult Soils (Collapsible - Soft Soil – Swelling - Fill) - Soil Stabilization and Improvement Techniques – Soil Grouting - Ground Water and its Control (Design Consideration – Surface Dewatering – Well Point System - Shallow and Deep Wells – Freezing Process - Soil Filter – Construction Precautions)										
References	• El-Kasaby, E. A., Soil Mechanics, Dar Al-Kutub Al-Almia, Cairo, 5th Ed., (21371/2013), ISBN 978 – 977 – 726 – 041 – 1, 2014. • El-Kasaby, E. A., Design and Construction of Deep and Special Foundations, Dar Al-Kutub Al-Almia, Cairo, 4th Ed., (10651/2016), ISBN 978 – 977 – 726 – 168 – 5, 2016. • Das, B. M, Principles of Foundation Engineering, Brooks - Cole, 9th. Ed., ISBN 978 – 133 – 770 – 502 – 8, 2017. • Bowles, J., Foundation Analysis and Design, McGraw - Hill, 5th. Ed., ISBN 978 – 007 - 912 – 247 – 7, 2009.										

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<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 334</td><td>Special Topics in Foundations Engineering</td><td>CIV 331</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Piers and Caissons (Construction and Design Considerations) – Wall Supports (Shafts - Mechanical Stabilization Wall - Crib - Barrette - Gabions) - SPW (Cantilever – Anchored (Free - Fixed – Grouted)) - Braced Excavations (Design Consideration – Berline Wall) - Reinforced Soil RW by Geotextiles - Soil Nailing and Anchoring - Cofferdams - Ground Oil Steel Tanks - Foundations on Difficult Soil - Foundations for Offshore Structures – Introduction in Tunnel Engineering - Dams (Earth Dams – Seepage - Dams Failures).</td></tr>
<tr><td>References</td><td colspan="11">• El-Kasaby, E. A., Soil Mechanics, Dar Al-Kutub Al-Almia, Cairo, 5th Ed., (21371/2013), ISBN 978 – 977 – 726 – 041 – 1, 2014.
• El-Kasaby, E. A., Design and Construction of Deep and Special Foundations, Dar Al-Kutub Al-Almia, Cairo, 4th Ed., (10651/2016), ISBN 978 – 977 – 726 – 168 – 5, 2016.
• Das, B. M, Principles of Foundation Engineering, Brooks - Cole, 9th. Ed., ISBN 978 – 133 – 770 – 502 – 8, 2017.
• Bernhard Maidl; Markus Thewes; Ulrich Maidl, Handbook of Tunnel Engineering, Volumes I and II, ISBN 978 – 343 – 303 – 078 – 3, 2014.
• Robin Fell; Patrick MacGregor; David Stapledon; Graeme Bell; Mark Foster, Geotechnical Engineering of Dams, CRC Press, 2nd Ed., ISBN 978 - 113 – 800 – 008 – 7, 2018.
• Bowles, J., Foundation Analysis and Design, McGraw - Hill, 5th. Ed., ISBN 978 – 007 - 912 – 247 – 7, 2009.</td></tr>
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<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 342</td><td>Satellite Geodesy</td><td>CIV 241</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Geodetic positioning using Artificial Satellites – positioning by satellites – satellite orbital space geometry – satellite coordinates and associated transformations – satellite Cartesian coordinates in the average terrestrial system – Satellite observing techniques - Basic Observation Concepts and Satellites Used in Geodesy - Doppler Techniques - Satellite Altimetry – Applications of Satellite altimetry.- Digital Elevation Models and Digital Terrain Models - Data Sources for Digital Terrain Modeling.</td></tr>
<tr><td>References</td><td colspan="11">• Seeber · Satellite Geodesy -2nd completely revised and extended edition - Walter de Gruyter ·Berlin New York 2003 - ISBN 3-11-017549-5
• Bock, Y., Leppard, N. (eds.) (1990): Global Positioning System. An Overview. Symposium No. 102, Edinburgh, August 7-8, 1989. International Association of Geodesy. Symposia, Springer-Verlag, New York - ISBN 978-1-4615-7111-7
• Zhilin Li, Qing Zhu, Christopher Gold (2004) DIGITAL TERRAIN MODELING Principles and Methodology -ISBN 0-415-32462-9</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 344	Underground Utility Survey	CIV 241	3	2	0	2	4	30	30	0	40
Course Contents	Basics of Surveying the Underground - Transferring Traversing and Levelling Measurements Transferring surface coordinates to underground workings Understanding limitations of transfer techniques - Traditional Methods to Map Utilities -Common Utility Types - Basic introduction to utility detection theory and methods –Electromagnetic pipe and cable locators Basic Ground Penetrating Radar (GPR) - Principles- Electro Magnetic VS GPR Comparison.										
References	• Walker J, Awange JL (2018) Surveying for Civil and Mine Engineers. Springer Nature. • Awange J, Paláncz B Geospatial Algebraic Computations. 3rd edition. Springer-Verlag GmbH- ISBN 978-3-030-45803-4 • Costello, Brad, UNDERGROUND CHECK SURVEY, ENG4111/4112 – Undergraduate dissertation, University of Southern Queensland, 2016. (https://eprints.usq.edu.au/31389/1/Costello_B_Gharineiat.pdf) • Erica Carrick utsi (2017) Ground Penetrating Radar Theory and practice – Elsevier - Paperback ISBN: 9780081022160										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 346	Hydrographic Survey	CIV 241	3	2	0	2	4	30	30	0	40
Course Contents	Hydrographic standards and classifications - Vertical depth measurements - Horizontal position fixing - Effects of vessel roll pitch and heave - The WGS84 datum - GNSS Terminology - Differential GNSS Reference Stations (DGPS & ERS) - Specifying hydrographic surveys - ERS Datum Transformation Requirements - Tides and Water Levels Requirements - Depth Sounding - Multibeam and Other Echosounders -Corrections to Echo Soundings and Uncertainty Assessment - Acoustic Backscatter.										
References	• HYDROGRAPHIC SURVEYS SPECIFICATIONS AND DELIVERABLES, April 2017 - National Oceanic and Atmospheric Administration • US Army Corps of Engineers. 1994. Hydrographic Surveying: Engineering and Design, Washington DC, US Army Corps of Engineers- ISBN 1110-2-1003										

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 351</td><td>Design of R.C. Structures III</td><td>CIV 252</td><td>3</td><td>2</td><td>0</td><td>1</td><td>3</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Halls - Arched systems (slab - girder) - Prestressed concrete (beams) - Design of water structures (Circular tank - Rectangular tanks - Underground tanks - Elevated tanks - Wide tanks) - Design of shell structures (domes - cones)- Design of deep beams.</td></tr>
<tr><td>References</td><td colspan="11">Egyptian Code for Design & Construction of Reinforced Concrete Structures – ECOP 203-2018.
Arthur H Nilson, D.Darwin, Charles W. Design of Concrete Structures, Fifteenth Edition,2016.
Mohammed Hilal, 1987, Design of Reinforced Concrete Halls – Part 1 & 2.
Mashhour Ghoneim, Mahmoud Elmihilmy, Design of reinforced concrete structures, Volume 3, First edition, 2011.
Mohammed Hilal, 1987, Theory And Design of Reinforced Concrete Tanks part 1 & 2.</td></tr>
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<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 352</td><td>R.C. Structures Design IV</td><td>CIV 351</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Pre-stressed concrete (slabs) – Types of joints (construction – shrinkage – expansion)- Design of short cantilever- Design of high-rise buildings (Loads – Resisting systems – Design of structural elements – Reinforcement details) – Types of R.C. bridges – Design of R.C. bridges (Slab type – Girder type – Box-girder type).</td></tr>
<tr><td>References</td><td colspan="11">• Egyptian Code for Design & Construction of Reinforced Concrete Structures – ECOP 203-2018.
• Design of Prestressed Concrete, Arthur H Nilson, 2nd Edition, 1991.
• Fundamentals of Reinforcement Concrete and Prestressed concrete, M.Hilal, 1987.
• Design of reinforced concrete structures, Mashhour Ghoneim, Mahmoud Elmihilmy, Volume 3, First edition, 2011.</td></tr>
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<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 361</td><td>Irrigation and Drainage Engineering</td><td>CIV 161</td><td>2</td><td>2</td><td>0</td><td>1</td><td>3</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Introduction, the Nile River, water consumptions, Irrigation methods, planning of irrigation networks, Basis and procedures for designing canal sections. Sprinkler irrigation, drip irrigation, Sources of drainage water, importance of land drainage, clarification of drainage systems. Surface and subsurface drainage, Design of horizontal and vertical drainage systems, drainage system performance, reuse of drainage water. Planning of irrigation projects.</td></tr>
<tr><td>References</td><td colspan="11">• Waller P, Yitayew M, Irrigation and Drainage Engineering, Springer 2016. ISBN: 978-3-319-34631-1
• Shun Lin, C. Lee. Water and Wastewater Calculations Manual, McGraw-Hill Professional, Second Edition, 2007, ISBN-13: 978-0071476249</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 362</td><td>Design of Irrigation Structures</td><td>CIV 162</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Introduction, irrigation and drainage network, irrigation structures and their functions, general requirements and design considerations (hydraulic design, loads, stability, Cracking limits, structural design), crossing structures (Culverts, Syphons, Aqueducts, Short span Bridges, weir, regulators), Tail escapes, Construction methods.</td></tr>
<tr><td>References</td><td colspan="11">• Novak, P., Moffat, A. I. B., Nalluri, C. & Narayanan, R. Hydraulic Structures, Fourth Edn, Spon, London, 2007, ISBN 9780415386265
• S. K. Sharma. design of irrigation structures, RSM Press, ISBN: 8121903297, 9788121903295</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 364</td><td>Coastal Engineering</td><td>CIV 162</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Waves and current movements- stability of shoreline- erosion and sedimentation in unstable shoreline- shore protection structures- modifying the wave property - Revetments of shoreline- theoretical and empirical equations representing sediments movements in marine structure zones- sand nourishment. Coastal water level fluctuations. Mechanics of wave motion. Beach profiles. Surf dynamics and sediment transport. Design wave characteristics. Wave forces on cylinders. Morison equation. Wave forces on vertical walls. Effects of approach angle and non- verticality, Breakwater design.</td></tr>
<tr><td>References</td><td colspan="11">Basic coastal engineering, by Sorensen R.M., Springer (2006), ISBN: 0387233326, 9780387233321</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 371</td><td>Sanitary Engineering</td><td>CIV 272</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Introduction, sources, types and characteristics of municipal wastewater, Municipal wastewater collection and transportation, Preliminary treatment of municipal Wastewater: deceleration chamber, screen and grit chamber, Primary treatment of municipal wastewater, Secondary treatment of municipal wastewater: activated sludge process, trickling filter process, rotating biological contactor, aerated lagoon and oxidation pond, Sludge treatment & disposal: thickening, stabilization and dewatering.</td></tr>
<tr><td>References</td><td colspan="11">• Metcalf & Eddy l AECOM (2014) Wastewater Engineering, Treatment and Resource Recovery, ISBN 978-0-07-340118-8
• Sewerage Prof. Dr. M. Basiouny
• Lectures presentations
• محطات الرفع - الصرف الصحى- الكود المصرى-
• أعمال المعالجة- الصرف الصحى - الكود المصرى-</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Determine PH, Temperature, Total Solids (TS), Chloride, Nitrogen, Phosphorus,
• Heavy Metals, Biochemical Oxygen Demand (BOD), Chemical Oxygen
• Demand (COD), Dissolved Oxygen (DO), total bacteria account and Total coliform.</td></tr>
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<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 372</td><td>Advanced Sanitary Engineering</td><td>CIV 371</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Nitrogen removal and recovery – Phosphorous Removal and recovery - Membrane filtration - Adsorption - Ion exchange - Reverse osmosis - Air and flotation - Wastewater reuse.</td></tr>
<tr><td>References</td><td colspan="11">Metcalf & Eddy l AECOM (2014) Wastewater Engineering, Treatment and Resource Recovery, ISBN 978-0-07-340118-8</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 381</td><td>Highway Engineering I</td><td>CIV 142
CIV 231
CIV 282</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Geometric design:
Functional Classification of Roads & Cross Section Elements, sight distance, Vertical Alignment, Horizontal Alignment.
Structural design:
Pavement types and components - Subgrade soil classification - Subgrade soil strength- Soil compaction - Soil stabilization - Stresses in flexible pavement - Flexible pavement design - Testing and specifications of road aggregates - Testing and specifications of bituminous materials - Hot mix asphalt concrete characteristics and design.</td></tr>
<tr><td>References</td><td colspan="11">• Traffic and Highway Engineering, Nicholas Garber and Lester Hoel, Fifth Enhanced SI Edition, CENGAG Learning, 2020, ISBN-13: 978-1-337-63104-4.
• AASHTO, A Policy on Geometric Design of Highways and Streets “Green Book”, 7th Edition, 2018, ISBN-13: 978-1560516767.
• Pavement Analysis and Design, Yang Huang, Second International Edition, Pearson, 2012, ISBN-13: 978-0-13-272610-8.
• Hot Mix Asphalt Materials, Mixture Design and Construction, E. Ray and Prithvi S. Kandhal and Freddy L. Roberts and Y. Richard Kim and Dah-Yinn Lee and Thomas W. Kennedy Brown , Third Edition, National Asphalt Pavement Association Research and Education Foundation, 2009, ISBN-13 : 978-0914313021
• الكود المصرى للطرق – 2020.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• CBR Test, and Plate Loading Test
• Tests of bituminous materials
• Hot mix asphalt concrete design (Marshall Method)</td></tr>
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<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 382</td><td>Airport Engineering</td><td>CIV 381</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Airport planning - Aircraft characteristics related to airport design - Airport configuration - Airport airside capacity and delay - Geometric design of the airfield – Planning and design of the terminal area - Structural design of airport pavements - Airport lighting, marking, and signing - Airport drainage.</td></tr>
<tr><td>References</td><td colspan="11">• Airport Design and Operation, ANTONI´N KAZDA & ROBERT E. CAVES, Emerald Group Publishing Limited, Third Edition, 2015, ISBN: 978-1-78441-870-0.
• Planning and Design of Airports, Robert Horonjeff, Francis X. McKelvey, William J. Sproule, and Seth B. Young, Fifth Edition, Mc Graw Hill, 2010, ISBN-13: 978-0071446419.
• Airport Engineering Planning and Design, Subhash C. Saxena, CBS Publishers & Distribution, India, First Edition, 2008, ISBN: 978-81-239-1550-0</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 384	Railway Engineering	CIV 282	3	2	0	2	4	30	30	0	40
Course Contents	Introduction to Railways Engineering, Urban and Sub-urban design of railways, Vertical and horizontal curves- rails design- wood and concrete sleepers design - stresses in gravels section - railways intersections - signs and design of control stations; Economical and environmental effect of railways.										
References	• Practical railway engineering, by Clifford F. Bonnett, Imperial College Press; Distributed by World Scientific Pub 2005, ISBN: 1860945155, 9781860945151 • Railway Engineering, by Satish Chandra, M.M. Agarwal, 2nd edition 2013, ISBN-10: 019808353X.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 398	Senior Design Project I	*	2	0	4	0	4	50	0	50	--
Course Contents	Topics are selected by groups of students according to their area of interest upon advisor approval. Projects address solutions to open-ended applications using an integrated engineering approach.										
References	According to the selected project										
Laboratory	According to the selected project										

* The student can register the senior design project course after passing 70% of the program cr. hrs, i.e., 112 Cr. Hr. + completion of the prerequisite courses of the project.

Code	Course Name	Pre-req.	Credit Hours	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 401	Construction Engineering & Management	CIV 300 *	2	2	0	1	3	30	30	0	40
Course Contents	Plan and manage construction processes, address construction defects, maintain safety issues for construction and materials deal with biddings and financial issues including project insurances. Acquire knowledge and understanding of project management and assess the economical environmental impact of construction projects. The ability to prepare the bill of quantities for any specified project. The preparation and calculation of the on-going works quantities. The ability to manage construction project.										
References	• A Guide to the Project Management Body of Knowledge (PMBOK® Guide), by Project Management Institute, Sixth Edition, 2017, ISBN-13: 978-1628251845. • Construction process planning and management, Sidney M. Levy, Elsevier publisher, 2010, ISBN: 978-1-85617-548-7.										
Used in Program		Civil & Architecture Engineering Program						Semester	9		

* Prerequisite for Civil Engineering Program Only

Code	Course Name	Pre-req.	Credit Hours	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 403	Construction project specifications, bids, and contracts	CIV 300	3	2	0	2	4	30	30	0	40
Course Contents	Participants in a construction contract. Contract definition. Types of contracts; formation principles of a contract, performance or breach of contractual obligations. Analysis and comparison of the different kinds of construction contracts. Bidding logistics. Legal organizational structures. Different types and uses of specifications. Different forms of contracts utilized in construction.										
References	Construction process planning and management, Sidney M. Levy, Elsevier publisher, 2010, ISBN: 978-1-85617-548-7.										

Code	Course Name	Pre-req.	Credit Hours	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 405	Value Engineering in the Construction Industry	CIV 300	3	2	0	2	4	30	30	0	40
Course Contents	The value concept: history, definitions, application to the construction industry, incentive provisions in construction contracts, factors to be considered, application to design. Value engineering methodology: information phase, speculative phase, analytical phase, proposal phase, and final report phase. Value engineering study procedures: objective, selecting the input required, required documentation, life cycle cost methodology.										
References	• Value Engineering Practical Applications for Design, Construction, Maintenance & Operations, Alphonse Dell ISOLA, RSMeans, 1997, ISBN: 0-87629-463-8. • Value Engineering Manual, By West Virginia Department of Transportation Division of Highways Engineering Division, Printed By: Wvdoh Office Services Division, January 1, 2004.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 407	Repair and Strengthening of Concrete Structures	CIV 304	3	2	0	2	4	30	30	0	40
Course Contents	Restoration style design - Specifications and selection of restoration materials (Concrete, cemented materials, Epoxy, FRP and others) - Concrete roof repair - Crack repair - Restoration and strengthening concrete elements (Columns, Beams, Slabs, Connections, Concrete walls, and Foundations)- Restoration and strengthening of reinforced concrete structures using fiber-reinforced polymers (FRP)-Applications and field examples.										
References	El-Kasaby, E. A., Repair of concrete structures, Dar Al-Kutub Al-Almia, Cairo, 2nd Ed., (19441/2015), ISBN 978-977-726-140-1, 2016.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 421	Modelling of Structures	CIV 322	3	2	2	0	4	30	30	0	40
Course Contents	General derivation of finite element equilibrium equations - General coordinate models for specific problem (one dimensional element - Plane stress/strain elements) - Lumping of structural properties and loads - Calculation of stresses and assessment of error - formulation of bar Element - Formulation of isoperimetric continuous elements: quadrilateral and triangular elements - Formulation of structural elements: beams - axisymmetric and plate bending elements - Numerical integration: Gauss formula (one dimension integration) - Integration in two dimensions- Computer Applications using ANSYS Engineering Simulation Software.										
References	• G. Ramamurty, " Applied Finite Element Analysis", New Delhi: 2nd Edition, I.K. Inc, 2010, ISBN-13: 978-9380578453 • George R. Buchanan," Schaum's Outline of Finite Element Analysis", 2nd Edition, United State of America, McGraw Hill Inc., 2015 • Saeed Moaveni, "Finite Element Analysis: Theory and Application with ANSYS", 4th Edition, Pearson Global Edition, 2015, ISBN 13: 978-0-273-77430-3.										
Laboratory	Computer Applications using ANSYS Engineering Simulation Software										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 431	Computer Application in Geotechnical Engineering and Foundations	CIV 331	3	2	2	0	4	30	30	0	40
Course Contents	Introduction to Design Geotechnical problems and Foundations by Modern Methods - Material Modelling (Definition of Stresses – Definition of Strains – Elastic and Plastic Strains) – Soil Modelling (Mohr-Coulomb Model – Hardening Soil Model) - Numerical Analysis of Shallow and Deep Foundations – Computer Applications Examples using Modern Programs (Raft – Piles – Retaining Structure).										
References	• El-Kasaby, E. A., Engineering of Surface Foundations, Dar Al-Kutub Al-Almia, Cairo, 5th Ed., (19440/2015), ISBN 978 – 977 – 726 – 139 – 5, 2015. • El-Kasaby, E. A., Design and Construction of Deep and Special Foundations, Dar Al-Kutub Al-Almia, Cairo, 4th Ed., (10651/2016), ISBN 978 – 977 – 726 – 168 – 5, 2016. • Pijush Samui; Sunita Kumari; Vladimir Makarov; Pradeep Kurup, Modeling in Geotechnical Engineering, 1st Ed., ISBN 978 - 012- 821 – 205 – 9, 2021. • Das, B. M, Principles of Foundation Engineering, Brooks - Cole, 9th. Ed., ISBN 978 – 133 – 770 – 502 – 8, 2017. • Bowles, J., Foundation Analysis and Design, McGraw - Hill, 5th. Ed., ISBN 978 – 007 - 912 – 247 – 7, 2009.										

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<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 339</td><td>Soil Mechanics & Foundations</td><td>CIV 259</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">The course aims to study soil characteristics and mechanics, and the selection and design of foundations: Soil Properties - Soil Classification - Soil Compaction - Stresses in Soil - Settlement of Soil - Lateral Earth Pressure - Shallow Foundations (Isolated Footing – Rectangular Footing) – Deep Foundations (Piles – Pile Caps).</td></tr>
<tr><td>References</td><td colspan="11">• El-Kasaby, E. A., Soil Mechanics, Dar Al-Kutub Al-Almia, Cairo, 5th Ed., (21371/2013), ISBN 978 – 977 – 726 – 041 – 1, 2014.
• El-Kasaby, E. A., Engineering of Surface Foundations, Dar Al-Kutub Al-Almia, Cairo, 5th Ed., (19440/2015), ISBN 978 – 977 – 726 – 139 – 5, 2015.
• El-Kasaby, E. A., Design and Construction of Deep and Special Foundations, Dar Al-Kutub Al-Almia, Cairo, 4th Ed., (10651/2016), ISBN 978 – 977 – 726 – 168 – 5, 2016.
• Das, B. M, Soil Mechanics Laboratory Manual, Oxford University Press, 9th. Ed., ISBN 978 – 019 – 020 – 966 – 7, 2016.
• Das, B. M, Principles of Foundation Engineering, Brooks - Cole, 9th. Ed., ISBN 978 – 133 – 770 – 502 – 8, 2017.
• Bowles, J., Foundation Analysis and Design, McGraw - Hill, 5th. Ed., ISBN 978 – 007 - 912 – 247 – 7, 2009.</td></tr>
<tr><td></td><td colspan="11"></td></tr>
<tr><td>Laboratory</td><td colspan="11">Specific Gravity Determination, Atterberg Limits (Liquid Limit – Plastic Limit – Shrinkage Limit).
Atterberg Limits (Liquid Limit – Plastic Limit – Shrinkage Limit), Grain Size Distribution - Coarse Grained Soils. (Sieve Analysis), Grain Size Distribution - Fine Grained Soils (Hydrometer Analysis),
Determination of Natural Unit Weight of Soil (Sand Bottle Test - Core Cutter Test).</td></tr>
<tr><td colspan="2">Used in Program</td><td colspan="5">Architecture Engineering Program</td><td colspan="2">Semester</td><td colspan="3">9</td></tr>
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<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 441</td><td>Remote Sensing and Geographical Information System</td><td>CIV 241</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Introduction to geographic information systems - remote sensing technologies - Active & passive remote sensing - Data structures – Map projections & coordinate systems - Processing of digital geographic information - Creation of digital elevation models – Visualization - Mapping of water and environmental features – Soil and land use mapping - Terrain analysis for hydrological and hydraulic modelling - Production of thematic maps - GIS as a decision support tool - Exercise and assignment.</td></tr>
<tr><td>References</td><td colspan="11">• Lillesand, T. M., Kiefer, R. W., and Chipman, J. W., (2007), "Remote Sensing and Image Interpretation', 6th ed. Madison: John Wiley & Sons. - ISBN: 978-1-118-34328-9
• Bonham-Carter, G.F., (1994), " Geographic Information Systems for Geoscientists: Modelling with GIS", Geological Survey of Canada, Love Printing Service Ltd, Ontario, Canada - eBook ISBN: 9780080571805.
• Principles of geographical information systems for land resources assessment. P. A. Burrough. Publisher Oxford University press 1986 (paperback) (193 pp) ISBN 0 19 854592 4</td></tr>
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<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 443</td><td>Photogrammetry by Drones</td><td>CIV 241</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Photogrammetry principles - Classifications of Photogrammetry according to the purpose - Classification of the Photogrammetry according to the sensor location - Space photogrammetry - Aerial Photogrammetry - Terrestrial Photogrammetry - Close Range Photogrammetry (CRP) - UAV Photogrammetry - UAV Classification - UAV images processing techniques and algorithms -Structure from motion (SFM).</td></tr>
<tr><td>References</td><td colspan="11">• Gruen, Armin, Baltsavias, Emmanuel, Henricsson, O. (Eds.) - Automatic Extraction of Man-Made Objects from Aerial and Space Images (II) - ISBN 978-3-0348-8906-3
• Faig, W. (1985), Lecture Notes on Aerial Triangulation and Digital Mapping, Monograph 10, School of Surveying, The University of New South Wales, Kensington, N.S.W., Australia – ISBN 0858390434
• Falkner, E.; Morgan, D., 2002. Aerial Mapping: Methods and Applications, 2nd ed.; CRC Press: Boca Raton, FL, USA - ISBN 1-56670-557-6</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 451</td><td>R.C. Structures Modelling</td><td>CIV 352</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Analysis and Design of Post-Tension Slabs using commercial software programs. Modeling of Slab edges, opening, supporting elements. Loads input, tendon profiling, material properties, anchorage properties, dead and live tendon ends. Prestress loss data input. Load combinations. Check of Punching, shear, and deflection. Reinforcement detailing.</td></tr>
<tr><td>References</td><td colspan="11">• Egyptian Code for Design & Construction of Reinforced Concrete Structures – ECOP 203-2018.
• Prestressed Concrete: 5th Edition, Edward G. Nawy, ISBN: 978-0136081500, 2009.
• Design of Prestressed Concrete, Arthur H Nilson, 2nd Edition, 1991.
• Software programs manual.</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 461</td><td>Inland Navigation</td><td>CIV 162</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Natural phenomena; wind, waves, Currents and tide - Vessels' specifications and movement - Planning of inland navigation projects Design of navigation channels cross section - Master plan of inland ports - Berthing facilities (quay walls) - Repairing facilities - Dredging and maintenance of navigation channels - Environmental impact of inland navigation.</td></tr>
<tr><td>References</td><td colspan="11">• Inland Navigation: Channel Training Works. Task Committee on Inland Navigation of the Waterways Committee of the Coasts, Oceans, Ports, and Rivers Institute of ASCE Edited by Thomas J. Pokrefke, P.E. ISBN: 978-0-7844-1253-4ISBN (PDF): 9780784477014
• https://doi.org/10.1061/9780784412534.fm Published online: May 06, 2013
• U. S. Army Corps of Engineers. Shore Protection Manual, 1977.</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 463</td><td>Hydraulic Modelling</td><td>CIV 162</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Governing Laws: Continuity principle , Momentum principle , Inertia forces, Momentum equations , Euler equation, Navier-Stokes equations , Bernoulli equation – 1D Channel Flow: Steady– Saint Venant equation for unsteady flow - Derivation of St Venant equation - Kinematic wave approximation - Applications of unsteady flow equations and solution methods- 2D and 3D Shallow Water Equations: Depth-averaged shallow water equations - Limit cases for depth-averaged flow and for 3D flow - Numerical models - Application software.</td></tr>
<tr><td>References</td><td colspan="11">• Computer Applications using ANSYS Engineering Simulation Software
• Le Mehaute, B. (1976). An Introduction to Hydrodynamics and Water Waves, Springer Verlag, New Work. https://doi.org/10.1007/978-3-642-85567-2 eBook ISBN: 978-3-642-85567-2</td></tr>
</table>

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 471</td><td>Environmental Engineering</td><td>-</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Introduction to environmental engineering, Philosophy of Environmental Controls – Emissions Control – Climate change – Environmental Impact Assessment – Sustainability – Sustainable water supply – Sustainable solid waste management – Nature and Sources of Air Pollution, Air: Quality, Environmental impact of Air pollution. Soil: Quality, Environmental impact of Soil pollution, Environmental laws and its applications.</td></tr>
<tr><td>References</td><td colspan="11">• US Environmental Protection Agency
• Introduction to Environmental Engineering by Mackenzie Davis, David Cornwell, McGrawHill, Fifth Edition, 2012
• Environmental Engineering: Designing a Sustainable Future (Green Technology), by Anne E. Maczulak, Facts on File 2009, ISBN: 9780816072002, 0816072000, 9781438127477</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>CIV 473</td><td>Modelling of Water & Wastewater Networks</td><td>CIV 371</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Modelling of water distribution systems, Analysis and design of water networks using computer applications, modelling of sewer systems, Analysis and design of Sewer Networks using computer applications, Applications</td></tr>
<tr><td>References</td><td colspan="11">• Haestad Methods Water Solutions, “Advanced Water Distribution Modeling and Management”, Haestad, 2003
• Haestad Methods Water Solutions, “Wastewater Collection System Modeling and Design”, Bentley institute press, 2007
• Different software package user guide manuals
• U.M. Shamsi, “GIS Applications for Water, Wastewater, and Stormwater Systems “, CRC Press, 2005, ISBN 9780849320972.
• Staff lectures notes</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 481	Highway Engineering II	CIV 381	3	2	0	2	4	30	30	0	40
Course Contents	Geometric design: At-grade intersection design - Interchange design - Capacity and level of service analysis on basic freeway and multilane highway segments - Capacity and level of service analysis of weaving, merge and diverge segments on freeways and multilane highways - Highway traffic safety. Structural design: Stresses in rigid pavement - Rigid pavement design - Asphalt concrete mix planet - Pavement layers construction - Pavement maintenance - Drainage.										
References	• Traffic and Highway Engineering, Nicholas Garber and Lester Hoel, Fifth Enhanced SI Edition, CENGAG Learning, 2020, ISBN-13: 978-1-337-63104-4. • Traffic Engineering, Roger P. Roess - Elena S. Prassas and William R. McShane, Fifth Edition, Pearson, 2019, ISBN-13: 978-9353434854. • AASHTO, A Policy on Geometric Design of Highways and Streets “Green Book”, 7th Edition, ISBN-13: 978-1560516767. • Pavement Analysis and Design, Yang Huang, Second International Edition, Pearson, 2012, ISBN-13: 978-0-13-272610-8. • Hot Mix Asphalt Materials, Mixture Design and Construction, E. Ray and Prithvi S. Kandhal and Freddy L. Roberts and Y. Richard Kim and Dah-Yinn Lee and Thomas W. Kennedy Brown , Third Edition, National Asphalt Pavement Association Research and Education Foundation, 2009, ISBN-13 : 978-0914313021 • الكود المصرى للطرق – 2020.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 483	Computer Application in Transportation Engineering	CIV 381	3	2	2	0	4	30	30	0	40
Course Contents	This course focuses on the fundamentals behind some of the most popular computer software packages used in the planning, design, operations, and management of transportation systems. Topics includes: highway planning and design, pavement design, signal optimization, forecasting of traffic flows and passenger volumes, simulation of traffic and transit systems, design and evaluation of Intelligent Transportation Systems.										
References	The manual of the used software.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec	Lab	Tut	Sum	SA	MT	PE/OE	Final
CIV 499	Senior Design Project II	CIV 398	3	1	4	0	5	50	0	50	--
Course Contents	Topics are selected by students according to their area of interest upon advisor approval. Student deals with the analysis and design of a complete project using the skills he gained during his study. Project report presented by the student should include the details of the analysis and design satisfying the concerned codes requirements, the computer applications as well as the experimental work, when necessary, in addition to the technical engineering drawing of his design.										
References	According to the selected project										
Laboratory	According to the selected project										

Code	Course Title	Pre-req	Cr. Hrs.	Ct Hrs				Assessment			
				Lec	Lab	Tut	Tot	SA	MT	PE/OE	Final
BES 111	Differential Equations	BES 012	3	2	0	2	4	30	30	-	40
Course Content	Ordinary differential equations (ODEs): Classification and types of solutions of ODEs. Solution of first order ODEs - Applications of ODEs (Newtons law of cooling, electric circuits) - Solution of nth order ODEs (homogeneous and non-homogeneous) - System of first order linear differential equations - Series solution of differential equations- Laplace transforms and inverse Laplace transforms with applications - Fourier series with applications. Gamma and Beta functions Partial Differential Equations (PDEs): Classification and types of solutions of PDEs. Applications of PDEs. Solution of linear PDEs with constant coefficients, solution of some initial-boundary value problems. Solution of PDEs by Laplace Transforms.										
References	• Morris Tenenbaum, Harry Pollard, "Ordinary Differential Equations: An Elementary Textbook for Students of Mathematics, Engineering, and the Sciences", Dover Publications, Last Edition. • Wei-Chau Xie, Differential Equations for Engineers, CAMBRIDGE UNIVERSITY PRESS, 2010.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab	Tut	Tot	SA	MT	PE/OE	Final
BES 112	Numerical Analysis	BES 111	3	2	2	0	4	10	30	20	40

Course Content

Numerical in general: Errors, norms, Numerical solution of a system of linear and nonlinear equations. matrix eigenvalues, least square method (Curve fitting), Interpolations, Numerical differentiation and integration.
Numerical ODEs and PDEs: methods for the solution of initial value problems in 1st order ODEs and higher order ODEs, Finite difference methods for boundary value problems in ODEs and initial-boundary value problems for PDEs (Elliptic and parabolic PDEs)- Lab simulations of engineering applications

References

- R W Hamming, "Numerical Methods for Scientists and Engineers", Courier Dover Publications, Last Edition.
- Steven C. Chapra, “Applied Numerical Methods with MATLAB for Engineers and Scientists”, Mcgraw-Hill, 3rd edition.
- Nita H. Shah, Numerical Methods with C++ Programming, PHI Learning, 2008.

Laboratory

Lab simulations by software’s as (C++, Matlab, Python,…)- Simulating practical technical problems- linear equations due to electric circuits , truss and spring mass systems. - Electric charge calculations- Nonlinear structural problems- Deflection of nonlinear springs- Calculating the shrinkage of a trunnion- Finding the longitudinal Young’s modulus -Estimating voltage drop on a resistor- Calculating the work done by stretching a string- Simulating equations due to the fluid continuum problems, DC motor speed control problems- interpolation and fitting for signals and voltage current relations- population growth calculations- Fluid flow rate calculations- Distributed wind force problems

Code	Course Title	Pre-req	Cr. Hrs.	Ct Hrs				Assessment			
				Lec	Lab	Tut	Tot	SA	MT	PE/OE	Final
BES 211	Engineering Statistics and Probability	BES 012	3	2	2	0	4	10	30	20	40

Course Content

Probability: Obtaining Data - Probability models: mathematical, deterministic model. Probability theory concepts. - Discrete Distributions: Binomial and Poisson distribution. Continuous Distributions: Normal and Exponential Distribution. - Joint distributions.
Statistics and Estimation: central point theorem, Single and multiple confidence interval, Prediction interval, tolerance interval - Hypothesis testing, - Inferences on the mean and variance of Normal distribution, Inference of two samples. – Simple and multiple Linear Regression and Correlation. - Applications involving uniform, Gaussian. Markov chains - Queueing Theory - Course examples are drawn from signal processing, system reliability, data science, wireless communications, civil engineering, and mechanical engineering - Lab simulations of engineering applications.

References

- R. E Walpole, R. H. Myers, “Probability and Statistics for Engineers and Scientists", Macmillan Publishing, Last Edition.
- David Levine, Patricia Ramsey , Robert Smidt, “Applied Statistics for Engineers and Scientists: Using Microsoft Excel & Minitab”, First Edition, 2000.

Laboratory

Lab simulations by software’s as (Excel, Matlab, Python,…)- Exploratory data analysis and data transformation (Tabulated data summaries and statistics, Histograms, Box and Correlation plots, Computation of means, variances, etc, Missing data imputation)- Simple random sampling with and without replacement- Stratified random sampling- Simulating Bernoulli process and Poisson distribution - Simulating Markov chains applications-Binary and sequential hypothesis testing and gambler's ruin -Gaussian Mixture Models, clustering and anomaly detection- Regression models and inference- Time series forecasting and ARIMA models.

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>BES 148</td><td>Water Chemistry</td><td>BES 041</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">This course aims to provide an introduction of equilibrium chemistry principles in aquatic systems. This course is designed for engineering students who are often required to understand the composition of solutions and direction of changes during treatment or in environmental systems. By completion of the course, the student will be able to interpret and communicate results related to water quality. Therefore the course syllabus includes the following topics: equilibrium principles of acids-bases, dissolution-precipitation, titration, gas-liquid equilibrium, oxidation-reduction, complexation and water quality analysis and quality control.</td></tr>
<tr><td>References</td><td colspan="11">- Sawyer, McCarty & Parkin, Chemistry for Environmental Engineering, McGraw Hill, 2003
- Stumm & Morgan, aquatic Chemistry. Third edition, John Wiley&Sons. 1995</td></tr>
<tr><td>Laboratory</td><td colspan="11">- Acid – base titration, Total hardness, Total alkali, conductivity, Total dissolved solids</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>St. Act.</th><th>MT</th><th>PE/ OE</th><th>Final</th></tr>
<tr><td>ARC 217</td><td>Architectural Engineering</td><td>CIV 101</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>0</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">The course focuses on the relation between building materials and the related adequate construction systems. Students study the basic elements of the building (roofs - floors - walls) and understand. The architectural and services elements of buildings (Function - Finishes - Building materials - Stairs - Elevators). This course provides the students with the fundamental skills and understanding the architectural drawings (Axes - Interior and exterior dimensions - Finishes tables…).</td></tr>
<tr><td>References</td><td colspan="11">• Ching, Francis D.K., Building Construction Illustrated, Van Nostrand Reinhold, 2008, ISBN-13: 978-0470087817.
• Highfield, David, Refurbishment and Upgrading of Building, London: E&FN Spon, 2000, ISBN13: 978–0–203–87916–0.
• Hardy, Steve, Time – Saver, Details for Roof Design, New York: McGraw-Hill,1997, ISBN-13: 978-0070263680.
• McKay W.B., Building Construction, Volume 1, Longman, 1971, ISBN-13: 978-0582422155.</td></tr>
<tr><td>Used in Program</td><td colspan="6">Civil Engineering Program</td><td colspan="3">Semester</td><td colspan="2">5</td></tr>
</table>

Program # 9 Architectural Engineering Program

Program Description

Architecture is facing a dilemma between human/cultural values and the technical capabilities of construction. In addition, the rapid development in digital technology is changing our ways of communication, expression, perception, thought and interaction. The architectural engineering program at Faculty of Engineering Benha, Benha University aims to implement the latest advances in Information and Communication Technology (ICT), stresses the local and historical context, and incorporates construction engineering. This will lead to a positive contribution to human development efforts in Egypt. The program strives to provide graduates with the necessary tools so that they can play a leading role in both local and international markets. Graduates of the architectural engineering program are educated to respect, analyze, and protect different cultural and social backgrounds. In addition, they are prepared to respond to local contexts and the local identity of prospective areas of work in addition to accepting their social responsibility.

Basic Information

Program Mission

The architecture program at Benha Faculty of Engineering is committed to preparing an architect who is intellectually and scientifically qualified and has the ability to compete in the labor market and keep pace with scientific and technological development in the field of architecture in a manner that serves and achieves the needs of society within the framework of an ethical approach that allows continuous improvement and preservation of the environment and society.

Program Objectives

1. Provide the students with a wide spectrum of fundamentals of the science and specialized skills with analytic, creativity and critical thinking to identify and solve architecture design problems in real life situation.
2. Prepare qualified innovative architects who can adhere to architectural engineering ethics and standards and work to develop the profession and the community and promote sustainability principles.
3. Enhance student's ability to work and lead a heterogeneous team and display leadership qualities, business administration, and entrepreneurial skills.
4. Promote student's capabilities to use techniques and modern engineering tools in architectural design and construction drawings.
5. Develop student's self-learning skills to communicate effectively in academic/professional fields.
6. Improve students' ability to solve problems, decision-making skills and develop architectural and urban solutions to serve the local community.
7. Inform students to create architectural designs that satisfy both aesthetic, technical and meet building users' requirements

Graduates Attributes

The graduate of the Architectural Engineering Program must be able to:

1. Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real life situations.
2. Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation.
3. Behave professionally and adhere to engineering ethics and standards.
4. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance.
5. Recognize his/her role in promoting the engineering field and contribute in the development of the profession and the community.
6. Value the importance of the environment, both physical and natural, and work to promote sustainability principles.
7. Use techniques, skills and modern engineering tools necessary for engineering practice.
8. Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies.
9. Communicate effectively using different modes, tools and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner.
10. Demonstrate leadership qualities, business administration and entrepreneurial skills
11. Knowing the laws, legislations and requirements in the field of architecture and urbanism and how to apply them to meet local needs and global developments.
12. The ability to combine outstanding creative design with technological development to improve the quality of the built environment and meet social, technological, and environmental challenges.

Program Learning Outcomes

According to NARS 2018 the graduate of architectural engineering program must be able to:

Level	Program Learning Outcomes
A	PLO1: Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science and mathematics.
	PLO2: Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.
	PLO3: Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.
	PLO4: Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.
	PLO5: Practice research techniques and methods of investigation as an inherent part of learning.
	PLO6: Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.
	PLO7: Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural team
	PLO8: Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.
	PLO9: Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

	PLO10: Acquire and apply new knowledge; and practice self, lifelong and other learning strategies.
B	PLO11: Create architectural, urban and planning designs that satisfy both aesthetic and technical requirements, using adequate knowledge of: history and theory, related fine arts, local culture and heritage, technologies and human sciences.
	PLO12: Produce designs that meet building users' requirements through understanding the relationship between people and buildings, and between buildings and their environment; and the need to relate buildings and the spaces between them to human needs and scale.
	PLO13: Generate ecologically responsible, environmental conservation and rehabilitation designs; through understanding of: structural design, construction, technology and engineering problems associated with building designs.
	PLO14: Transform design concepts into buildings and integrate plans into overall planning within the constraints of: project financing, project management, cost control and methods of project delivery; while having adequate knowledge of industries, organizations, regulations and procedures involved.
	PLO15: Prepare design project briefs and documents, and understand the context of the architect in the construction industry, including the architect's role in the processes of bidding, procurement of architectural services and building production.

Faculty Mission versus Program Mission Matrix

<table>
<tr><th colspan="2" rowspan="3">Faculty Mission</th><th colspan="3">Program Mission</th></tr>
<tr><td colspan="3">The architecture program at Benha Faculty of Engineering is committed to preparing an architect who is intellectually and scientifically qualified and has the ability to compete in the labor market and keep pace with scientific and technological development in the field of architecture in a manner that serves and achieves the needs of society within the framework of an ethical approach that allows continuous improvement and preservation of the environment and society.</td></tr>
<tr><td>The architecture program at Benha Faculty of Engineering is committed to preparing an architect who is intellectually and scientifically qualified and has the ability to compete in the market labor.</td><td>Keep pace with scientific and technological development in the field of architecture.</td><td>In a manner that serves and achieves the needs of society within the framework of an ethical approach that allows continuous improvement and preservation of the environment and society.</td></tr>
<tr><td rowspan="3">Benha Faculty of Engineering - Benha University is committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market, and capable of using and developing modern technology, and providing research in engineering fields to serve society and community.</td><td>Benha Faculty of Engineering - Benha University is committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market</td><td>√</td><td></td><td></td></tr>
<tr><td>Capable of using and developing modern technology</td><td></td><td>√</td><td></td></tr>
<tr><td>Providing research in engineering fields to serve society and community</td><td></td><td></td><td>√</td></tr>
</table>

Program Mission versus Program Objectives Matrix

<table>
<tr><th colspan="2" rowspan="2">Program Mission</th><th colspan="7">Program Objectives</th></tr>
<tr><th>PO1</th><th>PO2</th><th>PO3</th><th>PO4</th><th>PO5</th><th>PO6</th><th>PO7</th></tr>
<tr><td rowspan="3">The architecture program at Benha Faculty of Engineering is committed to preparing an architect who is intellectually and scientifically qualified and has the ability to compete in the labor market and keep pace with scientific and technological development in the field of architecture in a manner that serves and achieves the needs of society within the framework of an ethical approach that allows continuous improvement and preservation of the environment and society.</td><td>The architecture program at Benha Faculty of Engineering is committed to preparing an architect who is intellectually and scientifically qualified and has the ability to compete in the market labor.</td><td>✓</td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Keep pace with scientific and technological development in the field of architecture.</td><td>✓</td><td></td><td></td><td>✓</td><td></td><td></td><td>✓</td></tr>
<tr><td>In a manner that serves and achieves the needs of society within the framework of an ethical approach that allows continuous improvement and preservation of the environment and society.</td><td></td><td>✓</td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
</table>

Program Objectives vs. Program Learning Outcomes Matrix

The following matrix is needed to judge the adaptability of architectural engineering program with the competencies according to NARS 2018.

Program Objectives	Program Learning Outcomes														
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4	B5
PO1	√	√							√			√			
PO2			√									√	√		
PO3							√	√	√						
PO4				√				√		√					
PO5					√			√		√					
PO6						√			√					√	√
PO7			√	√		√					√				

Program Objectives vs. Graduate Attributes Matrix

Program Objectives	Graduate Attributes											
	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
PO1	✓	✓										
PO2			✓		✓	✓						
PO3				✓						✓		
PO4							✓					
PO5								✓	✓			
PO6											✓	✓
PO7											✓	✓

Career Prospects

Working closely with users and the local community, the architect's job description entails ensuring that designs not only meet the requirements, but are also cost-effective, and safe. An architect's job entails overseeing a project from start to finish while collaborating with a variety of construction experts such as engineers and surveyors. Students who finish a Higher Degree go on to satisfying jobs in architecture, construction, management, the arts, and community development, as well as a variety of other fields related to architecture and the built environment.

Requirements of Program Courses

In order to get a Bachelor of Science Degree in this program and to satisfy the Program learning outcomes, the following set of courses need to be completed.

Program Requirements

Requirement		Cr. Hrs.	Ct. Hr.			
			Lect.	Lab.	Tut.	Sum
Benha University Requirements		14	14	0	0	14
Benha Faculty of Engineering Requirements		32	20	35	45	50
Program Requirements	From Basic science	18	13	7	7	27
	Compulsory Courses	96	62	8	74	144
	Elective courses	18	12	4	8	24
Total		160	111	60	55	232

Program Requirements

Lists of Compulsory Courses (96 Cr. Hrs.)

Code	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lec.	Lab.	Tut.	Sum
ARC 101	Architecture Design 1		3	1	0	4	5
ARC 111	Introduction to Building Technology		3	2	0	3	5
ARC 131	Theory of Architecture 1		2	2	0	1	3
ARC 103	Visual Design		3	2	0	2	4
ARC 102	Architecture Design 2	ARC 101	3	1	0	4	5
ARC 112	Building Construction 1	ARC 111	3	2	0	3	5
ARC 132	History of Architecture 1		2	2	0	1	3
ARC 104	Perspective and Sciography		2	1	0	2	3
ARC 142	Computer Applications 1		3	2	2	0	4
ARC 152	Environmental Control & Design		2	2	0	1	3
ARC 201	Architecture Design 3	ARC 102	3	1	0	4	5
ARC 211	Building Construction 2	ARC 112	3	2	0	3	5
ARC 231	Theory of Architecture 2	ARC 131	2	2	0	1	3
ARC 221	Introduction to Urban Planning		3	2	0	2	4
ARC 213	Technical Installation		3	2	0	2	4
ARC 241	Computer Applications 2	ARC 142	3	2	2	0	4
ARC 202	Architecture Design 4	ARC 201	3	1	0	4	5

ARC 212	Working Drawing 1	ARC 211	3	1	0	4	5
ARC 232	History of Architecture 2	ARC 132	2	2	0	1	3
ARC 252	Smart Buildings Design	ARC 152	2	2	0	1	3
ARC 222	Introduction to Housing		3	2	0	2	4
ARC 214	Profession Practice &Building Legislation		2	2	0	1	3
ARC 361	Senior Design Project-1	---	2	1	0	3	4
ARC 311	Working Drawing 2	ARC 212	3	1	0	4	5
ARC 313	Quantities & Specifications		3	2	0	2	4
ARC 321	Introduction to Urban Design		3	2	0	2	4
ARC 334	Theory of Architecture 3	ARC 231	2	2	0	1	3
ARC 362	Senior Design Project-2	ARC 361	4	2	0	4	6
ARC 312	Working Drawing 3	ARC 311	3	1	0	4	5
ARC 421	Introduction to Landscape Architecture		3	2	0	2	4
CIV 123	Structure Analysis	BES 021	3	2	0	2	4
CIV 143	Construction Survey	BES 012	3	2	2	0	4
CIV 259	Design of RC Structures	CIV 123	2	2	0	1	3
CIV 339	Soil Mechanics & Foundations	CIV 259	3	2	2	0	4
CIV 229	Design of Steel Structures	CIV 123	2	2	0	1	3
CIV 401	Construction Engineering & Management		2	2	0	1	3
Total			96	63	8	73	144

*The student can register the Senior Design Project course after passing 70% of the program Cr. Hrs., i.e., 112 Cr. Hrs.

Lists of elective courses (18 Cr. Hrs.)

Elective Courses 1							
Code	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lec.	Lab.	Tut.	Sum
ARC 352	Acoustics and Daylighting in Buildings	ARC 152	3	2	0	2	4
ARC 314	Building Codes	ARC 214	3	2	0	2	4
ARC 302	Interior Design 1	ARC 103, ARC 202	3	2	0	2	4
Elective Courses 2							
Code	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lec.	Lab.	Tut.	Sum
ARC 342	Computer Aided Environmental Design	ARC 152, ARC 202	3	2	2	0	4
ARC 344	Computer Applications 3	ARC 241	3	2	2	0	4
ARC 346	Digital Presentation in Architecture	ARC 241, ARC 202	3	2	2	0	4
Elective Courses 3							
Code	Course Name	Pre-	Cr.	Ct. Hr.			

		requisites	Hrs.	Lec.	Lab.	Tut.	Sum
ARC 322	Urban Sociology	ARC 321	3	2	0	2	4
ARC 324	New Trends in Urbanism	ARC 321	3	2	0	2	4
ARC 326	Transportation of Urban Planning	ARC 221	3	2	0	2	4
Elective Courses 4							
Code	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lec.	Lab.	Tut.	Sum
ARC 451	Sustainable Community Design	ARC 152, ARC 252	3	2	0	2	4
ARC 401	Interior Design 2	ARC 302	3	2	0	2	4
ARC 403	Architecture Criticism	ARC 202	3	2	0	2	4
Elective Courses 5							
Code	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lec.	Lab.	Tut.	Sum
ARC 441	GIS in Planning	ARC 221, ARC 241	3	2	2	0	4
ARC 443	Advanced Modeling	ARC 344	3	2	2	0	4
ARC 445	Digital Media in Architectural Design	ARC 241	3	2	2	0	4
Elective Courses 6							
Code	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lec.	Lab.	Tut.	Sum
ARC 423	Aesthetics and Urban Design	ARC 152, ARC 202	3	2	0	2	4
ARC 425	Human Behavior & Urban Form	ARC 322	3	2	0	2	4
ARC 427	Qualitative Methods of Urban Planning	ARC 221	3	2	0	2	4

Proposed Study Plan

Level 0-1													
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lect.	Lab.	Tut.	Sum		St. Act.	Mids.	PE/ OE	Final Exam	Sum
BES 011	Mathematics I	-----	3	2	0	2	4	2	30	30	-	40	100
BES 021	Mechanics I	-----	3	2	0	2	4	2	30	30	-	40	100
BES 041	General Chemistry	-----	4	3	2	1	6	2	10	30	20	40	100
BES 031	Physics 1	-----	3	2	2	1	5	2	10	30	20	40	100
MEC 011	Engineering Graphics	-----	2	0	0	4	4	2	30	30	-	40	100
UHS 101	Foreign Language	-----	2	2	0	0	2	2	30	30	-	40	100
UHS 102	Information and Communication Technology	-----	2	2	0	0	2	2	30	30	-	40	100
Sum			19	13	4	10	27						700

Level 0-2													
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lect.	Lab.	Tut.	Sum		St. Act.	Mids.	PE/ OE	Final Exam	Sum
BES 012	Mathematics II	BES 011	3	2	0	2	4	2	30	30	-	40	100
BES 022	Mechanics II	BES 021	3	2	0	2	4	2	30	30	-	40	100
BES 032	Physics II	-----	3	2	2	1	5	2	10	30	20	40	100
MEC 014	Computer Aided Drafting	MEC 011	2	1	2	0	3	2	10	30	20	40	100
ELE 042	Computer Programming Fundamentals	-----	2	0	2	2	4	2	10	30	20	40	100
MEC 012	Production Engineering	-----	2	1	3	0	4	2	10	30	20	40	100
UHS 103	Societal Issue	-----	2	2	0	0	2	2	30	30	-	40	100
Sum			17	10	9	7	26						700

Level 1-1														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lect.	Lab.	Tut.	Sum		St. Act.	Mids.	PE/ OE	Final Exam	Sum
ARC 101	Architecture Design 1	-----	3	1	0	4	5	6	30	30	-	40	100
ARC 111	Introduction to Building Technology	-----	3	2	0	3	5	4	30	30	-	40	100
ARC 131	Theory of Architecture 1	-----	2	2	0	1	3	2	30	30	-	40	100
ARC 103	Visual Design	-----	3	2	0	2	4	4	30	30	-	40	100
CIV 123	Structure Analysis	BES 021	3	2	0	2	4	2	30	30	-	40	100
BES 141	Pollution & Industrial Safety	BES 041	2	2	1	0	3	2	10	30	20	40	100
Sum			16	11	1	12	24						600

Level 1-2														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lect.	Lab.	Tut.	Sum		St. Act.	Mids.	PE/ OE	Final Exam	Sum
ARC 102	Architecture Design 2	ARC 101	3	1	0	4	5	6	30	30	-	40	100
ARC 112	Building Construction 1	ARC 111	3	2	0	3	5	4	30	30	-	40	100
ARC 132	History of Architecture 1	-----	2	2	0	1	3	2	30	30	-	40	100
ARC 104	Perspective and Sciography	-----	2	1	0	2	3	4	30	30	-	40	100
ARC 142	Computer Applications 1	-----	3	2	2	0	4	2	30	30	-	40	100
ARC 152	Environmental Control & Design	-----	2	2	0	1	3	3	30	30	-	40	100
CIV 143	Construction Survey	BES 012	3	2	2	0	4	2	10	30	20	40	100
Sum			18	12	4	11	27						700

Field Training I														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lect.	Lab.	Tut.	Sum		St. Act.	Mids.	PE/ OE	Final Exam	Sum
FTR 103	Field Training I	Completion of 65 Cr. Hrs.	0	0	0	0	0	Oral	-	-	Pass or Fail	-	-

Level 2-1													
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lect.	Lab.	Tut.	Sum		St. Act.	Mids.	PE/ OE	Final Exam	Sum
ARC 201	Architecture Design 3	ARC 102	3	1	0	4	5	6	30	30	-	40	100
ARC 211	Building Construction 2	ARC 112	3	2	0	3	5	4	30	30	-	40	100
ARC 231	Theory of Architecture 2	ARC 131	2	2	0	1	3	2	30	30	-	40	100
ARC 221	Introduction to Urban Planning	-----	3	2	0	2	4	4	30	30	-	40	100
ARC 213	Technical Installation	-----	3	2	0	2	4	3	30	30	-	40	100
ARC 241	Computer Applications 2	ARC 142	3	2	2	0	4	2	30	30	-	40	100
CIV 259	Design of RC Structures	CIV 123	2	2	0	1	3	2	30	30	-	40	100
Sum			19	13	2	13	28						700

Level 2-2														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lect.	Lab.	Tut.	Sum		St. Act.	Mids.	PE/ OE	Final Exam	Sum
ARC 202	Architecture Design 4	ARC 201	3	1	0	4	5	6	30	30	-	40	100
ARC 212	Working Drawing 1	ARC 211	3	1	0	4	5	6	30	30	-	40	100
ARC 232	History of Architecture 2	ARC 132	2	2	0	1	3	2	30	30	-	40	100
ARC 252	Smart Buildings Design	ARC 152	2	2	0	1	3	3	30	30	-	40	100
ARC 222	Introduction to Housing	-----	3	2	0	2	4	4	30	30	-	40	100
ARC 214	Profession Practice &Building Legislation	-----	2	2	0	1	3	3	30	30	-	40	100
CIV 229	Design of Steel Structures	CIV 123	2	2	0	1	3	2	30	30	-	40	100
Sum			17	12	0	14	26						700

Field Training II													
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lect.	Lab.	Tut.	Sum		St. Act.	Mids.	PE/ OE	Final Exam	Sum
FTR 203	Field Training II	Completion of 96 Cr. Hrs.	0	0	0	0	0	Oral	-	-	Pass or Fail	-	-

Level 3-1														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lect.	Lab.	Tut.	Sum		St. Act.	Mids.	PE/ OE	Final Exam	Sum
ARC 361	Senior Design Project-1	---	2	1	0	3	4	6	50	-	50	--	100
ARC 311	Working Drawing 2	ARC 212	3	1	0	4	5	6	30	30	-	40	100
ARC 313	Quantities & Specifications	-----	3	2	0	2	4	3	30	30	-	40	100
ARC 321	Introduction to Urban Design	-----	3	2	0	2	4	4	30	30	-	40	100
ARC XXX*	Elective 1	*	3	2	0	2	4	3	30	30	-	40	100
CIV 339	Soil Mechanics & Foundations	CIV 259	3	2	2	0	4	2	10	30	20	40	100
UHS XXX	Humanities - Elective 1	-----	2	2	0	0	2	2	30	30	-	40	100
Sum			19	12	2	13	27						700

* According to the Course Name

Level 3-2														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lect.	Lab.	Tut.	Sum		St. Act.	Mids.	PE/ OE	Final Exam	Sum
ARC 362	Senior Design Project-2	ARC 361	4	2	0	4	6	Oral	50	-	50	--	100
ARC 312	Working Drawing 3	ARC 311	3	1	0	4	5	6	30	30	-	40	100
ARC 334	Theory of Architecture 3	ARC 231	2	2	0	1	3	2	30	30	-	40	100
ARC XXX**	Elective 2	*	3	2	2	0	4	2	10	30	20	40	100
ARC XXX***	Elective 3	*	3	2	0	2	4	3	30	30	-	40	100
UHS XXX	Humanities - Elective 2	-----	2	2	0	0	2	2	30	30	-	40	100
UHS 104	Professional Ethics	-----	2	2	0	0	2	2	30	30	-	40	100
Sum			19	13	2	11	26						700

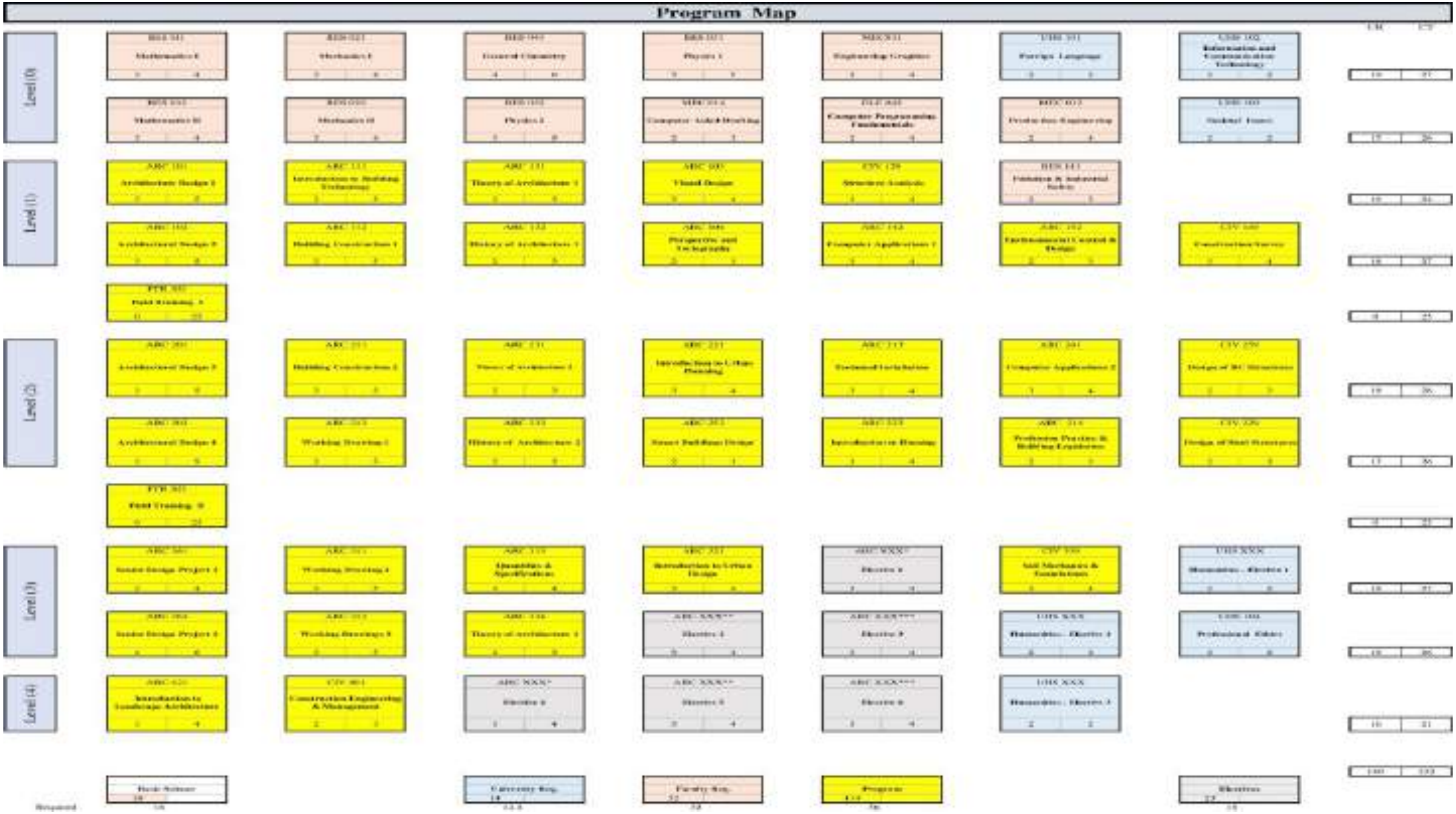
* According to the Course Name

Level 4-1														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lect.	Lab.	Tut.	Sum		St. Act.	Mids.	PE/ OE	Final Exam	Sum
ARC 421	Introduction to Landscape Architecture	-----	3	2	0	2	4	4	30	30	-	40	100
CIV 401	Construction Engineering & Management	-----	2	2	0	1	3	2	30	30	-	40	100
ARC XXX*	Elective 4	*	3	2	0	2	4	3	30	30	-	40	100
ARC XXX**	Elective 5	*	3	2	2	0	4	2	30	30	-	40	100
ARC XXX***	Elective 6	*	3	2	0	2	4	3	30	30	-	40	100
UHS XXX	Humanities - Elective 3	-----	2	2	0	0	2	2	30	30	-	40	100
Sum			16	12	2	7	21						600

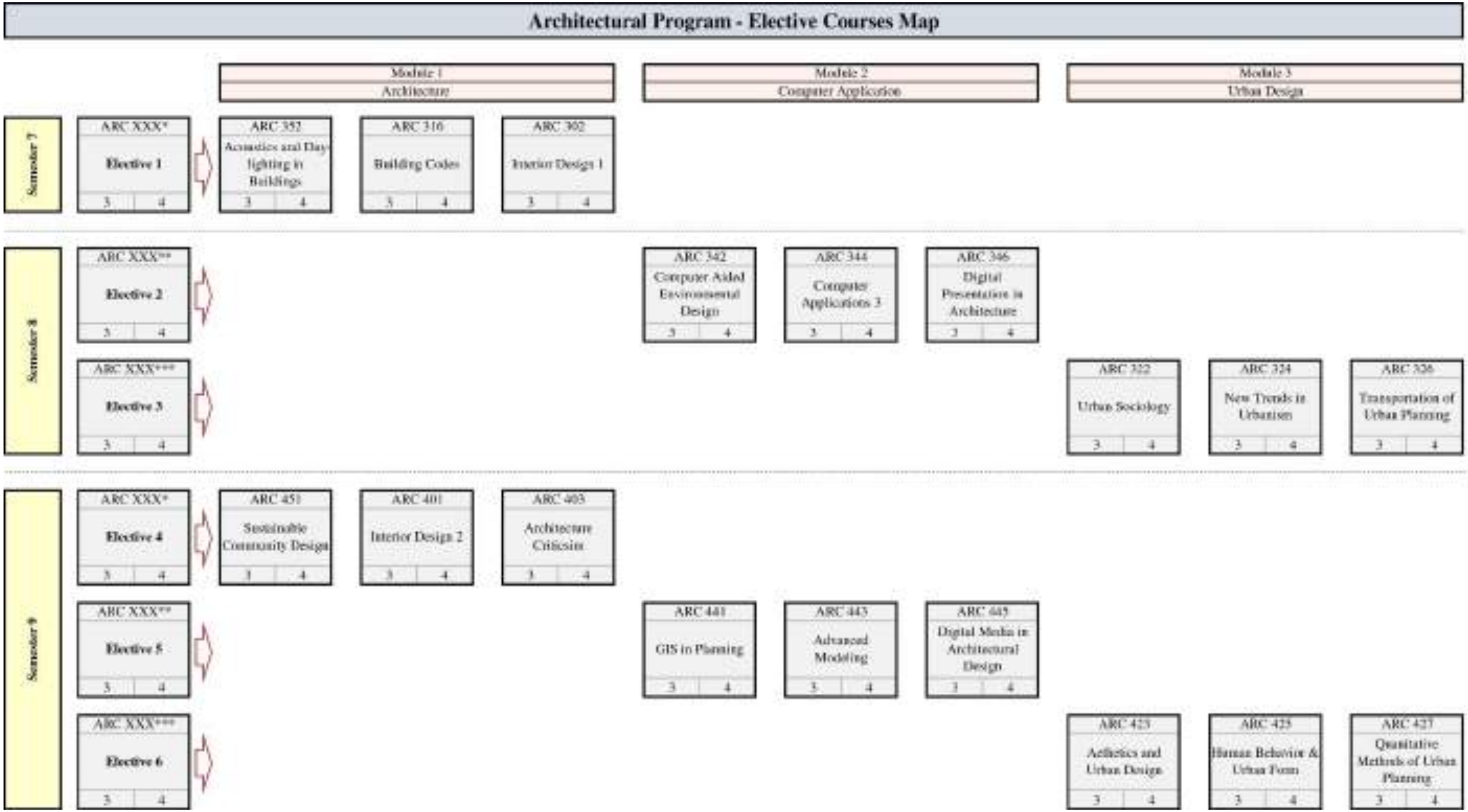
* According to the Course Name

Program Plan and Matrix

Program Map

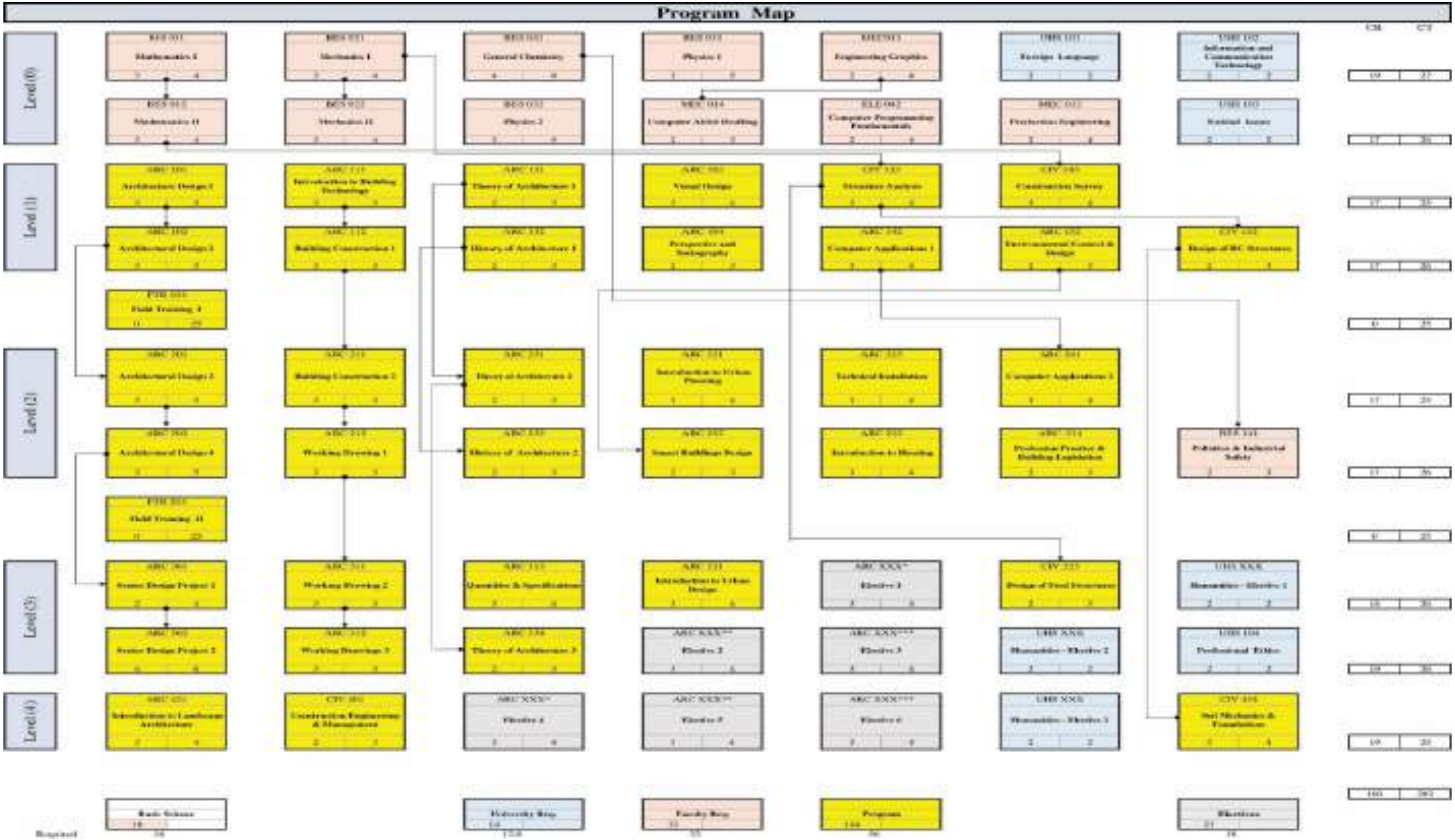


Elective Courses Flow Chart

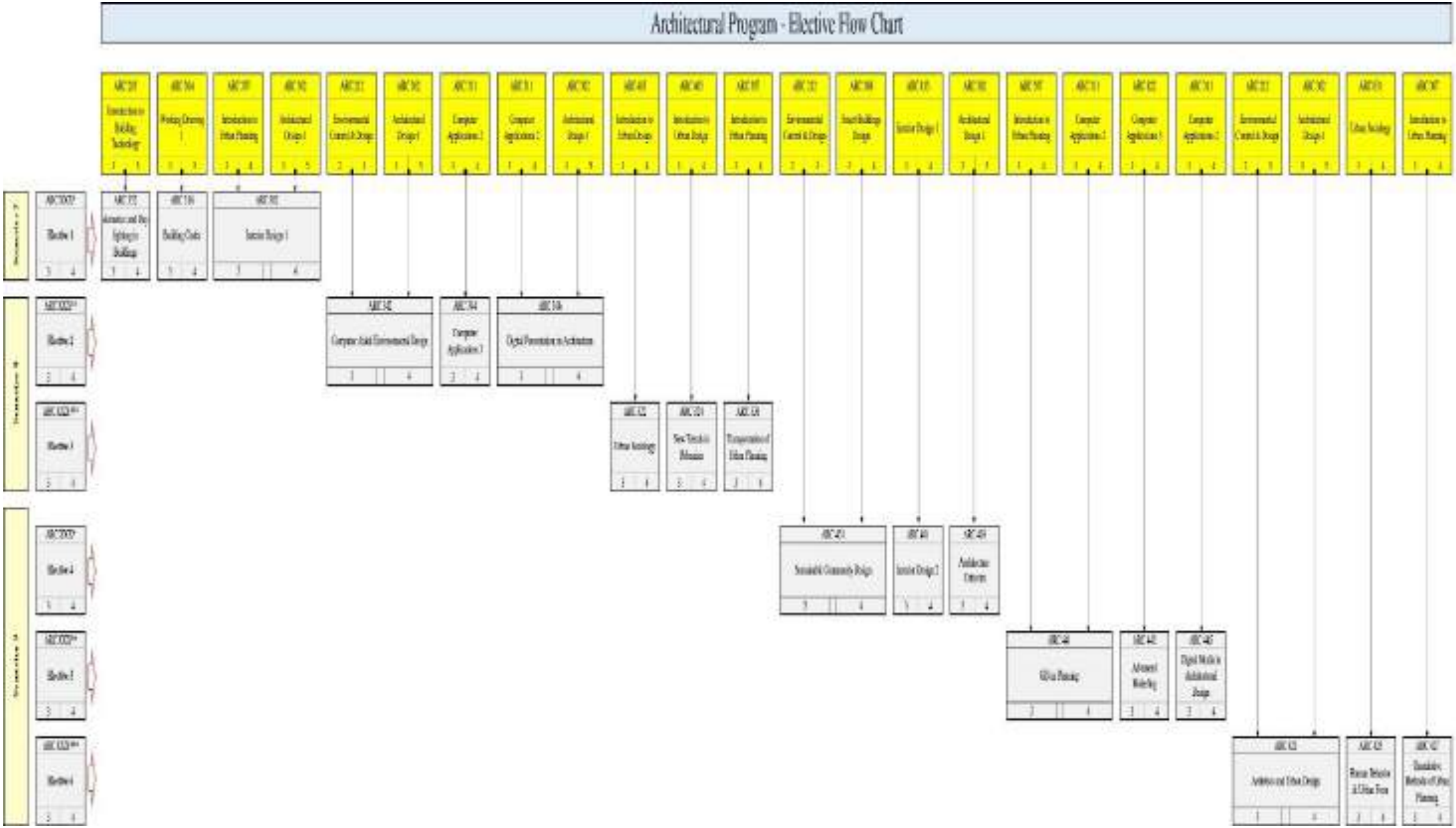


Course Prerequisites Flow Chart

Compulsory Courses Flow Chart



Elective Courses Flow Chart



Program Learning Outcomes to Program Courses Matrix

Courses			Program Learning Outcomes														
Levels	Code	Title	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15
Level 0-1	BES 011	Mathematics I	*		*												
	BES 021	Mechanics I	*	*													
	BES 041	General Chemistry	*	*													
	BES 031	Physics 1	*	*													
	MEC 011	Engineering Graphics						*		*							
	UHS 101	Foreign Language								*		*					
	UHS 102	Information and Communication Technology				*						*					
Level 0-2	BES 012	Mathematics II	*		*												
	BES 022	Mechanics II	*	*													
	BES 032	Physics 2	*	*													
	MEC 014	Computer Aided Drafting							*	*							
	ELE 042	Computer Programming Fundamentals	*		*												
	MEC 012	Production Engineering				*		*									
	UHS 103	Societal Issue							*			*					
Level 1-1	ARC 101	Architecture Design 1									*		*	*			
	ARC 111	Introduction to Building Technology					*		*						*		
	ARC 131	Theory of Architecture 1					*					*	*	*			
	ARC 103	Visual Design									*		*				
	CIV 123	Structure Analysis	*												*		
	BES 141	Pollution & Industrial Safety	*		*	*											
Level 1-2	ARC 102	Architecture Design 2									*		*	*			
	ARC 112	Building Construction 1					*								*		

	ARC 132	History of Architecture 1										*	*	*			
	ARC 104	Perspective and Sciography								*		*	*				
	ARC 142	Computer Applications 1								*			*				
	ARC 152	Environmental Control & Design			*				*					*	*		
	CIV 143	Construction Survey	*	*											*		
	FTR 103	Field Training I							*			*					
Level 2-1	ARC 201	Architecture Design 3									*		*	*			
	ARC 211	Building Construction 2					*								*		
	ARC 231	Theory of Architecture 2					*					*	*	*			
	ARC 221	Introduction to Urban Planning					*		*		*		*				
	ARC 213	Technical Installation					*								*		*
	ARC 241	Computer Applications 2								*			*				
	CIV 259	Design of RC Structures			*	*									*		
Level 2-2	ARC 202	Architecture Design 4									*		*	*			
	ARC 212	Working Drawing 1						*							*	*	
	ARC 232	History of Architecture 2										*	*	*			
	ARC 252	Smart Buildings Design			*							*			*		
	ARC 222	Introduction to Housing							*		*		*	*			
	ARC 214	Profession Practice &Building Legislation						*								*	*
	CIV 229	Design of Steel Structures			*	*									*		
	FTR 203	Field Training II							*			*					
Level 3-1	ARC 361	Senior Design Project-1			*			*			*		*	*	*		
	ARC 311	Working Drawing 2						*							*	*	*
	ARC 313	Quantities & Specifications						*								*	*
	ARC 321	Introduction to Urban Design							*				*	*			
	ARC XXX*	Elective 1				*									*		
	CIV 339	Soil Mechanics & Foundations		*	*										*		
	UHS XXX	Humanities - Elective 1			*	*											

Level 3-2	ARC 362	Senior Design Project-2			*			*			*		*	*	*		
	ARC 312	Working Drawing 3						*							*	*	*
	ARC 334	Theory of Architecture 3											*	*			
	ARC XXX**	Elective 2								*			*				
	ARC XXX***	Elective 3					*						*	*			
	UHS 104	Professional Ethics				*	*										
	UHS XXX	Humanities - Elective 2								*	*						
Level 4-1	ARC 421	Introduction to Landscape Architecture									*		*	*			
	CIV 401	Construction Engineering & Management						*								*	*
	ARC XXX*	Elective 4					*						*		*		
	ARC XXX**	Elective 5								*			*				
	ARC XXX***	Elective 6					*						*	*			
	UHS XXX	Humanities - Elective 3					*					*					

Matching Architectural Engineering Program Courses with ABET Requirements

ABET Program Criteria for Architecture and Similarly Named Engineering Programs

Lead Society: American Society of Civil Engineers

<table>
<tr><th colspan="2" rowspan="2">ABET Criteria</th><th colspan="3">Architecture Engineering Program Courses Required to Cover ABET Criteria</th></tr>
<tr><th>CODE</th><th>Course Name</th><th>Cr. Hrs.</th></tr>
<tr><td rowspan="6">A minimum of 30 semester credit hours (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program.</td><td rowspan="2">The curriculum must prepare graduates to apply knowledge of mathematics through differential equations.</td><td>BES 011</td><td>Mathematics I</td><td>3</td></tr>
<tr><td>BES 012</td><td>Mathematics II</td><td>3</td></tr>
<tr><td rowspan="2">Chemistry</td><td>BES 041</td><td>General Chemistry</td><td>4</td></tr>
<tr><td>BES 141</td><td>Pollution and Industrial Safety</td><td>2</td></tr>
<tr><td rowspan="2">Calculus-based physics</td><td>BES 031</td><td>Physics I</td><td>3</td></tr>
<tr><td>BES 032</td><td>Physics II</td><td>3</td></tr>
<tr><td colspan="4">Total</td><td>18</td></tr>
<tr><td rowspan="14">A minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design and utilizing modern engineering tools.</td><td rowspan="12">The four basic architectural engineering curriculum areas are building structures, building mechanical systems, building electrical systems, and construction/construction management.</td><td>ARC 111</td><td>Introduction to Building Technology</td><td>3</td></tr>
<tr><td>ARC 112</td><td>Building Construction 1</td><td>3</td></tr>
<tr><td>ARC 211</td><td>Building Construction 2</td><td>3</td></tr>
<tr><td>ARC 213</td><td>Technical Installation</td><td>3</td></tr>
<tr><td>ARC 212</td><td>Working Drawing 1</td><td>3</td></tr>
<tr><td>ARC 214</td><td>Profession Practice &Building Legislation</td><td>2</td></tr>
<tr><td>ARC 311</td><td>Working Drawing 2</td><td>3</td></tr>
<tr><td>ARC 313</td><td>Quantities & Specifications</td><td>3</td></tr>
<tr><td>ARC 312</td><td>Working Drawing 3</td><td>3</td></tr>
<tr><td>CIV 123</td><td>Structure Analysis</td><td>3</td></tr>
<tr><td>CIV 259</td><td>Design of RC Structures</td><td>2</td></tr>
<tr><td>CIV 401</td><td>Construction Engineering & Management</td><td>2</td></tr>
<tr><td rowspan="2">Discuss the basic concepts of architecture in a context of architectural design</td><td>ARC 221</td><td>Introduction to Urban Planning</td><td>3</td></tr>
<tr><td>ARC 222</td><td>Introduction to Housing</td><td>3</td></tr>
<tr><td rowspan="2">A minimum of 45 semester credit hours (or equivalent) of engineering topics</td><td rowspan="2">Discuss the basic concepts of architecture in a context of architectural design</td><td>ARC 321</td><td>Introduction to Urban Design</td><td>3</td></tr>
<tr><td>ARC 421</td><td>Introduction to Landscape</td><td>3</td></tr>
</table>

appropriate to the program, consisting of engineering and computer sciences and engineering design and utilizing modern engineering tools.			Architecture	
	Discuss the basic concepts of architecture in a context of history	ARC 131	Theory of Architecture 1	2
		ARC 132	History of Architecture 1	2
		ARC 231	Theory of Architecture 2	2
		ARC 232	History of Architecture 2	2
		ARC 334	Theory of Architecture 3	2
	Considers the systems or processes from other architectural engineering curricular areas	ARC 101	Architecture Design 1	3
		ARC 102	Architecture Design 2	3
		ARC 201	Architecture Design 3	3
		ARC 202	Architecture Design 4	3
		ARC 361	Senior Design Project-1	2
		ARC 362	Senior Design Project-2	3
	Includes communication and collaboration with other design or construction team members	UHS 302	Leadership Skills	2
		UHS 104	Professional Ethics	2
	Include principles of sustainability in design.	ARC 152	Environmental Control & Design	2
		ARC 252	Smart Buildings Design	2
		UHS 604	Environment & Sustainable Development	2
	Includes computer-based technology and considers applicable codes and standards.	ARC 142	Computer Applications 1	3
		ARC 241	Computer Applications 2	3
Total				**102**

Courses offered to Architecture Engineering Program

The course coding system is composed of three letters 3 letters that denotes the department who offers the course, followed by 3 digits: where:

- the first digit from left represents the course level (from 0 to 4),
- the middle digit represents the discipline who offers the course in the department, and
- the right digit represents the course sequence.

The coding system is demonstrated in the following table:

ARC XXX	Course offered by Architecture Engineering Department
CIV XXX	Course offered by Civil Engineering Department
ARC X0X	General & Design Courses
ARC X1X	Building Construction & Technology Courses
ARC X2X	Urban Design & Planning Courses
ARC X3X	History & Theory of Architecture Courses
ARC X4X	Computer Application Courses
ARC X5X	Environmental Courses
ARC X6X	Graduation Project

Abbreviations used:

Pre-req	Prerequisite	**Cr. Hrs.**	Credit Hour	**SA**	Student Activity
MT	Midterm Exam	**PE**	Practical Exam	**OE**	Oral Exam

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 101	Architectural Design 1	-	3	1	0	4	5	30	30	-	40
Course Contents	This course is an introduction to the fundamentals of architectural design through the design process, analyses, concepts, development, and presentation .Students will address fundamental lessons of architecture drawing techniques, geometry, proportion, scale and spatial definition with an emphasis on the principles of designing residential buildings. (Zoning and concept development). Drawings will be required for small scale building – final project (plan, elevations, sections, and layout). Physical models are asked to be made to support visualization of ideas in three dimensions.										
References	R Conway and Roenisch, 1987, Understanding Architecture, Routledge of Keegan, London										
	Generative Design: Form-finding Techniques in Architecture (Form + Technique) – Laurence King Publishing (February 9, 2016)										
	ACA: Architecture completion annual. Vol 14 (Education Culture Welfare & Sports), Lee Hwa-jeong, 2020										
	Szokolay, S. (2004), Introduction to Architectural Science; Basis for Sustainable Design, Oxford: Architectural Press										

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 102</td><td>Architecture Design 2</td><td>ARC 101</td><td>3</td><td>1</td><td>0</td><td>4</td><td>5</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">This course intends to help students further develop their architectural design abilities through the solution of moderately complex multi-functional programs. Emphasis is placed on the use of context, program functional and spatial requirements as a basis for the generation of design solutions as well as the appropriate solution of circulation and integration of structure in design development considering public buildings (commercial, administrative, mixed use, etc.) With the ability to generate creative forms. Drawings will be required for final project and perspective views.</td></tr>
<tr><td rowspan="4">References</td><td colspan="11">Szokolay, S. (2004), Introduction to Architectural Science; Basis for Sustainable Design, Oxford: Architectural Press.</td></tr>
<tr><td colspan="11">Nufert Architects' Data, 5th Edition, SBN: 978-1-119-28435-2 August 2019 WileyBlackwell</td></tr>
<tr><td colspan="11">Architecture: Form, space, and order, FDK Ching - 2014 - John Wiley & Sons</td></tr>
<tr><td colspan="11">Snodgrass, Adrian and Richard Coyne, Interpretation in Architecture: Design as Way of Thinking, Routledge, 2013</td></tr>
</table>

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 103</td><td>Visual Design</td><td>-</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">The course aims at developing students' skills related to visualization and visual expression of architectural/landscaping forms. It familiarizes students with basic skills, media (pencils, pen & ink, color media), and principles (shades/lights; depth/distance cues; colors/color schemes; rendering techniques; etc.) of drafting communication.
Topics include also photography, methods of model making, and principles of composition and aesthetic evaluation such as unity, proportions (Golden section, orders, module, etc.), balance, rhythm, contrast, symmetry, hierarchy, etc.</td></tr>
<tr><td rowspan="4">References</td><td colspan="11">Wang Shaoqiang, Sceno graphics Set Design & Paper craft Art, A New Graphic Design Approach, 2015</td></tr>
<tr><td colspan="11">Jennifer Ott & Anna, 1000 Ideas for Colour Shemes, The Ultimate Guide to Making Colours Work, 2016</td></tr>
<tr><td colspan="11">Doyle, M. E. (2006). Color Drawing: Design Drawing Skills and Techniques for Architects, Landscape Architects, and Interior Designers. New Jersey: Wiley. ISBN: 978-0471741909</td></tr>
<tr><td colspan="11">Krause, J. (2014). Visual Design: Ninety-five things you need to know. Massachusetts: Adams Media ISBN: 978-0321968159</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 104</td><td>Perspective and Sciography</td><td>-</td><td>2</td><td>1</td><td>0</td><td>2</td><td>3</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">The course presents to student method of perspective drawing (convert two-dimensional vision or drawing into three-dimensional drawing and representation). This course aims to teach the students the shade and shadows of a dot, a line, a surface, and a volume, the shade and shadow of buildings in plans, elevations, layouts and isometric & perspective.
And their application in architectural project.</td></tr>
<tr><td rowspan="6">References</td><td colspan="11">أ.د/ طارق عبد الرؤوف، 2004 -2005م الظل والمنظور، كلية الهندسة جامعة القاهرة، الجيزة</td></tr>
<tr><td colspan="11">Ching, F. D. (2015). Architectural Graphics (Six Edition). New Jersey: WILEY.</td></tr>
<tr><td colspan="11">Francis D. K. Ching, S. P. (2018). Design Drawing (3rd Edition). New Jersey: WILEY.</td></tr>
<tr><td colspan="11">Tim Fisher, Drawing Masterclass Prespective, 2017</td></tr>
<tr><td colspan="11">فواز القضاة، 2015م، الظل والمنظور الهندسي، دار مجدلاوي للنشر والتوزيع. عمان/ الأردن.

Joseph D, Amelio, 2004, Perspective Drawing Handbook, Dover Publications, USA.</td></tr>
<tr><td colspan="11">Freehand Drawing Sketching- https://www.kutub.info/library/book</td></tr>
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<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 111</td><td>Introduction to Building Technology</td><td>-</td><td>3</td><td>2</td><td>0</td><td>3</td><td>5</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">This course aims to introduce students the building construction, understanding relation between architectural designs, building components. It provides a fundamental understanding how to create the different basic components of the building and provides the students with the basic knowledge of building types, elements foundations, stairs and also internal and external finishing materials.</td></tr>
<tr><td rowspan="5">References</td><td colspan="11">Ching, Francis D. K., and Cassandra Adams. Building Construction Illustrated. New York, NY: John Wiley & Sons, 2000. ISBN: 9780471358985.</td></tr>
<tr><td colspan="11">Roy Chudley & Roger Greeno, Building Construction Handbook, Routledge, U.S.A., 10th edition, 2014</td></tr>
<tr><td colspan="11">McKay, W. B. (2005). Building Construction Metric Vol. I–IV. 4th Ed. Mumbai: Orient Longman.</td></tr>
<tr><td colspan="11">محمد عبد الله، إنشاء مبانى - تكنولوجيا البناء، مكتبة الأنجلو المصرية، القاهرة، مصر، طبعة 2018م</td></tr>
<tr><td colspan="11">محمود أحمد علي، سلسلة دليلك في عالم التنفيذ جزء 1 (دليلك اعمال المواد واعمال الحفر والاحلال)، 2021م</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 112	Building Construction 1	ARC 111	3	2	0	3	5	30	30	-	40
Course Contents	This course focus on various building materials and construction techniques would be emphasized based on the performing standards and codes, wherein application of each material would be discussed in detail. It focuses on the following topics: Concrete buildings and different types of roofing systems, wooden and steel construction, and introduction to technical Installations.										
References	Barry, R. (1999). The Construction of Buildings Vol. 2. 5th Ed. New Delhi: East-West Press.										
	Ching, F. D. K. (2000). Building Construction Illustrated. 3rd Ed. Wiley.										
	Meghashyam, K. K. (2005). Reinforced Concrete Constructions for 21st C. New Delhi :J.M. Jaina										
	Allen E. & Iano j. 2014, Fundamentals of Building Construction: materials & methods, 6th . Ed. John Wiley & Sons, NJ, USA										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 131	Theory of Architecture 1	-	2	2	0	1	3	30	30	-	40
Course Contents	The course aims at introducing students to the relation between architecture and human life/needs. Topics include: design objectives (firmness, commodity and delight), anthropometric standards, services and circulation spaces, spatial relationships and zoning. Topics include also evaluating and developing design concept, in addition to theories/principles of building types such as: residential buildings, nurseries, cafeterias/restaurants, schools … etc., covering functional relationships as well as visual and environmental criteria of the studied building types.										
References	Poldma, T. (2009). Taking up Space: Exploring the design Process. New York: Fairchild Books. ISBN:1563676284										
	Luca Molinari, Architecture Movements and Trends from 19^{th} Century to the Present, 2015										
	Enis Aldal & Husam, Sitre and Composition Design Strategies in Architecture and Urbanism, 2016										
	Neufert. E. (2000). Neufert Architects' Data, 4^{th} edition. New Jersey: Wiley-Blackwell. ISBN: 978-1405192538										

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 132</td><td>History of Architecture 1</td><td>-</td><td>2</td><td>2</td><td>0</td><td>1</td><td>3</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">The course aims at introducing the students to a comparative analytical study of architecture in different cultures/historical periods including: Prehistoric architecture; Ancient Egyptian architecture (old, middle, and late kingdoms as well as Ptolemaic/Roman period); West Asiatic and Mesopotamia architecture (Babylonian, Assyrian and Persian); Classical architecture (Greek and Roman); and Early Christian and Byzantine architecture with emphasis on selected examples from Egypt (Coptic architecture).</td></tr>
<tr><td rowspan="4">References</td><td colspan="11">Fletcher, B, Cruickshank, D. (1996). Sir Banister Fletcher's a History of Architecture. New York Architectural Press. ISBN: 978-0750622677</td></tr>
<tr><td colspan="11">Ancient Egyptian Construction and Architecture (Dover Books on Architecture), Dover Publications; First Edition, Thus (February 20, 2014)</td></tr>
<tr><td colspan="11">Vedula V.L.N., Architecture Pre-History to Ore-Gothic West Asia, Mediterranean and Europe, Vedula,V.L.N. Murthy, 2019</td></tr>
<tr><td colspan="11">Ramzy, N. (2011). From Imhotep to Calatrava, Architectural Styles: The Engineering of Aesthetics Saarbrücken: Lambert Academic Publishing, ISBN: 978-3-8443-8782-7</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 142</td><td>Computer Applications 1</td><td>-</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">This course covers software applications relevant to architectural design. It aims to train the student on how to design using computer drafting techniques. It focuses on 2d and 3D computer techniques, virtual reality techniques, Simulations, decision, and evaluation techniques.</td></tr>
<tr><td rowspan="3">References</td><td colspan="11">https://teracourses.com/ar/category/engineering-programs</td></tr>
<tr><td colspan="11">https://www.freelearn110.com/courses</td></tr>
<tr><td colspan="11">https://www.computeraideddesignguide.com/
أحمد نظام أحمد، 2020، شرح برنامج أوتوكاد 2020 من الصفر وحتى الاحتراف</td></tr>
<tr><td>Laboratory</td><td colspan="11">Student's engineering sketches and drawings carried out in the engineering Computer Labs.</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 152	Environmental Control & Design	-	2	2	0	1	3	30	30	-	40
Course Contents	The course aims to provide students with an environmental conscious design, sustainable development and environmental Studies, integrated environmental assessment (IEA), traditional and renewable energy sources.										
References	التصميم المعماري الصديق للبيئة، نحو عمارة خضراء، يحيى وزيري، مكتبة الاسره، 2007										
	Ching F. 2019, Building Construction Illustrated, 6th. Ed. John Wiley & sons, NJ, USA.										
	Allen E. & Iano j. 2014, Fundamentals of Building Construction: materials & methods, 6th . Ed. John Wiley & Sons, NJ, USA										
	Lechner N. 2015. Heating, Cooling, Lighting: Sustainable Design Methods for Architects. 4 th . Ed. John Wiley & Sons, NY, USA										

Code	Course Name	Pre-req.	Cr. Hrs .	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/ OE	Final
ARC 201	Architecture Design 3	ARC 102	3	1	0	4	5	30	30	-	40
Course Contents	This course targets designing projects at an intermediate level, focusing on the ways in which the nature of structural systems and building materials affect and influence architectural design. Students begin by researching basic structural systems. The students should be able to select building materials as well as design projects with sound structural systems, to satisfy the requirements of building programs as an integral part of the design (Museums, hospital, hotel, etc.) Focusing on form and function.										
References	A Practical Guide to Critical Thinking – Hunter, David A., 2009										
	ACA: Architecture completion annual. Vol 14 (Education Culture Welfare & Sports), Lee Hwa-jeong, 2020										
	Architecture composition annual VI, Education & Sports/ Office & Terminal/ Urban Planning & Distribution, 2016										

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 202</td><td>Architecture Design 4</td><td>ARC 201</td><td>3</td><td>1</td><td>0</td><td>4</td><td>5</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">This course extends students' understanding of how buildings are generated from a specific location. The course aims to enrich students with a greater understanding of physical context (character and style) and cultural context (social and behavioural environment) and the relationship between them. A project on a real piece of land respecting the legislative constraints of the surrounding area with studying the architecture integral elements of it. Focusing residential building to study uniform building code.</td></tr>
<tr><td rowspan="4">References</td><td colspan="11">A Practical Guide to Critical Thinking – Hunter, David A., 2009</td></tr>
<tr><td colspan="11">ACA: Architecture completion annual. Vol 14 (Education Culture Welfare & Sports), Lee Hwa-jeong, 2020</td></tr>
<tr><td colspan="11">Architecture composition annual VI, Education & Sports/ Office & Terminal/ Urban Planning & Distribution, 2016</td></tr>
<tr><td colspan="11">Brookes, Alan J & Poole, Dominique; Innovation in Architecture, Spon Press, 2005</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 211</td><td>Building Construction 2</td><td>ARC 112</td><td>3</td><td>2</td><td>0</td><td>3</td><td>5</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">This course provides an understanding of the different elements of staircase, the relation between Tread and Riser, and the different types and construction details of staircase. It provides also an introduction to doors, windows, sliding and folding doors and windows in timber.</td></tr>
<tr><td rowspan="3">References</td><td colspan="11">Brannigan, Francis. Building Construction for the Fire Service Quincy MA: National Fire Protection Association, 1994.</td></tr>
<tr><td colspan="11">Nils Van Merrienboer, Architectural Material & Detail Structure Masonry, 2017</td></tr>
<tr><td colspan="11">حيدر. فاروق عباس،،الموسوعة الهندسية في تكنولوجيا تشييد المبانى، الجزء ألاول والثاني ،مركز الدلتا للطباعة، اسبورتنج، الإسكندرية 2014</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 212	Working Drawing 1	ARC 211	3	1	0	4	5	30	30	-	40
Course Contents	This course imparts students the knowledge on various types of floors, flooring material, partitions, various surface finishes, and modes of vertical transportation to equip students with the advances in the building construction methods and their applications. It provides students with a comprehensive knowledge of the construction documentation, construction drawings, quantities and specifications, structures, as well as implementation methods. Students are required to carry out the preparation of complete working drawings for a medium scale building project.										
References	Wakita O., Bakhoum N., Richard M., The Professional Practice of Architectural Working Drawings 5th Edition, ISBN: 978-1-118-88052-4, Wiley, 2017.										
	Ching F., Building Construction Illustrated 6th Edition, ISBN: 978-1-119-58316-5, Wiley, 2020.										
	Allen E., Rand P., Architectural Detailing: Function, Constructability, Aesthetics 3rd Edition, ISBN: 978-1-118-88199-6, Wiley, 2016.										
	Emmitt S., Barry's Advanced Construction of Buildings, 4th Edition, ISBN: 978-1-118-97710-1, Wiley-Blackwell, 2018										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 213	Technical Installation	-	3	2	0	2	4	30	30	-	40
Course Contents	This course provides its students the required knowledge and experience in the field of technical installations. The course will support its students to become familiar with the disciplines of installation and maintenance of technical installations. Specifically, it provides the scientific and practical background in the areas of plumbing, heating ventilation and air-conditioning (HVAC) equipment, and renewable energy technologies.										
References	Smith, L., Plumbing Technology: Design and Installation, 4th Edition, 2008										
	Lechner N. 2015. Heating, Cooling, Lighting: Sustainable Design Methods for Architects. 4 th . Ed. John Wiley & Sons, NY, USA										
	Grondzik W.T. & Kwok A.G. 2015. Mechanical and electrical equipment for buildings. 12th . Ed., John Wiley & sons. USA										

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 214</td><td>Profession Practice & Building Legislation</td><td>-</td><td>2</td><td>2</td><td>0</td><td>1</td><td>3</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">The course introduces building legislations, in addition to types of contracts, bidding, construction supervision, and guarantee against construction flaws. It also introduces the Professional practice, designer and supervisors' responsibilities, quality and quality control, contractor and owner responsibilities, actors' relations, and roles.</td></tr>
<tr><td rowspan="3">References</td><td colspan="11">The Architecture Student's Handbook of Professional Practice 15th Edition, 2017.</td></tr>
<tr><td colspan="11">The Architect's Handbook of Professional Practice 15th Edition, 2013.</td></tr>
<tr><td colspan="11">Building Construction: Principles, Materials, and Systems, 3rd Edition, 2017.</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 221</td><td>Introduction to Urban Planning</td><td>-</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">This course will give students how cities are organized. It will look at the history of planning from the early 1800s to the present day, and the processes that shape growth and development and the major socio-politico-economic forces that define the social and constructed environments inside cities. The major theories, models, and methodological techniques that planners use to explain the function and structure of urban places.</td></tr>
<tr><td rowspan="5">References</td><td colspan="11">Lynch, K., Good City Form, MIT Press, 1984</td></tr>
<tr><td colspan="11">Speck, J., WALKABLE CITY: How Downtown Can Save America, One Step at a Time, North Point Press, 2013</td></tr>
<tr><td colspan="11">Simon Joss, Sustainable Cities Governing for Urban Innovating Planning, Environment Cities, 2015</td></tr>
<tr><td colspan="11">John Julius Norwich, Cities that shaped the ancient world, The British Library, 2015</td></tr>
<tr><td colspan="11">Hall ,Peter ,Urban and Regional Planning , 6th Edition , Routledge,2020</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 231	Theory of Architecture 2	ARC 131	2	2	0	1	3	30	30	-	40

Course Contents

The course aims at enhancing students' abilities for developing creative design ideas and solving architectural problems. It also aims at increasing their knowledge of elements of architectural composition, including: primary elements/forms, properties of form, regular and irregular forms, form transformation (dimensional, additive, and subtractive), elements of space, space treatment, space organization, spatial relationships, spatial continuity, etc.
Topics include also architectural program and theories/principles of designing public facilities including: office buildings, commercial buildings, transportation terminals, etc.

References

Ching F. & Eckler James F. 2015, Introduction to Architecture. Canada: WILE

Ching. F. 2014, Architecture: Form, Space, and Order, 4th. John Wiley & Sons Inc. New York, united states.

Roth L. M. and Clark A. C. 2018, Understanding Architecture: Its Elements, History, and Meaning, 3rd. Ed., New York London: Routledge.

Neufert. E. (2000). Neufert Architects' Data, 4th edition. New Jersey: Wiley-Blackwell. ISBN: 978-1405192538

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 232	History of Architecture 2	ARC 132	2	2	0	1	3	30	30	-	40

Course Contents

The course aims at introducing the students to a comparative analytical study of architecture in different cultures/historical periods with examples from religious and secular architecture that include: Romanesque architecture; Gothic architecture; Renaissance architecture; and Islamic architecture (Umayed, Abbasid, Tulunid, Fatimid, Ayyubid, Mamluk and Ottoman eras with emphasis on selected examples from Egypt)

References

Koch, W. (2006). Baustilkunde. Gütersloh: Bertelsmann Lexikon Institute. ISBN 978-3577104579

Fletcher, B, Cruickshank, D. (1996). Sir Banister Fletcher's a History of Architecture. New York Architectural Press. ISBN: 978-0750622677

Vedula V.L.N., Architecture Pre-History to Ore-Gothic West Asia, Mediterranean and Europe, Vedula,V.L.N. Murthy, 2019Ramzy, N. (2011). The Architecture of Coptic Churches: From Forth To Nineteenth Century.
Saarbrücken: Lambert Academic Publishing, ISBN: 978-3-8454-3774-3

عطية، إيمان محمد عيد: االتجاهات المعمارية المعاصرة، الطبعة األولى، دار الفكر العربي، القاهرة، 2019.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 241	Computer Applications 2	ARC 142	3	2	2	0	4	30	30	-	40

Course Contents	This course aims to develop the ideas with computers, and to facilitate the development of analytical, critical, and integrative thinking to help students to initiation, planning, execution and presentation of design computing projects or research thesis. It also encourages the students to examine, discuss, question and debate issues of computing and information technology in design.
References	https://www.m3aarf.com/course/84
	https://www.creativeonlinecourse.com/courses/sketchup
	https://teracourses.com/ar/courses/photoshop طارق الجرف، 2008م، الكتاب العربى لتعليم Sketch up، archive.org خالد محمد إسماعيل، 2015، كورس فوتوشوب، archive.org
Laboratory	Student's engineering sketches and drawings carried out in the engineering Computer Labs.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 252	Smart Buildings Design	ARC 152	2	2	0	1	3	30	30	-	40

Course Contents	This course provides the students the different definitions, theories and concepts of intelligent architecture and buildings, to provide the principles of building automation systems, and to provide basic knowledge of the construction and installation of the structured smart system in buildings.
References	Sinopoli, J., Advanced Technology for Smart Buildings, Artech House, 2016
	Sinopoli, J., Smart Buildings Systems for Architects, Owners and Builders Publisher: Butterworth-Heinemann, 2009
	Jadhav, Y., Green and Smart Buildings: Advanced Technology Options, Springer, 2016

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 311	Working Drawing 2	ARC 212	3	1	0	4	5	30	30	-	40

Course Contents	The course introduces preparation of integrated execution documents for projects, preparation of working drawings of a pre-designed medium to large scale project, including wide spans, general conditions and specifications, quantity surveying, analysis of bids, and shop and as built drawings. It also provides students with Principles and practices in plumbing and sanitary systems as well as the electrical and mechanical systems- its design, installation, operation, and maintenance in buildings.
References	Wakita O., Bakhoum N., Richard M., The Professional Practice of Architectural Working Drawings 5th Edition, ISBN: 978-1-118-88052-4, Wiley, 2017.
	Ching F., Building Construction Illustrated 6th Edition, ISBN: 978-1-119-58316-5, Wiley, 2020.
	Allen E., Rand P., Architectural Detailing: Function, Constructability, Aesthetics 3rd Edition, ISBN: 978-1-118-88199-6, Wiley, 2016.
	Emmitt S., Barry's Advanced Construction of Buildings, 4th Edition, ISBN: 978-1-118-97710-1, Wiley-Blackwell, 2018

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 312	Working Drawing 3	ARC 311	3	1	0	4	5	30%	30%	-	40%
Course Contents	The course introduces preparation of integrated execution documents for projects, preparation of working drawings of a pre-designed large-scale project, the writing of specifications documents presented with working drawings, structures, quantities, and specifications, plumbing and sanitary systems, electrical and mechanical systems, and shop and as built drawings.										
References	The Professional Practice of Architectural Working Drawings 5th Edition, 2017.										
	Building Construction Illustrated 6th Edition, 2020.										
	Architectural Detailing: Function, Constructibility, Aesthetics 3rd Edition, 2016.										
	Barry's Advanced Construction of Buildings, 4th Edition, 2018										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 313	Quantities & Specifications	-	3	2	0	2	4	30%	30%	-	40%
Course Contents	The course enhances Students' awareness of accuracy in respect of estimating needs of materials, construction elements, equipment's or techniques whether quantitatively or qualitatively. It helps students to consider the impact of estimating quantities and deciding the specifications on the design and execution of buildings. The students are able to understand the process of generating, bidding, and performing construction contracts, components of direct and indirect construction costs, work breakdown, contingency and risk.										
References	حساب الكميات والمواصفات، أحمد أبو عوده، مكتبة المجتمع العربي للنشر والتوزيع السلسلة: الهندسة المدنية، يناير 2014										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 321	Introduction to Urban Design	-	3	2	0	2	4	30	30	-	40
Course Contents	This course targets preparing the students to consider engineering inside an urban setting and features the situation of urban design regarding various degrees of preparation and plan. It includes models of urban analysis, contemporary theories of urban design and implementation strategies, supplemented by the illustration of methods of urban design practice. The course includes different urban analysis exercises and small-scale projects, which could deal with the design of a specific public space.										
References	Gehl, J., Svarre, B., How to Study Public Life, Island Press, 2013										
	Saliba, Robert ,Urban Design in the Arab World: Reconceptualizing Boundaries.2016										
	Lang ,Jon Lang Urban Design: A Typology of Procedures and ProductsBy.2017										
	Carmona ,Matthew,Public Places Urban Spaces :The Dimensions of Urban Design ,2021 ,Routledge										
	Lynch, K., The Image of the City, MIT Press, 1960.										

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 334</td><td>Theory of Architecture 3</td><td>ARC 231</td><td>2</td><td>2</td><td>0</td><td>1</td><td>3</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">The course introduces the students to the overall perspective of modern and contemporary architecture through the review, analysis and criticism of their concepts, philosophies, and ideologies such as: The Bauhaus and Modernism; International Styles; Organic architecture; Expressionism, Romanticism, Post modernism; Eclecticism, De-constructivism, etc.
Topics include also formulation and analysis of architectural program together with theories/principles of designing community facilities such as, cultural, health, recreational, touristic, etc. buildings.</td></tr>
<tr><td rowspan="3">References</td><td colspan="11">Neufert. E. (2000). Neufert Architects' Data, 4th edition. New Jersey: Wiley-Blackwell. ISBN: 978-1405192538</td></tr>
<tr><td colspan="11">Frampton, K. (2007). Modern Architecture, a Critical History, 4th Ed. New York: Thames & Hudson. ISBN: 978-0500203958</td></tr>
<tr><td colspan="11">Terry Farrell, Adam Nathaniel Furman, Revisiting Postmodernism, Routledge, 2019.</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 361</td><td>Senior Design Project-1</td><td>--</td><td>2</td><td>1</td><td>0</td><td>3</td><td>4</td><td>50</td><td>---</td><td>50</td><td>--</td></tr>
<tr><td>Course Contents</td><td colspan="11">The course targets preparing the students to: Exploring and proposing new (philosophical /conceptual) approaches to deals with actual, real (Urban/Architectural) current and futuristic problems and locations in local/ regional contexts, compromising with a whole sustainable development (Egypt Vision 2030& 2050), interweaving all means of available sciences and technologies with all previous accumulative conceptual and architectural skills obtained by the four studying years.
Achieving that, methodology of Graduation Project depends on two subsequent stages.</td></tr>
<tr><td rowspan="4">References</td><td colspan="11">Edward T., “Concept Sourcebook-A vocabulary of architectural forms”, Architectural MediaLTD.,1975</td></tr>
<tr><td colspan="11">Nufert Architects' Data, 5th Edition, SBN: 978-1-119-28435-2 August 2019 WileyBlackwell.</td></tr>
<tr><td colspan="11">Francis D. K. Ching. Architecture: Form, Space, and Order, 4th edition. John Wiley & Sons Inc. New York, united states. 2014</td></tr>
<tr><td colspan="11">أبو عوف، طارق – " تحليل الموقع" – مؤسسة سكاي للكتاب-مصر- 2014</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment Criteria</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>St. Act.</th><th>Mids.</th><th>Exp.</th><th>Final</th></tr>
<tr><td>ARC 362</td><td>Senior Design Project-2</td><td>ARC 361</td><td>4</td><td>2</td><td>0</td><td>8</td><td>6</td><td>50</td><td>---</td><td>50</td><td>--</td></tr>
<tr><td>Course Contents</td><td colspan="11">This course represents complementary 2nd. Stage of the (Final Senior Design graduation project), it is the creative and application part of the course, which deals with (Urban & Architectural) design development, then evaluating the design proposal (s)/Appraisal(s) – to get the optimum (Urban &Architectural) solution, depending upon well strategic understanding by another engineering disciplines (Structural -MEP-Traffic- Landscape…), then presenting the solution graphically and by aids of I.T. available tools.</td></tr>
<tr><td rowspan="5">References</td><td colspan="11">Joseph De Chiara& Michel J.Crosbie “Time-Saver standards: For building types”, McGraw Hill, 2017.</td></tr>
<tr><td colspan="11">Francis D. K. Ching. Architecture: Form, Space, and Order, 4th edition. John Wiley & Sons Inc. New York, united states. 2014.</td></tr>
<tr><td colspan="11">Nufert Architects' Data, 5th Edition, SBN: 978-1-119-28435-2 August 2019 WileyBlackwell.</td></tr>
<tr><td colspan="11">Joseph De Chiara& Michel J.Crosbie “Time-Saver standards: For Architectural Design Data”, McGraw Hill, 2017.</td></tr>
<tr><td colspan="11">Ching, Francis D.K.,”Architecture: Form, Space, &Order”, Wiley,1980.</td></tr>
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<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 421</td><td>Introduction to Landscape Architecture</td><td>-</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">This course presents the standards of landscape architecture. It intends to set up information and abilities about site examination, practical ideas, primer plan and expert arranging. It covers both knowledge and skills about site investigation, functional concepts, preliminary design, and master planning. It covers both hardscape and softscape components of landscape projects. In addition, it should apply the basics of Environmental design and building technologies in the field of landscape design.</td></tr>
<tr><td rowspan="4">References</td><td colspan="11">Bell, S, Elements of Landscape Visual Design in the Landscape, 3rd Edition, Routledge, 2020</td></tr>
<tr><td colspan="11">Elsaesser , Maxie, Landscaping For Beginners: The Ultimate Step-By-Step Guide To Home Landscaping And Garden Design: Landscaping A Sloped Backyard, Independently Published, 2021.</td></tr>
<tr><td colspan="11">Kindersley, Dorling, Encyclopedia of Landscape Design: Planning, Building, and Planting Your Perfect Outdoor Space, Published September 19th 2017 by DK Publishing.</td></tr>
<tr><td colspan="11">Booth, N., K., Residential Landscape Architecture, Design Process for the Private Residence, 6th Edition, Pearson Education, Inc, 2012</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 302	Interior Design 1	ARC 103, ARC 202	3	2	0	2	4	30	30	-	40
Course Contents	The course provides an introduction to the concept and aspects of interior design and the various aspects and considerations involved in in designing spaces. It acquaints the students with the profession of interior design including: design basics, planning, materials and elements, furniture, textiles, lighting, color, art and accessories, systems, and business practices.										
References	Karlen Mark, Kate Ruggeri & Peter Hahn, Space Planning Basics, Wiley publishers, 2003.										
	Joseph D Chiara, Julius Panero, & Martin Zelnick, Time Saver standards for Interior Design & space planning, 2nd edition, Mc-Graw Hill professional, 2001.										
	The Interior Design Handbook: Furnish, Decorate, and Style Your Space Clarkson Potter; Illustrated edition (October 27, 2020).										
	Francis.D. Ching & Corky Bingelli, Interior Design Illustrared, 2nd edition, Wiley publishers, 2004.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 316	Building Codes	ARC 214	3	2	0	2	4	30	30	-	40
Course Contents	This course considered as an introduction to building and safety regulations that covers several important aspects regarding code compliance, from design development through construction administration. It allows students to learn about commonly used building codes and standards applicable to building construction and inspection processes; safety practices and procedures, tables, charts, and guidelines contained in codes.										
References	Building Codes Illustrated: A Guide to Understanding the 2021 International Building Code 7th Edition, 2021.										
	قانون البناء الموحد، 2015										
	الكود المصري لتصميم المسكن والمجموعة السكنية، 2009										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 322	Urban Sociology	ARC 321	3	2	0	2	4	30	30	-	40
Course Contents	This course is an introduction to urban sociology. It will explore several topics related to urbanization and urbanism, with a general focus on Egyptian cities, and a spotlight on local neighbourhoods and issues. Topics include the history of urbanization in Egypt and its impacts on cities today; theories about how cities are socially and spatially organized and how these forms of organization are related; and how urban living affects social interaction.										
References	Abrahamson M., Urban Sociology - A Global Introduction, University of Connecticut, 2014										
	Gottdiener M., The New Urban Sociology, 2019										
	Menon S., Urban Sociology: An Introduction to the Study of Urban Communities, 2017										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 324	New Trends in Urbanism	ARC 321	3	2	0	2	4	30	30	-	40
Course Contents	The main content of the course relates the global new trends to a chosen urban environment. It focuses on development of planning and design tools on the urban scale. The scenarios for new urban developments will integrate concepts of ecologic, economic, and social sustainability. The focus is on the experimentation through the design process. The contradictions between various aspects of planning the new urban development is tested, compared and various tensions and relations explored.										
References	Soen D., New Trends in Urban Planning: Studies in Housing, Urban Design and Planning, 2013.										
	Silva C., Routledge Handbook of Urban Planning in Africa, 2019.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 326	Transportation of Urban Planning	ARC 221	3	2	0	2	4	30	30	-	40
Course Contents	This course prepares students to be effective practitioners and informed citizens at a time when rapid advances in technology are rapidly changing the transport field. At the end of this course, you will be able to understand and perform analyses common in the practice of transportation planning authoritatively discuss the key policy issues in current transportation planning debates.										
References	Black, J., Urban Transport Planning, Theory and Practice, 1st Edition, Routledge, 1981										
	Monzon-de-Cacere, A., Di Ciommo, F., CITY-HUBs: Sustainable and Efficient Urban Transport Interchanges, CRC Press, 2016										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 344	Computer Applications 3	ARC 241	3	2	2	0	4	10	30	20	40
Course Contents	This course aims to provide a strong foundation for students to understand modern computer programs in architecture and to apply these insights and principles to design projects. This course focuses advanced popular 3D modelling software- e.g. 3DStudio Max, Maya, Rhinoceros and other appropriate software.										
References	محمد خالد، 2019م، ثرى دى استوديو ماكس، عمر عبد الله سليم، 2021، شرح الريفيت للمبتدئين،										
	https://www.et3lemdelivery.com/2018										
	https://www.m3aarf.com/course/693 https://www.edraak.org/programs/specialization/rd101 http://www.astucestopo.net/2018/01/blog-post.html										
Laboratory	Student's engineering sketches and drawings carried out in the engineering Computer Labs.										

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<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 346</td><td>Digital Presentation in Architecture</td><td>ARC 241, ARC 202</td><td>3</td><td>1</td><td>3</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">This course is dealing with teaching students all the essentials about visual communication and architectural presentation skills expected of architects. The focus of this course is on digital architectural presentation tools such as 3D presentation. The most important goal of the course is to develop, through extensive practice, the visual communication skills required to effectively present a graphic model of a final project or to highlight specific details of a project.</td></tr>
<tr><td rowspan="2">References</td><td colspan="11">Jacobo Krauel, Jay Noden, William George, Contemporary Digital Architecture: Design & Techniques, 2010</td></tr>
<tr><td colspan="11">Margaret Fletcher, Visual Communication for Architects and Designers: Constructing the Persuasive Presentation, 2020</td></tr>
<tr><td rowspan="3">Laboratory</td><td colspan="11">Introduction to different programs for architectural presentation.</td></tr>
<tr><td colspan="11">Selection of proper technique for project presentation.</td></tr>
<tr><td colspan="11">Training on digital presentation for selected architecture project.</td></tr>
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<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 342</td><td>Computer Aided Environmental Design</td><td>ARC 152, ARC 202</td><td>3</td><td>1</td><td>3</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">The course aims to provide students with an environmental conscious design, by computer programs, Sustainable development and Environmental Studies, Integrated Environmental Assessment (IEA), Traditional and renewable energy sources.</td></tr>
<tr><td>References</td><td colspan="11">Computer Aided Design Guide for Architecture, Engineering and Construction. Ghassan Aouad, Song Wu , Angela Lee , Timothy Onyenobi.2012.</td></tr>
<tr><td>Laboratory</td><td colspan="11">Student's engineering sketches and drawings carried out in the engineering Computer Labs.</td></tr>
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<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 352</td><td>Acoustics and Daylighting in Buildings</td><td>ARC 152</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">The course introduces the basic knowledge of acoustics and daylighting, it focuses on the fundamental physical principles in both fields. It provides the fundamental knowledge to understand the key design aspects of building acoustics and noise control. Topics covered include introduction to environmental factors, daylighting systems and the integration of electrical lighting, acoustic fundamentals, sound outdoors, room acoustics, sound insulation, impact noise, and acoustics for sustainable design.</td></tr>
<tr><td rowspan="4">References</td><td colspan="11">Architectural Acoustics: A guide to integrated thinking, 2020</td></tr>
<tr><td colspan="11">Master Handbook of Acoustics, Seventh Edition, 2021</td></tr>
<tr><td colspan="11">الكود المصري لأسس تصميم وشروط تنفيذ اعمال الانارة، 2017</td></tr>
<tr><td colspan="11">الكود المصري لأسس تصميم وشروط تنفيذ أعمال الصوتيات والتحكم في الضوضاء للمباني، 2014</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 401	Interior Design 2	ARC 302	3	2	0	2	4	30	30	-	40
Course Contents	The course aims to promote students' creativity, aesthetic sensibility, and intellectual enquiry, together with the skills needed to design of interior spaces. It focuses on a different aspect of interior design process such as: Human and psychological factors, materials and finishing elements, and surface design and detailing.										
References	Joseph D Chiara, Julius Panero, & Martin Zelnick, Time Saver standards for Interior Design & space planning, 2nd edition, Mc-Graw Hill professional, 2001.										
	The Interior Design Handbook: Furnish, Decorate, and Style Your Space Clarkson Potter; Illustrated edition (October 27, 2020).										
	Francis. D. Ching & Corky Bingelli, Interior Design Illustrared, 2nd edition, Wiley publishers, 2004.										

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				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 403	Architecture Criticism	ARC 202	3	2	0	2	4	30	30	-	40
Course Contents	Students will develop knowledge of methodologies applied in the interpretation of architecture and design and the modes used to effectively communicate critical analysis. Students will apply research, analytical and critical skills in the appraisal of existing architectural works and designs or as a progressive evaluation of creative opportunities through written, verbal and graphic means.										
References	Fumihiko Maki, Nurturing Dreams. Collected Essays on Architecture and the City, Cambridge Massachusetts; London England: The MIT Press, 2008.										
	Peter Sloterdijk, "Spheres Theory, Talking to Myself about the Poetics of Space," in: Harvard Design Magazine 30, Spring/Summer, 2009										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 423	Aesthetics and Urban Design	ARC 152, ARC 202	3	2	0	2	4	30	30	-	40
Course Contents	The course deals with the urban aesthetics from its theoretical and applied sides: it introduces the idea of aesthetics in philosophy and how it was applied to the aspects of urbanism. The practical aspect of the course is applied to cities in Egypt and the world in terms of the built-up mass and the network of public spaces and the urban identity of place.										
References	Sydney H. William, Urban Aesthetics: An Approach to the Study of the Aesthetic Characteristics of Cities, 2019										
	Degen M., Rose G., The New Urban Aesthetic: Digital Experiences of Urban Change, 2021.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 425	Human Behavior & Urban Form	ARC 322	3	2	0	2	4	30	30	-	40
Course Contents	The concept of place is closely connected to urban form and has a direct link to social life; therefore, the relationships between characteristics of the physical environment and the humans using it, between the context and human responses will be studied in this course. The course explores how form & meaning, physically, socially, and virtually is perceived, and communicated and what implications these impacts, and consequences have on peoples' behaviours.										
References	Rapoport A., Human Aspects of Urban Form: Towards a Man—Environment Approach to Urban Form and Design, 2016.										
	Saliba R., Urban Design in the Arab World: Reconceptualizing Boundaries, 2016.										
	Nicholas J. Stevens, Paul M. Salmon, Guy H. Walker, Neville A. Stanton, Human Factors in Land Use Planning and Urban Design: Methods, Practical Guidance, and Applications, 2018.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 427	Qualitative Methods of Urban Planning	ARC 221	3	2	0	2	4	30	30	-	40
Course Contents	This course introduces students to a range of quantitative research methods used in the study and analysis of cities and urban regions. It provides a general introduction to qualitative research methods for urban design. Includes data collection methods (focus groups, interviews, ethnography, participant observation, and participatory action research) and various analytic methods and approaches.										
References	Ewing, R., Park, K., Basic Quantitative Research Methods for Urban Planners, Routledge, 2020										
	Babbie, R., The Practice of Social Research, 14th Edition, Boston, MA: Cengage Learning, 2016										
	Gaber, J., Gaber, S., Qualitative Analysis for Planning & Policy: Beyond the Numbers, Routledge, 2007										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 441	GIS in Planning	ARC 221, ARC 241	3	2	2	0	4	10	30	20	40
Course Contents	This course aims mainly to complete the previous course and provide the students with the fundamentals surveying and of the (GIS), image processing and interpretation of remote sensing data, classical and spatial statistics topology and Spatial Operations, Projections, Scale and Coordinate Systems, Thematic Mapping, GIS Analysis, Cartography, Network modeling & surface modeling, remote Sensing and Raster modeling, the business case for GIS, Practical Applications of GIS, Data Storage Strategies, Enterprise GIS, GIS Application for sustainable development.										
References	Kang -Tsung Chang, Introduction To Geographic Information Systems, Ninth Edition, University of Idaho, McGraw-Hill Education, 2019										
	Anita Graser and others, QGIS Map Design, 2nd edition, Design Locate Press, 2018. Michael N. DeMers, Fundamentals of Geographic Information Systems. 3rd Edition. Wiley,										
	Bolstad, P. (2019). GIS fundamentals: A first text on geographic information systems (6th Ed.). Ann Arbor, MI: XanEdu Publishing										
Laboratory	Student's engineering sketches and drawings carried out in the engineering Computer Labs.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab.	Tut.	Tot	SA	MT	PE/OE	Final
ARC 443	Advanced Modelling	ARC 344	3	2	2	0	4	10	30	20	40
Course Contents	The course provides students' basic modelling construction skills and introduces them to different modelling techniques. Students highlight the model's conceptual, and illustrational ability to convey design ideas across a range of scales. They develop a material sensibility that reveals the visual and structural potentials of any selected materials, and they extend their existing knowledge of software to incorporate advanced digital fabrication technologies, including milling, rapid prototyping and laser cutting.										
References	Bil J., Koning K., Kelley M., Gerrewy C., Hubert C., Topalovic M., Models and Other Spaces, OASE 84 Models Maquettes, Nai010 Publishers, 2011										
	Gigliotti R., Displayed Spaces, New means of Architecture Presentation through exhibitions, Spector Books, 2015										
	Dunn N., Architectural Model Making, Laurence King Publishing, 2001										
Laboratory	Introduction to different programs for 3D modelling in architecture.										
	Training on 3D modelling for selected architecture project.										

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 445</td><td>Digital Media in Architectural Design</td><td>ARC 241</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">This course introduces the theory and practice of creating digital video compositions that combine multiple video sources, computer generated objects, text and digital special effects in media and how to incorporate these in architecture design. It aims to provide you with the knowledge and skills of integrating various types of digital media and presentation materials for representing different aspects of an architectural design.</td></tr>
<tr><td>References</td><td colspan="11">Lupton, E. & Cole Phillips, J. (2008). Graphic Design: the New Basics. New York: Princeton Architectural Press.</td></tr>
<tr><td>Laboratory</td><td colspan="11">Students in this course will be using an array of software applications to complete assignments.</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab.</th><th>Tut.</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>ARC 451</td><td>Sustainable Community Design</td><td>ARC 152, ARC 252</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>30</td><td>-</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">The course deals with the study and analysis of the concepts of sustainable communities, the factors affecting the structure and formation, and the foundations of sustainable design, where the concept of sustainable development dominated discussions in the last two decades. Hence, this course focuses on studying a more comprehensive approach to sustainable community design. Various theories of sustainable urbanization are studied, as well as sustainability measurement systems at the level of urban communities.</td></tr>
<tr><td rowspan="4">References</td><td colspan="11">Woodrow W. Clark, Sustainable Communities Design Handbook: Green Engineering, Architecture, and Technology, 2010</td></tr>
<tr><td colspan="11">Patrick M. Condon, Seven Rules for Sustainable Communities: Design Strategies for the Post Carbon World, 2012</td></tr>
<tr><td colspan="11">Patrick M. Condon, Design Charrettes for Sustainable Communities, 2012</td></tr>
<tr><td colspan="11">Randolph John & Gilbert M. 2018, Energy for Sustainability: Technology, Planning, Policy, Island Press, Washington- DC.</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids.	PE/ OE	Final
CIV 123	Structure Analysis	BES 021	3	2	-	2	4	30	30	-	40
Course Contents	The course is an introduction to the basic tools of structural analysis and design. It contributes to the knowledge and skills required by the civil engineers in the following topics: Loads and reactions, stability of structures (external and internal), straining actions in statically determinate structures, normal stresses, shear stresses (pure shear, torsional), combined stresses, elastic deformations, and introduction to the analysis of statically indeterminate structures through 3-moment equation.										
References	• Structural Analysis by Russell C. Hibbeler, Pearson, 9th Edition, 2014, ISBN-13:978-0-13-394284-2. • Kenneth M. Leet, Chia-Ming Uang, Joel T. Lanning, Anne M. Gilbert. “Fundamentals of Structural Analysis”. McGraw-Hill Education, 2018. ISBN-13: 978-0073398006										
Used in Program	Architecture Engineering Program							Semester	3		

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids.	PE/ OE	Final
CIV 143	Construction Survey	BES 012	3	2	2	0	4	10	30	20	40
Course Contents	To introduce the student to basic elements of surveying and their architectural applications. Plotting scales. Vertical and horizontal angle measurement, levelling & theodolites. Map drawing. Traverse computations and adjustment. Area and Volume calculations. Photogrammetry and its architectural applications. Remote sensing.										
References	• Engineering Surveying. W. Schofield& M. Breach - Sixth Edition 2007- ISBN–13: 978-0-7506-6949-8 • Surveying Problem Solving with Theory and Objective Type Questions Dr / A M Chandra- 2005- ISBN (13) : 978-81-224-2532-1										
Laboratory	• Linear surveying measurements • Theodolite parts and calibration • Vertical and Horizontal angle measurements • Survey levelling instruments and height determination										
Used in Program	Architecture Engineering Program							Semester	4		

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids.	PE/ OE	Final
CIV 259	Design of RC Structures	CIV 123	2	2	0	1	3	30	30	-	40
Course Contents	The course presents the fundamentals of reinforced concrete structures such as reinforcement details of beams, solid slabs, columns, and stairs. It focuses on loads and load distribution. The course contributes to the knowledge and skills in the following topics: Statically determinate frames, ribbed and hollow block slabs, paneled beam slabs, flats slabs, and openings in slabs.										
References	• Egyptian Code of Practice – ECP 201-2018 • Structural design for architecture – Angus j macdonald, ISBN 0 7506 3090 6										
Used in Program	Architecture Engineering Program							Semester	5		

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids.	PE/ OE	Final
CIV 229	Design of Steel Structures	CIV 123	2	2	0	1	3	30	30	-	40
Course Contents	The course presents the fundamentals of steel structures and materials through the following topics: such as material properties and steel sections, allowable Stress Design method - Concept of tension members, compression members, and flexural members, the different Types and classification of beam cross sections, Concept of beam-columns (axial and flexural forces), bolted and welded connections.										
References	Egyptian code for design of steel structure.										
	• Advanced Steel Design Of Structures, by Prof. Srinivasan Chandrasekaran, Indian Institute of Technology, India. ISBN-13 9780367232900 • Steel Designers' Manual, By (Steel Construction Institute), Edited by Buick Davison and Graham W. Owens, ISBN-13 9781119249863										
Used in Program	Architecture Engineering Program							Semester	6		

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	St. Act.	Mids.	PE/ OE	Final
CIV 339	Soil Mechanics & Foundations	CIV 259	3	2	2	0	4	10	30	20	40

Course Contents	The course aims to study soil characteristics and mechanics, and the selection and design of foundations: Soil Properties - Soil Classification - Soil Compaction - Stresses in Soil - Settlement of Soil - Lateral Earth Pressure - Shallow Foundations (Isolated Footing – Rectangular Footing) – Deep Foundations (Piles – Pile Caps).
References	• El-Kasaby, E. A., Soil Mechanics, Dar Al-Kutub Al-Almia, Cairo, 5th Ed., (21371/2013), ISBN 978 – 977 – 726 – 041 – 1, 2014. • El-Kasaby, E. A., Engineering of Surface Foundations, Dar Al-Kutub Al-Almia, Cairo, 5th Ed., (19440/2015), ISBN 978 – 977 – 726 – 139 – 5, 2015. • El-Kasaby, E. A., Design and Construction of Deep and Special Foundations, Dar Al-Kutub Al-Almia, Cairo, 4th Ed., (10651/2016), ISBN 978 – 977 – 726 – 168 – 5, 2016. • Das, B. M, Soil Mechanics Laboratory Manual, Oxford University Press, 9th. Ed., ISBN 978 – 019 – 020 – 966 – 7, 2016. • Das, B. M, Principles of Foundation Engineering, Brooks - Cole, 9th. Ed., ISBN 978 – 133 – 770 – 502 – 8, 2017. • Bowles, J., Foundation Analysis and Design, McGraw - Hill, 5th. Ed., ISBN 978 – 007 - 912 – 247 – 7, 2009.
Laboratory	Specific Gravity Determination, Atterberg Limits (Liquid Limit – Plastic Limit – Shrinkage Limit). Atterberg Limits (Liquid Limit – Plastic Limit – Shrinkage Limit), Grain Size Distribution - Coarse Grained Soils. (Sieve Analysis), Grain Size Distribution - Fine Grained Soils (Hydrometer Analysis), Determination of Natural Unit Weight of Soil (Sand Bottle Test - Core Cutter Test).

Used in Program	Architecture Engineering Program	Semester	7

Part B: Inter-displinary Programs

Faculty Requirements

Inter-displinary Programs offered at Benha Faculty of Engineering, Benha University are Engineering Programs. The graduates have the opportunity of being Engineers and are registered in the Egyptian Engineering Syndicate.

According to the National Academic Reference Standards (NARS-2018), The Engineering Graduate must be able to (A-Level):

A1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science and mathematics.

A2. Develop and conduct appropriate experimentation and/or simulation, analyse and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

A3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

A4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.

A5. Practice research techniques and methods of investigation as an inherent part of learning.

A6. Plan, supervise and monitor implementation of engineering projects.

A7. Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural teams.

A8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.

A9. Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

A10. Acquire and apply new knowledge; and practice self, lifelong and other learning strategies.

To achieve these Learning Outcomes, a set of courses has to be completed as a Faculty Requirement. These courses are divided into Basic Science Courses and Basic Engineering Courses.

List of Faculty requirements courses for Inter-disciplinary Programs

Code	Course	Pre-requisites	Credit Hours	Ct. Hrs.			
				Lec.	Lab.	Tut	Sum
FRB 001	Analytical geometry & Linear Algebra	-----	3	2	0	2	4
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4
FRB 003	Statics	-----	3	2	0	2	4
FRB 004	Dynamics	FRB 003	3	2	0	2	4
FRB 005	Waves and Heat	-----	3	2	2	1	5
FRB 006	Electricity and Magnetism	-----	3	2	2	1	5
FRB 007	Chemistry for Engineers	-----	4	3	2	1	6
FRM 008	Production Systems Engineering	-----	2	1	3	0	4
FRM 009	Engineering Drawing	-----	2	0	0	4	4
FRM 010	Engineering Drawing by Computer	FRM 009	2	1	2	0	3
FRE 012	Computer Programming	-----	2	0	2	2	4
FRB 103	Environmental Pollution and Industrial Safety	FRB 007	2	2	1	0	3
FT 103	Field Training I	Completion of 65 CR. HRS.	0	0	0	0	0
FT 203	Field Training II	Completion of 96 CR. HRS.	0	0	0	0	0
Total			**32**	**19**	**14**	**17**	**50**

* Course teaching is shared between the Basic Engineering Science Department and Discipline Department.

Course Coding

The course coding is divided into two parts and follows the following convention:
1. Three Letters which are the Department code.
2. Three Numbers indicating the Level, the Specialization inside the department, and a counter inside the specialization.

FRB XXX	Courses offered by Basic Engineering Science Department
FRM XXX	Course offered by Mechanical Engineering Department for Faculty Requirement
FRE XXX	Course offered by Electrical Engineering Department for Faculty Requirement

The following abbreviations are the legend for the courses:

Pre-req	Prerequisite	**Cr. Hrs.**	Credit Hours	**Std. Act.**	Student Activity
Lec	Lectures	**Tut**	Tutorials	**Lab**	Laboratory
MT1	First Midterm Exam	**MT2**	Second Midterm Exam	**Final**	Final Exam

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab.	Tut.	Sum	MT1	MT2	Std. Act.	Final
FRB 001	Analytical geometry & Linear Algebra	-	3	2	0	2	4	30	20	10	40

Course Contents

Analytical geometry: Functions (Lines, Circles, Parabolas, Piecewise-Functions, Power Functions, Polynomials, Rational Functions, Algebraic Functions, Trigonometric Functions, Hyperbolic Functions, Exponential Functions and Logarithmic Functions) and their properties, their graphs and their inverses. Limits and continuity. Differentiation rules of real functions of one variable. Applications of derivatives (maxima, minima and inflection points, curve tracing, optimization problems). Taylor's and Maclaurin's series of functions of one variable.

Linear Algebra: Matrices and their properties, types, ranks and their inverses (Adjoint of matrix, Eigen equation and Gauss elimination). Existence and uniqueness of solutions. Solving system of linear equations by Matrices (Gauss elimination, Gauss – Jordan elimination, LU factorization). Eigenvalues and eigenvectors. Complex numbers. Elements of mathematical logic with applications.

References

- Howard Anton, "Calculus with analytical geometry", John Wiley & Sons, Last Edition.
- Gilbert Strang, "Introduction to Linear Algebra", Wellesley-Cambridge Press, Last Edition.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab.	Tut.	Sum	MT1	MT2	Std. Act.	Final
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4	30	20	10	40

Course Contents

Integration: Techniques of integration (Basic Integration Formulas, Integration by Parts, Integration of Rational Functions by Partial Fractions, Trigonometric Integrals and Substitutions). Applications of indefinite integrals. Applications of definite integrals (areas, volumes of revolution, lengths of curves and surface areas of revolution).

Multivariable functions: Curves and surfaces in three dimensions. Limits, continuity and partial derivatives of functions of several variables. Chain Rule. Directional and total derivatives. Applications (tangent planes and normal lines, Taylor series of functions of two variables, Extreme values and conditional extreme values of functions of two variables).

References

Howard Anton, "Calculus with analytical geometry", John Wiley & Sons, Last Edition.

George B. Thomas, Jr., Maurice D. Weir, Joel Hass, THOMAS' CALCULUS Multivariable (Twelfth Edition), 2010.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment				
				Lec.	Lab	Tut	Sum	SA	MT1	MT2	PE/OE	Final
FRB 003	Statics	0	3	2	0	2	4	10	30	20	0	40

Course Content

Vector algebra and applications to mechanics, Statics of particles in three dimensions, Moment of a forces about a point and a line and moment of couples, Equivalent systems of forces, Equilibrium of rigid bodies, Centroids and centers of gravity, Analysis of structures, Friction and its applications, Moments of inertia of areas and masses.

References

- F. P. Beer, E. R. Johnston, D. F. Mazurek, P. J. Cornwell, Vector Mechanics for Engineers: Statics and Dynamics, 10th edition (2013).
- Hibbeler, R. C. Engineering Mechanics: Statics and Dynamics, 10th Edition. Upper Saddle River, New Jersey: Prentice Hall, (2003).

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab.	Tut.	Sum	MT1	MT2	Std. Act.	Final
FRB 004	Dynamics	FRB 003	3	2	0	2	4	30	20	10	40

Course Contents

Kinematics of particles (rectilinear and curvilinear motion), Kinetics of particles (Newton's second law – principle of work and energy – principle of impulse and momentum - impact), Kinematics of rigid bodies (translation, rotation about a fixed axis and general plane motion), Kinetics of rigid bodies (force and acceleration method).

References

- F. P. Beer, E. R. Johnston, D. F. Mazurek, P. J. Cornwell, Vector Mechanics for Engineers: Statics and Dynamics, 10th edition (2013).
- Hibbeler, R. C. Engineering Mechanics: Statics and Dynamics, 10th Edition. Upper Saddle River, New Jersey: Prentice Hall, (2003).

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>FRB 005</td><td>Waves and Heat</td><td>-</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Simple harmonic motion, Wave motion, Sound waves, Superposition of waves, Interference of light waves, Diffraction of light, First law of thermodynamics, Kinetic theory of gases, specific heats of gases, thermodynamic processes: isochoric, isobaric, isothermal and adiabatic, Heat transfer: conduction, convection and radiation, Elasticity, Hooke’s law, Hydrostatics and surface tension, Hydrodynamics and Viscosity.</td></tr>
<tr><td>References</td><td colspan="11">• R. A. Serway and J. W. Jewett, Physics for scientists and engineers: Cengage learning, 2018.
• Tarek M. Abdolkader, Mohamed Elfaham, Mina Asham, Ibrahim Sayed, Walid Selmy, “Engineering Physics, Part I, Waves, Heat and Optics”, 1st edition, 2022.
• D. Halliday, et al., Fundamentals of physics: John Wiley & Sons, 2013.
• D. Giancoli, Physics for Scientists & Engineers with Modern Physics, 4th Edition ed. Pearson, 2008.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Simple harmonic motion
• Waves in stretched string,
• Sound waves,
• Interference and diffraction of light,
• Polarization of light,
• Specific heat,
• Thermistor and thermal conductivity.</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>FRB 006</td><td>Electricity and Magnetism</td><td>-</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Electric field, Gauss law and applications, Electric potential, Capacitors and dielectrics, Current and resistance, Magnetic field and magnetic force, Sources of magnetic field, Ampere’s law, Faraday’s law, Self-induction and magnetic energy.</td></tr>
<tr><td>References</td><td colspan="11">• R. A. Serway and J. W. Jewett, Physics for scientists and engineers: Cengage learning, 2018.
• Tarek M. Abdolkader, Mohamed Elfaham, Mina Asham, Ibrahim Sayed, Walid Selmy, “Engineering Physics, Part II, Waves, Heat and Optics”, 1st edition, 2022.
• D. Halliday, et al., Fundamentals of physics: John Wiley & Sons, 2013.
• D. Giancoli, Physics for Scientists & Engineers with Modern Physics, 4th Edition ed. Pearson, 2008.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Ohm's Law
• Wheatstone bridge & Metric bridge
• Electric Field Mapping
• Capacitor Charging and Discharging
• The Electric Transformer
• Faraday’s Law</td></tr>
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<tr><th rowspan="3">Code</th><th rowspan="3">Course Title</th><th rowspan="3">Pre-req</th><th rowspan="3">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/ OE</th><th>Final</th></tr>
<tr><td>3</td><td>2</td><td>1</td><td>6</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>FRB 007</td><td>Chemistry for Engineers</td><td>-</td><td>4</td><td colspan="8"></td></tr>
<tr><td>Course Content</td><td colspan="11">Gases: ideal & real gas laws, kinetic molecular theory- Liquids and solutions - Solids: arrangement of atoms, metallic solids, alloys - Chemical kinetics: reaction rates & order, catalysis – Electrochemistry: electrochemical cells, corrosion– Cements – Polymers – lubricants.</td></tr>
<tr><td>References</td><td colspan="11">- J. Brady, “General Chemistry, Principles and structures”, Wiley Inc., Fifth Edition, 1990.
- L. W. Fine, H. Beall, J. Stuehr, “Chemistry for Scientists and Engineering, Preliminary Edition, Brooks Cole; 1st edition, 1999.
-Steven S. Zumdahl, “Chemistry Principles”, Third Edition, Houghton Mifflin, 1998.
-Prof. Elsayed Fouad, Engineering Chemistry I, II.
-Steven S. Zumdahl, Susan A. Zumdahl “Chemistry” Seventh Edition, Houghton Mifflin, 2007.
-P. Barnes, J. Bensted, Structure and Performance of Cements, CRC Press, 2nd Edition, 2019.</td></tr>
<tr><td>Laboratory</td><td colspan="11">-Neutralization Reactions
-Oxidation-Reduction Reactions
-W/C Ratio
-Precipitation Reactions</td></tr>
</table>

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<tr><th rowspan="3">Code</th><th rowspan="3">Course Title</th><th rowspan="3">Pre-req</th><th rowspan="3">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/ OE</th><th>Final</th></tr>
<tr><td>1</td><td>3</td><td>0</td><td>4</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>FRM 008</td><td>Production Systems Engineering</td><td>-</td><td>2</td><td colspan="8"></td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction, Casting processes: Main steps of sand casting, Pattern design, melting of metals, Metal forming techniques: Forging, Rolling, Extrusion, Drawing, Bending Processes: Temporary and permanent joints, welding techniques, cutting techniques: Principles and elements of cutting processes, Basic cutting, and machining (Turning, Drilling, Milling, etc.,). Production planning and control principles, Fundamentals of quality control.</td></tr>
<tr><td>Reference s</td><td colspan="11">• Jiangshan Li, Semyon M. Meerkov, 2008, “Production Systems Engineering”, Springer; 1st ed. 2009 edition, 2008
• M. P. Groover, 2011, "Principles of Modern Manufacturing", 4th Ed., john Wiley & Sons, Inc.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Measurement operations and tools
• Sand-casting workshop
• welding techniques; electric arc welding, gas welding and cutting, and electric resistance welding
• Machining workshop; turning, shaping, drilling, milling, and grinding
• Metal forming workshop; rolling, bending, drawing, and extrusion
• Carpentry workshop
• Forging workshop</td></tr>
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<tr><td rowspan="2">Code</td><td rowspan="2">Course Title</td><td rowspan="2">Pre-req</td><td rowspan="2">Cr. Hrs.</td><td colspan="4">Ct. Hr.</td><td colspan="5">Assessment</td></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Tot</td><td>SA</td><td>MT 1</td><td>MT 2</td><td>PE/ OE</td><td>Final</td></tr>
<tr><td>FRM 009</td><td>Engineering Drawing</td><td>-</td><td>2</td><td>0</td><td>0</td><td>4</td><td>4</td><td>10</td><td>30</td><td>20</td><td>--</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="12">Principles and skills of Engineering drawing. Conventional lettering and dimensioning. Geometric constructions. Orthographic projection of engineering bodies. Theories of view derivation. Derivation of views from isometric drawings and deducing of missing views. Sectioning views: (full, half, offset, partial, revolved, removed, and partial sectioning). Steel construction, Symbols of electrical circuits</td></tr>
<tr><td>References</td><td colspan="12">• William Chalk, Goetsch, "Technical Drawing", Delmar technical graphics series, 6th edition, 2010.
• Allbert W. Boundy, "Engineering Drawing", McGraw-Hill Australia, 2012</td></tr>
<tr><td>Laboratory</td><td colspan="12">• Student's engineering sketches and drawings carried out in the engineering drawing Labs.</td></tr>
</table>

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<tr><td rowspan="2">Code</td><td rowspan="2">Course Title</td><td rowspan="2">Pre-req</td><td rowspan="2">Cr. Hrs.</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment</td></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Tot</td><td>SA</td><td>MT 1</td><td>MT 2</td><td>PE/OE</td></tr>
<tr><td>FRM 010</td><td>Engineering Drawing by Computer</td><td>-</td><td>2</td><td>1</td><td>2</td><td>0</td><td>3</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to Computer Aided Drawing, Benefits of computer-aided drawing. Graphics/CAD involves the visualization, sketching, and geometric construction of mechanical components. Industry standard for drawing. Layout and creation of 2D working industrial drawings. Illustrate CAD drawing construction techniques, implementation of graphical communication using the alphabet of lines, orthographic projection, section views, auxiliary views and the creation of assembly and detail mechanical components. 3D drawing of Mechanical Components.</td></tr>
<tr><td>References</td><td colspan="11">• William Chalk, Goetsch, "Technical Drawing", Delmar technical graphics series, 6th edition, 2010.
• Allbert W. Boundy, "Engineering Drawing", McGraw-Hill Australia, 2012</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Students practice engineering sketches and drawings in Computer Labs.</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Tot	SA	MT 1	MT 2	PE/OE
FRE 012	Computer Programming	-	2	0	2	2	4	10	30	20	40

Course Content

Introduction to Computer Programming, Basics of C++ language, Problem Solving and Algorithm Design, Pseudo-codes and Flow charts, Arithmetic Operators and Variables, Exploring input and output statements, Control Structure (Selection and iterative), Functions, Primary data structure of Arrays and its multi – dimensional behavior, Concepts of Pointers, Introductory knowledge of Structures.

References

- Paul Deitel, Harvey Deitel, "C++ How to Program", 10th Edition, Pearson; (February 29, 2016)
- Jery Hanly, Elliot Koffman, "Problem Solving and Program Design in C", 8th edition, Pearson, 2015, ISBN-13: 978-0134014890
- R. Sedgweck, K. Wayne, "Introduction to Programming in Java: An Interdisciplinary Approach", 2nd Edition, Addison-Wesley Professional, 2017, ISBN-13: 978-0672337840
- W. Savitch, "Problem Solving with C++", 10th Edition, Pearson, 2018, ISBN-13: 978-0134448282
- Nell Dale, Chip Weems, "Programming and Problem Solving with C++", 5th, Jones & Bartlett Learning; (May 14, 2009)

Laboratory

Problem solving labs using high level language (C, or C++) to apply explained topics in each lecture including:
Flowcharts, Data Types, Declaration of Variables and Constants, Conditioning Statements (if -- Then, switch -- case), Iteration Statements (For -- Next, Do -- while), Arrays , Predefined Functions - User Defined Functions, Strings and string functions

Code	Course Title	Pre-req	Cr. Hrs.	Ct Hrs				Assessment			
				Lec.	Lab	Tut	Tot	SA	MT	PE/ OE	Final
FRB 103	Environmental Pollution and Industrial Safety	FRB 007	2	2	1	-	3	10	30	20	40

Course Content

- Air pollution-Adverse effects -ozone depletion – green house effects- Acid rain and global warming -measurement and control methods.
- Water pollution- constituents of wastewater- primary treatment: various pre-treatment methods -Advanced Treatment: chemical oxidation, precipitation, air stripping

Construction Engineering and Managment students: Plan and manage construction health and safety, maintain safety issues for construction to introduce the foundations on which appropriate health and safety systems may be built. Occupation and health and safety affect all aspects of work. Legal framework for health and safety.

Electromechanical Engineering students: Hazards analysis-Hazards of pressure , uses of over pressure-hazards of temperature-HAZOP study regarding pressure, temperature & flow -static electricity & its control purging and inerting -relief valves and rupture disks-venting – flame arrester -flare system-alarms and types of alarms and its application-trips d interlock system-hot work permit , confined space vessel work permit & height work permit - personnel protective equipment-On-site &Off-site emergency plan.

Electric shock and burns from live wire contact, Fires from faulty wiring, overloading circuits, leaving electrical parts exposed, Electrocution or burns from lack of PPE, Explosions and fires from explosive and flammable substances, Contact with overhead power lines Electrical exposure to water.

References

- Handbook of "Industrial Safety and Health, Trade and Technical Press Ltd. Morden, U.K.1980.
- S.P. Mahajan, "Pollution Control in Process Industries" Tata McGraw Hill, NewDelhi1985.

Laboratory

- Air sampling, Water sampling, Adsorption, Precipitation

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab.	Tut.	Sum	MT1	MT2	Std. Act.	Final
FT 103	Field Training I	Completion of 65 CR. HRS.	0	0	0	0	0	-	-	-	Pass
Course Contents	For 6 weeks interval as a minimum. Field training conducted under the supervision of a faculty member and field mentor in the actual field practice. The student must submit a detailed technical report by the end of training period, explain what he learned during this training. By the end of the training the student will be able to: Apply the principles knowledge to execute practical engineering field works. The students will have the opportunity to work with multidisciplinary teams during the training period.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab.	Tut.	Sum	MT1	MT2	Std. Act.	Final
FT 203	Field Training II	Completion of 96 CR. HRS.	0	0	0	0	0	-	-	-	Pass
Course Contents	For 6 week interval as a minimum. Field training conducted under the supervision of a faculty member and field mentor in the actual field practice. The student must submit a detailed technical report by the end of training period, explain what he learned during this training. By the end of the training the student will be able to: Apply the principles knowledge to execute practical engineering field works. The students will have the opportunity to work with multidisciplinary teams during the training period.										

Program # 10 Electromechanical Engineering Program

Program Description

Electromechanical Engineering Program is a scientific and professional field specializing in designing, implementing, and managing mechanical and electrical systems projects in various buildings and establishments. The study in this program focuses on:

- Professionalism in engineering design.
- Understand legal and professional practice related to government approvals for mechanical and electrical systems projects.
- Understand implementation methods, coordination, systems, equipment, planning, scheduling, and occupational safety.
- Understand management topics such as economics and business, accounting, law, statistics, ethics, and leadership.
- Study and analysis of disasters and risks.
- Decision-making and development methods.

Program Mission

Electromechanical Engineering Program is committed to graduate engineers with an outstanding knowledge, keeping up with the rapid developing trends, and providing research to serve society and the community.

Basic Information

Preparing Electromechanical Engineers at the level of cognitive distinct and processions to the rapid development of new developments in this field and a commitment to professional ethics in the field of work and society.

Program Objectives

The main objectives of the program are to:

1. Apply a wide spectrum of engineering knowledge, science and specialized skills with analytic, critical and systemic thinking to identify and solve engineering problems in real life situation.
2. Behave professionally and adhere to engineering ethics and standards and work to develop the profession and the community and promote sustainability principles.
3. Work in and lead a heterogeneous team and display leadership qualities, business administration, and entrepreneurial skills.
4. Master self-learning and life -long learning strategies to communicate effectively in academic/professional fields.
5. Solve problems in the areas of integrated mechanics, electronics, computers, and software systems.
6. Capable of analyzing and investigating the inter-disciplinary characteristics of mechanical, electrical, and hydraulic systems.

Graduates Attributes

Graduate attributes are the academic abilities, personal qualities, and skills which Electromechanical Engineering graduates should have.

According to NARS 2018 all engineering graduates must:

1. Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real life situations.
2. Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation.
3. Behave professionally and adhere to engineering ethics and standards.
4. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance.
5. Recognize his/her role in promoting the engineering field and contribute in the development of the profession and the community;
6. Value the importance of the environment, both physical and natural, and work to promote sustainability principles.
7. Use techniques, skills, and modern engineering tools necessary for engineering practice.
8. Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies.
9. Communicate effectively using different modes, tools, and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner.
10. Demonstrate leadership qualities, business administration and entrepreneurial skills.

In addition to all engineering graduate attributes defined by NARS 2018, Electromechanical Engineering graduate should be able to:

11. Communicate effectively with experience to the use of computer applications in various electromechanical engineering disciplines.
12. Produce a design system that satisfies a given specification in electromechanical system.
13. Evaluate the sustainability and environmental issues related to electromechanical systems.
14. Solve problems in the areas of integrated mechanics, electronics, computers, and software systems, and analyze and investigate the inter-disciplinary characteristics of mechanical, electrical, and hydraulic systems.

Program Learning Outcomes

Level A Learning Outcomes:

According to NARS2018, the engineering graduate must be able to:

PLO1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics.

PLO2. Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess, and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

PLO3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical, and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

PLO4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues, and risk management principles.

PLO5. Practice research techniques and methods of investigation as an inherent part of learning.

PLO6. Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.

PLO7. Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural teams.
PLO8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.
PLO9. Use creative, innovative, and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.
PLO10. Acquire and apply new knowledge, and practice self, lifelong and other learning strategies.

Level D Learning Outcomes:

In addition to the competences for all Engineering Programs (A-Level), the Electromechanical Engineering Program graduate must be able to (D-Level):

PLO11. Model, analyze and design physical systems applicable to the specific discipline by applying the concepts of: Thermodynamics, Heat Transfer, Fluid Mechanics, solid Mechanics, Material Processing, Material Properties, Measurements, Instrumentation, Control Theory and Systems, Mechanical Design and Analysis, Dynamics, and Vibrations.
PLO12. Plan, manage and carry out designs of mechanical systems and machine elements using appropriate materials both traditional means and computer-aided tools and software contemporary to the mechanical engineering field.
PLO13. select and purchase electromechanical equipment, components, and systems according to the required performance that fulfill job requirements and functional specifications.
PLO14. Adopt suitable national and international standards and codes; and integrate legal, economic, and financial aspects to design, build, operate, inspect, and maintain mechanical equipment and systems, electrical / electronic / digital equipment, systems, and services.
PLO15. Select, model, and analyze electrical power systems applicable to the specific discipline by applying the concepts of generation, transmission, and distribution of electrical power systems.
PLO16. Design, model and analyze an electrical / electronic / digital system or component for a specific application; and identify the tools required to optimize this design.
PLO17. Design and implement elements, modules, sub-systems, or systems in electrical engineering using technological and professional tools.
PLO18. Estimate and measure the performance of an electrical / electronic / digital system and circuit under specific input excitation and evaluate its suitability for a specific application.

Career opportunity

Why does the labor market need an electromechanical engineer؟

- Meet the need for these systems to coordinate among themselves.
- Minimize the number of engineers working in these systems within the establishment. So one engineer will work in a facility and work in all electrical and mechanical systems.
- Provide graduates engineers with the knowledge of these systems as most of the traditional programs in the faculties of engineering do not cover in their study the knowledge needed to work in most of these systems.

What will graduate of this program be؟

Following are some of the job opportunities that can be pursued by the program graduates:

Design Engineer: Develops the basics and details of many electrical and mechanical systems projects.
Site Engineer (supervision or implementation): Implements and coordinates electrical and mechanical systems projects at the site.

Operation and Maintenance Engineer: Responsible for the process and maintenance of all electrical and mechanical systems at the sites.

Survey engineer: perform surveying activities for all types of electromechanical projects.

Cost estimator: develops itemized costs and budgets for design and implementation based upon knowledge and pre-design of operations, materials, and resources requirements.

Project manager: oversees all aspects of a project, coordinates subcontractors, and provides primary contact to the client as well as to the company's leaders.

Division head or vice president, president, chief executive officer: manage overall site operations.

Features of electromechanical Engineer:

In addition to the general features of the engineer, Features of an electromechanical engineer.

- Application of analytical and experimental techniques.
- Design and management of electrical and mechanical engineering systems.
- Coordination with each other and the use of modern tools.
- Understand the profession's global, ethical, and social applications in terms of safety and overall sustainability issues.
- Collecting, benefiting, communicating, and possessing personal leadership skills.
- Ability to work cooperatively in a multidisciplinary team.
- Continuous outstanding work and lifelong learning.

Faculty Mission vs. Program Mission Matrix

Faculty Mission		Program Mission		
		Electromechanical Engineering Program is committed to graduate engineers with an outstanding knowledge, keeping up with the rapid developing trends, and providing research to serve society and the community.		
		Program is committed to graduate engineers with an outstanding knowledge	Keeping up with the rapid developing trends	Providing research to serve society and community.
Benha Faculty of Engineering - Benha University is committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market, and capable of using and developing modern technology, and providing research in engineering fields to serve society and community.	committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market	√		
	capable of using and developing modern technology,		√	
	providing research in engineering fields serve society and community			√

Program Mission vs. Program Objectives Matrix

Program Mission		Program Objectives					
		PO1	PO2	PO3	PO4	PO5	PO6
Electromechanical Engineering Program is committed to graduate engineers with an outstanding knowledge, keeping up with the rapid developing trends, and providing research to serve society and the community.	Program is committed to graduate engineers with an outstanding knowledge	√				√	√
	Keeping up with the rapid developing trends		√	√	√	√	√
	Providing research to serve society and community.				√		√

Competencies vs. Program Objectives Matrix

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18
PO1	√	√							√		√	√	√	√	√	√	√	
PO2			√				√											
PO3							√	√	√		√	√		√				
PO4					√			√		√			√		√			
PO5			√	√			√	√	√							√	√	√
PO6	√	√				√					√	√	√		√			√

Program Objectives Vs Graduate Attributes

Program Objectives	Graduate Attribute													
	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12	GA13	GA14
PO1	√	√									√			
PO2			√		√	√							√	
PO3				√						√				
PO4								√	√					
PO5							√				√	√		√
PO6							√					√		√

Requirements of Program Courses

In order to get a Bachelor of Science Degree in this program, and to satisfy the Program competencies, the following set of courses need to be completed.

Program Requirements

Requirement		Cr. Hrs.	Contact Hours			
			Lec.	Lab.	Tut.	Sum
University Requirements		14	14	0	0	14
Faculty Requirements		**32**	**19**	**14**	**17**	**50**
Program Requirements	From Basic Science	12	8	0	8	16
	Compulsory Courses (Program Specialized)	**84**	**60**	**17**	**45**	**122**
	Elective Courses	18	12	0	12	24
Total		160	113	31	82	226

University Requirements of Electromechanical Engineering Program

Lists of Main Humanities Courses of Electromechanical Engineering Program

Code	**Course**	**Pre-requisites**	Cr. Hrs.	**Ct. Hrs.**			
				Lec	**Lab.**	**Tut.**	**Sum**
UHS 101	Foreign Language	-----	2	2	0	0	2
UHS 102	Information and Communication Technology	-----	2	2	0	0	2
UHS 103	Societal Issues	-----	2	2	0	0	2
UHS XXX	Humanities Elective I	-----	2	2	0	0	2
UHS XXX	Humanities Elective II	-----	2	2	0	0	2
UHS XXX	Humanities Elective III	-----	2	2	0	0	2
Total			**14**	**14**	**0**	**0**	**14**

Lists of Electives Humanities of Electromechanical Engineering Program

Humanities Elective		**Code**	**Course**
I	Entrepreneurship Courses	UHS 201	Principles of Entrepreneurship and Project Management
		UHS 203	Human Resources Management
II	Personal and acquired skills courses	UHS 301	Communication and Presentation Skills
		UHS 302	Leadership Skills
III	Scientific research and analysis courses	UHS 801	Research Methodologies
		UHS 803	Thinking Skills

Faculty Requirements of Electromechanical Engineering Program

Code	Course	Pre-requisites	Cr. Hrs.	Ct. Hrs. Lec.	Lab.	Tut	Sum
FRB 001	Analytical geometry & Linear Algebra	-----	3	2	0	2	4
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4
FRB 003	Statics	-----	3	2	0	2	4
FRB 004	Dynamics	FRB 003	3	2	0	2	4
FRB 005	Waves and Heat	-----	3	2	2	1	5
FRB 006	Electricity and Magnetism	-----	3	2	2	1	5
FRB 007	Chemistry for Engineers	-----	4	3	2	1	6
FRM 008	Production Systems Engineering	-----	2	1	3	0	4
FRM 009	Engineering Drawing	-----	2	0	0	4	4
FRM 010	Engineering Drawing by Computer	FRM 009	2	1	2	0	3
FRE 012	Computer Programming	-----	2	0	2	2	4
FRB 103	Environmental Pollution and Industrial Safety	FRB 007	2	2	1	0	3
FT 103	Field Training I	Completion of 65 CR. HRS.	0	0	0	0	0
FT 203	Field Training II	Completion of 96 CR. HRS.	0	0	0	0	0
Total			**32**	**19**	**14**	**17**	**50**

Basic Science Requirements of Electromechanical Engineering Program

CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hrs. Lec	Lab.	Tut.	Sum
FRB 001	Analytical geometry & Linear Algebra	-----	3	2	0	2	4
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4
FRB 101	Engineering Differential Equations	FRB 002	3	2	0	2	4
FRB 104	Engineering Numerical Analysis	FRB 101	3	2	2	0	4
FRB 201	Applied Engineering Probability and Mathematical Statistics	FRB 002	3	2	2	0	4
FRB 206	Multiple Integrals & Complex Analysis	FRB 002	3	2	0	2	4
FRB 007	Chemistry for Engineers	-----	4	3	2	1	6
FRB 103	Environmental Pollution and Industrial Safety	FRB 007	2	2	1	0	3
EMM 202*	Vibrations and System Dynamics	EMM 103, EMM 107	3	2	1	1	4
FRB 005	Waves and Heat	-----	3	2	2	1	5
FRB 006	Electricity and Magnetism	-----	3	2	2	1	5
Total			**33**	**23**	**12**	**12**	**47**

Program Requirements

Lists of Compulsory Courses (96 Credit Hours)

Code	Course Title	Pre-requisites	Cr. Hrs.	Contact Hours			
				Lec	Lab	Tut	Sum
FRB 101	Engineering Differential Equations	FRB 002	3	2	0	2	4
FRB 104	Engineering Numerical Analysis	FRB 101	3	2	2	0	4
FRB 201	Applied Engineering Probability and Mathematical Statistics	FRB 002	3	2	2	0	4
FRB 206	Multiple Integrals & Complex Analysis	FRB 002	3	2	0	2	4
	Total from Basic Science		**12**	**8**	**4**	**4**	**16**
EMM 101	Fluid Mechanics I	FRB 004	2	2	1	0	3
EMM 103	Mechanics of Machinery	FRB 004	3	2	0	2	4
EME 105	Electric Circuits Analysis	FRB 006	3	2	1	2	5
EMM 107	Strength and properties of Materials	FRB 004	2	2	1	0	3
EMM 109	Thermodynamics I	FRB 005	2	2	1	0	3
EMM 102	Fluid Mechanics II	EMM 101	2	2	1	0	3
EMM 104	Manufacture Technology	FRM 008	3	2	2	0	4
EME 106	Electrical Machines	EME 105	3	2	1	1	4
EMM 108	Measurements and Instrumentation	FRB 006	3	2	1	1	4
EMM 110	Solid Mechanics	EMM 107	2	2	1	0	3
EMM 112	Thermodynamics II	EMM 109	2	2	1	0	3
EME 201	Logic Circuits and Micro processors	EME 105	3	2	1	2	5
EMM 203	Heat Transfer	EMM 109	3	2	1	1	4
EMM 205	Projects Management	FRB 002	2	2	1	0	3
EME 207	Electrical Power Systems	EME 106	3	2	0	2	4
EMM 209	Design of Machine Elements	EMM 104 &EMM 110	3	2	1	2	5
EMM 202	Vibrations and System Dynamics	EMM 103, EMM 107	3	2	1	1	4
EMM 204	Plumbing Systems	EMM 102	3	2	0	2	4
EME 206	Electronic Devices and Circuits	EME 201	3	2	1	1	4
EMM 208	Fluid Machinery	EMM 102	3	2	1	1	4
EME 210	Electric Power Distribution Systems	EME 207	3	2	0	3	5
EMM 301	Refrigeration	EMM 112	2	2	1	0	3
EMM 303	Air Conditioning Systems	EMM 112	3	2	1	1	4
EME 305	Low Current Distribution Systems	EME 210	3	2	0	2	4
EMM 307	Fire Fighting Systems	EMM 102	3	2	0	2	4
EMM 309	Combustion	EMM 112	3	2	1	1	4
EMM 302	Refrigeration and AC Systems/Components	EMM 301 &EMM 303	3	2	1	1	4
EME 304	Automatic Control	EME 106	2	2	1	0	3
EMM 390	Senior Design Project I	*	2	0	4	0	4
EMM 401	Computer Applications in El/Mec System	EME 305 & EMM 303	2	1	2	0	3
EMM 403	Process Control and Building management System	EME 304	2	2	1	0	3
EMM 490	Senior Design Project II	EMM 390	3	1	4	0	5
Total Main Specialized Courses			**84**	**60**	**32**	**30**	**122**

Total Compulsory Courses	**96**	**68**	**35**	**35**	**138**

*The student can register the Senior design Project I course after passing 70% of the program Cr. Hrs, i.e., 112 Cr. Hr

Lists of Elective Courses (18 Credit Hours)

CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hrs.			
				Lec	Lab.	Tut.	Sum
Elective I							
EMM 312	Renewable Energy	EME 106 &EMM 109	3	2	0	2	4
EMM 314	Elevators and Escalators	EMM 209	3	2	0	2	4
EMM 316	Solar Thermal and PV Systems	EMM 203	3	2	0	2	4
Elective II							
EME 322	Advanced Industrial Electronics	EME 206	3	2	0	2	4
EME 324	Electrical Protection	EME 305	3	2	0	2	4
EME 326	Electrostatic and Electromagnetic Fields	EME 106	3	2	0	2	4
Elective III							
EMM 332	Internal Combustion Engines	EMM 309	3	2	0	2	4
EMM 334	Essentials of Energy Management	EMM 205	3	2	0	2	4
EMM 336	Wind Energy System Design	EMM 208 &EMM 309	3	2	0	2	4
Elective IV							
EMM 411	Cold Stores and Industrial Refrigeration	EMM 301	3	2	0	2	4
EMM 413	Automotive Engineering	EMM 309	3	2	0	2	4
EMM 415	Power Stations	EMM 112	3	2	0	2	4
Elective V							
EME 421	Electro-Hydraulic Circuits	EME 304	3	2	0	2	4
EME 423	Codes and Specifications of El/Mec Systems	EMM 302 &EME 305	3	2	0	2	4
EME 425	Computer Networks	EME 105	3	2	0	2	4
Elective VI							
EME 431	Modern Control System	EME 304	3	2	0	2	4
EME 433	Power System Analysis	EME 305	3	2	0	2	4
EME 435	Electrical Drives	EME 106 &EME 304	3	2	0	2	4
Total			18	12	0	12	24

Matching Electromechanical Engineering Program Courses with ABET Requirements

ABET criteria for Electromechanical Engineering Program

Lead Society: American Society of Mechanical Engineers

Electromechanical Engineering Program Courses Required to Cover ABET Criteria				
ABET Criteria		**CODE**	**Course Name**	**Cr. Hrs.**
A minimum of 30 semester credit hours (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program.	The curriculum must prepare graduates to apply knowledge of mathematics through differential equations.	FRB 001	Analytical geometry & Linear Algebra	3
		FRB 002	Integration & Multivariable functions	3
		FRB 101	Engineering Differential Equations	3
		FRB 206	Multiple Integrals & Complex Analysis	3
	At least one additional area of basic science; apply probability and statistics to address uncertainty	FRB 104	Engineering Numerical Analysis	3
		FRB 201	Applied Engineering Probability and Mathematical Statistics	3
	Chemistry	FRB 007	Chemistry for Engineers	4
		FRB 103	Environmental Pollution and Industrial Safety	2
	Calculus-based physics	FRB 005	Waves and Heat	3
		FRB 006	Electricity and Magnetism	3
Total				**30**
ABET Criteria		**CODE**	**Course Name**	**Cr. Hrs.**
A minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design and utilizing modern engineering tools.	Analyze and design mechanical and electrical processes and systems in a electromechanical engineering specialty field.	EMM 103	Mechanics of Machinery	3
		EMM 104	Manufacture Technology	3
		EME 106	Electrical Machines	3
		EMM 209	Design of Machine Elements	3
		EMM 202	Vibrations and System Dynamics	3
		EMM 307	Fire Fighting Systems	3
		EME 206	Electronic Devices and Circuits	3
		EMM 302	Refrigeration and AC Systems/Components	3
	Apply knowledge of methods, materials, equipment, planning, scheduling, safety, and cost analysis; to explain basic	EMM 107	Strength and properties of Materials	3
		EME 105	Electric Circuits Analysis	3
		EMM 101	Fluid Mechanics I	3
		EMM 109	Thermodynamics I	3

	legal and ethical concepts and the importance of professional engineering licensure in the construction industry	EMM 110	Solid Mechanics	3
	Explain basic concepts of economics, business, accounting, communications, leadership, decision and optimization methods, engineering economics	UHS XXX	Humanities Elective II	2
	the engineering relationships between the management tasks of planning, organization, leadership, control, and the human element in production, research, and service organizations;	UHS XXX	Humanities Elective I	2
		UHS XXX	Humanities Elective III	2
	The stochastic nature of management systems	EMM 205	Projects Management	2
		EMM 403	Process Control and Building management System	3
	Integrating management systems into a series of different technological environments	EMM 3XX	Elective I	3
		EMM 3XX	Elective III	3
Total				**56**

Proposed Study Plan

Level 0- 1															
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hrs.				Final Exam Time	Assessment					
				Lec	Lab.	Tut.	Sum		Mid 1	Mid 2	St. Act.	PE/OE	Final	sum
FRB 001	Analytical geometry & Linear Algebra	-----	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
FRB 003	Statics	-----	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
FRB 005	Waves and Heat	-----	3	2	2	1	5	2 hrs.	30	--	10	20	40	100
FRB 007	Chemistry for Engineers	-----	4	3	2	1	6	2 hrs.	30	--	10	20	40	100
FRM 009	Engineering Drawing	-----	2	0	0	4	4	2 hrs.	30	20	10	--	40	100
UHS 101	Foreign Language	-----	2	2	0	0	2	2 hrs.	30	20	10	--	40	100
UHS 103	Social issues	-----	2	2	0	0	2	2 hrs.	30	20	10	--	40	100
			19	13	4	10	27							700

Level 0- 2														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hrs.				Final Exam Time	Assessment					
				Lec	Lab.	Tut.	Sum		Mid 1	Mid 2	St. Act.	PE/OE	Final	sum
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
FRB 004	Dynamics	FRB 003	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
FRB 006	Electricity and Magnetism	-----	3	2	2	1	5	2 hrs.	30	--	10	20	40	100
FRM 008	Production Systems Engineering	-----	2	1	3	0	4	2 hrs.	30	--	10	20	40	100
FRM 010	Engineering Drawing by Computer	FRM 009	2	1	2	0	3	2 hrs.	30	20	10	40	--	100
UHS 102	Information and Communication Technology	-----	2	2	0	0	2	2 hrs.	30	20	10	--	40	100
FRE 012	Computer Programming	-----	2	0	2	2	4	2 hrs.	30	20	10	40	--	100
			17	10	9	7	26							700

Level 1- 1														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hrs.				Final Exam Time	Assessment					
				Lec	Lab.	Tut.	Sum		Mid 1	Mid 2	St. Act.	PE/OE	Final	sum
FRB 101	Engineering Differential Equations	FRB 002	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
EMM 101	Fluid Mechanics I	FRB 004	2	2	1	0	3	2 hrs.	30	--	10	20	40	100
EMM 103	Mechanics of Machinery	FRB 004	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
EME 105	Electric Circuits Analysis	FRB 006	3	2	1	2	5	2 hrs.	30	--	10	20	40	100
EMM 107	Strength and properties of Materials	FRB 004	2	2	1	0	3	2 hrs.	30	--	10	20	40	100
EMM 109	Thermodynamics I	FRB 005	2	2	1	0	3	2 hrs.	30	--	10	20	40	100
FRB 103	Environmental Pollution and Industrial Safety	FRB 007	2	2	1	0	3	2 hrs.	30	--	10	20	40	100
			17	14	5	6	25							700

* Course teaching is shared between the Basic Engineering Science Department and Mechanical Engineering Department.

Level 1- 2														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hrs.				Final Exam Time	Assessment					
				Lec	Lab	Tut.	Sum		Mid 1	Mid 2	St. Act.	PE/OE	Final	sum
FRB 104	Engineering Numerical Analysis	FRB 101	3	2	2	0	4	2 hrs.	30	-	10	20	40	100
EMM 102	Fluid Mechanics II	EMM 101	2	2	1	0	3	2 hrs.	30	--	10	20	40	100
EMM 104	Manufacture Technology	FRM 008	3	2	2	0	4	2 hrs.	30	--	10	20	40	100
EME 106	Electrical Machines	EME 105	3	2	1	1	4	2 hrs.	30	--	10	20	40	100
EMM 108	Measurements and Instrumentation	FRB 006	3	2	1	1	4	2 hrs.	30	--	10	20	40	100
EMM 110	Solid Mechanics	EMM 107	2	2	1	0	3	2 hrs.	30	--	10	20	40	100
EMM 112	Thermodynamics II	EMM 109	2	2	1	0	3	2 hrs.	30	--	10	20	40	100
			18	14	8	3	25							700

Field Training I														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hrs.				Final Exam Time	Assessment				
				Lec	Lab	Tut.	Sum		Mid 1	Mid 2	St. Act.	Final	sum
FT 103	Field Training I	Completion of 65 CR. HRS.	0	0	0	0	0	--	--	--	--	--	Pass / Fail

Level 2- 1														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hrs.				Final Exam Time	Assessment					
				Lec	Lab.	Tut.	Sum		Mid 1	Mid 2	St. Act.	PE/OE	Final	sum
FRB 201	Applied Engineering Probability and Mathematical Statistics	FRB 002	3	2	2	0	4	2 hrs.	30	--	10	20	40	100
EME 201	Logic Circuits and Micro processors	EME 105	3	2	1	2	5	2 hrs.	30	--	10	20	40	100
EMM 203	Heat Transfer	EMM 109	3	2	1	1	4	2 hrs.	30	--	10	20	40	100
EMM 205	Projects Management	FRB 002	2	2	1	0	3	2 hrs.	30	--	10	20	40	100
EME 207	Electrical Power Systems	EME 106	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
EMM 209	Design of Machine Elements	EMM 104 &EMM 110	3	2	1	2	5	2 hrs.	30	--	10	20	40	100
			17	12	5	8	25							600

Level 2- 2														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hrs.				Final Exam Time	Assessment					
				Lec	Lab.	Tut.	Sum		Mid 1	Mid 2	St. Act.	PE/OE	Final	sum
FRB 206	Multiple Integrals & Complex Analysis	FRB 002	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
EMM 202	Vibrations and System Dynamics	EMM 103, EMM 107	3	2	1	1	4	2 hrs.	30	--	10	20	40	100
EMM 204	Plumbing Systems	EMM 102	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
EME 206	Electronic Devices and Circuits	EME 201	3	2	1	1	4	2 hrs.	30	--	10	20	40	100
EMM 208	Fluid Machinery	EMM 102	3	2	1	1	4	2 hrs.	30	--	10	20	40	100
EME 210	Electric Power Distribution Systems	EME 207	3	2	0	3	5	2 hrs.	30	20	10	--	40	100
			18	12	3	10	25							600

Field Training II													
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hrs.				Final Exam Time	Assessment				
				Lec	Lab	Tut.	Sum		Mid 1	Mid 2	St. Act.	Final	sum
FT 203	Field Training II	Completion of 96 CR. HRS.	0	0	0	0	0	--	--	--	--	--	Pass / Fail

Level 3- 1														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hrs.				Final Exam Time	Assessment					
				Lec	Lab.	Tut.	Sum		Mid 1	Mid 2	St. Act.	PE/OE	Final	sum
EMM 301	Refrigeration	EMM 112	2	2	1	0	3	2 hrs.	30	--	10	20	40	100
EMM 303	Air Conditioning Systems	EMM 112	3	2	1	1	4	2 hrs.	30	--	10	20	40	100
EME 305	Low Current Distribution Systems	EME 210	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
EMM 307	Fire Fighting Systems	EMM 102	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
EMM 309	Combustion	EMM 112	3	2	1	1	4	2 hrs.	30	--	10	20	40	100
UHS XXX	Humanities Elective I	-----	2	2	0	0	2	2 hrs.	30	20	10	--	40	100
UHS XXX	Humanities Elective II	-----	2	2	0	0	2	2 hrs.	30	20	10	--	40	100
			18	14	3	6	23							700

Level 3- 2														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hrs.				Final Exam Time	Assessment					
				Lec	Lab.	Tut.	Sum		Mid 1	Mid 2	St. Act.	PE/OE	Final	sum
EMM 302	Refrigeration and AC Systems/Components	EMM 301 &EMM 303	3	2	1	1	4	2 hrs.	30	--	10	20	40	100
EME 304	Automatic Control	EME 106	2	2	1	0	3	2 hrs.	30	--	10	20	40	100
EMM 3XX	Elective I	*	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
EME 3XX	Elective II	*	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
EMM 3XX	Elective III	*	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
EMM 390	Senior Design Project I	**	2	0	4	0	4	2 hrs.	--	--	50	50	--	100
UHS 104	Professional Ethics	-----	2	2	0	0	2	2 hrs.	30	20	10	--	40	100
			18	12	6	7	25							700

* According to the Course Name
**The student can register for the Senior Design Project course after passing 70% of the program cr. hrs, i.e., 112 Credit. Hours

	Level 4- 1														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hrs.				Final Exam Time	Assessment					
				Lec	Lab.	Tut.	Sum		Mid 1	Mid 2	St. Act.	PE/OE	Final	sum
EMM 401	Computer Applications in El/Mec System	EME 305 & EMM 303	2	1	2	0	3	2 hrs.	30	--	10	20	40	100
EMM 403	Process Control and Building management System	EME 304	2	2	1	0	3	2 hrs.	30	--	10	20	40	100
EMM 4XX	Elective IV	*	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
EME 4XX	Elective V	*	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
EMM 4XX	Elective VI	*	3	2	0	2	4	2 hrs.	30	20	10	--	40	100
UHS XXX	Humanities Elective III	-----	2	2	0	0	2	2 hrs.	30	20	10	--	40	100
EMM 490	Senior Design Project II	EMM 390	3	1	4	0	5	2 hrs.	--	--	50	50	--	100
			18	12	7	6	25							700

* According to the Course Name

Electromechanical Engineering Program Map

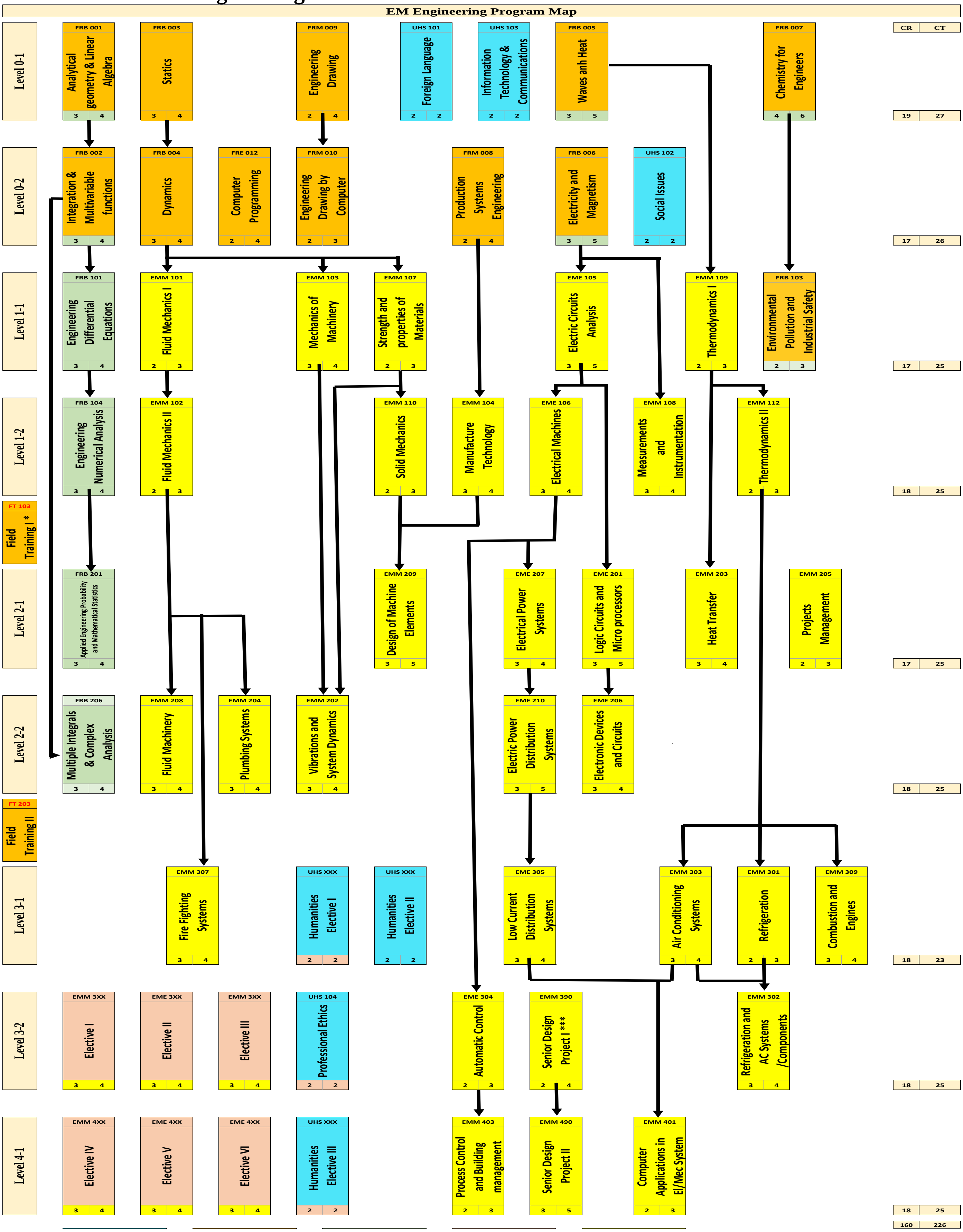
Electromechanical Engineering Program Map									
								CR	CT
Level 0-1	FRB 001 Analytical geometry & Linear Algebra 3 4	FRB 003 Statics 3 4	FRB 005 Waves and Heat 3 5	FRB 007 Chemistry for Engineers 4 6	FRM 009 Engineering Drawing 2 4	UHS 101 Foreign Language 2 2	UHS 103 Social Issues 2 2	19	27
Level 0-2	FRB 002 Integration & Multivariable functions 3 4	FRB 004 Dynamics 3 4	FRB 006 Electricity and Magnetism 3 5	FRM 008 Production Systems Engineering 2 4	FRM 010 Engineering Drawing by Computer 2 3	UHS 102 Information and Communication Technology 2 2	FRE 012 Computer Programming 2 4	17	26
Level 1-1	FRB 101 Engineering Differential Equations 3 4	EMM 101 Fluid Mechanics I 2 3	EMM 103 Mechanics of Machinery 3 4	FRB 103 Environmental Pollution and Industrial Safety 2 3	EME 105 Electric Circuits Analysis 3 5	EMM 107 Strength and properties of Materials 2 3	EMM 109 Thermodynamics I 2 3	17	25
Level 1-2	FRB 104 Engineering Numerical Analysis 3 4	EMM 102 Fluid Mechanics II 2 3	EMM 104 Manufacture Technology 3 4	EME 106 Electrical Machines 3 4	EMM 108 Measurements and Instrumentation 3 4	EMM 110 Solid Mechanics 2 3	EMM 112 Thermodynamics II 2 3	18	25
	FT 103 Field Training I								
Level 2-1	FRB 201 Applied Engineering Probability and Mathematical Statistics 3 4	EME 201 Logic Circuits and Micro processors 3 5	EMM 203 Heat Transfer 3 4	EMM 205 Projects Management 2 3	EME 207 Electrical Power Systems 3 4	EMM 209 Design of Machine Elements 3 5		17	25
Level 2-2	FRB 206 Multiple Integrals & Complex Analysis 3 4	EMM 202 Vibrations and System Dynamics 3 4	EMM 204 Plumbing Systems 3 4	EME 206 Electronic Devices and Circuits 3 4	EMM 208 Fluid Machinery 3 4	EME 210 Electric Power Distribution Systems 3 5		18	25
	FT 203 Field Training II								
Level 3-1	EMM 301 Refrigeration 2 3	EMM 303 Air Conditioning Systems 3 4	EME 305 Low Current Distribution Systems 3 4	EMM 307 Fire Fighting Systems 3 4	EMM 309 Combustion 3 4	UHS XXX Humanities Elective I 2 2	UHS XXX Humanities Elective II 2 2	18	23
Level 3-2	EMM 302 Refrigeration and AC Systems/Components 3 4	EME 304 Automatic Control 2 3	EMM 3XX Elective I 3 4	EME 3XX Elective II 3 4	EMM 3XX Elective III 3 4	EMM 390 Senior Design Project I 2 4	UHS 104 Professional Ethics 2 2	18	25
Level 4-1	EMM 401 Computer Applications in El/Mec System 2 3	EMM 403 Process Control and Building management System 2 3	EMM 4XX Elective IV 3 4	EME 4XX Elective V 3 4	EME 4XX Elective VI 3 4	EMM 490 Senior Design Project II 3 5	UHS XXX Humanities Elective III 2 2	18	25
	University Req. 14 14	Faculty Req. 32 50	Basic Science Req. 30 44	Elective Req. 18 24	Program Req. 84 122			160	226

Elective Courses Map:

EM Engineering Program - Elective Courses Map

Level	Elective slot	pre-req.	Course code	Course title		
Level 3-2	EMM 3XX Elective I (3, 4)	EME 106 & EMM 109	EMM 312	Renewable Energy	3	4
		EMM 209	EMM 314	Elevators and Escalators	3	4
		EMM 203	EMM 316	Solar Thermal and PV Systems	3	4
Level 3-2	EME 3XX Elective II (3, 4)	EME 206	EME 322	Advanced Industerial Electronics	3	4
		EME 305	EME 324	Electrical Protection	3	4
		EME 106	EME 326	Electrostatic and Electromagnetic Fields	3	4
Level 3-2	EMM 3XX Elective III (3, 4)	EMM 309	EMM 332	Internal Combustion Engines	3	4
		EMM 205	EMM 334	Essentials of Energy Management	3	4
		EMM 208 & EMM 309	EMM 336	Wind Energy System Design	3	4
Level 4-1	EMM 4XX Elective IV (3, 4)	EMM 301	EMM 411	Cold Stores and Industrial Refrigeration	3	4
		EMM 309	EMM 413	Automotive Engineering	3	4
		EMM 112	EMM 415	Power Stations	3	4
Level 4-1	EME 4XX Elective V (3, 4)	EME 304	EME 421	Electro-Hydraulic Circuits	3	4
		EMM 302 & EME 305	EME 423	Codes and Specifications of El/Mec Systems	3	4
		EME 105	EME 425	Computer Networks	3	4
Level 4-1	EME 4XX Elective VI (3, 4)	EME 304	EME 431	Modern Control System	3	4
		EME 305	EME 433	Power System Analysis	3	4
		EME 106 & EME 304	EME 435	Electrical Drives	3	4

Electromechanical Engineering Flowchart



6.3 Matrix of Program Learning Outcomes and Courses

Level	Code	Title	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18
Level 0-1	FRB 001	Analytical geometry & Linear Algebra	●		●															
	FRB 003	Statics	●	●																
	FRB 005	Waves and Heat	●	●																
	FRB 007	Chemistry for Engineers	●	●																
	FRM 009	Engineering Drawing						●		●										
	UHS 103	Social issues				●						●								
	UHS 101	Foreign Language								●		●								
Level 0-2	FRB 002	Integration & Multivariable functions	●		●															
	FRB 004	Dynamics	●	●																
	FRB 006	Electricity and Magnetism	●	●																
	FRM 008	Production Systems Engineering				●		●												
	FRM 010	Engineering Drawing by Computer				●				●										
	FRE 012	Computer Programming	●		●						●									
	UHS 102	Information and Communication							●			●								

Level	Code	Title	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18
		Technology																		
Level 1-1	FRB 101	Engineering Differential Equations	●	●																
	EMM 101	Fluid Mechanics I		●									●							
	EMM 103	Mechanics of Machinery			●					●				●		●				
	FRB 103	Environmental Pollution and Industrial Safety	●	●		●														
	EME 105	Electric Circuits Analysis	●	●														●	●	
	EMM 107	Strength and properties of Materials		●									●							
	EMM 109	Thermodynamics I	●	●									●	●						
Level 1-2	FRB 104	Engineering Numerical Analysis	●	●																
	EMM 102	Fluid Mechanics II	●	●									●		●					
	EMM 104	Manufacture Technology						●					●							
	EME 106	Electrical Machines					●									●	●			
	EMM 108	Measurements and Instrumentation		●												●	●			●
	EMM 110	Solid Mechanics		●									●							
	EMM 112	Thermodynamics II	●	●									●	●						
	FT 103	Field Training I							●			●								

Level	Code	Title	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18
Level 2-1	FRB 201	Applied Engineering Probability and Mathematical Statistics	●	●																
	EME 201	Logic Circuits and Micro processors		●	●												●	●		
	EMM 203	Heat Transfer	●	●									●		●					
	EMM 205	Projects Management								●	●									
	EME 207	Electrical Power Systems															●	●		
	EMM 209	Design of Machine Elements			●					●				●		●				
Level 2-2	FRB 206	Multiple Integrals & Complex Analysis	●	●																
	EMM 202	Vibrations and System Dynamics	●	●									●	●						
	EMM 204	Plumbing Systems	●	●									●		●					
	EME 206	Electronic Devices and Circuits		●									●					●	●	●
	EMM 208	Fluid Machinery	●	●									●		●					
	EME 210	Electric Power Distribution Systems														●	●			
	FT 203	Field Training II							●			●								
Level 3-1	EMM 301	Refrigeration	●	●									●	●						
	EMM 303	Air Conditioning Systems	●	●									●	●						

Level	Code	Title	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18
	EME 305	Low Current Distribution Systems														●	●			
	EMM 307	Fire Fighting Systems	●	●									●		●					
	EMM 309	Combustion	●	●									●	●						
	UHS XXX	Humanities Elective I	Refer to the next two courses																	
Humanities Elective I	UHS 201	Principles of Entrepreneurship and Project Management						●			●									
Humanities Elective I	UHS 203	Human Resources Management						●			●									
Level 3-1	UHS XXX	Humanities Elective II	Refer to the next two courses																	
Humanities Elective II	UHS 301	Communication and Presentation Skills								●	●									
Humanities Elective II	UHS 302	Leadership Skills								●	●									
Level 3-2	EMM 302	Refrigeration and AC Systems/Components	●	●									●	●						
Level 3-2	EME 304	Automatic Control	●		●								●	●					●	●
Level 3-2	EMM 3XX	Elective I	Refer to the next three courses																	
Elective I	EMM 312	Renewable Energy											●	●			●			
Elective I	EMM 314	Elevators and Escalators											●	●			●			
Elective I	EMM 316	Solar Thermal and PV Systems											●	●			●			
Level	EME	Elective II	Refer to the next three courses																	

Level	Code	Title	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18
3-2	3XX																			
Elective II	EME 322	Advanced Industrial Electronics														●		●	●	
Elective II	EME 324	Electrical Protection														●		●	●	
Elective II	EME 326	Electrostatic and Electromagnetic Fields														●		●	●	
Level 3-2	EMM 3XX	Elective III	Refer to the next three courses																	
Elective III	EMM 332	Internal Combustion Engines	●	●									●	●	●					
Elective III	EMM 334	Essentials of Energy Management	●	●									●	●	●					
Elective III	EMM 336	Wind Energy System Design	●	●									●	●	●					
Level 3-2	EMM 390	Senior Design Project I					●	●	●	●	●	●								
Level 3-2	UHS 104	Professional Ethics				●						●								
Level 4-1	EMM 401	Computer Applications in El/Mec System											●				●	●		
Level 4-1	EMM 403	Process Control and Building management System											●	●					●	●
Level 4-1	EMM 4XX	Elective IV	Refer to the next three courses																	
Elective IV	EMM 411	Cold Stores and Industrial Refrigeration	●	●									●	●	●					
Elective IV	EMM 413	Automotive Engineering	●	●									●	●	●					
Elective IV	EMM 415	Power Stations	●	●									●	●	●					

Level	Code	Title	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18
Level 4-1	EME 4XX	Elective V	Refer to the next three courses																	
Elective V	EME 421	Electro-Hydraulic Circuits				●							●	●		●				
	EME 423	Codes and Specifications of El/Mec Systems				●							●	●		●				
	EME 425	Computer Networks				●							●	●		●				
Level 4-1	EME 4XX	Elective VI	Refer to the next three courses																	
Elective VI	EME 431	Modern Control System															●	●	●	
	EME 433	Power System Analysis															●	●	●	
	EME 435	Electrical Drives															●	●	●	
Level 4-1	EMM 490	Senior Design Project II					●	●	●	●	●	●								
Level 4-1	UHS XXX	Humanities Elective III	Refer to the next two courses																	
Humanities Elective III	UHS 801	Research Methodologies					●					●								
	UHS 803	Thinking Skills					●					●								

Courses Coding System

The course coding system is composed of three letters that denotes the department which offers the course, followed by 3 digits: where:

- the first digit from left represents the course level (from 1 to 5),
- the next two digits represent the course sequence (odd for Fall Semesters and even for Spring Semesters).

The coding system is demonstrated in the following table:

UHS XXX	University Requirement Courses
FRB XXX	Courses offered by Basic Engineering Science Department
FRM XXX	Course offered by Mechanical Engineering Department for Faculty Requirement
FRE XXX	Course offered by Electrical Engineering Department for Faculty Requirement
EMM XXX	Course offered by Mechanical Engineering Department
EME XXX	Course offered by Electrical Engineering Department

Pre-req	Prerequisite	**Cr. Hrs.**	Credit Hours	**Std. Act.**	Student Activity
Lec	Lectures	**Tut**	Tutorials	**Lab**	Laboratory
MT1	First Midterm Exam	**MT2**	Second Midterm Exam	**Final**	Final Exam

Program Requirements

Compulsory Courses

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>MT1</th><th>MT2</th><th>Std. Act.</th><th>Final</th></tr>
<tr><td>FRB 101</td><td>Engineering Differential Equations</td><td>FRB 002</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Basic Concepts of Ordinary and Partial differential equations (ODEs & PDEs): Oder, Degree, Linearity, Formation, Geometric and physical applications (Newtons law of cooling, electric circuits), Types of solutions, Existence and uniqueness of solutions.
ODEs: Solution of first order ODEs (Separable, Homogeneous, Exact, Integrating factor, Linear and Bernoulli equations). Orthogonal trajectories. Solution of nth order ODEs (homogeneous and non-homogeneous). System of first order linear differential equations. Laplace transforms and inverse Laplace transforms with applications. Fourier series with applications. Gamma and Beta functions
PDEs: Solution of linear PDEs with constant coefficients, solution of some initial-boundary value problems. Solution of PDEs by Laplace Transforms.</td></tr>
<tr><td>References</td><td colspan="11">• Morris Tenenbaum, Harry Pollard, "Ordinary Differential Equations: An Elementary Textbook for Students of Mathematics, Engineering, and the Sciences", Dover Publications, Last Edition.
• Wei-Chau Xie, Differential Equations for Engineers, CAMBRIDGE UNIVERSITY PRESS, 2010.</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct Hrs</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Tot</th><th>SA</th><th>MT</th><th>PE/ OE</th><th>Final</th></tr>
<tr><td>FRB 103</td><td>Environmental Pollution and Industrial Safety</td><td>FRB 007</td><td>2</td><td>2</td><td>1</td><td>-</td><td>3</td><td>10</td><td>30</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">- Air pollution-Adverse effects -ozone depletion – green house effects- Acid rain and global warming - measurement and control methods.
- Water pollution- constituents of wastewater- primary treatment: various pre-treatment methods - Advanced Treatment: chemical oxidation, precipitation, air stripping
Construction Engineering and Managment students: Plan and manage construction health and safety, maintain safety issues for construction to introduce the foundations on which appropriate health and safety systems may be built. Occupation and health and safety affect all aspects of work. Legal framework for health and safety.
Electromechanical Engineering students: Hazards analysis-Hazards of pressure , uses of over pressure-hazards of temperature-HAZOP study regarding pressure, temperature & flow -static electricity & its control purging and inerting -relief valves and rupture disks-venting – flame arrester -flare system-alarms and types of alarms and its application-trips d interlock system-hot work permit , confined space vessel work permit & height work permit - personnel protective equipment-On-site &Off-site emergency plan.
Electric shock and burns from live wire contact, Fires from faulty wiring, overloading circuits, leaving electrical parts exposed, Electrocution or burns from lack of PPE, Explosions and fires from explosive and flammable substances, Contact with overhead power lines Electrical exposure to water.</td></tr>
<tr><td>References</td><td colspan="11">• Handbook of “Industrial Safety and Health, Trade and Technical Press Ltd. Morden, U.K.1980.
• S.P. Mahajan, “Pollution Control in Process Industries” Tata McGraw Hill, NewDelhi1985.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Air sampling
• Water sampling
• Adsorption
• Precipitation</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab.	Tut.	Sum	MT1	PE/OE	Std. Act.	Final
FRB 104	Engineering Numerical Analysis	FRB 101	3	2	2	0	4	30	20	10	40

Course Contents	**Numeric in General:** Solution of linear systems by iterative methods (Jacobi Iteration, Gauss–Seidel Iteration Method, Convergence and Matrix Norms). Solution of nonlinear equations (Fixed-Point Iteration, Newton–Raphson's method, Sufficient Convergence Condition). Curve fitting (Least square method). Interpolations (Lagrange Interpolation, Newton's Forward and Backward Interpolations). Numerical differentiation. Numerical integration (Rectangular Rule, Trapezoidal Rule, Simpson's Rule). **Numeric for ODEs and PDEs:** Solution of first-order ODEs (Euler's method, Runge–Kutta Methods). Solution of higher order ODEs. Boundary and initial-boundary value problems for ODEs, Elliptic and parabolic PDEs (Finite difference methods, Explicit method, Crank–Nicolson Method). Lab simulations of engineering applications.
References	• R W Hamming, "Numerical Methods for Scientists and Engineers", Courier Dover Publications, Last Edition. • Steven C. Chapra, "Applied Numerical Methods with MATLAB for Engineers and Scientists", Mcgraw-Hill, 3rd edition. • Nita H. Shah, Numerical Methods with C++ Programming, PHI Learning , 2008.
Laboratory	Lab simulations by software's as (C++, Matlab, Python,…)- Simulating practical technical problems- linear equations due to electric circuits , truss and spring mass systems. - Electric charge calculations- Nonlinear structural problems- Deflection of nonlinear springs- Calculating the shrinkage of a trunnion- Finding the longitudinal Young's modulus -Estimating voltage drop on a resistor- Calculating the work done by stretching a string- Simulating equations due to the fluid continuum problems, DC motor speed control problems- interpolation and fitting for signals and voltage current relations- population growth calculations- Fluid flow rate calculations- Distributed wind force problems

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>MT1</th><th>PE/OE</th><th>Std. Act.</th><th>Final</th></tr>
<tr><td>FRB 201</td><td>Applied Engineering Probability and Mathematical Statistics</td><td>FRB 002</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Probability: Basic Theorems of Probability. Conditional Probability. Independent Events. Discrete and Continuous Random Variables. Mean and Variance of Distributions. Discrete Distributions (Binomial, Poisson and Hypergeometric Distribution). Continuous Distributions (Normal and Exponential Distribution). Distributions of Several Random Variables (Discrete and Continuous Two-Dimensional Distributions).

Mathematical Statistics: Random Sampling. Sample mean and variance. Point Estimation of Parameters. Confidence Intervals. Simple and multiple Linear Regression and Correlation. Testing of Hypotheses. Markov chains. Quality Control. Engineering Applications. Lab simulations of engineering applications.</td></tr>
<tr><td>References</td><td colspan="11">• R. E Walpole, R. H. Myers, “Probability and Statistics for Engineers and Scientists", Macmillan Publishing, Last Edition.
• David Levine, Patricia Ramsey , Robert Smidt, “Applied Statistics for Engineers and Scientists: Using Microsoft Excel & Minitab”, First Edition, 2000.</td></tr>
<tr><td>Laboratory</td><td colspan="11">Lab simulations by software’s as (Excel, Matlab, Python,…)- Exploratory data analysis and data transformation (Tabulated data summaries and statistics, Histograms, Box and Correlation plots, Computation of means, variances, etc, Missing data imputation)- Simple random sampling with and without replacement- Stratified random sampling- Simulating Bernoulli process and Poisson distribution - Simulating Markov chains applications-Binary and sequential hypothesis testing and gambler's ruin -Gaussian Mixture Models, clustering and anomaly detection- Regression models and inference- Time series forecasting and ARIMA models.</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT1</th><th>PE/ OE</th><th>Std. Act.</th><th>Final</th></tr>
<tr><td>EMM 101</td><td>Fluid Mechanics I</td><td>FRB 004</td><td>2</td><td>2</td><td>1</td><td>0</td><td>3</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Fundamental notions; Physical properties of Fluids, Fluid viscosity and its importance’s, viscous and non-viscous flow, compressibility and surface tensions and their applications on practical problems, fluid statics, buoyancy and stability of floating and immersed bodies, fluid in rigid body motion, fluid kinematics and Foundations of flow analysis; basic laws for finite systems and finite control volumes, differential forms of the basic laws, dimensional analysis and similitude analysis; Types of Flow (steady, uniform, Incompressible viscous flow, General viscous flows , Potential flow).</td></tr>
<tr><td>References</td><td colspan="11">• Frank M white “Fluid Mechanics”, 8th edition 2015
• Munson, Young, and Okiishi, 2009, "Fundamentals of Fluid Mechanics", 7th Ed., Wiley.
• T. C. Clayton, F. E. Donald, and A. R. John, 2006,"Engineering Fluid Mechanics", John Wiley & Sons, Inc., 8th Ed.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Determination of fluid properties
• Hydrostatic pressure measurement
• Determination of pressure force on submerged surface
• Application of continuity equation for the flow through pipes
• Apparatus of impact water jet</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT 1</th><th>MT 2</th><th>Std. Act.</th><th>Final</th></tr>
<tr><td>FRB 206</td><td>Multiple Integrals & Complex Analysis</td><td>FRB 002</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Multiple Integrals: Double integrals (Areas, Volumes, Moments, Double integrals in polar form). Triple integrals (Volumes, Masses and Moments in three dimensions, Triple integrals in cylindrical and spherical coordinates). Substitution in multiple integrals. line and surface integrals, Green, Stock’s and Divergence theorems.
Complex Analysis: Complex Numbers, Complex plane, Polar form of complex number, Powers and roots, Complex Function, Limit, Continuity, Derivative, Cauchy-Riemann equations, Laplace’s Equation, Complex integration. Taylor and Laurent Series. Residue Integration. Conformal Mapping (linear function, Linear Fractional Transformations (or Möbius transformations), irrational functions, the exponential function, trigonometric functions).</td></tr>
<tr><td>References</td><td colspan="11">• Erwin Kreyszig, "Advanced Engineering Mathematics", / Paperback / Wiley, John & Sons, Last Edition.
• George B. Thomas, Jr., Maurice D. Weir, Joel Hass, THOMAS' CALCULUS Multivariable (Twelfth Edition), 2010.</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment			
EMM 102	Fluid Mechanics II	EMM 101	2	Lec.	Lab	Tut	Sum	MT1	PE/OE	Std. Act.	Final
				2	1	0	3	30	20	10	40

Course Content	Introduction to the theory and application of continuum fluid mechanics, Fluid properties and state relations. Incompressible laminar and turbulent flow using control volume, Reynolds Transport Theorem, and momentum and energy equations. Navier-Stokes Equations, Dimensional analysis, Buckingham Pi Theorem, and modeling. Flow rate, pipe sizing and minor losses in pipe systems. Compressible flow and gas dynamics in boundary layer theory, mach number, stagnation properties and shock waves.
References	• Frank M white "Fluid Mechanics", 8th edition 2015 • Munson, Young, and Okiishi, 2009, "Fundamentals of Fluid Mechanics", 7th Ed., Wiley. • T. C. Clayton, F. E. Donald, and A. R. John, 2006,"Engineering Fluid Mechanics", John Wiley & Sons, Inc., 8th Ed.
Laboratory	• Satisfying of the Bernoulli's theorem • Demonstration of the flow through orifice and free jet • Determination of the friction losses through pipes • Determination of the minor losses through pipe connections

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab	Tut	Sum	MT1	MT2	Std. Act.	Final
EMM 103	Mechanics of Machinery	FRB 004	3	2	0	2	4	30	20	10	40

Course Contents	A study of the fundamental concepts underlying the study of velocity, acceleration, and force analysis of machines; linkages, cams, gears, and flywheels; balancing of rotating and reciprocating machine elements.
References	• R.S. Khurmi and J K Gupta "Theory of Machines", S Chand & Co Ltd; 14th edition, 2005. • John J. Uicker, Jr., Gordon R. Pennock, Joseph E. Shigley "Theory of Machines and Mechanisms", Oxford University Press, 2017.

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="5">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT 1</th><th>MT 2</th><th>Std. Act.</th><th>PE/ OE</th><th>Final</th></tr>
<tr><td>EMM 104</td><td>Manufacture Technology</td><td>FRM 008</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>30</td><td>--</td><td>10</td><td>20</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="12">Metal Casting Technology: solidification process, metals and alloys, production of primary metals, production of shaped casting, sand casting (moulding, melting, pouring, solidification, cleaning, defects, and inspection). Contemporary casting processes (metallic mould, electro-slag, precision, and centrifugal casting).
Metal Forming Technology: Hot and cold working of metals, metal forming processes (rolling, forging, drawing, extrusion and spinning), pipe and tube manufacturing, joining technology (fastening, riveting, soldering, and brazing, welding, and adhesive bonding).

Welding: submerged arc welding, spot and seam welding, plasma welding, cold pressure welding, adhesive welding, testing of welded joints. Welding operations for ferrous metals – thermal welding – Oxy-Acy welding

Metal cutting technology: Cutting tools, metal cutting machine tools (turning, drilling, boring, milling, shaping, planning, broaching, grinding, special purpose, gear and thread cutting and super finishing machine tools).</td></tr>
<tr><td rowspan="2">References</td><td colspan="12">Andrew Y. C. Nee, 2015, “Handbook of Manufacturing Engineering and Technology,” Springer-Verlag London.</td></tr>
<tr><td colspan="12">Rajender Singh, 2006, " Introduction to basic manufacturing processes and workshop technology ", New age international publishers.</td></tr>
<tr><td>Laboratory</td><td colspan="12">Students make different mechanical models in all the following workshops:
• Casting workshop
• Metal forming technology
• Welding
• Metal cutting workshop</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="5">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT 1</th><th>MT 2</th><th>Std. Act.</th><th>PE/ OE</th><th>Final</th></tr>
<tr><td>EME 105</td><td>Electric Circuits Analysis</td><td>FRB 006</td><td>3</td><td>2</td><td>1</td><td>2</td><td>5</td><td>30</td><td>--</td><td>10</td><td>20</td><td>40</td></tr>
</table>

Course Content	Circuit Topologies and DC Analysis: Concepts, resistive network. Network laws and theorems: The Node-Voltage Method and Dependent Sources - The Mesh-Current Method and Dependent Sources - Thevenin and Norton Equivalents - Maximum Power Transfer - Superposition, Topology in Circuit Analysis - Inductance and capacitance. The Operational Amplifier circuits - Transient Response: RC circuits, RL circuits, RLC circuits. The Natural Response of RL and RC Circuits - Step Response of First Order RL and RC Circuits - Natural and Step Responses of RLC Circuits -Sinusoidal Steady-State Analysis - The Phasor - The Passive Circuit Elements – circuit theorems and Laws in the Frequency Domain - Sinusoidal Steady-State Power Calculations Appliance Ratings.
References	• Nilsson, J. W., & Riedel, S. A., “Electric circuits”, 2020. Pearson Education Limited.
Laboratory	Verify laws and theorems in the course using experiments, project construction and simulation, the topics include: • Ohm’s Law • Series/parallel connection circuit for resistance • Kirchhoff’ • Wheats • Capacitance Circuit • Inductance Circuit • RC & RL Circuit • LC Resonance Circuit

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	Std. Act.	Final
EME 106	Electric Machines	EME 105	3	2	1	1	4	30	20	10	40

Course Content

Magnetics, electromagnetic forces, generated voltage, and energy conversion - Motor action, and generator action - Transformer principles, construction, transformer action, ideal transformer, equivalent impedance of transformer, voltage regulation, per-unit impedance of transformer, transformer losses and efficiency. Transformer polarity and standard markings, transformer nameplates, autotransformers. Overview on Generation, Transmission and Distribution of Electrical Energy. Principles of DC machines, armature winding, developed torque. Principles of three phase induction motors - Synchronous Motors - Principles of DC machines.

References

- Charles I. Hubert, Electric machines Theory, Operation, Applications, Adjustment, and Control-Second Edition, 2002.
- Sen, P.C., Introduction to Electrical Machines and Power Electronics - First edition, Pitman

Laboratory

- Experiments on magnetics and electromagnetic forces and generated voltage
- Transformer Polarity Experiment, Loading and Unloading Exp.
- Voltage Regulation Exp.
- Open-Circuit Test and Short-Circuit Test Exp.
- Instrument Transformers
- Armature Control of DC Machines
- Field Control of DC Machines.
- Measure voltage, current and frequency of I.M. at starting and running.
- Measuring of synchronous speed, rotor speed, and slip of I.M.
- Speed reversing of I.M.
- I.M. Starting Methods
- Speed Control of I.M.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab	Tut	Sum	MT1	PE/OE	Std. Act.	Final
EMM 107	Strength and Properties of Materials	FRB 004	2	2	1	0	3	30	20	10	40

Course Contents	Introduction to engineering materials, Mechanics of deformable bodies: stress/strain, strain gages, material property relationships, classification of material behaviour, generalized Hooke's law. Engineering applications: axial loads, torsion of circular rods and tubes, bending and shear stresses in beams, deflection of beams, combined stresses, stress and strain transformation, Microstructure of solid materials, Strengthening mechanisms, Types of Steel and their alloys, Materials selection. Phase diagram, Mechanical properties of materials, Electrical and magnetic properties of materials, Optical properties of materials.
References	R. C. Hibbeler “Mechanics of Materials” Prentice Hall; 8th edition, 2010.
Laboratory	• Tensile Test • Fatigue Test • Application of Mechanical Load Cell • Shear Test • Impact Test • Creep Test • Hardness Test • Compression Test • Examination of Material Microstructure. • Torsion Test

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<tr><td rowspan="2">Code</td><td rowspan="2">Course Title</td><td rowspan="2">Pre-req</td><td rowspan="2">Cr. Hrs.</td><td colspan="4">Ct. Hrs.</td><td colspan="4">Assessment</td></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>MT 1</td><td>PE/ OE</td><td>Std. Act.</td><td>Final</td></tr>
<tr><td>EMM 108</td><td>Measurements and Instrumentation</td><td>FRB 006</td><td>3</td><td>2</td><td>1</td><td>1</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
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<table>
<tr><td>Course Content</td><td>Introduction, Error analysis and accuracy, Operating principles of sensors and transducers- Analog measuring instruments. General consideration for selection and evaluation of measurement equipment. Measuring of mechanical quantities (Temperatures, Pressures static and dynamic, Flow, and velocity, stress and strain,) Measurement of Electric quantities (currents, voltage, resistance, power). Comparisons methods for measurements. Active and reactive power measurements. Oscilloscopes. Digital millimeters- Uncertainty analysis.</td></tr>
<tr><td>References</td><td>Alan S. Morris, 2001, “Measurement and instrumentation principles”, 3rd edition, Alan S Moris Publisher: Butterworth-Heinemam.
Richard S. Figliola and Clemson University, “Theory and Design for Mechanical Measurements”, 5th edition, John Wiley & Sons, Inc., 2011.</td></tr>
<tr><td>Laboratory</td><td>Measuring Temperature (Mechanical Methods)
Measuring Temperature (Electrical Methods)
Measuring Pressure (Mechanical Methods)
Measuring Pressure (Electrical Methods)
Flow Measuring Instruments: Orifice Meter, Venturi Meter, Flow Nozzle, Pitot Tube, Movable Vane, ultrasonic</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.	Assessment

EMM 109	Thermodynamics I	FRB 005	2	Lec.	Lab	Tut	Sum	MT 1	PE/ OE	Std. Act.	Final
				2	1	0	3	30	20	10	40
Course Content	Definitions and basic concepts of thermodynamic systems, Properties of pure substances, phase change process, ideal gas. Work and Heat, First law of thermodynamics (closed system, unsteady and steady flow open systems, applications). Second law of hermodynamics (Heat engines and refrigerators, reversible and irreversible process, Carnot cycle). Entropy (Clausis inequality, entropy, increase of entropy principles, entropy change of pure substances, solids and liquids, entropy changes of ideal gases, adiabatic efficiency of process). Refrigeration Cycles (Refrigerators and Heat Pumps, The Reversed Carnot Cycle)										
References	• Yunus A.Cengel Michael A.Boles, 2014, “Thermodynamics An Engineering Approach”, McGraw Hill Education; 8th edition.										
Laboratory	• Identification and recognition of the application of work and heat • Identification and recognition of the application of the first law • Identification and recognition of the application of the second law • Computer controlled expansion processes of a perfect gas unit										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab	Tut	Sum	MT1	PE/OE	Std. Act.	Final
EMM 110	Solid Mechanics	EMM 107	2	2	1	0	3	30	20	10	40
Course Contents	Fundamental principles and methods of structural mechanics: static equilibrium, force resultants, support conditions, analysis of determinate planar structures (beams, trusses, frames), stresses and strains in structural elements, states of stress (shear, bending, torsion), statically indeterminate systems, displacements and deformations, introduction to matrix methods, elastic stability, and approximate methods. Design exercises to encourage creative student initiative and systems thinking.										
References	Professor Louis L. Bucciarelli, ”Engineering Mechanics for Structures”, Courier Dover Publications, 2009 - Technology & Engineering										
Laboratory	• Cable Structures • Uniaxial Tension • Truss Structures • Concrete Failure • Beam Bending • Buckling										

Code	Course Title	Pre-req	Cr.	Ct. Hrs.	Assessment

			Hrs.								
EMM 112	Thermodynamics II	EMM 109	2	Lec.	Lab	Tut	Sum	MT 1	PE/ OE	Std. Act.	Final
				2	1	0	3	30	20	10	40

Course Content	Vapor and Combined Power Cycles (The Carnot Vapor Cycle, Rankine Cycle). Gas power cycles (air standard assumptions, Otto and Diesel cycles, Striling and Ericsson cycles, Brayton cycle, Brayton cycle with intercooling, reheating and regeneration, ideal jet prolusion cycle). Gas Mixtures (Composition of a Gas Mixture: Mass and Mole Fractions, P-v-T Behavior of Gas Mixtures: Ideal and Real Gases). Chemical Reactions (Fuels and Combustion, Theoretical and Actual Combustion Processes, Enthalpy of Formation and Enthalpy of Combustion, First-Law Analysis of Reacting Systems, Adiabatic Flame Temperature. Heat of combustion, fuel heating values, constant volume combustion and constant pressure combustion,
References	• Yunus A.Cengel Michael A.Boles, 2014, “Thermodynamics An Engineering Approach”, McGrawHill Education; 8th edition.
Laboratory	investigate the thermodynamics components such as turbine, compressor, pump, boiler, condenser, etc.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment				
				Lec	Lab	Tut	Sum	MT 1	MT 2	Std. Act.	PE/ OE	Final
EME 201	Logic Circuits and Micro processors	EME 105	3	2	1	2	5	30	--	10	20	40

Course Content	Introduction to Digital Concepts with emphasis on the difference between analog and digital system and the need for digital system design – Number systems - number-based conversion – The binary arithmetic operations on the signed and unsigned binary numbers – Coding systems – Boolean Algebra - Logic Gates – logic minimization techniques (Karnaugh maps, Quine-McCluskey) Combinational circuits: Gate level design, Multiplexer, decoder, encoder, decoder, and adder. Sequential circuits: Flip-flops, latches, analysis and design of simple sequential circuits, state tables and state diagrams, counters, registers
References	• Floyd, Thomas L, "Digital Fundamentals", Pearson Education 11ED • M. Morris R. Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog” 6th Edition • John Wakerly, "Digital Design: Principles and Practices", 5th Edition
Laboratory	• Logic Trainer Familiarization, Breadboards and Building Digital Circuits. • adders, subtractors, encoders and decoders, multiplexers and demultiplexers. • Flip-flops, design and analysis of combinational circuit • design and analysis of simple sequential circuit

Code	Course Title	Pre-req	Cr.	Ct. Hrs.	Assessment

<table>
<tr><td></td><td></td><td></td><td>Hrs.</td><td colspan="4"></td><td colspan="4"></td></tr>
<tr><td rowspan="2">EMM 202</td><td rowspan="2">Vibrations and System Dynamics</td><td rowspan="2">EMM 103, EMM 107</td><td rowspan="2">3</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>MT 1</td><td>PE/ OE</td><td>Std. Act.</td><td>Final</td></tr>
<tr><td>2</td><td>1</td><td>1</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Foundation of mechanical systems, mathematical models of mechanical systems, systems modeling, electromechanical systems. Explore necessary algorithms to solve equations of motion, Laplace transform, matrix method, computer generated solutions. Dynamic response and evaluation of first and second order systems, oscillating motion with single DOF, measuring and analysis methods, damping of free motion. Isolation of vibration, vibration of two DOF, vibration of multi-degree of freedom system. Numerical methods for evaluation of natural frequency and patterns, design of frequency absorbers.</td></tr>
<tr><td>References</td><td colspan="11">• Ahmed A. Shabana, "Theory of Vibration, An Introduction", Springer, 3rd edition, 2019
• Rao, S.S., and A. Weiley, “Mechanical vibrations”, 4th edition, Prentice Hall, 1995</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Validation of a pendulum dynamics and estimation of gravitational acceleration.
• Verification of mass-spring system and estimation of spring stiffness.
• Estimation of the moment of inertia for a wheel and the damping condition.
• Vibration measurement methods, Double cantilever test.
• Computer-aided simulation and case studies, course project</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec.	Lab	Tut	Sum	MT 1	PE/ OE	Std. Act.	Final
EMM 203	Heat Transfer	EMM 109	3	2	1	1	4	30	20	10	40

Course Content	Thermal Conduction: Steady 1D Conduction, Plane Wall, Composite Plane Wall, Convection, Overall Heat Transfer Coefficient, Cylindrical Shell, Spherical Shell, Extended Surfaces (Fins), Conduction with Variable Thermal Conductivity, Steady 2D Conduction, Transient Conduction, Periodic Conduction. Convection: Types of Convection, Dimensionless Groups, Dimensional Analyses and similitude, Natural Convection, Forced Convection. Heat Exchanger. Thermal Radiation: Setfan-Boltzmann Law, Planck's Law, Radiation Properties of Real Surfaces, Emissivity and Absorptivity, Kirchoff's Law, Emissivity of Real Surfaces, Gray Surfaces, Selective Surfaces, Heat Exchange by Radiation, Heat Exchange between Two Planes, Heat Exchange between Two Cylinders or Spheres.
References	• Incropera and De Witt, Fundamentals of heat and mass transfer, 7th Edition, 2012. • Yunus A. Cengel, "Heat Transfer: A Practical Approach", 2nd ed., McGraw-Hill, 2015.
Laboratory	• Determination of the heat conductivity of solids • Steady heat conduction in bars • Steady convection in non-homogeneous bars • Steady convection in homogeneous bars • Steady conduction in homogeneous radial patterns • Heat exchangers: parallel and counter flow heat exchangers • Thermocouples calibration test rig • Combined forced convection and radiation

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab	Tut	Sum	MT1	MT2	Std. Act.	Final
EMM 204	Plumbing Systems	EME 102	3	2	0	2	4	30	20	10	40

Course Contents	Types of water services in buildings and facilities. Codes and standards for water supply and drainage systems. Water demands estimation, Systems of domestic water circulation, sizing of domestic water storage and piping system, Domestic hot water system and heating capacity, Sanitary drainage system (single pipe system, two pipes system, plumbing fixtures and fixtures units, sizing of drainage water piping system, sump pits and sump pumps, Rainwater drainage system, Ventilation system.
References	• Tim Wentz, "Plumbing Systems: Analysis, Design, and Construction" Prentice Hall; 1st edition, 1996.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	Std. Act.	Final
EMM 205	Projects Management	FRB 002	2	2	1	0	3	30	20	10	40

Course Content	Introduction to Project planning and scheduling, Project charter, Scope statement, Work Breakdown Structure, Responsibility Chart. Network diagram, Schedule analysis and possibilities using the Critical Path Method (CPM) and the Program Evaluation and Review Technique (PERT). Resource leveling and allocation, Time-cost trade off (Crashing a schedule), Gantt Chart, Time overlaps, Time and cost control, Risk monitoring and control, Computer applications
References	• Moder J., Phillips C., and Davis E., "Project Management with CPM, PERT and Precedence Diagramming", Last Edition. • Gail Freeman-Rue & James Balkwill, "Management in Engineering, Principles & Practice", Prentice Hall, Last Edition.
Laboratory	• Gantt chart drawing for simple projects • PERT and CPM models simulation

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment				
				Lec.	Lab	Tut	Sum	MT1	MT2	Std. Act.	PE/OE	Final
EME 206	Electronic Devices and Circuits	EME 201	3	2	1	1	4	30	--	10	20	40

Course Content	Semiconductor physics, Structure of diodes, Diode circuits and rectifiers, Structure of BJT, Biasing and operation modes of transistors, DC and small signal analysis of transistor circuits, Amplifiers circuits using BJT, Power amplifiers, Field effect transistors, Biasing of FET, Small signal model of FET. Amplifier circuits using FET, Design of amplifier circuits, Frequency response of amplifier circuits, Active filters, Feedback in electronic circuits, Different feedback configuration in electronic circuits, Oscillators circuits.
References	Adel S. Sedra and Kenneth C. Smith, “Microelectronic Circuits”, Oxford University press.
Laboratory	• PN Junction diode characteristics: Forward bias and Reverse bias. • Zener diode characteristics and voltage regulator. • Clipper, Clamping and doubler circuits. • Halfwave and Full wave Rectifiers with and without filter. • Design the transistor circuit as Switch. • Transistor CB, CC, CE characteristics (Input and Output). • Frequency response of Amplifiers.

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT1</th><th>MT2</th><th>Std. Act.</th><th>Final</th></tr>
<tr><td>EME 207</td><td>Electrical Power Systems</td><td>EME 106</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Representation of power systems, Generating stations, Parameters of transmission lines: series impedance, inductance and electrical capacitance, Electrical design of transmission lines, Models of transmission lines, Analysis of short, medium and long transmission lines, Performance of transmission lines, Mechanical design, Overhead transmission lines insulators, Corona, Distribution systems-general, DC distribution, AC distribution, underground cables.</td></tr>
<tr><td>References</td><td colspan="11">• Stevenson, W. D., Elements of Power System Analysis, McGraw Hill, 1995.
• Mehta, V. K. and Mehta, R., Principles of Power System, AMIE and Other Engineering Examinations. S. Chand Publishing, 2005.
• Glover, J. D., Sarma, M. S., & Overbye, T., Power system analysis & design,Cengage Learning, 2012.</td></tr>
</table>

<table>
<tr><th rowspan="3">Code</th><th rowspan="3">Course Title</th><th rowspan="3">Pre-req</th><th rowspan="3">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT 1</th><th>PE/ OE</th><th>Std. Act.</th><th>Final</th></tr>
<tr><td>2</td><td>1</td><td>1</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>EMM 208</td><td>Fluid Machinery</td><td>EMM 102</td><td>3</td><td colspan="8"></td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to turbo machines (definition, basic equation, similarity analysis). Flow analysis (one-dimensional fluid flow in turbo machines, two dimensional cascades in turbo machinery, and three dimensional flow). Types of pumps, fans, turbines and compressors. Thermal and hydraulic design and analysis of pumps, fans, turbines and compressors. Component selection, system design and performance evaluations.</td></tr>
<tr><td>References</td><td colspan="11">• William W. Peng, “Fundamentals of Turbo machinery” , Wiley
• A Sayers, “Hydraulic and compressible flow turbomachiners.” 1990.
• Husain et al, “Basic Fluid Mechanics and Fluid Machines”, 2008</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Measuring the performance of pelton wheel at different deflection angle and flow rate
• Measuring the performance of the Frances turbine at different inlet angle and flow rate
• Measuring the pump performance
• Measuring the generated forces from moving fluid (impact of jet)</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="5">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT 1</th><th>MT 2</th><th>Std. Act.</th><th>PE/ OE</th><th>Final</th></tr>
<tr><td>EMM 209</td><td>Design of Machine Elements</td><td>EMM 104
EMM 110</td><td>3</td><td>2</td><td>1</td><td>2</td><td>5</td><td>30</td><td>--</td><td>10</td><td>20</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="12">Introduction to design process. Review of load and stress analysis, Mohr's circle for plane stress. Failures resulting from static loading, variable loading, and fatigue failure. Material selection for strength and rigidity.
Design of mechanical elements: Knuckle joint - screws, fasteners - shafts and shaft components - mechanical springs - welding joints, Bonding, and permanent joints.</td></tr>
<tr><td>References</td><td colspan="12">• Robert L. Mott, " Machine elements in Mechanical Design", Pearson/Prentice Hall, 2004.
• J.E. Shigley and C. R. Mischke, "Mechanical Engineering Design", McGraw-Hill, Last Edition.</td></tr>
<tr><td>Laboratory</td><td colspan="12">Term design projects:
• Working and assembly drawing of parts and machine elements
• Computer aided drafting of assembly drawings and machine elements</td></tr>
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<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="5">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT1</th><th>MT2</th><th>Std. Act.</th><th>PE/OE</th><th>Final</th></tr>
<tr><td>EME 210</td><td>Electric Power Distribution Systems</td><td>EME 207</td><td>3</td><td>2</td><td>0</td><td>3</td><td>5</td><td>30</td><td>20</td><td>10</td><td>--</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="12">Power handling equipment: Medium voltage switchgear, Ring main unit, Automatic transfer switch, Distribution boards; Wiring and raceways: Cables, Conductors, Bus duct, Cable trays, Conduits, Ducts; Protective devices of distribution system: Circuit breakers, fuses, Overcurrent relays, Differential Relays, Ground fault circuit beakers; Control and utilization equipment: Static and dynamic loads, Contactors, Dimmers, Sockets, Different types of switches, Light current; Load estimation methods, Interior and exterior lighting design based on codes and standards, Sizing of cables, protection devices, Distribution transformer, etc; Calculations of short circuit, losses, voltage drop.</td></tr>
<tr><td>References</td><td colspan="12">• Stokes, G. (Ed.), Handbook of electrical installation practice, John Wiley & Sons, 2008.
•Egyptian Building Codes and Regulations; International Electrotechnical Commission (IEC); Egyptian Standard Specifications (ES); National Electrical Code (NEC).
• Atkinson, B., Lovegrove, R., & Gundry, G., Electrical Installation Designs, John Wiley & Sons, 2012.</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec.	Lab	Tut	Sum	MT 1	PE/ OE	Std. Act.	Final
EMM 301	Refrigeration	EMM 112	2	2	1	0	3	30	20	10	40
Course Content	Introduction to refrigeration and Refrigeration machines - Ideal and actual Vapour - compression refrigeration cycle - Refrigerants - Vapour refrigeration cycles (Single and multi stage) - Vapour absorption systems - Gas refrigeration cycles - Thermoelectric refrigeration systems - Lubricants in refrigeration systems - Expansion devices.										
References	R.S. Khurmi and J. K. Gupta, 1992, "A text book of refrigeration and air conditioning ", Eurasia Publishing House. Wilbert F. Stoecker, 1998, "Industrial Refrigeration Handbook, 1st Edition", McGraw-Hill Companies, Inc.										
Laboratory	Refrigeration Components Instruments and Tools Basic cycle performance, suction accumulator. Liquid receiver, different types of expansion device, oil separator, multi evaporators. Simple Vapour Compression Refrigeration System Performance Test General Cycle Refrigeration Trainer Computer controlled refrigeration system										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment				
				Lec	Lab	Tut	Sum	MT 1	MT 2	Std. Act.	PE/ OE	Final
EMM 302	Refrigeration and AC Systems/ Components	EMM 301 & EMM 303	3	2	1	1	4	30	--	10	20	40
Course Contents	Air conditioning systems and classifications, Air terminal units (air handling units, fan coil units), Sections of air handling units (filters, cooling and dehumidifying coils, heating coils, Humidifiers, Fans), Chillers (air cooled chillers, water cooled chillers, cooling towers), condensing units and its components, Desiccant dehumidifiers, Chilled water networks and pumps, energy recovery systems, expansion devices, unitary air conditioning units.											
References	• Ananth Narayanan, “Basic Refrigeration and Air Conditioning”, McGraw Hill, 2013 • Miller, Rex; Miller, Mark R, 2011, "Air Conditioning and Refrigeration", McGraw-Hill Education.											

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec.	Lab	Tut	Sum	MT 1	PE/ OE	Std. Act.	Final
EMM 303	Air Conditioning Systems	EMM 112	3	2	1	1	4	30	20	10	40
Course Content	Introduction to air conditioning-Psychrometry-Psychrometric processes-Psychrometry of Air Conditioning Systems- Heating and cooling Load calculations-Air distribution systems- Air duct design-Fundamentals of HVAC Control.										
References	Faye C. McQuiston,"HVAC Analysis and Design", 6th edition (2004) R.S. Khurmi and J. K. Gupta , "A text book of refrigeration and air conditioning"										
Laboratory	Heating, cooling, humidification, dehumidification processes. Controlling devices in air conditioning system.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	Std. Act.	Final
EME 304	Automatic Control	EME 106	2	2	1	0	3	30	20	10	40
Course Content	Transfer function - Block diagrams - Signal-flow graphs - State diagram. Mathematical modeling of physical systems - DC motors - linearization of nonlinear systems. State-variable analysis: Matrix representation of state equations, state-transition matrix - state-transition equation - relationship between state equations and transfer functions - characteristic equation Stability of linear control systems: methods of determining stability - Time-domain analysis of control systems - Transient and steady state response analysis - Root locus plots - Bode Diagrams - Polar plots and frequency response analysis										
References	• Nise, N. S. Control systems engineering. John Wiley & Sons., 2020 • Katsuhiko, Ogata. Modern control engineering. Pearson, 2010.										
Laboratory	MATLAB SIMULINK Programming LAB 1: • Differential Equation representation by SIMULINK • Time Response of Transfer Function to different inputs • State space representation in MATLAB • Root Locus Plots - Bode Plots • Frequency Response										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab	Tut	Sum	MT1	MT2	Std. Act.	Final
EME 305	Low Current Distribution Systems	EME 210	3	2	0	2	4	30	20	10	40
Course Contents	Fire Alarm Industry Codes and Standards, building, fire, and life safety codes, requirements for fire detection and alarm systems, NFPA 72 and design. introduction about Fire Alarm System, Type of Detectors, types of Call points, Manual Station, Break Glass, Alarms, Modules, Fire Alarm Control Panel F.A.C.P, cables and pipes network, Telephone System, Data Network, audio / video System, security system. Recognize general requirements for the inspection, testing, and maintenance of low current systems.										
References	• NFPA 72: National Fire Alarm and Signaling Code • Egyptian Code										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab	Tut	Sum	MT1	MT2	Std. Act.	Final
EMM 307	Fire Fighting Systems	EMM 102	3	2	0	2	4	30	20	10	40
Course Contents	Combustion and extinguishing theory for fire and explosion. Agents for fire extinguishing and flammability limits. Applicable Standards, Codes and Life Safety for firefighting system limitation, Fire Detection and Alarm System, Fire Fighting Systems, Manual Fire Fighting Systems (Portable Fire Extinguishers, Standpipe System, Fire Hydrant and Fire Department Connection), Automatic Fire Fighting Systems (Automatic Wet Suppression Systems, Automatic Dry Suppression Systems), Case Study and firefighting system design										
References	• A. Maurice Jones Jr., “Fire Protection Systems”, Publisher: Jones & Bartlett Learning; 2nd edition, 2014										

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT 1</th><th>PE/ OE</th><th>Std. Act.</th><th>Final</th></tr>
<tr><td>EMM 309</td><td>Combustion</td><td>EMM 112</td><td>3</td><td>2</td><td>1</td><td>1</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Thermal properties of combustible gases (Air/fuel ratio, product of combustion, heat of combustion, fuel heating values) constant volume combustion constant pressure combustion, Hillums and Gibbs functions, combustion equilibrium, kinetic theory of combustion, flammability limit, combustion efficiency, flame velocity, burning velocity, flame stability, flame structure- premixed flame- diffusion flame- furnaces- gas turbine combustion- fuel properties (gas fuel-Liquid fuel gaseous fuel) - fuel nozzles design(gaseous, liquid fuel) - combustion in boiler- design of combustion chamber, Fuel cells and electrochemical fundamentals</td></tr>
<tr><td>References</td><td colspan="11">• Stefan R. Turns, 2000, " An Introduction to combustion: Concepts and Applications", International Editions, by McGraw-Hill.
• Irvin Glassman, and Richard A. Yetter, 2008, "Combustion" , Fourth Edition, by Elsevier Inc.
• Shripad Revankar and Pradip Majumdar, 2014, "Fuel Cells Principles Design and Analysis", by Taylor & Francis Group, LLC
• John Newman and Karen E. Thomas-Alyea, 2004, "Electrochemical Systems", Third Edition, by Wiley Interscience</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Identification and recognition of different types of fuel sources
• Identification and recognition of different properties of liquid fuels, such as viscosity, density, heating value, flash and fire point, cetane number, octane number, etc.
• Investigate the Droplet Evaporation of liquid fuels
• Investigate the spray development of liquid fuel
• Investigate the laminar and diffusion flames</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment				
				Lec	Lab	Tut	Sum	MT 1	MT 2	PE/ OE	Std. Act.	Final
EMM 401	Computer Applications in El/Mec System	EMM 303 & EME 305	2	1	2	0	3	30	--	20	10	40
Course Contents	Computers software in air conditioning systems, Cooling load calculations software, Air duct design software, water networks and hydronics systems software, hydraulic calculations software for firefighting systems, lighting distributions software, electric power software, recent soft wears in electromechanical systems.											
References	Nonlinear Control and Filtering Using Differential Flatness Approaches: Applications to Electromechanical Systems by Gerasimos G. Rigatos , Springer; 2015.											
Laboratory	Student's programs of tasks and problems are carried out in the engineering Computer Labs.											

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab	Tut	Sum	MT1	PE/OE	Std. Act.	Final
EMM 403	Process Control and Building management System	EME 304	2	2	1	0	3	30	20	10	40
Course Contents	Design of PI, PD, PID controllers, Design of servo system, Computers automations including PLCs, SCADA to control process, Process control in air conditioning systems, Firefighting systems, lighting systems and powers systems. Security and observation, Access control, Fire alarm system, Lifts, elevators etc., Plumbing, Closed-circuit television (CCTV), Other engineering systems, Control Panel, PA system, Alarm Monitor, Security Automation										
References	• Damian Flynn, 2003, "Thermal Power Plant Simulation and Control", The Institution of Engineering and Technology. • Karl J. Astrom, Tore Hagglund, 2009, "PID Controllers", Tech-lib.										
Laboratory	• Steam temperature control • Liquid level control • Flow control • HVAC control										

Elective I Courses:

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab	Tut	Sum	MT1	MT2	Std. Act.	Final
EMM 312	Renewable Energy	EME 106 EMM 109	3	2	0	2	4	30	20	10	40
Course Contents	Sources of renewable energy - solar thermal energy - Solar radiation measurements - photovoltaic sources - Applications of solar energy - Energy from oceans, wind energy, tidal wave energy ,geothermal energy - Biomass and bio-fuels - Power from satellite stations - Hydrogen energy, hydro and other common electrical renewable generation schemes - Selection and sizing of systems components - Detailed design of a typical photovoltaic inverter battery system - Renewable energy integration with existing grid connected power.										
References	•A.A.M. Saigh (Ed): Solar Energy Engineering, Academic Press, 1977 •Abbasi S. A. and N. Abbasi, Renewable Energy Sources and Their Environmental Impact,Prentice Hall of India, 2001.. •G.N. Tiwari: Solar Energy-Fundamentals, Design, Modelling and Applications, NarosaPublishers, 2002 •Sawhney G. S., Non-Conventional Energy Resources, PHI Learning, 2012. •Tiwari G. N., Solar Energy- Fundamentals, Design, Modelling and Applications, CRC Press, 2002. •Khan B. H., Non-Conventional Energy Resources, Tata McGraw Hill, 2009.										
Laboratory	• Expriments on solar cell • measurements of short circuit current and open circuit voltage of solar cell										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab	Tut	Sum	MT1	MT2	Std. Act.	Final
EMM 314	Elevators and Escalators	EMM 209	3	2	0	2	4	30	20	10	40
Course Contents	Overview of elevators and escalators aspects, Planning and traffic analysis aspects, User safety aspects, public service elevators and escalators, locations components, operation and method of installation, commercial elevators and escalators. Anatomy of an escalators: step; Drive, step chain, lubricant free step chain; carriage, tracking system, safety benchmarking study. Planning: suitability for location, arrangements, width of step, internal/external drive, pit dimensions, angle of incline. Electrical systems: Safety devices, design principles, motor sizing and selection, drives, methods of starting, stopping and slowing down. Elevator and escalators backing.										
References	• George R. Strakosch, "Vertical transportation: elevators and escalators", Wiley, 2nd Edition, 1983.										

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT1</th><th>MT2</th><th>Std. Act.</th><th>Final</th></tr>
<tr><td>EMM 316</td><td>Solar Thermal and PV Systems</td><td>EMM 203</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Solar energy (solar radiation intensity, angles, estimations and measurements), Solar energy systems, solar thermal collectors, solar water heaters, solar thermal power generation, Photo Voltic cells operation and efficiency, PV solar power system, Solar energy storage systems. Design/selection of PV cell, inverter type, meters, measurement / monitoring devices, AC/DC protection device & AC/DC cables.</td></tr>
<tr><td>References</td><td colspan="11">• Olindo Isabella, Klaus Jäger , Arno Smets, René van Swaaij, Miro Zeman ,”Solar Energy: The Physics and Engineering of Photovoltaic Conversion, Technologies and Systems” UIT Cambridge Ltd, 2016</td></tr>
</table>

Elective II Courses:

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT1</th><th>MT2</th><th>Std. Act.</th><th>Final</th></tr>
<tr><td>EME 322</td><td>Advanced Industrial Electronics</td><td>EME 206</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Semiconductor diodes and Diodes applications, Resonant converters. Feedback and oscillator circuit, Power supply applications. Two terminal devices, Residential and industrial applications. Electric utility applications. Practical converter design considerations, operational and power amplifiers,</td></tr>
<tr><td>References</td><td colspan="11">• Robert L. Boylestad, : Louis Nashelsky, “Electronic Devices and Circuit Theory”, Pearson 11th edition, 2013.</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab	Tut	Sum	MT1	MT2	Std. Act.	Final
EME 324	Electrical Protection	EME 305	3	2	0	2	4	30	20	10	40

Course Contents

Effects of short-circuits on power systems, Basic elements of protective gear, Current and potential transformers, Protective relays, Electromechanical and static relays, Different types of electromechanical relays, Microprocessor-based relays, Differential protection of power systems, Protection of transmission lines (carrier protection), Impedance Relays, Types of circuit breakers, Bus-bars protection, Transformers protection, Generators protection, AC motors protection.

References

- Horowitz, S. H. and Phadke, A. G., Power system relaying, John Wiley & Sons, 2014.
- Ravindranath, B. and Chander, M., Power system protection and switchgear, New Age International, 1977.
- Bakshi, U. A. and Bakshi, M. V, Switchgear and Protection, Technical Publications, 2020.
- Deshpande, M. V., Switchgear and Protection, Tata McGraw Hill Co., 1991.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab	Tut	Sum	MT1	MT2	Std. Act.	Final
EME 326	Electrostatic and Electromagnetic Fields	EME 106	3	2	0	2	4	30	20	10	40

Course Contents

Applications of Electromagnetic Field Theory , Differences between Circuit Theory and Electromagnetic Field Theory, Mathematical Preliminaries and Vector analysis. Electrostatic Fields Static electric fields. Steady electric currents. Static magnetic field. Varying fields and Maxwell's equations Electromagnetic Fields and Waves, Guided Waves, Transmission Lines, Radiation and Antennas.

References

- G. S. N. Raju,”Electromagnetic Field Theory and Transmission Lines” Pearson India, June 2006.

Elective III Courses:

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td rowspan="1">MT1</td><td>MT2</td><td>Std. Act.</td><td>Final</td></tr>
<tr><td rowspan="2">EMM 332</td><td rowspan="2">Internal Combustion Engines</td><td rowspan="2">EMM 309</td><td rowspan="2">3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr></tr>
<tr><td>Course Content</td><td colspan="11">Fundamentals of Internal Combustion engines, engine types, configurations and history of engines. Review of thermodynamics and combustion chemistry. Spark Ignition Engines, operating principle, standard cycles. Combustion in SI engines, knocking, SI engine emissions and emission control, Control of SI engines, effect of throttling. Compression ignition (Diesel) Engines: operating principle, cycles, combustion in diesel engines, diesel engine emissions and emission control, Control of CI engines. Turbo/supercharging, Alternative engine cycles (Homogeneous charge compression ignition (HCCI), gasoline direct injection (GDI), downsizing), Alternative fuels, Hybrid vehicles/Electric vehicles</td></tr>
<tr><td>References</td><td colspan="11">• Chris Mi, M. Abul Masrur, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives (Automotive Series)", 2nd Edition, Wiley.
• H.N. Gupta, 2006,"Fundamentals of Internal Combustion Engines", 2nd edition,Prentice-Hall of India Pvt.Ltd.</td></tr>
</table>

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>MT 1</td><td>MT 2</td><td>Std. Act.</td><td>Final</td></tr>
<tr><td>EMM 334</td><td>Essentials of Energy Management</td><td>EMM 205</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Energy Resources, energy efficiency technologies, integration of renewable Energy with energy efficiency measures. Supply and demand side management. Industrial energy efficiency. Energy efficiency in residential, commercial, tourist and transport sectors. Energy efficiency policies, standards, codes, and benchmarking. Energy auditing and accounting, life cycle Assessment, Economics, and financing of Energy Efficiency options. Environmental impact of energy efficiency.</td></tr>
<tr><td>References</td><td colspan="11">• Craig B. Smith, Kelly Parmenter, 1981, "Energy, Management, Principles - Applications, Benefits, Savings", Pergamon.</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">CH</th><th colspan="4">Weekly Contact Hours</th><th colspan="4">Assessment Criteria %</th></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>MT 1</td><td>MT 2</td><td>Std. Act.</td><td>Final</td></tr>
<tr><td>EMM 336</td><td>Wind Energy System Design</td><td>EMM 208
EMM 309</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Geophysics of wind resources; aerodynamics of horizontal-axis wind turbines; wind turbine performance; design loads; conceptual design of horizontal-axis wind turbines; blade design and its optimization; materials properties and materials selection; mechanical design and safety factors; wind turbine control; installation; wind farms; electrical systems for wind turbines</td></tr>
<tr><td>References</td><td colspan="11">• Jan Wenske, 2023, “Wind Turbine System Design: Nacelles, drivetrains and verification”, Publisher : The Institution of Engineering and Technology.
• Gary L. Johnson, 1985, "Wind Energy Systems", Prentice-Hall
• Earnest J. and T. Wizelius, Wind Power Plants and Project Development, PHI Learning, 2011.</td></tr>
</table>

Elective IV Courses:

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab	Tut	Sum	MT1	MT2	Std. Act.	Final
EMM 411	Cold Stores and Industrial Refrigeration	EMM 301	3	2	0	2	4	30	20	10	40
Course Contents	Food storage and equipment, cooling and freezing times of food, food microbiology and refrigeration, refrigeration load, refrigerated facilities design, methods of precooling fruits, vegetables and cut flowers, industrial food freezing system, meat, poultry and fishery products, industrial applications (ice manufacturing, refrigeration in the chemical industries, low temperature applications and Cryogenics).										
References	• Shan K. Wang,"Handbook of Air Conditioning and Refrigeration" McGraw Hills, 2 Edition, 2016										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab	Tut	Sum	MT1	MT2	Std. Act.	Final
EMM 413	Automotive Engineering	EMM 309	3	2	0	2	4	30	20	10	40
Course Contents	Engine and associated systems (fuel, ignition, cooling, lubrication). Turbocharging. Transmission. Steering. Braking. Suspension. Emission-control systems. Recent advances. Thermodynamic analysis of fuel-air cycles. Combustion charts. Chemical equilibrium and dissociation. Control of exhaust emissions. Engine friction. Heat transfer. Engine energy balance. Testing and performance maps.										
References	• Jeffrey K. Ball, Richard Stone,"Automotive Engineering Fundamentals" SAE International, ISBN 978-0-7680-0987-3, 2004.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec.	Lab	Tut	Sum	MT 1	MT 2	Std. Act.	Final
EMM 415	Power Stations	EMM 112	3	2	0	2	4	30	20	10	40
Course Content	Co-Generation Plants, Combined Cycles, Heat Recovery Boilers, Efficiency of Combined Cycles, Performance Characteristics of Power Stations, Heat Rate and Incremental Rate, Optimum Load Division Among Power Generation Units, Control of the Steam Generators, Convection and Radiant Type Superheaters, Governing of Steam Turbines, Steam Partial Admission and Full Admission, Load Frequency Characteristics, Speed Regulation, Parallel Operation, Lubrication Systems, Protection and Tripping Systems, Start-Up and Shut Down Procedures, Procedure of Meeting the Power Demands: Adding Peaking Load Units, Connection between Zones of Different Longitudes, Energy Storage										
References	El-Wakil M. M., "Power Plant Technology", McGraw Hill, 1984 Gill A. B., "Power Plant Performance", Butterworth, 1984										

Elective V Courses:

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab	Tut	Sum	MT1	MT2	Std. Act.	Final
EME 421	Electro-Hydraulic Circuits	EME 304	3	2	0	2	4	30	20	10	40
Course Contents	Basic and components of hydraulic power systems, Hydraulic pumps, Hydraulic fluids, hydraulic valves, lines, fittings and seal, hydraulic modelling and simulation, hydraulic circuit design, hydrostatic transmission, Dynamic modelling and simulation, electric components, electro-hydraulic switches and switching circuitry, proportional and servo hydraulics, PLCs and hydraulic power.										
References	• M Rabie, "Fluid Power Engineering" McGraw-Hill Education; 1st edition, 2009										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab	Tut	Sum	MT1	MT2	Std. Act.	Final
EME 423	Codes and Specifications of El/Mec Systems	EMM 302 & EME 305	3	2	0	2	4	30	20	10	40
Course Contents	International standards, IEC standards regarding the main specifications, testing, inspection and commissioning of electrical equipment and drives. Firefighting system international codes and standards, NFPE, HVAC codes and standards, International building codes, Plumbing codes.										
References	• Egyptian local codes, NFPA codes, NEC codes, ASHAREA codes and standards. International building codes.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment			
EME 425	Computer Networks	EME 105	3	Lec.	Lab	Tut	Sum	MT1	MT2	Std. Act.	Final
				2	0	2	4	30	20	10	40
Course Content	Network applications, hardware, software, reference models: OSI and TCP/IP reference model - Internet Control Message Protocol - Address Resolution Protocol - Describe switching concepts (MAC learning , Frame switching, Frame flooding, MAC address table) - The difference between the router, switch and the rest of the linking devices - Network Device Domains (Collision, Broadcast Domains) - IPv4 Addressing - Subnetting - Variable length subnet mask - Route summarization - Router components - Router Configuration - Remote Access Telnet - Dynamic Host Configuration Protocol Operation - Configuring a Router as a DHCP Server - DHCP Relay Agent.										
References	• A.S. Tanenbaum, "Computer Networks", 4th edition, Pearson Education/ PHI, New Delhi, India. • James F. Kurose, Keith W. Ross, "Computer Networking a Top-Down Approach", Pearson, 8th edition, ISBN-13: 978-0-13-285620-1 • Peter L Dordal, "An Introduction to Computer Networks", 2020 available in: https://intronetworks.cs.luc.edu/current2/html/ • WENDELL ODOM, "CCNA-200-301-Official-Cert-Guide - volume 1 and 2", 2020, ISBN-10: 0-13-579273-8, Published by: Cisco Press										

Elective VI Courses:

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment			
EME 431	Modern Control Systems	EME 304	3	Lec.	Lab	Tut	Sum	MT1	MT2	Std. Act.	Final
				2	0	2	4	30	20	10	40
Course Content	PID controller design and tuning (Ziegler and Nichols and other advanced techniques). Nyquist stability criterion. State space modeling. Controllability and Observability. State feedback controller and observer design. Application of state-space method to the analysis and synthesis of feedback control systems. Pole Placement Using State Feedback. linear control systems with time delays – data control systems: PI – PID – Phase-Lead – Phase-Lag, Lead-Lag (Lag-Lead) – PID controller design using amplitude optimization methods. Case studies applied to Inverted Pendulum and Magnetic levitation using MATLAB.										
References	• Dorf, Richard C., and Robert H. Bishop, "Modern control systems". Pearson, 2011. • Katsuhiko, Ogata. "Modern control engineering". Pearson, 2010.										
Laboratory	• Time response for transfer function including P, PI, PD and PID Controllers • Lag-Lead compensators and overall system time and frequency response • State space representation for different systems (Benchmark-inverted pendulum, ball-beam system) • State feedback controller and observer design and Pole Placement techniques applications using MATLAB										

Code	Course Title	Pre-req	CH	Weekly Contact Hours				Assessment Criteria %			
EME 433	Power System Analysis	EME 304	3	Lec.	Lab	Tut	Sum	MT1	MT2	Std. Act.	Final
				2	0	2	4	30	20	10	40
Course Content	Equivalent circuits of power system elements, Per unit representation, Formulation of network matrices, Symmetrical fault analyses, Symmetrical components and unsymmetrical fault analyses, Load flow solutions and control: Load flow equations, The Gauss-Seidel method, Newton-Raphson method and approximations, De-coupled methods, Regulating transformers, Optimal dispatch of generation, Power system stability, Control in voltage stabilizers, Generator speed control.										
References	• Hadi Saadat, Power System Analysis, PSA Publishing, Third Edition, 2010. • J. D. Glover, M. S. Sarma and T. J. Overbye, Power System Analysis and Design, • Cengage Learning, Fifth Edition, 2012. • Gross, C.A., Power System Analysis, John Wiley, 1980. • Elgerd, O., Electric Energy System Theory: An Introduction, McGraw Hill, 1991.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab	Tut	Sum	MT1	MT2	Std. Act.	Final
EME 435	Electrical Drives	EME 106 EME 304	3	2	0	2	4	30	20	10	40
Course Contents	Criteria for selecting drive components, DC motor drives, regenerative braking and four quadrant operation, Induction motor drives, slip power recovery, Doubly Fed Induction Motor drive (DFIM), synchronous motor drives, Permanent Magnet Synchronous Machine drive (PMSM): motor and generator applications, Stepper motor drives.										
References	• Dave Polka, "Motors and Drives A Practical Technology Guide", The Instrumentation, Systems, and Automation Society, 2003. • R. Krishnan, " Electric Motor Drives modeling analysis and control", Virginia Tech. Blacksburg. VA, 2001. • Phipps, Clarence A., Variable Speed Drive Fundamentals, The Fairmont Press, Inc., Lilburn, GA, p. 22–28, 1994.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
EMM 390	Senior Design Project I	70% of total CH	2	0	4	0	4	50	--	50	--
Course Content	The Course exploits the design experience for undergraduate students. It provides the essential concepts, ideas, and principles of the engineering design process, with the use of other concepts as standards, constraints, and communication. Students work in teams (can be a multidisciplinary team if accepted from the college council) students develop the project proposal and are required to present their proposal in oral presentation and submit a written version of it.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
EMM 490	Senior Design Project II	EMM 390	3	1	4	0	5	50	--	50	--
Course Content	The second design experience course for the students. The students build\implement\ fabricate their design. They test and evaluate their design against the design specification. The students are asked to demonstrate a functional project to the discussion committee, make an oral presentation and deliver their final report that documents the project										

Program# 11 Construction Engineering and Management Program

Program Description

Construction engineering is a broad discipline concerned with the design, engineering, and management process of construction and building projects. It include: proficiency in engineering design; understanding of legal and professional practice issues related to the construction industry; understanding of construction processes, communications, methods, materials, systems, equipment, planning, scheduling, safety, cost analysis, and cost control; understanding of management topics such as economics, business, accounting, law, statistics, ethics, leadership, decision and optimization methods, process analysis and design, engineering economics, engineering management, safety, and cost engineering. The small class sizes within the Program allow a student-centric and individualized learning environment.

Basic Information

Program Vision

Our vision is to lead the field of construction engineering and management globally, as determined by the caliber of our professors, the influence of our academic work, and our stellar reputation.

Program Mission

The Benha faculty of Engineering Construction Engineering and Management program aims to develop the skills and knowledge students need to successfully complete construction projects on time and on budget while adhering to construction standards and safety guidelines within human values and social responsibility. Graduates will have sufficient knowledge and skills to develop their postgraduate research skills and find employment in the commercial, design-build, and residential sectors of the construction industry.

Program Objectives

The objectives of the BSc in The Construction Engineering and Management program are to enable its graduates to:

PO1. Apply a wide spectrum of engineering knowledge, science, and specialized skills with analytic, critical, and systemic thinking to identify and solve engineering problems in real-life situations.

PO2. Behave professionally, adhere to engineering ethics and standards, and work to develop the profession and community and promote sustainability principles.

PO3. Work in and lead a heterogeneous team and display leadership qualities, business administration, and entrepreneurial skills.

PO4. Master self-learning and life-long learning strategies to communicate effectively in academic/professional fields.

PO5. Apply analytical, experimental, design, construction engineering techniques and project management skills with proficiency aided by modern tools.

PO6. Graduate a postgraduate student who has the necessary scientific knowledge and innovative thinking needed for the Construction engineering and management engineering field.

Graduates Attributes

By the completion of the Construction Engineering and Management program of study, and according to NARS 2018, the graduate will be capable to:

1. Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real-life situations.

2. Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation.
3. Behave professionally and adhere to engineering ethics and standards.
4. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance.
5. Recognize his/her role in promoting the engineering field and contribute to the development of the profession and the community.
6. Value the importance of the environment, both physical and natural, and work to promote sustainability principles.
7. Use techniques, skills, and modern engineering tools necessary for engineering practice.
8. Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post-graduate and research studies.
9. Communicate effectively using different modes, tools, and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner.
10. Demonstrate leadership qualities, business administration, and entrepreneurial skills.

In addition to all engineering graduate attributes defined by NARS 2018, Construction and Management engineering graduates should be able to:

11. Identify the essential construction processes technologies techniques, Properties, behavior & fabrication of construction materials.
12. Master Projects management, including planning, finance, bidding, contract procedures, cost estimators, and quality systems.
13. Use the different analytical and computational methods that can be applied to the various areas of construction and building engineering.

Program Learning Outcomes

In addition to the competencies for all Engineering Programs (A-Level), the Construction Engineering and Management Program graduate must be able to (D-Level):

Level	Program Learning Outcomes according to NARS 2018	
A	General Competencies of Engineering Graduate	**PLO1**: Identity, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics.
		PLO2: Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.
		PLO3: Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.
		PLO4: Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.
		PLO5: Practice research techniques and methods of investigation as an inherent part of learning.
		PLO6: Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.
		PLO7: Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural team
		PLO8: Communicate effectively – graphically, verbally and in writing –

		with a range of audiences using contemporary tools.
		A9: Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.
		PLO10: Acquire and apply new knowledge; and practice self, lifelong and other learning strategies.
D	Competencies of Construction engineering and Management Program	**PLO11**: Select appropriate and sustainable technologies for construction of buildings, infrastructures and water structures; using either numerical techniques or physical measurements and/or testing by applying a full range of civil engineering concepts and techniques of: Structural Analysis and Mechanics, Properties and Strength of Materials, Surveying, Soil Mechanics, Hydrology and Fluid Mechanics.
		PLO12: Achieve an optimum design of Reinforced Concrete and Steel Structures, Foundations and Earth Retaining Structures; and at least three of the following civil engineering topics: Transportation and Traffic, Roadways and Airports, Railways, Sanitary Works, Irrigation, Water Resources and Harbors; or any other emerging field relevant to the discipline.
		PLO13: Plan and manage construction processes; address construction defects, instability and quality issues; maintain safety measures in construction and materials; and assess environmental impacts of projects.
		PLO14: Deal with biddings, contracts and financial issues including project insurance and guarantees.
		PLO15: Create architectural, urban, and planning designs that satisfy both aesthetic and technical requirements, using adequate knowledge of history and theory, related fine arts, local culture and heritage, technologies and human sciences
		PLO16: Generate ecologically responsible, environmental conservation and rehabilitation designs; through understanding of: structural design, construction, technology and engineering problems associated with building designs.

Faculty Mission vs. Program Mission Matrix

<table>
<tr><th colspan="2" rowspan="2">Faculty Mission</th><th colspan="3">Program Mission
The Benha faculty of Engineering Construction Engineering and Management program aims to develop the skills and knowledge students need to successfully complete construction projects on time and on budget while adhering to construction standards and safety guidelines within human values and social responsibility. Graduates will have sufficient knowledge and skills to develop their postgraduate research skills and find employment in the commercial, design-build, and residential sectors of the construction industry.</th></tr>
<tr><th>The Benha faculty of Engineering Construction Engineering and Management program aims to develop the skills and knowledge students need to successfully complete construction projects on time and on budget</th><th>adhering to construction standards and safety guidelines within human values and social responsibility.</th><th>Graduates will have sufficient knowledge and skills to develop their postgraduate research skills and find employment in the commercial, design-build, and residential sectors of the construction industry.</th></tr>
<tr><td rowspan="3">Benha Faculty of Engineering - Benha University is committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market, and capable of using and developing modern technology, and providing research in engineering fields to serve society and community.</td><td>Benha Faculty of Engineering - Benha University is committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market</td><td>√</td><td></td><td></td></tr>
<tr><td>Capable of using and developing modern technology</td><td></td><td>√</td><td></td></tr>
<tr><td>Providing research in engineering fields to serve society and community</td><td></td><td></td><td>√</td></tr>
</table>

Program Mission vs. Program Objectives Matrix

<table>
<tr><th colspan="2" rowspan="2">Program Mission</th><th colspan="6">Program Objectives</th></tr>
<tr><th>PO1</th><th>PO2</th><th>PO3</th><th>PO4</th><th>PO5</th><th>PO6</th></tr>
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<tr><td>adhering to construction standards and safety guidelines within human values and social responsibility.</td><td></td><td>√</td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>Graduates will have sufficient knowledge and skills to develop their postgraduate research skills and find employment in the commercial, design-build, and residential sectors of the construction industry.</td><td></td><td></td><td></td><td>√</td><td>√</td><td>√</td></tr>
</table>

Program Objectives vs. Program Competencies Matrix

Program Objectives	Program Competencies															
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	D1	D2	D3	D4	D5	D6
PO1	√	√							√		√	√		√	√	√
PO2			√								√	√	√		√	√
PO3							√	√	√				√			
PO4					√	√		√		√			√			
PO5				√	√	√	√	√		√				√		
PO6	Will be covered through postgraduate courses															

Program Objectives vs. Graduate Attributes Matrix

Program Objectives	Graduate Attributes												
	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12	GA13
PO1	√	√					√						
PO2			√		√	√		√					
PO3				√						√			
PO4						√			√				
PO5											√	√	√
PO6											√	√	√

Career Prospects

Graduates of the Construction Engineering and Management program design and manage construction processes that create living and working environments such as office buildings, industrial buildings, housing, roads, bridges, utilities and water Resources. They can work in projects for: construction management; construction engineering; structures of all types; geo-techniques & foundations; transportation systems; surveying works; environmental engineering works; water resources, water supply systems. Following are some of the job opportunities that can be pursued by the program graduates:

Field engineer: implements and coordinates engineered construction processes.
Design engineer: develop conceptual and detailed designs for many construction projects such as office buildings, industrial buildings, housing, roads, bridges, and utilities.
Survey engineer: perform surveying activities for all types of construction projects.
Cost estimator: develops itemized costs and budgets for design and construction based upon knowledge and pre-design of operations, materials, and resource requirements.
Planning /scheduling engineer: designs and monitors the plan for timing and sequence of construction operations.
Quality control / assurance engineer: ensures that the items of the construction project and the construction process conform to specifications and standards.
Projects controls engineer: reviews the cost and time performance of the project during construction. Contract administrator: reviews the project’s contracts and prepares / reviews change orders and claims.
Health and safety engineer: reviews and implements the project's health and safety system to ensure health and safety standards are adopted throughout the project.
Project engineer: designs all or part of the project construction process, coordinates construction engineering to accomplish the overall objectives of the facility design team.

Project manager: oversees all aspects of a project, coordinates subcontractors, and provides primary contact to the client as well as to the company's leaders.

Requirements of Program Courses

In order to get a Bachelor of Science Degree in this program, and to satisfy the Program Competencies, the following set of courses needs to be completed.

Program Requirements

Requirement		Cr. Hrs.	Ct. Hr.			
			Lect.	Lab.	Tut.	Sum
Benha University Requirements		14	14	0	0	14
Benha Faculty of Engineering Requirements		32	19	14	17	50
Program Requirements	From Basic science	12	8	6	2	16
	Compulsory Courses	84	58	30	40	128
	Elective courses	18	12	2	10	24
Total		160	111	52	69	232

University Requirements of Construction Engineering and Management Program

Lists of Humanities Courses of Construction Engineering and Management Program

Code	Course	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lect.	Lab.	Tut.	Sum
UHS 101	Foreign Language	-----	2	2	0	0	2
UHS 103	Social issues	-----	2	2	0	0	2
UHS 102	Information and Communication Technology	-----	2	2	0	0	2
UHS 104	Professional Ethics	-----	2	2	0	0	2
UHS XXX	Humanities Elective I	-----	2	2	0	0	2
UHS XXX	Humanities Elective II	-----	2	2	0	0	2
UHS XXX	Humanities Elective III	-----	2	2	0	0	2
Total			**14**	**14**	**0**	**0**	**14**

Lists of Electives Humanities of Construction Engineering and Management Program

Humanities Elective		Code	Course
I	Entrepreneurship Courses	UHS 201	Principles of Entrepreneurship and Project Management
		UHS 203	Human Resources Management
II	Personal and acquired skills courses	UHS 301	Communication and Presentation Skills
		UHS 302	Leadership Skills
III	Scientific research and analysis courses	UHS 801	Research Methodologies
		UHS 803	Thinking Skills

Faculty Requirements of Construction Engineering and Management Program

Code	Course	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lec.	Lab.	Tut	Sum
FRB 001	Analytical geometry & Linear Algebra	-----	3	2	0	2	4
FRB 003	Statics	-----	3	2	0	2	4
FRB 005	Waves and Heat	-----	3	2	2	1	5
FRB 007	Chemistry for Engineers	-----	4	3	2	1	6
FRM 009	Engineering Drawing	-----	2	0	0	4	4
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4
FRB 004	Dynamics	FRB 003	3	2	0	2	4
FRB 006	Electricity and Magnetism	-----	3	2	2	1	5
FRM 008	Production Systems Engineering	-----	2	1	3	0	4
FRM 010	Engineering Drawing by Computer	FRM 009	2	1	2	0	3
FRE 012	Computer Programming Fundamentals	-----	2	0	2	2	4
FRB 103	Pollution and Industrial Safety	FRB 007	2	2	1	0	3
FT1	Field Training I		0	0	0	0	0
FT2	Field Training II		0	0	0	0	0
Total			**32**	**19**	**34**	**47**	**50**

Basic Science Requirements of Construction Engineering and Management Program

CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lect.	Lab.	Tut.	Sum
FRB 001	Analytical geometry & Linear Algebra	-----	3	2	0	2	4
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4
FRB 101	Engineering Differential Equations	FRB 002	3	2	0	2	4
FRB 104	Engineering Numerical Analysis	FRB 101	3	2	2	0	4
FRB 201	Applied Engineering Probability and Mathematical Statistics	FRB 002	3	2	2	0	4
FRB 007	Chemistry for Engineers	-----	4	3	2	1	6
FRB 102	Water Chemistry	FRB 007	3	2	2	0	4
FRB 103	Pollution and Industrial Safety	FRB 007	2	2	1	0	3
FRB 005	Waves and Heat	-----	3	2	2	1	5
FRB 006	Electricity and Magnetism	-----	3	2	2	1	5
Total			**30**	**21**	**13**	**9**	**43**

Program Requirements

Lists of Compulsory Courses (96 Credit Hours)

Code	Course Title	Pre-requisites	Cr. Hrs.	Contact Hours			
				Lec.	Lab	Tut	Sum
FRB 101	Engineering Differential Equations	FRB 002	3	2	0	2	4
FRB 104	Engineering Numerical Analysis	FRB 101	3	2	2	0	4
FRB 201	Applied Engineering Probability and Mathematical Statistics	FRB 002	3	2	2	0	4
FRB 102	Water Chemistry	FRB 007	3	2	2	0	4
Total from Basic Science			**12**	**8**	**6**	**2**	**16**
CMC 101	Structural Analysis-1	FRB 003	3	2	0	2	4
CMC 103	Properties and Testing of Construction Materials	FRB 003	2	2	1	0	3
CMC 105	Surveying for Engineers-1	FRB 002	3	2	2	1	5
CMA 107	Basic Architectural Engineering	FRM 009	2	1	0	2	3
CMC 109	Fluid Mechanics	FRB 005	2	2	1	0	3
CMC 102	Structural Analysis- 2	CMC 101	3	2	0	2	4
CMC 104	Construction Materials and Concrete Technology	CMC 103	3	2	2	1	5
CMC 106	Construction Engineers Drawing	FRM 010	2	1	3	0	4
CMC 108	Surveying for engineers- 2	CMC 105	3	2	0	2	4
CMA 110	Building Construction	CMA 107	2	2	0	1	3
CMC 112	Hydraulics for Construction Engineers	CMC 109	2	2	1	0	3
CMC 201	Hydrology and Water Resources	CMC 112	3	2	0	2	4
CMC 203	Soil Mechanics	CMC 103	3	2	2	1	5
CMC 205	Design of Metallic Structures-1	CMC 102	3	2	0	2	4
CMC 207	Design of R.C. Structures-1	CMC 102 +CMC 104	3	2	0	2	4
CMC 202	Transportation and Traffic Engineering	FRB 201	3	2	1	2	5
CMC 204	Geotechnical Engineering & Foundations	CMC 203	3	2	2	1	5
CMC 206	Construction Project Management	-----	3	2	0	2	4
CMC 208	Design of R.C. Structures-2	CMC 207	3	2	0	2	4
CMA 210	Introduction to City Planning	----	2	2	0	1	3
CMM 301	Technical Installations in Buildings	------	2	1	3	0	4
CMC 303	Methods and Equipments for Construction	CMC 207	3	2	0	2	4
CMC 305	Design and Construction of Foundations & Earth Retaining Structures	CMC 204	3	2	0	2	4
CMC 307	Cost Engineering &	CMC 206	3	2	0	2	4

	Quantity Surveying						
CMC 309	Quality Control & Inspection of Structures	CMC 207	2	2	0	1	3
CMC 302	Sanitary Engineering	CMC 112	3	2	2	1	5
CMC 304	Construction and Site Safety	CMC 303	2	2	0	1	3
CMC 306	Project Planning, Scheduling, and Control	CMC 206	3	2	1	2	5
CMC 308	Senior Design Project I	*	2	0	4	0	4
CMC 401	Project Finance & Management	CMC 307	3	2	1	2	5
CMC 403	Construction Project Specifications, Bids, and Contracts	CMC 307	2	2	0	1	3
CMC 405	Senior Design Project II	CMC 308	3	1	4	0	5
			84	**58**	**30**	**40**	**128**

*The student can register for the Senior Design Project course after passing 70% of the program cr. hrs, i.e., 112 Cr. Hr

Lists of Elective Courses (18 Credit Hours)

CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lect.	Lab.	Tut.	Sum
Elective I							
CMA 311	Building Technology	----	3	2	0	2	4
CMC 313	Highway Facilities	CMC 202	3	2	0	2	4
CMC 315	Bridge Building Technology	CMC 208	3	2	0	2	4
Elective II							
CMC 310	Value Engineering in the Construction Industry	-----	3	2	0	2	4
CMC 312	Engineering Economy	-----	3	2	0	2	4
CMC 314	Construction Quality Management	-----	3	2	0	2	4
Elective III							
CMC 316	Dynamic of Structures	CMC 102	3	2	0	2	4
CMC 318	Design of Metallic Structures-2	CMC 205	3	2	0	2	4
CMC 320	Prefabricated Water and Prestressed Concrete Structures	CMC 208	3	2	0	2	4
Elective IV							
CMC 407	Engineering for a Sustainable Environment	--	3	2	0	2	4
CMC 409	Environmental Engineering	FRB 102	3	2	0	2	4
CMC 411	Special Topics in Structural Analysis	CMC 102	3	2	0	2	4
Elective V							
CMC 413	Advanced Engineering Materials	CMC 104	3	2	0	2	4
CMA 415	Finishing Materials Technology	---	3	2	0	2	4
CMA 417	Principles and Approaches of Smart Cities	CMA 210	3	2	0	2	4
Elective VI							
CMC 419	Modeling and Simulation of Construction Systems	CMC 306	3	2	2	0	4
CMC 421	Geographic Information System GIS	CMC 108	3	2	2	0	4
CMC 423	Modeling of structures	CMC 102	3	2	2	0	4
Total			**18**	**12**	**2**	**10**	**24**

Proposed Study Plan

Level 0-1														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	PE/OE	St. Act.	Final	sum
FRB 001	Analytical geometry & Linear Algebra	-----	3	2	0	2	4	2 hr	30	20	--	10	40	100
FRB 003	Statics	-----	3	2	0	2	4	2 hr	30	20	--	10	40	100
FRB 005	Waves and Heat	-----	3	2	2	1	5	2 hr	30	--	20	10	40	100
FRB 007	Chemistry for Engineers	-----	4	3	2	1	6	2 hr	30	--	20	10	40	100
FRM 009	Engineering Drawing	-----	2	0	0	4	4	2 hr	30	20	--	10	40	100
UHS 101	Foreign Language	-----	2	2	0	0	2	2 hr	30	20	--	10	40	100
UHS 103	Social issues	-----	2	2	0	0	2	2 hr	30	20	--	10	40	100
			19	13	4	10	27							700

Level 0-2														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	PE/OE	St. Act.	Final	sum
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4	2 hr	30	20	--	10	40	100
FRB 004	Dynamics	FRB 003	3	2	0	2	4	2 hr	30	20	--	10	40	100
FRB 006	Electricity and Magnetism	-----	3	2	2	1	5	2 hr	30	--	20	10	40	100
FRM 008	Production Systems Engineering	-----	2	1	3	0	4	2 hr	30	--	20	10	40	100
FRM 010	Engineering Drawing by Computer	FRM 009	2	1	2	0	3	2 hr	30	20	40	10	--	100
UHS 102	Information and Communication Technology	-----	2	2	0	0	2	2 hr	30	20	--	10	40	100
FRE 012	Computer Programming Fundamentals	-----	2	0	2	2	4	2 hr	30	20	40	10	--	100
			17	10	9	7	26							700

	Level 1-1													
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	PE/OE	St. Act.	Final	sum
FRB 101	Engineering Differential Equations	FRB 002	3	2	0	2	4	2 hr	30	20	--	10	40	100
CMC 101	Structural Analysis-1	FRB 003	3	2	0	2	4	2 hr	30	20	--	10	40	100
CMC 103	Properties and Testing of Construction Materials	FRB 003	2	2	1	0	3	2 hr	30	--	20	10	40	100
FRB 103	Environmental Pollution and Industrial Safety	FRB 007	2	2	1	0	3	2 hr	30	--	20	10	40	100
CMC 105	Surveying for Engineers-1	FRB 002	3	2	2	1	5	2 hr	30	--	20	10	40	100
CMA 107	Basic Architectural Engineering	FRM 009	2	1	0	2	3	2 hr	30	20	--	10	40	100
CMC 109	Fluid Mechanics	FRB 005	2	2	1	0	3	2 hr	30	--	20	10	40	100
			17	13	5	7	25							700

	Level 1-2													
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time		Assessment				
				Lect.	Lab	Tut.	Sum		Mid 1	Mid 2	PE/OE	St. Act.	Final	sum
FRB 102	Water Chemistry	FRB 007	3	2	2	0	4	2 hr	30	--	20	10	40	100
CMC 102	Structural Analysis- 2	CMC 101	3	2	0	2	4	2 hr	30	20		10	40	100
CMC 104	Construction Materials and Concrete Technology	CMC 103	3	2	2	1	5	2 hr	30	--	20	10	40	100
CMC 106	Construction Engineers Drawing	FRM 010	2	1	3	0	4	2 hr	30	20	40	10	--	100
CMC 108	Surveying for engineers 2	CMC 105	3	2	0	2	4	2 hr	30	20		10	40	100
CMA 110	Building Construction	CMA 107	2	2	0	1	3	2 hr	30	20		10	40	100
CMC 112	Hydraulics for Construction	CMC 109	2	2	1	0	3	2 hr	30	--	20	10	40	100
			18	13	8	6	27							700

Field Training I														
CODE	**Course Name**	**Pre-requisites**	**Cr. Hrs.**	**Ct. Hr.**				**Final Exam Time**	**Assessment**				
				Lect.	**Lab.**	**Tut.**	**Sum**		**Mid 1**	**Mid 2**	**St. Act.**	**Final**	**sum**
FT 103	Field Training I	Completion of 65 Cr. Hrs.	0	0	0	0	0	Oral	-	-	-	Pass or Fail	

	Level 2-1														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	PE/OE	St. Act.	Final	sum
FRB 201	Applied Engineering Probability and Mathematical Statistics	FRB 002	3	2	2	0	4	2 hr	30	--	20	10	40	100
CMC 201	Hydrology and Water Resources	CMC 112	3	2	0	2	4	2 hr	30	20	--	10	40	100
CMC 203	Soil Mechanics	CMC 103	3	2	2	1	5	2 hr	30	--	20	10	40	100
CMC 205	Design of Metallic Structures-1	CMC 102	3	2	0	2	4	2 hr	30	20	--	10	40	100
CMC 207	Design of R.C. Structures-1	CMC 102 +CMC 104	3	2	0	2	4	2 hr	30	20	--	10	40	100
UHS 3XX	Humanities Elective I	----	2	2	0	0	2	2 hr	30	20	--	10	40	100
			17	12	4	7	23							600

Level 2-2														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	PE/OE	St. Act.	Final	sum
FRB 104	Engineering Numerical Analysis	FRB 101	3	2	2	0	4	2 hr	30	--	20	10	40	100
CMC 202	Transportation and Traffic Engineering	FRB 201	3	2	1	2	5	2 hr	30	--	20	10	40	100
CMC 204	Geotechnical Engineering & Foundations	CMC 203	3	2	2	1	5	2 hr	30	--	20	10	40	100
CMC 206	Construction Project Management	-----	3	2	0	2	4	2 hr	30	20	--	10	40	100
CMC 208	Design of R.C. Structures-2	CMC 207	3	2	0	2	4	2 hr	30	20	--	10	40	100
CMA 210	Introduction to City Planning	----	2	2	0	1	3	2 hr	30	20	--	10	40	100
			17	12	5	8	25							600

Field Training I													
CODE	**Course Name**	**Pre-requisites**	**Cr. Hrs.**	**Ct. Hr.**				**Final Exam Time**	**Assessment**				
				Lect.	**Lab.**	**Tut.**	**Sum**		**Mid 1**	**Mid 2**	**St. Act.**	**Final**	**sum**
FT 203	Field Training II	Completion of 96 Cr. Hrs.	0	0	0	0	0	Oral	-	-	-	Pass or Fail	

Level 3-1															
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	PE/OE	St. Act.	Final	sum
CMM 301	Technical Installations in Buildings	---	2	1	3	0	4	2 hr	30	--	20	10	40	100
CMC 303	Methods and Equipment for Construction	CMC 207	3	2	0	2	4	2 hr	30	20	--	10	40	100
CMC 305	Design and Construction of Foundations & Earth Retaining Structures	CMC 204	3	2	0	2	4	2 hr	30	20	--	10	40	100
CMC 307	Cost Engineering & Quantity Surveying	CMC 206	3	2	0	2	4	2 hr	30	20	--	10	40	100
CMC 3XX	Elective I	*	3	2	0	2	4	2 hr	30	20	--	10	40	100
CMC 309	Quality Control & Inspection of Structures	CMC 207	2	2	0	1	3	2 hr	30	20	--	10	40	100
UHS 4XX	Humanities Elective II	-----	2	2	0	0	2	2 hr	30	20	--	10	40	100
			18	13	3	9	25							700

* According to the Course Name

Level 3-2														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	PE/OE	St. Act.	Final	sum
CMC 302	Sanitary Engineering	CMC 112	3	2	2	1	5	2 hr	30	--	20	10	40	100
CMC 304	Construction and Site Safety	CMC 303	2	2	0	1	3	2 hr	30	20	--	10	40	100
CMC 3XX	Elective II	*	3	2	0	2	4	2 hr	30	20	--	10	40	100
CMC 306	Project Planning, Scheduling, and Control	CMC 206	3	2	1	2	5	2 hr	30	--	20	10	40	100
CMC 3XX	Elective III	*	3	2	0	2	4	2 hr	30	20	--	10	40	100
UHS 104	Professional Ethics	-----	2	2	0	0	2	2 hr	30	20	--	10	40	100
CMC 308	Senior Design Project I	**	2	0	4	0	4	2 hr	--	--	50	50	--	100
			18	12	7	8	27							700

* According to the Course Name

**The student can register for the Senior Design Project course after passing 70% of the program cr. hrs, i.e., 112 Cr. Hr., Pre-requisites according to the project area.

Level 4-1															
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	PE/OE	St. Act.	Final	sum
CMC 401	Project Finance &Management	CMC 307	3	2	1	2	5	2 hr	30	--	20	10	40	100
CMC 4XX	Elective IV	*	3	2	0	2	4	2 hr	30	20	--	10	40	100
CMC 4XX	Elective V	*	3	2	0	2	4	2 hr	30	20	--	10	40	100
CMC 403	Construction Project Specifications, Bids, and Contracts	CMC 307	2	2	0	1	3	2 hr	30	20	--	10	40	100
CMC 4XX	Elective VI	*	3	2	2	0	4	2 hr	30	--	20	10	40	100
CMC 405	Senior Design Project II	CMC 308	3	1	4	0	5	2 hr	--	--	50	50	--	100
UHS XXX	Humanities Elective III	-----	2	2	0	0	2	2 hr	30	20	--	10	40	100
			19	13	5	9	27							700

* According to the Course Name

Matching Construction Engineering and Management Program Courses with ABET Requirements

ABET criteria for construction engineering management and similarly named engineering programs

Lead Society: Institute of Industrial and Systems Engineers , American Society of Civil Engineers

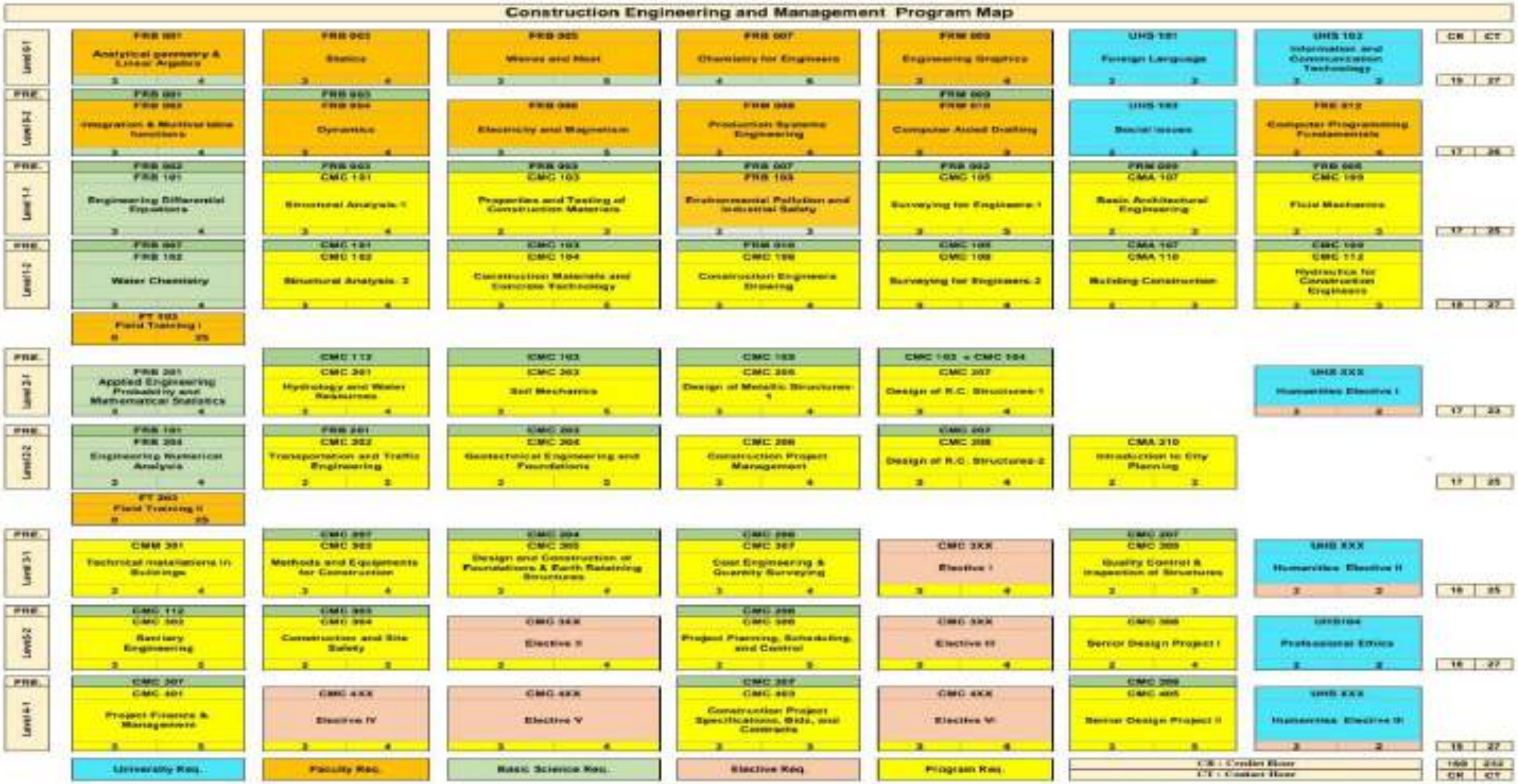
Construction Engineering and Management Program Courses Required to Cover ABET Criteria				
ABET Criteria		**CODE**	**Course Name**	**Credit Hours**
A minimum of 30 semester credit hours (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program.	The curriculum must prepare graduates to apply knowledge of mathematics through differential equations.	FRB 001	Analytical geometry & Linear Algebra	3
		FRB 002	Integration & Multivariable functions	3
		FRB 101	Engineering Differential Equations	3
	At least one additional area of basic science; apply probability and statistics to address uncertainty	FRB 104	Engineering Numerical Analysis	3
		FRB 201	Applied Engineering Probability and Mathematical Statistics	3
	Chemistry	FRB 007	Chemistry for Engineers	4
		FRB 102	Water Chemistry	3
		FRB 103	Environmental Pollution and Industrial Safety	2
	Calculus-based physics	FRB 005	Waves and Heat	3
		FRB 006	Electricity and Magnetism	3
Total				**30**
ABET Criteria		**CODE**	**Course Name**	**Credit Hours**
A minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design and utilizing modern engineering tools.	Analyze and design construction processes and systems in a construction engineering specialty field.	CMC 104	Construction Materials and Concrete Technology	3
		CMA 110	Building Construction	2
		CMM 301	Technical Installations in Buildings	2
		CMC 303	Methods and Equipments for Construction	3
		CMC 3XX	Elective I	3
		CMC 4XX	Elective V	3

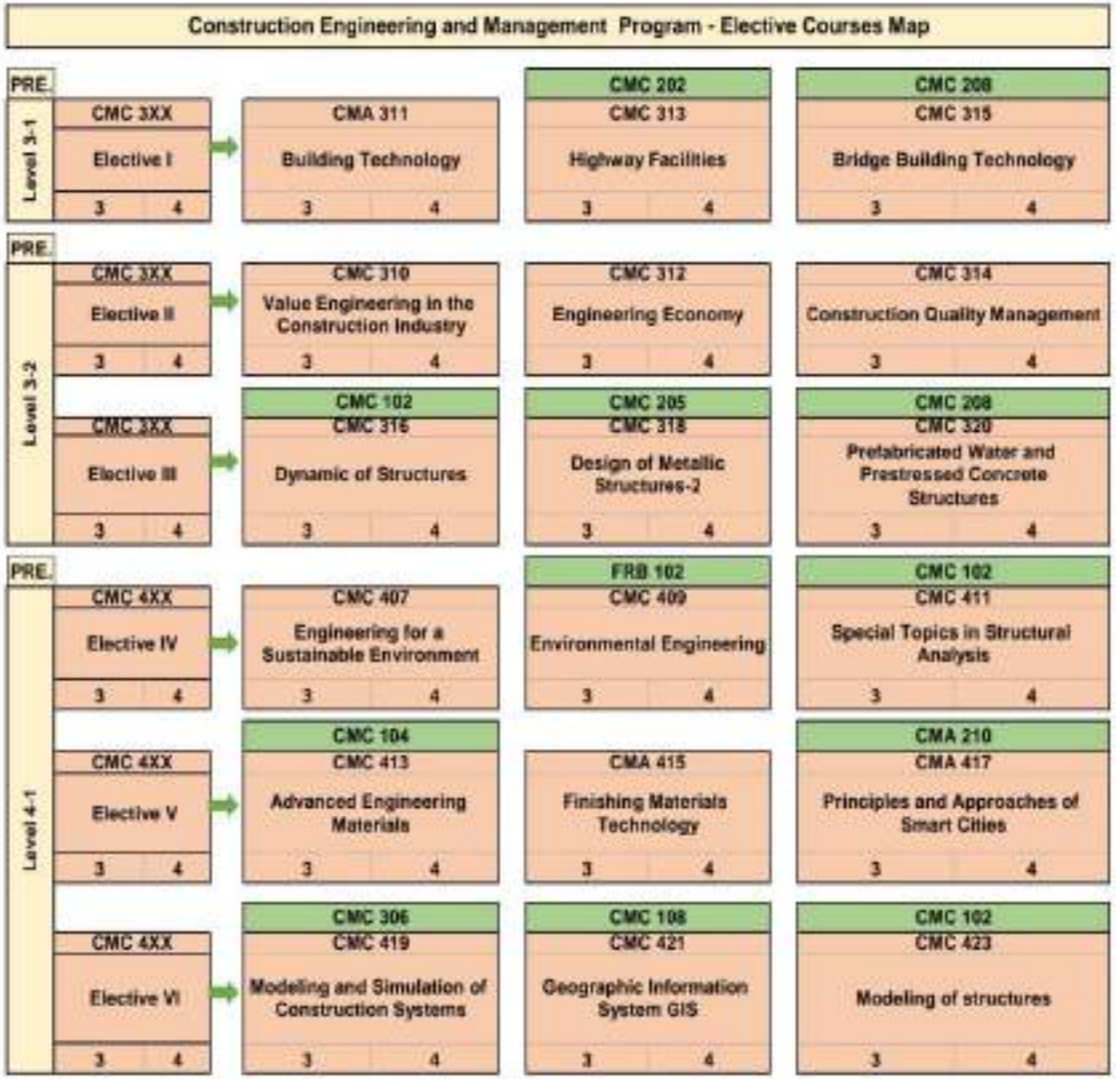
	Apply knowledge of methods, materials, equipment, planning, scheduling, safety, and cost analysis; to explain basic legal and ethical concepts and the importance of professional engineering licensure in the construction industry	CMC 306	Project Planning, Scheduling, and Control	3
		CMC 403	Construction Project Specifications, Bids, and Contracts	2
		CMC 304	Construction and Site Safety	2
		CMC 307	Cost Engineering & Quantity Surveying	3
		CMC 309	Quality Control &Inspection of Structures	2
	Explain basic concepts of economics, business, accounting, communications, leadership, decision and optimization methods, engineering economics	CMC 3XX	Elective II	3
		UHS XXX	Humanities Elective II	2
	the engineering relationships between the management tasks of planning, organization, leadership, control, and the human element in production, research, and service organizations;	UHS XXX	Humanities Elective I	2
		UHS XXX	Humanities Elective III	2
	The stochastic nature of management systems	CMC 206	Construction Project Management	3
		CMC 401	Project Finance & Management	3
	Integrating management systems into a series of different technological environments	CMC 4XX	Elective IV	3
Total				**46**

Courses Plan and Matrix

Construction Engineering and Management Program Map

Compulsory Courses

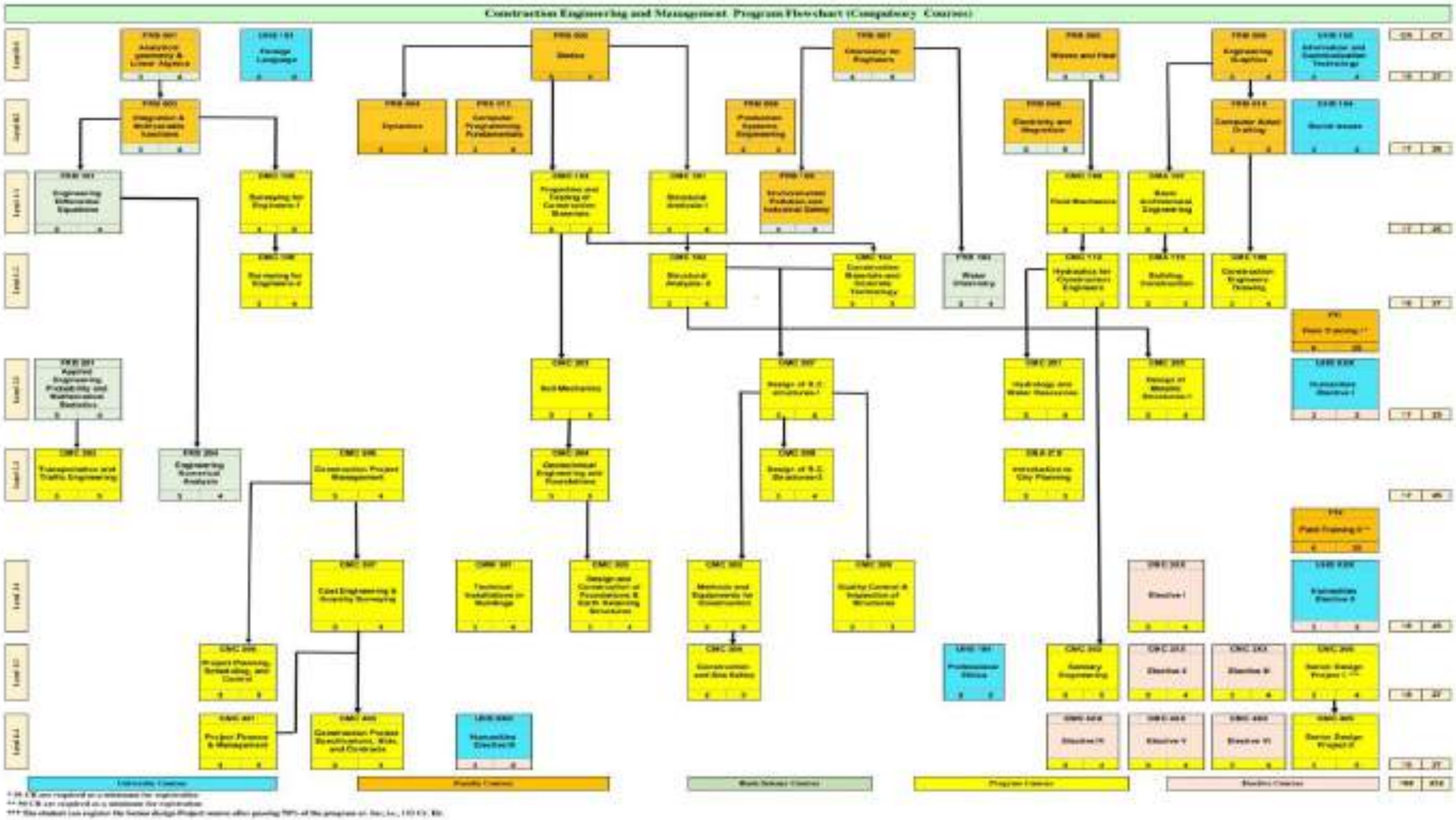



Construction Engineering and Management Program - Elective Courses Map
PRE.
Level 3-1
CMC 3XX
Elective I
3 4
CMA 311
Building Technology
3 4
CMC 202
CMC 313
Highway Facilities
3 4
CMC 208
CMC 315
Bridge Building Technology
3 4
PRE.
Level 3-2
CMC 3XX
Elective II
3 4
CMC 310
Value Engineering in the Construction Industry
3 4
CMC 312
Engineering Economy
3 4
CMC 314
Construction Quality Management
3 4
CMC 3XX
Elective III
3 4
CMC 102
CMC 316
Dynamic of Structures
3 4
CMC 205
CMC 318
Design of Metallic Structures-2
3 4
CMC 208
CMC 320
Prefabricated Water and Prestressed Concrete Structures
3 4
PRE.
Level 4-1
CMC 4XX
Elective IV
3 4
CMC 407
Engineering for a Sustainable Environment
3 4
FRB 102
CMC 409
Environmental Engineering
3 4
CMC 102
CMC 411
Special Topics in Structural Analysis
3 4
CMC 4XX
Elective V
3 4
CMC 104
CMC 413
Advanced Engineering Materials
3 4
CMA 415
Finishing Materials Technology
3 4
CMA 210
CMA 417
Principles and Approaches of Smart Cities
3 4
CMC 4XX
Elective VI
3 4
CMC 306
CMC 419
Modeling and Simulation of Construction Systems
3 4
CMC 108
CMC 421
Geographic Information System GIS
3 4
CMC 102
CMC 423
Modeling of structures
3 4

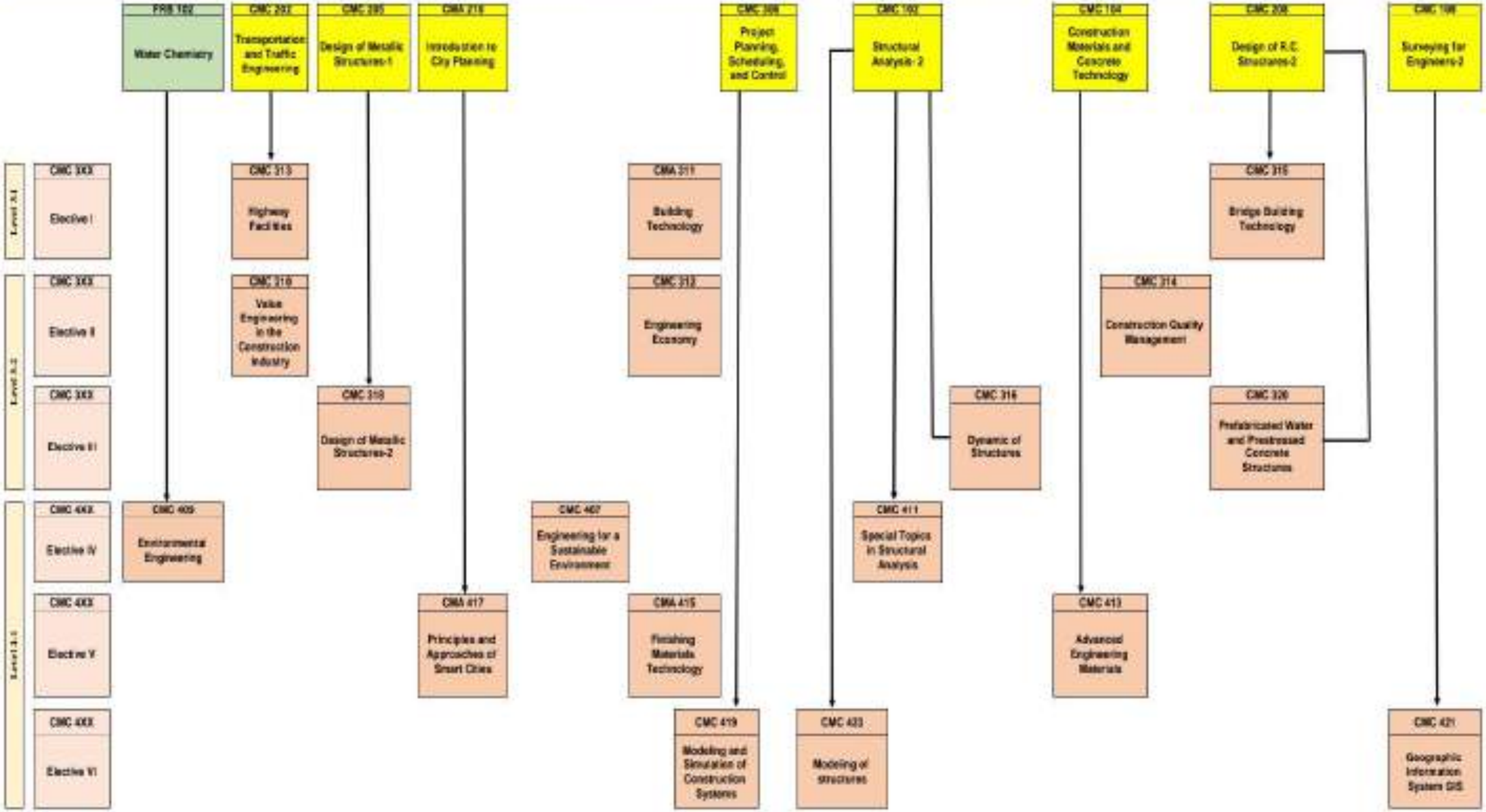
Construction Engineering and Management Program - Humanities Elective Map

Level	Elective		Option 1		Option 2	
Level 2-1	UHS XXX Humanities Elective I		UHS 201 Principles of Entrepreneurship and Project Management		UHS 203 Human Resources Management	
	2	2	2	2	2	2
level 3-1	UHS XXX Humanities Elective II		UHS 301 Communication and Presentation Skills		UHS 302 Leadership Skills	
	2	2	2	2	2	2
level 4-1	UHS XXX Humanities Elective III		UHS 801 Research Methodologies		UHS 803 Thinking Skills	
	2	2	2	2	2	2

Construction Engineering and Management Flowchart



Construction Engineering and Management Program Flowchart (Elective Courses)



Program Learning Outcomes to Course Matrix

Code	Title	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16
Main Humanities Courses																	
UHS 101	Foreign Language								*		*						
UHS 102	Information and Communication Technology				*						*						
UHS 103	Social issues							*			*						
UHS 104	Professional Ethics				*	*											
Elective Humanities Courses																	
UHS XXX	Humanities Elective I			*	*												
UHS XXX	Humanities Elective II								*	*							
UHS XXX	Humanities Elective III					*					*						
Basic Science Requirements Courses																	
FRB 001	Analytical geometry & Linear Algebra	*		*													
FRB 002	Integration & Multivariable functions	*		*													
FRB 101	Engineering Differential Equations	*	*														
FRB 104	Engineering Numerical Analysis	*	*														
FRB 201	Applied Engineering Probability and Mathematical Statistics	*	*														
FRB 007	Chemistry for Engineers	*	*														
FRB 102	Water Chemistry	*	*		*												
FRB 103	Environmental Pollution and Industrial Safety	*		*	*												
FRB 005	Waves and Heat	*	*														
FRB 006	Electricity and Magnetism	*	*														
Courses Used as Faculty Requirements																	
FRM 009	Engineering Drawing						*		*								
FRM 008	Production Systems Engineering				*		*										
FRM 010	Engineering Drawing by Computer				*				*								

Code	Title	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16
FRE 012	Computer Programming Fundamentals	*		*													
FRB 003	Statics	*	*														
FRB 004	Dynamics	*	*														
Compulsory Courses																	
CMC 106	Construction Engineers Drawing								*				*				
CMC 101	Structural Analysis-1	*										*					
CMC 102	Structural Analysis-2	*										*					
CMC 201	Hydrology and Water Resources	*										*	*				
CMC 103	Properties and Testing of Construction Materials		*									*					
CMC 104	Construction Materials and Concrete Technology		*									*					
CMC 105	Surveying for Engineers-1		*					*				*					
CMC 108	Surveying for Engineers-2					*						*					
CMM 301	Technical Installations in Buildings		*	*		*						*					*
CMA 107	Basic Architectural Engineering								*							*	
CMA 110	Building Construction					*			*								*
CMA 210	Introduction to City Planning						*									*	*
CMC 109	Fluid Mechanics	*	*									*					
CMC 112	Hydraulics for Construction Engineers		*	*								*					
CMC 401	Project Finance & Management		*				*							*	*		
CMC 203	Soil Mechanics		*			*						*					
CMC 204	Geotechnical Engineering and Foundations		*	*								*	*				
CMC 305	Design and Construction of Foundations & Earth Retaining Structures			*									*				*
CMC 205	Design of Metallic Structures-1			*	*								*				*
CMC 207	Design of R.C. Structures-1			*	*								*				*
CMC 208	Design of R.C. Structures-2			*	*								*				*

Code	Title	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16
CMC 309	Quality Control & Inspection of Structures						*			*				*		*	
CMC 206	Construction Project Management						*	*		*				*	*		
CMC 307	Cost Engineering & Quantity Surveying						*							*	*		
CMC 306	Project Planning, Scheduling, and Control		*				*							*	*		
CMC 403	Construction Project Specifications, Bids, and Contracts						*							*	*		
CMC 302	Sanitary Engineering		*										*				
CMC 202	Transportation and Traffic Engineering	*	*			*							*	*			
CMC 303	Methods and Equipment for Construction					*	*					*					
CMC 304	Construction and Site Safety				*		*							*		*	
CMC 308	Senior Design Project I			*	*		*	*	*	*	*	*	*	*	*	*	*
CMC 405	Senior Design Project II			*	*		*	*	*	*	*	*	*	*	*	*	*
Program Elective Courses																	
CMC 3XX	Program Elective Courses I				*	*						*		*			*
CMC 3XX	Program Elective Courses II						*							*	*		
CMC 3XX	Program Elective Courses III			*									*				*
CMC 4XX	Program Elective Courses IV			*	*									*			
CMC 4XX	Program Elective Courses V										*					*	*
CMC 4XX	Program Elective Courses VI							*		*	*	*					*
Field Training																	
FT1	Field Training I							*			*						
FT2	Field Training II							*			*						

Construction Engineering and Management Program Courses

The course coding system is composed of three letters 3 denotes the department that offers the course, followed by 3 digits, where:

- the first digit from the left represents the course level (from 1 to 5),
- the middle and right digits represent the course sequence.

The coding system is demonstrated in the following table:

UHS XXX	University Requirement Compulsory and Elective Courses
FRB XXX	Courses offered by Basic Engineering Science Department
CMM XXX	Course offered by Mechanical Engineering Department
FRM XXX	Faculty requirement course offered by Mechanical Engineering Department
FRE XXX	Course offered by Electrical Engineering Department
CMA XXX	Course offered by Architecture Engineering Department
CMC XXX	Course offered by Civil Engineering Department

Faculty Requirements

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>MT1</th><th>MT2</th><th>Std. Act.</th><th>Final</th></tr>
<tr><td>FRB 001</td><td>Analytical geometry & Linear Algebra</td><td>-</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Analytical geometry: Functions (Lines, Circles, Parabolas, Piecewise-Functions, Power Functions, Polynomials, Rational Functions, Algebraic Functions, Trigonometric Functions, Hyperbolic Functions, Exponential Functions and Logarithmic Functions) and their properties, their graphs and their inverses. Limits and continuity. Differentiation rules of real functions of one variable. Applications of derivatives (maxima, minima and inflection points, curve tracing, optimization problems). Taylor’s and Maclaurin's series of functions of one variable.

Linear Algebra: Matrices and their properties, types, ranks and their inverses (Adjoint of matrix, Eigen equation and Gauss elimination). Existence and uniqueness of solutions. Solving system of linear equations by Matrices (Gauss elimination, Gauss – Jordan elimination, LU factorization). Eigenvalues and eigenvectors. Complex numbers. Elements of mathematical logic with applications.</td></tr>
<tr><td>References</td><td colspan="11">• Howard Anton, "Calculus with analytical geometry", John Wiley & Sons, Last Edition.
• Gilbert Strang, "Introduction to Linear Algebra", Wellesley-Cambridge Press, Last Edition.</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4	30	20	10	40

Course Contents

Integration: Techniques of integration (Basic Integration Formulas, Integration by Parts, Integration of Rational Functions by Partial Fractions, Trigonometric Integrals and Substitutions). Applications of indefinite integrals. Applications of definite integrals (areas, volumes of revolution, lengths of curves and surface areas of revolution).

Multivariable functions: Curves and surfaces in three dimensions. Limits, continuity and partial derivatives of functions of several variables. Chain Rule. Directional and total derivatives. Applications (tangent planes and normal lines, Taylor series of functions of two variables, Extreme values and conditional extreme values of functions of two variables).

References

- Howard Anton, "Calculus with analytical geometry", John Wiley & Sons, Last Edition.
- George B. Thomas, Jr., Maurice D. Weir, Joel Hass, THOMAS' CALCULUS Multivariable (Twelfth Edition), 2010.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
FRB 003	Statics	-	3	2	0	2	4	30	20	10	40

Course Contents

Fundamentals of statics, Types of supports, Vector algebra and applications to mechanics, Statics of particles, Moments of forces and couples, Equivalent systems of forces and moments, Equilibrium of rigid bodies, Centroid and centre of gravity, Analysis of structure (trusses), Friction and its applications, Moments of inertia (areas and masses).

References

- F. P. Beer, E. R. Johnston, D. F. Mazurek, P. J. Cornwell, Vector Mechanics for Engineers: Statics and Dynamics, 10th edition (2013).
- Hibbeler, R. C. Engineering Mechanics: Statics and Dynamics, 10th Edition. Upper Saddle River, New Jersey: Prentice Hall, (2003).

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
FRB 004	Dynamics	FRB 003	3	2	0	2	4	30	20	10	40
Course Contents	Kinematics of particles (rectilinear and curvilinear motion), Kinetics of particles (force and acceleration method - work and energy method - impulse and momentum method), Kinematics of rigid bodies (translation, rotation around a fixed axis and general plane motion), Plane motion of rigid bodies (force and acceleration method).										
References	• F. P. Beer, E. R. Johnston, D. F. Mazurek, P. J. Cornwell, Vector Mechanics for Engineers: Statics and Dynamics, 10th edition (2013). • Hibbeler, R. C. Engineering Mechanics: Statics and Dynamics, 10th Edition. Upper Saddle River, New Jersey: Prentice Hall, (2003).										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	PE/OE	St. Act.	Final
FRB 005	Waves and Heat	-	3	2	2	1	5	30	20	10	40
Course Contents	Simple harmonic motion, Wave motion, Sound waves, Superposition of waves, Interference of light waves, Diffraction of light, First law of thermodynamics, Kinetic theory of gases, specific heats of gases, thermodynamic processes: isochoric, isobaric, isothermal and adiabatic, Heat transfer: conduction, convection and radiation, Elasticity, Hooke’s law, Hydrostatics and surface tension, Hydrodynamics and Viscosity.										
References	• R. A. Serway and J. W. Jewett, Physics for scientists and engineers: Cengage learning, 2018. • Tarek M. Abdolkader, Mohamed Elfaham, Mina Asham, Ibrahim Sayed, Walid Selmy, • D. Halliday, et al., Fundamentals of physics: John Wiley & Sons, 2013. • D. Giancoli, Physics for Scientists & Engineers with Modern Physics, 4th Edition ed. Pearson, 2008.										
Laboratory	• Simple harmonic motion • Waves in stretched string. • Sound waves. • Interference and diffraction of light • Polarization of light • Specific heat • Thermistor and thermal conductivity.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	PE/OE	St. Act.	Final
FRB 006	Electricity and Magnetism	-	3	2	2	1	5	30	20	10	40

Course Contents	Electric force and electric field, Motion of charge in electric field, Electric dipole, Gauss law and applications, Electric potential, Capacitors and dielectrics, Current and resistance, Magnetic field and magnetic force, Sources of magnetic field, Bio-Savart law and Ampere's laws, Electromagnetic induction and Faraday's law, Self-induction and magnetic energy.
References	• R. A. Serway and J. W. Jewett, Physics for scientists and engineers: Cengage learning, 2018. • Physics, Part II, Waves, Heat and Optics", 1st edition, 2022. • D. Halliday, et al., Fundamentals of physics: John Wiley & Sons, 2013. • D. Giancoli, Physics for Scientists & Engineers with Modern Physics, 4th Edition ed. Pearson, 2008.
Laboratory	• Ohm's Law • Wheatstone bridge & Metric bridge • Electric Field Mapping. • Capacitor Charging and Discharging • The Electric Transformer • Faraday's Law

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	PE/OE	St. Act.	Final
FRB 007	Chemistry for Engineers	-	4	3	2	1	6	30	20	10	40

urs e Co nte	Gaseous state- Liquid state - Solids - Chemical kinetics – Electrochemistry – Polymers.
References	• J. Brady, "General Chemistry, Principles and structures", Wiley Inc., Fifth Edition, 1990. • L. W. Fine, H. Beall, J. Stuehr, "Chemistry for Scientists and Engineering, Preliminary Edition, Brooks Cole; 1st edition, 1999. • Steven S. Zumdahl, "Chemistry Principles", Third Edition, Houghton Mifflin, 1998. • Prof. Elsayed Fouad, Engineering Chemistry I, II. • Steven S. Zumdahl, Susan A. Zumdahl "Chemistry" Seventh Edition, Houghton Mifflin, 2007. • P. Barnes, J.Bensted, Structure and Performance of Cements, CRC Press, 2nd Edition, 2019.
Laboratory	• Neutralization Reactions • Oxidation-Reduction Reactions • W/C Ratio • Precipitation Reactions

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	PE/OE	St. Act.	Final
FRM 008	Production Systems Engineering	-	2	1	3	0	4	30	20	10	40

Course Contents	Introduction, Types of industries, Casting processes: Main steps of sand casting, Pattern design, Melting of metals, Cleaning and inspection of casting, Metal forming processes: Forging, Rolling, Extrusion, Drawing, Bending, Joining Processes: Temporary and permanent joints, Welding techniques, Cutting Processes: Principles and elements of cutting processes, Basic cutting and machining (Turning, Drilling, Milling, etc.,..). Principles of production planning and control, Introduction to quality control.
References	• Jiangshan Li, Semyon M. Meerkov, 2008, “Production Systems Engineering”, Springer; 1st ed. 2009 • M. P. Groover, 2011, "Principles of Modern Manufacturing", 4th Ed., john Wiley & Sons, Inc.
Laboratory	• Practicing the workshop measuring operations and tools • Practicing the sand-casting workshop • Practicing the welding workshop; electric arc welding, gas welding and cutting, and electric resistance • Practicing the machining workshop; turning, shaping, drilling, milling, and grinding • Practicing the metal forming workshop; rolling, bending, drawing, and extrusion • Practicing the carpentry workshop • Practicing the forging workshop

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
FRM 009	Engineering Drawing	-	2	0	0	4	4	30	20	10	40

Course Contents	Engineering drawing techniques and skills. Conventional lettering and dimensioning. Geometric constructions. Theories of view derivation. Orthographic projection of engineering bodies. Derivation of views from isometric drawings and deducing of missing views. Sectioning views: (full, half, offset, partial, revolved, removed, and partial sectioning). Steel construction, Symbols of electrical circuits.
References	• William Chalk, Goetsch, "Technical Drawing", Delmar technical graphics series, 6th edition, 2010. • Allbert W. Boundy, "Engineering Drawing", McGraw-Hill Australia, 2012.

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>Mid 2</th><th>St. Act.</th><th>PE/OE</th></tr>
<tr><td>FRM 010</td><td>Engineering Drawing by Computer</td><td>FRM 009</td><td>2</td><td>1</td><td>2</td><td>0</td><td>3</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Introduction to Computer Aided Drafting, history, advantages, and limitation. Graphics/CAD involves the visualization, sketching, and geometric construction of mechanical components. Layout and creation 2D working industrial drawings that adhere to industry standards. Illustrate CAD drawing construction techniques, implementation of graphical communication through the use of the alphabet of lines, orthographic projection, section views, auxiliary views and the creation of assembly and detail mechanical components.</td></tr>
<tr><td rowspan="2">References</td><td colspan="11">• William Chalk, Goetsch, "Technical Drawing", Delmar technical graphics series, 6th edition, 2010.</td></tr>
<tr><td colspan="11">• Allbert W. Boundy, "Engineering Drawing", McGraw-Hill Australia, 2012.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Student's engineering sketches and drawings carried out in the engineering Computer Labs.</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>Mid 2</th><th>St. Act.</th><th>PE/OE</th></tr>
<tr><td>FRE 012</td><td>Computer Programming Fundamentals</td><td>-</td><td>2</td><td>0</td><td>2</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Computer System: Hardware, Software - Introduction to software design - evolution and comparison of programming languages - types and characteristics of translators - Program Design Process - Software Life Cycle - structured programming - Variables, Constants - Input and Output - Data Types and Representation - Simple Flow - Flow of Control (Conditioning, Iteration) - Array - Functions (Predefined - Programmer Defined) - Pointers- Strings - program maintenance & testing – documentation.

Course topics are explained using a high-level language (as C, or C++).</td></tr>
<tr><td rowspan="4">References</td><td colspan="11">• W. Savitch, "Problem Solving with C++" 10th Edition, Pearson, 2018.</td></tr>
<tr><td colspan="11">• K.N. King, “C Programming: A modern Approach”, 2nd edition, W.W. Norton & Company, 2008.</td></tr>
<tr><td colspan="11">• C.R. Severance, S. Blumenburg, "Python for Everybody: Exploring Data in Python 3", CreateSpace Independent Publishing Platform, 2016.</td></tr>
<tr><td colspan="11">• R. Sedgweck, K. Wayne, "Introduction to Programming in Java: An Interdisciplinary Approach (2nd Edition)", Addison-Wesley Professional, 2017</td></tr>
<tr><td>Laboratory</td><td colspan="11">Problem solving labs using high level language (C, or C++) to apply explained topics in each lecture including:
• Flowcharts, Data Types, Variable, Constant declaration. Input and Output
• Sequence Flow program, Conditioning Statements (if, nested if and switch case)
• Iteration Statements (for, while do while, Do Until, and nested loops)
• Arrays (1D and 2D arrays), Functions (predefined and user defined)
• Pointers, Strings and string functions, * Project:
At the end of the course the student must provide a project emphasizing the course content</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	PE/OE	St. Act.	Final
FRB 103	Environmental Pollution and Industrial Safety	FRB 007	2	2	1	0	3	30	20	10	40

Course Contents

- Air pollution-Adverse effects -ozone depletion – green house effects- Acid rain and global warming - measurement and control methods.

- Water pollution- constituents of wastewater- primary treatment: various pre-treatment methods - Advanced Treatment: chemical oxidation, precipitation, air stripping

Construction Engineering and Managment students: Plan and manage construction health and safety, maintain safety issues for construction to introduce the foundations on which appropriate health and safety systems may be built. Occupation and health and safety affect all aspects of work. Legal framework for health and safety.

Electromechanical Engineering students: Hazards analysis-Hazards of pressure , uses of over pressure-hazards of temperature-HAZOP study regarding pressure, temperature & flow -static electricity & its control purging and inerting -relief valves and rupture disks-venting – flame arrester -flare system-alarms and types of alarms and its application-trips d interlock system-hot work permit , confined space vessel work permit & height work permit - personnel protective equipment-On-site &Off-site emergency plan.

Electric shock and burns from live wire contact, Fires from faulty wiring, overloading circuits, leaving electrical parts exposed, Electrocution or burns from lack of PPE, Explosions and fires from explosive and flammable substances, Contact with overhead power lines Electrical exposure to water.

References

- Handbook of “Industrial Safety and Health, Trade and Technical Press Ltd. Morden, U.K.1980.
- S.P.Mahajan, “Pollution Control in Process Industries” Tata McGraw Hill, NewDelhi1985.

Laboratory

- Air sampling
- Water sampling
- Adsorption
- Precipitation

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
FT 103	Field Training I	*	0	0	0	0	0	-	-	-	Pass or Fail

Course Contents

Time of training: not less than four weeks
Field training conducted under the supervision of a faculty member and field mentor in the actual field practice. The student must submit a detailed technical report by the end of training period, explain what he learned during this training.

By the end of the training the student will be able to:
Apply the principles knowledge to execute practical engineering field works.
The students will have the opportunity to work with multidisciplinary teams during the training period.

* Completion of 65 Cr. Hrs.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
FT 203	Field Training II	*	0	0	0	0	0	-	-	-	Pass or Fail
Course Contents	Time of training: not less than four weeks Field training conducted under the supervision of a faculty member and field mentor in the actual field practice. The student must submit a detailed technical report by the end of training period, explain what he learned during this training. By the end of the training the student will be able to: Apply the principles knowledge to execute practical engineering field works. The students will have the opportunity to work with multidisciplinary teams during the training period.										

* Completion of 96 Cr. Hrs.

Program Requirements

Compulsory Courses

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
FRB 101	Engineering Differential Equations	FRB 002	3	2	0	2	4	30	20	10	40
Course Contents	**Basic Concepts of Ordinary and Partial differential equations (ODEs & PDEs):** Oder, Degree, Linearity, Formation, Geometric and physical applications (Newtons law of cooling, electric circuits), Types of solutions, Existence and uniqueness of solutions. **ODEs:** Solution of first order ODEs (Separable, Homogeneous, Exact, Integrating factor, Linear and Bernoulli equations). Orthogonal trajectories. Solution of nth order ODEs (homogeneous and non-homogeneous). System of first order linear differential equations. Laplace transforms and inverse Laplace transforms with applications. Fourier series with applications. Gamma and Beta functions **PDEs**: Solution of linear PDEs with constant coefficients, solution of some initial-boundary value problems. Solution of PDEs by Laplace Transforms.										
References	• Morris Tenenbaum, Harry Pollard, "Ordinary Differential Equations: An Elementary Textbook for Students of Mathematics, Engineering, and the Sciences", Dover Publications, Last Edition. • Wei-Chau Xie, Differential Equations for Engineers, CAMBRIDGE UNIVERSITY PRESS, 2010.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	PE/OE	St. Act.	Final
FRB 201	Applied Engineering Probability and Mathematical Statistics	FRB 002	3	2	2	0	4	30	20	10	40
Course Contents	**Probability:** Basic Theorems of Probability. Conditional Probability. Independent Events. Discrete and Continuous Random Variables. Mean and Variance of Distributions. Discrete Distributions (Binomial, Poisson and Hypergeometric Distribution). Continuous Distributions (Normal and Exponential Distribution). Distributions of Several Random Variables (Discrete and Continuous Two-Dimensional Distributions). **Mathematical Statistics:** Random Sampling. Sample mean and variance. Point Estimation of Parameters. Confidence Intervals. Simple and multiple Linear Regression and Correlation. Testing of Hypotheses. Markov chains. Quality Control. Engineering Applications. Lab simulations of engineering applications.										
References	• R. E Walpole, R. H. Myers, “Probability and Statistics for Engineers and Scientists", Macmillan Publishing, Last Edition. • David Levine, Patricia Ramsey , Robert Smidt, “Applied Statistics for Engineers and Scientists: Using Microsoft Excel & Minitab”, First Edition, 2000.										
Laboratory	• Lab simulations by software’s as (Excel, Matlab, Python,…)- Exploratory data analysis and data transformation (Tabulated data summaries and statistics, Histograms, Box and Correlation plots, Computation of means, variances, etc, Missing data imputation)- Simple random sampling with and without replacement- Stratified random sampling- Simulating Bernoulli process and Poisson distribution - Simulating Markov chains applications-Binary and sequential hypothesis testing and gambler's ruin -Gaussian Mixture Models, clustering and anomaly detection- Regression models and inference- Time series forecasting and ARIMA models.										

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>PE/OE</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>FRB 104</td><td>Engineering Numerical Analysis</td><td>FRB 101</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Numeric in General: Solution of linear systems by iterative methods (Jacobi Iteration, Gauss–Seidel Iteration Method, Convergence and Matrix Norms). Solution of nonlinear equations (Fixed-Point Iteration, Newton–Raphson’s method, Sufficient Convergence Condition). Curve fitting (Least square method). Interpolations (Lagrange Interpolation, Newton’s Forward and Backward Interpolations). Numerical differentiation. Numerical integration (Rectangular Rule, Trapezoidal Rule, Simpson’s Rule).

Numeric for ODEs and PDEs: Solution of first-order ODEs (Euler’s method, Runge–Kutta Methods). Solution of higher order ODEs. Boundary and initial-boundary value problems for ODEs, Elliptic and parabolic PDEs (Finite difference methods, Explicit method, Crank–Nicolson Method). Lab simulations of engineering applications.</td></tr>
<tr><td>References</td><td colspan="11">• R W Hamming, "Numerical Methods for Scientists and Engineers", Courier Dover Publications, Last Edition.
• Steven C. Chapra, “Applied Numerical Methods with MATLAB for Engineers and Scientists”, Mcgraw-Hill, 3rd edition.
• Nita H. Shah, Numerical Methods with C++ Programming, PHI Learning, 2008.</td></tr>
<tr><td>Laboratory</td><td colspan="11">Lab simulations by software’s as (C++, Matlab, Python…)- Simulating practical technical problems- linear equations due to electric circuits, truss and spring mass systems. - Electric charge calculations- Nonlinear structural problems- Deflection of nonlinear springs- Calculating the shrinkage of a trunnion- Finding the longitudinal Young’s modulus -Estimating voltage drop on a resistor- Calculating the work done by stretching a string- Simulating equations due to the fluid continuum problems, DC motor speed control problems- interpolation and fitting for signals and voltage current relations- population growth calculations- Fluid flow rate calculations- Distributed wind force problems.</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>PE/OE</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>FRB 102</td><td>Water Chemistry</td><td>FRB 007</td><td>3</td><td>2</td><td>2</td><td>-</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">This course aims to provide an introduction of equilibrium chemistry principles in aquatic systems. This course is designed for engineering students who are often required to understand the composition of solutions and direction of changes during treatment or in environmental systems. By completion of the course, the student will be able to interpret and communicate results related to water quality. Therefore, the course syllabus includes the following topics: equilibrium principles of acids-bases, dissolution-precipitation, titration, gas-liquid equilibrium, oxidation-reduction, complexation and water quality analysis and quality control.</td></tr>
<tr><td>References</td><td colspan="11">• Sawyer, McCarty & Parkin, Chemistry for Environmental Engineering, McGraw Hill, 2003
• Stumm & Morgan, aquatic Chemistry. Third edition, John Wiley&Sons. 1995</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Acid – base titration
• Total hardness,
• Total alkali,
• Conductivity,
• Total dissolved solids</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>Mid 2</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>CMC 101</td><td>Structure Analysis 1</td><td>FRB 003</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Loads and reactions – Stability of structures (external and internal) – Straining actions in Statically determinate structures- Normal stresses – Shear stresses (pure shear, torsional) – Combined stresses. Elastic deflection of determinate structures (double Integration method and virtual work method).</td></tr>
<tr><td>References</td><td colspan="11">• Structural Analysis by Russell C. Hibbeler, Pearson, 9th Edition, 2014, ISBN-13:978-0-13-394284-2.
• "Solved Examples in Determinate Structures", Dar-Elmaarefa, Egypt, Dr. Ahmed Youssef Kamal El-Deen, ISBN 21638/2016
• George, N. Frantziskonis. “Essentials of the Mechanics of Materials, Second Edition”. USA: Destech Publications, Inc. 2013. ISBN 13: 9781605950983
• Pytel, A. and Kiusalaas, J. “Mechanics of Materials Second Edition”. Cengage Learning2012. ISBN-13: 978-0-495-66775-9</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 102	Structure Analysis 2	CMC 101	3	2	0	2	4	30	20	10	40
Course Contents	Analysis of statically indeterminate structures (Three moment equations). Analysis of statically indeterminate structures: Force approach (Consistent deformation method). Displacement approach (Slope deflection Method, Moment distribution method). Introduction to Matrix Structural Analysis for 1-D element using Stiffness method (Truss, Beam, and frame elements).										
References	• Aslam Kassimali , "Structural Analysis" Stamford USA: Cengage Learning, 4th Si Edition, 2011, ISBN-13: 978-0-495-29567-9 • Aslam Kassimali, "Structural Analysis", Stamford USA: Cengage Learning, 6th Si Edition, 2019, ISBN-13: 978-1337630948 • Jack C. McCormac, "Structural Analysis Using Classical and Matrix Methods", John Wiley & Sons, Inc, 4th Edition, 2007, ISBN-13: 978-0470036082.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	PE/OE	St. Act.	Final
CMC 103	Properties and Testing of Construction Materials	FRB 003	2	2	1	0	3	30	20	10	40
Course Contents	Stress and strain - Types of tests - Testing machines - Strain gauge devices - Static tension test - Static compression test - Bending test - Shear test - Torsion test - Hardness test - Fatigue test - Impact test - Metals creep test.										
References	• Mechanics of Materials, James M. Kere & Barry J. Goodno, CENGAGE Learning, ISBN-13: 978-1111577735 / ISBN-10: 1111577730. • Strength of Materials, S. S. Bhavikatti,Vikas, Vicas, ISBN-13: 978-9325971578, ISBN-10: 9325971577. • A Textbook of Strength of Materials, Dr R.K. Bansal, LAXMI PUBLICATIONS (P) LTD, ISBN-10: 9788131808146 / ISBN-13: 978-8131808146. • المواد الهندسية مقاومتها واختبارها (الجزء الأول والجزء الثاني)، ا.د. احمد العريان - ا.د. عبد الكريم عطا • مقاومة واختبار المواد، د. عبد الوهاب محمد عوض - د. إبراهيم على درويش. • المواصفات القياسية المصرية.										
Laboratory	• Static tension test. • Static compression test. • Bending test. • Hardness test. • Impact test.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	PE/OE	St. Act.	Final
CMC 104	Construction Materials and Concrete Technology	CMC 103	3	2	2	1	5	30	20	10	40

Course Contents

Types and properties of construction materials. Aggregate types, sources and quality, cements. Introduction to fiber reinforced polymers. Steel in construction, insulation materials and coatings. Concrete mix design, admixtures. Asphalt cement, asphalt concrete mix design. Concrete manufacture. Properties of fresh concrete. Properties of hardened concrete. Durability of concrete. Non-destructive testing. Special concretes.

References

- للكود المصري لتصميم وتنفيذ المنشآت الخرسانية – 203.
- الملحق الثالث للكود المصري لتصميم وتنفيذ المنشآت الخرسانية (دليل الاختبارات المعملية لمواد الخرسانة).
- Building Materials, S. K. Duggal, Routledge, ISBN-10: 8122433790 / ISBN-13: 978-8122433791.
- Concrete Technology, AM Neville, JJ Brooks, Longman, ISBN-10: 0273732196, ISBN-13: 978-0273732198.
- Properties of Concrete and Structures, P.K. Mehta, Prentice Hall, ISBN-10: 0131671154, ISBN-13: 978-0131671157
- Materials of construction, R.C. Smith, McGraw-Hill, ISBN-10: 0070584761, ISBN-13: 978-0070584761.

Laboratory

- Specific surface area of cement, Setting time of cement, compressive strength of cement.
- Sieve analysis of coarse and fine aggregate, bulk density of aggregate – specific weight of aggregate.
- Coarse aggregate crushing value, Los Angles abrasion value of coarse aggregate.
- Compression test.
- Compacting factor test, Slump test.
- Compressive strength test - Splitting tensile strength test – Modulus of rupture test.
- Rebound hammer test - Ultrasonic Pulse velocity test.

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>PE/OE</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>CMC 105</td><td>Surveying for Engineers-1</td><td>FRB 002</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Principles of plane surveying; distances measurements (Optical, Electronic), angle and direction measurements; traverse computations; Coordinate systems for engineering works, setting out horizontal and vertical curves; earthwork computation; setting out engineering structures and construction projects, Levelling (theory, methods, and equipment)</td></tr>
<tr><td>References</td><td colspan="11">• Elementary Surveying - An Introduction to Geomatics -Thirteenth Edition-2012-CHARLES D. GHILANI-ISBN-13: 978-0-13-255434-3- ISBN-10: 0-13-255434-8
• Surveying for Civil and Mine Engineers Theory, Workshops, and Practicals-John Walker Joseph L. Awange- 2018-ISBN 978-3-319-53128-1- ISBN 978-3-319-53129-8 (eBook)
• Surveying Engineering & Instruments- Valeria Shank- First Edition-2012- ISBN 978-81-323-4403-2</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Distance measurements
• Theodolite parts and calibration
• Survey levelling instruments and height determination
• Total station parts & software
• Coordinates by Total Station
• Lay out and setting out by Total Station</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>Mid 2</th><th>St. Act.</th><th>PE/OE</th></tr>
<tr><td>CMC 106</td><td>Construction Engineers Drawing</td><td>FRM 010</td><td>2</td><td>1</td><td>3</td><td>0</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Introduction to BIM in Autodesk Revit. Model creation, view creation, in Revit. Geometrical Constructions; two- dimensional drawing, sketching for creating solid models. Introduction to solid Modeling in Autodesk Inventor, creating solid model of structures in Autodesk Inventor environment. Creating orthographic views from a solid model in AutoCAD.</td></tr>
<tr><td>References</td><td colspan="11">• A Textbook of Engineering Drawing: Along with an Introduction to AutoCAD, International Publishing House, 2015. ISBN 9789384588687.
• BIM and Construction Management: Proven Tools, Methods, and Workflows. Hardin and McCool, 2nd edition, Wiley 2015.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• BIM and Construction Management.
• BIM and Facility Management
• Draw plan and elevation views of a building in AutoCAD environment.
• Create solid models of objects; objects in basic shapes, custom built components, building models etc. using the tools of AutoCAD.</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMA 107	Basic Architectural Engineering	FRM 009	2	1	0	2	3	30	20	10	40
Course Contents	Architectural engineering drawings is the language that is used to describe the size and shape of buildings. The course will enable the student to understand and use the architectural drawings language. It is designed to introduce the students the concepts, practices, standards, and drafting techniques needed for architectural design.										
References	• Ching, Francis D. K. (2014). Form, Space, and Order, (4th Edition). New Jersey: John Wiley & Sons Inc, ISBN: 978-1-118-74508-3 • Zell, Mo (2018). Architectural Drawing Course: Tools and Techniques for 2-D and 3-D Representation, (2nd Edition), B.E.S., ISBN 13: 9781438011158										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Le ct.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 108	Surveying for engineers 2	CMC 105	3	2	0	2	4	30	20	10	40
Course Contents	Introduction to geodesy; Coordinate systems, Map projections, GNSS system concepts and characteristics, signal structure, receivers and antennae; GNSS measurements, GNSS time, error sources and measurement accuracy; position determination techniques – Errors Reduction Techniques, single point and differential positioning, static and kinematic GNSS, post-processing and Real-time processing, DGNSS concepts.										
References	• PRECISION SURVEYING The Principles and Geomatics Practice-JOHN OLUSEGUN OGUNDARE-2015-ISBN 978-1-119-10251-9 • Geodesy- Introduction to Geodetic Datum and Geodetic Systems-Zhiping Lu - Yunying Qu - Shubo Qiao-2014-ISBN 978-3-642-41244-8- ISBN 978-3-642-41245-5 (eBook) • ENGINEERING SATELLITE-BASED NAVIGATION AND TIMING-Global Navigation Satellite Systems, Signals, and Receivers-John W. Betz-2016-ISBN: 978-1-118-61597-3										

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid</th><th>PE/OE</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>CMC 109</td><td>Fluid Mechanics</td><td>FRB 005</td><td>2</td><td>2</td><td>1</td><td>0</td><td>3</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Dimensions and Units - Fluid Properties - Fluid Statics (Pressure distribution - Pressure measurements - Forces on submerged surfaces) - Buoyancy and Floatation - Fluids in Relative Equilibrium - Fluid Kinematics (Description of Fluids motion - Continuity Equation - Velocity and Acceleration) - Fluid Dynamics (Energy Equation - Applications of Bernoulli's Equation) - Impulse-Momentum Equation - Application of the Momentum Equation - Flow in Pipes – Pipes Systems.</td></tr>
<tr><td>References</td><td colspan="11">• A Brief Introduction to Fluid Mechanics, sixth Edition by Donald F. Young, Bruce R. Munson, Theodore H. Okiishi, Wade W. Huebsch, Wiley 2010, ISBN: 0470596791, 9780470596791
• E. Shashi Menon, "Liquid Pipeline Hydraulics", Marcel Dekker, 2004.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Determine Densities, Specific Gravities, Weights and Viscosity.
• Bernoulli’s Theorem Demonstration.
• Flow through sharp edged Orifice.
• Flow over Rectangular and Triangular Weirs.
• Friction in a smooth bore pipe, Minor loss Experiment.</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>Mid 2</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>CMA 110</td><td>Building Construction</td><td>CMA 107</td><td>2</td><td>2</td><td>0</td><td>1</td><td>3</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">The course aims to introduce students the relation between architectural designs and building components. It provides a fundamental understanding how to create the different basic elements of the building construction and provides the students with the basic knowledge of: Building Construction Stages, Wall bearing and Skeleton Structures, Stone construction, Masonry- raw bricks & brick masonry, Stairs detailing internal and external finishing materials.</td></tr>
<tr><td>References</td><td colspan="11">• McKay, W. B. (2005). Building Construction Metric Vol. I–IV. 4th Ed. Mumbai: Orient Longman.
• Ching, Francis D. K. (2019). Architectural Graphics (6th Edition). New Jersey: John Wiley & Sons Inc.</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
CMC 112	Hydraulics for Construction Engineers	CMC 109	2	2	1	0	3	30	20	10	40
Course Contents	Basic Principles (open channel flow) - Uniform Flow (Basic equations for steady uniform flow - Velocity and shear stress distributions in open channels) – Non-Uniform Flow (Specific energy - Hydraulics of channel bed transition) - Hydraulic Jumps - Gradually Varied Flow - Open Channel Design (Rigid boundary and erodible channel) - Dimensional analysis and Similarity (Methods of dimensional analysis - Model analysis and similarity) – Hydraulics Machinery (Pumps and Turbines)										
References	• Chadwick, A., Morfett, J. and Borthwick, M. (2021), Hydraulics in Civil and Environmental Engineering, 6th Edn., Published June 8, 2021, by CRC Press. ISBN 9780367460891. • Strum, W. T., (2001). Open Channels Hydraulics, McGraw-Hill Higher Education, USA. • Wynn P. (2014), Hydraulics for Civil Engineers by, ICE Publishing. First Edition. ISBN-13: 978-0727758453.										
Laboratory	• Open Channel Flow • Hydraulic Jump • Pump Characteristics										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 201	Hydrology and Water Resources	CMC 112	3	2	0	2	4	30	20	10	40
Course Contents	Introduction to water balance and hydrological cycle, Precipitation, Evaporation, Transpiration, Infiltration, Runoff, Hydrograph. Steam flow measurements, Hydrograph analysis, flood routing, storage operations. Hydrology of the Nile basin, Nile water resources. Major projects constructed on the river Nile and suggested storage projects. Water problems in Egypt, water scarcity, water resources in Egypt, Renewable Water Resources conventional resources, and non-conventional water resources. Principles of water resources assessment. Economics and assessment principles of water projects.										
References	• Mays, L.W., Ground and surface water hydrology. John Wiley & Sons, Inc., 2012. ISBN: 978-0-470-16987-2 • Waller P, Yitayew M, Irrigation and Drainage Engineering, Springer 2016. ISBN: 978-3-319-34631-1 • Loki Radoslav, Water Resources Engineering, 2011, Publisher: Pon Press, ISBN 6137819787.by Loki Radoslav										

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid</th><th>PE/OE</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>CMC 202</td><td>Transportation and Traffic Engineering</td><td>FRB 201</td><td>3</td><td>2</td><td>1</td><td>2</td><td>5</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Transportation Planning:
Introduction to transportation planning - Study area - Transportation planning surveys - Travel demand forecasting (Trip generation - Trip distribution - Modal split (Mode Choice) - Traffic assignment) - Transportation evaluation
Traffic Engineering:
Introduction (Road user characteristics - Vehicle characteristics) - Traffic volume - Traffic speed - Traffic density - Travel time and delay studies - Traffic Flow characteristics - Parking studies - Traffic control devices - Intersection control - Traffic signals design.</td></tr>
<tr><td>References</td><td colspan="11">• Traffic and Highway Engineering, Nicholas Garber and Lester Hoel, Fifth Enhanced SI Edition, CENGAG Learning, 2020, ISBN-13: 978-1-337-63104-4.
• الكود المصرى للطرق – 2016 .</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Traffic surveys (traffic volume count)
• Speed & delay study
• Parking study
• Roadside and household interviews.</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid</th><th>PE/OE</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>CMC 203</td><td>Soil Mechanics</td><td>CMC 103</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Introduction to Geotechnical Engineering - Definitions and Relationships - Index Properties of Soil - Soil Classification Systems (Unified – British) - Permeability and Seepage of Soil (Darcy's Law - Capillarity in Soils - Flow Net Analysis) - Stress Distribution in Soil (Point load – Uniform Load (Newmark – Fadum - Approximation)) - Shear Strength of Soil (Direct Shear Box - Triaxial– Unconfined Compression) - Lateral Earth Pressure (Active and Passive) - Soil Compaction (Standard Proctor - Modified Proctor).</td></tr>
<tr><td>References</td><td colspan="11">• El-Kasaby, E. A., Soil Mechanics, Dar Al-Kutub Al-Almia, Cairo, 5th Ed., (21371/2013), ISBN 978 – 977 – 726 – 041 – 1, 2014.
• Das, B. M, Soil Mechanics Laboratory Manual, Oxford University Press, 9th. Ed., ISBN 978 – 019 – 020 – 966 – 7, 2016 .</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Specific Gravity Determination.
• Atterberg Limits (Liquid Limit – Plastic Limit – Shrinkage Limit).
• Grain Size Distribution - Coarse Grained Soils. (Sieve Analysis).
• Grain Size Distribution - Fine Grained Soils (Hydrometer Analysis).
• Determination of Natural Unit Weight of Soil (Sand Bottle Test - Core Cutter Test).
• Constant Head Permeability Test.
• Falling Head Permeability Test.
• Direct Shear Box Test.
• Tri-axial Shear Test.
• Unconfined Shear Test.
• Standard Proctor Test.
• Modified Proctor Test.</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
CMC 204	Geotechnical Engineering & Foundations	CMC 203	3	2	2	1	5	30	20	10	40
Course Contents	Soil Consolidation and Settlement (Soil Consolidation Theory - Primary and Secondary Settlement - Oedometer Test) - Bearing Capacity of Soil (Terzaghi Eq. - Mayerhof Eq. – Egyptian Code Eq.) - Shallow Foundations (Construction Considerations - Design Considerations) - Design of Isolated Footings (Square and Rectangular Footings – Footing with Moment) - Design of Strip Footings - Design of Combined Footings - Design of Strap Beam Footings – Design of Rafts (Conventional Method – Ribbed Raft).										
References	• El-Kasaby, E. A., Soil Mechanics, Dar Al-Kutub Al-Almia, Cairo, 5th Ed., (21371/2013), ISBN 978 – 977 – 726 – 041 – 1, 2014. • El-Kasaby, E. A., Engineering of Surface Foundations, Dar Al-Kutub Al-Almia, Cairo, 5th Ed., (19440/2015), ISBN 978 – 977 – 726 – 139 – 5, 2015. • Das, B. M, Principles of Foundation Engineering, Brooks - Cole, 9th. Ed., ISBN 978 – 133 – 770 – 502 – 8, 2017.										
Laboratory	• One Dimensional Consolidation Test (Oedometer Test). • SPT: Standard Penetration Test. • CPT: Cone Penetration Test. • Plate Loading Test.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 205	Design of Metallic Structures-1	CMC 102	3	2	0	2	4	30	20	10	40
Course Contents	Steel as a construction material - Material properties and steel sections - Allowable Stress Design method - Design of tension members - Design of compression members - Columns in braced and unbraced frames - Design of flexural members - Types and classification of beam cross sections - Design of laterally supported and unsupported beams - Design of beam-columns (axial and flexural forces) - Design of bolted connections - Design of welded connections.										
References	• Egyptian code for design of steel structure. • Advanced Steel Design of Structures, by Prof. Srinivasan Chandrasekaran, Indian Institute of Technology, India. ISBN-13 9780367232900 • Steel Designers' Manual, by (Steel Construction Institute), Edited by Buick Davison and Graham W. Owens, ISBN-13 9781119249863 • Design of Metallic Structures, EHAB ELLOBODY, RAN FENG, BEN YOUNG, 2014, ISBN: 978-0-12-416561-8										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 206	Construction Project Management	-----	3	2	0	2	4	30	20	10	40
Course Contents	Introduction to construction project management, need for project management, project definition, project life cycle, project success factors, key roles and tasks of construction project participants, construction project organizational structure, the project team, project site management, preparation of construction method, safety and health roles in construction projects.										
References	• Author: Paul Netscher "Construction Management: From Project Concept to Completion" CreateSpace Independent Publishing Platform (October 2017), ISBN-10: 1975934342, ISBN-13: 978-1975934347										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 207	Design of R.C. Structures-1	CMC 102 +CMC 104	3	2	0	2	4	30	20	10	40
Course Contents	Properties of concrete materials - Ultimate limit states design method - Design of sections under pure bending moment (Rectangular, L & T - sections) - Load distribution – Design of section under shear – Design simple and continuous beams - Design of one-way and two-way solid slabs - Design of hollow block slabs - Design of panelled beams.										
References	• Egyptian Code for Design & Construction of Reinforced Concrete Structures – ECOP 203-2018 • Design of Concrete Structures, Arthur H Nilson, D.Darwin, Charles W. Fifteenth Edition,2016. • Design of reinforced concrete structures, Mashhour Ghoneim, Mahmoud Elmihilmy, Volume I, second edition, 2012. • Design of reinforced concrete structures, Mashhour Ghoneim, Mahmoud Elmihilmy, Volume 2, Third edition, 2012. • Fundamentals of Reinforcement Concrete and Prestressed concrete, M.Hilal, 1987.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 208	Design of R.C. Structures-2	CMC 207	3	2	0	2	4	30	20	10	40
Course Contents	Design of flat slabs - Design of sections subjected to bending moment and axial force - Analysis and design of columns – Design of RC frames -Design of Sections under Torsion- Serviceability limit states (deflection - crack width).										
References	• Egyptian Code for Design & Construction of Reinforced Concrete Structures – ECOP 203-2018 • Design of Concrete Structures, Arthur H Nilson, D.Darwin, Charles W. Fifteenth Edition,2016. • Fundamentals of Reinforcement Concrete and Prestressed concrete, M.Hilal, 1987. • Design of reinforced concrete structures, Mashhour Ghoneim, Mahmoud Elmihilmy, Volume 2, Third edition, 2012. • Design of reinforced concrete structures, Mashhour Ghoneim, Mahmoud Elmihilmy, Volume 3, First edition, 2011.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMA 210	Introduction to City Planning	----	2	2	0	1	3	30	20	10	40
Course Contents	The course aims to provide an introduction to understand the theoretical and practical skills of planning, its components, and problems by providing a historical and critical look. The course aims also to raise students' awareness on urban issues and problems. Throughout the course students will also become familiar with land use and spatial/physical components of the built environment.										
References	• Cervero, R., Guerra, E., Al, S., (2017), Beyond Mobility, Planning Cities for People and Places, Island Press, Washington, DCISBN-13: 978-1610918343										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
CMM 301	Technical Installations in Buildings	-----	2	1	3	0	4	30	20	10	40
Course Contents	Thermal Comfort Heating. Ventilation & Air Conditioning. (HVAC), Central heating & Cooling Systems, Distribution Media, Delivery Devices. Heat and Moisture Transfer in Buildings, Lighting On-site power generation, Normal electrical systems. Special systems. Water supply & Drainage systems, types of fixtures, private sewerage systems, Fire protection systems, Architectural acoustics.										
References	• Building Technology: Mechanical and Electrical Systems- Architecture by Benjamin Stein, John Wiley & Sons, 2010.										
Laboratory	• A suitable Software for power distribution.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
CMC 302	Sanitary Engineering	CMC 112	3	2	2	1	5	30	20	10	40

Course Contents

Sources of pollution, Water resources and characteristics, Water quality, Water collection works, Water purification works, Water distribution works, Sewer systems, Wastewater characteristics, Wastewater treatment works, Wastewater disposal works, Treated wastewater reuse, Industrial wastes.

References

- Introduction to Environmental Engineering by Mackenzie Davis, David Cornwell, McGrawHill, Fifth Edition, 2012.

Laboratory

- Determine PH, Temperature, Total Solids (TS), Chloride, Nitrogen, Phosphorus, Heavy Metals, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), total bacteria account and Total coliform.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 303	Methods and Equipment for Construction	CMC 207	3	2	0	2	4	30	20	10	40

Course Contents

Techniques of building construction. Methods, materials, tools and equipment of construction. Traditional, mechanized and prefabrication construction systems. Selection of construction equipment. Applications on influence of construction methods on design and details. Evaluation and selection of appropriate construction technology. Sizing, operation and maintenance of construction equipment, design of temporary construction elements such as: concrete formwork, scaffolding systems, cofferdams. Type of cranes.

References

- Construction Technology Paperback English by Mr Roy Chudley, Roger Greeno, ISBN-13 9780131286429

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 304	Construction and Site Safety	CMC 303	2	2	0	1	3	30	20	10	40
Course Contents	Students acquire working knowledge of the construction hazards, safety precautions, and effective integration of safety regulations into the design and construction phases. Different types of construction related hazards including crane, equipment, and machinery, universal, access, construction, operation, and maintenance hazards together with methods to prevent them from happening are discussed										
References	• Construction Safety Engineering Principles (McGraw-Hill Construction Series): Designing and Managing Safer Job Sites, ISBN13: 9780071482448.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 305	Design and Construction of Foundations & Earth Retaining Structures	CMC 204	3	2	0	2	4	30	20	10	40
Course Contents	Pile Foundations (Types of Piles - Load Transfer Mechanisms - Static Capacity for Piles - Field Load Tests – Pile Group – Elastic Centre Method - Design of Pile Caps) - Introduction to Earth Retaining Structures - Pile wall (Secant piles - Tangent Piles - Bored Pile Wall) - Construction Techniques and Design of Retaining Walls (Cantilever RW – Counterfort RW) – Introduction to Reinforced Soil RW - SPW.										
References	• El-Kasaby, E. A., Design and Construction of Deep and Special Foundations, Dar Al-Kutub Al-Almia, Cairo, 4th Ed., (10651/2016), ISBN 978 – 977 – 726 – 168 – 5, 2016. • Das, B. M, Principles of Foundation Engineering, Brooks - Cole, 9th. Ed., ISBN 978 – 133 – 770 – 502 – 8, 2017. • Bowles, J., Foundation Analysis and Design, McGraw - Hill, 5th. Ed., ISBN 978 – 007 - 912 – 247 – 7, 2009.										

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid</th><th>PE/OE</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>CMC 306</td><td>Project Planning, Scheduling, and Control</td><td>CMC 206</td><td>3</td><td>2</td><td>1</td><td>2</td><td>5</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Concept of project planning, definition of planning techniques [Bar chart, arrow network, program evaluation and review technique (PERT), critical path method (CPM), line of balance technique (LOB)], Work Breakdown Structure (WBS), logic, networking by using CPM technique, scheduling and control models. Resource allocation and levelling, optimal schedules, documentation and reporting, time and cost control, progress monitoring and evaluation. Computer applications by primavera software package.</td></tr>
<tr><td>References</td><td colspan="11">• Textbook: Authors: Jimmie-Hinze " Construction Planning and Scheduling" Publisher: Prentice Hall; (International Ed.) 4th edition (January 2013), ISBN-13: 978-9332505735
• Reference: Daniel W. Halpin, Bolivar A. Senior, Gunnar Lucko “Construction Management” John Wiley & Sons, Inc., 5th Edition (August 2017), ISBN: 978-1-119-25680-9</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Computer applications by primavera software package.</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>Mid 2</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>CMC 307</td><td>Cost Engineering & Quantity Surveying</td><td>CMC 206</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Introduction to project cost estimate, Conceptual estimating, cost indices, Quantity take-off methods, estimating costs for construction material, labour, equipment, project overhead, mark-up and profit, unit costs, production rates, and pricing methods, balanced bid and budget form preparation for projects., and bid unbalancing.</td></tr>
<tr><td>References</td><td colspan="11">• David Bratt, Fundamentals of Construction Estimating, 4th edition, Cengage Learning; 4th edition (January 1, 2018), ISBN-13: 978-1337399395
• Martin Brook “Estimating and Tendering for Construction Work”, Taylor & Francis Ltd, 5th edition, (26 Jul 2016), ISBN13: 9781138838062</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	PE/OE	St. Act.	Final
CMC 308	Senior Design Project I	*	2	0	4	0	4	---	50	50	--
Course Contents	Topics are selected by groups of students according to their area of interest upon advisor approval. Projects address solution to open ended applications using an integrated engineering approach. Actual construction projects are selected by groups of students upon advisor approval for analysis. The management and technology aspects of construction are simulated and investigated.										
References	• According to the selected project.										
Laboratory	• According to the selected project.										

*According to the selected project.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 309	Quality Control & Inspection of Structures	CMC 207	2	2	0	1	3	30	20	10	40
Course Contents	Introduction to quality improvement techniques. Control charts for variables and attributes. Quality systems; 1SO 9000, 1SO 14000. Total quality management. Maintenance of structures. Inspection and its related subjects. Deterioration of structures, causes and investigation. Structural behavior and different repair techniques for different structural materials.										
References	• Concrete and Steel Construction: Quality Control and Assurance by Mohamed A. El-Reedy, CRC press, 2013										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
CMC 401	Project Finance & Management	CMC 307	3	2	1	2	5	30	20	10	40
Course Contents	Preparation of budgets. Type of budget. Classification of costs. Project cost accounting, time cost envelope (S-Curve), income and expenses cash flow forecasting, and cost of capital lock-up. The factors that affect capital lock-up. Economic assessments. Profitability measures. Inflation. Accuracy of future estimates. Financial modeling. Cost-benefit analysis. The financing of plant. Systematic plant selection										
References	• Daniel W. Halpin “Construction Management” textbook, John Wiley & Sons; 5th edition (August 7, 2017), ISBN-13: 978-1119256809.										
Laboratory	• Application by suitable software.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 403	Construction Project Specifications , Bids, and Contracts	CMC 307	2	2	0	1	3	30	20	10	40

Course Contents

Participants in a construction contract. Contract definition. Types of contracts; formation principles of a contract, performance or breach of contractual obligations. Analysis and comparison of the different kinds of construction contracts. Bidding logistics. Legal organizational structures. Different types and uses of specifications. Different forms of contracts utilized in construction.

References

- Daniel W. Halpin, Bolivar A. Senior, Gunnar Lucko "Construction Management" John Wiley & Sons, Inc., 5th Edition (August 2017), ISBN: 978-1-119-25680-9
- Will Hughes, Ronan Champion, John Murdoch "Construction Contracts Law and Management" Published by Routledge (Taylor & Francis), April, 2015 ISBN 9780415657044.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	PE/OE	St. Act.	Final
CMC 405	Senior Design Project II	CMC 308	3	1	4	0	5	---	50	50	--

Course Contents

Topics are selected by groups of students according to their area of interest upon advisor approval. Projects address solution to open ended applications using an integrated engineering approach.
Actual construction projects are selected by groups of students upon advisor approval for analysis. The management and technology aspects of construction are simulated and investigated.

References

- According to the selected project.

Elective Courses

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMA 311	Building Technology	----	3	2	0	2	4	30	20	10	40

Course Contents

Building technology of the main elements of building structural systems. Different structural systems will be addressed through describing and explaining their varied functions, types, materials, design considerations and execution techniques. (Reinforced Concrete structures, Pre-cast reinforced concrete construction, Steel structures)

References

- Ching, Francis D.K., Building Construction Illustrated, 4th edition, John Wiley & Sons, Canada, 2001.
- Fleming, E., Construction Technology - an illustrated introduction, 1st Edition, 2005, Blackwell publishing Ltd.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 310	Value Engineering in the Construction Industry	---	3	2	0	2	4	30	20	10	40

Course Contents

The value concept: history, definitions, application to the construction industry, incentive provisions in construction contracts, factors to be considered, application to design. Value engineering methodology: information phase, speculative phase, analytical phase, proposal phase, and final report phase. Value engineering study procedures: objective, selecting the input required, required documentation, life cycle cost methodology

References

- Building Information Modeling- A Strategic Implementation Guide for Architects, Engineers, Constructors, and Real Estate Asset Managers - Dana K. Smith, FAIA - 2009- ISBN 978-0-470-25003-7
- Value Engineering by Alphonse Dell'Isola, RSMeans, 1997

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 312	Engineering Economy	--	3	2	0	2	4	30	20	10	40

Course Contents

Foundations of Engineering Economy, Interest Factors, Nominal and Effective Interest Rates, Present Worth Analysis, Annual Worth Analysis, Rate of Return Analysis, Benefit/Cost Analysis, Breakeven and Payback Analysis, Replacement and Retention Decisions, Effects of Inflation, Estimating Costs, Depreciation Methods, After-Tax Economic Analysis, Multiple Attributes and Risk.

References

- Basics of Engineering Economy, Leland Blank & Anthony Tarquim, McGraw HILL, Third Edition, 2020, ISBN-13: 978-1260571141
- Engineering Economy, William G. Sullivan, Elin M. Wicks, & C. Patrick Koelling, Seventeenth Global Edition, Pearson, 2020, ISBN 13: 978-1-292-26490-5.
- Engineering Economy, Leland Blank & Anthony Tarquim, McGraw HILL, Eighth Edition, 2018, ISBN: 978-0-07-352343-9

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 313	Highway Facilities	CMC 202	3	2	0	2	4	30	20	10	40

Course Contents

Analysis of factors in developing highway transportation facilities, problems of highway geometric and design standards, planning and location principles, intersection design factors, structural design of pavement and highway maintenance.

References

- Traffic and Highway Engineering, Nicholas Garber and Lester Hoel, Fifth Enhanced SI Edition, CENGAG Learning, 2020, ISBN-13: 978-1-337-63104-4.
- الكود المصرى للطرق – 2016 .

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 314	Construction Quality Management	----	3	2	0	2	4	30	20	10	40
Course Contents	Overview of quality, quality in construction projects, quality management system. Quality improvement techniques, control charts for variables and attributes. Lot-by-lot acceptance sampling by attributes, acceptance sampling systems, cost of quality, assessment of quality, total quality management. Computers and quality control.										
References	• Abdul Razzak Rumane, "Quality Management in Construction Projects" book, Published by CRC Press of Taylor & Francis Group, 2nd edition, December 10, 2019, ISBN 9780367890032										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 315	Bridge Building Technology	CMC 208	3	2	0	2	4	30	20	10	40
Course Contents	A study of the unique design considerations, construction challenges, and load paths for a range of bridge types. Topics include fixed and moveable bridges, stringer/girder, steel truss, concrete slab, box girder, arch, suspension, and cable stayed bridges. Emphasis is placed on AASHTO loading and design requirements, load testing, and verification of unconventional materials. Covers case studies of bridges around the world.										
References	• Steel-concrete Composite Bridges by Nicholas J. Garber, Lester A. Hoel, ICE Publishing, 2013. • AISC Steel Design manual from CMCE 2315.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 316	Dynamic of Structures	CMC 102	3	2	0	2	4	30	20	10	40
Course Contents	Types of dynamic loads and the formulation of the equation of motion. Single degree of freedom systems, free and forced vibrations of multi degree of freedom systems. Response of structures to earthquakes. Design response spectra for structures, Design criteria for seismic resistant structures, Seismic response of tall buildings.										
References	• Dynamics of Structures by Anil K. Chopra, Pearson, 4 Edition, 2011.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 318	Design of Metallic Structures-2	CMC 205	3	2	0	2	4	30	20	10	40

Course Contents: Composite construction - composite floor beams (Strength requirement - shear connectors - formed metal deck) - Design of composite columns - Flexural design of slender sections - Connection classification and design (Flexible - Rigid – Semi rigid) - Design of base plates and anchor bolts – Introduction of Load and Resistance Factor Design (LRFD) - Identification of Limit states (Strength limit state and Serviceability limit state) - Design of tension, compression and flexure members using LRFD approach.

References:

- Egyptian Code of Practice for Steel Construction and Bridges (LRFD).
- Steel Design for Engineers and Architects, by David A. Fanella, Rene Amon, Bruce Knobloch, Atanu Mazumder, United States of America ISBN-13: 978-1-4615-9731-5.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 320	Prefabricated Water and Prestressed Concrete Structures	CMC 208	3	2	0	2	4	30	20	10	40

Course Contents: Prefabricated concrete: design methods, floor and roof systems, wall panels and construction joints. Concrete water structures: design considerations, water tightness. Construction of circular and rectangular tanks. Prestressed concrete: basic principles, methods and systems of prestressing, partial loss of prestressing, analysis and design for flexural, shear and bearing.

References:

- Reinforced Concrete: Mechanics and Design by James K. Wight, James G. MacGregor, Prentice Hall, 5 Edition 2008.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 407	Engineering for a Sustainable Environment	----	3	2	0	2	4	30	20	10	40

Course Contents: Solid, industrial and hazardous waste generation and control, with an emphasis on sustainable engineering practices such as environmental impact assessment and performance, waste management, pollution prevention, waste minimization, cleaner production, energy recovery, recycling and reuse.

References:

- Energy, the Environment, and Sustainability- Efstathios E. Michaelides - International Standard Book Number-13: 978-1-138-03844-8

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 409	Environmental Engineering	FRB 102	3	2	0	2	4	30	20	10	40
Course Contents	Introduction to environmental engineering, pollution problems, types of pollution, degrees of Pollution, sources of pollution, surface water pollution, groundwater Pollution, rainwater Pollution, sea & ocean water pollution, air pollution. Soil pollution, pollution control, pollution prevention. Samples conditions, chemical pollutions measuring in water, microbiological & biological pollution measuring in water, field pollution monitoring, environmental protection laboratory. Water supply, wastewater systems, solid waste management, air pollution. Solid waste management: collection, handling, separation and treatment, disposal, recycling, and reuse. Monitoring and control, noise, air pollution, environmental laws and its applications										
References	• An Integrated Approach to Environmental Management by Dibyendu Sarkar (Editor), Rupali Datta (Editor), Avinandan Mukherjee (Editor), Robyn Hannigan (Editor), Wiley, 2015.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 411	Special Topics in Structural Analysis	CMC 102	3	2	0	2	4	30	20	10	40
Course Contents	Elements of plate bending theory, circular plates, rectangular plates, large deflections of plates. Membrane stresses in shells, bending stresses in shells. Applications to pipes, tanks and pressure vessels.										
References	• Theory of plates and shells by S.S. Bhavikatti, 2016, ISBN-10 9386070812, ISBN-13 978-9386070814.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMC 413	Advanced Engineering Materials	CMC 104	3	2	0	2	4	30	20	10	40
Course Contents	Polymers and Epoxies, types, properties and applications of polymers concrete, Fibers, different types, of fibers reinforced concrete, properties, production and applications. Theory of failure of fiber reinforced concrete, Introduction of composite materials, Lightweight aggregate, natural and artificial aggregate, lightweight concrete, Insulating concrete, structural lightweight concrete, properties of lightweight concrete, design mixes of lightweight concrete, failure theories of lightweight concrete under different stresses, Massing and heavy concrete. Introduction of Egyptian and International Specifications.										
References	• Advanced Mechanics of Materials, by Arthur P. Boresi, Richard J. Schmidt, Omar M. Sidebottom, Wiley, 6 Edition, 2013.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMA 415	Finishing Materials Technology	----	3	2	0	2	4	30	20	10	40
Course Contents	Focus will be placed on various building materials and construction techniques based on performing standards and codes, with each material's application explored in detail. To teach students about different types of floors and flooring materials, as well as partitions and panels, different surface finishes, and different routes of vertical transportation. To provide students with knowledge of the most recent advancements in building construction methods and their applications.										
References	• Dean, Y, (2016), Materials Technology, 2nd Edition, Routledge, ISBN: 9781315504278 • Fernandez, J., (2005), Material Architecture: emergent materials for innovative buildings and ecological construction, 1st Edition, Architectural Press, ISBN-13: 978-0750664974										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
CMA 417	Principles and Approaches of Smart Cities	CMA 210	3	2	0	2	4	30	20	10	40
Course Contents	The course will introduce the concept, and technologies of smart cities in (e.g., transportation, buildings), and the concept of smart cities. Students will not only master the core technologies for building and implementing solutions for a smart and sustainable city during the course, but they will also gain an understanding of the problems that these solutions face. Students are urged to use critical thinking skills to accept technological solutions that will help cities become smarter and sustainable.										
References	• Komninos, N. (2014), The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities) • Li, X. (2012), Smart City on Future Life - Scientific Planning and Construction, Posts and Telecom Press ISBN-13 : 978-7115270634										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
CMC 419	Modeling and Simulation of Construction Systems	CMC 306	3	2	2	0	4	30	20	10	40
Course Contents	Building Information Modeling, Computer modeling of construction processes, 4-D Simulation of construction operations, Productivity modeling, measuring, and forecasting, Sequencing and coordination of construction systems, Post-Optimality Analysis of Integer and Linear Programming Models in construction, discrete event simulation of construction processes.										
References	• Suitable Software Manual.										
Laboratory	• Suitable Software.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
CMC 421	Geographic Information System GIS	CMC 108	3	2	2	0	4	30	20	10	40
Course Contents	Fundamentals of GIS -type, source, and format of data. GIS components, Data models, vector data models, Raster Data models, Data, and file structure. - Spatial Data Modeling- GIS Data Management- Data Input and Editing- Data Quality Issues- Data Analysis and Modeling- Creation of Information System: A Case Study										
References	- An Introduction to Geographical Information Systems, by Ian Heywood, Sarah Cornelius, Steve Carver, Prentice Hall 2006, ISBN: 0-13-129317-6, 978-0-13-129317-5, 9781405898447 • ELEMENTS OF GEOGRAPHIC INFORMATION SYSTEM-Brad Maguire-Andrew Miller-2008 • Principle of Geographical Information Systems-Otto Husiman-2009- ISBN:978-90-6164-5										
Laboratory	• ARC GIS Program ENVI Program										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
CMC 423	Modeling of structures	CMC 102	3	2	2	0	4	30	20	10	40
Course Contents	General derivation of finite element equilibrium equations - General coordinate models for specific problem (one dimensional element - Plane stress/strain elements) - Lumping of structural properties and loads - Calculation of stresses and assessment of error - formulation of bar Element - Formulation of isoperimetric continuous elements: quadrilateral and triangular elements - Formulation of structural elements: beams -axisymmetric and plate bending elements - Numerical integration: Gauss formula (one dimension integration) - Integration in two dimensions- Computer Applications using ANSYS Engineering Simulation Software.										
References	• G. Ramamurty, " Applied Finite Element Analysis", New Delhi: 2nd Edition, I.K. Inc, 2010, ISBN-13: 978-9380578453 • George R. Buchanan," Schaum's Outline of Finite Element Analysis", 2nd Edition, United State of America, McGraw Hill Inc., 2015 • Saeed Moaveni, "Finite Element Analysis: Theory and Application with ANSYS", 4th Edition, Pearson Global Edition, 2015, ISBN 13: 978-0-273-77430-3.										
Laboratory	• ANSYS Software										

Program #12 Infrastructures and Utilities Engineering Program

Program Description

Civil engineering today is concerned with the deterioration of the nation's roads, bridges, water, and power distribution systems, storm and sanitary sewers, and other public infrastructure. The aim of the Infrastructures and Utilities Engineering Program is to graduate civil engineers responsible for the life cycle of the system he creates and must be capable of optimizing the total system performance of large-scale public works projects, including their social and environmental impacts, in a way that addresses critical issues of infrastructure behaviors, and deterioration science. On top of these fields comes surveying engineering, sanitary environment, transportation engineering, and water-related engineering projects who can enrich the water resources and public works field.

Basic Information

Program Vision

Our vision is to lead the world in infrastructure and utilities engineering, as determined by the caliber of our academics, the success of our research, and our stellar reputation.

Program Mission

The mission of the Infrastructures and Utilities Engineering program is to prepare well-educated and innovative graduates with knowledge and skills that meet the needs of the labor market and society, use modern technologies, and support lifelong learning.

Program Objectives

The objectives of the BSc in The Infrastructure and Utilities Engineering program are to enable its graduates to:

PO1. Apply a wide spectrum of engineering knowledge, science, and specialized skills with analytic, critical, and systemic thinking to identify and solve engineering problems in real-life situations.
PO2. Behave professionally, adhere to engineering ethics and standards, and work to develop the profession and community and promote sustainability principles.
PO3. Work in and lead a heterogeneous team and display leadership qualities, business administration, and entrepreneurial skills.
PO4. Master self-learning and life-long learning strategies to communicate effectively in academic/professional fields.
PO5. Preparing engineers with strong knowledge, and proficient skills in the design, operations, maintenance, analysis, evaluation systems, and rehabilitation of civil infrastructure projects.
PO6. Communicate with distinguished foreign universities in the field of Infrastructure and Utilities Engineering.

Graduates Attributes

By the completion of the Infrastructures and Utilities Engineering program of study, and according to NARS 2018, the graduate will be capable to:

1. Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real-life situations.
2. Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation.
3. Behave professionally and adhere to engineering ethics and standards.
4. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance.

5. Recognize his/her role in promoting the engineering field and contribute to the development of the profession and the community.
6. Value the importance of the environment, both physical and natural, and work to promote sustainability principles.
7. Use techniques, skills, and modern engineering tools necessary for engineering practice.
8. Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post-graduate and research studies.
9. Communicate effectively using different modes, tools, and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner.
10. Demonstrate leadership qualities, business administration, and entrepreneurial skills.

In addition to all engineering graduate attributes defined by NARS 2018, Infrastructures and Utilities Engineering graduates should be able to:

11. Design all types of roads, airport systems, transportation planning, railway engineering, and tunneling systems for different purposes.
12. Define and preserve properties (lands, real estate) of individuals, communities, and institutions, through different surveying and GIS tools.
13. Design all types of projects that are necessary for environmental engineering

Program Learning Outcomes

In addition to the competencies for all Engineering Programs (A-Level), the Infrastructures and Utilities Engineering Program graduate must be able to (B and C-Level):

Level	Program Learning Outcomes according to NARS 2018
A	**PLO1**: Identity, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics.
	PLO2: Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess, and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.
	PLO3: Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical, and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.
	PLO4: Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues, and risk management principles.
	PLO5: Practice research techniques and methods of investigation as an inherent part of learning.
	PLO6: Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.
	PLO7: Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural team
	PLO8: Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.
	PLO9: Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.
	PLO10: Acquire and apply new knowledge; and practice self, lifelong and other learning strategies.
B	**PLO11:** Select appropriate and sustainable technologies for construction of buildings, infrastructures, and water structures; using either numerical techniques or physical measurements and/or testing by applying a full range of civil engineering concepts and techniques of: Structural Analysis and Mechanics, Properties and Strength of Materials, Surveying, Soil Mechanics and Fluid Mechanics.

	PLO12: Achieve an optimum design of Reinforced Concrete and Steel Structures, Foundations and Earth Retaining Structures, Transportation and Traffic, Roadways and Airports, Railways, Sanitary Works, Irrigation, Water Resources and Harbours; or any other emerging field relevant to the discipline.
	PLO13: Plan and manage construction processes; address construction defects, instability and quality issues; and maintain safety measures in construction and materials.
	PLO14: Deal with biddings, contracts and financial issues including project insurance and guarantees; and assess environmental impacts of civil engineering projects.
C	**PLO15**: Identify principles in the fields of hydrographic and underground survey, geodesy, photogrammetry, remote sensing, roads, railways and airport systems, water and wastewater systems, and their codes of practice and standards. **PLO16:** Plan and design the highways, railways, airports, traffic and pavement management systems, water and wastewater networks, and treatment facilities and produce civil drawings. **PLO17:** Consider the environmental issues in transportation planning and traffic engineering, water and wastewater systems, and solid waste management, conduct field, and laboratory measurements, and assess the environmental impact of public works engineering projects. **PLO18:** Confirm the additional abilities to Use a wide range of analytical tools, techniques, equipment, and software packages in the field of, hydrographic and underground survey, photogrammetry, Geographic Information systems, and remote sensing.

Faculty Mission vs. Program Mission Matrix

<table>
<tr><th colspan="2" rowspan="3">Faculty Mission</th><th colspan="3">Program Mission</th></tr>
<tr><td colspan="3">The mission of the Infrastructures and Utilities Engineering program is to prepare well-educated and innovative graduates with knowledge and skills that meet the needs of the labor market and society, use modern technologies, and support lifelong learning.</td></tr>
<tr><td>the Infrastructures and Utilities Engineering program is to prepare well-educated and innovative graduates with knowledge and skills</td><td>To meet the needs of the labor market and society's needs</td><td>Capable of using modern technology and have a deep concern for lifelong learning.</td></tr>
<tr><td rowspan="3">Benha Faculty of Engineering - Benha University is committed to graduate well-prepared engineers equipped with the knowledge and skills necessary to compete for the in the labor market, capable of using and developing modern technology, and providing research in engineering fields to serve society and the community.</td><td>Benha Faculty of Engineering - Benha University is committed to graduate well-prepared engineers equipped with the knowledge and skills necessary to compete in the labor market</td><td>√</td><td></td><td></td></tr>
<tr><td>Providing research in engineering fields to serve society and the community</td><td></td><td>√</td><td></td></tr>
<tr><td>Capable of using and developing modern technology</td><td></td><td></td><td>√</td></tr>
</table>

Program Mission vs. Program Objectives Matrix

Program Mission		PO1	PO2	PO3	PO4	PO5	PO6
The mission of the Infrastructures and Utilities Engineering program is to prepare well-educated and innovative graduates with knowledge and skills that meet the needs of the labor market and society, use modern technologies, and support lifelong learning	The Infrastructures and Utilities Engineering program is to prepare well-educated and innovative graduates with knowledge and skills	√				√	
	To meet the requirements of the labor market, society's needs		√	√	√		
	Capable of using modern technology, and deep concern in lifelong learning.				√	√	√

Program Objectives vs. Program Competencies Matrix

Program Objectives	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	B1	B2	B3	B4	C1	C2	C3	C4
PO1	√	√							√		√	√	√					
PO2			√															
PO3							√	√	√									
PO4					√	√		√					√					
PO5				√								√	√	√	√	√	√	√
PO6								√							√	√	√	√

Program Objectives vs. Graduate Attributes Matrix

Program Objectives	Graduate Attributes												
	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12	GA13
PO1	√	√					√						
PO2			√		√	√		√					
PO3				√						√			
PO4						√			√				
PO5											√	√	√
PO6											√	√	√

Career Prospects

Graduate engineers of this program can work on various infrastructure projects (Environmental Engineering, Road, Railway Tunnel work, Underground Survey, GNSS, and Hydrographic Survey).

Program graduates:

Design Engineer: Develop the basics and details of many infrastructures projects
Site Engineer: Applies and coordinates the various infrastructure processes on the site.
Survey Engineer: Infrastructure projects survey works.
Project manager: oversees all aspects of a project, coordinates subcontractors, and provides primary contact to the client as well as to the company's leaders.
Graduates of this program can work with:
Government authorities
Municipalities
Urban infrastructure organizations
Civil engineering contractors and project managers
Water and sanitation utility companies
Transport authorities and operating companies
Environmental engineering and Water regulatory authority organizations

Requirements of Program Courses

In order to get a Bachelor of Science Degree in this program, and to satisfy the Program competences, the following set of courses needs to be completed.

Program Requirements

Requirement		Cr. Hrs.	Ct. Hr.			
			Lect.	Lab.	Tut.	Sum
Benha University Requirements		14	14	0	0	14
Benha Faculty of Engineering Requirements		32	19	14	16	49
Program Requirements	From Basic science	12	8	6	3	17
	Compulsory Courses	84	57	30	39	126
	Elective courses	18	12	2	10	24
Total		160	110	52	68	230

University Requirements of Infrastructures and Utilities Engineering Program
Lists of Humanities Courses of Infrastructures and Utilities Engineering Program

Code	Course	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lect.	Lab.	Tut.	Sum
UHS 101	Foreign Language	-----	2	2	0	0	2
UHS 103	Social Issues	-----	2	2	0	0	2
UHS 102	Information and Communication Technology	-----	2	2	0	0	2
UHS 104	Professional Ethics	-----	2	2	0	0	2
UHS XXX	Humanities Elective I	-----	2	2	0	0	2
UHS XXX	Humanities Elective II	-----	2	2	0	0	2
UHS XXX	Humanities Elective III	-----	2	2	0	0	2
Total			**14**	**14**	**0**	**0**	**14**

Lists of Electives Humanities of Infrastructures and Utilities Engineering Program

Humanities Elective		Code	Course
I	Entrepreneurship Courses	UHS 201	Principles of Entrepreneurship and Project Management
		UHS 203	Human Resources Management
II	Personal and acquired skills courses	UHS 301	Communication and Presentation Skills
		UHS 302	Leadership Skills
III	Scientific research and analysis courses	UHS 801	Research Methodologies
		UHS 803	Thinking Skills

Faculty Requirements of Infrastructures and Utilities Engineering Program

Code	Course	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lec.	Lab.	Tut	Sum
FRB 001	Analytical geometry & Linear Algebra	-----	3	2	0	2	4
FRB 003	Statics	-----	3	2	0	2	4
FRB 005	Waves and Heat	-----	3	2	2	1	5
FRB 007	Chemistry for Engineers	-----	4	3	2	1	6
FRM 009	Engineering Drawing	-----	2	0	0	4	4
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4
FRB 004	Dynamics	FRB 003	3	2	0	2	4
FRB 006	Electricity and Magnetism	-----	3	2	2	1	5
FRM 008	Production Systems Engineering	-----	2	1	3	0	4
FRM 010	Engineering Drawing by Computer	FRM 009	2	1	2	0	3
FRE 012	Computer Programming Fundamentals	-----	2	0	2	2	4
FRB 103	Environmental Pollution and Industrial Safety	FRB 007	2	2	1	0	3
FT 103	Field Training I		0	0	0	0	0
FT 203	Field Training II		0	0	0	0	0
Total			**32**	**19**	**14**	**17**	**50**

Basic Science Requirements of Infrastructures and Utilities Engineering Program

CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr. Lect.	Lab.	Tut.	Sum
FRB 001	Analytical geometry & Linear Algebra	-----	3	2	0	2	4
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4
FRB 101	Engineering Differential Equations	FRB 002	3	2	0	2	4
FRB 201	Applied Engineering Probability and Mathematical Statistics	FRB 002	3	2	2	0	4
FRB 104	Engineering Numerical Analysis	FRB 101	3	2	2	0	4
FRB 007	Chemistry for Engineers	-----	4	3	2	1	6
FRB 102	Water Chemistry	FRB 007	3	2	2	0	4
FRB 103	Environmental Pollution and Industrial Safety	FRB 007	2	2	1	0	3
FRB 005	Waves and Heat	-----	3	2	2	1	5
FRB 006	Electricity and Magnetism	-----	3	2	2	1	5
Total			**30**	**21**	**13**	**9**	**43**

Program Requirements
Lists of Compulsory Courses (96 Credit Hours)

Code	Course Title	Pre-requisites	Cr. Hrs.	Contact Hours Lec	Lab	Tut	Sum
FRB 101	Engineering Differential Equations	FRB 002	3	2	0	2	4
FRB 102	Water Chemistry	FRB 007	3	2	2	0	4
FRB 201	Applied Engineering Probability and Mathematical Statistics	FRB 002	3	2	2	0	4
FRB 104	Engineering Numerical Analysis	FRB 101	3	2	2	0	4
UIC 101	Structural Analysis I	FRB 003	3	2	0	2	4
UIC 103	Properties and Testing of Construction Materials	FRB 003	2	2	1	0	3
UIC 105	Surveying 1	FRB 002	3	2	2	1	5
UIC 107	CAD for Civil Engineers	FRM 010	2	1	3	0	4
UIC 109	Fluid Mechanics	FRB 005	2	2	1	0	3
UIC 102	Structural Analysis II	UIC 101	3	2	0	2	4
UIC 104	Construction Materials and Concrete Technology	UIC 103	3	2	2	1	5
UIC 106	Surveying 2	UIC 105	3	2	0	2	4
UIC 108	Engineering Geology	-----	2	2	0	1	3
UIC 110	Hydraulics	UIC 109	2	2	1	0	3
UIC 201	Transportation Planning	UIC 106	2	2	0	1	3
UIC 203	Design of R.C. Structures-1	UIC 102+ UIC 104	3	2	0	2	4
UIC 205	Environmental Engineering	FRB 102	2	2	0	1	3
UIC 207	Hydrographic Surveying	UIC 106	3	2	0	2	4
UIC 209	Soil Mechanics	UIC 103	3	2	2	1	5
UIC 202	Traffic Engineering	FRB 201	3	2	1	2	5
UIC 204	Design of R.C. Structures-2	UIC 203	3	2	0	2	4
UIC 206	Water Supply Engineering	UIC 110 +UIC 205	3	2	2	1	5
UIC 208	Under-Ground Utility Surveying	UIC 106	3	2	0	2	4
UIC 210	Geotechnical Engineering &	UIC 209	3	2	2	1	5

	Foundations						
UIC 301	Computer Applications	FRE 012	2	1	3	0	4
UIC 303	Highway Engineering I	UIC 201	3	2	2	1	5
UIC 305	Design of Metallic Structures-1	UIC 102	3	2	0	2	4
UIC 307	Wastewater Engineering	UIC 205	3	2	0	2	4
UIC 309	Design of Foundations and Earth Retaining Structures	UIC 210	3	2	0	2	4
UIC 302	Highway Engineering II	UIC303	3	2	0	2	4
UIC 304	Water Distribution &Sewer System design	UIC 206 +UIC 307	3	2	0	2	4
UIC 306	Ground Water Hydrology	UIC 110	3	2	0	2	4
UIC 308	Senior Design Project I	*	2	0	4	0	4
UIC 401	Infrastructure Management &Financing	-----	3	2	0	2	4
UIC 403	Senior Design Project II	UIC 308	3	1	4	0	5
			84	**57**	**30**	**39**	**126**

*The student can register the Senior design Project course after passing 70% of the program cr. hrs, i.e., 112 Cr. Hr

Lists of Elective Courses (18 Credit Hours)

CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.			
				Lect.	Lab.	Tut.	Sum
Elective I							
UIC 311	Dynamic of Structures	UIC102	3	2	0	2	4
UIC 313	Tunnels and Underground Structure	UIC 210	3	2	0	2	4
UIC 315	Special Topics in Structural Analysis	UIC 102	3	2	0	2	4
Elective II							
UIC 310	Photogrammetry by Drones	UIC 106	3	2	0	2	4
UIC 312	Remote Sensing	UIC 106	3	2	0	2	4
UIC 314	GIS Applications in Civil infrastructure Projects	UIC 106	3	2	0	2	4
Elective III							
UIC 316	Environmental Impact Assessment	UIC 205	3	2	0	2	4
UIC 318	Sustainable Transportation and Highways Engineering	UIC 202	3	2	0	2	4
UIC 320	Sustainable Environmental Engineering	UIC 205	3	2	0	2	4
Elective IV							
UIC 405	Pavement Evaluation and Management	UIC 303	3	2	0	2	4
UIC 407	Airports Engineering	UIC 303	3	2	0	2	4
UIC 409	Railways Engineering	UIC 201	3	2	0	2	4
Elective V							
UIC 411	Cost Engineering & Quantity Surveying	-----------	3	2	0	2	4
UIC 413	Project Planning, Scheduling, and Control	-----------	3	2	0	2	4
UIC 415	Construction Project	-----------	3	2	0	2	4

	Specifications, Bids, and Contracts						
Elective VI							
UIC 417	Computer Applications in Sanitary Engineering	UIC 304	3	2	2	0	4
UIC 419	Computer Applications in Transportation Systems	UIC 303	3	2	2	0	4
UIC 421	Programing Applications in Survey.	UIC 106	3	2	2	0	4
Total			**18**	**12**	**2**	**10**	**24**

Proposed Study Plan

Level 0-1														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	PE/OE	St. Act.	Final	sum
FRB 001	Analytical geometry & Linear Algebra	-----	3	2	0	2	4	2 hr	30	20	--	10	40	100
FRB 003	Statics	-----	3	2	0	2	4	2 hr	30	20	--	10	40	100
FRB 005	Waves and Heat	-----	3	2	2	1	5	2 hr	30	--	20	10	40	100
FRB 007	Chemistry for Engineers	-----	4	3	2	1	6	2 hr	30	--	20	10	40	100
FRM 009	Engineering Drawing	-----	2	0	0	4	4	2 hr	30	20	--	10	40	100
UHS 101	Foreign Language	-----	2	2	0	0	2	2 hr	30	20	--	10	40	100
UHS 102	Information and Communication Technology	-----	2	2	0	0	2	2 hr	30	20	--	10	40	100
Sum			**19**	**13**	**4**	**10**	**27**							**700**

Level 0-2														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	PE/OE	St. Act.	Final	sum
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4	2 hr	30	20	--	10	40	100
FRB 004	Dynamics	FRB 003	3	2	0	2	4	2 hr	30	20	--	10	40	100
FRB 006	Electricity and Magnetism	-----	3	2	2	1	5	2 hr	30	--	20	10	40	100
FRM 008	Production Systems Engineering	-----	2	1	3	0	4	2 hr	30	--	20	10	40	100
FRM 010	Engineering Drawing by Computer	FRM 009	2	1	2	0	3	2 hr	30	20	40	10	--	100
UHS 103	Societal Issues	-----	2	2	0	0	2	2 hr	30	20	--	10	40	100
FRE 012	Computer Programming Fundamentals	-----	2	0	2	2	4	2 hr	30	20	40	10	--	100
Sum			**17**	**10**	**9**	**7**	**26**							**700**

Level 1-1															
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	PE/OE	St. Act.	Final	sum
FRB 101	Engineering Differential Equations	FRB 002	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 101	Structural Analysis I	FRB 003	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 103	Properties and Testing of Construction Materials	FRB 003	2	2	1	0	3	2 hr	30	--	20	10	40	100
FRB 103	Environmental Pollution and Industrial Safety	FRB 007	2	2	1	0	3	2 hr	30	--	20	10	40	100
UIC 105	Surveying 1	FRB 002	3	2	2	1	5	2 hr	30	--	20	10	40	100
UIC 107	CAD for Civil Engineers	FRM 010	2	1	3	0	4	2 hr	30	20	40	10	--	100
UIC 109	Fluid Mechanics	FRB 005	2	2	1	0	3	2 hr	30	--	20	10	40	100
Sum			**17**	**13**	**8**	**5**	**26**							**700**

Level 1-2															
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	PE/OE	St. Act.	Final	sum
FRB 102	Water Chemistry	FRB 007	3	2	2	0	4	2 hr	30	--	20	10	40	100
UIC 102	Structural Analysis II	UIC 101	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 104	Construction Materials and Concrete Technology	UIC 103	3	2	2	1	5	2 hr	30	--	20	10	40	100
UIC 106	Surveying 2	UIC 105	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 108	Engineering Geology	-----	2	2	0	1	3	2 hr	30	20	--	10	40	100
UIC 110	Hydraulics	UIC 109	2	2	1	0	3	2 hr	30	--	20	10	40	100
Sum			**16**	**12**	**5**	**6**	**23**							**600**

Field Training I														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	St. Act.	Final	sum
FT 103	Field Training I	Completion of 65 Cr. Hrs.	0	0	0	0	0	Oral	-	-	-	Pass or Fail	

Level 2-1														
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	PE/OE	St. Act.	Final	sum
FRB 201	Applied Engineering Probability and Mathematical Statistics	FRB 002	3	2	2	0	4	2 hr	30	--	20	10	40	100
UIC 201	Transportation Planning	UIC 106	2	2	0	1	3	2 hr	30	20	--	10	40	100
UIC 203	Design of R.C. Structures-1	UIC 102 +UIC 104	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 205	Environmental Engineering	FRB 102	2	2	0	1	3	2 hr	30	20	--	10	40	100
UIC 207	Hydrographic Surveying	UIC 106	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 209	Soil Mechanics	UIC 103	3	2	2	1	5	2 hr	30	--	20	10	40	100
UHS XXX	Humanities Elective I	-----	2	2	0	0	2	2 hr	30	20	--	10	40	100
Sum			18	14	4	7	25							700

Level 2-2															
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	PE/OE	St. Act.	Final	sum
FRB 104	Engineering Numerical Analysis	FRB 101	3	2	2	0	4	2 hr	30	--	20	10	40	100
UIC 202	Traffic Engineering	FRB 201	3	2	1	2	5	2 hr	30	--	20	10	40	100
UIC 204	Design of R.C. Structures-2	UIC 203	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 206	Water Supply Engineering	UIC 110 +UIC 205	3	2	2	1	5	2 hr	30	--	20	10	40	100
UIC 208	Under-Ground Utility Surveying	UIC 106	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 210	Geotechnical Engineering & Foundations	UIC 209	3	2	2	1	5	2 hr	30	--	20	10	40	100
Sum			18	12	7	8	27							600

Field Training I													
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	St. Act.	Final	sum
FT 203	Field Training II	Completion of 96 Cr. Hrs.	0	0	0	0	0	Oral	-	-	-	Pass or Fail	

Level 3-1														
CODE	**Course Name**	**Pre-requisites**	**Cr. Hrs.**	**Ct. Hr.**				**Final Exam Time**	**Assessment**					
				Lect.	**Lab.**	**Tut.**	**Sum**		**Mid 1**	**Mid 2**	PE/OE	**St. Act.**	**Final**	**sum**
UIC 301	Computer Applications	FRE 012	2	1	3	0	4	2 hr	30	20	40	10	--	100
UIC 303	Highway Engineering I	UIC 201	3	2	2	1	5	2 hr	30	--	20	10	40	100
UIC 305	Design of Metallic Structures-1	UIC 102	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 307	Wastewater Engineering	UIC 205	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 3XX	Elective I	*	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 309	Design of Foundations and Earth Retaining Structures	UIC 210	3	2	0	2	4	2 hr	30	20	--	10	40	100
UHS XXX	Humanities Elective II	-----	2	2	0	0	2	2 hr	30	20	--	10	40	100
Sum			**19**	**13**	**5**	**9**	**27**							**700**

*** According to the Course Name**

Level 3-2														
CODE	**Course Name**	**Pre-requisites**	**Cr. Hrs.**	**Ct. Hr.**				**Final Exam Time**	**Assessment**					
				Lect.	**Lab.**	**Tut.**	**Sum**		**Mid 1**	**Mid 2**	PE/OE	**St. Act.**	**Final**	**sum**
UIC 3XX	Elective II	*	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 302	Highway Engineering II	UIC 303	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 3XX	Elective III	*	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 304	Water Distribution &Sewer System design	UIC 206 +UIC 307	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 306	Ground Water Hydrology	UIC 110	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 308	Senior Design Project I	**	2	0	4	0	4	2 hr	--	--	50	50	--	100
UHS 104	Professional Ethics	-----	2	2	0	0	2	2 hr	30	20	--	10	40	100
Sum			**19**	**12**	**4**	**10**	**26**							**700**

*** According to the Course Name**

** The student can register the senior design Project course after passing 70% of the program cr. hrs, i.e., 112 Cr. Hr. Pre-requisites according to the project area.

Level 4-1															
CODE	Course Name	Pre-requisites	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lect.	Lab.	Tut.	Sum		Mid 1	Mid 2	PE/OE	St. Act.	Final	sum
UIC 401	Infrastructure Management &Financing	-----	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 4XX	Elective IV	*	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 4XX	Elective V	*	3	2	0	2	4	2 hr	30	20	--	10	40	100
UIC 4XX	Elective VI	*	3	2	2	0	4	2 hr	30	--	20	10	40	100
UIC 403	Senior Design Project II	UIC 308	3	1	4	0	5	2 hr	--	--	50	50	--	100
UHS XXX	Humanities Elective III	-----	2	2	0	0	2	2 hr	30	20	--	10	40	100
Sum			**17**	**11**	**4**	**8**	**23**							**600**

*** According to the Course Name**

Matching Infrastructures and Utilities Engineering Program Courses with ABET Requirements

ABET Program Criteria for Civil and Similarly Named Engineering Programs

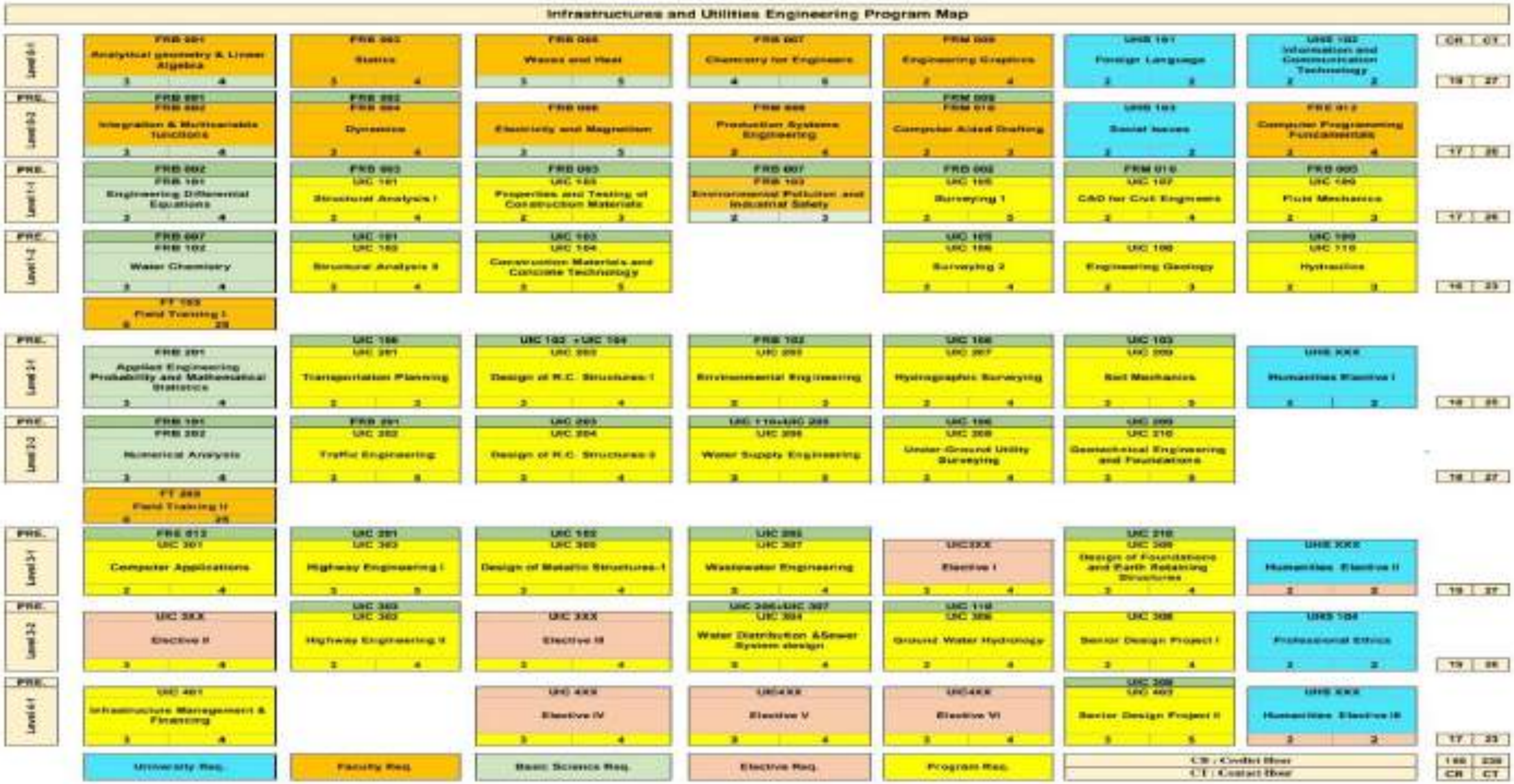
Lead Society: American Society of Civil Engineers

Construction Engineering and Management Program Courses Required to Cover ABET Criteria				
ABET Criteria		**CODE**	**Course Name**	**Credit Hours**
A minimum of 30 semester credit hours (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program	The curriculum must prepare graduates to apply knowledge of mathematics through differential equations.	FRB 001	Analytical geometry & Linear Algebra	3
		FRB 002	Integration & Multivariable functions	3
		FRB 101	Engineering Differential Equations	3
	At least one additional area of basic science; apply probability and statistics to address uncertainty	FRB 104	Engineering Numerical Analysis	3
		FRB 201	Applied Engineering Probability and Mathematical Statistics	3
	Chemistry	FRB 007	Chemistry for Engineers	4
		FRB 102	Water Chemistry	3
		FRB 103	Environmental Pollution and Industrial Safety	2
	Calculus-based physics	FRB 005	Waves and Heat	3
		FRB 006	Electricity and Magnetism	3
Total				**30**
ABET Criteria		**CODE**	**Course Name**	**Credit Hours**
A minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design and utilizing modern engineering tools.	Analyze and solve problems in at least four technical areas appropriate to civil engineering.	UIC 102	Structural Analysis II	3
		UIC 201	Transportation Planning	2
		UIC 208	Under-Ground Utility Surveying	3
		UIC 301	Computer Applications	2
		UIC 3XX	Elective Courses II	3
	Conduct experiments in at least two technical areas of civil engineering and analyze and interpret the resulting data.	UIC 105	Surveying 1	3
		UIC 109	Fluid Mechanics	2
		UIC 202	Traffic Engineering	3
		UIC 206	Water Supply Engineering	3
	Design a system, component, or process in at least two civil engineering contexts;	UIC 3XX	Elective Courses I	3
		UIC 303	Highway Engineering I	3
		UIC 404	Water Distribution &Sewer System design	3

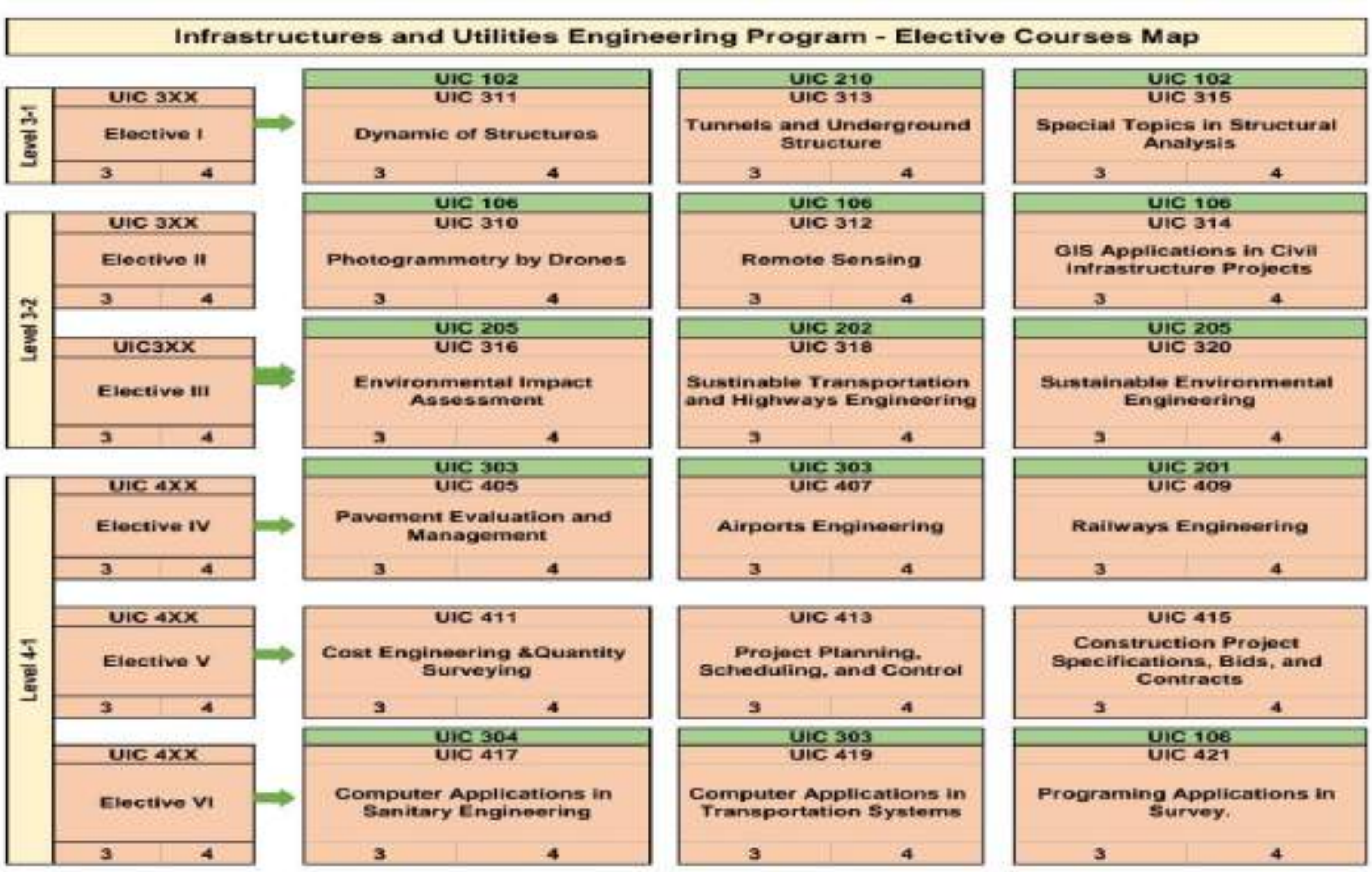
		UIC 309	Design of Foundations and Earth Retaining Structures	3
	Include principles of sustainability in design	UIC 3XX	Elective Courses III	3
	Explain basic concepts in project management, business, public policy, and leadership .	UHS 102	Information and Communication Technology	2
		UHS XXX	Humanities Elective I	2
		UHS XXX	Humanities Elective II	2
		UIC 401	Infrastructure Management &Financing	3
		UIC 4XX	Elective Courses V	3
	Analyze issues in professional ethics and explain the importance of professional licensure.	UHS 104	Professional Ethics	2
Total				**53**

Courses Plan and Matrix

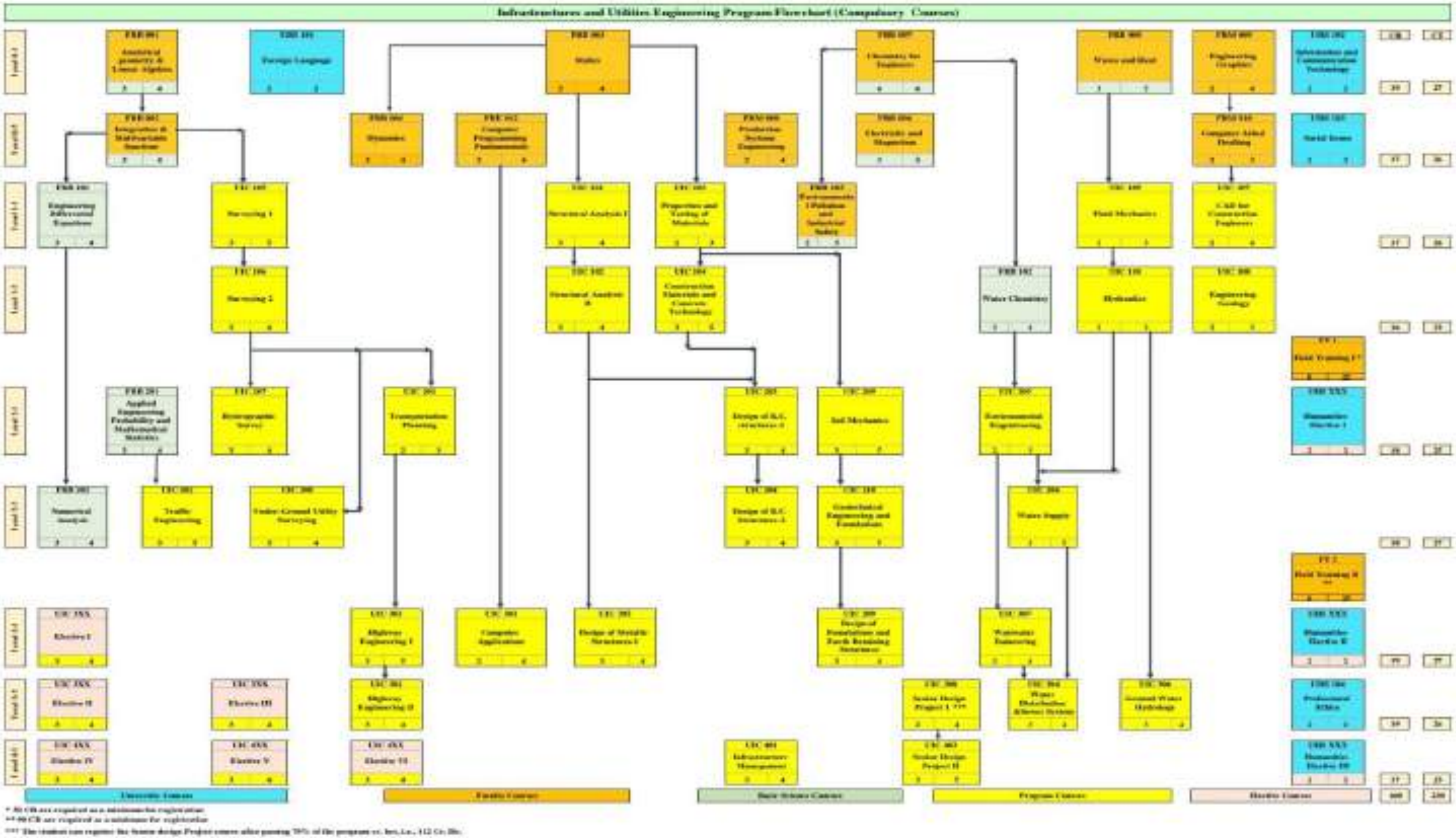
Infrastructures and Utilities Engineering Program Map



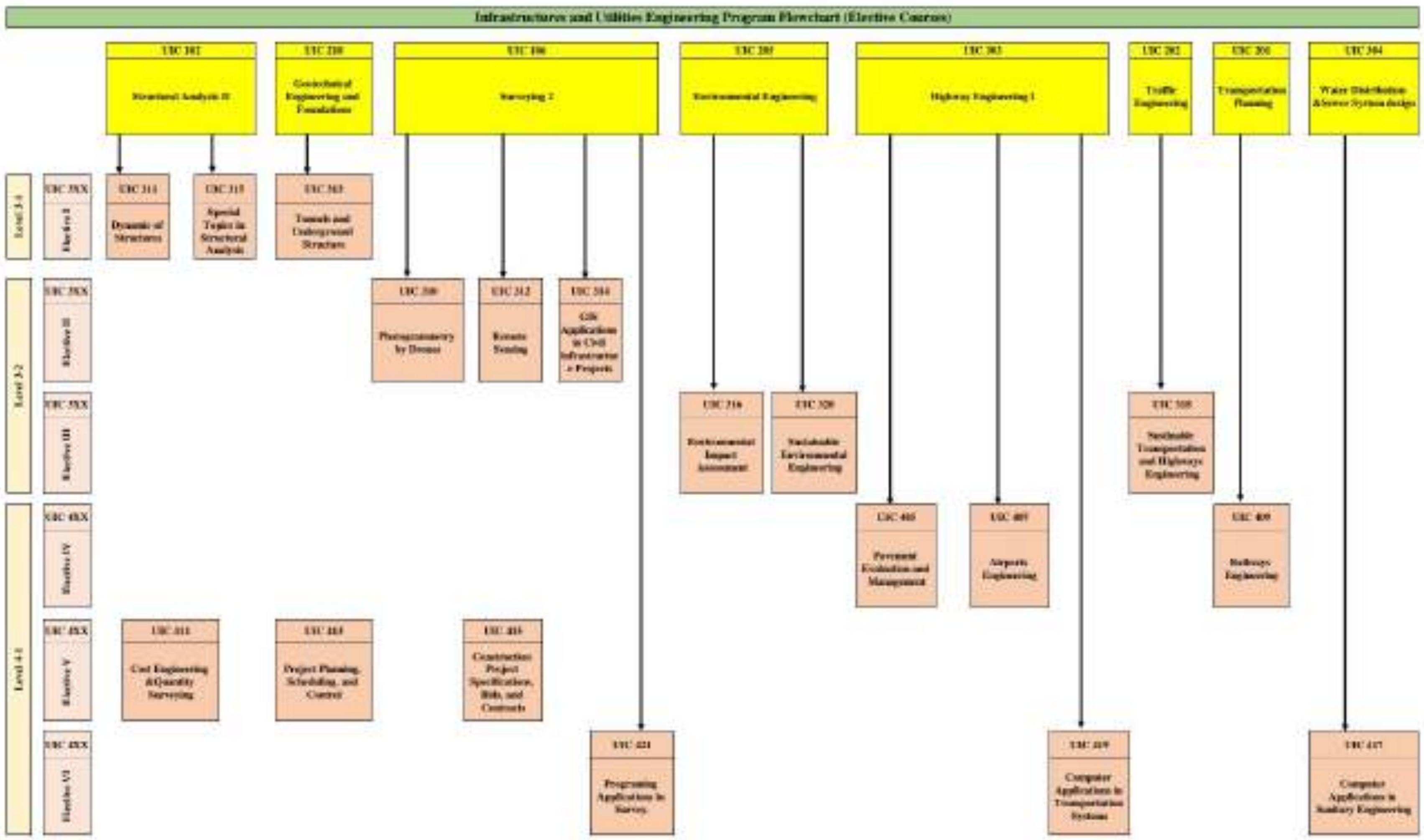
Elective Courses



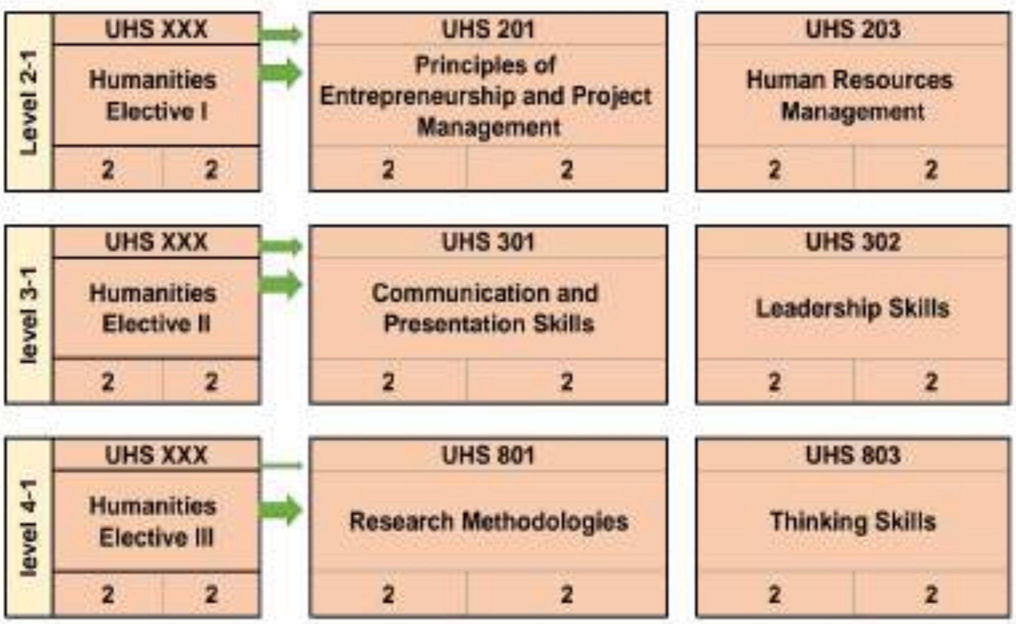
Infrastructures and Utilities Engineering Program Flowchart



Elective Courses



Infrastructures and Utilities Engineering Engineering Program - Humanities Elective Map



Program Learning Outcomes to Courses Matrix

Code	Title	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16	PLO17	PLO18
	Main Humanities Courses																		
UHS101	Foreign Language								*		*								
UHS 102	Information and Communication Technology				*						*								
UHS 103	Social issues							*			*								
UHS 104	Professional Ethics				*	*													
UHS XXX	Humanities Elective I			*	*														
UHS XXX	Humanities Elective II								*	*									
UHS XXX	Humanities Elective III					*					*								
FRB 001	Analytical geometry & Linear Algebra	*		*															
FRB 002	Integration & Multivariable functions	*		*															
FRB 101	Engineering Differential Equations	*	*																
FRB 104	Engineering Numerical Analysis	*	*																
FRB 201	Applied Engineering Probability and Mathematical Statistics	*	*																
FRB 007	Chemistry for Engineers	*	*																
FRB 102	Water Chemistry	*	*		*														
FRB 103	Environmental Pollution and Industrial Safety	*		*	*														
FRB 005	Waves and Heat	*	*																
FRB 006	Electricity and Magnetism	*	*																
FRM 009	Engineering Drawing						*		*										
FRM 008	Production Systems Engineering				*		*												
FRM 010	Engineering Drawing by Computer				*				*										
FRE 012	Computer Programming Fundamentals	*		*															
FRB 003	Statics	*	*																
FRB 004	Dynamics	*	*																
UIC 103	Properties and Testing of Construction Materials		*									*							
UIC 104	Construction Materials and Concrete Technology		*									*							
UIC 108	Engineering Geology					*						*							

UIC 209	Soil Mechanics		*			*						*							
UIC 210	Geotechnical Engineering and Foundations		*	*								*	*						
UIC 101	Structural Analysis I	*										*							
UIC 102	Structural Analysis II	*										*							
UIC 203	Design of R.C. Structures-1			*	*								*						
UIC 204	Design of R.C. Structures-2			*	*								*						
UIC 305	Design of Metallic Structures-1			*	*								*						
UIC 309	Design of Foundations and Earth Retaining Structures			*									*						
UIC 105	Surveying 1		*			*		*				*			*				
UIC 106	Surveying 2					*						*							
UIC 207	Hydrographic Surveying					*										*			*
UIC 208	Under-Ground Utility Surveying					*										*			*
UIC 201	Transportation Planning	*				*							*	*	*				
UIC 202	Traffic Engineering					*							*	*					
UIC 302	Highway Engineering II			*			*										*		
UIC 303	Highway Engineering I			*		*											*	*	
UIC 109	Fluid Mechanics	*	*									*							
UIC 110	Hydraulics			*		*						*							
UIC 306	Ground Water Hydrology				*							*							
UIC 205	Environmental Engineering				*										*				
UIC 206	Water Supply Engineering		*										*						
UIC 304	Water Distribution &Sewer System design			*												*	*		
UIC 307	Wastewater Engineering				*											*		*	
UIC 107	CAD for Construction Engineers				*								*						
UIC 301	Computer Applications		*														*		*
UIC 401	Infrastructure Management &Financing				*		*		*					*	*				
UIC 308	Senior Design Project I			*	*		*	*	*	*	*			*	*	*	*	*	*
UIC 403	Senior Design Project II			*	*		*	*	*	*	*			*	*	*	*	*	*
UIC 3XX	Program Elective Courses I			*						*			*						
UIC 3XX	Program Elective Courses II					*		*		*						*			*
UIC 3XX	Program Elective Courses III				*		*											*	
UIC 4XX	Program Elective Courses IV			*						*						*	*		
UIC 4XX	Program Elective Courses V						*							*	*				
UIC 4XX	Program Elective Courses VI					*	*	*		*	*						*	*	*
FT 103	Field Training I							*			*								
FT 203	Field Training II							*			*								

Infrastructures and Utilities Engineering Program Courses

Courses Coding System

The course coding system is composed of three letters 3 letters that denote the department that offers the course, followed by 3 digits, where:

- the first digit from the left represents the course level (from 1 to 5),
- the middle and right digits represent the course sequence.

The coding system is demonstrated in the following table:

UHS XXX	University Requirement Compulsory and Elective Courses
FRB XXX	Courses offered by Basic Engineering Science Department
FRM XXX	Faculty requirement course offered by Electrical Engineering Department
FRE XXX	Course offered by Electrical Engineering Department
UIC XXX	Course offered by Civil Engineering Department

Faculty Requirements

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec	Lab.	Tut.	Sum	MT1	MT2	Std. Act.	Final
FRB 001	Analytical geometry & Linear Algebra	-	3	2	0	2	4	30	20	10	40
Course Contents	**Analytical geometry:** Functions (Lines, Circles, Parabolas, Piecewise-Functions, Power Functions, Polynomials, Rational Functions, Algebraic Functions, Trigonometric Functions, Hyperbolic Functions, Exponential Functions and Logarithmic Functions) and their properties, their graphs and their inverses. Limits and continuity. Differentiation rules of real functions of one variable. Applications of derivatives (maxima, minima and inflection points, curve tracing, optimization problems). Taylor's and Maclaurin's series of functions of one variable. **Linear Algebra:** Matrices and their properties, types, ranks and their inverses (Adjoint of matrix, Eigen equation and Gauss elimination). Existence and uniqueness of solutions. Solving system of linear equations by Matrices (Gauss elimination, Gauss – Jordan elimination, LU factorization). Eigenvalues and eigenvectors. Complex numbers. Elements of mathematical logic with applications.										
References	• Howard Anton, "Calculus with analytical geometry", John Wiley & Sons, Last Edition. • Gilbert Strang, "Introduction to Linear Algebra", Wellesley-Cambridge Press, Last Edition.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4	30	20	10	40

Course Contents	Integration: Techniques of integration (Basic Integration Formulas, Integration by Parts, Integration of Rational Functions by Partial Fractions, Trigonometric Integrals and Substitutions). Applications of indefinite integrals. Applications of definite integrals (areas, volumes of revolution, lengths of curves and surface areas of revolution). Multivariable functions: Curves and surfaces in three dimensions. Limits, continuity and partial derivatives of functions of several variables. Chain Rule. Directional and total derivatives. Applications (tangent planes and normal lines, Taylor series of functions of two variables, Extreme values and conditional extreme values of functions of two variables).
References	• Howard Anton, "Calculus with analytical geometry", John Wiley & Sons, Last Edition. • George B. Thomas, Jr., Maurice D. Weir, Joel Hass, THOMAS' CALCULUS Multivariable (Twelfth Edition), 2010.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
FRB 003	Statics	-	3	2	0	2	4	30	20	10	40

Course Contents	Fundamentals of statics, Types of supports, Vector algebra and applications to mechanics, Statics of particles, Moments of forces and couples, Equivalent systems of forces and moments, Equilibrium of rigid bodies, Centroids and centres of gravity, Analysis of structure (trusses), Friction and its applications, Moments of inertia (areas and masses).
References	• F. P. Beer, E. R. Johnston, D. F. Mazurek, P. J. Cornwell, Vector Mechanics for Engineers: Statics and Dynamics, 10th edition (2013). • Hibbeler, R. C. Engineering Mechanics: Statics and Dynamics, 10th Edition. Upper Saddle River, New Jersey: Prentice Hall, (2003).

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
FRB 004	Dynamics	FRB 003	3	2	0	2	4	30	20	10	40
Course Contents	Kinematics of particles (rectilinear and curvilinear motion), Kinetics of particles (force and acceleration method - work and energy method - impulse and momentum method), Kinematics of rigid bodies (translation, rotation around a fixed axis and general plane motion), Plane motion of rigid bodies (force and acceleration method).										
References	• F. P. Beer, E. R. Johnston, D. F. Mazurek, P. J. Cornwell, Vector Mechanics for Engineers: Statics and Dynamics, 10th edition (2013). • Hibbeler, R. C. Engineering Mechanics: Statics and Dynamics, 10th Edition. Upper Saddle River, New Jersey: Prentice Hall, (2003).										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
FRB 005	Waves and Heat	-	3	2	2	1	5	30	20	10	40
Course Contents	Simple harmonic motion, Wave motion, Sound waves, Superposition of waves, Interference of light waves, Diffraction of light, First law of thermodynamics, Kinetic theory of gases, specific heats of gases, thermodynamic processes: isochoric, isobaric, isothermal and adiabatic, Heat transfer: conduction, convection and radiation, Elasticity, Hooke’s law, Hydrostatics and surface tension, Hydrodynamics and Viscosity.										
References	• R. A. Serway and J. W. Jewett, Physics for scientists and engineers: Cengage learning, 2018. • Tarek M. Abdolkader, Mohamed Elfaham, Mina Asham, Ibrahim Sayed, Walid Selmy, “Engineering Physics, • D. Halliday, et al., Fundamentals of physics: John Wiley & Sons, 2013. • D. Giancoli, Physics for Scientists & Engineers with Modern Physics, 4th Edition ed. Pearson, 2008.										
Laboratory	• Simple harmonic motion • Waves in stretched string. • Sound waves. • Interference and diffraction of light • Polarization of light • Specific heat • Thermistor and thermal conductivity.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
FRB 006	Electricity and Magnetism	-	3	2	2	1	5	30	20	10	40

Course Contents	Electric force and electric field, Motion of charge in electric field, Electric dipole, Gauss law and applications, Electric potential, Capacitors and dielectrics, Current and resistance, Magnetic field and magnetic force, Sources of magnetic field, Bio-Savart law and Ampere's laws, Electromagnetic induction and Faraday's law, Self-induction and magnetic energy.
References	• R. A. Serway and J. W. Jewett, Physics for scientists and engineers: Cengage learning, 2018. • Physics, Part II, Waves, Heat and Optics", 1st edition, 2022. • D. Halliday, et al., Fundamentals of physics: John Wiley & Sons, 2013. • D. Giancoli, Physics for Scientists & Engineers with Modern Physics, 4th Edition ed. Pearson, 2008.
Laboratory	• Ohm's Law • Wheatstone bridge & Metric bridge • Electric Field Mapping. • Capacitor Charging and Discharging • The Electric Transformer • Faraday's Law • Ohm's Law

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
FRB 007	Chemistry for Engineers	-	4	3	2	1	6	30	20	10	40

Course Contents	Gaseous state- Liquid state - Solids - Chemical kinetics – Electrochemistry and corrosion – Polymers.
References	• J. Brady, "General Chemistry, Principles and structures", Wiley Inc., Fifth Edition, 1990. • L. W. Fine, H. Beall, J. Stuehr, "Chemistry for Scientists and Engineering, Preliminary Edition, Brooks Cole; 1st edition, 1999. • Steven S. Zumdahl, "Chemistry Principles", Third Edition, Houghton Mifflin, 1998. • Prof. Elsayed Fouad, Engineering Chemistry I, II. • Steven S. Zumdahl, Susan A. Zumdahl "Chemistry" Seventh Edition, Houghton Mifflin, 2007. • P. Barnes, J.Bensted, Structure and Performance of Cements, CRC Press, 2nd Edition, 2019.
Laboratory	• Neutralization Reactions • Oxidation-Reduction Reactions • W/C Ratio • Precipitation Reactions

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
FRM 008	Production Systems Engineering	-	2	1	3	0	4	30	20	10	40

Course Contents	Introduction, Types of industries, Casting processes: Main steps of sand casting, Pattern design, Melting of metals, Cleaning and inspection of casting, Metal forming processes: Forging, Rolling, Extrusion, Drawing, Bending, Joining Processes: Temporary and permanent joints, Welding techniques, Cutting Processes: Principles and elements of cutting processes, Basic cutting and machining (Turning, Drilling, Milling, etc.,..). Principles of production planning and control, Introduction to quality control.
References	• Jiangshan Li, Semyon M. Meerkov, 2008, “Production Systems Engineering”, Springer; 1st ed. • M. P. Groover, 2011, "Principles of Modern Manufacturing", 4th Ed., john Wiley & Sons, Inc.
Laboratory	• Practicing the workshop measuring operations and tools • Practicing the sand-casting workshop • Practicing the welding workshop; electric arc welding, gas welding and cutting, and electric • Practicing the machining workshop; turning, shaping, drilling, milling, and grinding • Practicing the metal forming workshop; rolling, bending, drawing, and extrusion • Practicing the carpentry workshop • Practicing the forging workshop

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
FRM 009	Engineering Drawing	-	2	0	0	4	4	30	20	10	40

Course Contents	Engineering drawing techniques and skills. Conventional lettering and dimensioning. Geometric constructions. Theories of view derivation. Orthographic projection of engineering bodies. Derivation of views from isometric drawings and deducing of missing views. Sectioning views: (full, half, offset, partial, revolved, removed, and partial sectioning). Steel construction, Symbols of electrical circuits.
References	• William Chalk, Goetsch, "Technical Drawing", Delmar technical graphics series, 6th edition, 2010. • Allbert W. Boundy, "Engineering Drawing", McGraw-Hill Australia, 2012.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	PE/OE
FRM 010	Engineering Drawing by Computer	FRM 009	2	1	2	0	3	30	20	10	40

Course Contents	Introduction to Computer Aided Drafting, history, advantages, and limitation. Graphics/CAD involves the visualization, sketching, and geometric construction of mechanical components. Layout and creation 2D working industrial drawings that adhere to industry standards. Illustrate CAD drawing construction techniques, implementation of graphical communication through the use of the alphabet of lines, orthographic projection, section views, auxiliary views and the creation of assembly and detail mechanical components.
References	• William Chalk, Goetsch, "Technical Drawing", Delmar technical graphics series, 6th edition, 2010. • Allbert W. Boundy, "Engineering Drawing", McGraw-Hill Australia, 2012.
Laboratory	• Student's engineering sketches and drawings carried out in the engineering Computer Labs.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	PE/OE
FRE 012	Computer Programming Fundamentals	-	2	0	2	2	4	30	20	10	40

Course Contents	Computer System: Hardware, Software - Introduction to software design - evolution and comparison of programming languages - types and characteristics of translators - Program Design Process - Software Life Cycle - structured programming - Variables, Constants - Input and Output - Data Types and Representation - Simple Flow - Flow of Control (Conditioning, Iteration) - Array - Functions (Predefined - Programmer Defined) - Pointers- Strings - program maintenance & testing – documentation. Course topics are explained using a high-level language (as C, or C++).
References	• W. Savitch, "Problem Solving with C++" 10th Edition, Pearson, 2018. • K.N. King, “C Programming: A modern Approach”, 2nd edition, W.W. Norton & Company, 2008. • C.R. Severance, S. Blumenburg, "Python for Everybody: Exploring Data in Python 3", CreateSpace Independent Publishing Platform, 2016. • R. Sedgweck, K. Wayne, "Introduction to Programming in Java: An Interdisciplinary Approach (2nd Edition)", Addison-Wesley Professional, 2017
Laboratory	Problem solving labs using high level language (C, or C++) to apply explained topics in each lecture including: • Flowcharts • Data Types, Variable, Constant declaration. Input and Output • Sequence Flow program • Conditioning Statements (if, nested if and switch case) • Iteration Statements (for, while do while, Do Until, and nested loops) • Arrays (1D and 2D arrays) • Functions (predefined and user defined) • Pointers • Strings and string functions * Project: At the end of the course the student must provide a project emphasizing the course content

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>PE/OE</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>FRB 103</td><td>Environmental Pollution and Industrial Safety</td><td>FRB 007</td><td>2</td><td>2</td><td>1</td><td>0</td><td>3</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">- Air pollution-Adverse effects -ozone depletion – green house effects- Acid rain and global warming - measurement and control methods.

- Water pollution- constituents of wastewater- primary treatment: various pre-treatment methods - Advanced Treatment: chemical oxidation, precipitation, air stripping

Construction Engineering and Managment students: Plan and manage construction health and safety, maintain safety issues for construction to introduce the foundations on which appropriate health and safety systems may be built. Occupation and health and safety affect all aspects of work. Legal framework for health and safety.

Electromechanical Engineering students: Hazards analysis-Hazards of pressure , uses of over pressure-hazards of temperature-HAZOP study regarding pressure, temperature & flow -static electricity & its control purging and inerting -relief valves and rupture disks-venting – flame arrester -flare system-alarms and types of alarms and its application-trips d interlock system-hot work permit , confined space vessel work permit & height work permit - personnel protective equipment-On-site &Off-site emergency plan.

Electric shock and burns from live wire contact, Fires from faulty wiring, overloading circuits, leaving electrical parts exposed, Electrocution or burns from lack of PPE, Explosions and fires from explosive and flammable substances, Contact with overhead power lines Electrical exposure to water.</td></tr>
<tr><td rowspan="2">References</td><td colspan="11">• Handbook of “Industrial Safety and Health, Trade and Technical Press Ltd. Morden, U.K.1980.</td></tr>
<tr><td colspan="11">• S.P.Mahajan, “Pollution Control in Process Industries” Tata McGraw Hill, NewDelhi1985.</td></tr>
<tr><td rowspan="4">Laboratory</td><td colspan="11">• Air sampling</td></tr>
<tr><td colspan="11">• Water sampling</td></tr>
<tr><td colspan="11">• Adsorption</td></tr>
<tr><td colspan="11">• Precipitation</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
FT 103	Field Training I	*	0	0	10	15	25	-	-	-	Pass or Fail
Course Contents	Time of training: not less than four weeks Field training conducted under the supervision of a faculty member and field mentor in the actual field practice. The student must submit a detailed technical report by the end of training period, explain what he learned during this training. By the end of the training the student will be able to: Apply the principles knowledge to execute practical engineering field works. The students will have the opportunity to work with multidisciplinary teams during the training period.										

* Completion of 65 Cr. Hrs.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
FT 203	Field Training II	*	0	0	10	15	25	-	-	-	Pass or Fail
Course Contents	Time of training: not less than four weeks Field training conducted under the supervision of a faculty member and field mentor in the actual field practice. The student must submit a detailed technical report by the end of training period, explain what he learned during this training. By the end of the training the student will be able to: Apply the principles knowledge to execute practical engineering field works. The students will have the opportunity to work with multidisciplinary teams during the training period.										

* Completion of 96 Cr. Hrs.

Program Requirements
Compulsory Courses

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
FRB 101	Engineering Differential Equations	FRB 002	3	2	0	2	4	30	20	10	40
Course Contents	**Basic Concepts of Ordinary and Partial differential equations (ODEs & PDEs):** Oder, Degree, Linearity, Formation, Geometric and physical applications (Newtons law of cooling, electric circuits), Types of solutions, Existence and uniqueness of solutions. **ODEs:** Solution of first order ODEs (Separable, Homogeneous, Exact, Integrating factor, Linear and Bernoulli equations). Orthogonal trajectories. Solution of nth order ODEs (homogeneous and non-homogeneous). System of first order linear differential equations. Laplace transforms and inverse Laplace transforms with applications. Fourier series with applications. Gamma and Beta functions **PDEs**: Solution of linear PDEs with constant coefficients, solution of some initial-boundary value problems. Solution of PDEs by Laplace Transforms.										
References	• Morris Tenenbaum, Harry Pollard, "Ordinary Differential Equations: An Elementary Textbook for Students of Mathematics, Engineering, and the Sciences", Dover Publications, Last Edition. • Wei-Chau Xie, Differential Equations for Engineers, CAMBRIDGE UNIVERSITY PRESS, 2010.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
FRB 102	Water Chemistry	FRB 007	3	2	2	0	4	30	20	10	40
Course Contents	This course aims to provide an introduction of equilibrium chemistry principles in aquatic systems. This course is designed for engineering students who are often required to understand the composition of solutions and direction of changes during treatment or in environmental systems. By completion of the course, the student will be able to interpret and communicate results related to water quality. Therefore, the course syllabus includes the following topics: equilibrium principles of acids-bases, dissolution-precipitation, titration, gas-liquid equilibrium, oxidation-reduction, complexation and water quality analysis and quality control.										
References	• Sawyer, McCarty & Parkin, Chemistry for Environmental Engineering, McGraw Hill, 2003 • Stumm & Morgan, aquatic Chemistry. Third edition, John Wiley&Sons. 1995										
Laboratory	• Acid – base titration • Total hardness, • Total alkali, • Conductivity, • Total dissolved solids										

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>PE/OE</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>FRB 201</td><td>Applied Engineering Probability and Mathematical Statistics</td><td>FRB 002</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Probability: Basic Theorems of Probability. Conditional Probability. Independent Events. Discrete and Continuous Random Variables. Mean and Variance of Distributions. Discrete Distributions (Binomial, Poisson and Hypergeometric Distribution). Continuous Distributions (Normal and Exponential Distribution). Distributions of Several Random Variables (Discrete and Continuous Two-Dimensional Distributions).

Mathematical Statistics: Random Sampling. Sample mean and variance. Point Estimation of Parameters. Confidence Intervals. Simple and multiple Linear Regression and Correlation. Testing of Hypotheses. Markov chains. Quality Control. Engineering Applications. Lab simulations of engineering applications.</td></tr>
<tr><td>References</td><td colspan="11">• R. E Walpole, R. H. Myers, “Probability and Statistics for Engineers and Scientists", Macmillan Publishing, Last Edition.
• David Levine, Patricia Ramsey, Robert Smidt, “Applied Statistics for Engineers and Scientists: Using Microsoft Excel & Minitab”, First Edition, 2000.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Lab simulations by software’s as (Excel, Matlab, Python,…)- Exploratory data analysis and data transformation (Tabulated data summaries and statistics, Histograms, Box and Correlation plots, Computation of means, variances, etc, Missing data imputation)- Simple random sampling with and without replacement- Stratified random sampling- Simulating Bernoulli process and Poisson distribution - Simulating Markov chains applications-Binary and sequential hypothesis testing and gambler's ruin -Gaussian Mixture Models, clustering and anomaly detection- Regression models and inference- Time series forecasting and ARIMA models.</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
FRB 104	Engineering Numerical Analysis	FRB 101	3	2	2	0	4	30	20	10	40
Course Contents	Numerical in general: Errors, norms, Numerical solution of a system of linear and nonlinear equations. matrix eigenvalues, least square method (Curve fitting), Interpolations, Numerical differentiation and integration. Numerical ODEs and PDEs: methods for the solution of initial value problems in 1st order ODEs and higher order ODEs, Finite difference methods for boundary value problems in ODEs and initial-boundary value problems for PDEs (Elliptic and parabolic PDEs)- Lab simulations of engineering applications										
References	• R W Hamming, "Numerical Methods for Scientists and Engineers", Courier Dover Publications, Last Edition. • Steven C. Chapra, "Applied Numerical Methods with MATLAB for Engineers and Scientists", Mcgraw-Hill, 3rd edition. • Nita H. Shah, Numerical Methods with C++ Programming, PHI Learning, 2008.										
Laboratory	Lab simulations by software's as (C++, Matlab, Python…)- Simulating practical technical problems- linear equations due to electric circuits, truss and spring mass systems. - Electric charge calculations- Nonlinear structural problems- Deflection of nonlinear springs- Calculating the shrinkage of a trunnion- Finding the longitudinal Young's modulus -Estimating voltage drop on a resistor- Calculating the work done by stretching a string- Simulating equations due to the fluid continuum problems, DC motor speed control problems- interpolation and fitting for signals and voltage current relations- population growth calculations- Fluid flow rate calculations- Distributed wind force problems.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 101	Structure Analysis I	FRB 003	3	2	0	2	4	30	20	10	40
Course Contents	Loads and reactions – Stability of structures (external and internal) – Straining actions in Statically determinate structures- Normal stresses – Shear stresses (pure shear, torsional) – Combined stresses.										
References	• Structural Analysis by Russell C. Hibbeler, Pearson, 9th Edition, 2014, ISBN-13:978-0-13-394284-2. • "Solved Examples in Determinate Structures", Dar-Elmaarefa, Egypt, Dr. Ahmed Youssef Kamal El-Deen, ISBN 21638/2016 • George, N. Frantziskonis. "Essentials of the Mechanics of Materials, Second Edition". USA: Destech Publications, Inc. 2013. ISBN 13: 9781605950983 • Pytel, A. and Kiusalaas, J. "Mechanics of Materials Second Edition". Cengage Learning2012. ISBN-13: 978-0-495-66775-9										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 102	Structure Analysis II	UIC 101	3	2	0	2	4	30	20	10	40
Course Contents	Buckling of Column, Elastic deflection of determinate structures (double Integration method and virtual work method). Influence line for determinate beam. Analysis of statically indeterminate structures: Force approach (Consistent deformation method,….). Displacement approach (Slope deflection Method, Moment distribution method,…)										
References	• Aslam Kassimali , “Structural Analysis” Stamford USA: Cengage Learning, 4th Si Edition, 2011, ISBN-13: 978-0-495-29567-9 • Aslam Kassimali, “Structural Analysis”, Stamford USA: Cengage Learning, 6th Si Edition, 2019, ISBN-13 : 978-1337630948 • Jack C. McCormac, “Structural Analysis Using Classical and Matrix Methods”, John Wiley & Sons, Inc, 4th Edition, 2007, ISBN-13: 978-0470036082.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
UIC 103	Properties and Testing of Construction Materials	FRB 003	2	2	1	0	3	30	20	10	40
Course Contents	Stress and strain - Types of tests - Testing machines - Strain gauge devices - Static tension test - Static compression test - Bending test - Shear test - Torsion test - Hardness test - Fatigue test - Impact test - Metals creep test.										
References	• Mechanics of Materials, James M. Kere & Barry J. Goodno, CENGAGE Learning, ISBN-13: 978-1111577735 / ISBN-10: 1111577730. • Strength of Materials, S. S. Bhavikatti,Vikas, Vicas, ISBN-13: 978-9325971578, ISBN-10: 9325971577. • A Textbook of Strength of Materials, Dr R.K. Bansal, LAXMI PUBLICATIONS (P) LTD, ISBN-10: 9788131808146 / ISBN-13: 978-8131808146. • المواد الهندسية مقاومتها واختبارها (الجزء الأول والجزء الثاني)، ا.د. احمد العريان - ا.د. عبد الكريم عطا • مقاومة واختبار المواد، د. عبد الوهاب محمد عوض - د. إبراهيم على درويش. • المواصفات القياسية المصرية.										
Laboratory	• Static tension test. • Static compression test. • Bending test. • Hardness test. • Impact test.										

<table>
<tr><td rowspan="2">Code</td><td rowspan="2">Course Name</td><td rowspan="2">Pre-req.</td><td rowspan="2">Cr. Hrs.</td><td colspan="4">Ct. Hr.</td><td colspan="4">Assessment</td></tr>
<tr><td>Lect.</td><td>Lab.</td><td>Tut.</td><td>Sum</td><td>Mid</td><td>PE/OE</td><td>St. Act.</td><td>Final</td></tr>
<tr><td>UIC 104</td><td>Construction Materials and Concrete Technology</td><td>UIC 103</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Types and properties of construction materials. Aggregate types, sources and quality, cements. Introduction to fiber reinforced polymers. Steel in construction, insulation materials and coatings. Concrete mix design, admixtures. Asphalt cement, asphalt concrete mix design. Concrete manufacture. Properties of fresh concrete. Properties of hardened concrete. Durability of concrete. Non-destructive testing. Special concretes.</td></tr>
<tr><td>References</td><td colspan="11">• للكود المصري لتصميم وتنفيذ المنشآت الخرسانية – 203.
• الملحق الثالث للكود المصري لتصميم وتنفيذ المنشآت الخرسانية (دليل الاختبارات المعملية لمواد الخرسانة).
• Building Materials, S. K. Duggal, Routledge, ISBN-10: 8122433790 / ISBN-13: 978-8122433791.
• Concrete Technology, AM Neville, JJ Brooks, Longman, ISBN-10: 0273732196, ISBN-13: 978-0273732198.
• Properties of Concrete and Structures, P.K. Mehta, Prentice Hall, ISBN-10: 0131671154, ISBN-13: 978-0131671157
• Materials of construction, R.C. Smith, McGraw-Hill, ISBN-10: 0070584761, ISBN-13: 978-0070584761.
•</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Specific surface area of cement, Setting time of cement, compressive strength of cement.
• Sieve analysis of coarse and fine aggregate, bulk density of aggregate – specific weight of aggregate.
• Coarse aggregate crushing value, Los Angles abrasion value of coarse aggregate.
• Compression test.
• Compacting factor test, Slump test.
• Compressive strength test - Splitting tensile strength test – Modulus of rupture test.
• Rebound hammer test - Ultrasonic Pulse velocity test.</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
UIC 105	Surveying 1	FRB 002	3	2	2	1	5	30	20	10	40
Course Contents	Principles of plane surveying; distances measurements (Optical, Electronic), angle and direction measurements; traverse computations; Coordinate systems for engineering works, setting out horizontal and vertical curves; earthwork computation; setting out engineering structures and construction projects, Levelling (theory, methods, and equipment)										
References	• Elementary Surveying - An Introduction to Geomatics -Thirteenth Edition-2012-CHARLES D. GHILANI-ISBN-13: 978-0-13-255434-3- ISBN-10: 0-13-255434-8 • Surveying for Civil and Mine Engineers Theory, Workshops, and Practicals-John Walker Joseph L. Awange- 2018-ISBN 978-3-319-53128-1- ISBN 978-3-319-53129-8 (eBook) • Surveying Engineering & Instruments- Valeria Shank- First Edition-2012- ISBN 978-81-323-4403-2										
Laboratory	• Distance measurements • Theodolite parts and calibration • Survey levelling instruments and height determination • Total station parts & software • Coordinates by Total Station • Lay out and setting out by Total Station										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 106	Surveying 2	UIC 105	3	2	0	2	4	30	20	10	40
Course Contents	Introduction to geodesy; Coordinate systems, Map projections, GNSS system concepts and characteristics, signal structure, receivers and antennae; GNSS measurements, GNSS time, error sources and measurement accuracy; position determination techniques – Errors Reduction Techniques, single point and differential positioning, static and kinematic GNSS, post-processing and Real-time processing, DGNSS concepts.										
References	• PRECISION SURVEYING The Principles and Geomatics Practice-JOHN OLUSEGUN OGUNDARE-2015-ISBN 978-1-119-10251-9 • Geodesy- Introduction to Geodetic Datum and Geodetic Systems-Zhiping Lu - Yunying Qu - Shubo Qiao-2014-ISBN 978-3-642-41244-8- ISBN 978-3-642-41245-5 (eBook) • ENGINEERING SATELLITE-BASED NAVIGATION AND TIMING-Global Navigation Satellite Systems, Signals, and Receivers-John W. Betz-2016-ISBN: 978-1-118-61597-3										

Code	Course Name	Pre-	Cr.	Ct. Hr.	Assessment

		req.	Hrs.	Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 108	Engineering Geology	---	2	2	0	1	3	30	20	10	40
Course Contents	Earth composition. Major types of rocks and deposits. Soil and rock cycle. Minerals identification and classification. Clay minerals. Principles of structural geology: joints, faults, folds and landforms. Subsurface exploration: techniques and tests. Influence of geological origin on composition and structure of soils. Substance and mass properties of rock: compressibility, shear strength and permeability. Weathering and engineering aspects of transported soils: alluvial, colluvial, glacial, coastal, aeolian, lacustrine and residual soils. Soil description and engineering classification.										
References	• Basic Environmental and Engineering Geology by Bell, F.G., SPON, ISBN: 978-0-8155-1761-0, 978-0-8155-1340-7, 1-904445-02-0, 978-1-904445-02-9, 978-1-4200-4470-6										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	PE/OE
UIC 107	CAD for Civil Engineers	FRM 010	2	1	3	0	4	30	20	10	40
Course Contents	Application of AutoCAD Program in drawing different types of civil structures (Irrigation structures – Reinforced concrete structures – Steel structures- urban transportation systems).										
References	• A Textbook of Engineering Drawing: Along with an Introduction to AutoCAD, International Publishing House, 2015. ISBN 9789384588687										
Laboratory	• Irrigation structures drawing. • Reinforced concrete structures drawing. • Steel structures drawing. • Transportation systems drawing.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
UIC 109	Fluid Mechanics	FRB 005	2	2	1	0	3	30	20	10	40

Course Contents

Dimensions and Units - Fluid Properties - Fluid Statics (Pressure distribution - Pressure measurements - Forces on submerged surfaces) - Buoyancy and Floatation - Fluids in Relative Equilibrium - Fluid Kinematics (Description of Fluids motion - Continuity Equation - Velocity and Acceleration) - Fluid Dynamics (Energy Equation - Applications of Bernoulli's Equation) - Impulse-Momentum Equation - Application of the Momentum Equation - Flow in Pipes – Pipes Systems.

References

- A Brief Introduction to Fluid Mechanics, sixth Edition by Donald F. Young, Bruce R. Munson, Theodore H. Okiishi, Wade W. Huebsch, Wiley 2010, ISBN: 0470596791, 9780470596791
- E. Shashi Menon, "Liquid Pipeline Hydraulics", Marcel Dekker, 2004.

Laboratory

- Determine Densities, Specific Gravities, Weights and Viscosity.
- Bernoulli's Theorem Demonstration.
- Flow through sharp edged Orifice.
- Flow over Rectangular and Triangular Weirs.
- Friction in a smooth bore pipe, Minor loss Experiment.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
UIC 110	Hydraulics	UIC 109	2	2	1	0	3	30	20	10	40

Course Contents

Basic Principles (open channel flow) - Uniform Flow (Basic equations for steady uniform flow - Velocity and shear stress distributions in open channels) – Non-Uniform Flow (Specific energy - Hydraulics of channel bed transition) - Hydraulic Jumps - Gradually Varied Flow - Open Channel Design (Rigid boundary and erodible channel) - Dimensional analysis and Similarity (Methods of dimensional analysis - Model analysis and similarity) – Hydraulics Machinery (Pumps and Turbines)

References

- Chadwick, A., Morfett, J. and Borthwick, M. (2021), Hydraulics in Civil and Environmental Engineering, 6th Edn., Published June 8, 2021, by CRC Press. ISBN 9780367460891.
- Strum, W. T., (2001). Open Channels Hydraulics, McGraw-Hill Higher Education, USA.
- Wynn P. (2014), Hydraulics for Civil Engineers by, ICE Publishing. First Edition. ISBN-13: 978-0727758453.

Laboratory

- Open Channel Flow
- Hydraulic Jump
- Pump Characteristics

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 201	Transportation Planning	UIC 106	2	2	0	1	3	30	20	10	40

Course Contents

Introduction to transportation planning - Study area - Transportation planning surveys - Travel demand forecasting (Trip generation - Trip distribution - Modal split (Mode Choice) - Traffic assignment) - Transportation evaluation

References

- Traffic and Highway Engineering, Nicholas Garber and Lester Hoel, Fifth Enhanced SI Edition, CENGAG Learning, 2020, ISBN-13: 978-1-337-63104-4.
- الكود المصرى للطرق – 2016 .

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
UIC 202	Traffic Engineering	FRB 201	3	2	1	2	5	30	20	10	40

Course Contents

Introduction (Road user characteristics - Vehicle characteristics) - Traffic volume - Traffic speed - Traffic density - Travel time and delay studies - Traffic Flow characteristics - Parking studies - Traffic control devices - Intersection control - Traffic signals design.

References

- Traffic and Highway Engineering, Nicholas Garber and Lester Hoel, Fifth Enhanced SI Edition, CENGAG Learning, 2020, ISBN-13: 978-1-337-63104-4.
- الكود المصرى للطرق – 2016 .

Laboratory

- Traffic surveys (traffic volume count)
- Speed & delay study
- Parking study
- Roadside and household interviews.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 203	Design of R.C. Structures-1	UIC 102 +UIC 104	3	2	0	2	4	30	20	10	40
Course Contents	Properties of concrete materials - Ultimate limit states design method - Design of sections under pure bending moment (Rectangular, L & T - sections) - Load distribution – Design of section under shear – Design simple and continuous beams - Design of one-way and two-ways solid slabs - Design of hollow block slabs - Design of panelled beams.										
References	• Egyptian Code for Design & Construction of Reinforced Concrete Structures – ECOP 203-2018 • Design of Concrete Structures, Arthur H Nilson, D.Darwin, Charles W. Fifteenth Edition,2016. • Design of reinforced concrete structures, Mashhour Ghoneim, Mahmoud Elmihilmy, Volume I, second edition, 2012. • Design of reinforced concrete structures, Mashhour Ghoneim, Mahmoud Elmihilmy, Volume 2, Third edition, 2012. • Fundamentals of Reinforcement Concrete and Prestressed concrete, M.Hilal, 1987.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 204	Design of R.C. Structures-2	UIC 203	3	2	0	2	4	30	20	10	40
Course Contents	Design of flat slabs - Design of sections subjected to bending moment and axial force - Analysis and design of columns – Design of RC frames -Design of Sections under Torsion- Serviceability limit states (deflection - crack width). Design of water structures (Circular tank - rectangular tanks - Underground tanks - Elevated tanks - Wide tanks)										
References	• Egyptian Code for Design & Construction of Reinforced Concrete Structures – ECOP 203-2018 • Design of Concrete Structures, Arthur H Nilson, D.Darwin, Charles W. Fifteenth Edition,2016. • Fundamentals of Reinforcement Concrete and Prestressed concrete, M.Hilal, 1987. • Design of reinforced concrete structures, Mashhour Ghoneim, Mahmoud Elmihilmy, Volume 2, Third edition, 2012. • Design of reinforced concrete structures, Mashhour Ghoneim, Mahmoud Elmihilmy, Volume 3, First edition, 2011.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 205	Environmental Engineering	FRB 102	2	2	0	1	3	30	20	10	40
Course Contents	Introduction to environmental engineering, pollution problems, types of pollution, degrees of Pollution, sources of pollution, surface water pollution, groundwater Pollution, rainwater Pollution, sea & ocean water pollution, air pollution. Soil pollution, pollution control, pollution prevention. Samples conditions, chemical pollutions measuring in water, microbiological & biological pollution measuring in water, field pollution monitoring . Water supply, wastewater systems, air pollution.										
References	• An Integrated Approach to Environmental Management by Dibyendu Sarkar (Editor), Rupali Datta (Editor), Avinandan Mukherjee (Editor), Robyn Hannigan (Editor), Wiley, 2015.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
UIC 206	Water Supply Engineering	UIC 110+UIC 205	3	2	2	1	5	30	20	10	40
Course Contents	Introduction, Preliminary studies for water supply projects, sources of water, water quality and standards, design flow rates, water collection, Design of water treatment plants using conventional processes (Sedimentation - Coagulation and Flocculation - Filtration - Disinfection), water pumping and transportation works, water storage.										
References	• Water and Wastewater Technology: Pearson New International Edition, ISBN-13: 9781292021041 Lectures presentations • Water Engineering-Hydraulics, Distribution and Treatment,2015, ISBN 978-0-470-39098-6 • شبكات المياه - الكود المصرى • محطات تنقية مياه الشرب - الكود المصرى										
Laboratory	• Determine Turbidity, PH, Temperature, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Volatile Solids (VS), Chloride, Iron and Manganese, Arsenic, Fluorides and total bacteria account										

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>Mid 2</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>UIC 207</td><td>Hydrographic Surveying</td><td>UIC 106</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">introduction to natural phenomena and their effect on coasts and harbours - Planning factors which affect the design of harbours and their protection. Different kinds of hydrographic survey - Engineering projects that need the application of hydrographic surveying applications - Instruments used in hydrographic surveying, kinds and accuracies - Navigation tools used marine scanning - Topographic maps production of seabed - Different methods for volumes computations of sea bed for different hydrographic projects.</td></tr>
<tr><td>References</td><td colspan="11">• Manual of Offshore Surveying for Geoscientists and Engineers, by R. P. Loweth, Springer Netherlands (1997), ISBN: 978-94-010-6461-3, 978-94-011-5826-8
• Surveying for Civil and Mine Engineers, Theory, Workshops, and Practicals, John Walker • Joseph L. Awange, 2018, ISBN 978-3-319-53128-1</td></tr>
</table>

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>Mid 2</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>UIC 208</td><td>Under-Ground Utility Surveying</td><td>UIC 106</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Basics of Surveying the Underground - Transferring Traversing and Levelling Measurements Transferring surface coordinates to underground workings Understanding limitations of transfer techniques - Traditional Methods to Map Utilities -Common Utility Types - Basic introduction to utility detection theory and methods –Electromagnetic pipe and cable locators Basic Ground Penetrating Radar (GPR) - Principles- Electro Magnetic VS GPR Comparison.</td></tr>
<tr><td>References</td><td colspan="11">• Walker J, Awange JL (2018) Surveying for Civil and Mine Engineers. Springer Nature.
• Awange J, Paláncz B Geospatial Algebraic Computations. 3rd edition. Springer-Verlag GmbH- ISBN 978-3-030-45803-4
• Costello, Brad, UNDERGROUND CHECK SURVEY, ENG4111/4112 – Undergraduate dissertation, University of Southern Queensland, 2016. (https://eprints.usq.edu.au/31389/1/Costello_B_Gharineiat.pdf)
• Erica Carrick utsi (2017) Ground Penetrating Radar Theory and practice – Elsevier - Paperback ISBN: 9780081022160</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid</th><th>PE/OE</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>UIC 209</td><td>Soil Mechanics</td><td>UIC 103</td><td>3</td><td>2</td><td>2</td><td>1</td><td>5</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Introduction to Geotechnical Engineering - Definitions and Relationships - Index Properties of Soil - Soil Classification Systems (Unified – British) - Permeability and Seepage of Soil (Darcy's Law - Capillarity in Soils - Flow Net Analysis) - Stress Distribution in Soil (Point load – Uniform Load (Newmark – Fadum - Approximation)) - Shear Strength of Soil (Direct Shear Box - Triaxial– Unconfined Compression) - Lateral Earth Pressure (Active and Passive) - Soil Compaction (Standard Proctor - Modified Proctor).</td></tr>
<tr><td>References</td><td colspan="11">• El-Kasaby, E. A., Soil Mechanics, Dar Al-Kutub Al-Almia, Cairo, 5th Ed., (21371/2013), ISBN 978 – 977 – 726 – 041 – 1, 2014.
• Das, B. M, Soil Mechanics Laboratory Manual, Oxford University Press, 9th. Ed., ISBN 978 – 019 – 020 – 966 – 7, 2016 .</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Specific Gravity Determination.
• Atterberg Limits (Liquid Limit – Plastic Limit – Shrinkage Limit).
• Grain Size Distribution - Coarse Grained Soils. (Sieve Analysis).
• Grain Size Distribution - Fine Grained Soils (Hydrometer Analysis).
• Determination of Natural Unit Weight of Soil (Sand Bottle Test - Core Cutter Test).
• Constant Head Permeability Test.
• Falling Head Permeability Test.
• Direct Shear Box Test.
• Tri-axial Shear Test.
• Unconfined Shear Test.
• Standard Proctor Test.
• Modified Proctor Test.</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
UIC 210	Geotechnical Engineering & Foundations	UIC 209	3	2	2	1	5	30	20	10	40
Course Contents	Soil Consolidation and Settlement (Soil Consolidation Theory - Primary and Secondary Settlement - Oedometer Test) - Bearing Capacity of Soil (Terzaghi Eq. - Mayerhof Eq. – Egyptian Code Eq.) - Shallow Foundations (Construction Considerations - Design Considerations) - Design of Isolated Footings (Square and Rectangular Footings – Footing with Moment) - Design of Strip Footings - Design of Combined Footings - Design of Strap Beam Footings - Design of Rafts (Conventional Method – Ribbed Raft).										
References	• El-Kasaby, E. A., Soil Mechanics, Dar Al-Kutub Al-Almia, Cairo, 5th Ed., (21371/2013), ISBN 978 – 977 – 726 – 041 – 1, 2014. • El-Kasaby, E. A., Engineering of Surface Foundations, Dar Al-Kutub Al-Almia, Cairo, 5th Ed., (19440/2015), ISBN 978 – 977 – 726 – 139 – 5, 2015. • Das, B. M, Principles of Foundation Engineering, Brooks - Cole, 9th. Ed., ISBN 978 – 133 – 770 – 502 – 8, 2017. • Das, B. M, Soil Mechanics Laboratory Manual, Oxford University Press, 9th. Ed., ISBN 978 – 019 – 020 – 966 – 7, 2016.										
Laboratory	• One Dimensional Consolidation Test (Oedometer Test). • SPT: Standard Penetration Test. • CPT: Cone Penetration Test. • Plate Loading Test.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
UIC 301	Computer Applications	FRE 012	2	1	3	0	4	30	20	10	40
Course Contents	Suitable computer programming language. Computer applications in Infrastructures engineering (numerical applications, and engineering applications).										
References	• Computer Applications in Civil Engineering by Paul D. Spindel, Van Nostrand Reinhold Company.										
Laboratory	• A suitable computer programming language. • Computer applications by Infrastructures software package.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 302	Highway Engineering II	UIC 303	3	2	0	2	4	30	20	10	40

Course Contents	Geometric design: At-grade intersection design - Interchange design - Capacity and level of service analysis on basic freeway and multilane highway segments - Capacity and level of service analysis of weaving, merge and diverge segments on freeways and multilane highways - Highway traffic safety. Structural design: Stresses in rigid pavement - Rigid pavement design - Asphalt concrete mix planet - Pavement layers construction - Pavement maintenance - Drainage.
References	• Traffic and Highway Engineering, Nicholas Garber and Lester Hoel, Fifth Enhanced SI Edition, CENGAG Learning, 2020, ISBN-13: 978-1-337-63104-4. • Traffic Engineering, Roger P. Roess - Elena S. Prassas and William R. McShane, Fifth Edition, Pearson, 2019, ISBN-13: 978-9353434854. • AASHTO, A Policy on Geometric Design of Highways and Streets “Green Book”, 7th Edition, ISBN-13: 978-1560516767. • Pavement Analysis and Design, Yang Huang, Second International Edition, Pearson, 2012, ISBN-13: 978-0-13-272610-8.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
UIC 303	Highway Engineering I	UIC 201	3	2	2	1	5	30	20	10	40

Course Contents	Geometric design: Functional Classification of Roads & Cross Section Elements, sight distance, Vertical Alignment, Horizontal Alignment. Structural design: Pavement types and components - Subgrade soil classification - Subgrade soil strength- Soil compaction - Soil stabilization - Stresses in flexible pavement - Flexible pavement design - Testing and specifications of road aggregates - Testing and specifications of bituminous materials - Hot mix asphalt concrete characteristics and design.
References	• Traffic and Highway Engineering, Nicholas Garber and Lester Hoel, Fifth Enhanced SI Edition, CENGAG Learning, 2020, ISBN-13: 978-1-337-63104-4. • AASHTO, A Policy on Geometric Design of Highways and Streets “Green Book”, 7th Edition, 2018, ISBN-13: 978-1560516767. • Pavement Analysis and Design, Yang Huang, Second International Edition, Pearson, 2012, ISBN-13: 978-0-13-272610-8. • Hot Mix Asphalt Materials, Mixture Design and Construction, E. Ray and Prithvi S. Kandhal and Freddy L. Roberts and Y. Richard Kim and Dah-Yinn Lee and Thomas W. Kennedy Brown , Third Edition, National Asphalt Pavement Association Research and Education Foundation, 2009, ISBN-13 : 978-0914313021
Laboratory	• Tests of sub grade soil, • Tests of road aggregates • Tests of bituminous materials • Hot mix asphalt concrete design (Marshall Method)

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>Mid 2</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>UIC 304</td><td>Water Distribution &Sewer System design</td><td>UIC 206+ UIC 307</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Water distribution systems:
Introduction of water network, Classification of Water Distribution System, Requirements of a Good Water Distribution System, Basic Principles of Hydraulics Applicable to Water Distribution Systems, Design of Water Distribution System, Water Quality in Water Distribution Systems.
Sewer systems:
Introduction, types of sewer system (planning of sewer system, sewer pipes, sewer appurtenances, design of sewer system</td></tr>
<tr><td>References</td><td colspan="11">• Water and Wastewater Calculations Manual by Shun Lin, C. Lee, McGraw-Hill Professional, 2 Edition, 2007
• Water Engineering-Hydraulics, Distribution and Treatment,2015, ISBN 978-0-470-39098-6</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>Mid 2</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>UIC 305</td><td>Design of Metallic Structures-1</td><td>UIC 102</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Steel as a construction material - Material properties and steel sections - Allowable Stress Design method - Design of tension members - Design of compression members - Columns in braced and unbraced frames - Design of flexural members - Types and classification of beam cross sections - Design of laterally supported and unsupported beams - Design of beam-columns (axial and flexural forces) - Design of bolted connections - Design of welded connections.</td></tr>
<tr><td>References</td><td colspan="11">• Egyptian code for design of steel structure.
• Advanced Steel Design of Structures, by Prof. Srinivasan Chandrasekaran, Indian Institute of Technology, India. ISBN-13 9780367232900
• Steel Designers' Manual, by (Steel Construction Institute), Edited by Buick Davison and Graham W. Owens, ISBN-13 9781119249863
• Design of Metallic Structures, EHAB ELLOBODY, RAN FENG, BEN YOUNG, 2014, ISBN: 978-0-12-416561-8</td></tr>
</table>

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 306	Ground Water Hydrology	UIC 110	3	2	0	2	3	30	20	10	40
Course Contents	Introduction: Groundwater and hydrologic cycle, Importance of groundwater, the relation of groundwater to geologic structure, Types and physical properties of aquifers, Aquifer systems in Egypt. Groundwater exploration methods. Groundwater hydraulics: Infiltration, Seepage, Percolation, Darcy's law, Hydraulic conductivity measurements, Flow governing equations. Well hydraulics: Flow towards wells, Safe yield, Well construction, well development and pumping tests. Well evaluation. Introduction to Groundwater quality and pollution: Pollution sources. Pollution control and remedy measures.										
References	• Mays, L.W., Ground and surface water hydrology. John Wiley & Sons, Inc., 2012. ISBN: 978-0-470-16987-2 • Subramanya, K., Engineering Hydrology. 4th Edition 2017.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 307	Wastewater Engineering	UIC 205	3	2	0	2	4	30	20	10	40
Course Contents	Wastewater characteristics, Wastewater treatment works, Wastewater disposal works, Treated wastewater reuse, Industrial wastes. Preliminary studies for wastewater projects. Wastewater collection systems: flow rate. Physical, Chemical, and biological processes for wastewater treatment.										
References	• Wastewater Engineering - Treatment and Reuse (4th edition), by Metcalf & Eddy 2004, ISBN: 0070495394, 9780070495395 • Water Engineering-Hydraulics, Distribution and Treatment,2015, ISBN 978-0-470-39098-6										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	PE/OE	St. Act.	Final
UIC 308	Senior Design Project I	*	2	0	4	0	4	---	50	50	--
Course Contents	Topics are selected by groups of students according to their area of interest (Transportation Engineering OR Geomatics and Environmental Engineering OR Water Engineering) upon advisor approval. Projects address solution to open ended applications using an integrated engineering approach.										
References	• According to the selected project.										
Laboratory	• According to the selected project.										

* The student can register the Senior design Project course after passing 70% of the program cr. hrs, i.e., 112 Cr. Hr.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 309	Design of Foundations and Earth Retaining Structures	UIC 210	3	2	0	2	4	30	20	10	40
Course Contents	Pile Foundations (Types of Piles - Load Transfer Mechanisms - Static Capacity for Piles - Field Load Tests – Pile Group – Elastic Centre Method - Design of Pile Caps) - Introduction to Earth Retaining Structures - Pile wall (Secant piles - Tangent Piles - Bored Pile Wall) - Construction Techniques and Design of Retaining Walls (Cantilever RW – Counterfort RW) – Introduction to Reinforced Soil RW - SPW.										
References	• El-Kasaby, E. A., Design and Construction of Deep and Special Foundations, Dar Al-Kutub Al-Almia, Cairo, 4th Ed., (10651/2016), ISBN 978 – 977 – 726 – 168 – 5, 2016. • Das, B. M, Principles of Foundation Engineering, Brooks - Cole, 9th. Ed., ISBN 978 – 133 – 770 – 502 – 8, 2017. • Bowles, J., Foundation Analysis and Design, McGraw - Hill, 5th. Ed., ISBN 978 – 007 - 912 – 247 – 7, 2009.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 401	Infrastructure Management &Financing	-----	3	2	0	2	4	30	20	10	40
Course Contents	An introduction to infrastructure management systems, including management process, data collection technologies, interdependence, benchmarking, and best practices for sustainability. Other related issues, such as, resilience security of infrastructure systems are addressed, infrastructure economics, infrastructure, management systems, preparation of safety and health roles in the project and infrastructure planning under risk and uncertainty										
References	• Information Systems for Engineering and Infrastructure Asset Management, by Abrar Haider, Gabler Verlag 2013, ISBN: 978-3-8349-4233-3, 978-3-8349-4234-0										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	PE/OE	St. Act.	Final
UIC 403	Senior Design Project II	UIC 308	3	1	4	0	5	---	50	50	--
Course Contents	Topics are selected by groups of students according to their area of interest (Transportation Engineering OR Geomatics and Environmental Engineering OR Water Engineering) upon advisor approval. Projects address solution to open ended applications using an integrated engineering approach.										
References	• According to the selected project.										
Laboratory	• According to the selected project.										

Elective Courses

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 311	Dynamic of Structures	UIC 102	3	2	0	2	4	30	20	10	40
Course Contents	Types of dynamic loads and the formulation of the equation of motion. Single degree of freedom systems, free and forced vibrations of multi degree of freedom systems. Response of structures to earthquakes. Design response spectra for structures, Design criteria for seismic resistant structures, Seismic response of tall buildings.										
References	• Dynamics of Structures by Anil K. Chopra, Pearson, 4 Edition, 2011.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 313	Tunnels and Underground Structure	UIC 210	3	2	0	2	4	30	20	10	40
Course Contents	History of tunnels – Using of tunnels – Hydraulic tunnels classification - Tunneling methods in soft ground – Tunneling in rock – Rock mass evaluation systems – Technology of tunnels in soil and rock – Design of tunnel supporting systems – Planning and design of site investigation – Instrumentation, monitoring and evaluation of engineering behavior of underground structures – Numerical analysis of tunnels.										
References	Underground Structures: Design and Instrumentation, by R.S. Sinha, Academic Press, Elsevier 1989, ISBN: 978-0-444-87462-7 • Handbook of Tunnel Engineering, Volume I: Structures and Methods, by Bernhard Maidl, Markus Thewes, Ulrich Maidl, David S. Sturge, Ernst & Sohn 2013, ISBN: 9783433030486, 9783433603505, 9783433603512, 9783433603529, 978343360349.										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 315	Special Topics in Structural Analysis	UIC 102	3	2	0	2	4	30	20	10	40
Course Contents	Elements of plate bending theory, circular plates, rectangular plates, large deflections of plates. Membrane stresses in shells, bending stresses in shells. Applications to pipes, tanks and pressure vessels.										
References	• Theory of plates and shells by S.S. Bhavikatti, 2016, ISBN-10 9386070812, ISBN-13 978-										

	9386070814.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 310	Photogrammetry by Drones	UIC 106	3	2	0	2	4	30	20	10	40
Course Contents	Photogrammetry principles - Classifications of Photogrammetry according to the purpose - Classification of the Photogrammetry according to the sensor location - Aerial Photogrammetry - Terrestrial Photogrammetry - Close Range Photogrammetry (CRP) - UAV Photogrammetry - UAV Classification - UAV images processing techniques.										
References	• Handbook of Unmanned Aerial Vehicles- Kimon P. Valavanis • George J. Vachtsevanos-2015- ISBN 978-90-481-9706-4 -ISBN 978-90-481-9707-1 (eBook) • UAV-Based Remote Sensing -Volume 2- Felipe Gonzalez Toro - First Edition -2018- ISBN 978-3-03842-856-5										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 312	Remote Sensing	UIC 106	3	2	0	2	4	30	20	10	40
Course Contents	Basics and principles of remote sensing, Definitions, Energy sources. Advantages of remote sensing technique. Photo and image interpretation. Control points and ground truth observations. Field work steps. Remote sensing application in civil and environmental engineering. Image processing and interpretations.										
References	• REMOTE SENSING AND IMAGE INTERPRETATION- Thomas M. Lillesand, Emeritus - Seventh Edition-2015- ISBN 978-1-118-34328-9. • Remote Sensing Digital Image Analysis: An Introduction, by John A. Richards, Xiuping Jia, Springer 2005, ISBN 9783540251286, 3-540-25128-6										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 314	Geographic Information System GIS	UIC 106	3	2	0	2	4	30	20	10	40
Course Contents	Introduction to geographic information systems (GIS) -type, source and format of data. GIS components, Data models: coordinates, attribute data and types, vector data models, Raster Data models, Data and file structure. Map projection and coordinate systems. Building a GIS data base, digitizing, coordinate transformation. Digital Data. Attribute data and tables. Basic spatial analysis in infrastructure projects.										

References	• An Introduction to Geographical Information Systems, by Ian Heywood, Sarah Cornelius, Steve Carver, Prentice Hall 2006, ISBN: 0-13-129317-6, 978-0-13-129317-5, 9781405898447

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 316	Environmental Impact Assessment	UIC 205	3	2	0	2	4	30	20	10	40
Course Contents	Main parameters of environment impact on the projects. Environmental Impact of the project on the human. Environmental Impact of the project on animals and plants. Environmental impact of the project on the rest of components of the environment. Environmental impact of the project during and after the construction. Environmental impact assessment in Egypt and different countries. Steps for performing environmental impact assessment. Case studies and applications.										
References	• Environmental impact assessment: a guide to procedures, by DETR & The National Assembly for Wales, Thomas Telford Publishing 2000, ISBN: 2016-05-22 07:20:00 • Environmental Impact Assessment and Strategic Environmental Assessment: Towards an Integrated Approach, by Hussein Abaza, Ronald Bisset, Barry Sadler, ISBN: 9280724290, 9789280724295 • AIR POLLUTION ,EALTH AND ENVIRONMENTAL IMPACTS, BHOLA R, GURJAR,2010, ISBN 13: 978-1-439-0963-1										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab	Tut	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 318	Sustainable Transportation and Highways Engineering	UIC 202	3	2	0	2	4	30	20	10	40
Course Contents	Overview & analysis of concepts & designs for sustainable transportation from global-to-local, interdisciplinary perspective, including pedestrians, bicyclists, and public transportation. Addresses economy, environment, and equity. Hands on design project.										
References	• Sustainable Transportation Systems Engineering- Francis M. Vanek, -Largus T. Angenent, -.James H. Banks, 2014- ISBN: 9780071800129										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab	Tut	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 320	Sustainable Environmental Engineering	UIC 205	3	2	0	2	4	30	20	10	40
Course Contents	Sustainability. Sustainable water supply. Sustainable sanitation. Sustainable solid waste management. Life cycle analysis. Sustainable cities. Sustainable communities. Sustainable living. Leadership in Energy and Environmental Design (LEED) accreditation for buildings. Greenhouse gas emissions. Biodiversity. Sustainable water supply. Case studies and applications.										

<table>
<tr><td>References</td><td>

- Environmental Engineering: Designing a Sustainable Future (Green Technology), by Anne E. Maczulak, Facts on File 2009, ISBN: 9780816072002, 0816072000, 9781438127477

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>Mid 2</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>UIC 405</td><td>Pavement Evaluation and Management</td><td>UIC 303</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Structural and functional evaluation of pavements, flexible pavements by, Analysis of data, interpretation and applications. Use of modern equipment for pavement surface condition measurements. Evaluation of new pavement materials- Model studies, pavement testing Under controlled conditions, accelerated testing and evaluation methods. Instrumentation for pavement testing. Introduction to pavement management: components & principals of pavement management systems, pavement maintenance measures, planning investment, research management. Pavement Performance Prediction. Modelling in rehabilitation budget planning.</td></tr>
<tr><td>References</td><td colspan="11">

- Pavement Evaluation and Management System, R SRINIVASA. KUMAR, 2014. ISBN 9788173719226.
- Pavement Evaluation and Management, Faiq M. Sarhan Al-Zwainy, 2020, ISBN 0244561087.

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>Mid 2</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>UIC 407</td><td>Airports Engineering</td><td>UIC 303</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Types of airports – Airport planning and configuration – Geometric design of the landing area and runway direction – Safety areas – Instrument landing system – Marking and signing of airport – Airport lighting – Soil classification for airports - Structural design methods for flexible and rigid pavements of airports</td></tr>
<tr><td>References</td><td colspan="11">

- Planning and Design of Airports, by Robert Horonjeff, Francis McKelvey, William Sproule, Seth Young, McGraw-Hill Professional 2010, ISBN: 0071446419, 9780071446419
- Airport Design and Operation, ANTONI´N KAZDA & ROBERT E. CAVES, Emerald Group Publishing Limited, Third Edition, 2015, ISBN: 978-1-78441-870-0.

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid 1</th><th>Mid 2</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>UIC 409</td><td>Railway Engineering</td><td>UIC 201</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Introduction to Railways Engineering, Urban and Sub-urban design of railways, Vertical and horizontal curves- rails design- wood and concrete sleepers design- stresses in gravels section– railways intersections- signs and design of control stations; Economical and environmental effect of railways.</td></tr>
<tr><td>References</td><td colspan="11">

- Practical railway engineering, by Clifford F. Bonnett, Imperial College Press; Distributed by

</td></tr>
</table>

	World Scientific Pub 2005, ISBN: 1860945155, 9781860945151 • Railway Engineering, by Satish Chandra, M.M. Agarwal, 2nd edition 2013, ISBN-10: 019808353X.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 411	Cost Engineering & Quantity Surveying	------	3	2	0	2	4	30	20	10	40
Course Contents	Introduction to project cost estimate, Conceptual estimating, cost indices, Quantity take-off methods, estimating costs for construction material, labour, equipment, project overhead, mark-up and profit, unit costs, production rates, and pricing methods, balanced bid and budget form preparation for projects., and bid unbalancing.										
References	• David Bratt, Fundamentals of Construction Estimating, 4th edition, Cengage Learning; 4th edition (January 1, 2018), ISBN-13: 978-1337399395 • Martin Brook "Estimating and Tendering for Construction Work", Taylor & Francis Ltd, 5th edition, (26 Jul 2016), ISBN13: 9781138838062										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 413	Project Planning, Scheduling, and Control	------	3	2	0	2	4	30	20	10	40
Course Contents	Concept of project planning, definition of planning techniques [Bar chart, arrow network, program evaluation and review technique (PERT), critical path method (CPM), line of balance technique (LOB)], Work Breakdown Structure (WBS), logic, networking by using CPM technique, scheduling and control models. Resource allocation and levelling, optimal schedules, documentation and reporting, time and cost control, progress monitoring and evaluation. Computer applications by primavera software package.										
References	• Textbook: Authors: Jimmie-Hinze " Construction Planning and Scheduling" Publisher: Prentice Hall; (International Ed.) 4th edition (January 2013), ISBN-13: 978-9332505735 • Reference: Daniel W. Halpin, Bolivar A. Senior, Gunnar Lucko "Construction Management" John Wiley & Sons, Inc., 5th Edition (August 2017), ISBN: 978-1-119-25680-9										

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid 1	Mid 2	St. Act.	Final
UIC 415	Construction Project Specifications, Bids, and Contracts	-----	3	2	0	2	4	30	20	10	40

Course Contents: Participants in a construction contract. Contract definition. Types of contracts; formation principles of a contract, performance or breach of contractual obligations. Analysis and comparison of the different kinds of construction contracts. Bidding logistics. Legal organizational structures. Different types and uses of specifications. Different forms of contracts utilized in construction.

References:
- Daniel W. Halpin, Bolivar A. Senior, Gunnar Lucko "Construction Management" John Wiley & Sons, Inc., 5th Edition (August 2017), ISBN: 978-1-119-25680-9
- Will Hughes, Ronan Champion, John Murdoch "Construction Contracts Law and Management" Published by Routledge (Taylor & Francis), April, 2015 ISBN 9780415657044.

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
UIC 417	Computer Applications in Sanitary Engineering	UIC 304	3	2	2	0	4	30	20	10	40

Course Contents: introduction to Water Cad software: Training to feed the software with the input data such as: water demand, flow pattern, peak flow factors, elevated tanks data, pumps data, and junction ground levels, and fire hydrants data. Introduction to Sewer CAD: Training to feed the software with the input data such as flow at each manhole, conduit catalogues design constrains in Sewer CAD (such as minimum and maximum slopes minimum and maximum covers, velocity of flow, partially full and manhole). Laboratory training on using Water Cad and Sewer CAD (data entry and output data).

References:
- WaterCad & SewerCad manual

Laboratory:
- Training on using WaterCad and SewerCad (data entry and output data).

Code	Course Name	Pre-req.	Cr. Hrs.	Ct. Hr.				Assessment			
				Lect.	Lab.	Tut.	Sum	Mid	PE/OE	St. Act.	Final
UIC 419	Computer Applications in Transportation Systems	UIC 303	3	2	2	0	4	30	20	10	40

Course Contents: This course focuses on the fundamentals behind some of the most popular computer software packages used in the planning, design, operations, and management of transportation systems. Topics includes highway planning and design, pavement design, signal optimization, forecasting of traffic flows and passenger volumes, simulation of traffic and transit systems, design, and evaluation of Intelligent Transportation Systems.

References:
- The manual of the used software.

LAB.:
- According to used software.

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lect.</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>Mid</th><th>PE/OE</th><th>St. Act.</th><th>Final</th></tr>
<tr><td>UIC 421</td><td>Programing Applications in Survey</td><td>UIC 106</td><td>3</td><td>2</td><td>2</td><td>0</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">This course focuses on the fundamentals of the most popular computer software packages used in surveying engineering. Topics includes General software for surveying: Civil Cad, SURFER, Agi soft meta shape Program, ENVI Program</td></tr>
<tr><td>References</td><td colspan="11">• Handbook of Unmanned Aerial Vehicles- Kimon P. Valavanis • George J. Vachtsevanos-2015- ISBN 978-90-481-9706-4 -ISBN 978-90-481-9707-1 (eBook)
• REMOTE SENSING AND IMAGE INTERPRETATION- Thomas M. Lillesand, Emeritus - Seventh Edition-2015- ISBN 978-1-118-34328-9</td></tr>
<tr><td>Laboratory</td><td colspan="11">• ARC GIS Program</td></tr>
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Program # 13 Mechatronics and Automation Engineering Program

Program Description

Mechatronics and automation engineering program is the field concerned with the integration between mechanical systems, electrical systems and computer control systems to develop a new multidisciplinary system with better functionality and to convert conventional machines into automated and smart ones. Mechatronics and automation technologies are widely used in several applications and various aspects of industry including robotics, CNC machines, automotive industries, AI applications, etc.

Basic Information

Program Mission

Mechatronics and automation program aims to prepare an outstanding engineer with the skills required to handle fully automated industrial systems with high standards of safety and security. Additionally, it aims to help students develop the essential knowledge needed to keep up with the modern technologies to successfully compete in the current dynamic labor market. Mechatronics and automation graduates will possess sufficient expertise to serve the community in several multidisciplinary sectors.

Program Objectives

Upon completion of this program, mechatronics and automation engineering program graduates are expected to be able to:

PO1. Apply a wide spectrum of engineering knowledge, science, and specialized skills with analytic, critical, and systematic thinking to identify and solve engineering problems in real life situation.
PO2. Behave professionally and adhere to engineering ethics and standards and work to develop the profession and community and promote sustainability principles.
PO3. Work in and lead a heterogeneous team and display leadership qualities, business administration, and entrepreneurial skills.
PO4. Use techniques, skills, and modern engineering tools necessary for engineering practice.
PO5. Master self-learning and life-long learning strategies to communicate effectively in academic/professional fields.
PO6. Design and develop multidisciplinary systems to solve industrial problems.
PO7. Use modern engineering techniques, skills and methods to control Mechatronics applications.

Graduate Attributes (GA)

According to graduate attributes defined by NARS 2018, graduates should be able to:

GA1. Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real life situations.
GA2. Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation.
GA3. Behave professionally and adhere to engineering ethics and standards.
GA4. Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance.
GA5. Recognize his/her role in promoting the engineering field and contribute to the development of the profession and the community.
GA6. Value the importance of the environment, both physical and natural, and work to promote sustainability principles.
GA7. Use techniques, skills, and modern engineering tools necessary for engineering practice.
GA8. Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post-graduate and research studies.
GA9. Communicate effectively using different modes, tools, and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner.

GA10. Demonstrate leadership qualities, business administration and entrepreneurial skills.

In addition to all engineering and mechanical engineering graduate attributes defined by NARS 2018, mechatronics engineering graduate should be able to:

GA11. Demonstrate the theoretical and practical knowledge of multi disciplines within mechatronics systems.

GA12. Use latest technologies and apply knowledge in various disciplines to identify and solve complex mechatronics problem.

GA13. Design, develop, and conduct experimental tests in the mechatronic engineering.

GA14. Work efficiently and integrally in a multidisciplinary team with leading skills.

Program Learning Outcomes (PLO)

- **Level A**

The Engineering Graduate must be able to:

PLO1. Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics.

PLO2. Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess, and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.

PLO3. Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical, and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

PLO4. Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues, and risk management principles.

PLO5. Practice research techniques and methods of investigation as an inherent part of learning.

PLO6. Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements.

PLO7. Function efficiently as an individual and as a member of multi-disciplinary and multi-cultural teams.

PLO8. Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.

PLO9. Use creative, innovative, and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations.

PLO10. Acquire and apply new knowledge, and practice self, lifelong and other learning strategies.

- **Level D**

In addition to the Competencies for All Engineering Programs (Level A, NARS 2018), Mechatronics engineer must be able to:

PLO11. Model, analyze and design physical systems applicable to the specific discipline by applying the concepts of: Thermodynamics, Fluid Mechanics, Material Processing, Material Properties, Measurements, Instrumentation, Control Theory and Systems, Mechanical Design and Analysis, Dynamics, and Vibrations.

PLO12. Plan, manage and carry out designs of mechanical systems and machine elements using appropriate materials both traditional means and computer-aided tools and software contemporary to the mechanical engineering field.

PLO13: Design, model and analyze an electrical/electronic/digital system or component for a specific application; and identify the tools required to optimize this design.

PLO14: Design and implement elements, modules, sub-systems or systems in electrical/electronic/digital engineering using technological and professional tools.

PLO15: Understand the basic principles, theories, and engineering fundamentals within the field of mechatronics engineering including embedded systems, mechatronic systems design, controllers and data communication.

PLO16: Recognize mechatronics as the integration of multiple disciplines in industrial processes.

Benchmark: **University of Sydney**

URL: (https://www.sydney.edu.au/handbooks/engineering/engineering_combined/combined_mechatronic.shtml)

Comparison between Mechatronics and Automation competencies and the adopted learning outcomes of University of Sydney:

Benha University	University of Sydney
PLO15: Understand the basic principles, theories and engineering fundamentals within the field of mechatronics engineering including embedded systems, mechatronic systems design, controllers and data communication.	Demonstrate proficiency with the tools, methods, principles, technical knowledge, and conceptual frameworks of mechatronics, including embedded systems and mechatronic systems design, microcontrollers, and data communication
PLO16: Recognize mechatronics as the integration of multiple disciplines in industrial processes.	Recognise and respond to the interdisciplinary context of mechatronic engineering.

Faculty Mission vs. Program Mission Matrix

<table>
<tr><th colspan="2" rowspan="3">Faculty Mission</th><th colspan="3">Program Mission</th></tr>
<tr><td colspan="3">Mechatronics and automation program aims to prepare an outstanding engineer with the skills required to handle fully automated industrial systems with high standards of safety and security. Additionally, it aims to help students develop the essential knowledge needed to keep up with the modern technologies to successfully compete in the current dynamic labor market. Mechatronics and automation graduates will possess sufficient expertise to serve the community in several multidisciplinary sectors.</td></tr>
<tr><td>Mechatronics and automation program aims to prepare an outstanding engineer with the skills required to handle fully automated industrial systems with high standards of safety and security</td><td>Additionally, it aims to help students develop the essential knowledge needed to keep up with the modern technologies to successfully compete in the current dynamic labor market.</td><td>Mechatronics and automation graduates will possess sufficient expertise to serve the community in several multidisciplinary sectors.</td></tr>
<tr><td rowspan="3">Benha University is committed to graduate well prepared engineers equipped with knowledge and skills necessary to compete in labor market, and capable of using and developing modern technology, and providing research in engineering fields to serve society and community.</td><td>graduate well prepared engineers equipped with knowledge and skills</td><td>√</td><td></td><td></td></tr>
<tr><td>compete in labor market capable of using and developing modern technology, and providing research in engineering fields</td><td></td><td>√</td><td></td></tr>
<tr><td>serve society and community.</td><td></td><td></td><td>√</td></tr>
</table>

Program Mission vs. Program Objectives Matrix

Program Mission		Program Objectives PO1	PO2	PO3	PO4	PO5	PO6	PO7
Mechatronics and automation program aims to prepare an outstanding engineer with the skills required to handle fully automated industrial systems with high standards of safety and security. Additionally, it aims to help students develop the essential knowledge needed to keep up with the modern technologies to successfully compete in the current dynamic labor market. Mechatronics and automation graduates will possess sufficient expertise to serve the community in several multidisciplinary sectors.	Mechatronics and automation program aims to prepare an outstanding engineer with the skills required to handle fully automated industrial systems with high standards of safety and security	√	√		√		√	
	Additionally, it aims to help students develop the essential knowledge needed to keep up with the modern technologies to successfully compete in the current dynamic labor market.	√	√			√		√
	Mechatronics and automation graduates will possess sufficient expertise to serve the community in several multidisciplinary sectors.			√			√	√

Program Objectives vs. Program Competencies Matrix

Program Objectives	**Program Competencies** Level A										Level D					
	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**
PO1	√	√								√	√		√		√	√
PO2		√			√			√				√		√		
PO3			√			√	√		√						√	√
PO4		√	√	√							√		√			
PO5	√				√			√		√		√		√		
PO6															√	√
PO7															√	√

Program Objectives vs. Graduate Attributes Matrix

Program Objectives	Graduate Attributes													
	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12	GA13	GA14
PO1	√	√												
PO2			√		√	√								
PO3				√						√				
PO4							√							
PO5								√	√					
PO6											√	√	√	√
PO7											√	√	√	√

Career Prospects

Graduates of the mechatronics and automation engineering program will be qualified to work in a wide range of careers due to the huge experience they gain throughout their study. They can work in the automated production lines for maintenance, installation and operation purposes. They can also work in various mechatronics applications including robotics, embedded systems, automotive industry, AI-based systems and CNC machines, etc.

Program Concentrations

The graduate of the program can be specialized in one of the following two concentrations:

1. Mechatronics Engineering.
2. Automation Engineering.

The concentration focus is achieved by 23 Credit Hours including 18 Cr. Hrs. of elective courses and 5 Cr. Hrs. as the graduation project, all related to the specific concentration.

List of Mechatronics and Automation Engineering Requirement Courses

Requirement		Cr. Hrs.	Ct. Hr.			
			Lec.	Lab	Tut	Sum
University Requirements		14	14	0	0	14
Faculty Requirements		32	19	14	17	50
Program Requirements	From Basic Science	12	8	0	8	16
	Compulsory Courses	84	42	59	19	120
	Elective Courses	18	12	0	12	24
Total		160	95	73	56	224

Basic Science Requirements of Mechatronics and Automation Engineering

Code	Course Title	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
FRB 001	Analytical geometry & Linear Algebra	--	3	2	0	2	4
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4
FRB 005	Waves and Heat	--	3	2	2	1	5
FRB 006	Electricity and Magnetism	--	3	2	2	1	5
FRB 007	Chemistry for Engineers	--	4	3	2	1	6
FRB 101	Engineering Differential Equations	FRB 002	3	2	0	2	4
FRB 103	Environmental Pollution and Industrial Safety	FRB 007	2	2	1	0	3
FRB 104	Engineering Numerical Analysis	FRB 101	3	2	2	0	4
FRB 201	Applied Engineering Probability and Mathematical Statistics	FRB 002	3	2	2	0	4
FRB 206	Multiple Integrals & Complex Analysis	FRB 002	3	2	0	2	4
Total			**30**	**21**	**11**	**11**	**43**

Faculty requirement Courses

Code	Course	Pre-requisites	Cr. Hrs.	Ct. Hrs.			
				Lec.	Lab.	Tut	Sum
FRB 001	Analytical geometry & Linear Algebra	-----	3	2	0	2	4
FRB 003	Statics	-----	3	2	0	2	4
FRB 005	Waves and Heat	-----	3	2	2	1	5
FRB 007	Chemistry for Engineers	-----	4	3	2	1	6
FRM 009	Engineering Drawing	-----	2	0	0	4	4
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4
FRB 004	Dynamics	FRB 003	3	2	0	2	4
FRB 006	Electricity and Magnetism	-----	3	2	2	1	5
FRM 008	Production Systems Engineering	-----	2	1	3	0	4
FRM 010	Engineering Drawing by Computer	FRM 009	2	1	2	0	3
FRE 012	Computer Programming	-----	2	0	2	2	4
FRB 103*	Environmental Pollution and Industrial Safety	FRB 007	2	2	1	0	3
FT 103	Field Training I	Completion of 65 CH	0	0	0	0	0
FT 203	Field Training II	Completion of 96 CH	0	0	0	0	0
Total			**32**	**19**	**14**	**17**	**50**

Mechanical & Electrical Engineering Disciplines Requirements

Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr. Lec.	Lab.	Tut.	Sum
FRB 101	Engineering Differential Equations	FRB 002	3	2	0	2	4
FRB 104	Engineering Numerical Analysis	FRB 101	3	2	2	0	4
FRB 201	Applied Engineering Probability and Mathematical Statistics	FRB 002	3	2	2	0	4
FRB 206	Multiple Integrals & Complex Analysis	FRB 002	3	2	0	2	4
Total from Basic science			12	8	4	4	16
MAM 101	Fluid Mechanics	FRB 005	3	2	2	1	5
MAM 103	Kinematics of Machines	FRB 004	3	2	1	1	4
MAM 105	Mechanics and Testing of Materials	FRM 008	3	2	2	1	5
MAM 107	Materials Science and Engineering	FRB 006	3	2	2	0	4
MAE 101	Electrical Circuits	FRB 006	2	1	0	2	3
MAM 109	Computer Applications	FRE 012	2	1	2	0	3
MAM 102	Thermodynamics	FRB 005	3	2	1	2	5
MAM 104	Measurement and Instrumentation	FRB 006	2	1	2	1	4
MAM 106	Design of Machine Elements	MAM 105	3	2	3	0	5
MAM 108	Manufacturing Technology	FRM 008	2	1	2	0	3
MAE 102	Electronic Devices and Circuits	MAE 101	2	1	0	2	3
MAM 201	Project Management	FRB 002	2	2	1	0	3
MAM 203	Dynamic Modeling and Simulation	FRB 101	3	2	1	1	4
MAM 205	Fluid Power Systems	MAM 101	2	1	3	0	4
MAM 207	Mechanical Design	MAM 105	3	2	3	0	5
MAM 209	Mechanical Vibrations	FRB 004	3	2	2	1	5
MAE 211	Electric Machinery	MAE 101	3	2	1	1	4
MAM 202	Automatic Control Systems	MAM 209	3	2	2	1	5
MAM 204	Introduction to Mechatronics	MAE 102	3	2	2	0	4
MAE 206	Logic Circuits Design & Applications	MAE 102	3	2	2	0	4
MAM 208	Industrial Robots	MAM 103	3	2	2	0	4
MAM 301	Design of Mechatronic Systems	MAM 204	3	2	2	0	4
MAE 303	Power Electronics	MAE 211	3	2	2	0	4
MAM 309	Technical Reports		1	0	2	0	2
MAM 302	CAD/CAM	MAM 207	3	2	2	0	4
MAE 304	Microprocessors & Microcontrollers	MAE 206	3	2	1	1	4
MAM 306	Engineering Economics		2	2	0	1	3
MAM 390	Senior Design Project I		2	2	0	0	2
MAE 401	Artificial Intelligence	MAE 304	2	1	2	1	4

MAE 403	Programmable Logic Controllers	MAE 206	3	2	2	0	4
MAE 405	Electric Drives	MAE 303	3	2	1	2	5
MAM 490	Senior Design Project II	MAM 390	3	0	6	0	6
Total			**84**	**51**	**60**	**18**	**127**

*The student can register the Senior design Project course after passing 70% of the program cr. hrs., i.e., 112 Cr. Hr.

Major Requirements of Mechatronics and Automation Engineering

Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
MAM 204	Introduction to Mechatronics	MAE 102	3	2	2	0	4
MAE 206	Logic Circuits Design & Applications	MAE 102	3	2	2	0	4
MAM 208	Industrial Robots	MAM 103	3	2	2	0	4
MAM 301	Design of Mechatronic Systems	MAM 204	3	2	2	0	4
MAE 303	Power Electronics	MAE 211	3	2	2	0	4
MAX xxx	Elective I		3	2	0	2	4
MAX xxx	Elective II		3	2	0	2	4
MAM 302	CAD/CAM	MAM 207	3	2	2	0	4
MAE 304	Microprocessors & Microcontrollers	MAE 206	3	2	1	1	4
MAX xxx	Elective III		3	2	0	2	4
MAX xxx	Elective IV		3	2	0	2	4
MAE 405	Electric Drives	MAE 303	3	2	1	2	5
MAE 403	Programmable Logic Controllers	MAE 206	3	2	2	0	4
MAE 401	Artificial Intelligence	MAE 304	2	1	2	1	4
MAX xxx	Elective V		3	2	0	2	4
MAX xxx	Elective VI		3	2	0	2	4
MAM 390	Senior Design Project I		2	2	0	0	2
MAM 490	Senior Design Project II	MAM 390	3	0	6	0	6
Total			**52**	**33**	**23**	**17**	**73**

* Elective courses are selected from two concentrations (x, y)

Concentration Requirements Mechatronics Engineering (concentration "x")

Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
Pool Courses for Elective I, Elective II							
MAM 331	Mobile Robots	MAM 208	3	2	1	1	4
MAE 333	Digital Control	MAM 202	3	2	0	2	4
MAE 335	Computer Interfacing	MAE 206	3	2	0	2	4
Pool Courses for Elective III, Elective IV							
MAM 332	Autonomous systems	MAM 208	3	2	0	2	4
MAE 334	Micro Electromechanical Systems (MEMS)	MAM 301	3	2	0	2	4
MAM 336	Automotive Engineering	MAM 301	3	2	0	2	4
Pool Courses for Elective V, Elective VI							
MAE 431	Embedded System Design	MAE 304	3	2	1	2	5
MAM 433	Biomechatronic	MAM 301	3	2	1	2	5
MAM 435	Autotronics	MAM 301	3	2	1	2	5
Total			**18**	**12**	**4**	**17**	**27**

Concentration Requirements of Automation Engineering (MAX x4x)

Code	Course	Pre-Req	Cr. Hrs.	Ct. Hr.			
				Lec	Lab	Tut	Sum
Pool Courses for Elective I, Elective II							
MAE 341	Industrial Automation	MAM 208	3	2	0	2	4
MAE 343	Machine Vision Systems	MAM 204	3	2	0	2	4
MAM 345	Playware Technology	MAM 208	3	2	0	2	4
Pool Courses for Elective III, Elective IV							
MAE 342	Theory of Automata	MAE 341	3	2	0	2	4
MAM 344	Sensors and Actuators	MAM 208	3	2	0	2	4
MAM 346	Industrial Material Flow Management	MAM 301	3	2	0	2	4
Pool Courses for Elective V, Elective VI							
MAM 441	Hydraulic Servo Control	MAE 341	3	2	0	2	4
MAE 443	Internet of things	MAE 304	3	2	0	2	4
MAM 445	Computer Numerical Control (CNC)	MAM 302	3	2	0	2	4
Total			**18**	**12**	**0**	**12**	**24**

*The course content must be approved by Mechanical Engineering Department Council before registration.

Proposed Study Plan for Mechatronics and Automation Engineering

Level 0-1

Code	Course Title	Pre-Req	Cr. Hrs.	Ct. Hr. Lec	Lab	Tut	Sum	Final Exam Time	Assessment MT1	MT2	PE/ OE	SA	Final	Sum
FRB 001	Analytical geometry & Linear Algebra		3	2	0	2	4	2 Hr	30	20	--	10	40	100
FRB 003	Statics		3	2	0	2	4	2 Hr	30	20	--	10	40	100
FRB 007	Chemistry for Engineers		4	3	2	1	6	2 Hr	30	--	20	10	40	100
FRB 005	Waves and Heat		3	2	2	1	5	2 Hr	30	--	20	10	40	100
FRM 009	Engineering Drawing		2	0	0	4	4	2 Hr	30	20	--	10	40	100
UHS 101	Foreign Language		2	2	0	0	2	2 Hr	30	20	--	10	40	100
UHS 102	Information and Communication Technology		2	2	0	0	2	2 Hr	30	20	--	10	40	100
Total			19											700

Level 0-2

Code	Course Title	Pre-Req	Cr. Hrs.	Ct. Hr. Lec	Lab	Tut	Sum	Final Exam Time	Assessment MT1	MT2	PE/ OE	SA	Final	Sum
FRB 002	Integration & Multivariable functions	FRB 001	3	2	0	2	4	2 Hr	30	20	--	10	40	100
FRB 004	Dynamics	FRB 003	3	2	0	2	4	2 Hr	30	20	--	10	40	100
FRM 008	Production Systems Engineering		2	1	3	0	4	2 Hr	30	--	20	10	40	100
FRB 006	Electricity and Magnetism		3	2	2	1	5	2 Hr	30	--	20	10	40	100
FRM 010	Engineering Drawing by Computer	FRM 009	2	1	2	0	3	2 Hr	30	20	40	10	--	100
FRE 012	Computer Programming		2	0	2	2	4	2 Hr	30	20	40	10	--	100
UHS 103	Societal Issues		2	2	0	0	2	2 Hr	30	20	--	10	40	100
Total			17											700

Level 1-1														
Code	Course Title	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lec	Lab	Tut	Sum		MT1	MT2	PE/ OE	SA	Final	Sum
FRB 101	Engineering Differential Equations	FRB 002	3	2	0	2	4	2 Hr	30	20	--	10	40	100
MAM 101	Fluid Mechanics	FRB 005	3	2	2	1	5	2 Hr	30	--	20	10	40	100
MAM 103	Kinematics of Machines	FRB 004	3	2	1	1	4	2 Hr	30	--	20	10	40	100
MAM 107	Materials Science and Engineering	FRB 006	3	2	2	0	4	2 Hr	30	--	20	10	40	100
MAM 105	Mechanics and Testing of Materials	FRM 008	3	2	2	1	5	2 Hr	30	--	20	10	40	100
MAE 101	Electrical Circuits	FRB 006	2	1	0	2	3	2 Hr	30	20	--	10	40	100
MAM 109	Computer Applications	FRE 012	2	1	2	0	3	2 Hr	30	20	40	10	--	100
Total			19											700

Field Training I													
Code	Course Title	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		MT1	MT2	SA	Final	Sum
FT 103	Field Training I	Completion of 65 Cr. Hrs.	0	0	0	0	0	Oral	-	-	-	Pass or Fail	-

Level 1-2

Code	Course Title	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lec	Lab	Tut	Sum		MT1	MT2	PE/ OE	SA	Final	Sum
FRB 206	Multiple Integrals & Complex Analysis	FRB 002	3	2	0	2	4	2 Hr	30	20	--	10	40	100
MAM 102	Thermodynamics	FRB 005	3	2	1	2	5	2 Hr	30	--	20	10	40	100
MAM 106	Design of Machine Elements	MAM 105	3	2	3	0	5	2 Hr	30	--	20	10	40	100
MAM 104	Measurement and Instrumentation	FRB 006	2	1	2	1	4	2 Hr	30	--	20	10	40	100
MAM 108	Manufacturing Technology	FRM 008	2	1	2	0	3	2 Hr	30	--	20	10	40	100
MAE 102	Electronic Devices and Circuits	MAE 101	2	1	0	2	3	2 Hr	30	20	--	10	40	100
UHS 104	Professional Ethics		2	2	0	0	2	2 Hr	30	20	--	10	40	100
Total			17											700

Level 2-1

Code	Course Title	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lec	Lab	Tut	Sum		MT1	MT2	PE/ OE	SA	Final	Sum
MAM 201	Project Management	FRB 002	2	2	1	0	3	2 Hr	30	--	20	10	40	100
MAM 203	Dynamic Modeling and Simulation	FRB 101	3	2	1	1	4	2 Hr	30	--	20	10	40	100
MAM 205	Fluid Power Systems	MAM 101	2	1	3	0	4	2 Hr	30	--	20	10	40	100
MAM 207	Mechanical Design	MAM 106	3	2	3	0	5	2 Hr	30	--	20	10	40	100
MAM 209	Mechanical Vibrations	FRB 004	3	2	2	1	5	2 Hr	30	--	20	10	40	100
MAE 211	Electric Machinery	MAE 101	3	2	1	1	4	2 Hr	30	--	20	10	40	100
UHS XXX	Humanities - Elective I		2	2	0	0	2	2 Hr	30	20	--	10	40	100
Total			18											700

Level 2-2															
Code	Course Title	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lec	Lab	Tut	Sum		MT1	MT2	PE/OE	SA	Final	Sum
FRB 104	Engineering Numerical Analysis	FRB 101	3	2	2	0	4	2 Hr	30	--	20	10	40	100
MAM 204	Introduction to Mechatronics	MAE 102	3	2	2	0	4	2 Hr	30	--	20	10	40	100
MAE 206	Logic Circuits Design & Applications	MAE 102	3	2	2	0	4	2 Hr	30	--	20	10	40	100
MAM 208	Industrial Robots	MAM 103	3	2	2	0	4	2 Hr	30	--	20	10	40	100
MAM 202	Automatic Control Systems	MAM 209	3	2	2	1	5	2 Hr	30	--	20	10	40	100
FRB 103	Environmental Pollution and Industrial Safety	FRB 007	2	2	0	1	3	2 Hr	30	20	--	10	40	100
UHS 3XX	Humanities Elective II		2	2	0	0	2	2 Hr	30	20	--	10	40	100
Total			19											700

Field Training II														
Code	Course Title	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment				
				Lec	Lab	Tut	Sum		MT1	MT2	SA	Final	Sum
FT 203	Field Training II	Completion of 96 Cr. Hrs.	0	0	**0**	**0**	**0**	Oral	-	-	-	Pass or Fail	-

Level 3-1															
Code	Course Title	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lec	Lab	Tut	Sum		MT1	MT2	PE/OE	SA	Final	Sum
FRB 201	Applied Engineering Probability and Mathematical Statistics	FRB 002	3	2	2	0	4	2 Hr	30	--	20	10	40	100
MAX xxx	Elective I		3	2	0	2	4	2 Hr	30	20	--	10	40	100
MAM 301	Design of Mechatronic Systems	MAM 204	3	2	2	0	4	2 Hr	30	--	20	10	40	100
MAE 303	Power Electronics	MAE 211	3	2	2	0	4	2 Hr	30	--	20	10	40	100
MAX xxx	Elective II		3	2	0	2	4	2 Hr	30	20	--	10	40	100
MAM 309	Technical Reports		1	0	2	0	2	2 Hr	--	--	50	50	--	100
UHS 4XX	Humanities Elective III		2	2	0	0	2	2 Hr	30	20	--	10	40	100
Total			18											600

Level 3-2														
Code	Course Title	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lec	Lab	Tut	Sum		MT1	MT2	PE/OE	SA	Final	Sum
MAM 302	CAD/CAM	MAM 207	3	2	2	0	4	2 Hr	30	--	20	10	40	100
MAE 304	Microprocessors & Microcontrollers	MAE 206	3	2	1	1	4	2 Hr	30	--	20	10	40	100
MAX xxx	Elective III		3	2	0	2	4	2 Hr	30	20	--	10	40	100
MAX xxx	Elective IV		3	2	0	2	4	2 Hr	30	20	--	10	40	100
MAM 390	Senior Design Project I		2	2	0	0	2	-	-	-	50	50	--	100
MAM 306	Engineering Economics		2	2	0	1	3	2 Hr	30	20	--	10	40	100
Total			16											600

Level 4-1

Code	Course Title	Pre-Req	Cr. Hrs.	Ct. Hr.				Final Exam Time	Assessment					
				Lec	Lab	Tut	Sum		MT1	MT2	PE/OE	SA	Final	Sum
MAE 405	Electric Drives	MAE 303	3	2	1	2	5	2 Hr	30	--	20	10	40	100
MAE 403	Programmable Logic Controllers	MAE 206	3	2	2	0	4	2 Hr	30	--	20	10	40	100
MAX xxx	Elective V		3	2	0	2	4	2 Hr	30	20	--	10	40	100
MAX xxx	Elective VI		3	2	0	2	4	2 Hr	30	20	--	10	40	100
MAE 401	Artificial Intelligence	MAE 304	2	1	2	1	4	2 Hr	30	--	20	10	40	100
MAM 490	Senior Design Project II	MAM 390	3	0	6	0	6	-	-	-	50	50	--	100
Total			17											600

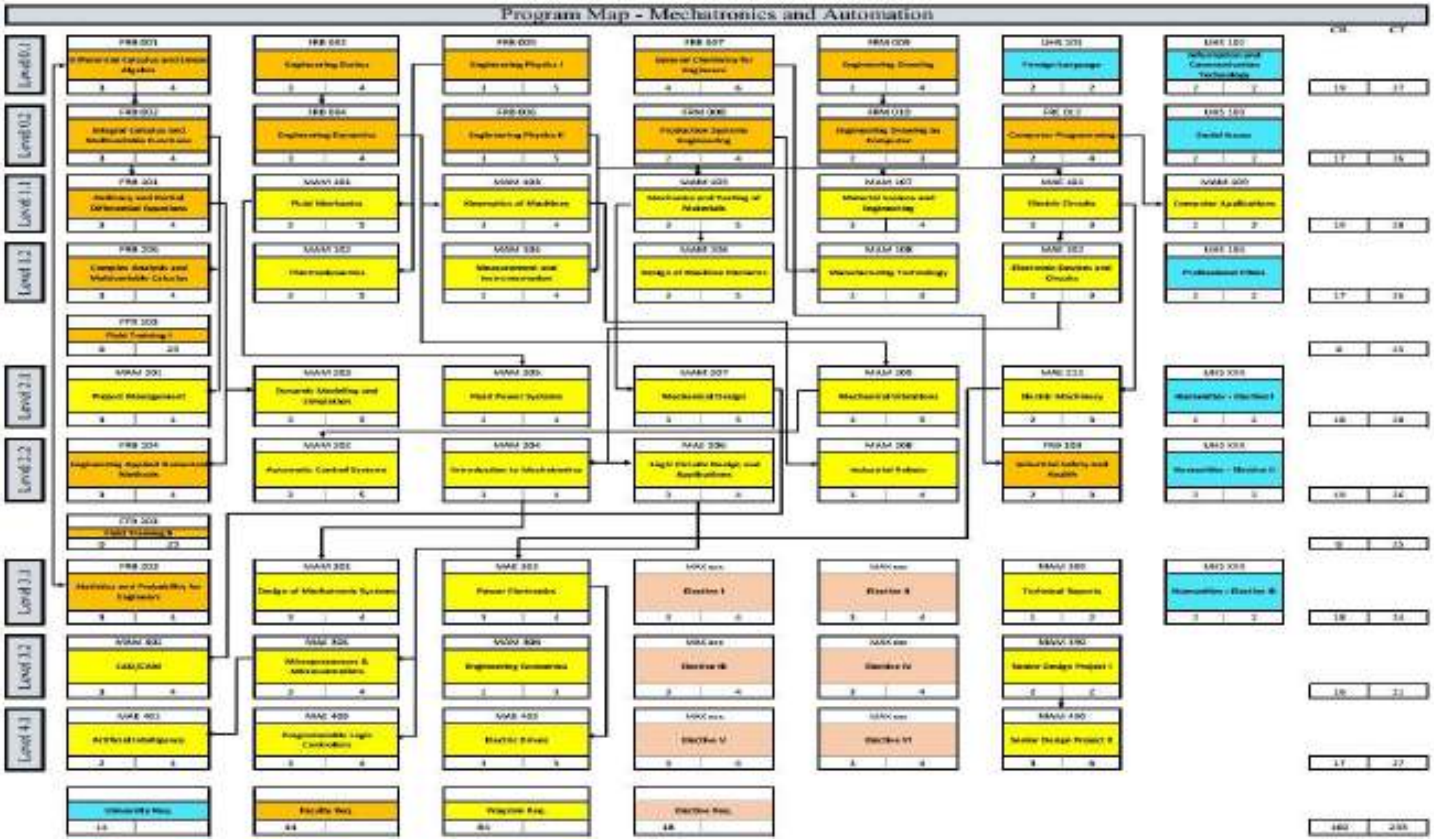
Matching Mechatronics Engineering Program Courses with ABET Requirements

ABET Program Criteria for Mechanical and Similarly Named Engineering Programs
Lead Society: American Society of Mechanical Engineers

Mechatronics Engineering Program Courses Required to Cover ABET Criteria				
ABET Criteria		**CODE**	**Course Name**	Cr. Hrs.
A minimum of 30 semester credit hours (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program.	basic science, and mathematics (including multivariate calculus and differential equations);	FRB 001	Analytical geometry & Linear Algebra	3
		FRB 002	Integration & Multivariable functions	3
		FRB 206	Multiple Integrals & Complex Analysis	3
		FRB 101	Engineering Differential Equations	3
		FRB 104	Engineering Numerical Analysis	3
		FRB 201	Applied Engineering Probability and Mathematical Statistics	3
	principles of engineering	FRB 007	Chemistry for Engineers	4
		FRB 003	Statics	3
		FRB 004	Dynamics	3
		FRB 103	Environmental Pollution and Industrial Safety	2
		FRB 005	Waves and Heat	3
		FRB 006	Electricity and Magnetism	3
Total				**36**
ABET Criteria		**CODE**	**Course Name**	Cr. Hrs.
A minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design and utilizing modern engineering tools.	Courses that cover Engineering fundamental principles of Mechanics, Thermodynamics, Fluid, Control, Electric & Electronic circuits.	FRM 009	Engineering Drawing	2
		FRM 008	Production Systems Engineering	2
		MAM 101	Fluid Mechanics	3
		MAM 102	Thermodynamics	3
		MAM 104	Measurement and Instrumentation	2
		MAM 107	Materials Science and Engineering	3
		MAM 108	Manufacturing Technology	2
		MAM 202	Automatic Control Systems	3

		MAM 205	Fluid Power Systems	2
		MAM 209	Mechanical Vibrations	3
		MAE 101	Electric Circuits	2
		MAE 102	Electronic Devices and Circuits	3
		MAE 211	Electric Machinery	2
		MAE 303	Power Electronics	3
		MAE 405	Electric Drives	3
	Courses that cover Computer science and computer-based topics	FRM 010	Engineering Drawing by Computer	2
		MAM 109	Computer Applications	2
		MAE 335	Computer Interfacing	3
		MAM 302	CAD/CAM	3
		MAE 304	Microprocessors & Microcontrollers	3
		MAE 403	Programmable Logic Controllers	3
		MAM 445	Computer Numerical Control (CNC)	3
	Courses that cover Design topics in Mechatronics program	MAM 103	Kinematics of Machines	3
		MAM 106	Design of Machine Elements	3
		MAM 207	Mechanical Design	3
		MAM 204	Introduction to Mechatronics	3
		MAM 301	Design of Mechatronic Systems	3
	Courses that cover modern engineering tools	MAM 208	Industrial Robots	3
		MAE 334	Micro Electromechanical Systems (MEMS)	3
		MAE 401	Artificial Intelligence	3
		MAE 431	Embedded System Design	3
		MAM 435	Autotronics	3
		MAE 443	Internet of things	3
Total				**88**

Courses Plan and Matrix



Course/Learning Outcomes Matrix

Learning Outcomes				PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	PLO13	PLO14	PLO15	PLO16
Level 0	Level 0-1	FRB 001	Analytical geometry & Linear Algebra	●		●													
		FRB 003	Statics	●	●														
		FRB 005	Waves and Heat	●	●														
		FRB 007	Chemistry for Engineers	●	●														
		FRM 009	Engineering Drawing						●		●								
		UHS 101	Foreign Language								●		●						
		UHS 102	Information & Communication Technology				●		●				●						
	Level 0-2	FRB 002	Integration & Multivariable functions	●		●													
		FRB 004	Dynamics	●	●														
		FRB 006	Electricity and Magnetism	●	●														
		FRM 008	Production Systems Engineering				●		●										
		FRM 010	Engineering Drawing by Computer				●				●								
		FRE 012	Computer Programming	●		●													
		UHS 103	Societal Issues							●			●						

Level 1	Level 1-1	FRB 101	Engineering Differential Equations	●	●														
		MAM 101	Fluid Mechanics	●										●					
		MAM 103	Kinematics of Machines											●	●				
		MAM 105	Mechanics and Testing of Materials		●									●					
		MAM 107	Materials Science and Engineering											●	●				
		MAE 101	Electerical Circuits																
		MAM 109	Computer Applications			●									●				
	Level 1-2	FRB 206	Multiple Integrals & Complex Analysis	●	●														
		MAM 102	Thermodynamics											●	●				
		MAM 104	Measurement and Instrumentation		●												●	●	
		MAM 106	Design of Machine Elements			●									●				
		MAM 108	Manufacturing Technology											●	●				
		MAE 102	Electronic Devices and Circuits													●	●		
		UHS 104	Profession Ethics				●	●											
		FT 103	Field Training I							●			●						
Level 2	Level 2-1	MAM 201	Project Management					●			●	●							
		MAM 203	Dynamic Modeling and Simulation											●				●	

		MAM 205	Fluid Power Systems	●	●									●					
		MAM 207	Mechanical Design			●									●				
		MAM 209	Mechanical Vibrations	●	●									●	●				
		MAE 211	Electric Machinery													●	●		
		UHS XXX	Humanities - Elective I			●	●												
	Level 2-2	FRB 104	Engineering Numerical Analysis	●	●														
		MAM 202	Automatic Control Systems			●								●					
		MAM 204	Introduction to Mechatronics															●	●
		MAE 206	Logic Circuits Design & Applications													●	●		
		MAM 208	Industrial Robots												●				●
		BES 141	Environmental Pollution and Industrial Safety	●		●	●												
		UHS XXX	Humanities - Elective II							●	●								
		FT 203	Field Training II					●	●	●		●	●						
Level 3	Level 3-1	FRB 201	Applied Engineering Probability and Mathematical Statistics	●	●														
		MAM 301	Design of Mechatronic Systems															●	●
		MAE 303	Power Electronics													●	●		
		MAX xxx	Elective I															●	●

		MAX xxx	Elective II															●	●
		MAM 309	Techincal Reports					●		●	●								
		UHS XXX	Humanities Elective III								●	●							
	Level 3-2	MAM 302	CAD/CAM												●			●	
		MAE 304	Microprocessors & Microcontrollers													●	●		
		MAM 306	Engineering Economics			●				●									
		MAX xxx	Elective III															●	●
		MAX xxx	Elective IV															●	●
		MAM 390	Senior Design Project I				●	●	●	●	●	●	●		●	●		●	●
Level 4	Level 4-1	MAE 401	Artificial Intelligence															●	●
		MAE 403	Programmable Logic Controllers													●	●		●
		MAE 405	Electric Drives													●	●	●	●
		MAX xxx	Elective V															●	●
		MAX xxx	Elective VI															●	●
		MAM 490	Senior Design Project II				●	●	●	●	●	●	●		●	●		●	●

Mechatronics & Automation Engineering Program Courses

Course Coding System

Each course has a code that is consisted of:

- 3 letters that denotes the department who offers the course, followed by
- 3 digits; where:
  - the first digit from left represents the course level,
  - the middle digit represents the program who offers the course in the department, and
  - the right digit represents the course sequence (odd digits for the fall semester and even digit for spring semester).

The coding system is demonstrated in the following table:

UHS 1xx, 2xx	University Requirement Compulsory Courses
UHS xxx	University Requirement Elective Courses
FRB XXX	Courses offered by Basic Engineering Science Department
FRM XXX	Faculty requirement course offered by Mechanical Engineering Department
FRE XXX	Course offered by Electrical Engineering Department
MAM xxx	Course offered by Mechanical Engineering Department
MAE xxx	Course offered by Electrical Engineering Department
MAX x3x	Elective Courses offered for Mechatronics Concentration
MAX x4x	Elective Courses offered for Automation Concentration

The following Abbreviation are used in the contents table:

Pre-req	Prerequisite	**Cr. Hrs.**	Credit Hours	**SA**	Student Activity
MT1	First Midterm Exam	**MT2**	Second Midterm Exam	**Final**	Final Exam

Faculty Requirements Courses

Courses Offered by Basic Engineering Science Department

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Name</th><th rowspan="2">Pre-req.</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hrs.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec</th><th>Lab.</th><th>Tut.</th><th>Sum</th><th>MT1</th><th>MT2</th><th>Std. Act.</th><th>Final</th></tr>
<tr><td>FRB 001</td><td>Analytical geometry & Linear Algebra</td><td>-</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Contents</td><td colspan="11">Analytical geometry: Functions (Lines, Circles, Parabolas, Piecewise-Functions, Power Functions, Polynomials, Rational Functions, Algebraic Functions, Trigonometric Functions, Hyperbolic Functions, Exponential Functions and Logarithmic Functions) and their properties, their graphs and their inverses. Limits and continuity. Differentiation rules of real functions of one variable. Applications of derivatives (maxima, minima and inflection points, curve tracing, optimization problems). Taylor’s and Maclaurin's series of functions of one variable.
Linear Algebra: Matrices and their properties, types, ranks and their inverses (Adjoint of matrix, Eigen equation and Gauss elimination). Existence and uniqueness of solutions. Solving system of linear equations by Matrices (Gauss elimination, Gauss – Jordan elimination, LU factorization). Eigenvalues and eigenvectors. Complex numbers. Elements of mathematical logic with applications.</td></tr>
<tr><td>References</td><td colspan="11">• Howard Anton, "Calculus with analytical geometry", John Wiley & Sons, Last Edition.
• Gilbert Strang, "Introduction to Linear Algebra", Wellesley-Cambridge Press, Last Edition.</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT1</th><th>MT2</th><th>SA</th><th>Final</th></tr>
<tr><td>FRB 002</td><td>Integration & Multivariable functions</td><td>FRB 001</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Integration: Techniques of integration (Basic Integration Formulas, Integration by Parts, Integration of Rational Functions by Partial Fractions, Trigonometric Integrals and Substitutions). Applications of indefinite integrals. Applications of definite integrals (areas, volumes of revolution, lengths of curves and surface areas of revolution).
Multivariable functions: Curves and surfaces in three dimensions. Limits, continuity and partial derivatives of functions of several variables. Chain Rule. Directional and total derivatives. Applications (tangent planes and normal lines, Taylor series of functions of two variables, Extreme values and conditional extreme values of functions of two variables).</td></tr>
<tr><td>References</td><td colspan="11">• Howard Anton, "Calculus with analytical geometry", John Wiley & Sons, Last Edition.
• George B. Thomas, Jr., Maurice D. Weir, Joel Hass, THOMAS' CALCULUS Multivariable (Twelfth Edition), 2010.</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT1</th><th>MT2</th><th>SA</th><th>Final</th></tr>
<tr><td>FRB 101</td><td>Engineering Differential Equations</td><td>FRB 002</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Basic Concepts of Ordinary and Partial differential equations (ODEs & PDEs): Oder, Degree, Linearity, Formation, Geometric and physical applications (Newtons law of cooling, electric circuits), Types of solutions, Existence and uniqueness of solutions.
ODEs: Solution of first order ODEs (Separable, Homogeneous, Exact, Integrating factor, Linear and Bernoulli equations). Orthogonal trajectories. Solution of nth order ODEs (homogeneous and non-homogeneous). System of first order linear differential equations. Laplace transforms and inverse Laplace transforms with applications. Fourier series with applications. Gamma and Beta functions
PDEs: Solution of linear PDEs with constant coefficients, solution of some initial-boundary value problems. Solution of PDEs by Laplace Transforms.</td></tr>
<tr><td>Referenc es</td><td colspan="11">• Morris Tenenbaum, Harry Pollard, "Ordinary Differential Equations: An Elementary Textbook for Students of Mathematics, Engineering, and the Sciences", Dover Publications, Last Edition.
• Wei-Chau Xie, Differential Equations for Engineers, CAMBRIDGE UNIVERSITY PRESS, 2010.</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT1</th><th>MT2</th><th>SA</th><th>Final</th></tr>
<tr><td>FRB 206</td><td>Multiple Integrals & Complex Analysis</td><td>FRB 002</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Multiple Integrals: Double integrals (Areas, Volumes, Moments, Double integrals in polar form). Triple integrals (Volumes, Masses and Moments in three dimensions, Triple integrals in cylindrical and spherical coordinates). Substitution in multiple integrals. line and surface integrals, Green, Stock’s and Divergence theorems.
Complex Analysis: Complex Numbers, Complex plane, Polar form of complex number, Powers and roots, Complex Function, Limit, Continuity, Derivative, Cauchy-Riemann equations, Laplace’s Equation, Complex integration. Taylor and Laurent Series. Residue Integration. Conformal Mapping (linear function, Linear Fractional Transformations (or Möbius transformations), irrational functions, the exponential function, trigonometric functions).</td></tr>
<tr><td>References</td><td colspan="11">• Erwin Kreyszig, "Advanced Engineering Mathematics", / Paperback / Wiley, John & Sons, Last Edition.
• George B. Thomas, Jr., Maurice D. Weir, Joel Hass, THOMAS' CALCULUS Multivariable (Twelfth Edition), 2010.</td></tr>
</table>

<table>
<tr><th rowspan="3">Code</th><th rowspan="3">Course Title</th><th rowspan="3">Pre-req</th><th rowspan="3">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>MT 1</td><td>PE/ OE</td><td>SA</td><td>Final</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>FRB 104</td><td>Engineering Numerical Analysis</td><td>FRB 101</td><td>3</td><td colspan="8"></td></tr>
</table>

Course Content

Numeric in General: Solution of linear systems by iterative methods (Jacobi Iteration, Gauss–Seidel Iteration Method, Convergence and Matrix Norms). Solution of nonlinear equations (Fixed-Point Iteration, Newton–Raphson's method, Sufficient Convergence Condition). Curve fitting (Least square method). Interpolations (Lagrange Interpolation, Newton's Forward and Backward Interpolations). Numerical differentiation. Numerical integration (Rectangular Rule, Trapezoidal Rule, Simpson's Rule).

Numeric for ODEs and PDEs: Solution of first-order ODEs (Euler's method, Runge–Kutta Methods). Solution of higher order ODEs. Boundary and initial-boundary value problems for ODEs, Elliptic and parabolic PDEs (Finite difference methods, Explicit method, Crank–Nicolson Method). Lab simulations of engineering applications.

References

- R W Hamming, "Numerical Methods for Scientists and Engineers", Courier Dover Publications, Last Edition.
- Steven C. Chapra, "Applied Numerical Methods with MATLAB for Engineers and Scientists", Mcgraw-Hill, 3rd edition.
- Nita H. Shah,Numerical Methods with C++ Programming, PHI Learning, 2008.

Laboratory

Lab simulations by software's as (C++, MATLAB, Python,…)- Simulating practical technical problems- linear equations due to electric circuits , truss and spring mass systems. - Electric charge calculations- Nonlinear structural problems- Deflection of nonlinear springs- Calculating the shrinkage of a trunnion- Finding the longitudinal Young's modulus -Estimating voltage drop on a resistor- Calculating the work done by stretching a string- Simulating equations due to the fluid continuum problems, DC motor speed control problems- interpolation and fitting for signals and voltage current relations- population growth calculations- Fluid flow rate calculations- Distributed wind force problems.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
FRB 201	Applied Engineering Probability and Mathematical Statistics	FRB 002	3	2	2	0	4	30	20	10	40

Course Content	**Probability:** Basic Theorems of Probability. Conditional Probability. Independent Events. Discrete and Continuous Random Variables. Mean and Variance of Distributions. Discrete Distributions (Binomial, Poisson and Hypergeometric Distribution). Continuous Distributions (Normal and Exponential Distribution). Distributions of Several Random Variables (Discrete and Continuous Two-Dimensional Distributions). **Mathematical Statistics:** Random Sampling. Sample mean and variance. Point Estimation of Parameters. Confidence Intervals. Simple and multiple Linear Regression and Correlation. Testing of Hypotheses. Markov chains. Quality Control. Engineering Applications. Lab simulations of engineering applications.
References	• R. E Walpole, R. H. Myers, "Probability and Statistics for Engineers and Scientists", Macmillan Publishing, Last Edition. • David Levine, Patricia Ramsey, Robert Smidt, "Applied Statistics for Engineers and Scientists: Using Microsoft Excel & Minitab", First Edition, 2000. .
Laboratory	Lab simulations by software's as (Excel, Matlab, Python,…)- Exploratory data analysis and data transformation (Tabulated data summaries and statistics, Histograms, Box and Correlation plots, Computation of means, variances, etc, Missing data imputation)- Simple random sampling with and without replacement- Stratified random sampling- Simulating Bernoulli process and Poisson distribution - Simulating Markov chains applications-Binary and sequential hypothesis testing and gambler's ruin -Gaussian Mixture Models, clustering and anomaly detection- Regression models and inference- Time series forecasting and ARIMA models.

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT1</th><th>PE/ OE</th><th>SA</th><th>Final</th></tr>
<tr><td>FRB 103</td><td>Environmental Pollution and Industrial Safety</td><td>FRB 007</td><td>2</td><td>2</td><td>1</td><td>-</td><td>3</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">- Air pollution-Adverse effects -ozone depletion – green house effects- Acid rain and global warming - measurement and control methods.
- Water pollution- constituents of wastewater- primary treatment: various pre-treatment methods - Advanced Treatment: chemical oxidation, precipitation, air stripping
Construction Engineering and Managment students: Plan and manage construction health and safety, maintain safety issues for construction to introduce the foundations on which appropriate health and safety systems may be built. Occupation and health and safety affect all aspects of work. Legal framework for health and safety.
Electromechanical Engineering students: Hazards analysis-Hazards of pressure , uses of over pressure-hazards of temperature-HAZOP study regarding pressure, temperature & flow -static electricity & its control purging and inerting -relief valves and rupture disks-venting – flame arrester -flare system-alarms and types of alarms and its application-trips d interlock system-hot work permit , confined space vessel work permit & height work permit -personnel protective equipment-On-site &Off-site emergency plan.
Electric shock and burns from live wire contact, Fires from faulty wiring, overloading circuits, leaving electrical parts exposed, Electrocution or burns from lack of PPE, Explosions and fires from explosive and flammable substances, Contact with overhead power lines Electrical exposure to water.</td></tr>
<tr><td>References</td><td colspan="11">• Handbook of “Industrial Safety and Health, Trade and Technical Press Ltd. Morden, U.K.1980.
• S.P. Mahajan, “Pollution Control in Process Industries” Tata McGraw Hill, NewDelhi1985.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Air sampling
• Water sampling
• Adsorption
• Precipitation</td></tr>
</table>

Courses Offered by Electrical Engineering Department

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	PE/ OE
FRE 012	Computer Programming	-	2	0	2	2	4	30	20	10	40

Course Content

Computer System: Hardware, Software - Introduction to software design - evolution and comparison of programming languages - types and characteristics of translators - Program Design Process - Software Life Cycle - structured programming - Variables, Constants - Input and Output - Data Types and Representation - Simple Flow - Flow of Control (Conditioning, Iteration) - Array - Functions (Predefined - Programmer Defined) - Pointers- Strings -program maintenance & testing – documentation.
Course topics are explained using a high-level language (as C, or C++).

References

- W. Savitch, "Problem Solving with C++" 10th Edition, Pearson, 2018
- K.N. King, “C Programming: A modern Approach”, 2nd edition, W.W. Norton & Company, 2008.
- C.R. Severance, S. Blumenburg, "Python for Everybody: Exploring Data in Python 3", CreateSpace Independent Publishing Platform, 2016
- R. Sedgweck, K. Wayne, "Introduction to Programming in Java: An Interdisciplinary Approach (2nd Edition)", Addison-Wesley Professional, 2017

Laboratory

Problem solving labs using high level language (C, or C++) to apply explained topics in each lecture including:

- Flowcharts
- Data Types, Variable, Constant declaration. Input and Output
- Sequence Flow program
- Conditioning Statements (if, nested if and switch case)
- Iteration Statements (for, while do while, Do Until, and nested loops)
- Arrays (1D and 2D arrays)
- Functions (predefined and user defined)
- Pointers
- Strings and string functions

* Project:
At the end of the course the student must provide a project emphasizing the course content

Code	Course Title	Pre-req	Cr.	Ct. Hr.	Assessment

			Hrs.								
MAE 101	Electrical Circuits	FRB 006	2	Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
				1	0	2	3	30	20	10	40

Course Content: DC circuit analysis: Circuit Variables, Kirchhoff's Laws, Simple Resistive Circuits, The Wheatstone Bridge, Δ to-Y (or π -to-T) Equivalent Circuits, The Node-Voltage Method and Dependent Sources, The Mesh-Current Method and Dependent Sources, The Venin and Norton Equivalents, Maximum Power Transfer, Superposition, Topology in Circuit Analysis, The Operational Amplifier circuits, Inductance and Capacitance, The Natural Response of RL and RC Circuits, Step Response of First-Order RL and RC Circuits.

References:
- James W. Nilsson, Susan A. Riedel, "Electric Circuits", Pearson educational Inc, 2012.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAE 102	Electronic Devices and Circuits	MAE 101	2	1	0	2	3	30	20	10	40

Course Content: Semiconductor physics, Structure of diodes, Diode circuits and rectifiers, Structure of BJT, Biasing and operation modes of transistors, DC and small signal analysis of transistor circuits, Amplifiers circuits using BJT, Power amplifiers, Field effect transistors, Biasing of FET, Small signal model of FET. Amplifier circuits using FET, Design of amplifier circuits, Frequency response of amplifier circuits, Active filters, Feedback in electronic circuits, Different feedback configuration in electronic circuits, Oscillators circuits.

References:
- "Microelectronic Circuits", by Adel S. Sedra and Kenneth C. Smith, Oxford University press.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAE 211	Electric Machinery	MAE 101	3	2	1	1	4	30	20	10	40

Course Content: Rotating electrical machines, operating principles, main terminology, and industrial standards. Static conversion of electrical energy: three- phase inverter and current control. DC motor: principle of operation, main characteristics and construction, electrical drives with DC motor, sizing of real application examples. Synchronous motor ("brushless"): principle of operation, main characteristics and construction, electrical drives with synchronous motor. Asynchronous motor: principle of operation, main characteristics and construction, electrical drives with asynchronous motor. Stepper motors.

References:
- "Electric machines and drives", By G.R. Slemon, Addison Wesley, MA, 1992

Laboratory:
- Experimental operations and checking the performance of various electric machines listed in the course description

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	SA	Final
MAE 206	Logic Circuits Design & Applications	MAE 102	3	2	2	0	4	30	20	10	40

Course Content	Number systems and data representation - Boolean algebra - simplification of Boolean functions - logic gates - combinational and sequential logic circuits. Registers, counters, and adders – Memory. Digital electronics. Performance of analogue and digital transducers; selecting a proper transducer for a given application. Digital transducers: optical encoders, ultrasonic sensors. Data acquisition systems (A/D and D/A converters). Stepper motors: microprocessors: structure, programming, applications.
References	• Charles H. Roth Jr., Larry L Kinney, 2009, "Fundamentals of Logic Design", 6th Edition, Publisher: CL Engineering • Sajjan G. Shiva, 1998, "Introduction to logic design", M. Dekker, New York
Laboratory	• Project: At the end of the course the student must provide a project emphasizing the course content

Used in Program	Mechatronics & Automation Engineering Program	Semester	6

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	SA	Final
MAE 303	Power Electronics	MAE 211	3	2	2	0	4	30	20	10	40

Course Content	Power semiconductor devices, diodes, thyristors, and applications. Drive circuit design and protection techniques. Power converter circuits Applications of AC-DC (rectifiers and controlled rectifiers), DC-DC (Choppers), and DC-AC power converter circuits (Inverters). Analyses of input and output waveforms of these circuits, harmonic performance. A basic understanding of devices, circuit principles and implications in input/output waveform quality. Application considerations for remote and un-interruptible power supplie..
References	• Rashid, M. H. (2006). Power electronics handbook: Devices, circuits, and applications. Burlington, MA: Academic

Used in Program	Mechatronics & Automation Engineering Program	Semester	7

Courses Offered by Mechanical Engineering Department

<table>
<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><td rowspan="2">FRM 009</td><td rowspan="2">Engineering Drawing</td><td rowspan="2">-</td><td rowspan="2">2</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>MT1</td><td>MT2</td><td>SA</td><td>Final</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Engineering drawing techniques and skills. Conventional lettering and dimensioning. Geometric constructions. Theories of view derivation. Orthographic projection of engineering bodies. Derivation of views from isometric drawings and deducing of missing views. Sectioning views: (full, half, offset, partial, revolved, removed, and partial sectioning). Steel construction, Symbols of electrical circuits</td></tr>
<tr><td>References</td><td colspan="11">• William Chalk, Goetsch, "Technical Drawing", Delmar technical graphics series, 6th edition, 2010.
• Allbert W. Boundy, "Engineering Drawing", McGraw-Hill Australia, 2012</td></tr>
<tr><td>Laboratory</td><td colspan="11">Student's engineering sketches and drawings carried out in the engineering drawing Labs.</td></tr>
</table>

<table>
<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><td rowspan="2">FRM 010</td><td rowspan="2">Engineering Drawing by Computer</td><td rowspan="2">FRM 009</td><td rowspan="2">2</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>MT1</td><td>MT2</td><td>SA</td><td>PE/ OE</td></tr>
<tr><td>1</td><td>2</td><td>0</td><td>3</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to Computer Aided Drafting, history, advantages, and limitation. Graphics/CAD involves the visualization, sketching, and geometric construction of mechanical components. Layout and creation 2D working industrial drawings that adhere to industry standards. Illustrate CAD drawing construction techniques, implementation of graphical communication through the use of the alphabet of lines, orthographic projection, section views, auxiliary views and the creation of assembly and detail mechanical components</td></tr>
<tr><td>References</td><td colspan="11">• William Chalk, Goetsch, "Technical Drawing", Delmar technical graphics series, 6th edition, 2010.
• Allbert W. Boundy, "Engineering Drawing", McGraw-Hill Australia, 2012</td></tr>
<tr><td>Laboratory</td><td colspan="11">Student's engineering sketches and drawings carried out in the engineering Computer Labs</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
FRM 008	Production Systems Engineering	-	2	1	3	0	4	30	20	10	40

Course Content	Introduction, Types of industries, Casting processes: Main steps of sand casting, Pattern design, melting of metals, Cleaning and inspection of casting, Metal forming processes: Forging, Rolling, Extrusion, Drawing, Bending, Joining Processes: Temporary and permanent joints, welding techniques, Cutting Processes: Principles and elements of cutting processes, Basic cutting, and machining (Turning, Drilling, Milling, etc.,). Principles of production planning and control, Introduction to quality control.
References	• Jiangshan Li, Semyon M. Meerkov, 2008, “Production Systems Engineering”, Springer; 1st ed. 2009 edition, 2008 • M. P. Groover, 2011, "Principles of Modern Manufacturing", 4th Ed., john Wiley & Sons, Inc.
Laboratory	• Practicing the workshop measuring operations and tools • Practicing the sand-casting workshop • Practicing the welding workshop; electric arc welding, gas welding and cutting, and electric resistance welding • Practicing the machining workshop; turning, shaping, drilling, milling, and grinding • Practicing the metal forming workshop; rolling, bending, drawing, and extrusion • Practicing the carpentry workshop • Practicing the forging workshop

Discipline Requirements of Mechanical Engineering Course Content

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	SA	Final
MAM 101	Fluid Mechanics	FRB 005	3	2	2	1	5	30	20	10	40

Course Content: Physical properties of fluids, Density, Viscosity, Surface tension. Continuum Hypothesis, Flow Classification, and Shear-Deformation Behavior of Fluids. Fluid statics (Buoyancy, Forces on submerged surfaces). Flow kinematics, Elementary fluid dynamics, Bernoulli equation. Control volume analysis (Mass conservation, Momentum conservation, Energy conservation, Practical applications). Differential fluid flow analysis (Continuity, Navier-Stokes equation). Flow in pipes (Laminar flow, turbulent flow, Frictional losses in pipes and pipe fittings). Dimensional analysis and similarity (Buckingham theorem, physical similarity). Classification of Turbomachines, Operation of centrifugal pumps, Series and Parallel Operation, Selection of Pumps.

References:

- Munson, Young, and Okiishi, 2009, "Fundamentals of Fluid Mechanics", 7th Ed., Wiley.
- T. C. Clayton, F. E. Donald, and A. R. John, 2006,"Engineering Fluid Mechanics", John Wiley & Sons, Inc., 8th Ed.

Laboratory:

- Determination of fluid properties
- Hydrostatic pressure measurement
- Determination of pressure force on submerged surface
- Application of continuity equation for the flow through pipes
- Apparatus of impact water jet
- Satisfying of the Bernoulli's theorem
- Demonstration of the flow through orifice and free jet
- Determination of the friction losses through pipes
- Determination of the minor losses through pipe connections

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	SA	Final
MAM 103	Kinematics of Machines	FRB 004	3	2	1	1	4	30	20	10	40

Course Content: Basic concepts of mobility and mechanisms – Graphical method of Kinematic analysis of mechanisms (displacement, velocity, and acceleration analysis). Computational method and computer utilization in kinematic analysis of mechanisms. Force Analysis of Mechanisms (Newton Euler formulation and principle of virtual work). Cams (types, follower types and motion, construction of cam profile, cam displacement, velocity, and acceleration diagrams). Gears, Gear trains, Balancing of rotating masses.

References:

- Norton, R.L., 2009, "Kinematics and Dynamics of Machinery", McGraw-Wiley
- R. S. Khurmi, 2005, "Theory of Machines", 14th Ed., New Delhi.
- H. Mabie, C. Reinholtz,"Mechanisms and Dynamics of Machinery", Wiley

Laboratory:

- To determine the state of balance of machines for primary and secondary forces.
- To determine the frequency of torsional vibration of a given rod.
- Determine the effect of varying mass on the centre of sleeve in porter and proell governor.

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT1</th><th>PE/ OE</th><th>SA</th><th>Final</th></tr>
<tr><td>MAM 108</td><td>Manufacturing Technology</td><td>FRM 008</td><td>2</td><td>1</td><td>2</td><td>0</td><td>3</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Metal Casting Technology: solidification process, metals and alloys, production of primary metals, production of shaped casting, sand casting (moulding, melting, pouring, solidification, cleaning, defects, and inspection). Contemporary casting processes (metallic mould, electro-slag, precision, and centrifugal casting).
Metal Forming Technology: Hot and cold working of metals, metal forming processes (rolling, forging, drawing, extrusion and spinning), pipe and tube manufacturing, joining technology (fastening, riveting, soldering, and brazing, welding, and adhesive bonding).
Welding: submerged arc welding, spot and seam welding, plasma welding, cold pressure welding, adhesive welding, testing of welded joints. Welding operations for ferrous metals – thermal welding – Oxy-Acy welding
Metal cutting technology: Cutting tools, metal cutting machine tools (turning, drilling, boring, milling, shaping, planning, broaching, grinding, special purpose, gear and thread cutting and super finishing machine tools).</td></tr>
<tr><td>References</td><td colspan="11">• Rajender Singh, 2006, " Introduction to basic manufacturing processes and workshop technology ", New age international publishers.</td></tr>
<tr><td>Laboratory</td><td colspan="11">Students make different mechanical models in all the following workshops:
• Casting workshop
• Metal forming technology
• Welding
• Metal cutting workshop</td></tr>
</table>

Code	Course Title	Pre-req	Cr.	Ct. Hr.	Assessment

			Hrs.								
MAM 105	Mechanics and Testing of Materials	FRM 008	3	Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
				2	2	1	5	30	20	10	40

Course Content

Introduction, Concept of stress and strain, Axial loading, Stress-strain diagrams – Behavior of ductile and brittle metals. Area moments of Inertia. Torsion, Pure bending, Transverse shear, Analysis, and design of beams for bending and shearing stresses. Deflection of beams and shafts - Statically indeterminate beams and shafts. Transformations of stress and strain, Principal stresses under a given loading, Internal forces, and moments in beams (axial force – shear force bending moment), Deflection of beams. Destructive testing of materials (Tension, compression, bending, Torsion, and impact tests).

References

- Russell C. Hibbeler, 2011, "Mechanics of Materials", 8E, Pearson.
- E.P. Popov, S. Nagarajan and Z.A. Lu, Mechanics of Materials, 2nd Ed., Prentice-Hall, Inc., 1976.

Laboratory

- Tension test, Stress-strain diagram
- Compression test
- Impact test
- Bending test
- Torsion test
- Hardness test

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
MAM 107	Materials Science and Engineering	FRB 006	3	Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
				2	2	0	4	30	20	10	40

Course Content

Introduction to engineering materials. Structure and structural defects of metals, Phase transformation of metals, Theory of alloying and constitutional diagrams. Plastic deformation machine of metals, Strengthening mechanisms, Heat treatment of metals and alloys. Deterioration of metallic materials, selection of alloys. Non-metallic materials. Non-destructive tests of materials (Hardness, Photo elasticity, X-ray, Acoustics, and Stain gages). Failure of materials due to creep and Fatigue.

References

- William F. Smith,1996,"Principles of Materials Science and Engineering", McGraw-Hill.
- William D. Callister Jr., David G. Rethwisch, 2006, "Materials Science and Engineering: An Introduction", Wiley.

Laboratory

- Optical microstructure
- Heat treatment of metals and alloys
- Hardness test
- Photo elasticity
- X-ray Test

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
MAM 109	Computer Applications	FRE 012	2	Lec.	Lab	Tut	Sum	MT1	MT2	SA	PE/ OE
				1	2	0	3	30	20	10	40
Course Content	Developing basic concepts of algorithmic thinking to solve problems of relevance in engineering practice and implementing these algorithms MATLAB. Loops, control structures, functions, arrays. Create MATLAB programs that solve real-world problems in engineering and the sciences. Numerical methods, solution of nonlinear equations, plotting, logic operations, and graphical user interfaces to design, test, and debug numerical algorithms.										
References	• Simin Nasseri, "Solving Mechanical Engineering Problems with MATLAB", Linus Publications										
Laboratory	Student's programs of tasks and problems are carried out in the engineering Computer Labs.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
MAM 102	Thermodynamics	FRB 005	3	Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
				2	1	2	5	30	20	10	40
Course Content	Definitions and basic concepts of thermodynamic systems, Properties of pure substances, phase change process, ideal gas. Work and Heat, first law of thermodynamics (closed system, unsteady and steady flow open systems, applications). Second law of thermodynamics (Heat engines and refrigerators, reversible and irreversible process, Carnot cycle). Entropy (Clausis inequality, entropy, increase of entropy principles, entropy change of pure substances, solids and liquids, entropy changes of ideal gases, adiabatic efficiency of process). Refrigeration Cycles: Refrigerators and Heat Pumps, The Reversed Carnot Cycle.										
References	• Yunus A.Cengel Michael A.Boles, 2014, "Thermodynamics An Engineering Approach", McGraw Hill Education; 8th edition.										
Laboratory	• Identification and recognition of the application of work and heat • Identification and recognition of the application of the first law • Identification and recognition of the application of the second law • Computer controlled expansion processes of a perfect gas unit • investigate the thermodynamics components such as turbine, compressor, pump, boiler, condenser, etc.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 106	Design of Machine Elements	MAM 105	3	2	3	0	5	30	20	10	40

Course Content	Introduction to design process. Review of load and stress analysis, Mohr's circle for plane stress. Failures resulting from static loading, variable loading, and fatigue failure. Material selection for strength and rigidity. Design of mechanical elements: Knuckle joint - screws, fasteners - shafts and shaft components - mechanical springs - welding joints, Bonding, and permanent joints.
References	• Robert L. Mott, " Machine elements in Mechanical Design", Pearson/Prentice Hall, 2004. • J.E. Shigley and C. R. Mischke, "Mechanical Engineering Design", McGraw-Hill, Last Edition.
Laboratory	Term design projects: • Working and assembly drawing of parts and machine elements • Computer aided drafting of assembly drawings and machine elements

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 104	Measurement and Instrumentation	FRB 006	2	1	2	1	4	30	20	10	40

Course Content	Introduction – operating principles of sensors and transducers – general considerations for selection and evaluation of measurement equipment – statistical treatment of data – temperature sensors – pressure transducers – fluid transducers – strain gauges – load cells and force measurement – position and level measurement – uncertainty analysis of complete measurement systems – introduction to signal conditioning and data processing – Opto-electronics. Laboratory experiments on the course topics.
References	• Richard S. Figliola and Clemson University, “Theory and Design for Mechanical Measurements”, 5th edition, John Wiley & Sons, Inc., 2011. • Alan S. Morris, “Measurement and Instrumentation Principles”, 3rd edition, Alan S. Morris, 2001.
Laboratory	• Measuring Temperature (Mechanical Methods) • Measuring Temperature (Electrical Methods) • Measuring Pressure (Mechanical Methods) • Measuring Pressure (Electrical Methods) • Flow Measuring Instruments: Orifice Meter, Venturi Meter, Flow Nozzle, Pitot Tube, Movable Vane, ultrasonic

<table>
<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><td rowspan="2">MAM 201</td><td rowspan="2">Project Management</td><td rowspan="2">FRB 002</td><td rowspan="2">2</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>MT1</td><td>PE/OE</td><td>SA</td><td>Final</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>3</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to Project planning and scheduling, Project charter, Scope statement, Work Breakdown Structure, Responsibility Chart. Network diagram, Schedule analysis and possibilities using the Critical Path Method (CPM) and the Program Evaluation and Review Technique (PERT). Resource leveling and allocation, Time-cost trade off (Crashing a schedule), Gantt Chart, Time overlaps, Time and cost control, Risk monitoring and control, Computer applications</td></tr>
<tr><td>References</td><td colspan="11">• Moder J., Phillips C., and Davis E., "Project Management with CPM, PERT and Precedence Diagramming", Last Edition.
• Gail Freeman-Rue & James Balkwill, "Management in Engineering, Principles & Practice", Prentice Hall, Last Edition.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Gantt chart drawing for simple projects
• PERT and CPM models simulation</td></tr>
</table>

<table>
<tr><th>Code</th><th>Course Title</th><th>Pre-req</th><th>Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><td rowspan="2">MAM 205</td><td rowspan="2">Fluid Power Systems</td><td rowspan="2">MAM 101</td><td rowspan="2">2</td><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>MT1</td><td>PE/OE</td><td>SA</td><td>Final</td></tr>
<tr><td>1</td><td>3</td><td>0</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Thermal Properties of fluids, Bulk modulus, Types of Hydraulic fluids,
Flow through conduits and orifices, Power losses, Pressure transients in hydraulic conduits.
Hydraulic pumps, Analysis of ideal and practical pumps and motors, Performance curves.
Hydraulic control valves, Spool valve analysis, Three-way spool valve, Flapper valve analysis.
Hydraulic power elements, Valve controlled motors. Pump controlled motor. Pressure and flow control valves. Electro-Hydraulic operation of fluid power systems.</td></tr>
<tr><td>References</td><td colspan="11">• Herbert E. Merritt, 1991, "Hydraulic Control Systems", John Wiley & Sons.
• John Watton: Fundamentals of Fluid Power Control. Cambridge University Press, 2009</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Demonstrate basic hydraulic operation.
• Build circuits with pumps, filters, flow and pressure-control valves and act
• Analyze hydraulic systems using simulation software
• Build control and automation of an application using fluid components</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 207	Mechanical Design	MAM 106	3	2	3	0	5	30	20	10	40
Course Content	Design methodology revision and creative problem solving, Design of chain drives selection, Belt drives, gear drives selection, shaft design, roller element bearing selection, Electric motor selection, structural issues, small collaborative project.										
References	• J.E. Shigley and C. R. Mischke, "Mechanical Engineering Design", McGraw-Hill, Last Edition. • George E. Dieter, Linda C. Schmidt, 2021, "Engineering design", 6th Edition.										
Laboratory	Students will use derived knowledge and work in groups to make an assigned projects in computer aided laboratories to demonstrate their capability of producing integrated system design, then oral discussion will be followed.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 209	Mechanical Vibrations	FRB 004	3	2	2	1	5	30	20	10	40
Course Content	Foundation of mechanical systems, mathematical models of mechanical systems, systems modeling, electromechanical systems. Explore necessary algorithms to solve equations of motion, Laplace transform, matrix method, computer generated solutions. Dynamic response and evaluation of first and second order systems, oscillating motion with single DOF, measuring and analysis methods, damping of free motion. Isolation of vibration, vibration of two DOF, vibration of multi-degree of freedom system. Numerical methods for evaluation of natural frequency and patterns, design of frequency absorbers.										
References	• Ahmed A. Shabana, "Theory of Vibration, An Introduction", Springer, 3rd edition, 2019 • Rao, S.S., and A. Weiley, “Mechanical vibrations”, 4th edition, Prentice Hall, 1995										
Laboratory	• Validation of a pendulum dynamics and estimation of gravitational acceleration. • Verification of mass-spring system and estimation of spring stiffness. • Estimation of the moment of inertia for a wheel and the damping condition. • Vibration measurement methods, Double cantilever test. • Computer-aided simulation and case studies, course project										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	SA	Final
MAM 202	Automatic Control Systems	MAM 209	3	2	2	1	5	30	20	10	40
Course Content	Introduction to feedback control systems. Modeling of dynamic systems, Laplace transform, Block diagrams, State Space. Control system characteristics: time response, steady state error, Stability. Analyze control systems using root loci - Design of feedback control systems using root locus. Polar and Nyquist plot - small gain theory - Bode plots. Linear control systems analysis in State Space. PID Controllers and Tuning. Computer simulation and case studies.										
References	• K. Ogata, 1997, "Modern control engineering", Prentice Hall. • R. C. Dorf and R. H. Bishop, "Modern Control Systems", 10th Ed., Prentice Hall, 2004. • B. C. Kuo and F. Golnaraghi, "Automatic Control Systems", 8th Ed., John Wiley & Sons Inc, 2002.										
Laboratory	• Modeling of dynamic systems using MATLAB/LabVIEW • Block diagrams Using of MATLAB / SIMULINK/LabVIEW • Modeling and Control of liquid level system • Modeling and Control of DC motor • Controller design of inverted pendulum • Modeling and Control of liquid level system										

Code	Course Title	Pre-req.	CH	Ct. Hr.				Assessment			
				Lec.	Lab.	Tut.	Sum	SA	MT1	MT2	Final
MAM 306	Engineering Economics	-	2	2	-	1	3	10%	30%	20%	40%
Course Contents	Principles of Economics, Economical Analysis, Cost estimation, Comparison between alternatives, Present worth method, Future worth, Depreciation, Taxes, Inflation, Risk and uncertainty, Introduction to Engineering cost analysis and budgeting.										
References	N. Gregory Mankiw, Euston Quah and Peter Wilson, “Principles of Economics”, Delmar, Cengage Learning, - 2020, An Asian Edition, ISBN-13: 978-981-4227-87-2										

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT1</th><th>PE/ OE</th><th>SA</th><th>Final</th></tr>
<tr><td>MAM 309</td><td>Technical Reports</td><td>-</td><td>1</td><td>0</td><td>2</td><td>0</td><td>2</td><td>--</td><td>50</td><td>50</td><td>--</td></tr>
<tr><td>Course Content</td><td colspan="11">The student is assigned a practical problem to study and write a though report covering all its aspects. He is expected to do one or all the following: gather information, collect data, review literature, analyze or test in pursue of reliable results and solutions.</td></tr>
<tr><td>Laboratory</td><td colspan="11">Practical and Simulation experiment and data collection and writing concluding results with illustrative drawings in well-organized technical report.</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT 1</th><th>PE/ OE</th><th>SA</th><th>Final</th></tr>
<tr><td>MAM 203</td><td>Dynamic Modeling and Simulation</td><td>FRB 101</td><td>3</td><td>2</td><td>1</td><td>1</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to systems: system, classification of systems, multi-domain engineering systems, linear versus non-linear systems, time-varying versus time-invariant systems, lumped versus distributed parameter systems, continuous-time versus discrete-time systems, deterministic versus stochastic systems, time-driven versus event-driven systems. Systems modeling: need of system modeling, modeling techniques and methods, classification of models (mechanical, electrical, thermal, fluidic, etc.), mathematical modeling. Simulation: introduction, advantages of simulation, applications of simulation, simulation techniques, numerical methods of simulation, characteristics of numerical models, discrete-event modeling and simulation, Hardware In the Loop simulation (HIL). Case studies for modeling and simulation of mechatronic systems, such as: physical subsystems (motor, mass-spring-damper system, etc.), longitudinal control of an aircraft, submarine depth control system, pilot ejection control system.</td></tr>
<tr><td>References</td><td colspan="11">KLUEVER, C. A. (2015). Dynamic systems: modeling, simulation, and control.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Demonstration of Physical System Modeling
• Modeling of Polymer-Based Actuators
• Dynamic Modeling of a Stirling Engine
• Simulation of Pneumo-Elastic Finger Response</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 204	Introduction to Mechatronics	MAE 102	3	2	2	0	4	30	20	10	40

Course Content

Mechatronics fundamentals, Electrical actuation systems, Digital logic, combinational and sequential logic circuits. Microprocessors & Microcontrollers. System performance, System Interfacing, Instrumentation, and Control Systems, Sensor technology (Proximity switches, Photoelectric sensors, Fiber optic sensors), signal acquisition, filtering, and conditioning – Device communications, Computer simulation and Practical training, Case studies and Applications.

References

- Robert H. Bishop, 2010, “Mechatronics: An Introduction”, CRC Press.
- David, G. and Michael, B., Introduction to Mechatronics and Measurement Systems, McGraw Hill, 2003.

Laboratory

- Control, drives and real-time interaction with mechatronic system
- Transducer calibration system for certain application
- Sensors for condition monitoring
- Transistor Operation, Passive filters, and an Op Amp circuit experiment.
- Stepper Motor Motion Control
- Barcode reader
- DC Motor Speed Control Using PWM

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAE 206	Logic Circuits Design & Applications	MAE 102	3	2	2	0	4	30	20	10	40

Course Content

Number systems and data representation - Boolean algebra - simplification of Boolean functions - logic gates - combinational and sequential logic circuits. Registers, counters, and adders – Memory. Digital electronics. Performance of analogue and digital transducers; selecting a proper transducer for a given application. Digital transducers: optical encoders, ultrasonic sensors. Data acquisition systems (A/D and D/A converters). Stepper motors: microprocessors: structure, programming, applications.

References

- Charles H. Roth Jr., Larry L Kinney, 2009, "Fundamentals of Logic Design", 6th Edition, Publisher: CL Engineering
- Sajjan G. Shiva, 1998, "Introduction to logic design", M. Dekker, New York

Laboratory

- Project: At the end of the course the student must provide a project emphasizing the course content

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	SA	Final
MAM 208	Industrial Robots	MAM 103	3	2	2	0	4	30	20	10	40

Course Content

Definition of robot, areas of application, general structure of industrial robots. Geometrical Modeling of Industrial Robot Arms. Working space and working volume of industrial robots. Homogeneous Transformation Matrix (HTM), Position and Orientation of the robot arm end effector center. HTM between two adjacent links. Generalized HTMs of spatial robots. Direct Kinematic Modeling of Industrial Robot Arms. Direct kinematic position model (DKPM), direct kinematic velocity model (DKVM), robot arm Jacobian matrix, direct Kinematic acceleration Model (DKAM). Trajectory generation. Inverse Kinematic Modeling of Industrial Robot Arms. Dynamic Modeling of Industrial Robot Arms.

References

- Megahed, S., 1993, "Principles of Robot Modelling and Simulation", John Wiley & Sons Ltd, England.
- Craig, J.,2005, "Introduction to Robotics: Mechanics and Control", 3rd edition, by Addison-Wesley Publishing Company, Inc.

Laboratory

- Computer aided analysis of kinematics of robots
- Kinematic modeling of 5R articulated robot
- Kinematic modeling of SCARA robot
- Kinematic modeling of 6 DOFs robot
- Computer aided trajectory generation between several points
- Dynamic analysis of planar and spatial robots

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	SA	Final
MAM 301	Design of Mechatronic Systems	MAM 204	3	2	2	0	4	30	20	10	40

Course Content

Modeling hypothesis and mathematical models of complex mechatronics systems. Principle of operation of various sensors and transducers. Design of control strategies for vehicles and robotic systems. Adopting and designing different components of a mechatronics system. Microcontrollers and electrical components, Electromechanical actuators and control, Mechanical components and mechanisms, Programmable motion control and algorithm development, Closed loop control. Essential tools for the mechatronics system design using the V-model: MATLAB/SIMULINK, LabVIEW, PROTEUS VSM, SOLIDWORKS, etc. Case studies of various mechatronics systems. Control interface of mechatronic systems using MATLAB/LabVIEW.

References

- Clarence W. De Silva, 2005, “Mechatronics: An integrated approach”, CRC Press, 2005.
- Alciatore, D. G. and Histand, M.B., Introduction to Mechatronics and Measurement Systems, McGraw Hill,2003.

Laboratory

- Demonstration and presentation of at least two mechatronic systems.
- Performing some experiments on some basic components.
- Using an ADDA card to control two types of systems through a PC, based system.
- Mechatronic control in automated manufacturing
- MATLAB/LabVIEW interface of mechatronic system.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	SA	Final
MAE 303	Power Electronics	MAE 211	3	2	2	0	4	30	20	10	40
Course Content	Power semiconductor devices, diodes, thyristors, MOSFETS, and other insulated gate devices such as the IGBT, MCT and the FCT. Static and switching characteristics, gate drive and protection techniques. Drive circuit design and protection techniques. Power converter circuits Applications of AC-DC, DC-DC, and DC-AC power converter circuits. Analyses of input and output waveforms of these circuits, harmonic performance. A basic understanding of devices, circuit principles and implications in input/output waveform quality. Application considerations for remote and un-interruptible power supplies, and for computer systems, telecommunications, automobiles, traction and other industrial processes; Utility interaction, harmonic distortion.										
References	• Adel S. Sedra and Kenneth C. Smith, “Microelectronic Circuits”, by Oxford University press.										
Laboratory	• Characteristic of silicon-controlled rectifier • Triggering of IGBT, MOSFET & Power Transistor • Experimental study Bridge inverter using IGBT • Experimental study Series Inverter using MOSFET										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	SA	Final
MAM 302	CAD/CAM	MAM 207	3	2	2	0	4	30	20	10	40
Course Content	CAD: Geometric modeling, data exchange and integration, mechanical assembly and drafting, mechanical tolerance, mechanical stress analysis. CAD/CAM: Process planning and Tool path generation, integration of CAD/CAM with the production machine. Programming for lathe, drilling and milling machines, canned cycles, subroutines, Loops, Computer assisted part programming, DNC, CNC. Group Technology: Part families, part classifications and coding systems, group technology machine. Computer Integrated Manufacturing: Types of manufacturing systems, types of CIMS, special manufacturing systems, Flexible Manufacturing Systems (FMS), Manufacturing Cells.										
References	• M.P. Groover, E.w. Zimmers, “Computer- Aided Design & Manufacturing”, Prentice-Hall, Inc, New Jersey, 1984.										
Laboratory	• Make various subroutines/program of different workpieces machining operations in CNC machine										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	SA	Final
MAE 304	Microprocessors and Microcontrollers	MAE 206	3	2	1	1	4	30	20	10	40

Course Content

Historical background - Organization & Architectural Features of Microprocessor & Micro Controllers - Instructions Set - Instruction format, addressing modes - Assembly language programming of 8085 and 8051 - Interfacing of memory devices - Data transfer techniques and I/O ports - Interfacing of keyboard and display devices; Programmable Interrupt - Interfacing of sensors, actuators, A/D & D/A Converters - Analog Signal Conditioning Circuits, Standard Interfaces – RS232, USB - Application examples.

References

- B. Ram, "Fundamentals of Microprocessors and Microcomputers", Dhanpat Rai Publications.
- A.K.Ray and K.M.Bhurchandi – "Advanced Microprocessors & Peripherals" Tata McGraw Hill.
- M.A. Mazidi and J.G. Mazidi, "The 8051 Microcontroller and Embedded Systems", Pearson Education, India.

Laboratory

- BIT ARITHMETIC OPERATIONS
- SORTING AN ARRAY FOR 8086

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	SA	Final
MAE 405	Electric Drives	MAE 303	3	2	1	2	5	30	20	10	40

Course Content

Electric drives block diagram, criteria for selecting drive components, Dynamics of Motor-Load system, Motor-load Operating point, stability check, Operation of motors: starting, speed and braking control techniques, DC drives, AC drives, basics of industrial motor control, DC motor drives, equivalent circuit of dc motors, permanent magnet DC motors, DC servomotors, adjustable speed DC drives, industrial examples, electric traction examples, induction motor drives, slip power recovery from induction motor, variable frequency AC motor drives, injection braking of induction motors, synchronous motor drives, stepper motor drives, computer controlled drives

References

- El-Sharkawi, M. A. (2000). Fundamentals of electric drives. Pacific Grove, CA: Brooks/Cole.

Laboratory

- Thyristor controlled (half-wave and full wave) DC Drive
- Chopper fed (Two/Four-quadrant) DC Drive
- Regenerative / Dynamic braking operation for DC Motor
- Closed loop control of DC Drives
- PWM Inverter fed 3 phase Induction Motor control
- V/f control operation of 3 phase induction motor drive
- Closed loop control of Induction Motor Drives

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/OE	SA	Final
MAE 403	Programmable Logic Controllers	MAE 206	3	2	2	0	4	30	20	10	40

Course Content

Basic theory and applications of programmable logic controllers (PLCs). Processor units, numbering systems, memory organization, relay type devices, timers, counters, data manipulators, and programming. Explain the architecture and operation of industrial PLC's. Integration of PLCs with electro-mechanical systems. Develop, troubleshoot, test, and optimize PLC programs. Use of industrial data monitoring and supervision systems. Networking, building simple supervisory control and data acquisition (SCADA) system integrated with a PLC for sequential control problems.

References

- Dag H. Hanssen, Programmable Logic Controllers: A Practical Approach to IEC 61131-3 using CoDeSys, 2015, Wiley.

Laboratory

- Program logic functions in PLC's using both graphical and text-based languages
- Use timers, counters, and shift-registers to achieve sequential functionality
- Monitoring and Control of filling a tank
- Case study project to solve problems encountered in industry
- Examine a communication protocol used with PLC's
- Hybrid boat control system

<table>
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<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT1</th><th>PE/OE</th><th>SA</th><th>Final</th></tr>
<tr><td>MAE 401</td><td>Artificial Intelligence</td><td>MAE 304</td><td>2</td><td>1</td><td>2</td><td>1</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Basics of intelligent control. Design of simple intelligent controllers. Basics of Artificial intelligence, Fuzzy set theory, Fuzzy logic, Fuzzy reasoning, Fuzzy controllers, Fuzzy PID control. Introduction to Neural networks, perception model, classification problem, multilayer networks, Feed forward networks, back propagation learning algorithms, recurrent networks, radial basis networks, neural network control. Neuro-fuzzy systems, introduction to optimization methods such as swarm optimizations and ants colony.</td></tr>
<tr><td>References</td><td colspan="11">• Y. Sin and C. Xu, Intelligent Systems: Modeling, Optimization, and Control, CRC Press, 2008
Jinkun, Liu, “Intelligent Control Design and MATLAB Simulation”</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Design a fuzzy controller for the system using MATLAB/LabVIEW
• Design a neural controller for simple control system using MATLAB/LabVIEW
• Training a multilayer perceptron with the MATLAB/LabVIEW Neural Networks Toolbox
• Investigate the performance of a neural network on the 2D XOR problem
• Fuzzy model reference learning control for a tanker ship
• Train Convolutional Neural Network for Regression using MATLAB/LabVIEW</td></tr>
</table>

Contents of Elective Courses

Elective Courses – Mechatronics track (MAX x3x)

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT1</th><th>PE/OE</th><th>SA</th><th>Final</th></tr>
<tr><td>MAM 331</td><td>Mobile Robots</td><td>MAM 208</td><td>3</td><td>2</td><td>1</td><td>1</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to mobile robots, Mobile robot hardware: locomotion, Mobile robot hardware: sensors, Mobile robot control system: hardware and software, Navigation I: localization and mapping, Navigation II: reasoning and motion planning, Wireless communication for mobile robots, Advanced topics: multiple robots’ coordination. Design software structures and user interfaces for mobile robots.</td></tr>
<tr><td>References</td><td colspan="11">• Introduction to Autonomous Mobile Robots”, Seigwart et al, 2004.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Select and implement planning algorithms
• Design and implement a robot or autonomous system
• Design navigation algorithms for a specific selection of sensors
• Design and implement user interfaces
• Path Planning and Navigation for Autonomous Robots</td></tr>
</table>

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs .</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>MT1</td><td>MT2</td><td>SA</td><td>Final</td></tr>
<tr><td>MAE 333</td><td>Digital Control</td><td>MAM 202</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Introduction to digital control systems, AD/DA conversion. Conversion of linear time invariant systems from continuous-time to discrete-time. Identification of unknown systems. Design of digital controllers and filters. Sampling continuous-time systems, time-delay systems, transfer functions in z-domain, block diagram simplification, stability analysis of digital systems, transformation techniques, compensator designs, PID controllers, digital filters, state space models,controllability, observability, state feedback, output feedback, and introduction to system identification. Laboratory experiments on the course topics.</td></tr>
<tr><td>References</td><td colspan="11">• Ioan D. Landau and GianlucaZito, Digital Control Systems Design, Identification and Implementation, springer, 2006.</td></tr>
</table>

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>MT1</td><td>MT2</td><td>SA</td><td>Final</td></tr>
<tr><td>MAE 335</td><td>Computer Interfacing</td><td>MAE 206</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Computer Interfacing: Architecture of a virtual instrument, data-flow techniques, graphical programming. Development of Virtual Instruments (VIs) using GUI, Real-time systems. Loops, charts, arrays, clusters and graphs, structures, formula nodes, local and global variables, string and file I/O. Instrument Drivers, Introduction to data acquisition on PC, Sampling fundamentals, Input/ Output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements. Common Instrument Interfaces.</td></tr>
<tr><td>References</td><td colspan="11">• Wells, L.K. and Travis, J., LabVIEW for Everyone, Prentice Hall Inc. (1996).
• Sokoloft, L., Basic Concepts of LabVIEW 4, Prentice Hall Inc. (2004).</td></tr>
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<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>MT1</td><td>MT2</td><td>SA</td><td>Final</td></tr>
<tr><td>MAM 332</td><td>Autonomous systems</td><td>MAM 208</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Autonomous versus automatic systems, Advanced topics in autonomous systems, including filters for localization, probabilistic map-based localization and mapping, motion planning and navigation algorithms. Design exception handling systems for autonomous systems. Select and implement planning algorithms. Knowledge-base: facts and procedures, acquisition, exploration, skill transfer, learning. Autonomous systems architecture: behavioral principles, expert systems, knowledge-bases, multi-level control concepts. Applications of autonomous systems.</td></tr>
<tr><td>References</td><td colspan="11">• Seigwart et al, 2004, Introduction to Autonomous Mobile Robots", Wiley.</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAE 334	Micro Electromechanical Systems (MEMS)	MAM 301	3	2	0	2	4	30	20	10	40
Course Content	Introduction to Micro and Nano-Electromechanical Systems (MEMS/NEMS). Design of MEMS/NEMS; Fabrication of MEMS/NEMS; Principles of sensing and actuation in MEMS/NEMS: Electrostatic – Piezoresistive - Magnetic; Applications of MEMS/NEMS; Computer Simulations and Course Project.										
References	• Adim Maluf, Kirt Williams, 2004, "An Introduction to MEMs Engineering", Artech House										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAM 336	Automotive Engineering	MAM 301	3	2	0	2	4	30	20	10	40
Course Content	Characteristics of Ground Vehicle, Classification of Motor Vehicle. Manual and automatic Transmission Systems, Propeller Shaft and Drive Shaft. Tires, Construction of Tire, Tire Dynamics. Types of Suspension System: Mechanical, Pneumatic and Hydraulic suspension systems. Design Analysis of Suspension System, Braking System, Steering System, introduction of hybrid cars, autonomous cars.										
References	• Abubakar, S.; Alammari, Youssef; Kaisan, M. U.; Mahroogi, Faisal O.; Narayan, S.; Sakthivel, R, 2019, " An introduction to automotive engineering", John Wiley & Sons & Scrivener Publishing.										

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
MAM 390	Senior Design Project I	70% of total CH	2	2	0	0	2	50	--	50	--
Course Content	The Course exploits the design experience for undergraduate students. It provides the essential concepts, ideas, and principles of the engineering design process, with the use of other concepts as standards, constraints, and communication. Students work in teams (can be a multidisciplinary team if accepted from the college council) students develop the project proposal and are required to present their proposal in oral presentation and submit a written version of it.										

<table>
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<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>MT1</td><td>PE/ OE</td><td>SA</td><td>Final</td></tr>
<tr><td>MAE 431</td><td>Embedded System Design</td><td>MAE 304</td><td>3</td><td>2</td><td>1</td><td>2</td><td>5</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Fundamentals of embedded system hardware and firmware. Embedded processor selection, glue logic, circuit design, circuit layout, circuit debugging, development tools, firmware architecture, firmware design, and firmware debugging. Microcontrollers’ family, architecture of microcontroller, wire wrapped microcontroller board. Development of embedded software using C language. The students will be able to grasp the main principles of embedded system design and understand the concept of hardware-software co-design.</td></tr>
<tr><td>References</td><td colspan="11">• Embedded systems design with the Atmel AVR microcontroller, Barrett, Steven F., and Steven Frank Barrett, Morgan & Claypool Publishers, 2010.
• AVR Microcontroller and Embedded Systems, Mazidi, The. Pearson India, 2010.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Testing of microcontrollers IO pins
• Generation of different signals using Microcontroller.
• Microcontroller interface with sensors.
• Microcontroller interface with actuators and motors (DC and servo motors)
• Microcontroller interface with peripheral devices and communication.
• Digital function implementation using digital blocks</td></tr>
</table>

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<tr><td>Lec.</td><td>Lab</td><td>Tut</td><td>Sum</td><td>MT1</td><td>PE/ OE</td><td>SA</td><td>Final</td></tr>
<tr><td>MAM 433</td><td>Biomechatronic</td><td>MAM 301</td><td>3</td><td>2</td><td>1</td><td>2</td><td>5</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Fundamentals of embedded system hardware and firmware. Embedded processor selection, glue logic, circuit design, circuit layout, circuit debugging, development tools, firmware architecture, firmware design, and firmware debugging. Microcontrollers family, architecture of microcontroller, wire wrapped microcontroller board. Development of embedded software using C language. The students will be able to grasp the main principles of embedded system design and understand the concept of hardware-software co-design.</td></tr>
<tr><td>References</td><td colspan="11">• Embedded systems design with the Atmel AVR microcontroller, Barrett, Steven F., and Steven Frank Barrett, Morgan & Claypool Publishers, 2010.
• AVR Microcontroller and Embedded Systems, Mazidi, The. Pearson India, 2010.</td></tr>
<tr><td>Laboratory</td><td colspan="11">• Testing of microcontrollers IO pins
• Generation of different signals using Microcontroller.
• Microcontroller interface with sensors.
• Microcontroller interface with actuators and motors (DC and servo motors)
• Microcontroller interface with peripheral devices and communication.
• Digital function implementation using digital blocks</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	PE/ OE	SA	Final
MAM 435	Autotronics	MAM 301	3	2	1	2	5	30	20	10	40

Course Content	Basics of control and electronic systems. Introduction to Autotronics, Vehicle main components and subsystems: propulsion systems, suspension systems, braking systems, steering systems, Engine starting system, fuel supply system and ignition system. Advanced vehicle systems: Anti-lock Braking system, Brake-By-Wire system, semi-active and active suspension systems, driving assistance systems, drive-By-Wire system, passive and active driving safety systems, and Steering-By-Wire systems. Electric vehicles and hybrid vehicles.
References	• Konrad Reif, 2019, " Automotive Mechatronics: Automotive Networking, Driving Stability Systems, Electronics", Bosch Professional Automotive Information.
Laboratory	• Sensor Simulation and Control using Arduino • Anti-lock Braking System (ABS) Simulation • Smart Lighting Control with Photoresistor • Line Following Robot with IR Sensors

Elective Courses – Automation track (MAX x4x)

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAE 341	Industrial Automation	MAM 208	3	2	0	2	4	30	20	10	40

Course Content	Principles of integrating robots in factories, emphasizing computer numerical control (NC, CNC, DNC), computer aided design (CAD), and computer integrated manufacturing (CIM). Computer aided process planning, Process Systems and automated machinery, Automated material handling and storage systems, Simulation of automated Systems. Components of automation lines, industrial robot programming, system drivers and sensors. Construction of 3D CAD drawings of mechanical parts of automated manufacturing systems. Study of famous applications such as: Binder-Processing machine, Sagger load station, Tray handlers, Cotton classing system.
References	• Chanchal Dey, Sunit Kumar Sen, 2020, " Industrial Automation Technologies", CRC press

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAE 343	Machine Vision Systems	MAM 204	3	2	0	2	4	30	20	10	40

Course Content	Machine Vision Systems: Image understanding and image representation, feature extraction, segmentation, optical flow, and structure from motion. Image processing algorithms and traditional computer vision approaches. Use of image information to control a robot. Camera calibration, Artificial vision, Motion detection, Object tracking, Motion capture. Three-dimensional imaging, Epipolar geometry, Stereoscopic vision, Active range imaging, structured lighting. Visual servoing, target tracking, Mapping and robot guidance, activity monitoring, motion estimation, autonomous systems, biomedical imaging devices.
References	• “Robotics, Vision and Control, Fundamental Algorithms in MATLAB”, By Peter Corke, Springer.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAM 345	Playware Technology	MAM 208	3	2	0	2	4	30	20	10	40

Course Content	Fundamental principles and tools for the development of entertainment and educational robotics. Adaptivity, embodied artificial intelligence, hardware and software adaptivity, modularity, distributed processing, tangible interfaces, man-machine interaction, human-robot interaction, interaction design, play and play dynamics. Integrate knowledge on play and interaction in synthesis. Design of a modular robotic playware platform. Playful interaction with voice sensing modular robots. Adaptivity and implementations of adaptivity in playware.
References	• S. Papert. Mindstorms: children, computers, and powerful ideas. New York, NY, USA: Basic Books, Inc., 1980. • Standard Guide for Rapid Prototyping of Information Systems, ASTM, 2010.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAE 342	Theory of Automata	MAE 341	3	2	0	2	4	30	20	10	40

Course Content	Fundamental concepts in automata theory and formal languages including grammar, finite automaton, regular expression, formal language, pushdown automaton. Deterministic finite automaton and nondeterminism. Minimization of automata and applications. Turing machines and (un)decidability. Form basic models of computation. Foundation of computer science, compilers, software engineering, concurrent systems. The properties of these models will be studied and various rigorous techniques for analyzing and comparing them will be discussed, by using both formalism and examples.
References	• John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, 2001, "Introduction to automata theory, languages, and computation", Addison-Wesley

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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT1</th><th>MT2</th><th>SA</th><th>Final</th></tr>
<tr><td>MAM 344</td><td>Sensors and Actuators</td><td>MAM 208</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Sensors: Sonar and Optical Sensors, Inertial Measurement Units, Temperature, Pressure, and Tactile Sensing, Body-Surface Biopotential Electrodes. Actuators: Solenoids, DC Motors, Stepper Motors, Servo Motors, Linear Actuators, Pneumatic Muscles, Shape Memory Alloys.</td></tr>
<tr><td>References</td><td colspan="11">• Clarence W. de Silva,2015, “Sensors and Actuators Engineering System Instrumentation”, Second Edition, CRC press.</td></tr>
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<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT1</th><th>MT2</th><th>SA</th><th>Final</th></tr>
<tr><td>MAM 346</td><td>Industrial Material Flow Management</td><td>MAM 301</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Sensors: Sonar and Optical Sensors, Inertial Measurement Units, Temperature, Pressure, and Tactile Sensing, Body-Surface Biopotential Electrodes. Actuators: Solenoids, DC Motors, Stepper Motors, Servo Motors, Linear Actuators, Pneumatic Muscles, Shape Memory Alloys.</td></tr>
<tr><td>References</td><td colspan="11">• Bernd Wagner, Stefan Enzler, 2005, "Material Flow Management: Improving Cost Efficiency and Environmental Performance", Springer Science</td></tr>
</table>

<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Course Title</th><th rowspan="2">Pre-req</th><th rowspan="2">Cr. Hrs.</th><th colspan="4">Ct. Hr.</th><th colspan="4">Assessment</th></tr>
<tr><th>Lec.</th><th>Lab</th><th>Tut</th><th>Sum</th><th>MT1</th><th>MT2</th><th>SA</th><th>Final</th></tr>
<tr><td>MAM 441</td><td>Hydraulic Servo Control</td><td>MAE 341</td><td>3</td><td>2</td><td>0</td><td>2</td><td>4</td><td>30</td><td>20</td><td>10</td><td>40</td></tr>
<tr><td>Course Content</td><td colspan="11">Fields of applications of hydraulic servo systems –Hydraulic servo systems versus proportional systems and electric servo systems – Hydraulic servo valves; types, static characteristics, valves coefficients, lapping conditions – Transient and steady state flow forces acting on spools and flappers – Pilot operated servo valves and types of feedback – Dynamic characteristics of servo valves and fluid lines – Hydro mechanical and electro-hydraulic servo systems; loop gain, stability, dynamics – Course project.</td></tr>
<tr><td>References</td><td colspan="11">• John Watton, 2009, “Fundamentals of Fluid Power Control”, Cambridge University Press.</td></tr>
</table>

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAE 443	Internet of Things	MAE 304	3	2	0	2	4	30	20	10	40

Course Content

Introduction to Internet of Things, physical design of IOT. Logical design of IOT, IOT enabling technologies, IOT Levels. Interconnection and integration of the physical world and the cyber space. Home automation, cities, environment, energy, retail, logistics. Agriculture, industry, Health and Lifestyle. Simple Network Management Protocol (SNMP), Limitations of SNMP, Network Operator Requirements. IOT design and Methodology. IOT Devices, exemplary device, Board, Linux on Raspberry Pi, Interfaces, and Programming & IOT Devices

References

- Jamil Y. Khan, Mehmet R. Yuce, 2019, "Internet of things: Systems and Applications", Jenny Stanford Publishing.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hr.				Assessment			
				Lec.	Lab	Tut	Sum	MT1	MT2	SA	Final
MAM 445	Computer Numerical Control (CNC)	MAM 302	3	2	0	2	4	30	20	10	40

Course Content

Numerical Theory – Control Units of Me
anical Systems – Control of Manufacturing processes – Sensing Elements – Programming Languages of Numerical Control Machines – Programming Applications in Manufacturing – Computer Control in Manufacturing Machines – CAM software e.g. Artcam - CNC-PLC integration and communication

References

- Peter Smid, "CNC Programming Handbook", Third Edition, Industrial press inc.
- Michael Fitzpatrick, Keith Smith, "Machining and CNC Technology" 4th Edition, Mc Graw Hill.

Code	Course Title	Pre-req	Cr. Hrs.	Ct. Hrs.				Assessment			
				Lec.	Lab	Tut	Sum	SA	MT	PE/OE	Final
MAM 490	Senior Design Project II	MAM 390	3	0	6	0	6	50	--	50	--

Course Content

The second design experience course for the students. The students build\implement\ fabricate their design. They test and evaluate their design against the design specification. The students are asked to demonstrate a functional project to the discussion committee, make an oral presentation and deliver their final report that documents the project