اللائحة الداخلية
لدرجة ماجستير العلوم الهندسية

تخصص "هندسة الميكاترونيات"

المحتويات

اللائحه الداخليه للبرنامج الجديد لدرجة ماجستير العلوم الهندسية في تخصص هندسه الميكاترونيات

أولا: أحكام عامة

مادة (١): تعريف بالدرجة:

تمنح درجة الماجستير في العلوم الهندسية تخصص هندسة الميكاترونيات في اطار مرحلة الدراسات العليا للبرامج الجديدة بكلية الهندسة جامعة الزقازيق كدرجة ممهدة للحصول على درجة دكتوراه الفلسفة في ذات التخصص أو أي تخصص اخر مناسب وفقا لما تحدده اللائحة المنظمة لذلك.

و درجة الماجستير هنا هي درجة بينية (Inter-disciplinery) يشارك فيها أكثر من قسم علمي.

مادة (٢): الأقسام العلمية المشاركة :

تشارك الأقسام العلمية الاتية بشكل رئيس في تدريس المقررات و في الارشاد الأكاديمي لطلاب درجة الماجستير في هندسة الميكاترونيات:

(أ) قسم هندسة القوى الميكانيكية.

(ب) قسم هندسة التصميم الميكانيكي و الانتاج.

(جـ) قسم هندسة الالكترونيات و الاتصالات الكهربية.

(د) قسم هندسة القوى و الآلات الكهربية.

(هـ) قسم هندسة الحاسبات و المنظومات

و تشارك كل هذه الأقسام أو بعضها في الاشراف على الرسالة.

مادة (٣) : المجلس العلمي

يشكل مجلس علمي لادارة برنامج درجة ماجستير هندسة الميكاترونيات من رؤساء مجالس الأقسام المشاركة المبينة في المادة (٢) ، ويجوز ضم أستاذ أو أكثر من ذوي الخبرة الي هذا المجلس ويكون رئيسه هو اقدم الأعضاء ، ويحدد مجلس الكلية مهامه.

ماده (٤) : المنح

تمنح جامعه الزقازيق بناءا على طلب مجلس كلية الهندسة درجة الماجستير فى العلوم الهندسيه "تخصص هندسه الميكاترونيات".

وينص فى شهاده الحصول على الدرجه على عنوان الرساله و على مسمى الأقسام العلميه المشاركه فى الاشراف عليها.

ماده (٥) : نظام الدراسه

الدراسه لدرجة الماجستير فى تخصص "هندسه الميكاترونات" تكون بنظام الساعات المعتمده .

ويقصد بالساعة المعتمدة ساعة محاضرة واحدة أو ساعتين من التمارين النظريه أو العمليه اسبوعيا.

ماده (٦) : الارشاد الأكاديمي و الاشراف:

(أ) يعين لكل مجموعة من الطلاب مرشد أكاديمي من بين أعضاء هيئة التدريس في الأقسام المبينة في المادة (٢)، و تكون مهمته معاونة الطالب في التسجيل و اختيار المقررات وفي حل اية مشكلات تقابله خلال الدراسة.

(ب) يعين مجلس الكلية بتوصية من المجلس العلمي للبرنامج مشرفا أو أكثر على رسالة الطالب من بين أعضاء هيئة التدريس من الأساتذة (أو الأساتذة المساعدين) بالأقسام المختصة بموضوع الرسالة.

مادة (٧): درجة الماجستير المزدوجة (Dual Degree)

يجوز للطالب الحصول على درجة ماجستير مزدوجة في هندسة الميكاترونيات ، وعليه في هذه الحالة قضاء فصل دراسي كامل أو أكثر (مقررات أو رسالة أو كلاهما) في الجامعة الأجنبية الموقعة على الاتفاقية الخاصة بذلك .

ويحدد عدد الساعات المعتمدة هنا وفقا للنظام المتبع في الجامعة الأجنبية، وتحتسب ضمن الساعات المطلوبة للحصول علي الدرجة ، مع مراعاة حكم المادة (٩) من هذه اللائحة .

ماده (٨) : التحويل

يجوز للطالب المقيد لدرجة ماجستير الهندسة في تخصص معين التحويل الى القيد لدرجة ماجستير العلوم الهندسية (تخصص هندسة الميكاترونيات) أو العكس بموافقة الأقسام العلمية المختصة والمجلس العلمي للبرنامج (المادة(٣))، مع مراعاة حكم المادة (١٢) من هذه اللائحة، وعمل المقاصة اللازمة في هذه الحالة.

ثانيا: الأحكام المنظمة للدراسة

ماده (٩) : المتطلبات

يتطلب الحصول على درجه الماجستيرفى العلوم الهندسيه (تخصص الميكاترونيات) مايلى :

ـ دراسة عدد من المقررات من مستوى (٥٠٠) باجمالى (٣٠) ساعات معتمده والنجاح فيها مع تحقيق تقدير تراكمى فيها لا يقل عن (C).

- اجراء بحث علمى تطبيقى واعداد رساله عنه تجيزها لجنة الحكم والمناقشه بتقدير B على الأقل وتكافىء الرساله ١٥ ساعات معتمدة، و توزع الساعات المعتمدة الاجمالية على الفصول الدراسية و فقا للمادة (١٢).

ماده (١٠) : رسوم الدراسه :

(أ) يسدد الطالب الرسوم الدراسية العادية أو رسوم التسجيل المتأخر حسب عدد الساعات المعتمدة المسجل لها بالاضافة الى الرسوم الأخرى التي قد تقررها الجامعة.

(ب) تقرر الجامعة سنويا الرسوم الدراسية العادية و رسوم التسجيل المتأخر عن الساعة المعتمدة الواحدة وكذلك الرسوم الاضافية . و تحدد أيضا الحد الأدنى لرسوم الدراسة.

مادة (١١): اختيار المقررات:

يقوم الطالب المتقدم بالتسجيل في فصل دراسي معين بالاختيار من بين مقررات مطروحة في الجداول الملحقة بهذه اللائحة بحد أدنى ٢ مقرر (٦ ساعات اسبوعيا) وحد أقصى ٥ مقررات (١٥ ساعة اسبوعيا) وبالاستعانة بالمرشد الأكاديمي في تحديد المقررات المناسبة للطالب .

ماده (١٢): مدة الدراسة

(أ) مدة الدراسه لدرجة الماجستير فى تخصص هندسة الميكاترونيات سنتان أكاديميتان على الأقل من تاريخ القيد (شاملا دراسة المقررات و اجراء البحث و اعداد الرسالة) علي النحو التالي :

ـ السنة الأولى من فصلين دراسيين (S_1, S_2) بكل فصل ١٢ ساعات معتمده دراسيه ، ويجوز طرح فصل صيفى اذا لزم الأمر .

ـ السنة الثانية (S_3, S_4) يخصص الفصل الأول لدراسة ٦ ساعات معتمدة (عدد ٢) مقررات دراسية و ٥ ساعات معتمدة للجزء الأول للرسالة و الفصل الثاني للبحث و الرسالة بما يكافيء ١٠ ساعات معتمدة (اجمالي ٤٥ ساعة معتمدة).

(ب) الحد الأقصى لمدة الدراسة لدرجة الماجستير هو خمس سنوات أكاديمية.

(جـ) يجوز مد الحد الأقصى المنصوص عليه في الفقرة (ب) بناءا على تقرير من لجنة الاشراف على الرسالة وموافقة المجلس العلمي للبرنامج و مجلس الكلية، و بحد أقصى ستة سنوات.

مادة (١٣) : توقيتات الدراسة

تقسم السنة الأكاديمية الى ثلاث فصول دراسية على النحو التالي:

(أ)الفصل الدراسي الأول (فصل الخريف (Automn Term)): و يبدأ من السبت الثالث من شهر سبتمبر و تستمر لستة عشر اسبوعا.

(ب) الفصل الدراسي الثاني (فصل الربيع (Spring Term)) : و يبدأ السبت الثاني من شهر فبراير ويستمر لستة عشر اسبوعا.

(جـ) الفترة الصيفية (Summer Term) : و تبدأ من السبت الثالث من شهر يونيو و يستمر لثمانية أسابيع ، و يطرح الفصل الصيفي في اطار الضرورة و مصلحة الطالب. وفي الفترة الصيفية يضاعف عدد الساعات الفعلية للمقرر.

مادة (١٤) : فئات وتوقيتات القيد والتسجيل :

(أ) يجوز القيد والتسجيل لدرجة الماجستير فى هندسه الميكاترونيات للحاصلين على درجة بكالوريوس الهندسه فى تخصص هندسة الميكاترونيات أو أحد تخصصات الهندسه الميكانيكيه أو الهندسه الكهربيه من أحدى الجامعات أو المعاهد المصريه أو مايعادلها و المعترف بها من المجلس الأعلى للجامعات بتقدير تراكمى جيد أو (+C) على الأقل بنظام الساعات المعتمده.

(ب) يتم الاعلان عن فتح باب القيد لأي فصل دراسي (Semester) في الفترات الزمنية المختلفة قبل ستة أسابيع من بدء الفترة الزمنية التي سوف يدرس بها الطالب و تقدم طلبات الالتحاق لادارة البرنامج و لمدة خمسة أسابيع و طبقا للمادة (١٣).

(ج) يتم القيد و التسجيل لأي مرحلة دراسية قبل اسبوعين من بدء أي فترة زمنية و بعد سداد الرسوم المقررة.

ماده (١٥) : تسجيل المقررات و الرسالة:

(أ) المقررات:

يكون التسجيل للمقررات الدراسية خلال الاسبوع الأول من الفترة الدراسية و لعدد ساعات معتمدة وفقا للمادتين (١١) ، (١٢) و بموافقة المرشد الأكاديمي. و لا يعد التسجيل نافذا الا اذا سدد الطالب الرسوم الدراسية المقررة.

الجزء الأول يشمل دراسة الطالب لمقررات تعادل ٣٠ ساعات معتمدة و يمكن أن تسجل على عدد من الفصول الدراسية بحد أدنى ٦ ساعات للفصل الدراسي العادي و بحد أقصى ١٢ ساعة معتمدة. و يجوز أن يسجل حد أدنى ٣ ساعات و حد أقصى ٦ ساعات للفصل الدراسي الصيفي.

(ب) الرسالة:

الجزء الثاني: ويشمل اعداد الرسالة و التي تعادل ١٥ ساعة معتمدة مقسمة على جزئين (٥، ١٠) ساعات معتمدة. و لا يكون تسجيل الرسالة نافذا الا اذا سدد الطالب الرسوم الدراسية عن ذلك ، و يحدد في استمارة التسجيل موضوع الرسالة بموافقة المجلس العلمي للبرنامج و اعتماد مجلس الكلية.

(جـ) التسجيل المتأخر:

يجوز عند الضرورة السماح للطالب بالتسجيل في المقررات أو الرسالة بعد انتهاء الوقت الرسمي الوارد من فقرة (أ) من هذه الماده و لظروف اضطرارية، و لا تزيد مدة التسجيل المتأخر عن يومين بعد انتهاء الوقت الرسمي مباشرة.

و يسدد الطالب رسوما اضافية وفقا للمادة (١٠) مقابل السماح له بالتسجيل متأخرا.

مادة (١٦) الحذف و الاضافة والانسحاب

أ يحق للطالب بموافقة المرشد الأكاديمي، حذفا أو اضافة، مقرر أو أكثر خلال أسبوعين من بدء الدراسة مع مراعاة الحدين الأدنى والأقصى لساعات التسجيل و ذلك بموافقة المرشد الأكاديمي، و ترحل رسوم المقرر المحذوف الى مقرر مضاف في حالة حذف مقرر في مقابل اخر مضاف.

ب للطالب الحق في الانسحاب من المقرر أو الفصل الدراسي بالكامل خلال ثمانية أسابيع على الأكثر من بداية الدراسة في أي فترة زمنية و لا ترد له الرسوم الدراسية في هذة الحالة . ويكون الانسحاب بطلب يقدم من الطالب وموقع عليه من المرشد الأكاديمي.

ج للطالب الحق بموافقة المرشد الأكاديمي في إعادة التسجيل (دراسة وامتحانا) في أي مقرر رسب فيه أو يرغب تحسين تقديره مع سداد رسوم المقرر، مع مراعاة المتطلب السابق (ان وجد).

مادة (١٧) الحرمان من دخول الامتحان النهائي

يحرم الطالب من دخول الامتحان النهائي للمقرر اذا قلت نسبة حضوره فيه عن ٧٥% من إجمالي الساعات الفعلية على أن يتم إنذار الطالب عند بلوغ نسبة غيابه ١٥%. ويكون ذلك بناء على تقرير من أستاذ المادة مع موافقة المجلس العلمي للبرنامج و اعتماد مجلس الكلية وفي هذه الحالة يعتبر الطالب راسبا في المقرر (تقدير F).

مادة (١٨) الاعتذار عن عدم دخول الامتحان النهائي

يجوز للمجلس العلمي للبرنامج قبول اعتذار الطالب عن عدم دخول امتحان أحد المقررات إذا تقدم بطلبه قبل بدء الامتحان أو خلال ٤٨ ساعة من تاريخ الامتحان مدعما بمبرر مقبول. وفي حالة عدم تقديم عذر أو تقديم عذر غير مقبول يعتبر الطالب راسبا في المقرر (تقدير F).

مادة (١٩) التوقف عن الدراسة

لا يحق للطالب أن يتوقف عن الدراسة (القيد و التسجيل) لأي مرحلة دراسية (مقررات أو رسالة) لأكثر من أربعة فترات زمنية متتالية وإلا يعتبر قيده لاغيا.

مادة (٢٠) إعادة القيد

إذا تم إلغاء قيد الطالب لأي سبب يجوز إعادة قيده بناءا على اقتراح المجلس العلمي للبرنامج و موافقة مجلس الكلية. ويجوز أن يعفى الطالب المعاد قيده من المقررات التي يكون سبق له دراستها قبل الغاء القيد و لم يمض على نجاحه فيها أكثر من خمس سنوات اكاديمية، وذلك بناء على طلب من المجلس العلمي للبرنامج وموافقة المجلس العلمي للبرنامج واعتماد مجلس الكلية.

مادة (٢١) احتساب ساعات معتمدة من خارج الكلية

يجوز لمجلس الكلية و بناء على اقتراح من المجلس العلمي للبرنامج و مجلس القسم المختص احتساب ساعات معتمدة مقابلة لمقررات على مستوى الدراسات العليا يكون سبق للطالب دراستها و النجاح في نفس التخصص في أي كلية أو معهد علمي آخر معترف به من المجلس الأعلى للجامعات ما لم يمض

على نجاحه فيها أكثر من خمس سنوات على ألا يكون قد حصل من خلالها على درجة علمية و لا يقل تقديره فيها عن (+C) أو (٧٥%).

مادة (٢٢) النقاط و المتوسطات و التقديرات

أ – تحسب تقديرات المقررات على اجمالي درجات اعمال الفصل والعملي (ان وجد) بحد اقصى 30 % ودرجات الامتحان النهائي (التحريري أو العملي) بحد ادنى ٧٠% .

ب - تحدد النقاط المقابلة لكل ساعة معتمدة من الجدول رقم (١) التالي:

جدول (١)

النسبة المئوية لدرجة الطالب الاجمالية في المقرر	تقدير المقرر		عدد النقاط لكل ساعة معتمدة
من 90 فأكثر	A	أ	4.0
من 88 الى اقل من 90	A^-	أ-	3.7
من 85 الى اقل من 88	B^+	ب+	3.3
من 80 الى اقل من 85	B	ب	3.0
من 78 الى اقل من 80	B^-	ب-	2.7
من 75 الى اقل من 78	C^+	جـ+	2.3
من 70 الى اقل من 75	C	جـ	2.0
من 68 الى اقل من 70	C^-	جـ-	1.7
من 65 الى اقل من 68	D^+	د+	1.3
من 60 الى اقل من 65	D	د	1.0
أقل من 60 (راسب)	F	هـ	0.0

(جـ) متوسط النقاط:

- تحسب نقاط كل مقرر على أنها عدد ساعاته المعتمدة مضروبا في نقاط كل ساعة من الجدول السابق.

- يحسب مجموع النقاط للطالب في أي فصل دراسي على أنه مجموع نقاط المقررات التي درسها في الفصل.
- يحسب متوسط نقاط أي فصل دراسي (SPA) على انه ناتج قسمة مجموع نقاط الفصل مقسوما على مجموع الساعات المعتمدة للمقررات التي درسها الطالب في هذا الفصل ويحدد و تقديره في الفصل من الجدول رقم (٢).
- المقرر الذي يحصل فيه الطالب على تقدير اقل من C يتم اعتباره في حساب متوسط النقاط الفصلي ولا يعتد به ضمن الساعات المعتمدة المقررة في المرحلة إلا إذا أعاده ونجح فيه بتقدير C أو أعلى فتحسب له الاخيرة فقط .
- يحسب المتوسط التراكمي للنقاط (GPA) أو (CPA) من مجموع نقاط الطالب في الفصل أو الفصول السابقة عليه مقسوما على مجموع الساعات المعتمده التي اجتازها الطالب في الفصل و الفصول السابقة عليه ويحدد التقدير التراكمي من الجدول رقم (٢).
- المقرر الذي يقوم الطالب بتحسين تقديره و نقاطه فيه، يتم اسقاط تقديره و نقاطه قبل التحسين من حساب متوسط النقاط (سواء الفصلي أو التراكمي) مهما كان عدد مرات التحسين.

مادة (٢٣) الحكم والمناقشة:

تتخذ اجراءات الحكم والمناقشة لرسالة الماجستير في تخصص هندسة الميكاترونيات وفقا للنصوص الواردة في قانون تنظيم الجامعات المصرية و قرارات المجلس الأعلى للجامعات في هذا الشأن. ويجوز في حالة الدرجة المزدوجة أن يشارك عضو هيئة تدريس من الجامعة الأجنبية الموقعة على الاتفاقية وبلجنة الحكم والمناقشة، و يحال تقرير لجنة الحكم والمناقشة الى المجلس العلمي للبرنامج، و يرفع التقرير النهائي الى مجلس الكلية للاعتماد.

جدول (٢)

متوسط النقاط (الفصلي أو التراكمي)	التقدير		(الفصلي أو التراكمي)
من ٣,٨ الى ٤,٠	A^+	أ+	ممتاز+
من ٣,٦ الى أقل من ٣,٨	A	أ	ممتاز
من ٣,٤ الى أقل من ٣,٦	A^-	أ-	ممتاز-
من٣,٢ الى ٣,٤	B^+	ب+	جيد جدا+
من ٣,٠ الى أقل من ٣,٢	B	ب	جيد جدا
من ٢,٨ الى أقل من ٣,٠	B^-	ب-	جيد جدا-
من ٢,٧ الى ٢,٨	C^+	جـ+	جيد+
من ٢,٦ الى أقل من ٢,٧	C	جـ	جيد
من ٢,٥ الى أقل من ٢,٦	C^-	جـ-	جيد-
من ٢,٤ الى ٢,٥	D^+	د+	مقبول+
من ٢,٣الى أقل من ٢,٤	D	د	مقبول
من ٢,٠ الى أقل من ٢,٣	D^-	د-	مقبول-
أقل من ٢,٠	F	هـ	راسب

ثالثا: أحكام التطبيق:

مادة (٢٤) تطبيق اللائحة بعد صدورها:

يبدأ تطبيق هذه اللائحة وملاحقتها على الطلاب المقبولين بها من بداية العام الدراسي التالي مباشرة لصدور القرار الوزاري الخاص بها.، مع مراعاه أحكام المادتين (١٤) ،(١٥)

مادة (٢٥) في شأن ما لم يرد له نص في اللائحة:

تطبق فيما لم يرد بشأنه نص في هذه اللائحة أحكام القانون (٤٩) لتنظيم الجامعات المصرية و لائحته التنفيذية ة القوانين المعدلة لهما و كذلك القرارات الوزارية المبينة على قرارات صادرة من المجلس الأعلى للجامعات.

الملاحق

ملحق (أ) جداول المقررات و المحتوى العلمي

جدول رقم (١) الفصل الدراسي الأول (S_1)

كود المقرر	اسم المقرر	الساعات المعتمدة Credit Hours	الساعات الفعلية			ساعات الامتحان التحريري النهائي Final Exam Hours
			٢	٢	–	
رفه (٥٠١) EMP 501	الرياضيات الهندسية المتقدمة Advanced Engineering Mathematics	3	٢	٢	–	3
رفه (٥٠٢) EMP 502	البرمجة المتقدمة Advanced Programming	3	٢	٢	–	3
ميك (٥٠١) MEC 501	الميكاترونيات الصناعية والأنظمة الروبوتية Industrial Mechatronics and Robotic Systems	3	٢	٢	–	3
ميك (٥٠٢) MEC 502	نمذجة ومحاكاة نظم الميكاترونيك Mechatronics Systems Modeling and Simulation	3	٢	٢	–	3
ميك* (٥٠٣) MEC 503	مقرر اختياري رقم ١ Elective course 1	3	٢	٢	–	3

* يتم اختيار المقرر من جدول (٣)

جدول رقم (٢) الفصل الدراسي الثاني (S_2)

كود المقرر	اسم المقرر	Credit Hours	Exam Hours
ميك (٥٠٤) MEC 504	انظمة الوقت الفعلى الموزعة والمضمنة Distributed and Embedded Real time Systems.	٣ ٢+٢	3
ميك (٥٠٥) MEC 505	نظرية التحكم المتقدمة Advanced Control Theory	٣ ٢+٢	3
ميك (٥٠٦) MEC 506	انظمة وحساسات القياس المتقدمة Advanced Measurement Systems and Sensors	٣ ٢+٢	3
ميك* (٥٠٧) MEC 507	مقرر اختياري رقم ٢ Elective 2	٢ ١+٢	3
ميك (٥٠٨) MEC 508	منهجية البحث Research Methodology	٢ ١+٢	3

* يتم اختيار المقرر من جدول (٤)

خامسا: البرامج الدراسية
لمرحلة الدراسات العليا

جدول (٣) قائمة المقررات الاختيارية للفصل الدراسى الاول (المقرر اختياري رقم ١)

الكود	اسم المقرر	الساعات المعتمدة	ساعات الامتحان
ميك (٥٠٣أ) MEC 503a	مقرر تكيف الهندسة الميكانيكية Adaptation Course in Mechanical Engineering	٣ ٢+٢	3
ميك (٥٠٣ب) MEC 503b	مقرر تكيف الهندسة الكهربية Adatation Course in Electrical Engineering	٣ ٢+٢	3
ميك (٥٠٣جـ) MEC 503c	الذكاء الالى Machine Intelligence	٣ ٢+٢	3
ميك (٥٠٣د) MEC 503d	معالجة الصور المتقدم Advanced Image Processing	٣ ٢+٢	3
ميك (٥٠٣هـ) MEC 503e	تخطيط الأعمال والإدارة الاستراتيجية Business Planning & Strategic Management	٣ ٢+٢	3
ميك (٥٠٣و) MEC 503f	محركات الروبوت: الحركة، الديناميكية، التحكم Robot Manipulators: Kinematics, Dynamics, Control	٣ ٢+٢	3

جدول (٤) قائمة المقررات الاختيارية للفصل الدراسى الثانى (المقرر اختياري رقم ٢)

الكود Code	المقرر Subject	الساعات المعتمدة	ساعات الامتحان
ميك (٥٠٧أ) MEC (507a)	المشاريع الهندسية الموجهة للميكاترونيات Mechatronics-Oriented Engineering Projects	٣ (٢+٢)	٣
ميك (٥٠٧ب) MEC (507b)	مراقبة العمليات المتقدم Advanced Process Control	٣ (٢+٢)	٣
ميك (٥٠٧جـ) MEC (507c)	مواضيع مختارة في الميكاترونيات المتقدمة Selected Topics in Advanced Mechatronics	٣ (٢+٢)	٣
ميك (٥٠٧د) MEC 507d	برمجة وحدة التحكم المنطقية المتقدمة Advanced PLC	٣ (٢+٢)	٣
ميك (٥٠٧هـ) MEC (507e)	نظم التصنيع المتقدمة Advanced Manufacturing Systems	٣ (٢+٢)	٣
ميك (٥٠٧و) MEC (507f)	المعالجة الرقمية للاشارات المتقدمة Advanced Digital Signal Processing	٣ (٢+٢)	٣

Cources syllabus and curriculum

Advanced Engineering Mathematics					
Identification number MM11	***Workload*** *180 h*	***Credits*** *6 ECTS 3 CH*	***Semester*** *1*	***Frequency of offer*** *Winter semester*	***Duration*** *1 Semester*

1	***Courses*** *Course instruction: 2 HPW* *Exercise: 2 HPW*	***Contact time*** *4 HPW / 60 h*	***Self-study*** *120 h*	***Planed group size*** *20 students*

2

Course Description

Build on the undergraduate students' math knowledge in order to provide the necessary skills in analytical and computational mathematical methods to work in a scientific environment and solve engineering problems in research and development projects.

3

Learning outcomes / competencies

On completing the course, students will be able to have to following skills:

- *Knowledge and understanding*

  A1. Understand analytical and computational principles in advanced mathematical methods.
  A2. Identify different transformations methods for the solution of advanced problems.
- *Intellectual skills*

  B1. Formulate strategies for solutions to advanced engineering problems based on the methods taught
  B2. Select mathematical tools appropriate for advanced engineering problems
- *Professional and practical skills*

  C1. Apply advanced mathematical methods for solving engineering problems.
  C2. Recognize the advantages / disadvantages of different computational solutions and select appropriate algorithms and software accordingly
- *General and transferrable skills*

  D1. Use a structured approach to advanced quantitative engineering problems.
  D2. Communicate solutions adequately

4 ***Contents***

- *Analytical Methods: Real and complex analysis; Partial differential equations, Fourier Transforms; Laplace transforms; Difference equations; Z-Transforms; advanced matrix operations and manipulations*

Computational Methods: *Computer arithmetic; Numerical solutions of nonlinear equations and systems; Numerical solutions using least squares methods; Optimization theory.*

5 ***Teaching Method***
Lectures, tutorials, problem solving, modeling, and self-studies.

6 ***Requirements***
Bachelor degree (BSc, BEng) in Engineering

7 ***Examination***
Written in-class exams; Take-home exams

8 ***Requirements for awarding credit points***
Module examination

9 ***Significance of the mark for the final score***
70%

10 ***Representative module and full-time teachers***
Name of module coordinator at offering institution

11	***Other Information*** ***Books*** ▫ *K. A. Stroud, Advanced Engineering Mathematics, Industrial Press, 2011* ▫ *S. Chapra: Applied Numerical Methods with MATLAB, 3rd ed. McGraw Hill 2011.* ▫ *E. Kreyszig, Advanced Engineering Math, Wiley Publisher. 10th edition, 2010*

Advanced programming						
Identification number MM12	**Workload** 180 h	**Credits** 6 ECTS 3 CH	**Semester** 1	**Frequency of offer** Winter semester		**Duration** 1 Semester
1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW		**Contact time** 4 HPW / 60 h	**Self-study** 120 h		**Planed group size** 20 students
2	*Course Description* Motivate Students' knowledge of Object Oriented Concepts (OOP). Teaching the knowledge and skills needed to develop reusable, quality programs. Using OOP to design and implement complex and real-time systems and to increase their proficiency in programming using available software Packages.					
3	*Learning outcomes / competencies* On completing the course, students will e able to have to following skills: ▫ Knowledge and understanding A1. Tell the principles of Object Oriented paradigms (OOP). A2. Use of knowledge of OOP to design and implement complex and real-time systems. ▫ Intellectual skills B1. Formulate and model designs for solutions to advanced engineering problems based on the methods taught B2. Choose modeling and programming tools appropriate to solve complex systems. ▫ Professional and practical skills C1. Apply OOP methods in control and mechatronic systems. in engineering problems. C2. Create and model complex problems by using appropriate tools. ▫ General and transferrable skills D1. Get hand-on experience in OOP method of thinking. D2. Communicate solutions adequately					
4	**Contents** Analytical Methods: Object-Oriented Paradigm (Static, Dynamic). Parallel, Distributed Systems. Introduction to Database System. Practical Methods: The use of OOP to analyze, design, and implement complex systems. Choose an application example to evaluate its performance. The use of Unified Modeling Language (UML) as a tool for designing and implementing the control and mechatronic systems. Application using available software (LABVIEW, MATLAB, or any OO-Language such as Java).					
5	**Teaching Method** Lectures, tutorials, problem solving, modeling, self-studies.					
6	**Requirements** Bachelor degree (BSc, BEng) in Electrical Engineering, Mechanical Engineering or Computer Science					
7	**Examination** written examination					
8	**Requirements for awarding credit points** Module examination					
9	**Significance of the mark for the final score** **70%**					
10	**Representative module and full-time teachers**					

11	**Other Information** **Books** ▫ Beginning C# Object-Oriented Programming, Apress, 2011. ▫ Beginning Visual C# 2012 Programming, John Wiley & Sons, 2012. ▫ Real-Time Object Uniform Design Methodology with UML, Springer; 2007.

Industrial Mechatronics and Robotic Systems					
Identification number MM13	**Workload** 180 h	**Credits** 6 ECTS 3 CH	**Semester** 1	**Frequency of offer** Winter semester	**Duration** 1 Semester

1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW	**Contact time** 4 HPW / 60 h	**Self-study** 120 h	**Planed group size** 20 students

2

Course Description:

The main objectives of this course are to introduce:

1. The different automation systems used in modern industry and the use of robots in soft automation ones.
2. The fundamental transformation techniques from different frames of reference and kinematic analysis of robots.
3. Robot dynamics.
4. Machine vision.

3

Learning outcomes / competencies

On completing the course, students will be able to have to following skills:

- **Knowledge and understanding**
  - A1. Classify the different industrial automation types.
  - A2. Classify the different types of robots.
  - A3. Derive the transformation matrices between different frames of references.
  - A4. Formulate the forward and inverse kinematics problems.
  - A5. Clarify the machine vision concepts.
- **Intellectual skills**
  - B1. Analyze robots motion.
  - B2. Use inverse kinematics to calculate the inputs for the actuators.
  - B3. Design of the robots links considering the static and dynamic analysis.
- **Professional and practical skills**
  - C1. Apply robot programming for robots to achieve a given task. .
  - C2. Create robots models for design and analysis.
  - C3. Apply machine vision technology for robot control.
- **General and transferrable skills**
  - D1. Use information Technology for design and analysis. .
  - D2. Communicate solutions adequately
  - D3. Lifelong self-learning.

4 **Contents:**

Automation and robots- Robot classifications- Robot applications in Manufacturing - Performance specification and robot selection criteria - Fundamental theory and practical applications of robotic manipulators and mobile robots – Forward kinematics – Inverse kinematics- Work space analysis and trajectory planning -Equations of motion- Robot dynamics and statics - Motion planning - introduction to machine vision- basics of robot programming.).

5 **Teaching Method**

Lectures, tutorials, problem solving, modelling, self-studies.

6 **Requirements**

Bachelor degree (BSc, BEng) in Electrical Engineering, Mechanical Engineering or Computer Science

7 **Examination**

	written examination
8	**Requirements for awarding credit points** Module examination
9	**Significance of the mark for the final score** 70%
10	**Representative module and full-time teachers**
11	**Other Information** **Books** ▫ John J. Craig; "Introduction to Robotics Mechanics and Control"; Pearson Prentice Hall, Latest edition. . ▫ Robert J. Schilling; " Fundamental of Robotics- Analysis & Control.

Mechatronics Systems Modeling and Simulation					
Identification number MM14	**Workload** 180 h	**Credits** 6 ECTS 3CH	**Semester** 1	**Frequency of offer** Winter semester	**Duration** 1 Semester

1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW	**Contact time** 4 hpw / 60 h	**Self-study** 120 h	**Planed group size** 20 students

2

Course Description

This course covers three main areas: modelling, simulation, and identification. It presents several modelling methodologies that can be used for mechatronics systems. This will cover mathematical and graph models. Software tools, such as MATLAB/Simulink and/or LABVIEW, will be used to simulate the systems and analyze the responses. Also, an introduction to system identification will be provided

3

Learning outcomes) / competencies

On completing the course, students will acquire to following skills:

- Knowledge and understanding

A1. Recognize modelling and identification concepts as related to mechatronics systems
A2. Understand simulation tools and results' analysis

- Intellectual skills

B1 Comprehend complex models
B2. Recognize patterns among different systems

- Professional and practical skills

C1. Simulate industrial systems using software packages
C2. Identify dynamic physical systems

- General and transferrable skills

D1. Apply modelling and simulation techniques to engineering system design
D2. Optimize system performance

4 **Contents**

Modeling and Simulation Principles; System Analogies (mechanical, electrical, fluid and heat elements); Block Diagram Models and Transfer Functions; State Space Models; Model Linearization, Linear Graphs, Modeling of Electrical, Mechanical Systems, and Mechatronics Systems; System Response and Simulation, Model verification and validation; System Identification (parametric vs. nonparametric methods)

5 **Teaching Method**

Lectures, presentations and movies, discussions, tutorials, problem solving, projects, self study.

6 **Requirements**

Undergraduate courses in Control and engineering mathematics.

7 **Examination**

written examination

8 **Requirements for awarding credit points**

Module examination

9 **Significance of the mark for the final score**

70%

10 **Representative module and full-time teachers**

Name of module coordinator at the offering institution

11 **Other Information**

	Literature: ▫ Mechatronics: An integrated approach by Clarence de Silva 2005 ▫ Digital Control Systems: Design, Identification and Implementation by Landau and Zito 2006 ▫ System Identification: Theory for the user by Lennart Ljung. Prentice Hall 1999 ▫ Modeling Identification and Simulation of Dynamic Systems by PP van den bosch and AC van der Klauw. CRC Press. 1994 ▫ Modeling of Dynamic Systems by Lennart Ljung and Torkel Glad. Prentice Hall 1994 ▫ Identification of Dynamic Systems: An introduction with applications by Rolf Isermann and Marco Munchhof. Springer 2010

Distributed and Embedded Real time Systems					
Identification number MM21	**Workload** 180 h	**Credits** 6 ECTS 3 CH	**Semester** 2	**Frequency of offer** Spring Semester	**Duration** 1 Semester

1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW	**Contact time** 4 HPW / 60 h	**Self-study** 120 h	**Planed group size** 20 students

2

Course Description

Mechatronics is the merger of mechanics, electronics and computer concepts (interfacing and programming). This course involves computer interfacing and programming to control mechanical objects. In this course we will use a microcontroller or a field programmable chip (computer-on-a-chip) to interface with Mechatronics components such as switches, LED's, DC motors, stepper motors, relays, remote controls, and others. It will also present Personal Computers Interface (PCI) through Data Acquisition Cards (DAQ).

3

Learning outcomes) / competencies

On completing the course, students will e able to have to following skills:

- Knowledge and understanding

A1-Tell the principles of microcontroller-based systems design
A2-. Mention the design requirements of embedded systems

- Intellectual skills

B1. Show improved comprehensive quality and innovative ability
B2. Design and implement a real system based on a single chip microcontroller

- Professional and practical skills

C1. Implement small mechatronics system considering both H/W and S/W requirements for a single-chip design.
C2. Work with system design development tools such as MATLAB, LABVIEW, PROTEUS or any other available software.

- General and transferrable skills

D1. Use programmable chip to manage operation of a Mechatronic system
D2. Choose suitable hardware and software components for a reliable system

4

Contents

Designing and developing computer-based system: analysis phase, design phase, and implementation phase, **Design phase:** choosing a processor, choosing OS, choosing programming language, choosing developing tools, **Implementation phase:** Buses, I/O devices, timer/counter, interrupts, data acquisition systems, data distribution systems, **Microcontroller programming:** C program elements; header & source files, preprocessor directives, macros & functions, data type & data structures, loop & pointers, queues & stacks, **Embedded programming in C++, Motor control examples** (closed and open-loops), **PID example of mechatronic system, Serial and USB Communication:** connecting to PC, internet, wireless sensor networks for mechatronics systems, **Software engineering concepts in the system development process:** algorithm complexity, s/w process life cycle, **s/w analysis & design, s/w implementation, testing, validating & debugging, Realization of real-time algorithms, Hardware and Software co-design, Real-time programming:** soft & hard tasks, RTOS, RTOS

	Task scheduling, Interrupt routines in RTOS, Case studies of programming with RTOS, **Computer Interface through DAQ:** Specifications and Interface, **PC Control Programming through DAQ** (LABVIEW or MATLAB)
5	**Teaching Method** Lectures, discussions, tutorials, problem solving, modeling, project, self study.
6	**Requirements** Bachelor degree (BSc, BEng) in Electrical Engineering, Mechanical Engineering, or Computer Science
7	**Examination** written examination
8	**Requirements for awarding credit points** Module examination
9	**Significance of the mark for the final score** ***70 %***
10	**Representative module and full-time teachers:** Name of module coordinator at the offering institution
11	**Other Information** ▫ **Books** ▫ P. Laplante, *Real-Time Systems Design and Analysis*, IEEE Press, 2004 ▫ Q. Li, *Real-Time Concepts for Embedded Systems*, CMP Books, 2003 ▫ T. Noergaard, *Embedded Systems Architecture*, Newess Press, 2005 ▫ J. Peatman, "Embedded Systems Design with the PIC18F452 microcontroller", Prentice-Hall, USA 2003. ▫ M. Zurawski, *Embedded Systems Handbook*, CRC Press, 2005**.** ▫ Steven Heath, "Embedded Systems Design", 2nd edition, Newton, Mass. USA, 2002. **Websites** ▫ http://www.labcenter.com/download/prodemo_download.cfm#professional ▫ http://www.mathworks.com/products/matlab/ ▫ http://www.ni.com/labview/

Advanced Control Theory					
Identification number MM22	**Workload** 180 h	**Credits** 6 ECTS 3 CH	**Semester** 2	**Frequency of offer** Spring Semester	**Duration** 1 Semester

1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW	**Contact time** 4 HPW / 60 h	**Self-study** 120 h	**Planed group size** 20 students

2

Course Description

The course introduces advanced concepts in the theory, analysis and design of control systems.

3

Learning outcomes) / competencies

On completing the course, students will be able to have to following skills:

- Knowledge and understanding

A1. Model and analyse control systems
A2. Evaluate the performance of control systems

- Intellectual skills

B1 Apply control engineering know-how to other scientific disciplines.
B2. Conduct research in advance control field to generate novel techniques.

- Professional and practical skills

C1. Design and simulate industrial and practical systems
C2. Improve performances of control systems

- General and transferrable skills

D1. Understand the requirements and operations of control systems
D2. Design and tuning techniques for performance improvement

4 **Contents**

Review of control engineering fundamentals: Dynamic response**,** Stability in the time-domain and frequency domain, Root locus analysis and design, PID controllers, **State space application and analysis:** State space technique for stability analysis, controllability, observability, design of state space controllers, **Robust control, optimum criteria, symmetric optimum**, **advanced control structures,** feed forward control, cascade control, pilot control, **Multi variable control systems, Non linear control systems**

5 **Teaching Method**

Lectures, discussions, tutorials, projects, modeling, computer simulations, self study.

6 **Requirements**

Under graduate Control course and Informatics, Advanced Engineering Mathematics.

7 **Examination**

Written examination

8 **Requirements for awarding credit points**

Module examination + Simulation Project

9 **Significance of the mark for the final score**

70%

10 **Representative module and full-time teachers**

Name of module coordinator at the offering institution

11 **Other Information**

Literature:

- Control System Engineering, Norman S. Nise, 6th edition. John Wiley & Sons 2011

	▫ Modern Control Systems, Richard C. Doft and Robert Bishop 2004 ▫ Modern Control Engineering, 5th edition by Katsuhiko Ogata, 2009 ▫ Analysis and Control of Nonlinear Process Systems, Katalin M. Hangos, Jozef Bokor and Gabor Szederkenyi, Springer 2010 ▫ Control Systems Theory and Engineering Applications by Sergey Lyshevski ▫ Automatic Control Systems by Benjamin C. Kuo and Farid Golnaraghi

<table>
<tr><th colspan="6">Advanced Measurement Systems and Sensors</th></tr>
<tr><td>Identification number MM23</td><td>Workload
180 h</td><td>Credits
6 ECTS
3 CH</td><td>Semester
2</td><td>Frequency of offer
Spring Semester</td><td>Duration
1 Semester</td></tr>
<tr><td>1</td><td colspan="2">Courses
Course instruction: 2 HPW
Exercise: 2 HPW</td><td>Contact time
4 HPW / 60 h</td><td>Self-study
120 h</td><td>Planed group size
20 students</td></tr>
<tr><td>2</td><td colspan="5">Course Description:
The course is based on mechatronic philosophy, regarding mechanic, electronic and informatics as a whole. After finishing the course the student should be able to:-
• Analyze measurement- and control problems,
• Design and/or select the best suited sensors for a specified problem, regarding range, accuracy, dynamic behavior, environment requirements etc.
• Perform all necessary calculations regarding the sensor implementation and the analog and digital signal processing required.</td></tr>
<tr><td>3</td><td colspan="5">Learning outcomes / competencies
On completing the course, students will be able to have to following skills:
▫ Knowledge and understanding
A1- Describe the concepts of different measurement & Mechatronics systems used in industry.
A2 - Describe the function, suitability of different sensors and Transducers.
A3- Know and understand in depth the concepts of Input/ Output Signal conditioning
▫ Intellectual skills
B1-Analyze, Design and/or select the suitable sensors for a given system.
B2-Analyze & design the signal conditioning circuits.
B3 – Conduct research in measurement system and sensor field to generate novel techniques
▫ Professional and practical skills:
C1- Carry out calibration and error estimation of measuring devices .
C2- Design and assessment of the sensors used in industrial systems.
C3 – Improve system performance
▫ General and transferrable skills
D1- Critical thinking.
D2- Team work
D3- Self learning..</td></tr>
<tr><td>4</td><td colspan="5"><u>Contents:</u> Introduction- Mechatronics systems – Measurement systems- Performance terminology of sensors - Passive Sensors (Resistors-Capacity-Inductive); Active sensors: Piezoelectric sensors for force, pressure and vibration, electrodynamic sensors for speed and rotation, Photodiodes and Thermocouples. –Signal conditioning (Analog data processing- Digital data processing – Protection – Filtering)- Elements of optical sensors: LED, laser diode, photodiode, CCD sensor, optical waveguides, opto coupler:
Optical sensor systems: Light barriers, triangulation, fiber-optic sensors, spectrometer;
Lasers: Gauß beam, coherence, optical resonators, interaction of laser light with matter
Smart sensors and smart sensor systems (Definition – Different types- new trends)- Sensors</td></tr>
</table>

	selection- Small course project (groups of 3-4 students).
5	**Teaching Method:** Lectures, discussions, projects, tutorials and self-study.
6	**Requirements** Bachelor degree (BSc, BEng) in Engineering
7	**Examination** Written in-class exams; Take-home exams
8	**Requirements for awarding credit points** Module examination
9	**Significance of the mark for the final score** **70%**
10	**Representative module and full-time teachers** *Name of module coordinator at offering institution*
11	**Other Information** • Göpel, Hesse, Zemel: Sensors. Volumes 1, 4, 5, 7, VCH Verlag, Weinheim • Löffler-Mang: Optical Sensors. Vieweg and Teubner, Wiesbaden • Hecht, Zajac: Optics. Addision-Wesley Publishing Company

Research Methodology					
Identification number MM25	**Workload** 180 h	**Credits** 6 ECTS 3 CH	**Semester** 2	**Frequency of offer** Spring Semester	**Duration** 1 Semester

1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW	**Contact time** 4 HPW / 60 h	**Self-study** 120 h	**Planed group size** 20 students
2	*Course Description* The main aim of this course is to teach the students how to write thesis/research proposals. Therefore, the course provides the students with an opportunity to engage in research activities such as literature reviews, research planning, data analysis and reporting (written and oral) using a chosen mechatronics engineering research topic.			
3	*Learning outcomes) / competencies* On completing the course, students will be able to have the following skills: ▫ Knowledge and understanding A1.Recognize the ethical principles of conducting applied research. A2. Identify various sources of information. A3. Identifying and formulating research problem. ▫ Intellectual skills B1. Carry out literature searches and some ability to critically evaluate literature. B2. Design and conduct experiments, devise appropriate measurements, analyse and interpret data and form reliable conclusions. ▫ Professional and practical skills C1. Undertake and manage a research project of significant size and scope. C2. Demonstrate awareness of the importance of documenting all aspects of the development of an engineering project. ▫ General and transferrable skills			

	D1. Apply project management skills to research activities D2. Communicate effectively in written and oral ways.
4	**Contents** The course introduces students to some fundamentals of research methodology. This includes: Research ethics, engineering research methods, problem specifications, gathering and organizing relevant information, reading conference and journal papers, assessing retrieved information, analyzing and writing critical reviews, proposing and comparing different solutions, design of experiments, and technical writing. At the end of the course, students should write his/her research proposal that will be carried out in the semester to follow
5	**Teaching Method** Lectures, discussions, tutorials, and self study.
6	**Requirements** Undergraduate degree in engineering
7	**Examination** Research proposal: Report and presentation
8	**Requirements for awarding credit points** Module examination
9	**Significance of the mark for the final score** 70%
10	**Representative module and full-time teachers** *Name of module coordinator at offering institution*
11	**Other Information:**

<table>
<tr><td colspan="6">Master Thesis</td></tr>
<tr><td>Identification number
MT4</td><td>Workload
900 h</td><td>Credits
30 (25+5)
ECTS
CH</td><td>Semester
4</td><td>Frequency of offer
Spring semester</td><td>Duration
One Semester</td></tr>
<tr><td>1</td><td colspan="2">Courses
Thesis Report
Thesis Defense</td><td>Contact time
0 h</td><td>Self-study
900 h</td><td>Planed group size
One Student</td></tr>
<tr><td>2</td><td colspan="5">Course Description
This is a research-oriented work that builds on Thesis I: The candidate is required to extend his Thesis I work (that was carried at a partner institution) and continue at his original institution. The type of research extension will be setup by the department and agreed upon at the end of Thesis I. This extension might include further analysis of results, modified algorithms with new simulation runs, and/or laboratory/industry application of developed work.
The candidate will present his Thesis work to an examination committee selected by the department. The presentation should explain the research work and analyze its results. The candidate will then go through an oral examination regarding his work.</td></tr>
<tr><td>3</td><td colspan="5">Learning Outcomes
On completing the course, students will be able to have to following skills:
▫ Knowledge and understanding
A1. Understand detailed and advanced research concepts
A2. Review and analyse related literature
▫ Intellectual skills
B1. Improve the students' research and innovative ability
B2. Derive, design, and apply advanced concepts
▫ Professional and practical skills
C1. Write technical reports and research papers
C2. Communicate effectively by presenting and defending ones work
▫ General and transferrable skills
D1. Transfer technology between institutions
D2. Build teamwork for research work</td></tr>
<tr><td>4</td><td colspan="5">Contents
Thesis topics will be based on: research directions of the institution and local industrial needs. The work will be deal with advanced mechatronics concepts</td></tr>
<tr><td>5</td><td colspan="5">Teaching Method
Single or small groups</td></tr>
<tr><td>6</td><td colspan="5">Requirements
Passing Thesis I</td></tr>
<tr><td>7</td><td colspan="5">Examination
Master’s Thesis Report
Presentation and Oral Exam</td></tr>
<tr><td>8</td><td colspan="5">Requirements for awarding credit points
Passing the module examinations
Submitting research work for publication</td></tr>
</table>

9	Significance of the mark for the final score
10	Representative module and full-time teachers
11	Other Information

<table>
<tr><th colspan="6">Adaption Course Mechanical Engineering</th></tr>
<tr><td>Identification number MM15-1</td><td>Workload
180 h</td><td>Credits
6 ECTS
3 CH</td><td>Semester
1</td><td>Frequency of offer
Winter Semester</td><td>Duration
1 Semester</td></tr>
<tr><td>1</td><td colspan="2">Courses
Course instruction: 2 HPW
Exercise: 2 HPW</td><td>Contact time
4 HPW / 60 h</td><td>Self-study
120 h</td><td>Planed group size
10 students</td></tr>
<tr><td>2</td><td colspan="5">Course Description:
The Adaption course Mechanical Engineering is a high level course mainly designed with consecration of applicants of non mechanical engineering specialization. After completion of this course the applicant should have the knowledge and skills that enable her/ him to understand and apply the basics of thermo fluid, fluid power engineering, and mechanical engineering design. The applicant will also appreciate its importance in Mechatronics systems.</td></tr>
<tr><td>3</td><td colspan="5">Learning outcomes) / competencies
On completing the course, students will be able to have to following skills:
▫ Knowledge and understanding
A1.Explain the fundamentals of: Thermodynamics, Fluid Mechanics, Fluid power, and Mechanical Engineering Design.
A2. Interoperate the basic theories of Thermodynamics, Fluid Mechanics, Fluid power, and Mechanical Engineering Design..
▫ Intellectual skills:
B1 Design, and/or select the suitable mechanical components for Mechatronics systems.
B2.Analyse and asses the performance of the Mechanical systems.
B3. Design and/or select the fluid power circuits and components for Mechatronics systems.
▫ Professional and practical skills:
C1. Apply the basic theories of Mechanical power and design engineering in solving engineering problems especially in Mechatronics.
▫ General and transferrable skills
D1. Encourage the applicants for self learning in a discipline which may be different than their specialization.</td></tr>
<tr><td>4</td><td colspan="5">Contents: (Parts of the following may be assigned as self-learning).
Introduction to Fluid Mechanics -Measurement of pressure, thrust on submerged surfaces. Principles of Fluid Motion- Description of fluid flow; continuity equation - Introduction to Fluid Power - applications of fluid power, fluid power system components, types of fluid power control systems - Energy and power, source of power (pumps & compressors), Actuators and motors, valves and other control components, circuit design and analysis-Electrical control for fluid power systems.
Introduction to Thermodynamics - Properties of matter, the state of matter, processes and cycles, open and closed thermodynamic systems.-Properties of Pure Substances: property tables, property diagrams, phase change, equations of state for ideal gas -Energy: Energy transfer by heat, work and mass- The First Law of Thermodynamics: Closed system, open system, steady-flow engineering devices. The Second Law of Thermodynamics: Statements of the 2nd Law, heat engines, refrigeration devices, reversible versus irreversible processes, the Carnot cycle.
Introduction to Mechanical Engineering Design – Basics (Introduction- Material – Load &</td></tr>
</table>

	stress analysis- Deflection & stiffness)- Failure prevention (Failure from static loading- Fatigue failure) – Design of some mechanical elements (selected items from: couplings- clutches – brakes – flywheels- Shafts – gears- screws – permanent fasteners).
5	**Teaching Method** Lectures, discussions, tutorials, projects, self study.
6	**Requirements** BSc. In Engineering or Computer.
7	**Examination** Written examination
8	**Requirements for awarding credit points** Module examination
9	**Significance of the mark for the final score** 70%
10	**Representative module and full-time teachers** Name of module coordinator at the offering institution
11	**Other Information** ▫ *Recommended Books:*

Adaption Course Electrical Engineering					
Identification number MM15-2	**Workload** 180 h	**Credits** 6 ECTS 3 CH	**Semester** 1	**Frequency of offer** Winter Semester	**Duration** 1 Semester

1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW	**Contact time** 4 HPW / 60 h	**Self-study** 120 h	**Planed group size** 20 students

2

Course Description:

The Adaption course Electrical Engineering is a high level intensive course mainly designed with consecration of applicants of nonelectrical engineering specialization. After completion of this course the applicant should have the knowledge and skills that enable her/ him to understand and apply the basics of modern electrical and electronics engineering in addition to the basics of modern digital circuits and the software based VLSI and also appreciate its importance in Mechatronics systems.

3

Learning outcomes) / competencies

On completing the course, students will be able to have to following skills:

- **Knowledge and understanding**

A1.Explain the fundamentals of modern electrical and electronics engineering

A2. Interoperate the basic theories of electrical and electronics engineering.

A3. Introduce the fundamentals of modern Digital circuits and microprocessor based control units.

- **Intellectual skills:**

B1 Design, and/or select the suitable electronics components, digital circuits, and microprocessor based control units suitable for Mechatronics systems.

B2.Analyse the performance of systems of electronics, digital circuits and microprocessor based control units of Mechatronics systems.

- **Professional and practical skills:**

C1. Apply the basic theories of electrical and electronics engineering in solving engineering problems especially in Mechatronics.

C2. Select and program the suitable microprocessor based control unit (Microcomputer-PLC- Computer, etc..).

- **General and transferrable skills**

D1. Encourage the applicants for self learning in a discipline which may be different than their specialization.

4

Contents: ***(Parts of the following may be assigned as self learning).***

Introduction- Electric circuits & components (Basic Electrical Elements – Kirchhoff's Laws – Alternating Current Circuits – Power in Electrical Circuits –Transformers) - Semiconductor Electronics (Semiconductor Physics- Junction Diode – Transistors -)- Analogue Signal Processing using Operational Amplifiers (Amplifiers – Operational amplifiers- Different operational amplifier circuits- Sample and hold Circuits.).

Digital Circuits (Digital representations – Combinational logic - Boolean algebra – Design of logic networks- Sequential logic – TTL &CMOS-Special purpose Digital Integrated circuits – Integrated Circuit System Design- Basics & programming of :Microcontrollers – PLC.

5

Teaching Method

Lectures, discussions, tutorials, projects, self study.

6	**Requirements** BSc. In Engineering or Computer.
7	**Examination** Written examination
8	**Requirements for awarding credit points** Module examination
9	**Significance of the mark for the final score** 70%
10	**Representative module and full-time teachers** Name of module coordinator at the offering institution
11	**Other Information** ▫ *Recommended Books:* *Alciator & Histand, " Introduction to Mechatronics & Measurements Systems"; McGraw-Hill , Latest Edition*

Machine Intelligence					
Identification number MM15-3	**Workload** 180 h	**Credits** 6 ECTS 2 CH	**Semester** 1	**Frequency of offer** Winter semester	**Duration** One Semester

1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW	**Contact time** 4 HPW / 60 h	**Self-study** 120 h	**Planed group size** 20 students

2

Course Description

This course discuses intelligent control theory to the students and presents latest trends in the area. The main two topics are Fuzzy Controllers and Artificial Neural Networks techniques. The course will include mathematical modeling, simulation, and implementation of discrete-time intelligent controllers

3

Learning outcomes) / competencies

On completing the course, students will acquire following skills:

- Knowledge and understanding

A1. Know the advantages and drawbacks of intelligent controllers and therefore when to apply them

A2. Understand how to derive, develop, and apply intelligent controllers

- Intellectual skills

B1 Comprehend advanced mathematical models and intelligent systems

B2. Design intelligent systems for various applications

- Professional and practical skills

C1. Simulate and analyze responses to advanced controller concepts

C2. Apply intelligent controllers to physical systems

- General and transferrable skills

D1. Apply intelligent decision making techniques to engineering systems

D2. Optimize system performance

4 **Contents**

Intelligent vs. classical control; Fuzzy Logic and Math; Fuzzy Controllers; Neural Network Architectures (multi-layer, feed forward, and recurrent nets); Neural Network Algorithms; Learning Methods; Neural Networks for Identification; Neural Networks for Control; Pattern Recognition and Classification; Function Approximation; Neuro-Fuzzy Systems; Intelligent Systems for High-Level Decision Making; Advanced Math Modeling and Simulation for Intelligent Systems; Applications to Unmanned Vehicles; Latest trends in Machine Intelligence

5 **Teaching Method**

Lectures, presentations, and projects

6 **Requirements**

Control, Advanced Engineering Mathematics, and Programming

7 **Examination**

Written examination

Homework

Simulation and Analysis Project

8 **Requirements for awarding credit points**

	Module examination
9	**Significance of the mark for the final score** **70%**
10	**Representative module and full-time teachers**
11	**Other Information** References: Intelligent Control Systems using Soft Computing Methodologies by Ali Zilouchian and Mo Jamshidi. CRC Press 2001. A First Course in Fuzzy and Neural Control by Nguyen, Prasad, Walker, and Walker. Chapman Hall /CRC Press 2003 Digital Neural Networks by S. Y. kung. Prentice Hall 1993 Nonlinear Identification and Control: A neural network approach by G. P. Liu. Springer 2001 Neural Networks: A comprehensive foundation by Simon Haykin 1998 Learning and Soft Computing: Support Vector Machines, Neural Networks and Fuzzy Logic Models by Vojislav Kecman. Bradford Book 2001 MATLAB Fuzzy Logic Toolbox 2 / MATLAB Neural Network Toolbox 6: user's guide

<table>
<tr><td colspan="6">Advanced image processing</td></tr>
<tr><td>Identification number
MM15-4</td><td>Workload
180 h</td><td>Credits
6 ECTS
3 CH</td><td>Semester
1</td><td>Frequency of offer
Winter Semester</td><td>Duration
1 Semester</td></tr>
<tr><td>1</td><td colspan="2">Courses
Course instruction: 2 HPW
Exercise: 2 HPW</td><td>Contact time
4 HPW / 60 h</td><td>Self-study
120 h</td><td>Planed group size
10 students</td></tr>
<tr><td>2</td><td colspan="5">Course Description:
Digital image processing has various applications ranging from remote sensing and entertainment to medical applications. This course explores a few major areas of digital image processing at an advanced level, with primary emphasis on medical applications. Topics covered include image filtering and enhancement, visualization, image segmentation and image registration. For image registration, in addition to classical techniques that are based on image feature or intensity, a newly emerging technique based on the biomechanics of tissue deformation will be also covered. Examples will be presented to give the students exposure to real-world applications in medicine and other applications.</td></tr>
<tr><td>3</td><td colspan="5">Learning outcomes) / competencies
On completing the course, students will be able to have to following skills:
▫ Knowledge and understanding
A1- The ability to convert art image to digital coding.
A2-Practical experience implementing and using the presented image processing algorithms.

▫ Intellectual skills:
B1- Deduce and/or select the suitable mathematical models for converting art image.
B2- Analyze the color degree and convert it to a coding number.

▫ Professional and practical skills:
C1. Expose the students to some of the state of the art image processing techniques and their applications especially medical applications as listed in the course content.
C2. Provide the students with practical experience implementing and using the presented image processing algorithms.
C3. Present novel alternate ways of solving research problems with medical image registration components

▫ General and transferrable skills
D1- Team work
D2- Self learning</td></tr>
<tr><td>4</td><td colspan="5">Contents: (Parts of the following may be assigned as self-learning).
1) Introduction
2) Morphological Image Processing
• Morphological processing on binary images
• Morphological processing on gray-scale images
3) Image Segmentation
• Introduction
• Thresholding</td></tr>
</table>

	• Deformable Models 4) Review of Mathematical and Computational Concepts Linear Algebra and Inverse Problems 5) Motion tracking • Optical Flow 6) Medical Image Registration • Introduction • Image registration algorithms using geometric features • Image registration using similarity measures • Modeling Tissue Deformation and Finite Element Analysis • Non-rigid image registration using tissue deformation models
5	**Teaching Method** Lectures, tutorials, lab follow-up, problem solving, modeling, and self-studies.
6	**Requirements** Bachelor degree (BSc, BEng) in Engineering
7	**Examination** Written in-class exams; Take-home exams
8	**Requirements for awarding credit points** Module examination
9	**Significance of the mark for the final score** 70%
10	**Representative module and full-time teachers** *Name of module coordinator at offering institution*
11	**Other Information** 1. Milan Sonka and J. Michael Fitzpatrick (Editors), Handbook of Medical Imaging, Volume2. Medical Image Processing and Analysis, SPIE Press, 2004. BME 9519B / ECE 9202B – A. Samani 2. J. V. Hanjal, Derel Hall and D. J. Hawkes (Editors), Medical Image Registration, CRC Press LLC, 2001. 3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Prentice Hall, New Jersey, 2001. 4. A.K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, Inc., Englewood Cliffs, 1989. 5. R. Kimmel, Numerical Geometry of Images, Theory, Algorithms, and Applications, Springer-Verlag, 2004

Business Planning & Strategic Management					
Identification number MM15-5	**Workload** 180 h	**Credits** 6 ECTS 3 CH	**Semester** 1	**Frequency of offer** Winter semester	**Duration** 1 semester

1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW	**Contact time** 4 HPW / 60 h	**Self-study** 120 h	**Planed group size** 20 students

2

Course Description:

The objective of this course is to introduce you to the concepts, issues, and themes related to business planning, strategy, and entrepreneurship. The course will provide an overview of the functional activities in a typical business venture, such as organizational behaviour, human resources, finance, marketing, and operations. It will explore the business planning and strategic management issues of technology-driven enterprises in the early stages of development. Business analysis and planning skills are developed in this course.

3

Learning outcomes) / competencies

On completing the course, students will be able to have to following skills:

- **Knowledge and understanding**
  A1. Know and understand the concepts, issues, and themes related to business planning, strategy, and entrepreneurship
- **Intellectual skills:**
- **Professional and practical skills:**
  C1. Develop a business strategy for a technology-based idea
  C2. Business analysis and planning skills
- **General and transferrable skills**
  D1. Communicate and work in a team

4 **Contents**: ***(Parts of the following may be assigned as self-learning).***

Introduction
Identifying Valuable Opportunities
Selecting The Right Industry
Conducting A Business Feasibility Analysis
Managing Technological Transitions
Creating An Effective Business Model
Financial Viability
Understanding The Market
Understanding Customer Adoption
Creating An Effective Team
Sources Of Financing And Funding
Ethics And Managing Intellectual Property

5 **Teaching Method**

Lectures, discussions, tutorials, problem solving, modeling, project, lab training, self study

6 **Requirements**

Bachelor degree (BSc, BEng) in Electrical Engineering, Mechanical Engineering, or Computer Science

7 **Examination**

	Exams	35%
	Project/Participation	15%
	Laboratory	25%
	Final Exam	25%
8	**Requirements for awarding credit points** Module examination	
9	**Significance of the mark for the final score** *70%*	
10	**Representative module and full-time teachers** Name of module coordinator at the offering institution	
11	**Other Information** **Textbook:** Barringer, B.R. and Ireland, R.D. (2011). Entrepreneurship: Successfully Launching New Ventures, 4th Edition. Pearson Prentice Hall: New Jersey.	

Robot Manipulators: Kinematics, Dynamics, Control					
Identification number MM15-5	**Workload** 180 h	**Credits** 6 ECTS 3 CH	**Semester** 1	**Frequency of offer** Winter semester	**Duration** 1 semester

1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW	**Contact time** 4 HPW / 60 h	**Self-study** 120 h	**Planed group size** 20 students

2

Course Description:

This course covers the following topics, Homogeneous transformations, D-H convention, forward and inverse kinematics. Differential transformations and Jacobians. Robot dynamics. Programming, trajectory generation and joint control. End-of-arm sensing and outer loop control. Industrial applications.

3

Learning outcomes) / competencies

On completing the course, students will be able to have to following skills:

- **Knowledge and understanding**
  A1. Know and understand the work of the different components of the robot system
- **Intellectual skills:**
- **Professional and practical skills:**
  C1. The assemply of different components in ordere to make a robot system with specific functions
- **General and transferrable skills**
  D1. Communicate and work in a team

4

Contents: ***(Parts of the following may be assigned as self-learning).***

Homogeneous transformations,
D-H convention,
forward and inverse kinematics.
Differential transformations and Jacobians.
Robot dynamics.
Programming, trajectory generation and joint control.
End-of-arm sensing and outer loop control.
Industrial applications.

5

Teaching Method

Lectures, discussions, tutorials, problem solving, modeling, project, lab training, self study

6

Requirements

Bachelor degree (BSc, BEng) in Electrical Engineering, Mechanical Engineering, or Computer Science

7

Examination

Exams		35%
Project/Participation	15%	
Laboratory	25%	
Final Exam	25%	

8

Requirements for awarding credit points

Module examination

9

Significance of the mark for the final score

70%

10	**Representative module and full-time teachers** Name of module coordinator at the offering institution
11	**Other Information** **Textbook:** Analysis of mechanisms and robot manipulators by Joseph Duffy (1980)

Numerical Control of Machine Tools 1						
Identification number MM15-5	**Workload** 180 h	**Credits** 6 ECTS 3 CH	**Semester** 1	**Frequency of offer** Winter semester	**Duration** 1 semester	
1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW	**Contact time** 4 HPW / 60 h	**Self-study** 120 h	**Planed group size** 20 students		
2	*Course Description:* This course covers the following topics: Operation fundamentals of NC machine tools. NC part programming: manual, and CAD/CAM methods. Mechanics of metal cutting: examples of turning, milling, and drilling. Tool wear and breakage. Optimum cutting conditions. Dimensional and form errors due to static deformations. Dynamics of machining. And will contain Laboratory work provides hands-on experience in tool path generation, machining, and measurements of cutting forces and vibration.					
3	*Learning outcomes) / competencies* On completing the course, students will be able to have to following skills: ▫ **Knowledge and understanding** A1. Know and understand the NC machines operation and topics related to machining tools. ▫ **Intellectual skills:** ▫ **Professional and practical skills:** C1. The ability to treat NC machines and make mantainance for machine tools ▫ **General and transferrable skills** D1. Communicate and work in a team					
4	**Contents**: ***(Parts of the following may be assigned as self-learning).*** Operation fundamentals of NC machine tools. NC part programming: manual, and CAD/CAM methods. Mechanics of metal cutting: examples of turning, milling, and drilling. Tool wear and breakage. Optimum cutting conditions. Dimensional and form errors due to static deformations. Dynamics of machining.					
5	**Teaching Method** Lectures, discussions, tutorials, problem solving, modeling, project, lab training, self study					
6	**Requirements** Bachelor degree (BSc, BEng) in Electrical Engineering, Mechanical Engineering, or Computer Science					
7	**Examination** Exams 35% Project/Participation 15% Laboratory 25% Final Exam 25%					
8	**Requirements for awarding credit points** Module examination					
9	**Significance of the mark for the final score** *70%*					

10	**Representative module and full-time teachers** Name of module coordinator at the offering institution
11	**Other Information** **Textbook:**

Mechatronics-Oriented Engineering Project					
Identification number MM24-1	**Workload** 180 h	**Credits** 6 ECTS 3 CH	**Semester** 2	**Frequency of offer** Spring semester	**Duration** 1 Semester

1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW	**Contact time** 4 HPW / 60 h	**Self-study** 120 h	**Planed group size** 20 students

2

Course Description

The "Mechatronics-oriented Engineering Project" is a project based course in which a team of two or three students work together to design and implement a Mechatronics project. After completion of this course the student should have the knowledge and skills that enable her/ him to design an intelligent Mechatronics System in addition to implement a small prototype. The intelligence ranges from pre-programmed tasks to decision taking. The overall aims of the course are to:

a. Deepen the fundamentals of Mechatronics system design and implementation with emphasis on: multidisciplinary, Integration and Synergism.
b. Build the ability of time planning for performing specific task during a specified time period.
c. Encourage the students to work and communicate inside a team (Team work project)

3

Learning outcomes / competencies

On completing the course, students will be able to have to following skills:

- **Knowledge and understanding:**

On successful completion of the course, the student should demonstrate knowledge and understanding of:

A1- Advanced principles of design of Mechatronics Systems including elements design (Mechanical parts, Sensors, Control unit, Signal conditioning, and actuators), the process and the whole system.
A2- The modern engineering technologies in the areas of: sensors, control, and actuators.
A3- The basics of modeling, identification, and simulation of Mechatronics systems.
A4- The design cycle based on recognition of needs and market feedback loop for sustainable

- **Intellectual skills:**

On successful completion of the course, the student should be able to.:

B1- Deduce and/or select the suitable mathematical models for Mechatronics systems including mechanical, fluid, thermal and electrical systems.
B2- Analyze the performance of Mechatronics systems and suggest the engineering solutions for improvements to achieve given goals.
B3- Judge engineering decisions considering balanced costs, benefits, safety, quality, reliability, and environmental impact.
B4-Select the optimum components using internet search and other means considering availability, and the tradeoff between quality and cost.
B5- Identify, at an appropriate level, the design, production, interfacing and software needs of different parts of Mechatronics systems - Sensors, actuators , different types of control units (Simple logic circuits, microcontrollers, and PLC's) and the suitable signal conditioning

	▫ **Professional and practical skills:** On successful completion of the course, the student should be able to: C1- Apply the principles of sustainable design and development for building up real simple Mechatronics systems with the integration of electronics and control systems. C2- Utilize practical systems approach to design and performance evaluation of a simple Mechatronics system. C3 Use computer software such as MATLAB, SIMULINK ,Broutus, Solidworks, or other available reputable programs to design, and/or simulate Mechatronics systems and their components. C4- Apply the essential safety rules of using electronics, electrical, and mechanical components.. C5- Demonstrate basic organizational and project management skills during planning, designing, making and finishing phases of the course project. ▫ .**General and transferrable skills** On successful completion of the course, the student should be able to: D1- Collaborate effectively with others and work in a team trough group assignments and project work. D2- Communicate effectively through assignments, reports, exams (written & Oral). D3- Lead and motivate individuals through project work. D4- Effectively manages tasks, time, and resources trough assignments and project work. D5- Search for information in library and Internet and engage in life-long self learning discipline through assignment and project. D6- Refer to relevant literatures when writing proposal, and the final report of the project.
4	**Contents** Each two or three applicants choose a project (Preferably related to industry). They should prepare and deliver a proposal no later than the end of the second week. The proposal should contain a Title page, abstract, general lay out, parts list with approximate price, and a time plane. The chosen project must represent a Mechatronics system controlled with a microcontroller, PLC, or a PC. By the end of the semester, the following are to be delivered: Final report, 15 minutes power point presentation, hardware reliable working model and simulation using MATLAB, Lab View, or any other available reputable software. The following topics may be covered through direct lectures and/or self learning: Project planning & management – Mechatronics systems- Selection of sensors & actuators- Control units – Signal conditioning – Simulation of Mechatronics systems.
5	**Teaching Method** Lectures, tutorials, lab follow-up, problem solving, modeling, and self-studies.
6	**Requirements** Bachelor degree (BSc, BEng) in Engineering
7	**Examination** Project implementation, Final report, Presentation and discussion
8	**Requirements for awarding credit points** Module examination
9	**Significance of the mark for the final score** **70%**
10	**Representative module and full-time teachers** *Name of module coordinator at offering institution*

11	**Other Information** ▫ *Recommended Books:* *Alciator & Histand, " Introduction to Mechatronics & Measurements Systems"; McGraw-Hill , Latest Edition.*

<table>
<tr><td colspan="6">Advanced Process control</td></tr>
<tr><td>Identification number MM24-2</td><td>Workload
180 h</td><td>Credits
6 ECTS
3CH</td><td>Semester
1</td><td>Frequency of offer
Winter semester</td><td>Duration
1 semester</td></tr>
<tr><td>1</td><td colspan="2">Courses
Course instruction: 2 HPW
Exercise: 2 HPW</td><td>Contact time
4 HPW / 60 h</td><td>Self-study
120 h</td><td>Planed group size
20 students</td></tr>
<tr><td>2</td><td colspan="5">Course Description:
This course is an advanced study of the principles governing methods of using process variables in the control of industrial processes. The study includes methods and procedures for measuring, displaying and transmitting process variables according to industry standards. The course also includes an in-depth study of mathematics pertaining to industrial control instruments.</td></tr>
<tr><td>3</td><td colspan="5">Learning outcomes) / competencies
On completing the course, students will be able to have to following skills:
▫ Knowledge and understanding
A1. Understand different control schemes
A2. Understand the difference between PLC and DCS systems
A3. Understand different types of control loops
▫ Intellectual skills:
B1. Discover problems in control circuits and fix it
▫ Professional and practical skills:
C1. Recognize different communications networks
▫ General and transferrable skills
D1. Communication and work In a team</td></tr>
<tr><td>4</td><td colspan="5">Contents: (Parts of the following may be assigned as self-learning).
- Miscellaneous Measuring Devices
– Introduction to Control Loops
– Control Loops Primary Sensors
– Control Loops Controllers and Final Control Elements
– Control Loops Valves and Regulators
– Instrumentation Troubleshooting
– Switches Relays and Annunciators
– Signal Transmission and Conversion
– Controllers
– Control Schemes
– Advanced Control Schemes
– Introduction to Digital Control
- Programmable Logic Control (PLC)
- Distributed Control Systems (DCS)
- Instrumentation Power Supply
– Emergency Shut Down Interlocks and Protective Devices
– Instrumentation Malfunctions</td></tr>
<tr><td>5</td><td colspan="5">Teaching Method
Lectures, discussions, tutorials, problem solving, modeling, project, lab training, self study.</td></tr>
</table>

6	**Requirements** Bachelor degree (BSc, BEng) in Electrical Engineering, Mechanical Engineering, or Computer Science
7	**Examination** Exams 35% Project/Participation 15% Laboratory 25% Final Exam 25%
8	**Requirements for awarding credit points** Module examination
9	**Significance of the mark for the final score** *70%*
10	**Representative module and full-time teachers** Name of module coordinator at the offering institution
11	**Other Information** **Textbook:** ***Instrumentation*** by Pearson Custom Publishing, ISBN: 0-536-85949-3

Selected Topics in advanced Mechatronics					
Identification number MM24-3	**Workload** 180 h	**Credits** 6 ECTS 3 CH	**Semester** 2	**Frequency of offer** Spring Semester.	**Duration** 1 Semester

1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW	**Contact time** 4 HPW / 60 h	**Self-study** 120 h	**Planed group size** 10 students

2

Course Description: ***The topics of this course are flexible mechatronics related and may selected in accordance to one or more of the following: Modern Contemporary issues in Mechatronics, An industry problem, and /or the applicant thesis.***

3

Learning outcomes) / competencies

On completing the course, students will be able to have to following skills:

- **Knowledge and understanding**

A1. Describe the modern trends in Mechatronics, a related industry problem, or his thesis problem.

A2. Find the solutions for the given issue.

- **Intellectual skills:**

B1: Analyze and search for the modern trends, analyze and search for solving a real industry problem in Mechatronics, or his research project problem.

- **Professional and practical skills:**

C1. Apply the obtained information in modern Mechatronics issues to industry and or his thesis.

- **General and transferrable skills**

D1.Search for information.

D2. Communicate effectively.

4 **Contents**:

The topics are to be selected by the applicant with consultation of the instructor of the course and should be approved by Program coordinator. The topics are flexible mechatronics related and may be selected in accordance to one or more of the following: Modern Contemporary issues in Mechatronics, An industry problem, and /or the applicant thesis. The assignment of this course should include analysis, design, and recommendation for the given issue..

5 **Teaching Method**

Discussion, Project, and self-learning.

6 **Requirements:**

BSc. In Engineering.

7 **Examination**

Final Report, Presentation & Oral discussion

8 **Requirements for awarding credit points**

	Module examination
9	**Significance of the mark for the final score** **70%**
10	**Representative module and full-time teachers** *Name of module coordinator at offering institution*
11	**Other Information :** Literature: • Published research in the area. • Web resources.

Advanced PLC					
Identification number MM24-4	**Workload** 180 h	**Credits** ECTS 2 CH	**Semester** 2	**Frequency of offer** Summer semester	**Duration** 1 Semester

1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW	**Contact time** 4 HPW / 60 h	**Self-study** 120 h	**Planed group size** 20 students

2

Course Description

This course is designed to provide an in depth understanding of the PLC Networking, Analog systems, advanced instruction set features, communications, diagnostics, modem and internet connections, remote I/O, Ethernet, motion control. Formal methods are introduced during this course to encourage the students to design a control algorithm. Formal methods are also important to verify and validate the control algorithm before implementing it. Distributed control and automation (DCS) according to IEC 61499.

3

Learning outcomes / competencies

On completing the course, students will e able to have to following skills:

- Knowledge and understanding

A1. Understand formal methods and their use in designing a PLC programs.
A2. Understand new technologies related to PLCs, such as motion control, Ethernet and Internet Communication, and DCS.

- Intellectual skills

B1. Formulate strategies for solutions to advanced engineering problems based on the formal methods taught.
B2. Choose appropriate tools and PLC algorithms to implement a control system.

- Professional and practical skills

C1. Apply advanced PLC methods in engineering problems.
C2. Enable the students to create and formalize complex problems through the use of formal methods.

- General and transferrable skills

D1. Get hand-on experience in PLCs to build control algorithms.
D2. Communicate solutions adequately

4 **Contents**

Analytical Methods: Logic Control, Formal Methods, Verification and Validation, Ethernet, Remote I/O, DCS.
Practical Methods: The use of formal methods to verify, design, and implement control systems. Introducing Internet and Ethernet communication, Remote I/O. An introduction to DCS using IEC 61499 is introduced.

5 **Teaching Method**

Lectures, tutorials, problem solving, modeling, self-studies.

6 **Requirements**

Bachelor degree (BSc, BEng) in Electrical Engineering, Mechanical Engineering or Computer Science

7 **Examination**

	written examination
8	**Requirements for awarding credit points** Module examination
9	**Significance of the mark for the final score** **70%**
10	**Representative module and full-time teachers**
11	**Other Information** ▫ **Books** ▫ Programmable Logic Controllers: An Emphasis on Design and Application Second Edition, by Kelvin T. Erickson, 2011 ▫ Design and formal analysis of Petri net based logic control algorithms by Georg Frey, 2002. ▫ Practical Data Communications for Instrumentation and Control Search, by Park, John; Mackay, Steve; Wright, Edwin, 2010 ▫ PLC open Motion Control Part1, Technical Specification , PLC open - Technical Committee 2 – Task Force, Function blocks for motion control, Version 1.1, 2005.

Advanced Manufacturing Systems					
Identification number MM24-5	**Workload** 180 h	**Credits** 6 ECTS 3 CH	**Semester**	**Frequency of offer**	**Duration** One Semester

1	**Courses** Course instruction: 2 hpw Exercise: 2 hpw	**Contact time** 4 hpw / 60 h	**Self-study** 120 h	**Planed group size** 20 students

2

Course Description

The aim of this course is to develop the students' knowledge in production systems. This course is designed to provide in-depth understanding of the automation in design and manufacturing process within the production system. This includes: Computer Integrated manufacturing (CIM), Computer Aided Design (CAD), product modeling, design paradigms, Computer Aided Engineering (CAE), virtual prototyping, performance analysis, Finite Element Analysis (FEA), structure analysis, Computer Aided Manufacturing (CAM), Computer Numerical Control (CNC), and Flexible Manufacturing System (FMS).

3

Learning outcomes) / competencies

On completing the course, students will acquire following skills:

- Knowledge and understanding

A1. Understand the different production system types, components, and operations, automation in production system, CIM, CAD, CAE, and CAM.

A2. Comprehend the production design, analysis, and manufacturing steps.

- Intellectual skills

B1 Apply the CAM technology to support the manufacturing simulation, process planning, rapid prototyping, CNC machining, and manufacturing cost estimation.

B2. Develop computer-based model to represent, simulate, test, and evaluate the product design

- Professional and practical skills

C1. Design and analyze products using CAD software.

C2. Implement advanced CNC programming.

- General and transferrable skills

D1. Develop advanced manufacturing systems, namely, FMS, Intelligent manufacturing system (IMS), and Next Generation Manufacturing (NGM).

4

Contents

Automation in production systems (CAD/CAE/CAM, CIM); Product design modeling (parametric modeling, mechanical assembly, assembly sequence and analysis, design parameterization, product data management); The e-Design (The e-Design paradigm, Virtual prototyping, product performance analysis, product virtual manufacturing, Physical prototyping); Structure analysis (Analytical methods, Finite element methods and modeling; Finite Element Analysis (FEA) software, case studies); Motion analysis (analytical methods, computer aided methods, motion simulation, case studies); Fatigue, fracture, and reliability analysis (The stress life approach, dynamic stress calculation and cumulative damage, reliability analysis methods), Product

	manufacturing and cost estimation, Advanced Machining Processes and calculations (Milling, turning, drilling, broaching…), Introduction to Computer numerical control CNC (construction, motion control analysis, G-code programming), Advance CNC programming using CAD/CAE (Pro/Engineer software), Advanced Manufacturing Systems (FMS, IMS, and NGM).
5	**Teaching Method** Lectures, presentations, and projects
6	**Requirements** Control, Advanced Engineering Mathematics, and Programming
7	**Examination** Written examination Homework Design and manufacturing Project
8	**Requirements for awarding credit points** Module examination
9	**Significance of the mark for the final score** **70%**
10	**Representative module and full-time teachers**
11	**Other Information** **References** Kuang-Hua Chang, “Product performance evaluation using CAD/CAE”, Elsevier 2013. Lalit Narayan Et Al, “Computer Aided Design and Manufacturing”, 2008. Kuang-Hua Chang, “Product design modeling using CAD/CAE”, Elsevier 2013 Kuang-Hua Chang, “ Product manufacturing and cost estimation using CAD/CAE”, , Elsevier 2013 Kuang-Hua Chang, “ Design theory and methods using CAD/CAE”, Elsevier 2013 Automation, Production Systems, and Computer Integrated manufacturing, Grover; Prentice Hall 2008 Robot Manipulators: Modeling, Performance Analysis and Control (Control Systems, Robotics & Manufacturing Series (ISTE-CAM)) by Etienne Dombre, 2004. Introduction to Computer Numerical Control (CNC), James Valentino, 3rd edition Prentice Hall 2003.

Advanced Digital Signal Processing					
Identification number MM15-5	**Workload** 180 h	**Credits** 6 ECTS 3 CH	**Semester** 1	**Frequency of offer** Winter semester	**Duration** 1 semester

1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW	**Contact time** 4 HPW / 60 h	**Self-study** 120 h	**Planed group size** 20 students

2

Course Description:

Digital filter design requirements and methodologies. Finite Impulse Response (FIR) filters design using windowing and frequency sampling method. IIR filter design using poles and zeroes placement method. The concept of adaptive linear filters; optimal (Wiener filter), normal equation, Least Squares (LS) solution, Least Mean Squares (LMS) solution, Recursive Least Mean Squares (RLMS) solution. Introduction to multi-rate digital signal processing: sub-sampling, and up-sampling by an integer factor for baseband and band-pass signals, sampling rate changes by a rational factor. Multi-stage approach to sampling rate conversion. Structures of FIR decimators and interpolators, multi-rate filter banks, quadrature mirror filter (QMF) bank design.

3

Learning outcomes) / competencies

On completing the course, students will acquire following skills:

- Knowledge and understanding

  A1. digital filter design procedures and analysis methods;
  A2. design choices of Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) type digital filters;
  A3. design and analysis of optimal (in LS sense) digital filters;
  A4. design and analysis of adaptive Least Mean Squares (LMS) filters
  A5. design and analysis of adaptive Recursive Least Square (RLS) filters

- Intellectual skills

- Professional and practical skills

  C1. design finite impulse response (FIR) systems using windowing and frequency sampling methods;
  C2. design infinite impulse response (IIR) systems using Pole zero placement, Impulse invariant and bi-linear z-transform methods;
  C3. analyse and use optimal (LS) filters based on the Wiener equation;
  C4. analyse and use adaptive filters based on the Wiener-Hopf equation;
  C5. analyse and design adaptive least mean square (LMS) filters;
  C6. analyse and design adaptive recursive least square (RLS) filters
  C7. re-sample a digital signal;

- General and transferrable skills

  D1. project writing, communication, presentation, numerical skills and analytical problem solving;

4	**Contents**: ***(Parts of the following may be assigned as self-learning).*** Introduction Digital processing of continuous-time signals Discrete Fourier Transform and Fast Fourier Transform Digital filters Multirate digital signal processing Spectral estimation
5	**Teaching Method** Lectures, discussions, tutorials, problem solving, modeling, project, lab training, self study
6	**Requirements** Bachelor degree (BSc, BEng) in Electrical Engineering, Mechanical Engineering, or Computer Science
7	**Examination** Exams 35% Project/Participation 15% Laboratory 25% Final Exam 25%
8	**Requirements for awarding credit points** Module examination
9	**Significance of the mark for the final score** *70%*
10	**Representative module and full-time teachers** Name of module coordinator at the offering institution
11	**Other Information** **Textbook:** "The Scientist and Engineer's Guide to Digital Signal Processing", California Technical Publishing