BULLETIN

UNIVERSITY OF DEBRECEN

ACADEMIC YEAR 2015/2016

Faculty of Engineering

MECHATRONICS ENGINEERING BSc

Coordinating Center for International Education

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CHAPTER 1
DEAN'S WELCOME

Welcome to the Faculty of Engineering!

This is an exciting time for you, and I encourage you to take advantage of all that Faculty of Engineering UD offers you during your bachelor’s or master's studies. I hope that your time here will be both academically productive and personally rewarding. Think creatively and be confident.
The Faculty of Engineering of the University of Debrecen is at the forefront of the education and training of engineers in the North-Great-Plain Region of Hungary. It is a dynamically developing Faculty with over 3000 students and a highly-qualified and enthusiastic teaching staff of about 80 members. We offer a great variety of BSc, MSc courses and post-graduate training courses tailored to suit the rapidly changing world of engineering and focusing on European and international trends.
In order to optimize the quality of training the Faculty continuously strives to expand the number of industry and educational partners at home and abroad.
The Faculty was awarded the Quality Prize in 2011 by the Ministry of Education as recognition of its efforts in this field.
I wish you every success in your studies and hope to meet you personally in the near future.

Best wishes,

Edit Szűcs Dean

CHAPTER 2
THE HISTORY OF THE UNIVERSITY AND DEBRECEN

The history of Debrecen's higher education dates back to the 16th century. The Calvinist Reformed College, established in 1538, played a central role in education, teaching in the native language and spreading Hungarian culture in the region as well asin the whole country. The College was a sound base for the Hungarian Royal University, founded in 1912. Apart from the three academic faculties (arts, law, theology) a new faculty, the faculty of medicine was established, and the University soon became one of the regional citadels of Hungarian higher education. Today the University of Debrecen is classified as a “University of National Excellence” and offers the highest number of academic programs in the country, hence it is one of the best universities in Hungary. Its reputation is a result of its quality training, research activities and the numerous training programs in different fields of science and engineering in English. With 14 faculties and a student body of almost 30.000, of which about 3700 are international students, the University of Debrecen is one of the largest institutions of higher education in Hungary.

CHAPTER 3
ADMINISTRATION UNITS OF THE FACULTY OF ENGINEERING

Dean:	Ms. Edit Szűcs Dr. habil.
E-mail:	dekan@eng.unideb.hu
Vice-Dean for Educational Affairs:	Géza Husi PhD habil.
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Administrator for Foreign Students:	Ms. Ágnes György
Phone number:	+36-415-155/77833
E-mail:	agnes@eng.unideb.hu
Head of English Program Office:	Zsolt Tiba PhD habil
International Relationship Coordinator:	Ms. Zita Szilágyi Popovicsné
Address:	4028 Debrecen, Ótemető u. 2-4.
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CHAPTER 4
DEPARTMENTS OF THE FACULTY OF ENGINEERING

DEPARTMENT OF ARCHITECTURE

Ótemető u. 2-4., Debrecen, 4028
Telephone: +36 (52) 415-155/ 78704
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Professor, Head of Department		Antal Puhl DLA, habil
College Professor		Gábor Mátyás Csanády DLA
		Marcel Ferencz DLA, habil
Associate Professor		Balázs Falvai DLA
		Péter Kovács M.D., DLA, Ph.D., D.Sc.
		Tamás Szentirmai DLA
		Dávid Török DLA
Assistant Lecturer		Béla Bogdándy
		Miklós János Boros
		Ferenc Kállay
	Ms.	Anita Kántor
		Gábor Zombor
Secretary	Ms.	Anita Tóth-Szél

DEPARTMENT OF BASIC TECHNICAL STUDIES

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College Professor		Gusztáv Áron Sziki Ph.D.
College Associate Professor	Ms.	Mária Krauszné Princz Ph.D.
		Balázs Kulcsár Ph.D.
	Ms.	Rita Nagyné Kondor Ph.D.
	Ms.	Éva Csernusné Ádámkó
		Csaba Gábor Kézi
	Ms.	Erika Perge
		Attila Vámosi
Secretary	Ms.	Sándorné Anton

DEPARTMENT OF BUILDING SERVICES AND BUILDING ENGINEERING

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College Professor, Head of Department		Ferenc Kalmár Ph.D.
College Associate Professor, Deputy Head of Department		Ákos Lakatos Ph.D.
College Associate Professor	Ms.	Tünde Klára Kalmár Ph.D.
Assistant Lecturer		Béla Bodó
		Imre Csáky
		Sándor Hámori
		Gábor L. Szabó
		Ferenc Szodrai
		Zoltán Verbai
Departmental Engineer		Attila Kerekes
Emeritus		András Zöld DSc
Secretary		Lola Csibi

DEPARTMENT OF MECHANICAL ENGINEERING

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College Professor, Head of Department	Ms.	Istvánné Ráthy Dr. Ph.D.
College Professor, Deputy Head of Department		Lajos Fazekas Dr. Ph.D.
		Tamás Mankovits Ph.D.
College Professor		Zsolt Tiba Dr. habil.
Associate Professor	Ms.	Ágnes Battáné Gindert-Kele Dr. Ph.D.
		György Juhász Ph.D.
College Associate Professor		Sándor Bodzás Ph.D.
Assistant Lecturer		Gábor Balogh
		Krisztián Deák
		József Menyhárt
		Sándor Pálinkás Ph.D.
Departmental Engineer		Zsolt Békési

		András Gábora
		Dávid Huri
Senior Lecturer		Sándor Hajdu
Technical Lecturer		Márton Lévai
		István Székács
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DEPARTMENT OF ENGINEERING MANAGEMENT AND ENTERPRISE

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College Professor, Dean, Head of Department	Ms.	Edit Szűcs Dr. habil.
Titular Professor		Tibor Szász Ph.D.
College Professor		Géza Lámer Ph.D.
College Senior Lecturer	Ms.	Éva Dr. Bujalosné Kóczán
Associate Professor		István Budai Ph.D.
	Ms.	Judit T. Kiss Ph.D.
Master Lecturer	Ms.	Tünde Jenei
Assistant Lecturer		Tibor Balla M.Sc.
	Ms.	Anita Dr. Mikó-Kis
		Attila Halczman M.Sc.
	Ms.	Kata Anna Váró
Departmental Engineer		Róbert Sztányi
Engineering Lecturer		Gyula Mikula
Senior Lecturer	Ms.	Éva Diószeginé Zentay
	Ms.	Andrea Emese Matkó Ph.D.
Secretary	Ms.	Sándorné Anton

DEPARTMENT OF CIVIL ENGINEERING

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College Professor, Head of Department	Imre Kovács Ph.D.
College Professor	György Csomós Ph.D.

		János Major Ph.D. habil.
Associate Professor		József Garai Ph.D. habil.
	Ms.	Kinga Nehme Ph.D.
College Associate Professor		Sándor Fehérvári Ph.D.
	Ms.	Gabriella Hancz Ph.D.
Assistant Lecturer	Ms.	Krisztina Kozmáné Szirtesi
	Ms.	Beáta Pataki
		Ádám Ungvárai
		Zsolt Vadai
		Zsolt Varga
		László Tamás Vincze
Departmental Engineer		József Kovács
		Zsolt Martonosi
	Ms.	Beáta Szakács
		László Tarcsai
Engineering Lecturer		János Bíró
Senior Lecturer	Ms.	Herta Czédli Ph.D.
		László Radnay Ph.D.
Assistant Lecturer Practitioner		János Bíró
Invited Lecturer		Zoltán Bereczki
		Titusz Igaz
		Péter Lugosi
		István Szabó
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DEPARTMENT OF ELECTRICAL ENGINEERING AND MECHATRONICS

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College Associate Professor	János Tóth Ph.D.
Master Lecturer	István Ákos Bartha
Assistant Lecturer	Sándor Piros Ph.D.
	Attila Vitéz

Departmental Engineer		Gyula Attila Darai
		István Nagy
Secretary	Ms.	Nóra Tóth
PhD Student	Ms.	Emese Bánóczy-Sarvajcz
		István Pógár

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College Associate Professor		Norbert Boros Ph.D.
	Ms.	Andrea Keczánné Üveges Ph.D.
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Head of the English Program Office		Zsolt Tiba Dr. habil.
International Relationship Coordinator	Ms.	Zita Popovicsné Szilágyi

CHAPTER 5
ACADEMIC CALENDAR OF THE FACULTY OF ENGINEERING

Faculty calendar of the academic year 2015/2016	
Faculty of Engineering, University of Debrecen	
Opening ceremony of the academic year	6th September 2015
1st semester registration week	From 7th September till 11th September 2015.
Repeat period of exam courses announced for the 1st semester of the academic year 2015/2016	From 7th September till 11th September 2015
1st semester study period of BSc program	From 14th September till 18th December 2015 (14 weeks). In case of finalist courses: from 14th September till 13th November 2015 (10 weeks).
1st semester study period of BSc dual program	From 14th September till 11th December 2015 (13 weeks).
Reporting period (Drawing week) of BSc and BSc dual program	From 2nd November till 6th November 2015 (5 working days without scheduled lessons, consultation schedule announced previously).
Reporting period (Drawing week, term for elaborating tasks apart from the finalist courses) of BSc program	From 14th December till 18th December 2015 (5 working days without scheduled lessons, consultation schedule announced previously).
1st semester exam period	From 21th December 2015 till 5th February 2016 (7 weeks). From 16th November till 18th December 2015 (5 weeks) for graduating students
Deadline of submitting degree theses and dissertations	According to the decision of the departments but in 21 days in proportion to the first day of the final exam.
Final exams (according to the decision of the departments)	At least one occasion in January 2016. The departments shall advertise the date of the final exam until 15th September 2015.
2nd semester registration week	From 8th February till 12th February 2016.
2nd semester study period of BSc program	From 15th February till 20th May 2016 (14 weeks). In case of finalist courses: from 15th February till 29th April 2016 (10 weeks).
2nd semester study period of BSc dual program	From 15th February till 13th May 2016 (13 weeks).
Reporting period (Drawing week) of BSc and BSc dual program	From 4th April till 8th April 2016. (5 working days without scheduled lessons, consultation schedule announced previously)
Reporting period (Drawing week, term for elaborating tasks apart from the finalist courses) of BSc program	From 16th May till 20th May 2016 (5 working days without scheduled lessons, consultation schedule announced previously).

2nd semester exam period	From 23rd May till 8th July 2016 (7 weeks) From 2nd May till 3rd June 2016 (5 weeks) for graduating students.
Deadline of submitting degree theses and dissertations	According to the decision of the departments but in 21 days in proportion to the first day of the final exam.
Final exams (according to the decision of the departments)	At least one occasion in June 2016. The departments shall advertise the date of the final exam until 15th February 2016.

CHAPTER 6
THE ECTS CREDIT POINT SYSTEM

The European Credit Transfer System (ECTS) is a system based on allocation and transfer of academic credits. It was developed and tested in a pilot scheme by 145 European institutions of higher education from all Member States and EFTA countries. ECTS was developed as an instrument of improving academic recognition throughout the European Universities by means of effective and general mechanisms. ECTS serves as a model of academic recognition, as it provides greater transparency of study programmes and student achievement. ECTS in no way regulates the content, structure and or equivalence of study programmes. These are issues of quality which have to be determined by the higher education institutions themselves when establishing a satisfactory basis for co-operation agreements, bilaterally or multilaterally.

The main characteristics of ECTS are:

Credits are allocated to each course unit. The starting point is the normal pattern of courses a student would have to take in an academic year. 60 credits represent the workload of an academic year of study. Each institution produces an information package as a guide to all courses available to ECTS students. The courses are described not only in terms of content but also have credits added to each course. Before the student leaves for the host institution, the home institution, the host institution and the student sign a learning agreement in which the study programme abroad is agreed upon. A transcript of records which gives all details of previous higher education is attached to the learning agreement. The transcript of records lists all successfully completed courses together with details on the course, code, content and credits. The home institution guarantees full academic recognition. The study period abroad replaces a comparable period of study at the home university. In order to promote a universal implementation of ECTS as part of ERASMUS, the European Commission respects the right of each institute of higher education, to choose whatever recognition methods or agreements best suit their particular needs. If, however, student mobility is to provide universal academic recognition, as many universities as possible should give thought to a system of recognition using commonly understood measurements. ECTS has so far proved the best instrument to create transparency. Universities that receive financial support for their ERASMUS programmes should envisage measurements to implement ECTS at their institution - or if it is already in use, to try to progress ECTS implementation within further departments/ faculties.

Hungarian Grading Scale Definition ECTS Grading Scale Percentage of successful students usually achieving this grade

5 - Excellent: Outstanding performance with only minor errors - A - 10

4 - Good: Above the average standard but with some errors -B - 25

3 - Good: Generally sound work with a number of notable errors - C - 30

3 - Satisfactory: Generally sound work with a number of notable errors - D - 25

2 - Sufficient: Performance meets the minimum criteria - E - 10

1 - Fail: Some more work required before the credit can be awarded - F - 0

On the following pages the mandatory courses are listed within the framework of the usual schedule of studies for students of medicine at the University of Debrecen. Here incoming ERASMUS students can find the allotted number of ECTS credit points, as well as a brief description of the course content and the assessment requirements. International students study the English or Hungarian Program of the University of Debrecen. The curriculum parallels that of the Hungarian Engineering Program.

CHAPTER 7
ACADEMIC PROGRAM FOR MECHATRONICS ENGINEERING BSC

Department of Basic Technical Studies

Subject: **INFORMATICS FOR ENGINEERS I**
Year, Semester: 1st year/1st semester
Seminar: **2**

1st week:
Seminar: Introduction to informatics.

2nd week:
Seminar: Computer structures. Operating systems.

3rd week:
Seminar: Computer networks, the Internet.

4th week:
Seminar: Theoretical and practical data structures.

5th week:
Seminar: Algorithms.

6th week:
Seminar: Spreadsheets: entering data, records, fields, creating a table.

7th week:
Seminar: Sorting and filtering data.

8th week:
Seminar: Mid-term test.

Self Control Test

9th week:
Seminar: Expanding databases, formatting databases.

10th week:
Seminar: Relational databases.

11th week:
Seminar: SQL language.

12th week:
Seminar: Normalizing databases.

13th week:
Seminar: Securing databases (confidentiality, integrity and availability).

14th week:
Seminar: Keys, transactions.

15th week:
Seminar: End-term test

Requirements

Topics: Introduction to informatics. Computer structures. Operating systems. Computer networks, the Internet. Theoretical and practical data structures. Algorithms. Spreadsheets: entering data, records, fields, creating a table, sorting and filtering data, expanding databases, formatting databases. Relational databases, SQL language, normalizing databases, securing databases (confidentiality, integrity and availability), keys, transactions.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practices and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with

an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.
During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in a mid-semester grade (AW5). Based on the average of the marks of the tests the grade for the tests is given according to the following table: Score Grade 0-49 fail (1) 50-64 pass (2) 65-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5)

Required reading materials

J. Walkenbach: Excel 2007
Wiley Publishing Inc.,
C. N. Prague, M. R. Irwin, J. Reardon: Access 2003 Bible
Wiley Publishing Inc., 2003.

Subject: **MATHEMATICS I**
Year, Semester: 1st year/1st semester
Lecture: **2**
Seminar: **3**

1st week:
Lecture: Arithmetic of real and complex numbers.
Seminar: Arithmetic of real and complex numbers.

2nd week:
Lecture: Algebra of vectors in 2 and 3 dimensions.
Seminar: Algebra of vectors in 2 and 3 dimensions.

3rd week:
Lecture: Coordinate systems. Functions and their graphs.
Seminar: Coordinate systems. Functions and their graphs.

4th week:
Lecture: Composition of functions. Inverse functions.
Seminar: Composition of functions. Inverse functions.

5th week:
Lecture: Sequences and series of numbers, and convergence criteria.
Seminar: Sequences and series of numbers, and convergence criteria.

6th week:
Lecture: Sequences and series of functions, power series, convergence criteria.
Seminar: Sequences and series of functions, power series, convergence criteria.

7th week:
Lecture: Real functions. Polynomials.
Seminar: Real functions. Polynomials.

8th week:
Lecture: The mid-term test.
Self Control Test

9th week:
Lecture: Limits, continuity. Interpolation.
Seminar: Limits, continuity. Interpolation.

10th week:
Lecture: Arithmetic of matrices. Determinants.
Seminar: Arithmetic of matrices. Determinants.

11th week:
Lecture: Systems of linear equations. Cramer's

rule
Seminar: Systems of linear equations. Cramer's rule

12th week:
Lecture: Linear space, subspace, generating systems.
Seminar: Linear space, subspace, generating systems.

13th week:
Lecture: Bases, orthogonal and orthonormal bases.
Seminar: Bases, orthogonal and orthonormal bases.

14th week:
Lecture: Linear transformations, eigenvectors, eigenvalues.
Seminar: Linear transformations, eigenvectors, eigenvalues.

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: Arithmetic of real and complex numbers. Algebra of vectors in 2 and 3 dimensions. Coordinate systems. Functions and their graphs. Composition of functions. Inverse functions. Sequences and series of numbers, and convergence criteria. Sequences and series of functions, power series, convergence criteria. Real functions. Polynomials. Limits, continuity. Interpolation. Arithmetic of matrices. Determinants. Systems of linear equations. Cramer's rule. Linear space, subspace, generating systems, bases, orthogonal and orthonormal bases. Linear transformations, eigenvectors, eigenvalues.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practices and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. The attendance on practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in an exam grade (ESE). The grade for the test is given according to the following table: Score Grade 0-49 fail (1) 50-64 pass (2) 65-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5)

Required reading materials

Addison Wesley : Thomas' Calculus
11th.2005. ISBN: 0-321-24335-8
S. Minton: Calculus Concept and Connections
McGraw Hill , 2006. ISBN: 0-07111200-6

CHAPTER 7

Subject: **OPERATION AND THEORY OF MACHINES**
Year, Semester: 1st year/1st semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: SI units, basic and derived quantities, prefixes.
Practical: Examples.

2nd week:
Lecture: Translational and rotational motion, moment of inertia, torque, work, power.
Practical: Examples.

3rd week:
Lecture: Conservation of energy, viscous friction, dry friction, rolling resistance.
Practical: Examples.

4th week:
Lecture: Efficiency, power loss of machines.
Practical: Examples.

5th week:
Lecture: Bernoulli's equation, law of continuity, Venturi tube, water jet force.
Practical: Examples.

6th week:
Lecture: Entropy, specific heat capacity, latent heat, temperature-entropy diagram for steam.
Practical: Examples.

7th week:
Lecture: Classification of machines, power drives. Drive gears, flywheels, breaks, springs, bearings.
Practical: Examples.

8th week:
Lecture: Mid-term test.
Self Control Test

9th week:
Lecture: Otto engines, Diesel engines.
Practical: Examples.

10th week:
Lecture: Positive displacement pumps, centrifugal pumps and gear pumps.
Practical: Examples.

11th week:
Lecture: Fans, compressors.
Practical: Examples.

12th week:
Lecture: Steam boilers, steam turbines, steam power plants
Practical: Examples.

13th week:
Lecture: Water turbines, wind power plants.
Practical: Examples.

14th week:
Lecture: Adaptation of prime movers and driven machines.
Practical: Examples.

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: SI units, basic and derived quantities, prefixes. Translational and rotational motion, moment of inertia, torque, work, power. Conservation of energy, viscous friction, dry friction, rolling resistance. Efficiency, power loss of machines. Bernoulli's equation, law of continuity, Venturi tube, water jet force. Entropy, specific heat capacity, latent heat, temperature-entropy diagram for steam. Classification of machines, power drives. Drive gears, flywheels, breaks, springs, bearings. Otto engines, Diesel engines. Positive displacement pumps, centrifugal pumps and gear pumps. Fans, compressors. Steam boilers, steam turbines, steam power plants, water turbines, wind power plants. Adaptation of prime movers and driven machines.

A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practices and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence due to the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in an exam grade (ESE). The grade for the test is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5)

Required reading materials

Mechanical Engineers' Handbook, Volume 4
John Willey & Sons, 2006.
M. R. Lindeburg: Mechanical Engineering Reference Manual
12th. Professional Publications Inc., 2006.

Department of Electrical Engineering and Mechatronics

Subject: **METHODS OF PRESENTATION AND VISUALIZATION**
Year, Semester: 1st year/1st semester
Lecture: **1**
Practical: **1**

1st week:
Lecture: Introduction to presentation techniques, historical overview.
Practical: Practicing presentation methods in Power Point

2nd week:
Lecture: Methods of printing techniques.
Practical: Practicing presentation methods in Power Point

3rd week:
Lecture: Methods of printing techniques.
Practical: Practicing presentation methods in Power Point.

4th week:
Lecture: Methods of printing techniques.
Practical: Practicing presentation methods in Power Point.

5th week:
Lecture: Type and form of written presentations, IEEE format.
Practical: Practicing presentation methods in Power Point.

6th week:
Lecture: Form of poster presentations.
Practical: Practicing in presentation methods in Acrobat Reader.

7th week:
Lecture: The form of a catalogue, and a brochure
Practical: Practicing in presentation methods in Acrobat Reader.

8th week:
Lecture: Mid-term Presentation

Self Control Test

9th week:
Lecture: Oral presentation methods: Presentation in Power Point.
Practical: Practicing presentation methods in Prezi Presenter.

10th week:
Lecture: Oral presentation methods: Adobe Reader.
Practical: Practicing presentation methods in Prezi Presenter.

11th week:
Lecture: Oral presentation methods: Prezi Presenter
Practical: Practicing presentation methods in Microsoft Word.

12th week:
Lecture: Human Machine Interface (HMI) introduction, basic rules.
Practical: Practicing presentation methods in Microsoft Excel.

13th week:
Lecture: First HMI interface VJD.
Practical: Practicing presentation methods. HMI making methods in console.

14th week:
Lecture: Vijeo Cictect.
Practical: HMI making methods in SCADA.

15th week:
Lecture: End-term task presentation
Self Control Test

Requirements

Topics: Elementary knowledge of a colour. Elementary principals of light propagation. Process of vision. Formation of an image. Making a technical documentation. Rules of citations. The technique of making and inserting figures and diagrams. Digital information in an image. Displaying instruments. Cameras, scanners in theory. Computer aided image processing. Fast Fourier Transformation. Compression of an image. Axonometric 3D view. Key rules of making a presentation. Definition, usage and structure of webpages. Components of a webpage. The HTML language. Designing principals of a front panel and a HMI (Human Machine Interface). Visualization of an industrial process.
A, for a signature: Attendance at lectures is recommended, but not compulsory.
B, for a mid semester-grade: Students have to submit one HMI, one poster presentation and one article in a given topic not later than 12th week of the semester, and have to make an oral presentation using the rules mentioned in the lectures. Presentation will be held in a greater plenum. The course ends in a mid-semester grade (AW5). Based on the average of the marks of the tasks.

Required reading materials

Introducing Microsoft FrontPage
Microsoft Press, 1996.

Department of Engineering Management and Enterprise

Subject: **MATERIALS SCIENCE I**
Year, Semester: 1st year/1st semester
Lecture: **2**
Seminar: **2**

1st week:
Lecture: Introduction to material science.

Definiton of the word “material”, classes of materials and their properties.

Seminar: The materials cycle. Recycling

2nd week:
Lecture: Atomic structure Metallic bondsIonic bonding, Covalent bonding, Secondary bonds.
Seminar: The periodic table.

3rd week:
Lecture: Crystal structures. Crystalline and noncrystalline materials.
Seminar: the building structure of crystal

4th week:
Lecture: Imperfections in solids. Defect types: point, line, bulk, surface.
Seminar: Microscopic examinations.

5th week:
Lecture: Electrical and thermal properties of materials.
Seminar: Test of electrical and thermal conduction.

6th week:
Lecture: Magnetic and optical properties of materials.
Seminar: Application of optical phenomena.

7th week:
Lecture: Diffusion - Mechanism of atomic movement. Diffusion coefficient Fick' Laws.
Seminar: The importance of materials.

8th week:
Lecture: Mid-term test
Self Control Test

9th week:
Lecture: Phase diagrams. Basic concepts, binary and multi-component systems.
Seminar: Calculation of phase diagrams.

10th week:
Lecture: Phase transformations: development of microstructure and alteration of mechanical properties.
Seminar: Determination of the iron–carbon phase diagram.

11th week:
Lecture: Mechanical properties of metals. Elastic and plastic deformations.
Seminar: Design of materials by Ashby.

12th week:
Lecture: Dislocation and strengthening mechanism.
Seminar: The Tensile test and stress-strain curves

13th week:
Lecture: Failure: fracture, fatigue, creeps.
Seminar: Hardness tests.

14th week:
Lecture: End-term test
Self Control Test

15th week:
Lecture: Making up for practice.

Requirements

Topics: The lectures and practice classes cover the followings: structure and composition of materials, including the types of atoms and their arrangement, as viewed over a range of length scales (nano-, micro-, meso-, and macro-scale), crystalline structure of metals, crystal defects, solid solutions, compounds, alloys, equilibrium conditions of systems, binary systems, phase diagrams, the iron-carbon phase diagram, austenite transformations, principles of transformation diagrams (isothermal, continuous cooling), ferrous and non-ferrous metals, basic micro-structures, polymers, ceramics, composites, material properties (physical, mechanical, electrical, optical, magnetic), calculation tasks on crystalline systems, phase diagrams, transformation diagrams.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group.

Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, being discussed with the tutor. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 14th week. Students have to sit for the tests.
B, for a grade: The course ends in an exam, the grade is calculated as: - 60% from the exam - 20%-20% from the two tests The minimum requirement for passing is 60%, the grade for the final mark is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, students once can take a retake test of the whole semester material.

Required reading materials

J.-P. Mercier: Introduction to Materials Science
Elsevier, 2002.
William D. Callister and David G. Rethwisch: Materials Science and Engineering
9th SI version. John Wiley and Sons , 2011. ISBN: 978-0-470-505861-1
Alloy Phase Diagrams (ASM Handbook, Vol. 3)
ASM International, 1992.

Department of Mechanical Engineering

Subject: **ENGINEERING PHYSICS**
Year, Semester: 1st year/1st semester
Lecture: **2**

1st week:
Lecture: The basics of kinematics and dynamics of particles: Giving the position of a particle.

2nd week:
Lecture: Position-time function, velocity and acceleration.

3rd week:
Lecture: Newton's laws. Types of forces.

4th week:
Lecture: The concept of mechanical work, potential and kinetic energy.

5th week:
Lecture: Work-energy theorem.

6th week:
Lecture: The basics of electricity and magnetism. Electrostatics, electrical potential.

7th week:
Lecture: electric fields around conductors, capacity and capacitors.

8th week:
Lecture: Mid-term test.
Self Control Test

9th week:
Lecture: Transport processes. Electric current, AD circuits.

10th week:
Lecture: Heat transfer: thermal conductions, convection and radiation.

11th week:
Lecture: The fields of moving charges

12th week:
Lecture: Magnetic fields, electromagnetic induction.

13th week:
Lecture: Maxwell's equations.

14th week:
Lecture: AC circuits, electric and magnetic fields in matter.

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: The basics of kinematics and dynamics of particles. Giving the position of a particle. Position-time function, velocity and acceleration. Newton's laws. Types of forces. The concept of mechanical work, potential and kinetic energy. Work-energy theorem. The basics of electricity and magnetism. Transport processes. Electrostatics, electrical potential, electric fields around conductors, capacity and capacitors. Transport processes. Electric current, AD circuits. A heat transfer: thermal conduction, convection and radiation. The fields of moving charges, magnetic fields, electromagnetic induction and Maxwell's equations, AC circuits, electric and magnetic fields in matter.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice with another group. The attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence due to the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in an exam grade (ESE). The grade for the test is given according to the following table: Score Grade 0-49 fail (1) 50-64 pass (2) 65-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5)

Required reading materials

Alvin Halpern : 3,000 Solved Problems in Physics (SCHAUM'S SOLVED PROBLEM SERIES)
McGraw-Hill, 1988. ISBN: 0-07-025734-5
Michael Browne : Physics for Engineering and Science
McGraw-Hill, 1999. ISBN: 0-07-161399-6
Robert Balmer: Thermo-dynamics, 868 pages
Jaico Publishing House , 2006. ISBN: 817224262X

Subject: **TECHNICAL DRAWING I**
Year, Semester: 1st year/1st semester
Lecture: **1**
Practical: **2**

1st week:
Lecture: Introduction to the multiview depiction
Practical: Introduction to the multiview depiction

2nd week:
Lecture: On regular solids
Practical: Tranceted polyhedrons

3rd week:
Lecture: Introduction to the Monge's method of

projecting
Practical: Introduction to the Monge's method of projecting

4th week:
Lecture: Intersection tasks I.
Practical: Intersection tasks I.

5th week:
Lecture: Intersection tasks II.
Practical: Intersection tasks II.

6th week:
Lecture: Methods of the replacing image-planes
Practical: Methods of the replacing image-planes

7th week:
Lecture: Mid-term test
Self Control Test

8th week:
Lecture: Metrical problems I.
Practical: Metrical problems I.

9th week:
Lecture: Metrical problems II.
Practical: Metrical problems II.

10th week:
Lecture: Polyhedrons: prisms and pyramids
Practical: Polyhedrons: prisms and pyramids

11th week:
Lecture: Intersection of the polyhedrons with lines and planes
Practical: Intersection of the polyhedrons with lines and planes

12th week:
Lecture: Intersection of two polyhedrons I.
Practical: Intersection of two polyhedrons I.

13th week:
Lecture: Intersection of two polyhedrons II.
Practical: Intersection of two polyhedrons II.

14th week:
Lecture: Curved surfaces
Practical: Curved surfaces

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: Monge's method of projecting: methods of projection, an image-plane system, representation of spatial elements, reconstruction. The fundamentals of intersections: line-plane and plane-plane intersections. Metrical problems: distance and angle tasks, perpendicularity, rotation of a plane to parallel to an image plane, methods of replacing image-planes, constructing an illustrative picture using new image-planes, visibility. Polyhedrons: their representation, their intersection with a line, plane and the other polyhedron. Curved surfaces: construction and representation of curved surfaces, their intersection with a line, a plane.

A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't make up a practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, to be discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence due to the lack of active participation in class. During the semester there is some homework related to each topic and there are two tests: the mid-term test is in the 7th week and the end-term test in the 15th week. Conditions for the signature: • to reach the 50 % score on both tests. • to hand the homework tasks in time.

B, for a grade: The course ends in a mid-semester grade (AW5). During the exam period there is

another test on all the topics of the semester. This test is accepted with minimum 50 % score. The total score of the semester is the sum of the scores of all tests (mid-term, end-term, exam) and the homework tasks, and the grade is given according to the following table: Score Grade 0-99 fail (1) 100-129 pass (2) 130-159 satisfactory (3) 160-179 good (4) 180-200 excellent (5)

Required reading materials

Vlasta Szirovicza: Descriptive geometry
Self-published, Zagreb, Croatia, 2007. ISBN: 978-953-95667-0-6
Paré, E. G.: Descriptive geometry
Prentice Hall, 1997.
Gordon, V. O.: A course in descriptive geometry
Mir, 1980.

Subject: **TECHNICAL MECHANICS I**
Year, Semester: 1st year/1st semester
Lecture: **2**
Practical: **2**

1st week:
Lecture: Vector algebra: description of a vector, vector operations, geometric representation of vector operations
Practical: vector operations and their application for solving geometry problems

2nd week:
Lecture: Introduction to Statics, Newton's laws of motion, force formulas (gravitational, spring and reaction force), equilibrium equations for a material point
Practical: calculation and construction of the net force of a force system, calculation and construction of unknown forces acting on a material point

3rd week:
Lecture: A moment of force, net force and a net moment of a force system, connection between the net moments of a force system relative to different points, equivalence of force systems.
Practical: calculation and construction of the net force and net moment of a force system

4th week:
Lecture: The resultant of a force system, couples and screw, classification of force systems, calculation of the resultant of a plane force system
Practical: Calculation of the resultant of a plane force system

5th week:
Lecture: Construction of the resultant of a plane force system
Practical: Construction of the resultant of a plane force system

6th week:
Lecture: The resultant of a homogeneous gravitational force system, centre of gravity, continuously distributed force systems
Practical: Calculation of the centre of gravity of material point systems and rigid discs with constant areal density and thickness

7th week:
Lecture: An equilibrium state and its conditions, equilibrium equations for a general and a plane for system, statically determinate and indeterminate structure, frictionless constraints
Practical: calculation of unknown external forces and torques acting on a rigid plate (specially a cantilever, supported or fractionated line beam) in equilibrium

8th week:
Lecture: Mid-term test I
Practical: calculation of unknown force and torques acting on a rigid plate (specially a cantilever, supported or fractioned line beam) in

equilibrium
Self Control Test

9th week:
Lecture: Construction of unknown external forces acting on a determinate structure in equilibrium
Practical: Construction of unknown external forces acting on a determinate structure in equilibrium

10th week:
Lecture: Constraints with friction (friction, pin-friction, rope friction) and rolling resistance.
Practical: analysis of structures which contain constraints with friction or rolling resistance, calculation the ranges of parameters at which the structure is in equilibrium

11th week:
Lecture: Internal force system of a rigid body, calculation of the net force and moment of the force system and also their components (normal force, shear force, moment of torsion and bending), loading of a beams (cantilevers, freely supported beams, fraction lined beams)
Practical: calculation of the internal forces and moments of beams, drawing their loading (normal force, shear force and bending moment) diagrams

12th week:
Lecture: Simple rules for the drawing of the loading diagrams of beams
Practical: drawing of the loading diagrams of beams (cantilevers, freely supported beams, fraction lined beams)

13th week:
Lecture: Statically determined beam structures (hinged-bar systems, compound beams, truss systems).
Practical: analysis of statically determined beam structures

14th week:
Lecture: Statically determined beam structures (hinged-bar systems, compound beams, truss systems).
Practical: analysis of statically determined beam structures

15th week:
Lecture: Mid-term test II
Self Control Test

Requirements

Topics: The fundamentals of mechanics and statics. Newton's three laws of motion. Force, moment, and couples. Reduction of a force system. Resultant forces and the classification of force systems. Equilibrium equations. Statics of material points. Statics of rigid bodies (moment of inertia, systems of planar forces). Static problems in planar systems. Internal force systems of rigid bodies. Loading of beams (cantilevers, freely supported beams, fraction lined beams). Determination of shear and moment functions, and diagrams of beams. Statically determined beam structures (hinged-bar systems, compound beams, truss systems). Practical structures (friction, pin-friction, rolling resistance, rope friction).
A, for a signature: Attendance at lectures and practice classes is compulsory. A student may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice class with another group. Attendance on lectures and practice classes will be recorded by the lecturer. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. Everybody has to write two midterm tests during the semester. The first (40 points max) in the 8th, the second (40 points max) in the 14th week. At the end of the semester everybody will get a seminar grade on the basis of the table below: Fail (1) 0-39 Pass (2) 40-50 Satisfactory (3) 51-60 Good (4) 61-70 Excellent (5) 71-80 If

somebody fails them he or she has to write both tests in the 1st week of the exam period again. If the result is 40 points (50%) or better, then he can take an exam. If somebody has to repeat his midterm tests then his seminar grade can't be better than (2). There will be homework from week to week. Only students who have handed in all their homework at the time of the midterm test will be allowed to write it. The problems in the midterm tests will be selected from the homework assignments.
B, for a grade: Everybody will get an exam grade for their exams. The final grade will be the average of the seminar and exam grade. If it is for example (3.5) then the lecturer decides if it is (3) or (4). An offered grade: -

Required reading materials

Joseph F. Shelley : 800 solved problems in vector mechanics for engineers, Volume I: Statics. (SCHAUM'S SOLVED PROBLEM SERIES)
McGraw-Hill, 1990. ISBN: 0-07-056835-9
Russel C. Hibbeler : Engineering Mechanics – Statics and Dynamics
Prentice Hall, 2006. ISBN: 9780132215091
Lakshmana C. Rao, J. Lakshminarasimhan, Raju Sethuraman, Srinivasan M. Sivakumar: Engineering Mechanics: Statics and Dynamics
PHI Learning Pvt. Ltd., 2004. ISBN: 8120321898, 97881203
Ferdinand P. Beer, E. Russell Johnston, Jr: Mechanics for Engineers: Statics and Dynamics (Package)
4th. University of Connecticut, 1987. ISBN: ISBN-13 978007004584
Lawrence E. Goodman, Susan Goodman, William H. Warner : Statics Courier
Dover Publications, 2001. ISBN: 0486420051, 97804864

Department of Basic Technical Studies

Subject: **INFORMATICS FOR ENGINEERS II**
Year, Semester: 1st year/2nd semester
Seminar: **2**

1st week:
Seminar: Database basics. Elements of relational databases: tables, records, fields, keys, primary keys, indexes. Relationship between tables, relationship types. A user interface of software.

2nd week:
Seminar: Create a new database. Create and import tables. Data types. Create relations between tables. Referential integrity. Insert, delete, update records, fields.

3rd week:
Seminar: Format. Input masks. Fast finding, Filtering, and Sorting Data. Queries (Select, Crosstab). Calculated fields. Summarizing Data.

4th week:
Seminar: Queries (Making table queries, appending queries, Updating queries, deleting queries)

5th week:
Seminar: Creating forms using the Form wizard. Creating reports using the Report wizard. Formatting a report.

6th week:
Seminar: Modeling and creating a new database. Practicing the learned material.

7th week:
Seminar: 1st Mid-term exam.

Self Control Test

8th week:
Seminar: 2nd module: LABVIEWVirtual instruments. A user interface of software.Main components: a front Panel, a block Diagram, an icon and a connector pane. Data types. Elements of a block diagram: nodes, functions, subVÍs.

9th week:
Seminar: A data flow model.Troubleshooting and debugging. Decision making: using selection. Using case structure.

10th week:
Seminar: Loops: While loop. For Loop. Iterative data transfer: Use Shift register. Timing.

11th week:
Seminar: Modularity. Functions and SubVIs. Three types of Functions: ExpressVIs, Standard VIs, Functions. Creating SubVIs.

12th week:
Seminar: File I/O. Graph Indicators.

13th week:
Seminar: Create codes. Practice the learned material.

14th week:
Seminar: 2nd Mid-term exam.
Self Control Test

15th week:
Seminar: Make up or improve grades: End-term exam.

Requirements

A, for a signature: Participation at practice classes is compulsory. Students have to attend the practice classes and mustn't miss more than three occasions during the semester. In case a student does more so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented.
B, for a grade (AW5): Everybody has to take two mid-term exams during the semester at the end of the modules. The minimum requirement for the mid-term exams is 50%. Based on the score of the mid-term exams, the grade for each exam is given according to the following table: Score Grade 0-49 % fail (1) 50-62 % pass (2) 63-75 % satisfactory (3) 76-88 % good (4) 89-100 % excellent (5) Both modules must be obtained at least pass (grade 2). Students can make up or improve their grades at the last week of the semester. At the end of the semester everybody will get a final grade (AW5) based on the average of his/her all grades: If the average is for example (3.5) then the lecturer decides if it is (3) or (4).

Subject: **MATHEMATICS II**
Year, Semester: 1st year/2nd semester
Lecture: **2**
Seminar: **3**

2nd week:
Lecture: Applications in physics. Taylor polynomials.
Seminar: Applications in physics. Taylor polynomials.

3rd week:
Lecture: Extreme values. Monotony and convexity testing.
Seminar: Extreme values. Monotony and convexity testing.

4th week:
Lecture: Mean value theorems, l'Hospital's rule, Taylor's theorem.
Seminar: Mean value theorems, l'Hospital's rule, Taylor's theorem.

5th week:
Lecture: Antiderivatives. Integration by parts and by substitution.
Seminar: Antiderivatives. Integration by parts and by substitution.

6th week:
Lecture: Integration in special classes of functions.
Seminar: Integration in special classes of functions.

7th week:
Lecture: The Riemann integral. The Newton-Leibniz theorem. Improper integrals.
Seminar: The Riemann integral. The Newton-Leibniz theorem. Improper integrals.

8th week:
Lecture: Mid-term test
Self Control Test

9th week:
Lecture: Applications of the integration in geometry and physics. Fourier series.
Seminar: Applications of the integration in geometry and physics. Fourier series.

10th week:
Lecture: Lecture: Classification of differential equations. Initial value problems, boundary value problems. First order differential equations.
Seminar: Lecture: Classification of differential equations. Initial value problems, boundary value problems. First order differential equations.

11th week:
Lecture: Slope fields. Euler's and Runge-Kutta methods. Problems leading to differential equations.
Seminar: Slope fields. Euler's and Runge-Kutta methods. Problems leading to differential equations.

12th week:
Lecture: Problems leading to differential equations. Separable differential equations.
Seminar: Problems leading to differential equations. Separable differential equations.

13th week:
Lecture: Second order differential equations. The theory of linear differential equations.
Seminar: Second order differential equations. The theory of linear differential equations.

14th week:
Lecture: Method of variation of parameters, method of undetermined coefficients, application of the Laplace transform.
Seminar: Method of variation of parameters, method of undetermined coefficients, application of the Laplace transform.

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: Derivatives, linear approximation. Differentiation rules. Applications in physics. Taylor polynomials. Extreme values. Monotony and convexity testing. Mean value theorems, l'Hospital's rule, Taylor's theorem. Curve sketching for a function, local and absolute extrema. Antiderivatives. Integration by parts and by substitution. Integration in special classes of functions. The Riemann integral. The Newton-Leibniz theorem. Improper integrals. Applications of the integration in geometry and physics. Fourier series. Classification of differential equations. Initial value problems, boundary value problems. First order differential equations. Slope fields. Euler's and Runge-Kutta methods. Problems leading to differential equations. Separable differential equations. Second order differential equations. The theory of linear differential equations, method of variation of parameters, method of undetermined coefficients, application of the Laplace transform.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group.

Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate their participation as an absence due to the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in an exam grade (ESE). The grade for the test is given according to the following table: Score Grade 0-49 fail (1) 50-64 pass (2) 65-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5)

Required reading materials

S. Minton: Calculus Concept and Connections
McGraw Hill , 2006. ISBN: 0-07111200-6
Addison Wesley : Thomas' Calculus
11th.2005. ISBN: 0-321-24335-8
M. D. Greenberg: Fundamentals of engineering analysis
Cambridge University Press, ISBN: 978-0-521-80526-1

Department of Chemical and Environmental Engineering

Subject: **ENVIRONMENTAL PROTECTION**
Year, Semester: 1st year/2nd semester
Seminar: **2**

1st week:
Seminar: The basic concepts of environmental protection and management. The development of environmental management related events.

2nd week:
Seminar: Environmental chemistry: Characterization of environmental elements. Green chemistry. Chemicals in the environment: their fate and transport.

3rd week:
Seminar: Transport processes in the environment. Conservation of mass. Conservation of mass in an integral (control volume) form. Differential forms of conservation of mass.

4th week:
Seminar: Groundwater hydrology. Diffusion of an instantaneous, point source. Reactions and exchanges. Exchanges across an air-water interface. Partitioning of a solid. Transport of particles in the environment.

5th week:
Seminar: Global and local environmental problems and their analyses.

6th week:
Seminar: Earth systems and their relations. Characterization of natural resources.

7th week:
Seminar: Protection of nature and landscape.

8th week:
Seminar: Mid-term test
Self Control Test

9th week:
Seminar: Environmental analyses.

10th week:
Seminar: Air chemistry. Air pollution controls.

11th week:
Seminar: Water management: Water resource systems. Aquatic chemistry. Water quality controls. Water and waste water treatment technologies.

12th week:
Seminar: Soil management: soil pollution controls, soil degradation, erosion and deflation processes.

13th week:
Seminar: Waste management.

14th week:
Seminar: Noise and vibration protection: the concept of noise. Noise levels and operation with noise levels. The effect of noise on human beings. Perceptual acoustics. The spread of sound. Traffic noise. Noise mapping.

15th week:
Seminar: End-term test
Self Control Test

Requirements

Topics: This series of practice classes is based on the topics of environmental issues. The basic concepts of environmental protection and management. Characterization of environmental elements. Green chemistry. Chemicals in the environment: their fate and transport. Transport processes in the environment. Conservation of mass. Conservation of mass in integral (control volume) form. The differential form of conservation of mass. Groundwater hydrology. Diffusion of an instantaneous, point sources. Reactions and exchanges. Exchanges across an air-water interface. Partitioning of a solid. The transport of particles in the environment. Water resource systems. Aquatic chemistry. Water quality controls. Water and wastewater treatment technologies. Air chemistry. Air, water and soil pollution controls, waste management, recycling, noise and vibration problems, environmental health engineering. Pollution controlling through different methods.
A, for a signature: Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. The attendance on practice will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in a mid-semester grade (AW5). The mid-semester grade is calculated as an average of the two tests' results. The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, once students can take a retake test of the whole semester material.

Required reading materials

Mukesh Doble: Green Chemistry and Engineering
Hardcover, 2007. ISBN: 978-0123725325
Andrew Farmer: Handbook of Environmental Protection and Enforcement: Principles and Practice
Hardcover, 2007. ISBN: 978-1844073092

Department of Electrical Engineering and Mechatronics

Subject: **INSTRUMENTAL TECHNIQUE**
Year, Semester: 1st year/2nd semester
Practical: **2**

1st week:
Practical: Preparation, course registration, description of subject requirements, description of the course schedule, description of the course literature lists, registration week.

2nd week:
Practical: Understanding the main basic measurement concepts such as: measurements, measured quantity, measure, measurement methods, measurement procedures. What metrology is and what are the main areas.

3rd week:
Practical: The grouping of measurement errors. Distinction between measurement errors according to their nature and origin. (absolute, relative, random, systematic error). What verification and calibration is.

4th week:
Practical: The concept of reliability limit. The calculation of the measurement uncertainty. Characterization of indirect measurements. The steps of determining the measurement result from individual and measurement series.

5th week:
Practical: Introduction equipment for checking geometric dimensions. The concept of measurement and measuring instruments. The main aspects of choosing a suitable instrument for a given measurement task.

6th week:
Practical: Presentation of the features of analog and digital instrumentation and measurement techniques, such as: measuring range, sensitivity, instrument constant, consumption, capacity, accuracy class.

7th week:
Practical: Analog measuring devices (permanent magnet, electro-dynamic, soft-iron), their working principle, characteristics, structure.

8th week:
Practical: Mathematical statistical characterization of measurement results. The reasons for using statistical methods. Statistical features of measurement series. The content and format of the test report. Evaluation of the measured values in MS Excel software. Preparation of reports aspects.

9th week:
Practical: Mid-term test
Self Control Test

10th week:
Practical: Measurement 1: National Instruments hardware and software, voltage measurements and their evaluations.

11th week:
Practical: Measurement 2: A thermocouple voltage measurement with National Instruments hardware and software and its evaluation.

12th week:
Practical: Measurement 3: voltage divider measurement and evaluation the characteristics of a variable resistor.

13th week:
Practical: Measurement 4: measurements with data acquisition cards, digital output controls.

14th week:
Practical: Measurement 5: measurements with National Instruments hardware and software, controlling of analog outputs and inputs.

15th week:
Practical: End-term test
Self Control Test

Requirements

Topics: Basic knowledge of key measurement concepts such as: measurement, the measured quantity, measure, measurement methods, measurement procedure, main areas of metrology. Measurement errors, their nature and origin, (absolute, relative, random, systematic error). What is certification and calibration? Analogue and digital instrumentation and measurement techniques: described features such as: measuring range, sensitivity, instrument constant, consumption, capacity, accuracy classes. Statistical properties of measurements series. Content and format of a test report. Evaluation of measured values by MS EXCEL software. Fundamentals of time and frequency, signal processing and conditioning, signals & systems. Experimenting National Instrument myDAQ data acquisition card and NI Labview software; Virtual measurements with ELVIS Educational Laboratory Virtual Instrumentation Suite and MyDAQ.
A, for a signature: Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. The attendance on practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, being discussed with the tutor. Students are required to bring the necessary utensils (e.g. calculator) to the course to each practice class and they have to prepare a written report of their work. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his or her participation as an absence due to the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in a mid-semester grade (AW5). Based on the average of the reports and the average of the test results, the mid-semester grade is calculated as an average of them: - the average grade of the reports - the average grade of the two tests The minimum requirements for the mid-term and the end-term tests are 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, the student once can take a retake test of the whole semester material.

Required reading materials

Preben Howarth and Fiona Redgrave: METROLOGY – IN SHORT
3rd.2008. ISBN: 978-87-988154-5-7

Department of Mechanical Engineering

Subject: **MANUFACTURING PROCESSES I**
Year, Semester: 1st year/2nd semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Basic principles of manufacturing technologies.
Practical: The practice classes are separated into 4 different practice types means 4x3 lectures in the semester instead of 1 lecture per week.

2nd week:
Lecture: Types of manufacturing methods, a chip generation process, chip types

Practical: Machining Practice (on a turning machine)

3rd week:
Lecture: Cutting force and cutting tool geometries and the affects of the accuracy of workpieces. Factors of the cutting force.
Practical: Action planning practice (shaft-typed workpieces)

4th week:
Lecture: Shaft tool wear, tool life and its equations. The economics of the machining an economical method for calculating tool life
Practical: Tool-geometry practice (dimensional analysis of different cutting tools)

5th week:
Lecture: Parts of cutting tools and their classification, tool materials.
Practical: Dimensional measuring practice

6th week:
Lecture: Single-point cutting tools, turning tools, planer knives, chisel knives
Practical: Presenting the results of the task

7th week:
Lecture: Boring tools, drill bits, countersinks, reamers, saws, structural design, the applicability of them. Types of grooving tools, the main steps of the applicability of tool designing.
Practical: Presenting the results of the task.

8th week:
Lecture: Mid-term test: Design of milling tools, types, usability.
Practical: Presenting the results of the task.

Self Control Test

9th week:
Lecture: Threading tools, gear manufacturing tools, grinding tools. Fine machining.
Practical: Presenting the results of the task

10th week:
Lecture: Classification of turning machines. Design and components analysis.
Practical: Presenting the results of the task

11th week:
Lecture: Classification of milling machines. Design and components analysis.
Practical: Presenting the results of the task.

12th week:
Lecture: Classification of grinding and gear production machines. Design and component analysis.
Practical: Presenting the results of the task

13th week:
Lecture: Special technologies. Electric arc cutting, ultrasonic milling, water-jet cutting, electro-polishing.
Practical: Presenting the results of the task

14th week:
Lecture: Methods to design a production technology. Calculation of basic technological parameters.
Practical: Presenting the results of the task

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: Basic principles of mechanical engineering. Overview of generally used raw materials manufacturing processes (steel-, copper-, alumina based and other alloys). Introduction of the basic material removal manufacturing processes. The basic concept of cutting, applicable tools and tool materials. Machining processes, turning, milling, drilling, planning, chipping, abrasive processes, gearing, and thread cutting technology. Methods of tool life analysis and management. Special machining, UP, HSC, electrochemical, laser-, and water-jet cutting.
For a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practices and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice class with another group.

Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. Students have to submit all the tasks as scheduled minimum on a sufficient level.
During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

Required reading materials

L. Edwards, M. Endean: Manufacturing with Materials
Butterworths, 1990. ISBN: 0-408-02770-3
M. F. Ashby: Materials Selection in Mechanical Design
3rd. Elsevier, 2005. ISBN: 0-7506-6168-2
DeGarmo, Black, Kohser: DeGarmo's Materials and Processes inManufacturing
10th.2008. ISBN: 978-0-470-05512-0
Groover: Fundamentals of Modern Manufacturing: Materials, Processes and Systems
3rd.2007. ISBN: 978-0-471-74485-6

Subject: **TECHNICAL DRAWING II**
Year, Semester: 1st year/2nd semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Drawing standards, formal requirements of machine drawing. Drawing sheet dimensions, a title block, defining line types and thickness groups. Standardized letter and figure shapes and sizes, scales, the full size, reduction scales, enlarged scales.
Practical: issuing task 1: Lettering

2nd week:
Lecture: Defining the surfaces of a part. Presentation method in machine drawing, views, auxiliary view, local view, breaking, sectional views and sections.
Practical: issuing the task 2: Drawing Machine Parts. Practicing the presentation methods.

3rd week:
Lecture: Complex sectional views, removed elements, removed sections, specific sectional view and sections, conventional practice in machine drawing.
Practical: submitting task 1: Lettering, elaborating the task 2. Practicing the presentation methods.

4th week:
Lecture: General prescriptions for dimensioning, choosing basis surfaces. Conventional dimensioning methods.
Practical: submitting task 2, issuing the task 3: Shaft drawing. Practicing the presentation methods.

5th week:
Lecture: Specific dimensioning, defining and giving conical taper and flat taper
Practical: Applying the dimensioning methods to dimensioning parts.

6th week:
Lecture: ISO Tolerance system. The basic size, the actual size, limits, deviation, fundamental deviation
Practical: submitting task 3, issuing task 4: Designing Fitting Pieces. Applying the cutting plane and the cutting sphere method to construct the intersection lines of interpenetrating surfaces.

7th week:
Lecture: ISO Tolerance system. Defining the tolerance IT grades, a hole-base system, a shaft base system. Free dimensional tolerance.
Practical: Designing Fitting Pieces. Applying the triangulation and parallel line methods todevelop fitting pieces. Representing tolerances and calculating its dimensions.

8th week:
Lecture: Mid-term testISO Tolerance system. Defining fits: clearance, transition and interference fit.
Practical: Designing Fitting Pieces. Applying the triangulation and parallel line methods todevelop fitting pieces. Representing fits and calculating its dimensions.
Self Control Test

9th week:
Lecture: The ISO tolerance system. Form and position tolerance types.
Practical: elaborating the shop drawing of pattern, development of fitting pieces

10th week:
Lecture: Defining the surface roughness. Feasible roughness with different processing methods. Correlation between the surface roughness and the IT grade of dimension.
Practical: issuing the task 5: Screw Fastening and Joints. Presentation of tolerances and fits in drawing. Presentation of surface roughness in drawing.

11th week:
Lecture: Standardized thread forms and its main features. Threads and thread symbols in drawing. Threaded joints: a bolted joint, a studded joint, screw fastening.
Practical: elaborating the task 5, Drawing threaded joints in section and on view.

12th week:
Lecture: springs: standardized representation of a helical spring, a belleville spring, a buffer spring, an annular spring, a multi-leaf spring. Keyed joints with saddle keys, sunk keys, parallel keys and woodruff keys. A splinted shaft joint.
Practical: submitting task 5, issuing task 6: Gearing. Drawing keyed joints and a splinted shaft joint in section and on view.

13th week:
Lecture: Gears and toothed parts. Spur and helical gears, bevel gears, worms, rack and pinion gears, sprockets.
Practical: elaborating the gear task 5. Drawing meshing gears in section and on view.

14th week:
Lecture: rolling bearings: ball and roller bearings. Riveted joints. Welding symbols and welded joints: butt joint, a lap joint, a tee joint, a corner joint.
Practical: submitting task 6. Drawing bearings, riveted and welded joints in section and on view.

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: The series of lectures are based on the relevant standards. It reviews the fundamental rules and formal requirements of the technical drawing, the drawing of projections, views and sections, auxiliary and sectional views. Representations of threaded parts, and threaded fasteners, gears, splines and keys. Drawing standardized machine elements and the concept of manufacturing tolerance and fitting, dimensional specification, geometrical and positioning tolerancing, surface roughness and the rules of elaboration of the workshop drawing and detailed drawings of simple machine elements. In seminar there are six tasks to elaborate: workshop drawing of different machine elements and components.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practices and my not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student

must repeat the course. Students can't make up a practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, being discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments for the course to each occasion. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate their participation as an absence because of the lack of active participation in class. Students have to submit all the six drawing tasks as scheduled minimum on a sufficient level. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in a mid-semester grade. Based on the average of the marks of the drawings and the average of the test results, the mid-semester grade is calculated as an average of them: - the average grade of the six drawing tasks - the average grade of the two tests The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, the student once can take a retake test of the whole semester material.

Required reading materials

Tiba Zs.: Machine Drawing
Debrecen University Press , 2010. ISBN: 978-963-318-066-2

Subject: **TECHNICAL MECHANICS II**
Year, Semester: 1st year/2nd semester
Lecture: **2**
Practical: **2**

1st week:
Lecture: Statics review, equilibrium equations, loadings, supports. Mathematical preliminaries (vector, matrix and tensor algebra).
Practical: Reaction forces calculation and stress resultant drawing.

2nd week:
Lecture: Basics of strength of materials. Physical interpretation of displacement field.
Practical: A displacement vector and derivative tensor.

3rd week:
Lecture: Physical interpretation of strain terms. State of deformation.
Practical: Strain tensor, a strain vector, normal strain and shear angle determination

4th week:
Lecture: State of stresses. Cauchy stress vector. Principal values of normal stresses, principal axes (eigenvalue problem).
Practical: Stress tensor, a stress vector, normal stress and shear stress determination.

5th week:
Lecture: Strain energy and the constitutive equation of linear elastic solids.
Practical: Hooke's law, material constants. Stress-strain relations. Mid-term test No.1.
Self Control Test

6th week:
Lecture: Basics of sizing and controlling. Simple loadings I. (tension and compression)
Practical: Examples on prismatic beams under tension and compression (stress and strain calculations, sizing and controlling).

7th week:
Lecture: Simple loadings II. (bending). Area moment of inertia and product of inertia.
Practical: Examples on prismatic beams under

bending (stress and strain calculations, sizing and controlling).

8th week:
Lecture: Simple loadings III. (torsion, shear). Polar moment of inertia.
Practical: Examples on prismatic beams under torsion (stress and strain calculations, sizing and controlling).

9th week:
Lecture: Mohr's circle and principal normal stress determination. General Hooke's law.
Practical: Mohr's circle drawing. Stress-strain relation in a general case. A mid-term test No.2.

10th week:
Lecture: Combined loadings I. (tension and bending, compression and bending).
Practical: Examples on prismatic beams under tension/compression and bending (stress and strain calculations, sizing and controlling).

11th week:
Lecture: Combined loadings II. (inclined bending, excentric bending).
Practical: Examples on prismatic beams under inclined bending and excentric bending (stress and strain calculations, sizing and controlling).

12th week:
Lecture: Combined loadings III. (tension and torsion, compression and torsion). HMH and Mohr sizing theorems (equivalent stress).
Practical: Examples on prismatic beams under tension/compression and torsion (stress and strain calculations, sizing and controlling).

13th week:
Lecture: Combined loadings IV. (bending and torsion).
Practical: Examples on prismatic beams under bending and torsion (stress and strain calculations, sizing and controlling).

14th week:
Lecture: Buckling of columns.
Practical: Examples on buckling of columns. A mid-term test No.3.
Self Control Test

15th week:
Lecture: A Retake test

Requirements

Topics: Statics review. Mathematical preliminaries (vector, matrix and tensor algebra). Fundamentals of the strength of materials. Physical interpretation of strain terms. State of deformation. State of stresses. Principal values of normal stresses, principal axes. Strain energy. Constitutive equation (Hooke's law). Simple loadings (tension, compression, bending, torsion, shear). Sizing methods. Area moment of inertia and product of inertia. A polar moment of inertia. Determination of principal axes. Mohr's circle. Combined loadings (tension and bending, inclined bending, excentric tension, tension and torsion, bending and torsion). Buckling of columns.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate their participation as an absence because of the lack of active participation in class. During the semester there are three tests on the 5th, 9th and 14th week. Students have to sit for the tests.
B, for a grade: The course ends in an exam. The minimum requirement for the mid-term tests and the examination is respectively 50%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table: Score Grade 0-49 fail (1) 50-64

pass (2) 65-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 50, the student can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. An offered grade: it may be offered for the students if the average grade of the three mid-term tests is at least good (4).

Required reading materials

Stephen Timoshenko : Strength of Materials: Elementary Theory and Problems
Van Nostrand, 1955.
Ladislav Cerny : Elementary Statics and Strength of Materials
McGraw-Hill, 1981. ISBN: 0070103399, 97800701
3. László Kocsis : Brief Account of the Lectures of Mechanics, Strength of Materials
BME, 1988.
Ferdinand P. Beer, E. Russel Johnston, Jr., John T. DeWolf : Mechanics of Materials
4th. University of Connecticut , 2006. ISBN: 9780073107950

Department of Basic Technical Studies

Subject: **MATHEMATICS FINAL EXAM**
Year, Semester: 2nd year/1st semester

Subject: **MATHEMATICS III**
Year, Semester: 2nd year/1st semester
Lecture: **2**
Seminar: **2**

1st week:
Lecture: Functions of several variables, and scalar fields.
Seminar: Functions of several variables, and scalar fields.

2nd week:
Lecture: Continuity, differential calculus, partial derivatives, gradients.
Seminar: Continuity, differential calculus, partial derivatives, gradients.

3rd week:
Lecture: Young's theorem. Local and global extrema.
Seminar: Young's theorem. Local and global extrema.

4th week:
Lecture: Double and triple integrals. The Jacobian determinant.
Seminar: Double and triple integrals. The Jacobian determinant.

5th week:
Lecture: Vector-valued functions and curves.
Seminar: Vector-valued functions and curves.

6th week:
Lecture: Derivatives. Linear approximation.
Seminar: Derivatives. Linear approximation.

7th week:
Lecture: Curvature, torsion.
Seminar: Curvature, torsion.

8th week:
Lecture: Mid-term test
Self Control Test

9th week:
Lecture: Motion in space, velocity, acceleration.
Seminar: Motion in space, velocity, acceleration.

10th week: **Lecture:** Vector fields. Derivatives. Divergence and curl. **Seminar:** Vector fields. Derivatives. Divergence and curl.	**Seminar:** The theorems of Gauss and Stokes, Green's formula. **13th week:** **Lecture:** Conservative vector fields, potentials. **Seminar:** Conservative vector fields, potentials.
11th week: **Lecture:** Line and surface integrals. **Seminar:** Line and surface integrals.	**14th week:** **Lecture:** Applications in physics. **Seminar:** Applications in physics.
12th week: **Lecture:** The theorems of Gauss and Stokes, Green's formulae.	**15th week:** **Lecture:** End-term test **Self Control Test**

Requirements

Topics: Functions of several variables, and scalar fields. Continuity, differential and integral calculus, partial derivatives, gradients, and Young's theorem. Local and global extrema. Double and triple integrals. The Jacobian determinant. Vector-valued functions and curves. Derivatives. Linear approximation. Curvature, torsion. Motion in space, velocity, acceleration. Vector fields. Derivatives. Divergence and curl. Line and surface integrals. The theorems of Gauss and Stokes, Green's formula. Conservative vector fields, potentials. Applications in physics.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice class will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence due to the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in an exam grade (ESE). The grade for the test is given according to the following table: Score Grade 0-49 fail (1) 50-64 pass (2) 65-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5)

Required reading materials

S. Minton: Calculus Concept and Connections
McGraw Hill , 2006. ISBN: 0-07111200-6
M. D. Greenberg: Fundamentals of engineering analysis
Cambridge University Press, ISBN: 978-0-521-80526-1
Addison Wesley : Thomas' Calculus
11th.2005. ISBN: 0-321-24335-8

Department of Electrical Engineering and Mechatronics

Subject: **BASICS OF MECHATRONICS**
Year, Semester: 2nd year/1st semester
Lecture: **1**
Practical: **2**

1st week:
Lecture: Introduction to mechatronic engineering, Overall of Physics terminology, analogies, Mechanical components state-space representation, input-output model, model linearization.
Practical: Visiting the laboratories of Electrical engineering and department and equipment of mechatronics.

2nd week:
Lecture: Symbols and Abbreviations, Basic concepts, mathematical description of physical phenomena, Definition of the real physical system.
Practical: Definition of a signal, inputs and outputs. Definition of a system. Definitions of linear and non-linear systems.

3rd week:
Lecture: Problems, Definition of a parameter and a variable. Theory of distributed and concentrated parametric description. Description of deterministic and stochastic systems.
Practical: The concept of causality. Deterministic description with lumped parameters. The concept of static systems. The concept of dynamic systems.

4th week:
Lecture: Linear, quantized, single input and output systems. Linear, quantized, an input-output system. The generalized derivative. Basic tasks on state, state variable, state equation. Solvability of the most important basic tasks.
Practical: Complex tasks. The concept of stability state space representation

5th week:
Lecture: Investigation in time region (Dividing into components)
Practical: Dirac impulse and unit step. Summation of the effect of the impulse separated input signal.

6th week:
Lecture: Analyses in frequency domain Fourier series, Fourier-series Fourier Transform Laplace transformation. Application of the Laplace transformation. Residuum theory (Inverse Laplace transformation of rational function with s real coefficient.)
Practical: Fourier-series. Fourier Transform Laplace transformation. Application of the Laplace transformation.

7th week:
Lecture: Bond graphs I., Power variables, Standard elements, Power directions, Bond numbers
Practical: System equations, Activation, Example models, Art of creating models, Fields, Mixed-causal fields

8th week:
Lecture: Mid-term test
Practical: Mid-term test
Self Control Test

9th week:
Lecture: Bond graphs II. Differential causality Algebraic loops Causal loops Duality. Multi and Vector bond graphs. Suggested reading.
Practical: Differential causality Algebraic loops. Causal loops. Duality. Multi and Vector bond graphs. Suggested reading.

10th week:
Lecture: Introduction: kinematic I. links, pairs, chains, and mechanisms; motion: planar vs. spatial; four-bar linkage- relative motion; kinematic diagrams.
Practical: four-bar chains; degrees of Freedom; analysis versus synthesis, and movie of kinematic pairs

11th week: **Lecture:** Introduction: kinematic II. four-bar linkage- relative motion; kinematic diagrams. **Practical:** four-bar chains; degrees of Freedom; analysis versus **12th week:** **Lecture:** Actuators and drive systems. Electrical actuators, Mechanical actuators. Sensors and Transducers components interconnection. **13th week:** **Lecture:** Pneumatics Theory and applications	**Practical:** Pneumatics applications in FESTO lab. **14th week:** **Lecture:** Hydraulics Theory and applications **Practical:** Hydraulics applications in BOSCH lab. **15th week:** **Lecture:** End-term test **Self Control Test**

Requirements

Topics: The aim of Systems Engineering's curriculum is to describe a variety of physical phenomena, technical operation of objects by the means of a unified mathematical toolkit, to reveal functional similarities between completely different physical phenomena and technical objects. Based on these functional similarities of the physical phenomena and technological objects, regardless of the specific appearance they could be categorized. It has the advantage that completely different physical phenomenon, operation of technical objects, belonging into the same category, either with analysis of a passive or an active control of operation, general mathematical methods can be applied, independently of a specific object. Often the case that at a technical sub-field such as calculations of electrical circuits develops a mathematical procedure and is used to calculate other areas such as magnetic loops or thermal problems. The concept of impedance is also used in the calculation of circuits and force control of robots. These examples demonstrate the best the justification of systems engineering. This curriculum aims to present mathematical techniques that will help to solve certain types of problems occurring in engineering practice.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't make up a practice with another group. Attendance at practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Students are required to bring their notes and use engineering instruments (square rule, bows, calculating machine) to each practice during the course. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade (AW5): The course ends in a mid-semester grade. Based on the average of the test results, the mid-semester grade is calculated as an average of them: - the average grade of the two tests The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, the student once can take a retake test covering the whole semester material.

Required reading materials

Géza HUSI: Mechatronics Control Systems : Course Book
University of Debrecen Faculty of Engineering, 2012. ISBN: 978 963 473 520 5
Géza HUSI: Mechatronics Control Systems - laboratory handbook
1st. University of Debrecen, 2012. ISBN: 978-963-473-521-2
Péter KORONDI: Systems and control - course book
1st. BME, 2013.
De Silva, Clarence W.: Mechatronics : an integrated approach
CRC Press, 2005.

Subject: **ELECTROTECHNICS AND ELECTRONICS I**
Year, Semester: 2nd year/1st semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: The laws of electromagnetism. Superconductivity.
Practical: Examples and application of the laws of electromagnetism. Superconductivity.

2nd week:
Lecture: Single- and three-phase AC circuits. Transformers.
Practical: Single and three-phase exercises.

3rd week:
Lecture: Induction, synchronous and DC motors.
Practical: Induction, synchronous and DC motors exercises.

4th week:
Lecture: Principles of electric and electronic diagrams.
Practical: Principles of electric and electronic diagrams. Schematic reading and drawing.

5th week:
Lecture: Semiconductor devices. Integrated circuits: processors, controllers, memories.
Practical: Semiconductor devices. Integrated circuits: processors, controllers, memories.

6th week:
Lecture: Power electronics. Basic electrotechnical laws.
Practical: Exercises on power electronics. Basic electrotechnical laws.

7th week:
Lecture: Electrotechnical and electronic materials.
Practical: Electrotechnical and electronic materials.

8th week:
Lecture: Mid-term testBasic concepts and theorems in circuit theory. Kirchhoff's and Ohm's laws.
Practical: Basic concepts and theorems in circuit theory. Kirchhoff's and Ohm's laws. Exercises.

9th week:
Lecture: Thevenin's and Norton's theorems.
Practical: Thevenin's and Norton's theorems. Exercises.

10th week:
Lecture: The constant current. Other currents. RLC circuits.
Practical: The constant current. Other currents. RLC circuits. Exercises.

11th week:
Lecture: Unstable states, transient state analyses.
Practical: Unstable states, transient state analyses. Exercises.

12th week:
Lecture: Resonance circuits. Theories and Applications.

Practical: Resonance circuits. Theories and Applications. Exercises. **13th week:** **Lecture:** Application of industrial electronics I.: electrical drive systems. **Practical:** Application of industrial electronics I.: electrical drive systems.	**14th week:** **Lecture:** Application of industrial electronics II.: Controlling and measurement. **Practical:** Application of industrial electronics II.: Controlling and measurement. Exercises. **15th week:** **Lecture:** End-term test

Requirements

Topics: The laws of electromagnetism. Superconductivity. Single- and three-phase AC circuits. Transformers. Induction, synchronous and DC motors. The principles of electric and electronic diagrams. Semiconductor devices. Integrated circuits: processors, controllers, memories. Power electronics. Basic electrotechnical laws. Electrotechnical and electronic materials. Basic concepts and theorems in circuit theories. Kirchhoff's and Ohm's laws. Thevenin's and Norton's theorems. The constant current. Other currents. RLC circuits. Unstable states, transient state analyses. Resonance circuits. Linking p-n-p and n-p-n. The aim is to get to know the basic electrotechnical laws in the field of system theory. The structure of the basic electrotechnical circuits in computer systems. Basic concepts of the theory of analogue signals, its characteristics. Basic operations in linear signals.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice class with another group. The attendance on practice classes will be recorded by the practice leader. Being late is equivalent with absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, being discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments to the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in an exam (ESE) based on the average of the test results, the exam grade is calculated as an average of them: - an average grade of the two tests The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, the student once can take a retake test of the whole semester material.

Required reading materials

David Crecraft, David Gorham: Electronics The Open University
2003. ISBN: 0 7487 7036 4
Ralf Kories, Heinz Schmidt-Walter: Electrical Engineering a pocket reference
Spriger, 2003. ISBN: 3-540-43965-X
Wai-Kai Chen Editor-in-Cheif: The Electrical Engineering Handbook
Elsevier Academic Press, 2005. ISBN: 0-12-170960-4

Department of Engineering Management and Enterprise

Subject: **ECONOMICS FOR ENGINEERS**
Year, Semester: 2nd year/1st semester
Lecture: **3**

1st week:
Lecture: Introduction to economics. The method of economics. Microeconomics and Macroeconomics. Introduction to Macroeconomics. Economic Policy and economic problems. Economics in practice.

2nd week:
Lecture: Measuring national output and national income (Gross Output, Gross Domestic Product, calculating GDP, real versus nominal GDP, the components of the GDP, the expenditure approach, the income approach, GDP deflator, Gross National Income, and Gross National Disposable income). Calculation exercises.

3rd week:
Lecture: Measuring the cost of living (GDP and social welfare, the Consumer Price Index, GDP deflator versus CPI, real and nominal interest rates. Sustainable development).Calculation exercises.

4th week:
Lecture: The Keynesian Theory of consumption, consumption function, marginal propensity to consume, planned investment, saving function, marginal propensity to saving, aggregate output, determination of equilibrium output, the multiplier, IS curve. Calculation exercises.

5th week:
Lecture: The government and fiscal policy. Government purchases, taxes, disposable income, government budget deficits and surpluses, determination of equilibrium output, fiscal policy, the government spending multiplier, the tax multiplier. Average tax rates, tax wedges, and marginal tax rates. Calculation exercises.

6th week:
Lecture: Open-Economy, Equilibrium output in an Open Economy, net exports. Imports and exports and Trade Feedback effect. Calculation exercises.

7th week:
Lecture: Mid-term test. The meaning of money, the functions of money, measuring the supply of money. The creation of money, required reserve ratio. The money multiplier. Open market operations. Calculation exercises.
Self Control Test

8th week:
Lecture: Demanding money. Supplying and demanding in the money market. The equilibrium interest rates. The IS-LM model. The equilibrium price-level.

9th week:
Lecture: Aggregate demand and aggregate supply. The effects of a shift in aggregate demanding. Labour market. Labour demand and supply curve. Calculation exercises.

10th week:
Lecture: The demand for labour, the supply of labour, labour force, working-age population, active and inactive population, labour participation rate, Unemployment, the unemployment rate, the activity rate. Okun law. Calculation exercises.

11th week:
Lecture: Inflation; (Price level, inflation rate, definition and measuring of inflation, types and causes of inflation, The Philips curve). Calculation exercises.

12th week:
Lecture: Growth (sources of economic growth, increasing in the quality of labour, human capital, education and skills), Economic growth around the world.

13th week:
Lecture: Basic tools of finance. Investment and interest rates (measuring the time value of money, future values and present values, compounding, trading off between risk and return, the efficient market hypothesis). Investments analysis. Calculation exercises.

14th week:
Lecture: Comparative analysis. Case studies.

Requirements

Topics: This course focuses on the theory and application of the following: Measuring national income and output (real vs. nominal GNP, GDP, NNP, NDP, the problem of double counting). Consumption and Investment. IS model. Economic role of government (externalities). Fiscal policy and output determination. The role of money in the economy, the evolution of money, central bank, commercial banking, supply and demand for money. Monetary policy (varieties and problems of monetary policy). IS-LM analysis: the integration of the goods and money market models. Aggregate demand and supply. Labour market. Unemployment and inflation.
A, for a signature: Attendance at lectures is recommended, but not compulsory.
B, for a grade: The course ends in an exam grade (ESE). Attendance at lectures is recommended, but not compulsory. During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 15th week. Based on the cumulative results of the 2 tests written in Economics for Engineers, students are offered an exam grade. The students can either accept or refuse the offered grades. If a student does not accept the grade offered by the lecturer, they should sit for a written exam during the examination period. Evaluation of the written exam (ESE) is according to the following table: Score Grade 0 - 49 fail (1) 50 - 62 pass (2) 63 - 75 satisfactory (3) 76 - 88 good (4) 89 - 100 excellent (5)

Required reading materials

T. KISS, J., : Introduction to Macroeconomics for Engineers and technical Managers
Debrecen University Press, 2014. ISBN: 978 963 318 416 5
SAMUELSON P.A., NORDHAUS W.D.: Economics
18th. Academic Internet Publishers Inc., 2006. ISBN: 0072872055
PARKIN, M., POWELL, M. & MATTHEWS, K. : Economics
7th. Harlow: Addison, 2008. ISBN: 9780132041225

Subject: **TECHNOLOGY OF STRUCTURAL MATERIALS**
Year, Semester: 2nd year/1st semester
Lecture: **1**
Practical: **1**

1st week:
Lecture: Introduction to manufacturing and manufacturing processes. Production systems
Practical: Introduction of safety laboratory work.

2nd week:
Lecture: Equilibrium and non-equilibrium transformations of steel. C-curves.
Practical: Analyses of phase diagrams.

3rd week:
Lecture: The □□□ transformation's driving force behind these products properties of perlite, bainite and martensite in case of transformation.
Practical: Determination of iron–carbon phase diagrams.

4th week:
Lecture: Types of typical alloy steel and their properties.
Practical: Effects of Alloying elements

5th week:
Lecture: Annealing methods: full annealing, stress relief annealing
Practical: Heat treating processes

6th week:
Lecture: Diffusion Hardening Carburizing, Nitriding, carbonitriding
Practical: Equipment for heat treating operations

7th week:
Lecture: Direct hardening : austenitizing and quench, selective hardening
Practical: Hardening test of heat treated specimen

8th week:
Lecture: Brazing, soldering adhesive bonding
Practical: The Jominy test

9th week:
Lecture: Characterization of engineering powders. Production of metallic powders conventional and alternative pressing.
Practical: Design considerations in powder metallurgy. Materials and products for powder metallurgy

10th week:
Lecture: Quality controls and inspectionproduct quality, process of capability and tolerances, modern inspection technologies
Practical: Image processing program

11th week:
Lecture: Overview of a welding technology. A weld joint. Physics of welding. Features of a fusion-welded joint.
Practical: Different welding technologies

12th week:
Lecture: Arc welding. Resistance of welding. Oxyfuel gas welding. Other fusion-welding processes. Solid-state welding. Weld quality. Weld ability.
Practical: Machines of welding technologies.

13th week:
Lecture: Introduction to theologies of liquids and semi-solid systems and suspensions.
Practical: Measurement technologies

14th week:
Lecture: Overview of casting technologies. Solidification and cooling. Sand casting
Practical: Metal casting probe.

15th week:
Lecture: make up for laboratory practice

Requirements

Topics: Definition and classification of technological processes applied for engineering materials. Basic principles of heat treatments (phase transformations; transformation without diffusion). Hardening, tempering, annealing. Surface heat treatments (case hardening), thermo-chemical treatments (nitriding). Joining technologies and their applications. Classification of welding, major welding technologies. Heat sources, filler materials, machines for different welding technologies. Arc-welding processes (with consumable and non-consumable electrode), resistance welding, pressure welding, high energy welding, etc. Fusion welded joints (weld quality). Application fields of the various welding processes. Brazing and soldering.
For a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and not miss more than three during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't take part in a practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, being discussed with the tutor.
During the semester there are six laboratory practice tasks. The students have to prepare all the test reports of the measurements. Active participation is evaluated by the teacher in every class. If a

student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence as the lack of active participation in class. Students have to submit six test reports as scheduled minimum at a sufficient level. B, for a grade: The course ends in a final written exam which is evaluated according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5)

Required reading materials

Groover: Fundamentals of Modern Manufacturing: Materials, Processes and Systems 3rd.2007. ISBN: 978-0-471-74485-6

Department of Mechanical Engineering

Subject: **MACHINE ELEMENTS I**
Year, Semester: 2nd year/1st semester
Lecture: **3**
Practical: **2**

1st week:
Lecture: Requirements against components, stressing theories.
Practical: Issuing task 1: Designing a welded machinery base.

2nd week:
Lecture: Theory of a fatigue failure, designing a simple and a combined fluctuating load. Goodman diagram, Smith diagram.
Practical: Scathing different constructions for a welded base.Measuring the dimension of parts, calculating the tolerance and fit dimensions.

3rd week:
Lecture: Power screws and fasteners. Free body diagrams of power screws, wrench torques. Fastener materials and stress. Lap joints from bolted joints. Bolt tightening of pressure vessel caps.
Practical: Design of welded constructions. Dimensioning a welded base. Determining the friction coefficient in a bolted joint by measurement.

4th week:
Lecture: Riveted joints. Welded joints, strength of a butt and lap joint subjected to a constant load, a fatigue load and an eccentric load.
Practical: Constructing a welded base.

5th week:
Lecture: Positive and frictional torque transmitting connections. Torque capacity of keyed joints, spline joints, clamped joints.
Practical: Submitting a welded base design. Issuing a hydraulic cylinder designing task.

6th week:
Lecture: Seals, operation principles. Contacting and non -contacting seals and their application fields.
Practical: Studying the operation method of a hydraulic cylinder, determining its main dimensions.

7th week:
Lecture: Springs, tasks and operation principles of springs. Stressing of bar springs, leaf springs, multi-leaf springs, Belleville springs.
Practical: Sketching different constructions for a piston, a cap and a cover regarding sealing.

8th week:
Lecture: Mid-term test. Helical springs, designing and stressing for a fatigue load.
Practical: Sketching different constructions for a piston, a cap and a cover regarding sealing, studying similar constructions. Determining a spring diagram by measuring.
Self Control Test

9th week:
Lecture: Rubber springs, features and spring diagrams. Designing and stressing block and cylindrical rubber springs for compression, shear and torsion load.
Practical: Constructing the assembly drawing of a hydraulic cylinder.

10th week:
Lecture: Bearings, lubrication principles and methods. Heat balance and application fields of journal bearings.
Practical: Constructing the assembly drawing of the hydraulic cylinder.

11th week:
Lecture: Rolling bearings, features of different types of bearings. Separable, non separable bearings, bearing clearances (initial, mounting, working).
Practical: Elaborating the shop drawings of the parts: a piston, a piston rod, a head, and a cover.

12th week:
Lecture: Bearing arrangements. Locating, non locating bearing arrangement.
Practical: Elaborating the shop drawings of the parts: a piston, a piston rod, a head, a cover.

13th week:
Lecture: Cross located bearing arrangements with adjusted or floating bearings
Practical: Elaborating the records of stressing and design.

14th week:
Lecture: Selection of ball and roller bearings for service life.
Practical: Submitting a hydraulic cylinder task.

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: The series of lectures are based on the topics of technical drawing and mechanics. It reviews the fundamental relations of the sizing procedure of machineries (stress analysis for static combined loads; dimensioning on strength at harmonically varying loads, fatigue and life of members) and the concept of manufacturing tolerance and fitting. After that it deals with connections between components (connection with force transmission by friction, positive connections, bolted joints, weldings), gaskets, elastic connections (metal springs, rubber springs) beds for machine eg. rolling bearings, plain journal bearings. In the laboratory, being connected with the lectures machine elements are studied and tests of them are carried out. In seminars there are two design tasks to elaborate: a welded machinery base, and a hydraulic cylinder.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. Students have to submit all the two designing tasks as scheduled minimum on a sufficient level. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in an examination. Based on the average of the grades of the designing tasks and the examination, the exam grade is calculated as an average of them: - the average grade of the two designing tasks - the result of the examination The minimum requirements

for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. An offered grade: it may be offered for students if the average grade of the two designing tasks is at least good (4) and the average of the mid-term and end-term tests is at least good (4). The offered grade is the average of them.

Required reading materials

Tiba Zs.: Machine Drawing
Debrecen University Press , 2010. ISBN: 978-963-318-066-2
Joseph Shigley, Charles Mischke, Richard Budynas: Mechanical Engineering Design
7th. Hardcover , 2004. ISBN: 9780072921939
Ansel Ugural: Mechanical Design: An Integrated Approach
1st. NEW JERSEY INSTITUTE TECH, 2004. ISBN: 9780072921854

Subject: **MANUFACTURING PROCESSES II**
Year, Semester: 2nd year/1st semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Overview of Plastic Deformation of sheet metals. Stresses and shape modification during plastic deformation.
Practical: The practice classes are separated into 4 different practice types means 4x3 lecture instead of 1 lecture per week

2nd week:
Lecture: Stress tensors, stress depensity of defomation, calculation methods, scalar and vectoric methods
Practical: Machining Practice (on a turning machine)

3rd week:
Lecture: Calculation of the minimal force to plastic forming, work nneds calculations, and average stress calculation in different forming types
Practical: Gear wheel production practice (on a turning machine and a product oriented milling machine)

4th week:
Lecture: Pressing and punching techniques (extrusion, wire drawing, tube drawing, reduction)
Practical: Thread production practice

5th week:
Lecture: Technology of forging. Physical basics, and force calculation.
Practical: Sheet-metal forming practice.

6th week:
Lecture: Forward and backward tubing technics, machines, technologies.
Practical: Presenting the results of the task.

7th week:
Lecture: Splitting techniques in sheet metal forming. Machines, technologies.
Practical: Presenting the results of the task.

8th week:
Lecture: Mid-term test. Cutout and punching tools. Standard parts, basic rules of designing these elements, tool types.
Practical: Presenting the results of the task.
Self Control Test

9th week:
Lecture: Bending and deep drawing. Standard

parts, basic rules of designing these elements, tool types.
Practical: Presenting the results of the task.

10th week:
Lecture: Grouping of plastics, typical properties, application in industrial fields.
Practical: Presenting the results of the task.

11th week:
Lecture: Thermoplastics production technologies, pressing tools and design methods.
Practical: Presenting the results of the task.

12th week:
Lecture: Production technologies of thermo setting plastic types, pressing tools and design methods.
Practical: Presenting the results of the task.

13th week:
Lecture: Cutting, milling, forming machines for plastic. Design, technologies, limitations.
Practical: Presenting the results of the task.

14th week:
Lecture: Summary of forming technologies, industrial examples, case studies.
Practical: Presenting the results of the task.

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: Planning of technological methods in manufacturing. Introduction of the basic industrial design and operation documentation procedure in manufacturing. Primary forming processes (casting, powder metallurgy, metallurgical, hot forming processes). Sheet metal forming processes and its technology (volume shaping, material separation processes, sheet forming). The main methods of forging and its manufacturing processes, forging machines. Manufacturing of forming plastic, ceramic, composite, its technologies and applicable tools and machines.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation in practice classes is compulsory. A student must attend the practices and my not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Student can't make up any practice class with another group. The attendance on practice classes will be recorded by the practice leader. Being late is equal with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. Students have to submit all the tasks as scheduled minimum on a sufficient level. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in a mid-semester grade (AW5). Based on the average of the marks of the drawings and the average of the test results, the mid-semester grade is calculated as an average of them: - the grade of the drawing task - the average grade of the two tests The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, students once can take a retake test of the whole semester material.

Required reading materials

L. Edwards, M. Endean: Manufacturing with Materials
Butterworths, 1990. ISBN: 0-408-02770-3
M. F. Ashby: Materials Selection in Mechanical Design
3rd. Elsevier, 2005. ISBN: 0-7506-6168-2

S. Kalpakjian, S.R. Schmid, Chih-Wah Kok: Manufacturing Processes for Engineering Materials SI,
John A. Schey: Introduction to Manufacturing Procesesses (McGraw-Hill Series in Mechanical & Materials Science)

Subject: **TECHNICAL MECHANICS III**
Year, Semester: 2nd year/1st semester
Lecture: **1**
Practical: **1**

1st week:
Lecture: Description of the motion of the particle with scalar quantities: scalar position, velocity and acceleration, connection between the s(t), v(t) and a(t) functions, example: motion with constant velocity and acceleration
Practical: calculation of the s(t), v(t) and a(t) functions with differential and integral calculus, drawing the diagrams of the functions in simple cases

2nd week:
Lecture: Description of the motion of the particle with vector quantities: position, velocity and acceleration vector, connection between the $\bar{r}(t)$, $\bar{v}(t)$ and $\bar{a}(t)$ functions, example: motion with constant acceleration
Practical: calculation of the $\bar{r}(t)$, $\bar{v}(t)$ and $\bar{a}(t)$ functions with differential and integral calculus, solving problems for motion with constant acceleration

3rd week:
Lecture: Description of circular motion: angular position, velocity and acceleration, connections between the peripheral and angular quantities and between the □(t), □(t) and □(t) functions, the tangential and normal component of acceleration example: circular motion with constant angular velocity and acceleration
Practical: solving problems for circular motion

4th week:
Lecture: Description of the motion of the particle in Frenet frame: The concept of Frenet basis, the components of velocity and acceleration in Frenet frame
Practical: calculation of the components of velocity and acceleration in Frenet frame

5th week:
Lecture: Newton's laws of motion for particles, force formulas: Newton's laws of motion, gravitational, springs, drag and reaction forces, the differential equation of motion, example: oscillation under the effect of a linear spring
Practical: application of Newton's laws in kinetic problems

6th week:
Lecture: Theorem of kinetics for a particle, force fields: impulse-momentum and work-energy theorem, homogeneous, central and conservative force fields, the conservation of mechanical energy
Practical: application of the impulse-momentum and work-energy theorem in kinetic problems

7th week:
Lecture: Constrained motion on a given space or plane curve: Newton's second law in Frenet frame and its application for the calculation of the kinematic parameters and reaction force
Practical: application of Newton's second law in Frenet frame

8th week:
Lecture: Mid-term test I
Self Control Test

9th week:
Lecture: Translation, rotation and general plane motion of a rigid disc: Basic concepts (plane motion, rigid body and disc), description of the translation, rotation and general plane motion of the disc
Practical: solving problems for the kinematic analysis of rigid discs

10th week:
Lecture: Instantaneously centre of zero velocity and acceleration: definition and determination of the centres with calculation and construction
Practical: solving problems for the kinematic analysis of rigid discs and simple mechanisms

11th week:
Lecture: Rolling without slipping: definition and kinematic conditions, formulas for the velocity and acceleration of the centre of curvature of a rolling curve
Practical: solving problems for the kinematic analysis of simple mechanisms containing rolling parts

12th week:
Lecture: Basic concepts for the kinetics of rigid bodies and discs: centre of mass, momentum, angular momentum, moment of inertia and kinetic energy, the Huygens-Steiner theorem, calculation of moment of inertia
Practical: calculation of the moment of inertia of rigid discs

13th week:
Lecture: Newton's laws for bodies, theorem of kinetics for rigid discs: Newton's laws for bodies, impulse-momentum, angular momentum and work-energy theorem for the plane motion of rigid bodies
Practical: application of Newton's laws and the theorem of kinetics for the plane motion of rigid bodies

14th week:
Lecture: Examples on rotation about a fixed axis, rolling, sway motion
Practical: application of Newton's laws and the theorem of kinetics for rotational, rolling and sway motion

15th week:
Lecture: Mid-term test II
Self Control Test

Requirements

Topics: Kinematics of particles: description of motion with scalar and vector quantities, examples (free motion with constant acceleration, circular motion), the Frenet-Serret frame. Kinetics of particles: Newton's laws for particles, force formulas (gravitational, spring, drag and reaction forces), the differential equation of motion, the impulse-momentum and work-energy theorems, homogeneous, central and conservative force fields, the concept and calculation of potential energy. Kinematics of plane motion of rigid bodies: Basic concepts, velocity and acceleration analyses of translation, rotation and general plane motion, instantaneous centre of zero velocity and acceleration, rolling without slipping, presenting general plane motion as rolling. Kinetics of plane motion of rigid bodies: basic concepts (centre of mass, momentum, angular momentum, moment of inertia and kinetic energy), the Huygens-Steiner theorem, calculation of moment of inertia, Newton's laws for bodies, impulse-momentum, angular momentum and work-energy theorem for the plane motion of rigid bodies, rotation about a fixed axis, rolling and sway motion.
For a signature: Attendance at lectures and practice classes is compulsory. A student mustn't miss more than three times of lectures and practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice with another group. Attendance at lectures and practice classes will be recorded by the lecturer. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his or her participation as an absence because of the lack of active participation in class.
Everybody has to write two midterm tests during the semester. The first (40 points max) in the 8th, the second (40 points max) in the 14th week. At the end of the semester everybody will get a seminar grade on the basis of the table below: Fail (1) 0-39 Pass (2) 40-50 Satisfactory (3) 51-60 Good (4) 61-70 Excellent (5) 71-80 If somebody fails them he or she has to write both tests in the

1st week of the exam period again. If the result is 40 points (50%) or better, then he or she can take an exam. If somebody has to repeat his or her midterm tests his seminar grade can't be better than (2). There will be homework from week to week. Only students who have handed in all their homework at the time of the midterm test will be allowed to write it. The problems in the midterm tests will be selected from the homework assignments. B, for a grade: For their exam everybody will get an exam grade (ESE). The final grade will be the average of the seminar and exam grade. If it is for example (3.5) then the lecturer decides if it is (3) or (4).
An offered grade: -

Required reading materials

Joseph F. Shelley : 700 solved problems in vector mechanics for engineers, Volume II: Dynamics. (SCHAUM'S SOLVED PROBLEM SERIES)
McGraw-Hill, 1990. ISBN: 0-07-056687-9
Russel C. Hibbeler : Engineering Mechanics – Statics and Dynamics
Prentice Hall, 2006. ISBN: 9780132215091
Ferdinand P. Beer, E. Russell Johnston, Jr.: Mechanics for Engineers: Statics and Dynamics (Package)
4th. University of Connecticut, 1987.

Department of Electrical Engineering and Mechatronics

Subject: **ELECTROTECHNICS AND ELECTRONICS II**
Year, Semester: 2nd year/2nd semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Pure and doped semiconductor characteristics, behavior of a PN junction at forward and reverse bias conditions.
Practical: Safety regulations, laboratory orders, the use of measuring instruments.

2nd week:
Lecture: Characteristics and applications of semiconductor diodes, a rectifier circuit operation, one-way, two-way rectifier circuit operations.
Practical: Silicon diode opening and closing characteristics measurements.

3rd week:
Lecture: Bipolar transistor structure, gain, transistor parameters and characteristics, the FE connection, adjusting the set point.
Practical: analysis of rectifier circuits

4th week:
Lecture: Areas of application of bipolar transistors, circuit transistor basic (CB, CC circuits), Principles of operation of field-effect transistors.
Practical: analysis of common emitter basic circuits

5th week:
Lecture: Feedback concepts, types and implementation. Operational amplifier model structure (differential amplifier, level transmitting amplifiers) and features.
Practical: measurements of emitter follower type transistor stabilizers

6th week:
Lecture: Operation and characteristics of basic operational amplifier circuits (inverting, non-inverting, follower basic circuits)
Practical: analysis of phase inverting operational amplifier basic circuits

7th week:
Lecture: Boolean logic functions and the concept of electrical realization of Boolean algebra, basic logic circuits.
Practical: measurements of an adder circuit

8th week:
Lecture: Mid-term testCombinational network's characteristics, its implementation and simplification.
Practical: NOT and NAND logic circuits, taking up a truth table.
Self Control Test

9th week:
Lecture: MSI combinational circuits and their application.
Practical: Testing of OR and NOR logic circuits.

10th week:
Lecture: Basics of pulse techniques circuits.
Practical: Measurement of multiplexer and de-multiplexer circuits.

11th week:
Lecture: Features of sequential networks basic sequential circuits (flip-flop's) characteristics, implementation of storage,assessment of counter functions.
Practical: examination of a stable multivibrator

12th week:
Lecture: Description of MSI sequential circuits, synchronous and asynchronous counters, registers).
Practical: Measurements of binary counter.

13th week:
Lecture: AD / DA converters, semiconductor memory circuits (RAM, ROM circuits)
Practical: Testing D / A converters

14th week:
Lecture: Microprocessors and block schematic structures of microcomputers.
Practical: Substituting measurement dates.

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: Introduction: electronics circuits, components, introduction to mechatronics systems. Signals: Sinusoidal waves, periodic and quasi-periodic signals. Amplifiers: a 4 port theory, transfer functions, feedback: positive and negative. Common emitter amplifier. Differential amplifiers: operational modes, circuits. Class A and AB amplifiers. Power amplifiers. Operational amplifiers: inverting and non-inverting types. Regulated power supplies: linear regulators, zener diode. AC-DC converter: a non-controlled one phase, a controlled three phase. DC-AC converters: one and three phase converters. Oscillators: RC and LC oscillators. Si oscillators. Filters: Low and high pass filters, band pass filter.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice with another group. Attendance on practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, to be discussed with the tutor. Students are required to bring the necessary utensils (e.g. calculator) for the course to each practice class. Active participation is evaluated by the teacher in every class. If student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate their participation as an absence due to the lack of active participation in class. During the semester there are two tests: the mid-term test is in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in an exam (ESE), the grade is calculated as: - 60% from the exam - 20%-20% from the two tests The minimum requirement for passing is 60%, the grade for the final

mark is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, the student once can take a retake test of the whole semester material.

Required reading materials

U. Tietze, Ch. Schenk: Electronic Circuits: Handbook for Design and Application
2nd.2008. ISBN: 3540004297

Subject: **MEASUREMENT AND AUTOMATICS I**
Year, Semester: 2nd year/2nd semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Basic concepts of measurement. Sensors (sensors) and transducers. The sensors are grouped. The structure and characteristics of the measuring apparatus. Measurement Systems. Measurement errors. Measurement methods.
Practical: General description about laboratory regulations. Accident prevention and safety education.

2nd week:
Lecture: Theoretical basis of inductivity sensors. Different types of inductive sensors (differential coil sensor, FLDT, LVDT, proximity sensors) modes of operation and signal processing.
Practical: Measurement of inductive position sensor.

3rd week:
Lecture: Theoretical basis of Light electric effect sensors. The photodiode and photovoltaic structure, modes of operation and application. Multi-color LEDs. The structure and characteristics of optical interfaces. The scanner structure and characteristics of CCD sensors.
Practical: Examination of solar cell.

4th week:
Lecture: Types of photo resist and application. The structure and features of a phototransistor. The structure and use of a light pencil. The structure, characterization and application of a liquid crystal display.
Practical: Measurement of LED characteristics.

5th week:
Lecture: Measuring elastic deformation instruments. Piezoelectric and piezoresistive sensors. Elastic deformation measuring instruments. Bellows. Microelectronic capacitive pressure sensors. PN-gradient sensors and the MOSFET structure.
Practical: Measurement of elastic deformation.

6th week:
Lecture: Thermoelectric sensors. The operating principles, construction and characteristics of an infrared motion sensor. Thermoelectric transducer coupling, the PVDF film. Thermocouples, semiconductor structure, function and features of metal thermometers and other thermometers.
Practical: Measurement of temperature.

7th week:
Lecture: An optical gate. Its structure, working principle and characteristics and application areas.
Practical: Measurement of an optical gate.

8th week:
Lecture: Mid-term test
Self Control Test

9th week:
Lecture: A capacitive proximity switch. Its structure, working principle, characteristics and application areas.
Practical: Measuring of capacitive proximity switch.

10th week:
Lecture: Ultrasonic sensors. Their structures, working principles, characteristics, and application areas.
Practical: Measuring of an ultrasonic distance sensor.

11th week:
Lecture: Strain gages. Foil strain gauges, semiconductor strain gauge, strain sensor wires, one, two and four-sensing bridge circuits.
Practical: Measuring of strain gages.

12th week:
Lecture: The Reed switch and magneto inductive sensors. Their structures, working principles, characteristics and Application areas.
Practical: Measuring of reed switch.

13th week:
Lecture: Description of the main features of the NI LabVIEW software.
Practical: Preparation degrees Fahrenheit conversion program by LabVIEW.

14th week:
Lecture: Structure of the NI data acquisition systems. DAQ connecting to your computer.
Practical: Recording and evaluation of data measured by National Instruments Hardware

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: Basic Concepts of Measurement, measurement systems. Measuring instrument designs, measurement instruments. Electromechanical and electronic instruments. Digital instrumentation. Microelectronic sensors. Elastic deformation gauges. Temperature, light and radiation sensors. Fiber optic sensors. Signal processing systems. Pressure, temperature, strain and rotational movement measurement using National Instruments LabVIEW software.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with absence. Missed practices should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his or her participation as an absence because of the lack of active participation in the class. Students have to submit all the twelve reports as scheduled minimum at a sufficient level. During the semester there is one test: the end-term test in the 15th week. Students have to sit for this test.
B, for a grade (ESE): At the end of the course an oral exam must be taken. Based on the average of the grades of the reports and the test results, the mid-semester grade is calculated as an average of them: - the average grade of the twelve reports (30 %) - the grade of the tests (20 %) - the oral exam (50 %) The minimum requirement for end-term test is 60%. Based on the score of the test separately, the grade for the test is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5)

Required reading materials

David G. Alciatore, Michael B. Histand: Introduction to mechatronics and measurement systems
1st. McGraw-Hill, 2013. ISBN: 978-0073380230
U. A. Bakshi – V.U. Bakshi: Electronic Measurement and Instrumentation
1st. Technical Publications Pune, 2009. ISBN: 9788184315295

Subject: **MECHATRONICS I**
Year, Semester: 2nd year/2nd semester
Lecture: **1**
Practical: **2**

1st week:
Lecture: Development of pneumatics. Compressed air properties. Pneumatic equipment economy. State equation of gases.
Practical: General descriptions, laboratory regulations. Accident prevention and safety education.

2nd week:
Lecture: Compressed air production. Compressed air supply. Compressed air preparation.
Practical: Recognizing of the physical elements. Description of symbols in technical drawing.

3rd week:
Lecture: Pneumatic actuators (structure-cylinder, rotary actuators, sizing cylinders).
Practical: Actuator elements direct operation in real and FluidSIM software environment.

4th week:
Lecture: Generally about valves (way-, closing-, pressure managing-, stop-, time-).
Practical: Actuator elements actuation via indirect valves.

5th week:
Lecture: Basic circuit (single- and double acting cylinder controlling, control with And-Orelements, increase speed)
Practical: Implementation of logical circuits, speed controls in real environment and FluidSIM software.

6th week:
Lecture: Pneumatic-electric transducers, relays.
Practical: Implementation of complex control exercises in real environment and FluidSIMsoftware.

7th week:
Lecture: The basic concepts of a control technology. Pneumatic and electro-pneumatic controls. Basics of electricity.
Practical: Understanding Electro-pneumatic devices in real and FluidSIM software environment.

8th week:
Lecture: Mid-term test
Self Control Test

9th week:
Lecture: Basics of electricity. The electrical power supply. Electric transducers, signal processors. Buttons, switches.
Practical: Saw machine exercises.

10th week:
Lecture: Sensors. Relays and contactors. Freely programmable controllers (PLC).
Practical: Package lift machineexercise.

11th week:
Lecture: Electrically operated valves. Usage of solenoid valves and structures. Construction methods.
Practical: Slotting machine exercises.

12th week:
Lecture: Relay controls. Relay controls applications. Direct and indirect control. Logic controls. Signal storage with relay.
Practical: Sheet beading machineexercise.

13th week:
Lecture: Time tracking controls. Workflow controls. Pneumatic drives. Sensors. Signal processing.
Practical: Expanding machine exercises.

14th week:
Lecture: Electric drive proportional pneumatics. Proportional pressure control valves. Proportional valves.
Practical: Cascade controlling exercises.

15th week:
Lecture: End-term test

Self Control Test

Requirements

Topics: Development of pneumatics. Producing compressed air. Pneumatic actuators. Valves in general. Basic circuits. Pneumatic-electric transducers. Pneumatic and electro-pneumatic controls. Electric transducers, signal processors. Relays and protective relays. Electrically operated valves. Direct and indirect controls. Logic controls. Time tracking controls. Workflow controls. Electric drives. Proportional pneumatics. Proportional directional control valves.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice with another group. The attendance on practice will be recorded by the practice leader. Being late is counted as an absence. Missed practices should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his or her participation as an absence because of the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in a mid-semester grade (AW5). Based on the average of the marks of the drawings and the average of the test results, the mid-semester grade is calculated as an average of them: - the average grade of the two tests The minimum requirements for the mid-term and end-term tests are 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5)

Required reading materials

Peter Croser, Frank Ebel: Pneumatics Basic Level
Festo Didactic GmbH and Co., 2002.
G. Prede, D. Scholz: Electropneumatics Basic Level
Festo Didactic GmbH & Co., 2002.

Subject: **PROGRAMMING AND DIGITAL TECHNIQUES I**
Year, Semester: 2nd year/2nd semester
Practical: **2**

1st week:
Practical: Preparation, Course-up, description of subject requirements, course schedule description, description of the course literature list

2nd week:
Practical: Embedded systems, Microcontroller, software development environments, debugging (debug) solutions sw simulation, ICD: In-Circuit Debugger ICE: In-circuit Emulation

3rd week:
Practical: Microcontroller families: 8, 16 and 32-bit microcontrollers. Using development environments and tools.

4th week:
Practical: Steps of the program development and documentation: - Preparation of the specification: Define the outside world, user communication, timing and reaction time. - Documentation - Program documentation methods: a source code level (commentary and headers), a high level (flowchart communication

diagram)

5th week:
Practical: C Programming Language Reference: - Simple data structures, assignment, type conversion - Operators and Precedence

6th week:
Practical: Cycles: - While cycle- For loop - Do-while loop - Break and continue

7th week:
Practical: Conditional statement: - IF - ELSE - SWITCH - CASE

8th week:
Practical: Midterm exercise
Self Control Test

9th week:
Practical: Arrays, strings, multidimensional arrays, Indicators. Pointer arithmetic, arrays relationship

10th week:
Practical: Dynamic memory management,complex data structures: structures, typed ef and enum

11th week:
Practical: Functions: defining, declaration, parameter passing, a recursive function call, function pointers

12th week:
Practical: Variables visibility and lifetime

13th week:
Practical: Following treatment of microcontroller peripherals examples I (eg, DIO, ADC, DAC, PWM)

14th week:
Practical: Following treatment of microcontroller peripherals examples I (eg UART, SPI, LCD)

15th week:
Practical: End-term task
Self Control Test

Requirements

Topics: Introduction to the microcontroller programming and digital techniques. Introduction to MPLAB programming environment, C programming language and their typical properties. Programming in practice: interrupts, timers, pulse-width modulation, analogue-digital converter.
A, for a signature: Attendance at lectures is compulsory.
B, for a mid semester-grade: Students have to fulfil a mid-term exercise at least for 50% to take part in the next lectures. All students, who failed the mid-term exercise will not get a mid-semester grade. At the end of the semester, all the students have to solve a real life problem in programming. Also a task, to make a complete documentation of a project file, using all the methods, mentioned during the session. The course ends in a mid-semester grade (AW5). Based on the average of the marks of the tasks.

Department of Engineering Management and Enterprise

Subject: **MICROECONOMICS**
Year, Semester: 2nd year/2nd semester
Lecture: **1**
Seminar: **2**

1st week:
Lecture: Demand and supply analyses. Demand curves, Supply curves; demand, supply and market equilibrium; shift in demand and supply.

Seminar: Calculating problems: equilibrium price and quantity; market demand and individual demand; shifts versus movements along the demand curve (supply curve); market supply and individual supply; shifts versus movements along the supply curve.

2nd week:
Lecture: Consumer theories, consumer preferences, cardinal ranking. Total utility, marginal utility. Principle of diminishing marginal utility. Indifference curves, diminishing marginal rate of substitution.
Seminar: Calculating problems: marginal utility, marginal rate of substitution. Indifference curves with diminishing (increasing marginal rate of substitution).

3rd week:
Lecture: Consumer choice, the budget constraint, budget line, optimal choice. The effects of a change in price, demand curve, the effects of a change in income, Engel curve. Income and substitution effect.
Seminar: Calculating problems: determination of optimal choice, consumption basket, income and substitution effects. Understanding consumer surplus.

4th week:
Lecture: The elasticity of demand (price elasticity of demand, cross price elasticity of demand, income elasticity of demand). The elasticity of supply. Total revenue and the price elasticity of demand.
Seminar: Application of elasticity of demand. Energy and price elasticity. Types of goods (substitutes, complements, independents).

5th week:
Lecture: Production. Inputs and production functions. Total product functiosn. Marginal and average product of labour.
Seminar: Calculating problems (average product of labour (capital), marginal products of labour (capital), relationship between marginal products and average products.

7th week:
Lecture: Costs of production. (Total, fixed and variable costs, marginal and variable cost). Relationship between marginal and average cost. Total revenue, total profit curves.
Seminar: Costs of production. (Total, fixed and variable costs, marginal and variable cost). Relationship between marginal and average cost. Total revenue, total profit curves.

8th week:
Lecture: Perfectly competitive markets I. (main characteristics of perfect competition, profit-maximizing output, shut down and breakeven points, the competitive firm's supply curve.
Seminar: Calculating problems (marginal average, total revenue, average and marginal profits, profit-maximizing outputs, the marginal cost curve and the supply curve. Determination of the shut down and breakeven points.

9th week:
Lecture: Competitive markets II. Taxes and subsidies. Price ceilings, production quotas, tariffs.
Seminar: Calculating problems (consumer surplus, producer surplus – tariffs, quotas).

10th week:
Lecture: Monopoly (the profit-maximization condition; average revenue, marginal revenue, total revenue curves).
Seminar: Problems (calculation of the profit-maximization output and price. Relationship between the marginal revenue and the linear demand curve).

11th week:
Lecture: First-degree price discrimination, second-degree price discrimination and third-degree price discrimination. Consumer surplus, producer surplus, deadweight loss.
Seminar: Monopoly equilibrium versus perfectly competitive equilibrium.

12th week:
Lecture: Market structure and competition. The main characteristics of oligopoly and monopolistic competition.
Seminar: Comparative analyses.

13th week:
Lecture: Time value of money. Present value calculation, net present value, profitability index.
Seminar: Analysing of an investment possibility. Net present value calculation.

14th week:
Lecture: Payback period and discounted payback period.
Seminar: Analysis of investment possibilities. Annuities.

15th week:
Lecture: End-term test

Requirements

Topics: This course aims to make students familiar with the basic concepts of microeconomic analysis. In particular, the course will be focused on the analysis of how economic actors, consumers and firms choose between different alternatives. By the end of the course, the student should be able to use the basic tools and models of microeconomics, and apply them in solving problems. The course focuses on the theory and application of the following: The basics of supply and demand. Market equilibrium. Elasticity of demand (supply). Consumer behavior - Households' choices (Marginal utility theory, indifference (curve) analysis. Firm's production (factors), costs of production, profit-maximizing behavior. Market structures (perfect competition, imperfect competition: monopoly, oligopoly, monopolistic competition). Profit maximizing under perfect competition, and monopoly. Investment, interest, profits and capital.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice with another group. The attendance on practice will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his or her participation as an absence due to the lack of active participation in class. During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in a mid-semester grade (AW5). The mid-semester grade is calculated as an average of the test results. The minimum requirement for the mid-term and end-term tests is 50%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0 - 49 fail (1) 50 - 62 pass (2) 63 - 75 satisfactory (3) 76 - 88 good (4) 89 - 100 excellent (5) If the score of any test is below 50, the student once can take a retake test of the whole semester material.

Required reading materials

1. BESANKO, DAVID – BREAUTIGAM, RONALD R.: Microeconomics (International Student version)
3rd. John Wiley and Sons, Inc., 2008.
2. BESANKO, DAVID – BREAUTIGAM, RONALD R.: Microeconomics Study Guide
3rd. John Wiley and Sons, Inc., 2008.
GREGORY MANKIW: Principles of Microeconomics
4th. South-Western College Publishing, 2006.
GREGORY MANKIW: Principles of Microeconomics - Study Guide
Western College Publishing, 2006.

Department of Mechanical Engineering

Subject: **ENGINEERING ETHICS**
Year, Semester: 2nd year/2nd semester
Lecture: **2**

1st week:
Lecture: The code of engineering ethics. Rights to engineering services.

2nd week:
Lecture: An engineer's obligations to society. Obligations to his/her profession, employers and clients.

3rd week:
Lecture: Roles of engineering societies in ethics.

4th week:
Lecture: Ethical behavior versus management. Internal and external procedures for considering dissenting views.

5th week:
Lecture: Case studies. Discussing and analyzing the case studies in terms of engineering ethics.

6th week:
Lecture: Case studies. Discussing and analyzing the case studies in terms of engineering ethics.

7th week:
Lecture: Case studies. Discussing and analyzing the case studies in terms of engineering ethics.

8th week:
Lecture: Case studies. Discussing and analyzing the case studies in terms of engineering ethics.

9th week:
Lecture: Case studies. Discussing and analyzing the case studies in terms of engineering ethics.

10th week:
Lecture: Case studies. Discussing and analyzing the case studies in terms of engineering ethics.

11th week:
Lecture: Case studies. Discussing and analyzing the case studies in terms of engineering ethics.

12th week:
Lecture: Case studies. Discussing and analyzing the case studies in terms of engineering ethics.

13th week:
Lecture: Case studies. Discussing and analyzing the case studies in terms of engineering ethics.

14th week:
Lecture: Case studies. Discussing and analyzing the case studies in terms of engineering ethics.

15th week:
Lecture: Case studies. Discussing and analyzing the case studies in terms of engineering ethics.

Requirements

Topics: This course is intended to introduce students to the study of ethics, the branch of philosophy that aims to understand what actions are right and wrong, what states of affairs are good and bad, and what traits of personality are desirable and undesirable. Our central question will be "What should I (morally) do?" Similarly, although it is impossible to separate the discussion of ethical theories from their application to particular moral problems, this course will emphasize the former. The most well-developed and carefully formulated ethical theory that addresses our central question is utilitarianism: what I should do to make the world a better place. In the second half of we review of the growth and development of professions, engineering ethics, obligations to employers and their peers, limits of professional responsibility, codes of ethics and enforcement. Traditional function of engineering societies. Ethical engineers and the lows, the public interest analyzing some case studies.

A, for a signature: Participation at lectures is compulsory. Students must attend the lecture and may not miss more than three practice during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a lecture with another group. Attendance at lecture will be recorded by the lecturer. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed lectures should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the lecture in every lecture. If a student's behavior or conduct doesn't meet the requirements of active participation, the lecturer may evaluate his/her participation as an absence because of the lack of active participation in class. Each student must give one short presentation about a case study during the semester. The presenter has to show his or her ability to present the case study clearly, focuses on the most important parts in a concise manner and answers the questions raised by the audience or the lecturer. Student has to analyze his or her case study in terms of ethical behavior, obligation to the profession, to the society, to the employer and the client.
B, for a grade: The course ends in an examination (ESE). Based on the grades of the presentation and the examination, the exam grade is calculated as an average of them: The minimum requirement for the examination is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any tests is below 60, the student can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. An offered grade: it may be offered for students if the grade of the presentation is at least satisfactory (3).

Required reading materials

Charles E. Harris, Michael S. Pritchard, Michael J. Rabins: Engineering Ethics: Concepts and Cases
2008.

Subject: **MACHINE ELEMENTS II**
Year, Semester: 2nd year/2nd semester
Lecture: **2**
Practical: **2**

1st week:
Lecture: Energy equilibrium of braking processes. A mechanical model of a winch crane.
Practical: Issuing task 1: Designing an external double-shoe thruster released a drum brake.

2nd week:
Lecture: Calculation of an external shoe drum brake, a serviceable diagram. Designing a brake spring and choosing its thruster.
Practical: Scathing different constructions for brake actuation.

3rd week:
Lecture: Derivation of the braking moment capacity of an internal shoe drum brake, band brakes and disc brakes and clutches. A uniform wear model, a uniform pressure model.
Practical: A service diagram of a brake: maximum brake moment, maximum drum speed, checking for heat generation. Designing the brake spring, selecting the brake thruster.

4th week:
Lecture: Designing steps of an external shoe thruster released drum brake.
Practical: Constructing a brake assembly drawing.

5th week:
Lecture: Couplings, rigid couplings, flexible couplings, universal joints. Supplementary loads on shafts having misalignment.
Practical: Submitting a brake design. Issuing a

counter drive designing task.

6th week:
Lecture: Belt drives. Flat, round, V and timing belts. Forces on a belt, optimal belt speed. Belt drive arrangements, selection procedure of a belt profile, designing a belt drive.
Practical: Designing the layout of a counter drive. Dividing the total speed ratio for a belt drive and for a chain drive.

7th week:
Lecture: A chain drive. Types and application fields of chains, chordal action. Designing a chain drive, selecting a chain from brand catalogue.
Practical: Designing a belt and a chain drive of a counter drive.

8th week:
Lecture: Mid-term test. A shaft and its associate parts. Designing a shaft and stressing against fatigue, plastic deformation, elastic deflection and critical speed.
Practical: Designing a counter shaft and its keyed joints. Stressing a shaft and checking against fatigue and plastic deformation.
Self Control Test

9th week:
Lecture: Gears, types of gears. Nomenclature of a spur gear. Involving gears. A standard basic rack tooth profile.
Practical: Designing a counter shaft bearing. Selecting ball bearings.

10th week:
Lecture: Unmodified, modified gear pairs, addendum modification.
Practical: Constructing an assembly drawing of a counter drive.

11th week:
Lecture: Definition of a modified gear's dimensions.
Practical: Elaborating an assembly drawing. Designing a chain drive chasing.

12th week:
Lecture: Checking gears for crest width, contact ratio and undercut.
Practical: Elaborating the shop drawing of the parts: a shaft, a pulley, a sprocket, a bearing house.

13th week:
Lecture: Load bearing capacity of a gear.
Practical: Elaborating the shop drawing of the parts: a shaft, a pulley, a sprocket, a bearing house.

14th week:
Lecture: Resistance to pitting, tooth root bending.
Practical: Submitting the Counter Drive task.

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: The series of lectures review types of couplings, clutches and breaks and their sizing. It deals with classification and sizing of shafts, gives review of the components of drive chains, and the construction of a drive chain: Operation methods of a belt and a chain drive, mechanical relations of a sizing procedure. After that it deals with the types of gearing, gear tooth geometry, load capacity of gears, design of geared transmission. In the laboratory, connected to the lecture the machine elements are studied and tests of them are carried out. In seminars there are two design tasks to elaborate: an external long-shoes drum break, and a counterdrive containing a V-belt drive and a chain drive.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice class with another group. Attendance at practice will be recorded by the practice leader. Being late is equivalent with an

absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments for the course with them to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate their participation as an absence because of the lack of active participation in class. Students have to submit all the two designing tasks as scheduled minimum on a sufficient level. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in an examination (ESE). Based on the average of the grades of the designing tasks and the examination, the exam grade is calculated as an average of them: - the average grade of the two designing tasks - the result of the examination The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. An offered grade: it may be offered for the students if the average grade of the two designing tasks is at least good (4) and the average of the mid-term and end-term tests is at least good (4). The offered grade is the average of them.

Required reading materials

Tiba Zs.: Machine Drawing
Debrecen University Press , 2010. ISBN: 978-963-318-066-2
Joseph Shigley, Charles Mischke, Richard Budynas: Mechanical Engineering Design
7th. Hardcover , 2004. ISBN: 9780072921939
Ansel Ugural: Mechanical Design: An Integrated Approach
1st. NEW JERSEY INSTITUTE TECH, 2004. ISBN: 9780072921854

Subject: **TECHNICAL MECHANICS IV**
Year, Semester: 2nd year/2nd semester
Lecture: **1**
Practical: **1**

1st week:
Lecture: Description and classification of vibratory motions and vibrating systems. Basic definitions and properties of vibratory motion.
Practical: Generation and analytical solution of the motion equations to a single degree of freedom undamped and damped vibrating systems.

2nd week:
Lecture: Investigation of the elements of vibrating systems 1: masses and inertial elements.
Practical: Reduction of masses. Replacement of rigid bodies by lumped masses.

3rd week:
Lecture: Investigation of the elements of vibrating systems 2: flexible and damping elements.
Practical: Reduction of springs and damping elements.

4th week:
Lecture: External excitation effects: force excitation, inertial (unbalance) excitation, ground motion excitation.
Practical: Calculations about excitation effects.

5th week:
Lecture: Opportunities of the model investigations. Two ways of motion equation generation: the D'Alembert's principle and the Lagrange equations of motion.
Practical: Generating the motion equation of a single DOF damped linear system; solving the motion equation using the phase plane method.

6th week:
Lecture: Investigation and properties of the excited vibrations of single DOF undamped and damped systems.
Practical: Calculation examples of several kinds of excited vibrations in case of single DOF undamped and damped systems 1.

7th week:
Lecture: Investigation of the excited vibrations. Basic types of excited vibrating systems.
Practical: Calculation examples of several kinds of excited vibrations in case of single DOF undamped and damped systems 2.

8th week:
Lecture: Mid-term test
Practical: Summary of the first part of lectures and practices.
Self Control Test

9th week:
Lecture: Multiple DOF systems: introduction; generation of the motion equations; basic properties.
Practical: Calculation examples about the motion equation generation of multiple DOF systems 1.

10th week:
Lecture: Properties of multiple DOF systems: natural frequencies and modes.
Practical: Calculation examples about the motion equation generation of multiple DOF systems 2.

11th week:
Lecture: Investigation and of the excited vibrations of multiple DOF systems using Laplace transformation.
Practical: Calculation examples about Laplace transformation.

12th week:
Lecture: Application of the impulse response function (IRF) and convolution theorems. Transfer functions.
Practical: Calculation of transfer functions in case of actual systems.

13th week:
Lecture: Simulation of single and multiple DOF systems. Introduction of Runge-Kutta methods.
Practical: Introduction of Matlab-Simulink.

14th week:
Lecture: Simulation of single and multiple DOF systems. Generation of the block diagram of systems.
Practical: Using of Matlab-Simulink in case of vibrating systems.

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: This course presents periodic motion machines and investigates harmonic vibratory motion mathematically. The series of lectures cover the following topics: properties of vibrating systems; single-degree-of-freedom vibrating systems; free, undamped vibrations; pendulums; damped vibrations (dry friction, viscous damping); forced (harmonically excited) vibrations of undamped and damped mechanical systems; isolation of vibrations; multiple-degrees-of-freedom systems; application of Langrange's equation; natural frequencies and vibration modes; normal mode analyses; approximate solutions to the equations of motion: the Runge-Kutta method; simulation methods for vibrating systems: usage of MATLAB Simulink; operation principle of the oscillation measuring apparatus.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more

than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice with another group. Attendance at practice will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in a mid-semester grade (AW5) based on the average grade of the two tests. The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, the student once can take a retake test of the whole semester material.

Required reading materials

Meirovitch, Leonard: Fundamentals of Vibration
McGraw-Hill Publishing Company, 2000. ISBN: 0071181741

Department of Building Services and Building Engineering

Subject: **BUILDING PHYSICS**
Year, Semester: 3rd year/1st semester
Lecture: **2**
Seminar: **1**

1st week:
Lecture: Effects of climate conditions on the energy demand of buildings (temperature, humidity, wind, solar radiation).
Seminar: Effects of climate conditions on the energy demand of buildings (temperature, humidity, wind, solar radiation).

2nd week:
Lecture: Humid indoor air (absolute humidity, relative humidity, enthalpy, a dew point, psychometric chart).
Seminar: Humid indoor air (absolute humidity, relative humidity, enthalpy, a dew point, psychometric chart).

3rd week:
Lecture: A degree day, specific heat loss, temperature distribution in the building elements. Surface temperatures.
Seminar: A degree day, specific heat loss, temperature distribution in the building elements. Surface temperatures.

4th week:
Lecture: Thermal bridges. Two and three dimensional heat transfer. Linear heat transfer coefficient. Surface condensation.
Seminar: Thermal bridges. Two and three dimensional heat transfer. Linear heat transfer coefficient. Surface condensation.

5th week:
Lecture: Thermal insulation materials. Advantages, disadvantages. Built-in possibilities and technologies
Seminar: Thermal insulation materials. Advantages, disadvantages. Built-in possibilities and technologies

6th week:
Lecture: Sorption. Capillary condensation. Mould. Protection measures.
Seminar: Sorption. Capillary condensation. Mould. Protection measures.

7th week:
Lecture: Vapor diffusion through porous media.

Partial pressure distribution in building elements. Verification of building elements for vapor diffusion.
Seminar: Vapor diffusion through porous media. Partial pressure distribution in building elements. Verification of building elements for vapor diffusion.

8th week:
Lecture: A non-steady state heat transfer. Retardation time. Mitigation of temperature oscillation.
Seminar: A non-steady state heat transfer. Retardation time. Mitigation of temperature oscillation.

9th week:
Lecture: Heat storage. Specific heat. Storage capacity. Thermal mass. Effect of thermal insulation on heat storage.
Seminar: Heat storage. Specific heat. Storage capacity. Thermal mass. Effect of thermal insulation on heat storage.

10th week:
Lecture: Heat losses of a building. Transmission losses. Filtration losses. Heat loss coefficient. Room time constant.
Seminar: Heat losses of a building. Transmission losses. Filtration losses. Heat loss coefficient. Room time constant.

11th week:
Lecture: Energy balance of opaque building elements. Energy balance of transparent building elements. Greenhouse effect.
Seminar: Energy balance of opaque building elements. Energy balance of transparent building elements. Greenhouse effect.

12th week:
Lecture: Solar gains. A shadow mask of a transparent surface. Cylindrical sun path diagrams.
Seminar: Solar gains. A shadow mask of a transparent surface. Cylindrical sun path diagrams.

Requirements

Topics: overall heat transfer coefficient of building elements, heat losses and gains through building elements, humid air, moisture in buildings, sorption, surface and capillary condensation, thermal mass, heat storage, energy balance of opaque and transparent building elements, heat demand of buildings.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't make up a practice with another group. The practice leader records the attendance. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Students are required to bring calculator to each practice. The activity of participation is evaluated by the teacher. If student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate their participation as an absence due to the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to obtain at least grade 2 (pass) for the tests.
B, for a grade (ESE): The examination consists of two parts: • Two exercise tests during the semester. (50%) • 2 hours theory test. (50%) The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, the student once can take a retake test covering the whole semester material.

Required reading materials

Johannesson G.: Building Physics
Terc Kft., 2013.
H. Hens Building Physics : Heat, Air and Moisture: Fundamentals and Engineering Methods with Examples and Exercises
Ernst & Sohn, 2012.
C. E Hagentoft: Introduction to Building Physics
Studentlitteratur AB, 2011.

Subject: **BUILDING SERVICE SYSTEMS I**
Year, Semester: 3rd year/1st semester
Lecture: **2**

1st week:
Lecture: Components and materials of gas transportation systems.

2nd week:
Lecture: Conception and steps of planning gas supply systems of buildings.

3rd week:
Lecture: Components and materials of heating systems.

4th week:
Lecture: Types of heating systems: individual and central heating systems, radiation heating.

5th week:
Lecture: Conception and steps of planning heating systems of buildings. Operation of heating systems.

6th week:
Lecture: Components and materials of ventilation and air conditioning systems.

7th week:
Lecture: Types of ventilation systems. Conception and steps of planning ventilation and air conditioning systems of buildings.

8th week:
Lecture: Drinking water quality. Requirements. Drinking water sources.

9th week:
Lecture: Conception and steps of planning drinking water supply systems of buildings.

10th week:
Lecture: Water supply systems for high buildings. Sewage systems.

11th week:
Lecture: Local and central preparation of hot water.

12th week:
Lecture: Hot water preparation equipment, storage tanks.

Requirements

Topics: Theory of gas supply systems, heating systems, ventilation and air conditioning systems, cold and hot water systems, sewage systems.
A, for a signature: Attendance at lectures is recommended, but not compulsory. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade (ESE): Examination consists of two parts: • Two exercise tests during the semester. • a 20–minute long theory test. The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the

following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, the student once can take a retake test covering the whole semester material.

Required reading materials

Robert McDowall: Fundamentals of HVAC Systems
SI Edition. Academic Press, 2007.
William Bobenhausen: Simplified Design of HVAC Systems
Wiley, 1994.
Billy C. Langley: Fundamentals of Air Conditioning Systems
The Fairmont Press, 2000.

Department of Electrical Engineering and Mechatronics

Subject: **BUILDING AUTOMATION I**
Year, Semester: 3rd year/1st semester
Lecture: **2**

1st week:
Lecture: Basic: a control system

2nd week:
Lecture: Control theory: continuous and on-off controllers, adaptive controls

3rd week:
Lecture: Sensors and actuators. Temperature, pressure, humidity sensors. Electric and hydraulic actuators for valves.

4th week:
Lecture: Building management software: architecture, functions, communication and reporting.

5th week:
Lecture: Sensor data signals: analogue and digital signals. 0-10V and 4-20 mA network, cables and cable routing, noise rejection.

6th week:
Lecture: Actuators in details, valves: one-way, two-ways, control valves. Performance curves.

7th week:
Lecture: Thermal zone controllers. Room temperature control.

8th week:
Lecture: Mid-term testFacility management (FM). Reporting of building management systems for FM.
Self Control Test

9th week:
Lecture: Renewable energy utilization. I. Photovoltaic panels, sun collectors, water and air systems.

10th week:
Lecture: Renewable energy utilization II. Heat pumps: air-to-water, water-to-water heat pumps. Theory, COP, operation.

11th week:
Lecture: Operation of renewable energy utilization systems. Stand-alone and networked operation.

12th week:
Lecture: Field communication and networks. Modbus, LON, ZigBee

13th week:
Lecture: Refrigerant and cooling systems. Air cooling systems.

14th week: **Lecture:** Security systems: components: sensors, sirens, controllers, and consoles.	**15th week:** **Lecture:** End-term test **Self Control Test**

Requirements

Topics: This subject introduces the topics of building automation. The main topics are: Security systems, building automation and building information technology.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't make up a practice with another group. Attendance at practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Students are required to bring their notes and use engineering instruments (square rule, bows, calculating machine) to each practice during the course. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.
B, for a grade: The course ends in an exam (ESE). The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, the student once can take a retake test covering the whole semester material.

Subject: **MATERIAL HANDLING**
Year, Semester: 3rd year/1st semester
Lecture: **2**
Seminar: **1**

1st week: **Lecture:** Basic concepts for the handling and conveyance of materials. Classification of material handling systems. **Seminar:** Basic calculations of material handling.	**4th week:** **Lecture:** Designing principles and safety equipments of belt conveyors. **Seminar:** Designing calculations of belt conveyors.
2nd week: **Lecture:** Fundamental elements of material handling systems. Properties of handled materials. **Seminar:** Basic calculations of handled materials.	**5th week:** **Lecture:** Continuous operating material handling equipment: bucket elevators. Configurations of bucket elevators. **Seminar:** Designing calculations of bucket elevators.
3rd week: **Lecture:** Continuous operating materials handling equipment: belt conveyors. Configurations of belt conveyors. **Seminar:** Basic calculations of belt conveyors.	**6th week:** **Lecture:** Continuous operating material handling equipment: overhead conveyors. Configurations of overhead conveyors. **Seminar:** Designing calculations of overhead

conveyors.

7th week:
Lecture: Continuous operating material handling equipment: roller conveyors and screw conveyors. Configurations of roller and screw conveyors.
Seminar: Designing calculations of roller and screw conveyors.

8th week:
Lecture: Mid-term test. Continuous operating material handling equipment: pneumatic conveyors. Configurations of pneumatic conveyors.
Seminar: Designing calculations of pneumatic conveyors.
Self Control Test

9th week:
Lecture: Powered industrial trucks and forklifts. Configurations and safety equipment of trucks.
Seminar: Calculations about stability of forklifts. A forklift truck loading diagram.

10th week:
Lecture: ISO Cranes and lifting equipment. Configurations of cranes.
Seminar: Basic calculations of cranes.

11th week:
Lecture: Designing and safety rules of cranes. Safety equipment of hoisting machines.
Seminar: Designing calculations of cranes, part 1.

12th week:
Lecture: Introduction to unit load forming and container transporting technologies.
Seminar: Designing calculations of cranes, part 2.

13th week:
Lecture: Introduction to warehousing principles and technologies.
Seminar: Basic calculations about warehousing.

14th week:
Lecture: Automatic storage warehouses with high racks and their equipment. Stacker cranes.
Seminar: Designing calculations of stacker cranes.

Requirements

Topics: Basic concepts for the handling and conveyance of materials. Classification of material handling systems. Fundamental elements of material handling systems. Properties of handled materials. Configurations and calculations of continuous operating materials handling equipment: belt conveyors, bucket elevators, overhead conveyors, roller conveyors, screw conveyors, pneumatic conveyors. Powered industrial trucks and forklifts. Designing and safety rules of cranes and lifting equipment. Introduction to unit load forming and container transporting technologies. Introduction to warehousing principles and technologies. Automatic storage warehouses with high racks and their equipment. Stacker cranes.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. Students must attend the practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Student can't make up a practice class with another group. Attendance at practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in a mid-semester grade (AW5) based on the average grade of the two tests. The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the

score of any test is below 60, the student once can take a retake test covering the whole semester material.

Required reading materials

Mulcahy, David E.: Materials Handling Handbook
McGraw-Hill Professional, 1999. ISBN: 007044014X

Subject: **MEASUREMENT AND AUTOMATICS II**
Year, Semester: 3rd year/1st semester
Lecture: **2**
Practical: **2**

1st week:
Lecture: The theoretical bases of control technology. Basic concepts, symbols and allocation. Comparison of control and feedback control. Subdivision of control and feedback control.
Practical: General description about laboratory regulations. Accident prevention and safety education.

2nd week:
Lecture: Feedback control. Signs and characteristics of a control loop. Loop tags (a sensor, a signal generator, subtraction, signal processing, an amplifier, an actuator). Automatic feedback control subdivision.
Practical: Realization of logic functions "And, Or, Not" with relays.

3rd week:
Lecture: Control systems. Boolean algebra, basic operations (And, Or, Not). Basic identity of Boolean algebra.
Practical: "Nand" and "Nor" logic functions realization with relays.

4th week:
Lecture: De Morgan's theorems. Two-variable logic functions (Nor, Inhibition, Antivalency, Equivalency, Implication).
Practical: Compilation of logical relations on practicing board with "Nand" gates.

5th week:
Lecture: Functions to simplify algebraic and graphical way. Operation and programming of freely programmable logic controllers (PLCs).
Practical: Compilation of logical relations on practicing board with Nor gates.

6th week:
Lecture: Linear Control Systems. Test methods (time domain, frequency domain, and transfer functions method).
Practical: PLC programming. Measuring internal timers and counters.

7th week:
Lecture: Linear control steady-state operation. Linear terms (P, I, D) and transmission coefficient. Linear coupling of tags (serial, parallel, feedback).
Practical: Analysis and determination of one variable proportional transfer function.

8th week:
Lecture: Mid-term test
Self Control Test

9th week:
Lecture: A proportional tag, negative feedback through a proportional tag. Examination of feedback.
Practical: Determination of a variable proportional transfer function and its analysis.

10th week:
Lecture: Analysis of proportional (type 0) control. Examination of integral (type 1) control. Gaining and measuring a concept loop.
Practical: Analysis transfer function of two variable proportional tag.

11th week:
Lecture: Linear feedback control transition state. Typical testing functions. Linear tags differential equations. Transfer function preparation about transmission function.
Practical: Conditions and analysis of a variable storage differentiator tag and its transfer function.

12th week:
Lecture: Transition, transfer function and differential equations of a proportional and integral tag. Transition, transfer function and differential equations of a derivate and dead time tag.
Practical: Analyze proportional-integral (PI) tag transition function.

13th week:
Lecture: Control loops investigation in a transition state. Control loops stability criterion with Routh-Hurwitz and high-quality specifics.
Practical: Analyzing the proportional-derivative (PD) tag and its transition function.

14th week:
Lecture: Continuous (P, I, D, PI, PD, PID) controllers. Non-electrical quantities electrical measuring. Temperature and pressure measurement. Flowing liquids and gases in fluid volume measurement.
Practical: The Proportional-Integral-Derivative (PID) tag recording its transition function and function analyzing.

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: Different theoretical foundation of control engineering. Technical and application control functions. Programmable logic controllers. Members of the control loop. The members of the control loop steady state analysis. Linear transition state regulations. Linear members describing state transition. Control loop analysis. Stability and quality characteristics. Selection and setting of regulators. Digital controllers.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. Missed practice classes must be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as absence because of the lack of active participation in class. Students have to submit all the twelve reports as scheduled minimum on a sufficient level. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for these tests.
B, for a grade: The course ends in a mid-semester grade (AW5) based on the average of the grades of the drawings and the average of the test results. The mid-semester grade is calculated as an average of them: - the average grade of the twelve reports - the average grade of the two tests The minimum requirement for the mid-term and end-term tests is 60%. Basing on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5)

Required reading materials

Robert H. Bishop: Labview 2009 student edition. Prentice Hall, 2009. ISBN: 978-0132141291
Travis, Jeffrey : Labview for everyone: graphical programming made easy and fun p:1032
Jeffrey Travis, Jim Kring, 2007.

Subject: **MECHATRONICS II**
Year, Semester: 3rd year/1st semester
Lecture: **1**
Practical: **2**

1st week:
Lecture: Functions of hydraulic equipment. Symbols and drawing techniques.
Practical: General description about laboratory regulations. Accident prevention and safety education.

2nd week:
Lecture: Structure and circuit diagrams (control, power supply) of hydraulic systems.
Practical: Understanding of physical elements. Technical description of drawing symbols.

3rd week:
Lecture: Physical basics of hydraulics (pressure transmission, force transmission, way transmission, pressure ratio). Kind of flows. Working fluid (types of tasks, viscosity).
Practical: Actuator elements operation in real environments and Fluid SIM software. Exercises on bending machines.

4th week:
Lecture: Equipment representation (layout drawings, wiring diagrams, operating charts). Power supply system components (gear motor, pump, filter, tank).
Practical: Operation actuator elements via indirect valves. Exercises on roller tracks.

5th week:
Lecture: Valves (method of construction, the nominal value, slide). Pressure control valves. Way valves (2/2, 3/2, 4/2, 4/3).
Practical: Implementation of complex control exercises in real environment and Fluid SIM software. Lift table exercise. Exercises on lidded containers.

6th week:
Lecture: Shut-off valves (check valve, controlled check valve). Flow control valves (one way control valves, 2 way flow control valve).
Practical: Exercises on paint drying furnaces. Exercises on holders. Exercises on hydraulic tilting platforms.

7th week:
Lecture: Hydraulic cylinders (single, double-acting, sealing, venting, buckling). Hydraulic motors.
Practical: Exercises on turning machine feeding. Exercises on grinding machines. and drill machines.

8th week:
Lecture: Mid-term test
Self Control Test

9th week:
Lecture: Electrical symbols. Electro-hydraulic controls. (hydraulic, electrical diagram, function graphs)
Practical: Understanding electro-hydraulic devices. Exercises on sawing machines.

10th week:
Lecture: Electro-hydraulic structure of equipment. Electrical basic concepts.
Practical: Exercises on lifting stations. and conveyor belt.

11th week:
Lecture: Electrical components. Electro-hydraulic circuits (And, Or, Xor).
Practical: Exercises on press machines.

12th week:
Lecture: Electro-hydraulic circuits (signal storage way control).
Practical: Exercises on glue devices and furnace door control.

13th week:
Lecture: Electro-hydraulic circuits (falling edge automatic mode).
Practical: Exercises on trimmer machines.

Exercises on unit lifting.

14th week:
Lecture: Hydraulic processes control by PLC.
Practical: Exercises on auto assembly.

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: Hydraulic machine functions. Design of hydraulic systems and circuit diagrams. Physical principles of hydraulics. Parts of power supply systems. Pressure control valves. Stop valves. Flow control Valves. Hydraulic cylinders. Electro hydraulic controls. Electrical basics. Electro-hydraulic circuits. A signal storage path-dependent overthrow control. Processes to hydraulic PLC control.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Student can't make up a practice class with another group. Attendance at practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Students are required to bring the necessary utensils (e.g. calculator) for the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence due to the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in a mid-semester grade (AW5). Based on the average of the marks of the drawings and the average of the test results, the mid-semester grade is calculated as an average of them: - the average grade of the two tests The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5)

Required reading materials

D. Merkle, B.Schrader, M. Thomes: Hydraulics Basic Level
Festo Didactic GmbH and Co., 2003.
Dieter Scholtz: Electrohidraulics Basic Level
Festo Didactic GmbH & Co., 2001.
De Silva, Clarence W.: Mechatronics : an integrated approach
CRC Press, 2005.

Subject: **PROGRAMMABLE LOGIC CONTROLLERS I**
Year, Semester: 3rd year/1st semester
Practical: **4**

1st week:
Practical: Basic knowledge of PLC

2nd week:
Practical: Basic functions, and handling of the programming environment (Twido Suite)Making of Test project.

3rd week:
Practical: Basic structures of PLCSimple switches, pushbuttons, other types of contactors.

4th week:
Practical: Basic structures of PLCUsing the

structure of timers, TP TON, TOF.

5th week:
Practical: Basic structures of PLCUsing the structure of counters, upcounting, downcounting

6th week:
Practical: Basic structures of PLCUsing the structures, building in step counters, ring counters

7th week:
Practical: Basic structures of PLCUsing internal memory spaces, merkers, merker words, merker flags

8th week:
Practical: Midterm exercise

9th week:
Practical: Basic structures of PLC Using comparative blocks, and word-type pointers.

10th week:
Practical: Basic structures of PLCSubroutines

11th week:
Practical: Practice of various industry inspired problems.

12th week:
Practical: Practice of various industry inspired problems.

13th week:
Practical: End-term task

14th week:
Practical: End-term task

15th week:
Practical: End-term task

Requirements

Topics: Basic knowledge of main structures of programming PLC in theory and in practice, using TWIDO PLC. Introduction to the installation of programming software, learning the usage of the program. Basic knowledge of the internal structure of PLC. Basic knowledge of programming: usage of mathematical and logical structures. Programming in practice: Principles of using logical functions, timer structures, counter structures, analogue problems in theory and practice. Modelling of real industrial processes.
A, for a signature: Attendance at lectures is compulsory.
B, for a mid-semester grade (AW5): Students have to fulfill a mid-term exercise at least for 50% to take part on the next practice classes. All students, who failed the mid-term exercise will not get a mid-semester grade. At the end of the semester, all students have to solve a real life problem in programming. Also a task, to make a complete documentation of the project file, using all the methods, mentioned during the semester. The course ends in a mid-semester grade. Based on the average of the grades of the tasks.

Subject: **PROGRAMMING AND DIGITAL TECHNIQUES II**
Year, Semester: 3rd year/1st semester
Practical: **4**

1st week:
Practical: Preparation, Course-up, description of subject requirements, course schedule description, description of the course literature list

2nd week:
Practical: The basics of Boolean algebra, postulates and theorems of Boolean algebra, Boolean functionsKnowledge of digital circuits, measurement parameters

3rd week:
Practical: The Binary number system, arithmetic operations with binary numbers, negative numbers representationDesigning circuits using

SSI(AND, OR, NOT gates)

4th week:
Practical: Numerical codes, logic families, logic gates, Boolean operatorsDesign circuits using SSI (AND, OR, NOT gates)

5th week:
Practical: The TTL circuit family, CMOS technology, ECL Circuit Family Design circuits using MSI (multiplexers, demultiplexers)

6th week:
Practical: Theory of combination circuits, circuit design, SSI, MSI circuit design, digital circuit design LSI, ROM memory, RAM memory. Design using MSI circuits (decoders, multiplexers)

7th week:
Practical: Extension of memory size of the programmable logic matrix, FPGA circuitsDesigning using LSI circuits

8th week:
Practical: : FPGA circuits, Tipper circuits, registers circuits, Counting circuits, Using counter and register circuits

9th week:
Practical: Mid-term test
Self Control Test

10th week:
Practical: Sequential circuits, asynchronous sequential circuits design, synchronous sequential circuit design. Construction of synchronous and asynchronous sequential circuits

11th week:
Practical: Microcontrollers. Microcontroller programming in Assembly language

13th week:
Practical: Microprocessors. Microcontroller programming in Assembly language

14th week:
Practical: Programming a Data Processing Card Microcontroller programming in Assembly language

15th week:
Practical: End-term task
Self Control Test

Requirements

Topics: Introduction to FPGA programming and digital techniques. Introduction to Xilinx ISE programming environment, VHDL programming language and their typical properties. Programming in practice: logic gates, multiplexers, demultiplexers, counters, final state machines.
A, for a signature: Attendance at lectures is compulsory.
B, for a mid semester-grade: Students have to fulfill a mid-term exercise at least for 50% to take part in the next lectures. All students, who failed the mid-term exercise will not get a mid-semester grade. At the end of the semester, all the students have to solve a real life problem in programming. Also a task, to make a complete documentation of a project file, using all the methods, mentioned during the session. The course ends in a mid-semester grade. Based on the average of the marks of the tasks.

Subject: **SENSORS AND ACTUATORS**
Year, Semester: 3rd year/1st semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Sensors and actuators in mechatronic systems. Measuring device system-regulation system.
Practical: Transducers.

2nd week:
Lecture: Signals types and their characteristics. Analog signals processing, digitization.
Practical: The analog signals digitization.

3rd week:
Lecture: Classification of signals. Analog signal processing vs. digital signal processing.
Practical: The signal sampling and signal reconstruction.

4th week:
Lecture: Binary encoding.Representation of positive integers. Signed integer representation.
Practical: Basic electronic circuits of the transducers.

5th week:
Lecture: Signal conditioning circuits (The amplifiers, Operational amplifier, Instrumentation amplifiers, Programmable gain amplifier, Isolation amplifier).
Practical: Basic electronic circuits (Electronic switch, Sample & hold circuits, Analog multiplexer circuit.

6th week:
Lecture: General characteristics of DAC.DAC using binary weighted resistor network.
Practical: DAC for different types of binary codes.

7th week:
Lecture: Analog to Digital Converters (ADC). ADC general characteristics. Quantization. The ADC errors.
Practical: ADC types (Flash ADC,Successive Approximation DAC, Dual slope DAC)

8th week:
Lecture: Mid-term test
Self Control Test

9th week:
Lecture: The general structure of sensors. Sensors classification.
Practical: General characteristics of the sensors.

10th week:
Lecture: Photo Semiconductors (photoresists, photodiodes phototransistors, LED). Optocouplers.
Practical: CCD sensors.

11th week:
Lecture: Incremental converters (Hardware-based position determination Software-based position determination). Absolute converters.
Practical: The speed measurement.

12th week:
Lecture: Physical effects used inmechatronics. The sound used in mechatronics.
Practical: The Hall effect.

13th week:
Lecture: The Seebeck and Peltier effect. Piezoelectric effect.
Practical: Piezoresistive effect.

14th week:
Lecture: Actuators - general characteristics. Electromechanical actuators (Electro magnets, DC motors, Brushless DC electric motor, The asynchronous motors, The asynchronous motor control, Stepper motor, Linear motors)
Practical: The asynchronous motor PWM speed control

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: Sensors and Actuators in the mechatronics system. Signal processing (properties and forming of incoming signals.) Digitalization of analogue signals. Binary coding. Sampling and rebuilding of a signal. Elementary Sample and Holder circuits. D/A and A/D converter topologies. Working principals of sensors and actuators. Usage of magnetism, sound, light and other phenomena in mechatronics systems. Bus systems (parallel and serial ports). Electromagnetic actuators. Usage and working principals of DC/AC driving systems. Hydraulic and pneumatic servo systems.

A, for signature: Attendance on the lectures is recommended, but not compulsory. Participation at practice is compulsory. Student must attend the practices and my not miss more than three practice during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Student can't make up a practice with another group. The attendance on practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments for the course with them to each practice. Active participation is evaluated by the teacher in every class. If student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate their participation as an absence due to the lack of active participation in class. Students have to submit all the six drawing tasks as scheduled minimum on a sufficient level. During the semester there are two tests: the mid-term test is in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for grade: The course ends in mid-semester grade (AW5). Based on the average of the marks of the drawings and the average of the test results, the mid-semester grade is calculated as an average of them: - average grade of the six drawing tasks - average grade of the two tests The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, the student once can take a retake test covering the whole semester material.

Required reading materials

De Silva, C.W.: Sensors and Actuators, Control System Instrumentation
CRC Press, 2007.
I. R. Sinclair and J. Dunton: Practical electronics handbook
Elsevier, 2007.

Department of Engineering Management and Enterprise

Subject: **BASICS OF QUALITY MANAGEMENT**
Year, Semester: 3rd year/1st semester
Lecture: **1**
Seminar: **1**

1st week:
Lecture: Quality and global competitiveness
Seminar: Discussion with different dispute methods, case studies.

2nd week:
Lecture: Strategic management: planning and execution
Seminar: Discussions with different dispute methods, case studies.

3rd week:
Lecture: Quality management and ethics, and communication and interpersonal relations.
Seminar: Case studies, situational tasks.

4th week:
Lecture: Total quality management.
Seminar: Discussions with different dispute methods, case studies.

5th week:
Lecture: Quality improvement techniques.
Seminar: Case studies, group work, situational tasks.

6th week:
Lecture: Statistical concepts

Seminar: Discussion with different dispute methods, case studies.

7th week:
Lecture: Control charts for variables, control chart interpretations and analyses, other variable control charts.
Seminar: Case studies, group work.

8th week:
Lecture: Control charts for variables, control chart interpretations and analyses, other variable control charts.
Seminar: Case studies, group work.

9th week:
Lecture: Fundamentals of probability. Reliability.
Seminar: Discussion with different dispute methods, case studies.

10th week:
Lecture: Quality costs
Seminar: Discussion with different dispute methods, case studies.

11th week:
Lecture: Quality function deployment. Design of experiments
Seminar: Case studies, group work.

12th week:
Lecture: Quality systems: ISO 9000
Seminar: Case studies, group work.

13th week:
Lecture: Quality systems: ISO 9000
Seminar: Case studies, group work.

14th week:
Lecture: Six Sigma
Seminar: Case studies, group work.

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: This course focuses on making the theories and principles of total quality both practical and useful ways. Practitioners in a corporate setting will find it a valuable guide in helping them to learn how to be effective agents of the total quality approach, to understand and implement total quality.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. During the semester there is an end-term test in the 15th week. Students have to sit for the test.
B, for a grade: The course ends in a mid-semester grade (AW5) based on the average of the grades for the participation and the average of the test results, the mid-semester grade is calculated as an average of them: - an average grade of the practice - a grade of the test The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the test, the grade for the test is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of the test is below 60, once the student can take a retake test of the whole semester material.

Required reading materials

David L. Goetsch, Stanley Davis: Quality management: introduction to total quality management for production
Pearson Prentice Hall, 2013. ISBN: 0-13-287097-5, 978-0
B. G. Dale: Managing Quality
Wiley-Blackwell, 2007. ISBN: 978-1-4051-4279-3

Subject: **STATE ADMINISTRATION AND LAW**
Year, Semester: 3rd year/1st semester
Lecture: **2**

1st week:
Lecture: Introducing the law systems of the world, especially the common law and the e continental law system by explaining details of the main characteristics of the two systems.

2nd week:
Lecture: The constitutional basics of the municipality structure, state organization, municipality levels, basic civil rights, a historical overview of the civil institutions. Operation of municipalities, their organization system, statutory supervision, and the major rules and regulations of the municipal, state and administrative procedures

3rd week:
Lecture: The main characteristics and structure of the Hungarian Law System. The sources of law.

4th week:
Lecture: The main rules of the administration system.

5th week:
Lecture: The major rules of commercial law and proprietary rights. The major forms of responsibility (compensation, indemnity) related to the activity, and general rules and regulations of concluding a contract.

6th week:
Lecture: The major forms of responsibility (compensation, indemnity) related to the activity, and general rules and regulations of concluding a contract.

7th week:
Lecture: The basics of contract law (written and oral contracts, the contracts of corporations)

8th week:
Lecture: Mid-term test
Self Control Test

9th week:
Lecture: The evolution, history and development of the European integration: the integration issue after the second world war.

10th week:
Lecture: The Rome treaty and the establishment of the European Economic Community. .; The EU after Maastricht, new enlargements, the Amsterdam Treaty, and the Treaty of Nice, the further enlargements with the Eastern European countries, The Lisbon Treaty, the future of the EU.

11th week:
Lecture: The law of the European Union: the Community law, the sources of the Community law (primary and secondary legal sources, and other sources) The features of the Community legal system.

12th week:
Lecture: The European Court of Justice. Human rights and the Universal Declaration of Human Rights.

13th week:
Lecture: The characteristics of the Hungarian municipality structure in light of the EU municipality systems. The sources of law in the EU.

14th week:
Lecture: Informal conversation with the students about their homeland's law system.

15th week:
Lecture: Consultation

Requirements

Topics: Legal systems of the world, civil and human rights, the main characteristics and structure of the Hungarian Law System, major rules of commercial law and proprietary rights, evolution,

history and development of the European integration.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, being discussed with the tutor. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in mid-semester grade (ESE) based on the average grade of the two tests. The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, the student once can take a retake test of the whole semester material.

Required reading materials

Péter Smuk: The transformation of the Hungarian Legal System 2010-2013
Complex, 2013.
Zoltán Horváth: Handbook on the European Union
HVG-ORAC, 2011.

Department of Mechanical Engineering

Subject: **CAD AND CAE I**
Year, Semester: 3rd year/1st semester
Practical: **2**

1st week:
Practical: Introduction to AUTOCAD, describe and set up the Workspace.

2nd week:
Practical: Creating drawings: using the Dynamic Input interface, Object Snap and Snap points, Polar Tracking and Polar Snap, using Units command to set drawing units. Drawing commands: Line, Circle etc.

3rd week:
Practical: Manipulating objects: using of Move, Copy, Rotate, Mirror, Array, Erase etc.

4th week:
Practical: Drawing organization and inquiry commands. Measuring distance, angle, area and perimeter. Layers. Object properties.

5th week:
Practical: Altering objects: using of Offset, Trim, Stretch, Explode etc.

6th week:
Practical: Working with Layouts. Layout mode, Viewports.

7th week:
Practical: Annotating the drawing: Text and Multiline Text commands, Text Styles

8th week:
Practical: Mid-term testDimensioning. Create and modify Dimension Styles to control the appearance of dimensions.
Self Control Test

9th week:
Practical: Hatching objects. Create Hatch

patterns and fills.

10th week:
Practical: Working with reusable content: use the Block command to create a block definition, use the Insert command to insert a block reference in a drawing.

11th week:
Practical: Creating additional drawing objects. Use the Tablestyle command to create table styles.

12th week:
Practical: Plotting. Create and modify Page Setup.

13th week:
Practical: 3D modelling. Create basic 3D objects. Create 3D objects from 2D objects.

14th week:
Practical: Parametric drawing in AUTOCAD.

15th week:
Practical: End-term test
Self Control Test

Requirements

Topics: The series of practice classes cover the following topics: introduction to AUTOCAD, creating drawings in AUTOCAD, manipulating objects, drawing organization and inquiry commands, altering objects, working with Layouts, annotating, dimensioning and hatching objects. Working with reusable content, plotting, creating 3D objects and parametric drawing in AUTOCAD.
A, for a signature: Participation at practice classes is compulsory. Students must attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't take part in any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor. During the semester there are two tests: the mid-term test is on the 8th week and the end-term test is on the 15th week. Students must sit for the tests.
B, for a grade: The course ends in a mid-semester grade (AW5) based on the average grade of the two tests. The minimum requirement of the mid-term and the end-term test is 60% separately. The grade for each test is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, the student once can take a retake test of the whole semester material.

Required reading materials

Randy H. Shih: AutoCad 2010 Tutorial
SDC Publications, 2009. ISBN: 978-1-58503-498-7

Department of Building Services and Building Engineering

Subject: **BUILDING ENERGETICS I**
Year, Semester: 3rd year/2nd semester
Lecture: **3**

1st week:
Lecture: Energy policy, building-related energy directives and regulations in Hungary and EU.

2nd week:
Lecture: Building energy need: heating,

ventilation, hot water preparation.

3rd week:
Lecture: Heat generation and transportation. Boilers.

4th week:
Lecture: Energy efficiency of thermal machines.

5th week:
Lecture: Renewable energy sources. Heat pumps.

6th week:
Lecture: Renewable energy sources. Solar collectors.

7th week:
Lecture: Renewable energy sources. PV systems.

8th week:
Lecture: Renewable energy sources. Wind energy.

9th week:
Lecture: Enhancing energy efficiency of heating systems.

10th week:
Lecture: Enhancing energy efficiency of ventilation and cooling systems.

11th week:
Lecture: Low-energy buildings, passive buildings: main technical aspects.

12th week:
Lecture: Building energy requirements.

Requirements

Topics: Energy policy, energy requirement of buildings, renewable energy sources, heat pumps, solar collectors, PV systems, passive houses.
A, for a signature: Attendance at lectures is recommended, but not compulsory. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The examination consists of two parts: • Two exercise tests taught during the semester. • 20–minute theory test. The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, the student once can take a retake test covering the whole semester material.

Required reading materials

Kalmár F.: Energy conscious heating
Akadémiai Kiadó, 2011.
Hodge B.: Alternative Energy Systems and Applications
Wiley, 2009.
Keith J. Moss : Energy Management in Buildings
Taylor & Francis, 2006.

Subject: **BUILDING SERVICE SYSTEMS II**
Year, Semester: 3rd year/2nd semester
Practical: **3**

1st week:
Practical: determination of heat load of a building

2nd week:
Practical: Determination of moisture load of a

building.

3rd week:
Practical: Determination of air flow demand for ventilation.

4th week:
Practical: Choosing the elements of a ventilation system (humidifiers, dehumidifiers, heating and cooling elements).

5th week:
Practical: Hydraulic planning of the air channels.

6th week:
Practical: Choosing the ventilators. Verification of air speed in an occupation zone.

7th week:
Practical: Determination of heat demand of a building. Choosing radiators and boilers.

8th week:
Practical: Hydraulic planning of pipes and choosing the pump of a heating system.

9th week:
Practical: Determination of cold and hot water demand of a building.

10th week:
Practical: Designing pipes, determination of pressure demand.

11th week:
Practical: Choosing hot water storage tanks, hydraulic planning of hot water pipes.

12th week:
Practical: Hydraulic planning of circulation pipes. Choosing of a circulation pump.

Requirements

Topics: Planning of heating systems, ventilation and air conditioning systems, cold and hot water preparation systems.
A, for a signature: Participation at practice classes is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't make up a practice with another group. Attendance at practice will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, being discussed with the tutor. Students are required to bring calculators to each practice. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence due to the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade (AW5): Examination, consisting of two parts: • Three exercise tests during the semester. • a 20–minute long theory test. The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, the student once can take a retake test covering the whole semester material.

Required reading materials

Robert McDowall: Fundamentals of HVAC Systems
SI Edition. Academic Press, 2007.
William Bobenhausen: Simplified Design of HVAC Systems
Wiley, 1994.
Billy C. Langley: Fundamentals of Air Conditioning Systems
The Fairmont Press, 2000.

Department of Electrical Engineering and Mechatronics

Subject: **BUILDING AUTOMATION II**
Year, Semester: 3rd year/2nd semester
Lecture: **2**
Practical: **4**

1st week:
Lecture: Review of building automation components: sensors, actuators, valves, pumps, fans, heat exchangers and boilers.
Practical: basic heating and cooling hydraulic circuits, indoor air control systems

2nd week:
Lecture: Control theory: continuous and on-off controllers, adaptive controls
Practical: Simulation with continuous and on-off controllers, adaptive controllers

3rd week:
Lecture: Sensors and actuators. Temperature, pressure, humidity sensors. Electric and hydraulic actuators for valves.
Practical: application of valves and actuators.

4th week:
Lecture: Building management software: architecture, functions, communication and reporting.
Practical: Introduction of building management software

5th week:
Lecture: Info-Communication Technologies in building automation, sharing and distribution of information, digital networks.
Practical: Introduction of field networks, LAN, WAN

6th week:
Lecture: Security systems: components: sensors, sirens, controllers, and consoles. Access control systems, RFID technology.
Practical: introduction of a security system and a fire alarm system. Design and installation.

7th week:
Lecture: Electrical distribution systems, Overvoltage and overcurrent protection. Main and auxiliary power systems, diesel generators, PV panels.
Practical: Introduction on building power distribution. PV panels and generators.

8th week:
Lecture: Mid-term test. Facility management (FM).
Practical: Report generation for facility management
Self Control Test

9th week:
Lecture: Renewable energy utilization I. Photovoltaic panels, sun collectors, water and air systems.
Practical: practice on PV systems.

10th week:
Lecture: Renewable energy utilization II. Heat pumps: air-to-water, water-to-water heat pumps. Theory, COP, operation.
Practical: Heat pump control practice.

12th week:
Lecture: Security and safety. Risk analysis and management. Design of security systems to minimize risk and damage.
Practical: Design examples.

13th week:
Lecture: Security system components: mechanical, electrical, and software components. Network and access control security.
Practical: Design example with risk management.

14th week:
Lecture: Surveillance systems. Cameras, Networked digital recording. Operation and installation.
Practical: Designing examples.

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: This subject introduces the topics of advanced building automation. The main topics are: Security systems, building automation and building information technology.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. Students must attend practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't make up a practice with another group. Attendance at practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Students are required to bring their notes and use engineering instruments (square rule, bows, calculating machine) to each practice during the course. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.
B, for a grade: The course ends in an exam (ESE). The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, the student once can take a retake test covering the whole semester material.

Subject: **ELECTRICAL MACHINES AND DRIVES**
Year, Semester: 3rd year/2nd semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Classification of electrical energy converters
Practical: Classification of electrical energy converters

2nd week:
Lecture: DC Motors: structures, mechanical and electronic commutators
Practical: DC Motors: structures, mechanical and electronic commutators

3rd week:
Lecture: DC Motors: operation
Practical: DC Motors: operation

4th week:
Lecture: Transformers: operating principles, induced voltage, open circuit, short circuit and load conditions
Practical: Transformers: operating principles, induced voltage, open circuit, short circuit and load conditions

5th week:
Lecture: 3Phase transformers
Practical: 3Phase transformers

6th week:
Lecture: The basics of rotating field theory and its applications
Practical: The basics of rotating field theory and its applications

7th week:
Lecture: Synchronous Machines: Construction

and principles of operation of a three-phase cylindrical rotor synchronous machine
Practical: Synchronous Machines: Construction and principles of operation of a three-phase cylindrical rotor synchronous machine

8th week:
Lecture: Mid-term test
Self Control Test

9th week:
Lecture: Three-phase asynchronous machines: structures and working principles of an induction motor
Practical: Three-phase asynchronous machines: structures and working principles of an induction motor

10th week:
Lecture: Three-phase asynchronous machines: operation
Practical: Three-phase asynchronous machines: operation

11th week:
Lecture: stepper motors
Practical: stepper motors

12th week:
Lecture: Special electric machines
Practical: Special electric machines

13th week:
Lecture: Rectifier circuits, rectifier bridges
Practical: Rectifier circuits, rectifier bridges

14th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: The classification of electric energy converters. DC machines: structure, operation, mechanical and electronic commutators. Transformers: working principle, induced voltage, open circuit, short circuit and load conditions. Special transformers; three-phase transformers, measurement transformers (VT and CT). The rotating-field Theory and its applications. Synchronous machines: a three-phase cylindrical rotor synchronous machine structure and its working principle. Three-phase asynchronous machines: architecture and design principles and operation. Stepper motors, special electric machines. Rectifier bridge circuits, PWM drives, frequency converters.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. Students must attend the practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Student can't make up a practice class with another group. Attendance at practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Students are required to bring the necessary utensils (e.g. calculator) for the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence due to the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade (ESE): The course ends in an exam, the grade is calculated as: - 60% from the exam - 20%-20% from the two tests The minimum requirement for passing is 60%, the grade for the final mark is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, the student once can take a retake test covering the whole semester material.

Required reading materials

Miroslav Chomat: Electric Machines and Drives
ISBN: 978-953-307-548-8

Subject: **PROGRAMMABLE LOGIC CONTROLLERS II**
Year, Semester: 3rd year/2nd semester
Practical: **4**

1st week:
Practical: Basic knowledge of the PLC

2nd week:
Practical: Basic functions, and handling of the programming environment (Unity Pro)Making a test project.

3rd week:
Practical: Basic programming languages of PLCSimple structures in various programming languages.

4th week:
Practical: Ladder diagram, a structure text, an instruction listProgramming of basic structures, timers, counters, memory management.

5th week:
Practical: a sequentional function chart, a functional block diagramProgramming of basic structures, timers, counters, memory management.

6th week:
Practical: Flow chart representation of PLCUsing multiply instances for the same problem.

7th week:
Practical: Array structures in PLCUsing internal memory spaces.

8th week:
Practical: Midterm exercise
Self Control Test

9th week:
Practical: Basic Communication methods. RS-485, Modbus

10th week:
Practical: Basic Communication methods. A fieldbus, a modbus TCP/IP

11th week:
Practical: Basic knowledge of SCADA programming.Practice of various industry inspired problems.

12th week:
Practical: Complex SCADA visualization in PCPractice of various industry inspired problems.

13th week:
Practical: Basic knowledge of HMI programming environment (Vijeo Designer)A simple HMI board program.

14th week:
Practical: End-term task
Self Control Test

15th week:
Practical: End-term task
Self Control Test

Requirements

Topics: Introduction of the key industrial communication protocols. Industrial protocols having taught during the semester: Theoretical and practical connections in a PLC Modbus, a CAN bus, a TCP/IP protocol. Making the basic net connections for such systems. Configuration of the mentioned industrial communication protocols. Introduction of the unity programming

environment, programming languages and their typical properties (Ladder Diagramm, structure texts, a function block diagramm, an instruction list and a sequential function chart). Introduction of the internal structure of M340 type PLC, main guidelines of programming. Programming in practice: principals of using logical functions, timer structures, counter structures, analogue problems in theory and in practice. Modelling of real industrial processes.

Subject: **ROBOTICS**
Year, Semester: 3rd year/2nd semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Introduction to robotics.
Practical: Examples and application of robotics

2nd week:
Lecture: Classification of robot systems, architectures, coordinating systems, and work spaces.
Practical: Classification of robot systems, architectures, coordinating systems, and work spaces. Exercises.

3rd week:
Lecture: The mechanical structure of robots, kinematic chains, and equations of motion.
Practical: The mechanical structure of robots, kinematic chains, and equations of motion. Exercises.

4th week:
Lecture: End effectors and tools.
Practical: End effectors and tools. Exercises.

5th week:
Lecture: Robots programming: methods and technologies, internal and external information processing, and basic terms of programming.
Practical: Programming robots: methods and technologies, internal and external information processing, and basic terms of programming.

6th week:
Lecture: Description of robot motion by programming languages.
Practical: Description of robot motion by programming languages.

7th week:
Lecture: General principles of moving paths, linear and curved paths, the interpolation of circles.
Practical: General principles of moving paths, linear and curved paths, the interpolation of circles.

8th week:
Lecture: Mid-term test. Robot programming applications, communication with other robots.
Practical: Robot programming applications, communication with other robots. Exercises.
Self Control Test

9th week:
Lecture: Robot applications, the design of robot applications. Application examples.
Practical: Robot applications, the design of robot applications. Application examples. Exercises.

10th week:
Lecture: Technological and work piece flow applications.
Practical: Technological and work piece flow applications. Exercises.

11th week:
Lecture: Performance and safety issues.
Practical: Performance and safety issues. Exercises.

12th week:
Lecture: Scheduling and communication with other systems.
Practical: Scheduling and communication with other systems. Exercises.

13th week:
Lecture: Introduction to robot operating systems.
Practical: Introduction to robot operating systems.

14th week:
Lecture: Robot operating functions: sensor, actuator and network communication functions.
Practical: Robot operating functions: sensor, actuator and network communication functions. Exercises.

15th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: Introduction to robotics and the classification of robot systems, architectures, coordinate systems, and work spaces. The mechanical structure of robots, kinematic chains, and equations of motion. End effectors and tools. Programming robots: methods and technologies, internal and external information processing, and basic terms of programming. Description of robot motion by programming languages. General principles of moving paths, linear and curved paths, the interpolation of circles. Robot applications, the design of robot applications. Technological and work piece flow applications. Performance and safety issues. Scheduling with other systems. Introduction to robot operating systems. Introduction to robot operating functions: sensor, actuator and network communication functions. Grading requirement: a working and accepted robot program.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. The attendance on practice will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments for the course with them to each practice. Active participation is evaluated by the teacher in every class. If a students' behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in an exam. The grade for the exam is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5)

Required reading materials

Reza N. Jazar: Theory of Applied Robotics: Kinematics, Dynamics, and Control
Springer, 2010. ISBN: 978-1441917492
Saeed B. Niku: Introduction to Robotics: Analysis, Control, Applications
Wiley, 2010. ISBN: 978-0470604465
Operating and programming manuals of KUKA Robots
Géza HUSI: Mechatronics Control Systems - course book
1st. University of Debrecen , 2012. ISBN: 978-963-473-520-5
Géza HUSI: Mechatronics Control Systems - laboratory handbook
1st. University of Debrecen, 2012. ISBN: 978-963-473-521-2

Department of Engineering Management and Enterprise

Subject: **INDUSTRIAL SAFETY**
Year, Semester: 3rd year/2nd semester
Lecture: **2**

1st week:
Lecture: Concepts of Hazard Avoidance & Ergonomics

2nd week:
Lecture: Health and Toxic Substances

3rd week:
Lecture: Environmental control and noise

4th week:
Lecture: Flammable and explosive materials

5th week:
Lecture: Personal Protection and first aid

6th week:
Lecture: Fire protection

7th week:
Lecture: Materials handling and storage. Machine guarding

8th week:
Lecture: Mid-term test
Self Control Test

9th week:
Lecture: Electrical hazards, effects of electric current on a human body

10th week:
Lecture: Regulations, standards for shock protection

11th week:
Lecture: First aid measurments in case of people suffering from electric shock

12th week:
Lecture: Implementation of protection against an accidental contact

13th week:
Lecture: Implementation of earthing. Lightning and surge protection

14th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: The Industrial Safety focuses on most of the real issues of future safety and health practitioners, such as dealing with enforcement, protecting workers from ergonomic hazards, and accommodating the latest advances in process technologies, health management, a modern perspective on compliance with mandatory standards for workplace safety and health, and a variety of solved problems. Topics covered include workers' compensation, fault tree analyses, hearing protection, environmental protection, fire protection, workers with disabilities, OSHA violation policy.
A, for a signature: Attendance at lectures is recommended, but not compulsory. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in an exam (ESE), the grade is calculated as: - 60% from the exam - 20%-20% from the two tests The minimum requirement for passing is 60%, the final grade is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any tests is below 60, the student once can take a retake test of the whole semester material.

Required reading materials

C. Ray Asfahl, David W. Rieske: Industrial safety and health management
6th. Boston Pearson, 2010. ISBN: 13 978-0-13-207650-0
Roger L. Brauer: Safety and health for engineers
2nd. John Wiley cop., 2006.

Subject: **MANAGEMENT FOR ENGINEERS**
Year, Semester: 3rd year/2nd semester
Lecture: **1**
Seminar: **3**

1st week:
Lecture: The history of management. A classical school, integrating management theories, emerging management positions
Seminar: group work, situational tasks, discussion with different dispute methods

2nd week:
Lecture: Organization structures. Matrix, Functional, Divisional, Line
Seminar: SWOT analysis

3rd week:
Lecture: Management gurus. Fayol, Taylor, Mitzberg, Porter, Weber, Mayo
Seminar: Pest model

4th week:
Lecture: Functions of management, Leadership theories. Planning, Organizing, Directing, Controlling, Innovation and Representation, Trait theory, Behavioural theories, The Contingencialist Leadership Models, Hersey and Blanchard
Seminar: Situational tasks in group work, Tests measuring leadership styles

5th week:
Lecture: Managing people perception, learning and personality, motivation and organizational learning
Seminar: group work, situational tasks, discussion with different dispute methods

6th week:
Lecture: Leadership styles Autocratic, Bureaucratic, Laissez-faire, Democratic, Transformational leadership
Seminar: Tests measuring leadership styles, discussion of the results

7th week:
Lecture: Leadership qualities Most important leadership skills and qualities, Generic leadership traits, What you have to know, What you need to do, How to turn the core leadership functions into skills
Seminar: Tests measuring leadership qualities, discussion of the results

8th week:
Lecture: Time management, Energy management. Taming Time, A Few Myths About Managing Your Time, Lining Up Your Ducks: Prioritize!, Knowing Your Time Management Style, How You Relate to Time
Seminar: Techniques to manage the time and energy

9th week:
Lecture: The basics of strategic management , Problem-solving strategic analysis, strategy formulation, strategy implementation, what is a problem? How can it be solved?
Seminar: Why-why analysis, 80/20 theory, fishbone diagram

10th week:
Lecture: Work Performance determining work performance, analyze the problems, find solutions
Seminar: Test measuring Work Performance,, discussion of the results

11th week:
Lecture: Emotional Intelligence determining

emotional intelligence, highlighting the EM'S role and its effect in the leadership **Seminar:** Tests measuring the Emotional Intelligence, discussion of the results **12th week:** **Lecture:** Managing relationships communications, interpersonal relationships, building groups into teams communications, interpersonal relationships, building groups into teams **Seminar:** Tests measuring, discussion of the results	**13th week:** **Lecture:** Coaching, stress caused by leadership defining what a coach is, identifying, the tasks of coaching and authoritarian leadership, signs of stress, recognizing symptoms **Seminar:** Case studies, stress tests **14th week:** **Lecture:** The basic of Quality Management ISO 9001:2008, TOM, EFQM **Seminar:** Case studies. **15th week:** **Lecture:** End-term test **Self Control Test**

Requirements

Topics: In the Management for Engineers course students gain in sight into the key areas of leadership. During the course students become familiar with the new management trends, such as coaching authoritarian leadership, time- and energy management and with the importance of emotional intelligence in effective leadership. In the framework of practical classes the students' leadership skills, emotional intelligence and their soft skills are measured and analyzed.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. Students must attend the practices and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. During the semester there is an end-term test in the 15th week. Students have to sit for the test.
B, for a grade: The course ends in a mid-semester grade (AW5) based on the average of the grades of the participation and the average of the test results, the mid-semester grade is calculated as an average of them: - the average grade of practice - the average grade of the test The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, once students can take a retake test of the whole semester material.

Required reading materials

McKeown, A. – Wright, R. : Professional English in Use
Cambridge University Press, 2011.
McKeown, A. – Wright, R. : Leader Effectiveness Training
Cambridge University Press, 2011.
Schwart, T – Loehr, J. : The Power of Full Engagement: Managing Energy, Not Time, Is the Key to High Performance and Personal Renewal
Free Press, 2005.
Mancini, M. : Time management
McGraw-Hill Companies, 2003.
Taylor, J. : Decision Management System
IBM Press, 2012.

Department of Mechanical Engineering

Subject: **CAD AND CAE II**
Year, Semester: 3rd year/2nd semester
Practical: **2**

1st week:
Practical: Mask programmable and field programmable technology (FPGA)

2nd week:
Practical: VHDL technology: Logic design for integrated systems

3rd week:
Practical: Design for testability. CAD tools for digital systems design: simulation

4th week:
Practical: Design for testability. CAD tools for digital systems design:synthesis and fabrication.

5th week:
Practical: Constructing and labelling a variety of circuits and gaining further experience in the Multisim environment I.

6th week:
Practical: Constructing and labelling a variety of circuits and gaining further experience in the Multisim environment II.

7th week:
Practical: Constructing and labelling a variety of circuits and gaining further experience in the Multisim environment III.

8th week:
Practical: Mid-term test
Self Control Test

9th week:
Practical: Wiring and operating a monostable multivibrator and determining the pulse width of a monostable multivibrator I.

10th week:
Practical: Wiring and operating a monostable multivibrator and determining the pulse width of a monostable multivibrator II.

11th week:
Practical: Construct and operate a D/A converter in IC form with an operational amplifier.

12th week:
Practical: Converting analogue signals to digital signals using an IC D/A converter I

13th week:
Practical: Converting analogue signals to digital signals using an IC D/A converter II

14th week:
Practical: Introduction to the CÍM system

15th week:
Practical: End-term test
Self Control Test

Requirements

Topics: Essential background for anyone interested in modern integrated circuits whether high speed digital, analogue, system-on-chip or system-in-a-package: algorithms and methodologies that underpin state of the art computer aided design (CAD) tools for Electronics & Electrical Engineering. Design, implementation and testing of a digital system: methodologies and tools.
A, for a signature: Participation at practice classes is compulsory. Students must attend practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't make up a practice

with another group. Attendance at practice classes will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Students are required to bring the made notes and using engineering instruments (square rulers, bows, calculating machine) to each practice class of the course. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence due to the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade: The course ends in a mid-semester grade (AW5). Based on the average of the test results, the mid-semester grade is calculated as an average of them: - the average grade of the two tests The minimum requirements for the mid-term and end-term tests are 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5) If the score of any test is below 60, once students can take a retake test covering the whole semester material.

Required reading materials

Mircea Teodor POP: CAD FOR MECHATRONICS - laboratory handbook
University of Debrecen , 2012. ISBN: 978-963-473-515-1
Mircea Teodor POP: CAD for Mechatronics - course book
University of Debrecen, 2012. ISBN: 978-963-473-514-4

Department of Electrical Engineering and Mechatronics

Subject: **PROJECT OF MECHATRONICS**
Year, Semester: 4th year/1st semester
Practical: **16**

1st week:
Practical: Consultation

2nd week:
Practical: Consultation

3rd week:
Practical: Consultation

4th week:
Practical: Consultation

5th week:
Practical: Consultation

6th week:
Practical: Consultation

7th week:
Practical: Consultation

8th week:
Practical: Consultation

9th week:
Practical: Consultation

10th week:
Practical: Consultation

11th week:
Practical: Consultation

12th week:
Practical: Consultation

13th week:
Practical: Consultation

14th week: **Practical:** Consultation **15th week:** **Practical:** Consultation	**16th week:** **Practical:** Consultation

Requirements

Topics: Project of Mechatronics is a self-made task. Supervision of the teacher is compulsory to get a good result. Students have to use their abilities gathered during the previous semesters such as Mechatronics, Electronics, Programming, Robotics, especially in the field of interest of the supervisor and the project.
For an end term-grade (AW5): Students have to submit a poster presentation and have to make an oral presentation about the topic covered by the Project. Presentation will be held in a greater plenum. The course ends in a mid-semester grade. Based on the average of the marks of the tasks.

CHAPTER 8
INTERNSHIP

All the necessary formal documents can be downloaded from the website of the Faculty of Engineering. www.eng.unideb.hu (English Page/Internship)
Internship Guide Mechatronics Engineering BSc, Operational and Maintenance Specialization
Students majoring in the Mechatronics Engineering BSc have to carry out a 6 weeks internship involved in the model curriculum. The internship course must be signed up for previously via the NEPTUN study registration system in the spring semester (4th semester). Its execution is the criteria requirement of getting the leaving certificate (absolutorium).
I. Objective of the internship, competences ·
Students get acquainted with professional work in conformity with their major at the company or institution and join in the daily working process. They have to resolve tasks independently assigned by their supervisor and gain experiences may be utilized later in the labour market. ·
During the internship common and professional competences may be acquired. Common competences: precise working on schedule either individually or in team, talk shop applying correct technical terms. Professional competences: applying the professional skill gained during the training and acquiring new knowledge.
II. Places suitable for internship
All the organizations, institutions and companies, provide students with the opportunity to acquire proficiency in accordance with their specialization in the field of operation, repairing technology, installation, management and development of different machines and vehicles, may be a suitable place.
III. Documents necessary for commencing and completing the internship
The numbers of document copies is equivalent with the number of signers. The document types which must be signed are here: Invitation Letter, Internship Cooperation, “Megállapodás” (Company in Hungary), Student Agreement (Company abroad) The submission deadline is 30th May 2016 to secretariat (Ms. Nóra Tóth, room 120).
Evaluation Sheet and Certificate must be submitted till 9th September 2016 to Ms. Nóra Tóth. Initiative of the internship at the company and providing for the documents from the company is the student’s duty. If the student doesn’t specify the receiving company or doesn’t provide for the Invitation Letter or the initiative of the Agreement and the Student Agreement (or its signature) in time, the major responsible will refuse the Internship Certificate.
IV. Execution of the Internship and its certification
1. The duration of the internship is 6 weeks.
2. Besides completing the internship, students have to compile a 15-20 pages essay about the work done. The topic of the essay must be negotiated with the supervisor and attached to the activity actually done by the student. It is expedient to choose a topic which may be appropriate either for participating in the National Scientific Students' Associations Conference ("OTDK") or a thesis.
3. The execution of the internship must be certified by the Evaluation Sheet and Certificate form can be downloaded from the website of the Department of Mechatronics Engineering. The deadline of submitting the Essay and the “Evaluation Sheet and Certificate”: 9th September 2016, office 120 (Ms. Nóra Tóth) Summary of the tasks and deadlines regarding the internship · the student sign up for the Internship course via the NEPTUN in the spring semester,
· contact the company and provide for the Invitation Letter (1 copy) must be submitted to the secretariat, for the Internship Cooperation (2 original copies, company is abroad) or ““Internship Cooperation with Company in Hungary”” (4 original copies, company is in Hungary) and for the Student Agreement (3 original copies) respectively signed by the company till 30th May 2016. Please remember that it is the student’s responsibility to meet the deadline given! Having the documents signed by the Dean of the Faculty and sending copies to the company by post is the duty

of the secretariat.

· executing the 6 weeks internship in the summertime,

· providing for the Evaluation Sheet and Certificate form at the end of the internship and submitting it together with the essay to Mr. András Gábora responsible for the internship program at the department till 9th September 2016.

V. Exemption

A partial exemption may be required by the student who has completed an internship in the secondary school and it is certified by the secondary school certificate. The request for partial exemption can be submitted till 30th May 2016. After this deadline requests are denied. The copy of the secondary school certificate and the written request addressed to Dr. Géza Husi major responsible must be submitted to Ms. Nóra Tóth secretary (office 120). In case of any problem arising from the internship please contact Mr Géza Husi head of the Department of Electrical and Mechatronic Engineering (office 120, tothnora@eng.unideb.hu) or Ms. Nóra Tóth secretary (office 120, tothnora@eng.unideb.hu).

CHAPTER 9
THESIS

1. „Thesis” course
The „Thesis” course may be signed up for in the beginning of the semester via the NEPTUN system after negotiating it with the internal tutor (supervisor). During the semester students have to give an account of the actual state of the thesis to the internal tutor at least three times, which is certified on the Consultation Sheet. The Consultation Sheet is made out and managed by the supervisor. The thesis can be submitted at the end of the semester after approving it by the supervisor on the Consultation Sheet. The grade gained for it is not identical with the grade of the evaluation of the Thesis, it is merely a grade of the „Thesis” course. The precondition of approving the course must be negotiated with the supervisor however in general 80% readiness of the thesis is the minimum requirement. The Consultation Sheet signed by the supervisor must be bound into the thesis!
2. After negotiating with the supervisor for the company providing for the thesis topic, the external tutor has to have the Form of Thesis Topic Announcement signed certifying that his/her company provides Thesis Topic for the student. Thesis Topic Announcement Form signed by the external tutor and the company must be delivered to the Department. In addition to this, the filled form without signature in MS Word file should be sent to secretary's e-mail address as soon as it is finalized but not later than the deadline. On the basis of this, the Thesis Sheet is constructed by the Department and it must be bound into the thesis. The data necessary for constructing the Thesis Sheet must be handed in at the department (in that case as well, if the company didn’t sign the Thesis Topic Announcement Form in time): - name of the student, - title of the thesis, - tasks must be elaborated in some sentences, (commonly the same as the chapters of the thesis), - name of the internal tutor (supervisor), - name of the external tutor, name of the company, - two chose subjects for the final exam (qv. final exam guide).
3. Plagiarism is strictly forbidden! Student has to sign the Plagiarism Statement must be bound into the thesis between the Thesis Sheet and the Consultation Sheet. The Plagiarism Statement must be filled electronic as well.
4. Formal Thesis Requirements (minimum number of pages, font style and size, prescriptions regarding the content, etc.) may be downloaded from the above mentioned website as well.
To be handed in:
- 2 bound copies (1 for the Department, 1 for the external examiner) The following must be bound (in this sequence):
- Thesis Sheet (with serial number and the signature of the head of department) – can be required from the secretariat after the end of November (it is not the sheet signed by the company!), - Plagiarism Statement – must be filled electronic and sign by the student, - Consultation Sheet (issued and signed by the supervisor), - occasional Confidential Agreement,
- photo 4x4 cm. To be handed in with the thesis, but not bound:
- max. 1 page abstract* in English containing the name of the student, the title of the thesis, and the brief summary of the topic, with readable signature,
- max. 1 page abstract* in Hungarian containing the name of the student, the title of the thesis, and the brief summary of the topic, with readable signature, - thesis in electronic version (tagged: name, major, title of thesis, date of final exam) on CD or DVD in MS Word or PDF format. * It is not identical with the “Summary” chapter of the thesis though obviously similar to its content. It contains the objective, the topics and tasks elaborated by the student, and the conclusion in some sentences regarding the topic respectively! One copy of the thesis remains at the department which will be presented in the final exam. Another copy is given for the external examiner which after referee will get back to the student.
You can find all the formal documents you need to download on the website of the Faculty here: http://www.eng.unideb.hu (English Page/Thesis)

Objective

These guidelines describe the formal principles that must be observed when writing thesis at the Faculty of Engineering. Adhering to these principles ensures comparability between different theses. Furthermore, this guidance provides you assistance to the successful elaboration and submission of the thesis. General principles Students majored in engineering have to write thesis for completing the academic studies. The successful elaboration and submission of the thesis is the condition of admission for the finals. The aim of writing thesis is to systematize the theoretical and the professional knowledge of the candidates and to prove the skill in the field of constructing and seizing procedures. The thesis is a resolution of a real technical problem as an engineering task. The candidate proves by writing thesis that he/she is capable of working on engineering task independently. This is why the thesis must be elaborated and compiled with the greatest carefulness considering the specific requirements for format and structure.

The topics of the thesis are provided by the companies, firms, research institutes from their running tasks to be elaborated. Consequently, the appropriate solution of the engineering task is useful for the companies as well. Full and part time students can obtain thesis topic unaided from companies. The essay and experiment report made for the National Scientific Students' Association Conference ("OTDK") may be developed for degree thesis as well. For the elaboration of the thesis 3 weeks are ensured – stated in the model curriculum – after finishing the scheduled lessons in the term (before the examination period). Of course, there is opportunity to study the specialized literature and negotiate it with the supervisor earlier since the thesis topic has been issued previously. The candidate is supported by the internal tutor (supervisor) and the external tutor (supervisor) however the task must be solved individually. The internal supervisor assigned the details must be elaborated which could not be defined at the announcement of the thesis topic. The profoundness of the elaboration and the proportion of the parts are specified by the supervisors primarily and by the internal one. The thesis is pronounced by the supervisors to be appropriate for submission if it is completed and meets the formal, content and look requirements.

Format, layout, structure and the length of the thesis:

Structure of the thesis: (bounded with black fabric cover with gilt letters on it) - Cover page
- Original thesis sheet (must be bound!)
- Table of contents (with the page number 3, after that it is consecutively numbered)
- List of abbreviations and symbols (if applicable)
- Text (introduction, main part, conclusion)
- Bibliography
- Appendix (if applicable)
- Drawings
- Abstract (Max. 1 page abstract in Hungarian and in English containing the name of the student, the title of the thesis and the brief summary of the topic. The abstracts are not bound into the thesis!) The structure of a paper should allow the reader to quickly gain an overview of its contents. It is thus important that the selected headings reflect the content in a concise way. The central theme should be clearly visible from the structure as presented in the table of contents. Layout of the thesis: The paper format is DIN A4, portrait orientation.

The thesis must be printed single-sided and bound in hardcover.

The page margin is 30 mm on left side to allow printing and binding. The page margin is 20 mm on the right side. The page margin is 25 mm on the top/bottom.

The recommended standard font and font size are the following: Times New Roman CE 13, full justification, Arial CE 12, full justification, Line spacing is 1.5. The content is structured in consecutively numbered chapters.

Chapter sections and subsections should also be assigned a numerical index. E.g.: 1.Introduction 1.1. Problem definition 1.1.1. The method of inspection, measurement 1.1.1.1. Results, implication The chapter structure should not have more than 4 hierarchical levels. Headings of the first

hierarchy 14 points, bold; heading 2: 12 points, bold; heading 3: 12 points, bold and italic; heading 4: 12 points, italic. One section requires a minimum of two sub-sections or none at all. Page numbers should be indicated on every page on the bottom / outside. Length of the thesis: The main body of the text of the thesis must be between 30-50 A4 pages in length. It contains about 1500 characters (including space characters) per page. The table of contents, the reference list and appendixes are not to be included in the count. Additional tables, calculations and graphs that are too voluminous for or not explicitly mentioned in the running text have to be placed in the appendix. Language of the thesis: The thesis in the English program must be written in English. Both UK and US spelling are possible. Look of the thesis The look of the thesis has to be nice with uniform appearance in some respect. This is why the following formal specifications have to be kept. The pages are not framed like a sizing record or a shop drawing. Text and figures built in the text The text has to be started with table of contents.
The table of contents (on a separated page) is followed by the list of the abbreviations and symbols. You should start the main text with an introduction that briefly and clearly outlines the topic of your work and the survey of the specialized literature. The candidate has to prove his/her proficiency in the topic. The text should be concise clear and contain correct technical terms. The figures and pictures have to be inserted into the Microsoft Word document. Tables and figures should be numbered and have a caption. Please be aware that also figures need to be referenced. In particular, please pay attention to copyright issues and the often-required permission to reprint figures.
The stressing and sizing procedures must be explained in the text in that way so that it can be followed by a non-professional person as well.
Before the main text begins, you should also include a list of abbreviations, a list of graphs and tables, and a list of formulas and symbols (in this order) that are used in your paper. They should also be listed in your table of contents. The list of abbreviations contains all the abbreviations that are used in the thesis except for those in common use like "e.g.", "etc.", "i.e.", which can be found in a standard dictionary. All abbreviated terms must be written out when they are first mentioned in the text.
Calculated and measured data should be compiled in a table placed either in the text or in the appendix with numbering and referring.
Tables, graphs and formulas
Tables, graphs and formulas should be numbered continuously per section to make them uniquely identifiable. Example: Table 2.3 is the third table in chapter 2.
Tables and graphs are to be given a caption to characterize their content and should be explanatory by themselves. Example: Graph 3.4: Example of a table header (Source: Statistisches Bundesamt: Statistisches Jahrbuch 2008 für die Bundesrepublik Deutschland, Wiesbaden, September 2008, p. 58).
Additional tables and graphs that are too voluminous or are not explicitly mentioned in the running text must be placed in the appendix.
The formulas are numbered per section and the numbering must be stated on the right in parenthesis and right-justified. Numbers
Numbers from zero to twelve should be written out.
To depict decimals use a point in English; thousands are separated by a comma in English (i.e. English: 1,234,567.89).
Units of measurement that do not follow a number are to be written out: “15 kg”, but “Kilogram is a unit of measurement.”
References
References must be displayed in the list of references. Clear references are of importance throughout the thesis and must be numbered eg. [4]. The numbering of the references is made from 1 to “n” in the order of appearances. Referring to own papers or assignments must also be in a proper way. The same applies to references from the Internet. The electronic references must be

referred to in such a way that a reader can relocate your reference. The plagiarism is strictly forbidden. The reference list must contain:
Last name and initials of the author's first name
Full title of the book, periodical or article
Publisher and place of publishing
Year of publishing For Example: [4] Pattantyus Á.G.: Gépész és villamosmérnökök kézikönyve Budapest, Műszaki Könyvkiadó, 1961. [5] K.V.Jegorov: Osznovü teorij avtomaticseszkogo regulirovanyija Izdatyel'sztvo Energija, Moszkva, 1967. [8] Lajtai I.: Szerszámgép-kiszolgáló robotok megfogószerkezetei Automatizálás, 1983. 3.sz. p. 37-41.
Drawings
Drawings are made either by computer program or by hand and ink in on max. A/1 drawing sheet. All the drawings must be numbered. The drawing number consists of two parts. The first part corresponds with the serial number of the thesis (placed at the right top corner of the cover page). The other one numbered from 1000 is the number of the drawing according to the rules of drawing numbering (assembly drawing, part assembly drawing, shop drawing). The drawings must be fold into A/4 size and put into the bag formed in the internal side of the cover at the back. It is expedient to inform the bookbinder about the amount of drawings must be stored in it. Handing in, evaluation The thesis fulfilling the formal requirements has to be handed in to the internal supervisor in two copies on schedule.
The hand in-date is indicated on the thesis sheet. The submission is approved by the signature of the supervisor. The print out has to be accompanied by an electronic version on a CD or DVD (word, pdf or image format). The thesis is evaluated by the two supervisors. The final mark is given by the Finals Committee. One 4 cm x 4 cm photo of the candidate must be bound on the internal side of the cover at the back. Elaborating/submitting the Thesis
1. „Thesis” course
The „Thesis” course may be signed up for in the beginning of the semester via the NEPTUN system after negotiating it with the internal tutor (supervisor). During the semester students have to give an account of the actual state of the thesis to the internal tutor at least three times, which is certified on the Consultation Sheet. The Consultation Sheet is made out and managed by the supervisor. The thesis can be submitted at the end of the semester after approving it by the supervisor on the Consultation Sheet. The grade gained for it is not identical with the grade of the evaluation of the Thesis, it is merely a grade of the „Thesis” course. The precondition of approving the course must be negotiated with the supervisor however in general 80% readiness of the thesis is the minimum requirement. The Consultation Sheet signed by the supervisor must be bound into the thesis!
2. After negotiating with the supervisor…
After negotiating with the supervisor for the company providing for the thesis topic, the external tutor has to have the Form of Thesis Topic Announcement signed certifying that his/her company provides Thesis Topic for the student. Thesis Topic Announcement Form signed by the external tutor and the company must be delivered to the Department. In addition to this, the filled form without signature in MS Word file should be sent to tothnora@eng.unideb.hu address as soon as it is finalized but not later than the deadline. On the basis of this, the Thesis Sheet is constructed by the Department and it must be bound into the thesis. The data necessary for constructing the Thesis Sheet must be handed in at the department (in that case as well, if the company didn’t sign the Thesis Topic Announcement Form in time): name of the student,
title of the thesis,
tasks must be elaborated in some sentences, (commonly the same as the chapters of the thesis),
name of the internal tutor (supervisor),
name of the external tutor, name of the company,
two chosen subjects for the final exam (qv. state exam guide).
3. Plagiarism

Plagiarism is strictly forbidden! Student has to sign the Plagiarism Statement must be bound into the thesis between the Thesis Sheet and the Consultation Sheet. The Plagiarism Statement must be filled electronic as well.

4. Formal Thesis Requirements (minimum number of pages, font style and size, prescriptions regarding the content, etc.) may be downloaded from the above mentioned website as well.

To be handed in:

2 bound copies (1 for the Department, 1 for the external examiner) The following must be bound (in this sequence):

Thesis Sheet (with serial number and the signature of the head of department) - can be required from the secretariat (it is not the sheet signed by the company!),

Plagiarism Statement - must be filled electronic and sign by the student,

Consultation Sheet (issued and signed by the supervisor),

occasional Confidential Agreement,

photo 4x4 cm. To be handed in with the thesis, but not bound:

max. 1 page abstract* in English containing the name of the student, the title of the thesis, and the brief summary of the topic, with readable signature,

max. 1 page abstract* in Hungarian containing the name of the student, the title of the thesis, and the brief summary of the topic, with readable signature,

thesis in electronic version (tagged: name, major, title of thesis, date of state exam) on CD or DVD in MS Word or PDF format. * It is not identical with the “Summary” chapter of the thesis though obviously similar to its content. It contains the objective, the topics and tasks elaborated by the student, and the conclusion in some sentences regarding the topic respectively! One copy of the thesis remains at the department which will be presented in the state exam. Another copy is given for the external examiner which after referee will be got back to the student.

CHAPTER 10
MODEL CURRICULUM

Compulsory courses												
1. year												
		1st semester					2nd semester					
Subjects	**Neptun code**	L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	**Prerequisites of taking the subject**
Engineering Physics	**MFMFI31G02-EN**	2			ESE	2						None
Environmental Protection	**MFKOR31X02-EN**							2		ESE	2	Technical Chemistry MFKEM31X03-EN
Informatics for Engineers I	**MFINF31X03-EN**		2		AW5	3						None
Informatics for Engineers II	**MFINF32X03-EN**							2		AW5	3	Informatics for Engineers I. MFINF31X03-EN
Instrumental Technique	**MFMUS31R04-EN**								2	AW5	4	Methods of Presentation and Visualization MFMTC31R04-EN
Manufacturing Processes I	**MFGYT31G04-EN**						2		1	ESE	4	Materials Science I. MFANI31G04-EN
Materials Science I	**MFANI31G04-EN**	2	2		ESE	4						None
Mathematics I	**MFMAT31S05-EN**	2	3		ESE	5						None
Mathematics II	**MFMAT32S05-EN**						2	3		ESE	5	Mathematics I. MFMAT31S05-EN

Compulsory courses												
1. year (continued)												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
Methods of Presentation and Visualization	**MFMTC31R04-EN**	1		1	AW5	4						None
Operation and Theory of Machines	**MFAGT31G03-EN**	2		1	ESE	3						None
Technical Drawing I	**MFMAB31G03-EN**	1		2	AW5	3						None
Technical Drawing II	**MFMAB32G03-EN**						2		1	AW5	3	Technical Drawing I MFMAB31G03-EN
Technical Mechanics I	**MFMMC31G04-EN**	2		2	ESE	4						None
Technical Mechanics II	**MFMMC32G04-EN**						2		2	ESE	4	Technical Mechanics I. MFMMC31G04-EN, Mathematics I. MFMAT31S05-EN

Compulsory courses												
2. year												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
Basics of mechatronics	**MFMEA31R04-EN**	1		2	AW5	4						Mathematics I.MFMAT31S05-EN, Operation and Theory of MachinesMFAGT31G03
Economics for Engineers	**MFKGZ31X04-EN**	3			ESE	4						None
Electrotechnics and Electronics II	**MFELT32G02-EN**						2		1	ESE	2	None
Engineering Ethics	**MFTAI31X02-EN**						2			ESE	2	None
Machine Elements I	**MFGEP31G05-EN**	3		2	ESE	5						Technical Mechanics II. MFMMC32G04-EN, Technical Drawing II MFMAB32G03-EN
Machine Elements II	**MFGEP32G05-EN**						2		2	ESE	5	Machine Elements I. MFGEP31G05-EN
Manufacturing Processes II	**MFGYT32G04-EN**	2		1	AW5	4						Manufacturing Processes I. MFGYT31G04-EN

Compulsory courses												
2. year (continued)												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
ExamMathematics Final	**MFMAT30X00-EN**				FE	0						MFMAT33S03-EN
Mathematics III	**MFMAT33S03-EN**	2	2		ESE	3						Mathematics II. MFMAT32S05-EN
Measurement and Automatics I	**MFMET31R03-EN**						2		1	ESE	3	Electrotechnics and Electronics I. MFELT31G03-EN
Mechatronics I	**MFMHT31R04-EN**						1		2	AW5	4	Basics of mechatronics: MFMEA31R04-EN
Microeconomics	**MFVGF31X04-EN**						1	2		ESE	4	Economics for Engineers MFKGZ31X04-EN
Programming and Digital Techniques I	**MFDIG01R02-EN**								2	AW5	2	None
Technical Mechanics III	**MFMMC33G03-EN**	1		1	ESE	3						Technical Mechanics II. MFMMC32G04-EN, MATHEMATICS II. MFMAT32S05-EN

Compulsory courses												
2. year (continued)												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
Technical Mechanics IV	**MFMMC34G02-EN**						1		1	AW5	2	Technical Mechanics III. MFMMC33G03-EN
Technology of Structural Materials	**MFSAT31G02-EN**	1		1	ESE	2						Materials Science II. MFANI32G04-EN

Compulsory courses												
3. year												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
Basics of Quality Management	**MFMIN31X04-EN**	1	1		AW5	4						None
Building Automation I	**MFEPA31R03-EN**	2			ESE	3						MFEUG31EE2_EN
Building Automation II	**MFEPA32R05-EN**						2		4	ESE	5	Building Automation I.MFEPA31R03-EN, MFERZ31R03-EN
Building Energetics I	**MFEEN31G13-EN**						3			ESE	3	MFEPF31E03-EN
Building Physics	**MFEPF31E03-EN**	2	1		ESE	3						MFMFI31G02-EN
Building Service Systems I	**MFEUG31EE2-EN**	2			ESE	2						None
Building Service Systems II	**MFEUG32EE3-EN**								3	AW5	3	MFEUG31EE2-EN
CAD and CAE I	**MFCAD31G03-EN**			2	AW5	3						Informatics for engineers I. MFINF32X03-EN
CAD and CAE II	**MFCAD32G02-EN**								2	AW5	2	CAD and CAE I.MFCAD31G03-EN

Compulsory courses												
3. year (continued)												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
Electrical Machines and Drives	**MFVGH31R02-EN**						2		1	ESE	2	MFPRL31R04-EN Programmable Logic Controllers I.
Industrial Safety	**MFBIZ31X02-EN**						2			ESE	2	None
Management for Engineers	**MFMAM31X04-EN**						1	3		AW5	4	None
Material Handling	**MFARO31G03-EN**	2	1		AW5	3						MFGEP32G05-EN Logistics I.
Measurement and Automatics II	**MFMET32R04-EN**	2		2	AW5	4						Electrotechnics and Electronics II. MFELT32G02-EN, Measurement and Automatics I. MFMET31R03-EN
Mechatronics II	**MFMHT32R06-EN**	1		2	AW5	6						Mechatronics I: MFMHT31R04-EN

Compulsory courses												
3. year (continued)												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
Programmable Logic Controllers I	**MFPRL31G04-EN**			4	AW5	4						Electrotechnics and Electronics I. MFELT31G03-EN, Hydraulic and Pneumatic Machines MFHPG31G04-EN
Programmable Logic Controllers II	**MFPRL32R04-EN**								4	AW5	4	MFPRL31R04-EN
Programming and Digital techniques II	**MFDIG31R03-EN**			4	AW5	3						MFDIG01R02-EN
Robotics	**MFARO32R33-EN**						2		1	AW5	3	Logistics I. MFLOG31G02-EN
Sensors and actuators	**MFERZ31R03-EN**	2		1	ESE	3						Electrotechnics and Electronics II:MFELT32R04-EN
State administration and Law	**MFJOG31X02-EN**	2			ESE	2						None

Compulsory courses												
4. year												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
Project of Mechatronics	**MFMPR31R05-EN**			16	AW5	5						MFEEN31G13-EN, MFEPA32R05-EN, MGVGH31R02-EN, MFARO32R33-EN, MFPRL32R04-EN, MFSGY31R00-EN

BSc in Mechanical Engineering Compulsory courses												
1. year												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
CAD modelling I	**MFCAD31S04-EN**								4	AW5	4	Descriptive Geometry I.: MFABR31X04-EN
Construction Materials I	**MFEPA31S03-EN**						2	1		AW5	3	Engineering Physics: MFMFI31S03-EN, Technical Chemistry: MFKEM31S03-EN
Engineering Ethics	**MFTAI31X02-EN**						2			ESE	2	None
Engineering Physics	**MFMFI31G02-EN**	2			ESE	2						None
Environmental Protection	**MFKOR31X02-EN**							2		ESE	2	Technical Chemistry MFKEM31X03-EN
Informatics for Engineers I	**MFINF31X03-EN**			2	AW5	3						None
Informatics for Engineers II	**MFINF32X03-EN**								2	AW5	3	Informatics for Engineers I. MFINF31X03-EN
Instrumental Technique	**MFMUS31R04-EN**								2	ESE	4	None
Manufacturing Processes I	**MFGYT31G04-EN**						2		1	ESE	4	Materials Science I. MFANI31G04-EN

BSc in Mechanical Engineering Compulsory courses												
1. year (continued)												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
Materials Science I	**MFANI31G04-EN**	2	2		ESE	4						None
Materials Science II	**MFANI32G04-EN**						2	2		AW5	4	Materials Science I. MFANI31G04-EN
Mathematics I	**MFMAT31S05-EN**	2	3		ESE	5						None
Mathematics II	**MFMAT32S05-EN**						2	3		ESE	5	Mathematics I. MFMAT31S05-EN
Operation and Theory of Machines	**MFAGT31G03-EN**	2		1	ESE	3						None
Technical Chemistry	**MFKEM31X03 -EN**	2	1		ESE	3						None
Technical Drawing I	**MFMAB31G03-EN**	1		2	AW5	3						None
Technical Drawing II	**MFMAB32G03-EN**						2		1	AW5	3	Technical Drawing I MFMAB31G03-EN
Technical Mechanics I	**MFMMC31G04-EN**	2		2	ESE	4						None
Technical Mechanics II	**MFMMC32G04-EN**						2		2	ESE	4	Technical Mechanics I. MFMMC31G04-EN, Mathematics I. MFMAT31S05-EN

BSc in Mechanical Engineering Compulsory courses												
1. year (continued)												
		1st semester					2nd semester					
Subjects	**Neptun code**	L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	**Prerequisites of taking the subject**
Thermodynamics and Fluid Mechanics I	**MFHOA31G05-EN**						2	2		ESE	5	Mathematics I. MFMAT31S05-EN, Engineering Physics MFMFI31G02-EN

BSc in Mechanical Engineering Compulsory courses												
2. year												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
3D Computer Aided Design	**MF3DP31G03-EN**								2	AW5	3	Machine Elements I. MFGEP31G05-EN, CAD and CAE I. MFCAD31G03-EN
Automotive Constructions	**MFITE31G03-EN**	2			AW5	3						None
CAD and CAE I	**MFCAD31G03-EN**	1		1	AW5	3						Informatics for Engineers II. MFINF32X03-EN
Calculations with Matlab	**MFECM31X03-EN**							2		AW5	3	Mathematics I, Mathematics II
Economics for Engineers	**MFKGZ31X04-EN**	3			ESE	4						None
Electronics and Electrotechnics II	**MFELT32G02-EN**						2		1	ESE	2	Electrotechnics and Electronics I. MFELT31G03-EN

BSc in Mechanical Engineering Compulsory courses												
2. year (continued)												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
Electrotechnics and Electronics I	**MFELT31G03-EN**	2		1	ESE	3						Mathematics II. MFMAT32S05-EN, Engineering Physics MFMFI31G02-EN
Electrotechnics and electronics I	**MFELT31G03-EN**	2		1	ESE	3						Mathematics II. MFMAT32S05-EN, Engineering Physics MFMFI31G02-EN
Engineering Experimentation	**MFEEX31X02-EN**			2	AW5	2						None
Hydraulic and Pneumatic Machines	**MFHPG31G04-EN**						2		2	ESE	4	Thermodynamics and Fluid Mechanics II. MFHOA32G05-EN
Logistics I	**MFLOG31G02-EN**	2			ESE	2						None
Machine Elements I	**MFGEP31G05-EN**	3	2		ESE	5						Technical Mechanics II. MFMMC32G04-EN, Technical Drawing II MFMAB32G03-EN

BSc in Mechanical Engineering Compulsory courses												
2. year (continued)												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
Machine Elements II	**MFGEP32G05-EN**						2	2		ESE	5	Machine Elements I. MFGEP31G05-EN
Manufacturing Processes II	**MFGYT32G04-EN**	2		1	AW5	4						Manufacturing Processes I. MFGYT31G04-EN
Manufacturing Processes III	**MFGYT33G03-EN**						1		2	AW5	3	Manufacturing Processes II. MFGYT32G04-EN
examMathematics final	**MFMAT30X00-EN**				FE	0						MFMAT33S03-EN
Mathematics III	**MFMAT33S03-EN**	2	2		ESE	3						Mathematics II. MFMAT32S05-EN
Measurement and Automatics I	**MFMET31R03-EN**						2		1	ESE	3	Electrotechnics and Electronics I MFELT31G03-EN
Mechatronics I	**MFMHT31R04-EN**						1		2	AW5	4	Basics of mechatronics: MFMEA31R04-EN
Microeconomics	**MFVGF31X04-EN**						1	2		ESE	4	Economics for Engineers MFKGZ31X04-EN

BSc in Mechanical Engineering Compulsory courses												
2. year (continued)												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
Steel Constructions	**MFACS31G03-EN**						2	1		ESE	3	Technical Mechanics III. MFMMC33G03-EN, Technology of Structural Materials MFSAT31G02-EN
Technical Mechanics Final Exam	**MFMMC30G00-EN**									FE	0	Technical Mechanics III MFMMC33G02-EN
Technical Mechanics III	**MFMMC33G03-EN**	1		1	ESE	3						Technical Mechanics II. MFMMC32G04-EN, MATHEMATICS II. MFMAT32S05-EN
Technical Mechanics IV	**MFMMC34G02-EN**						1		1	AW5	2	Technical Mechanics III. MFMMC33G03-EN
Technology of Structural Materials	**MFSAT31G02-EN**	1		1	ESE	2						Materials Science II. MFANI32G04-EN
Thermal and Fluid Machines I	**MFHOG31G03-EN**						2		1	ESE	3	Thermodynamics and Fluid Mechanics I. MFHOA31G05-EN

BSc in Mechanical Engineering Compulsory courses													
2. year (continued)													
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
Thermodynamics and Fluid Mechanics II	**MFHOA32G05-EN**	2	2		ESE	5						Thermodynamics and Fluid mechanics I. MFHOA31G05-EN

BSc in Mechanical Engineering Compulsory courses												
3. year												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
Basics of Quality Management	**MFMIN31X04-EN**	1	1		AW5	4						None
Diagnostics	**MFDIA31G03-EN**	2		1	ESE	3						Machine Elements II. MFGEP32G05-EN
Drive Train Optimization	**MFHAT31G04-EN**						2		2	ESE	4	Machine Elements II. MFGEP32G05-EN, Manufacturing Processes III. MFGYT33G03-EN
Finite Element Method	**MFVEG31G04-EN**	2	1		AW5	4						3D Computer Aided Design: MF3DP31G03-EN,
Fracture Mechanics	**MFTMA31G03-EN**						2		1	ESE	3	Technical Mechanics IV. MFMMC34G02-EN,
Industrial Safety	**MFBIZ31X02-EN**						2			ESE	2	None
Machine Repairing I	**MFGPJ31G03-EN**	2		2	AW5	3						Technology of Structural Materials MFSAT31G02-EN
Machine Repairing II	**MFGPJ32G03-EN**						2		1	AW5	3	Machine Repairing I. MFGPJ31G03-EN

BSc in Mechanical Engineering Compulsory courses												
3. year (continued)												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
Maintenance Engineering I	**MFUZM31G03-EN**	2		1	ESE	3						Manufacturing Planning MFGYA31G04-EN, Internship MFTGY30G00-EN
Maintenance Engineering II	**MFUZM32G04-EN**						2		1	ESE	4	Maintenance Engineering I. MFUZM31G03-EN
Management for Engineers	**MFMAM31X04-EN**						1	3		AW5	4	None
Manufacturing Planning	**MFGYA31G34-EN**	2	2		AW5	4						Manufacturing Processes III. MFGYT33G03-EN
Material Handling	**MFARO31G03-EN**	2	1		AW5	3						MFGEP32G05-EN Logistics I.

BSc in Mechanical Engineering Compulsory courses												
3. year (continued)												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	
Measurement and Automatics II	**MFMET32R04-EN**	2		2	AW5	4						Electrotechnics and Electronics II. MFELT32G02-EN, Measurement and Automatics I. MFMET31R03-EN
Programmable Logic Controllers	**MFPRL31G04-EN**			4	AW5	4						Electrotechnics and Electronics I. MFELT31G03-EN
Project work	**MFPRO31G32-EN**							2		AW5	2	MFGEP32G05, MFGYT33G032
Robotics	**MFARO32R33-EN**						2		1	AW5	3	Logistics I. MFLOG31G02-EN
State administration and Law	**MFJOG31X02-EN**	2			ESE	2						None
Thermal and Fluid Machines II	**MFHOG32G03-EN**	2		1	ESE	3						None

BSc in Mechanical Engineering Freely Chosen Courses								
Department	**Subject**	**Neptun code**	**Crd. point**	**Semester**	**Nr. of hours**	**Exam**	**Prerequisites of taking the subject**	**Coordinator**
Department of Electrical Engineering and Mechatronics	**Advanced Robot Applications**	**MFARA31X03-EN**	3	2	4	AW5	Material Handling I.	Péter Tamás Szemes Ph.D.