BULLETIN

UNIVERSITY OF DEBRECEN

ACADEMIC YEAR 2016/2017

Mechanical Engineering BSc

FACULTY OF ENGINEERING

Coordinating Center for International Education

Table of Contents

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
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		Marcel Ferencz DLA
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
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	Ms.	Rita Nagyné Kondor Ph.D.
Assistant Lecturer	Ms.	Adrien Árvainé Molnár
	Ms.	Éva Csernusné Ádámkó
		Csaba Gábor Kézi
	Ms.	Erika Perge
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Assistant Lecturer		Béla Bodó
		Imre Csáky
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		Gábor L. Szabó
		Ferenc Szodrai
		Zoltán Verbai
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CHAPTER 5
ACADEMIC CALENDAR OF THE FACULTY OF ENGINEERING

It is an informative table. you can see the actual Academic Calendar on our website: www.eng.unideb.hu (in English Program menu).

Faculty calendar of the academic year 2016/2017	
Faculty of Engineering, University of Debrecen	
Opening ceremony of the academic year	11th September 2016.
1st semester registration week	From 12th September till 16th September 2016.
Repeat period of exam courses announced for the 1stsemester of the academic year 2016/2017	From 12th September till 16th September 2016.
1st semester study period of BSc program	From 19th September till 23rd December 2016 (14 weeks). In case of finalist courses: from 19th September till 18th November 2016 (10 weeks).
1st semester study period of BSc dual program	From 19th September till 16th December 2016 (13 weeks).
Reporting period (Drawing week) of BSc and BSc dual program	From 31st October till 4th November 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 12th December till 16th December 2016 (5 working days without scheduled lessons, consultation schedule announced previously).
1st semester exam period	From 27th December 2015 till 10th February 2016 (7 weeks). From 21st November till 23rd December 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 state exam.
State exams (according to the decision of the departments)	At least one occasion in January 2017. The departments shall advertise the date of the state exam until 15th September 2016.
2ndsemester registration week	From 13th February till 17th February 2017.
2nd semester study period of BSc program	From 20th February till 26th May 2017 (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 20th February till 19th May 2017 (13 weeks).
Reporting period (Drawing week) of BSc and BSc dual program	From 27th March till 31st March 2017. (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 15th May till 19th May 2017 (5 working days without scheduled lessons, consultation schedule announced previously).
2nd semester exam period	From 29th May till 14th July 2017 (7 weeks). From 24th April till 26th May 2017 (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 state exam.
State exams (according to the decision of the departments)	At least one occasion in June 2016. The departments shall advertise the date of the State exam until 15th February 2017.

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
MODEL CURRICULUM OF MECHANICAL ENGINEERING BSC TRAINING

Compulsory courses for the 1st year

Sem.	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
1	Basics of Engineering Calculations	MFTTA31X00-EN		2		AW5	0	None
1	Engineering Physics	MFMFI31G02-EN	2			ESE	2	None
1	Informatics for Engineers I	MFINF31X03-EN			2	AW5	3	None
1	Materials Science I	MFANI31G04-EN	2	2		ESE	4	None
1	Mathematics I	MFMAT31S05-EN	2	3		ESE	5	None
1	Operation and Theory of Machines	MFAGT31G03-EN	2		1	ESE	3	None
1	Technical Chemistry	MFKEM31X03 -EN	2	1		ESE	3	None
1	Technical Drawing I	MFMAB31G03-EN	1		2	AW5	3	None
1	Technical Mechanics I	MFMMC31G04-EN	2		2	ESE	4	None

Compulsory courses for the 1st year

Sem.	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
2	CAD modelling I	MFCAD31S04-EN			4	AW5	4	Descriptive Geometry I: MFABR31X04-EN
2	Construction Materials I	MFEPA31S03-EN	2	1		AW5	3	Engineering Physics: MFMFI31S03-EN, Technical Chemistry: MFKEM31S03-EN
2	Engineering Ethics	MFTAI31X02-EN	2			ESE	2	None
2	Environmental Protection	MFKOR31X02-EN		2		ESE	2	Technical Chemistry MFKEM31X03-EN
2	Informatics for Engineers II	MFINF32X03-EN			2	AW5	3	Informatics for Engineers I MFINF31X03-EN
2	Instrumental Technique	MFMUS31R04-EN			2	ESE	4	None
2	Manufacturing Processes I	MFGYT31G04-EN	2		1	ESE	4	Materials Science I MFANI31G04-EN
2	Materials Science II	MFANI32G04-EN	2	2		AW5	4	Materials Science I MFANI31G04-EN
2	Mathematics II	MFMAT32S05-EN	2	3		ESE	5	Mathematics I MFMAT31S05-EN
2	Technical Drawing II	MFMAB32G03-EN	2		1	AW5	3	Technical Drawing I MFMAB31G03-EN
2	Technical Mechanics II	MFMMC32G04-EN	2		2	ESE	4	Technical Mechanics I. MFMMC31G04-EN, Mathematics I MFMAT31S05-EN
2	Thermodynamics and Fluid Mechanics I	MFHOA31G05-EN	2	2		ESE	5	Mathematics I MFMAT31S05-EN, Engineering Physics MFMFI31G02-EN

Compulsory courses for the 2nd year

Sem.	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
1	Automotive Constructions	MFITE31G03-EN	2			AW5	3	None
1	CAD and CAE I	MFCAD31G03-EN	1		1	AW5	3	Informatics for Engineers II MFINF32X03-EN
1	Economics for Engineers	MFKGZ31X04-EN	3			ESE	4	None
1	Electrotechnics and Electronics I	MFELT31G03-EN	2		1	ESE	3	Mathematics II MFMAT32S05-EN, Engineering Physics MFMFI31G02-EN
1	Electrotechnics and electronics I	MFELT31G03-EN	2		1	ESE	3	Mathematics II MFMAT32S05-EN, Engineering Physics MFMFI31G02-EN
1	ENGINEERING EXPERIMENTATION	MFEEX31X02-EN			2	AW5	2	None
1	Logistics I	MFLOG31G02-EN	2			ESE	2	None
1	Machine Elements I	MFGEP31G05-EN	3	2		ESE	5	Technical Mechanics II. MFMMC32G04-EN, Technical Drawing II MFMAB32G03-EN
1	Manufacturing Processes II	MFGYT32G04-EN	2		1	AW5	4	Manufacturing Processes I MFGYT31G04-EN
1	Mathematics final exam	MFMAT30X00-EN				FE	0	MFMAT33S03-EN
1	Mathematics III	MFMAT33S03-EN	2	2		ESE	3	Mathematics II MFMAT32S05-EN
1	Technical Mechanics III	MFMMC33G03-EN	1		1	ESE	3	Technical Mechanics II MFMMC32G04-EN, MATHEMATICS II MFMAT32S05-EN
1	Technology of Structural	MFSAT31G02-EN	1		1	ESE	2	Materials Science II MFANI32G04-EN

	Materials							
1	Thermodynamics and Fluid Mechanics II	MFHOA32G05-EN	2	2		ESE	5	Thermodynamics and Fluid mechanics I MFHOA31G05-EN

Compulsory courses for the 2nd year

Students have other compulsory courses at their specialization which are not in this table but listed and detailed in Chapter 8.

Sem.	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
2	3D Computer Aided Design	MF3DP31G03-EN			2	AW5	3	Machine Elements I MFGEP31G05-EN, CAD and CAE I. MFCAD31G03-EN
2	Calculations with Matlab	MFECM31X03-EN		2		AW5	3	Mathematics I, Mathematics II
2	Electronics and Electrotechnics II	MFELT32G02-EN	2		1	ESE	2	Electrotechnics and Electronics I MFELT31G03-EN
2	Machine Elements II	MFGEP32G05-EN	2	2		ESE	5	Machine Elements I MFGEP31G05-EN
2	Manufacturing Processes III	MFGYT33G03-EN	1		2	AW5	3	Manufacturing Processes II MFGYT32G04-EN
2	Measurement and Automatics I	MFMET31R03-EN	2		1	ESE	3	Electrotechnics and Electronics I MFELT31G03-EN
2	Mechatronics I	MFMHT31R04-EN	1		2	AW5	4	Basics of mechatronics: MFMEA31R04-EN
2	Microeconomics	MFVGF31X04-EN	1	2		ESE	4	Economics for Engineers MFKGZ31X04-EN
2	Technical Mechanics Final Exam	MFMMC30G00-EN				FE	0	Technical Mechanics III MFMMC33G02-EN
2	Technical Mechanics IV	MFMMC34G02-EN	1		1	AW5	2	Technical Mechanics III MFMMC33G03-EN
2	Thermal and Fluid Machines I	MFHOG31G03-EN	2		1	ESE	3	Thermodynamics and Fluid Mechanics I MFHOA31G05-EN

Compulsory courses for the 3rd year

Students have other compulsory courses at their specialization which are not in this table but listed and detailed in Chapter 8.

Sem.	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
1	Basics of Quality Management	MFMIN31X04-EN	1	1		AW5	4	None
1	Maintenance Engineering I	MFUZM31G03-EN	2		1	ESE	3	Manufacturing Planning MFGYA31G04-EN, Internship MFTGY30G00-EN
1	Material Handling	MFARO31G03-EN	2	1		AW5	3	MFGEP32G05-EN Logistics I
1	Measurement and Automatics II	MFMET32R04-EN	2		2	AW5	4	Electrotechnics and Electronics II MFELT32G02-EN, Measurement and Automatics I MFMET31R03-EN
1	State administration and Law	MFJOG31X02-EN	2			ESE	2	None
1	Thermal and Fluid Machines II	MFHOG32G03-EN	2		1	ESE	3	None

Compulsory courses for the 3rd year

Sem.	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
2	Industrial Safety	MFBIZ31X02-EN	2			ESE	2	None
2	Management for Engineers	MFMAM31X04-EN	1	3		AW5	4	None
2	Project work	MFPRO31G32-EN		2		AW5	2	MFGEP32G05, MFGYT33G032
2	Robotics	MFARO32R33-EN	2		1	AW5	3	Logistics I MFLOG31G02-EN

CHAPTER 8
ACADEMIC PROGRAM FOR MECHANICAL ENGINEERING BSC

Basics of Natural Sciences

Subject: **BASICS OF ENGINEERING CALCULATIONS**
Coordinator: **Imre Kocsis**
Year, Semester: 1st year/1st semester
Seminar: **2**

1st week:
Seminar: Fractions, decimals. A ratio, a proportion, a percentage. Calculations with fractions. Handling exponents. Rounding and estimating. Normal forms of numbers (scientific notation). Basic number sets. Prime numbers, prime factorization.

2nd week:
Seminar: Points, lines, planes, segments, rays. Distance between points. Angles, types of angles. Parallel lines and transversals. Types of triangles (scalene, isosceles, equilateral, right). Congruent triangles. Centres of triangles.

3rd week:
Seminar: Polygons, interior and exterior angles of a polygon. Quadrilaterals. Characteristics of parallelograms. Kites and trapezoids.

4th week:
Seminar: Transformations (reflection, rotation, translation). Similar polygons, scale factor. Similar triangles. Right Triangles. Pythagorean theorem.

5th week:
Seminar: Parts of a circle, angles. Perimeter and area: triangles, quadrilaterals, general polygons, circles. Surface area and volume: polyhedral, prisms, cylinders, pyramids, cones, spheres.

6th week:
Seminar: Basic functions (polynomial, power, exponential, logarithmic, trigonometric), graphs and properties. Shifting and scaling.

7th week:
Seminar: Linear functions equations and inequalities. Graphical solution. Rates of change. Quadratic polynomials equations and inequalities. Factoring.

8th week:
Seminar: Test 1.
Self Control Test

9th week:
Seminar: Exponential, logarithmic, trigonometric equations and inequalities.

10th week:
Seminar: Random events. Probability. Classical probability formula. Conditional probability.

11th week:
Seminar: Empirical probabilities based on specific sample data. Percentile rank of an item in a data set, first, second, and third quartiles.

12th week:
Seminar: A histogram, a cumulative frequency histogram, a box-plot diagram. a scatter plot.

13th week:
Seminar: Discrete and continuous random variables. a mean, a median, a mode, a standard deviation, a variance.

14th week:
Seminar: A linear regression model. Normal distribution.

15th week:
Seminar: Test 2.
Self Control Test

Requirements

Topics:
Numbers and Basic Operations: Fractions, decimals. A ratio, a proportion, a percentage. Calculations with fractions. Handling exponents. Rounding and estimating. Normal forms of numbers (scientific notation). Prime numbers, prime factorization. Geometry: Points, lines, planes, segments, rays. Distance between points. Angles, types of angles. Parallel lines and transversals. Vectors, vector operations. Types of triangles (scalene, isosceles, equilateral, right). Congruent triangles. Centers of triangles. Polygons, interior and exterior angles of a polygon. Quadrilaterals. Characteristics of parallelograms. Kites and trapezoids. Transformations (reflection, rotation, translation). Similar polygons, a scale factor. Similar triangles. Right triangles. Pythagorean theorem. Parts of a circle, angles. Perimeter and area: triangle, quadrilaterals, general polygons, circles. Surface area and volume: polyhedral, prisms, cylinders, pyramids, cones, spheres. Constructing lines, angles, polygons, circles and arcs. Functions, equations and inequalities: Basic functions (polynomial, power, exponential, logarithmic, trigonometric), graphs and properties. Shifting and scaling. Linear functions equations and inequalities. Graphical solution. Rates of change (examples in physics). Quadratic polynomials equations and inequalities. Factoring. Exponential, logarithmic, trigonometric equations and inequalities. Statistics: Random events. Probability. Classical probability formulas. Conditional probability. Empirical probabilities based on specific sample data. Percentile rank of an item in a data set, first, second, and third quartiles. Histogram, cumulative frequency histogram, a box-plot diagram. A scatter plot. Discrete and continuous random variables. Mean, median, mode, standard deviation, variance. Linear regression models. Normal distribution. A, for a signature: Participation at practice is compulsory. Students must attend practice classes and may not miss more than three times during the semester. 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-term grade. 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

Mitas, P.J.: Basic Math Quick Reference eBook
ISBN: 978-0-615-27390-7
Zegarelli, M.: Basic Math & Pre-Algebra for dummies
Wiley Publishing, Inc.,
Freeman, C.M.: Hand-On-Geometry
Prufrock Press Inc., ISBN: 978-1-59363-555-8
Alexander, D.C., Koeberlein, A.: Elementary Geometry for College Students
BROOKS/COLE, 2011.
Larson, R., Farber, B.: Elementary Statistics - Picturing the World
Prentice Hall, 2012.

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: The 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

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

Subject: **MATHEMATICS II**
Year, Semester: 1st year/2nd semester
Lecture: **2**
Seminar: **3**
Practical: **5**

1st week:
Lecture: Derivatives, linear approximation. Differentiation rules.
Seminar: Derivatives, linear approximation. Differentiation rules.

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: Classification of differential equations. Initial value problems, boundary value problems. First order differential equations.
Seminar: 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

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

Addison Wesley : Thomas' Calculus
11th.2005. ISBN: 0-321-24335-8
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

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.

11th week:
Lecture: Line and surface integrals.
Seminar: Line and surface integrals.

12th week:
Lecture: The theorems of Gauss and Stokes,

Green's formulae.
Seminar: The theorems of Gauss and Stokes, Green's formulae.

13th week:
Lecture: Conservative vector fields, potentials.
Seminar: Conservative vector fields, potentials.

14th week:
Lecture: Applications in physics.
Seminar: Applications in physics.

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 formulae. 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

Addison Wesley : Thomas' Calculus
11th.2005. ISBN: 0-321-24335-8
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

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

Subject: **TECHNICAL MECHANICS I**
Coordinator: **Tamás Mankovits**
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 fractioned 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
Lawrence E. Goodman, Susan Goodman, William H. Warner : Statics Courier
Dover Publications, 2001. ISBN: 0486420051, 97804864
Ferdinand P. Beer, E. Russell Johnston, Jr: Mechanics for Engineers: Statics and Dynamics (Package)
4th. University of Connecticut, 1987. ISBN: ISBN-13 978007004584

Subject: **TECHNICAL MECHANICS II**
Coordinator: **Tamás Mankovits**
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.
Self Control Test

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

Subject: **TECHNICAL MECHANICS III**
Coordinator: **Tamás Mankovits**
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 r(t), v(t) and a(t) functions, example: motion with constant acceleration
Practical: calculation of the r(t), v(t) and 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: 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. ISBN: ISBN-13 978007004584

Subject: **TECHNICAL MECHANICS IV**
Coordinator: **Tamás Mankovits**
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

Subject: **TECHNICAL MECHANICS FINAL EXAM**
Coordinator: **Tamás Mankovits**
Year, Semester: 2nd year/2nd semester

Subject: **ENGINEERING PHYSICS**
Coordinator: **Zsolt Tiba**
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

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: **OPERATION AND THEORY OF MACHINES**
Coordinator: **Imre Kocsis**
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.

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.

Subject: **THERMODYNAMICS AND FLUID MECHANICS I**
Coordinator: **Ákos Lakatos**
Year, Semester: 1st year/2nd semester
Lecture: **2**
Seminar: **2**

1st week:
Lecture: Definitions and Fundamental Ideas of Thermodynamics.
Seminar: Solving problems in the theme of the lecture.

2nd week:
Lecture: Changing thesState of a system with heat and work. Zeroth Law of Thermodynamics
Seminar: Solving problems in the theme of the lecture.

3rd week:
Lecture: The isotherm, isochor, isobar, adiabatic and polytrophic process. The First Law of Thermodynamics: Conservation of Energy
Seminar: Solving problems in the theme of the lecture.

4th week:
Lecture: Corollaries of the First Law. Generalized Representation of Thermodynamic Cycles.
Seminar: Solving problems in the theme of the lecture.

5th week:
Lecture: The Carnot Cycle. Entropy. The second law of Thermodynamics.
Seminar: Solving problems in the theme of the lecture.

6th week:
Lecture: Reversibility andIrreversibility in natural processes. Technical work. Enthalpy. Exergy.
Seminar: Solving problems in the theme of the lecture

7th week:
Lecture: Mixtures: Partial pressure, Dalton's laws. Gas mixtures. Gas mixtures. Real gases.
Seminar: Solving problems in the theme of the lecture

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

9th week:
Lecture: Steam. Humid air. T-s diagram.
Seminar: Solving problems in the theme of the lecture

10th week:
Lecture: Energy cycles. Carnot 's Cycle, Joule' s cycle.
Seminar: Solving problems in the theme of the lecture

11th week:
Lecture: Heat transfers. Basic forms of a heat transfer
Seminar: Solving problems in the theme of the lecture. Threaded joints in section and on view.

12th week:
Lecture: Fundamental equations. General differential equation of heat conduction. Steady state and transient conduction.
Seminar: Solving problems in the theme of the lecture.

13th week:
Lecture: Thermal resistance. Conduction (plane walls, cylindrical walls, spherical walls). Convection: concepts and basic relations, boundary layers, similarity concept.
Seminar: Solving problems in the theme of the lecture.

14th week:
Lecture: Free convection, forced convection (the Reynolds, Grasshof, Prandtl, Galilei, Nusselt numbers).
Seminar: Solving problems in the theme of the lecture.

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

Requirements

Topics: Thermodynamic properties. Definitions and fundamental ideas of thermodynamics. Changing the state of a system with heat and work. Change of phase. The zeroth law of thermodynamics. The isotherm, isochore and isobar, adiabatic and polytropic processes. The first law of thermodynamics: conservation of energy. Generalized representation of thermodynamic cycles. The Carnot cycle. Entropy. The second law of thermodynamics. Reversibility and irreversibility in natural processes. Technical work. Enthalpy. Exergy. Gas mixtures: partial pressures, Dalton's law. Real gas types. Steam. Humid air. T-s diagrams. Energy cycles. Modes of heat transfer. Heat Flux, thermal conductivity. The general differential equation of heat conduction. Steady state and transient conduction. Thermal resistance. Conduction rectangular and cylindicar coordinates. Convection: concepts and basic relationships, boundary layers, the similarity concept. Heat transfer through gases, fluids and solids. Overall heat transfer coefficient. Moving heat sources. Extended surfaces, fin performances. Radiative heat transfers. Heat exchangers.
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 misses more than three, 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 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 drawing tasks and drawing instruments for the course 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 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 with an exam grade. Based on the average of the test results x 0.4 + the exam grade from the trheoryx0.6 the mid-semester grade is calculated as an average of them: The minimum requirement for the mid-term, end-term tests and for the exam is 50%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-50 fail (1) 51-60 pass (2) 61-74 satisfactory (3) 75-89 good (4) 90-100 excellent (5)

Required reading materials

LAKATOS A. : Thermodynamics and Fluid mechanics
2014.

Subject: **THERMODYNAMICS AND FLUID MECHANICS II**
Coordinator: **Ákos Lakatos**
Year, Semester: 2nd year/1st semester
Lecture: **2**
Seminar: **2**

1st week:
Lecture: Definitions and Fundamental Ideas of Fluid mechanics and Hydrostatics.Introducing to concepts, principles, laws, observations, and models of fluids at rest.
Seminar: Solving problems in the theme of the lecture.

2nd week:
Lecture: Introducing to concepts, principles, laws, observations, and models of fluids at rmotion.
Seminar: Solving problems in the theme of the lecture.

3rd week:
Lecture: Pressure and its variation, measurement and forces on plane and curved surfaces (fluid statics)
Seminar: Solving problems in the theme of the lecture.

4th week:
Lecture: Velocity and acceleration representations, visualizing and describing motion, rotational motion (fluid kinematics)
Seminar: Solving problems in the theme of the lecture.

5th week:
Lecture: Control volume (integral) approach for property (mass, energy, momentum) conservation Euler and Bernoulli equations
Seminar: Solving problems in the theme of the lecture.

6th week:
Lecture: Dimensional analysis and similitude/modeling.
Seminar: Solving problems in the theme of the lecture.

7th week:
Lecture: Ideal fluid kinematics and dynamics (applications to flow nets, pressure distributions and lift)
Seminar: Solving problems in the theme of the lecture.

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

9th week:
Lecture: Real fluid phenomena and description (resistance, laminar and turbulent flow, boundary layers, separation) with applications to lift and drag on objects.
Seminar: Solving problems in the theme of the lecture.

10th week:
Lecture: Shear, pressure and velocity distributions in pipe flow.
Seminar: Solving problems in the theme of the lecture.

11th week:
Lecture: Friction and fitting losses in pipe flow.
Seminar: Solving problems in the theme of the lecture.

12th week:
Lecture: Analysis and design of single pipe systems, types and characteristics of open channel flow (analysis of uniform flow)
Seminar: Solving problems in the theme of the lecture.

13th week:
Lecture: Modified Bernoulli. Diffusor.
Seminar: Solving problems in the theme of the lecture.

14th week:
Lecture: Forces acting on the body merged in fluid.
Seminar: Solving problems in the theme of the lecture.

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

Requirements

Topics: Definitions, concepts and properties of fluids. Hydrostatics, pressure, density. Main equations (Continuity, Law of Impulse Navier-Stokes etc.) Velocity and acceleration representations. Euler and Bernoulli equations. Ideal and Real Fluids. Flows in piped, friction and fitting losses in pipe flow. Frictional Bernoulli equation.
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 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 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 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 with an exam grade. Based on the average of the test results x 0.4 + the exam grade from the theory x0.6 the mid-semester grade is calculated as an average of them: The minimum requirement for the mid-term, end-term tests and for the exam is 50%. Based on the score of the tests separately, the grade for the tests is given according to the following table: Score Grade 0-50 fail (1) 51-60 pass (2) 61-74 satisfactory (3) 75-89 good (4) 90-100 excellent (5)

Required reading materials

LAKATOS A. : Thermodynamics and Fluid mechanics
2014.

Subject: **TECHNICAL CHEMISTRY**
Year, Semester: 1st year/1st semester
Lecture: **2**
Seminar: **1**

1st week:
Lecture: Sciences and chemistry, Quantitative laws in chemistry, basic concepts of stoichometry

2nd week:
Lecture: Characterization of macroscopic chemical systems, states of matter

3rd week:
Lecture: Solutions

4th week:
Lecture: Thermochemistry

5th week:
Lecture: Reaction rates

6th week:
Lecture: Equilibrium

7th week:
Lecture: Acid-base equilibriums, Heterogeneous equilibriums

8th week:
Lecture: Redox reactions

9th week:
Lecture: The structure of atoms

10th week:
Lecture: The structure of the nucleus

11th week:
Lecture: Quantum mechanical model of the atom

12th week:
Lecture: The chemical bond

13th week:
Lecture: Structures and bonding in chemical systems

14th week:
Lecture: Principles of determination a chemical structure

15th week:
Lecture: Theoretical models of solid materials: band theory and its applications to metals. Superconductivity and its applications. Commercial methods of metal production.

Requirements

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.
B, for a grade (ESE): A test after the completion of the semester, no midterm tests, sample test

questions provided on the website in the beginning of December. Website: http://www.inorg.unideb.hu/ All lecture materials are posted at least one day before the lecture. 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, once students can take a retake test of the whole semester material.

Required reading materials

Tom Holme, Larry Brown: Chemistry for Engineering Student
Brooks Cole, 2006. ISBN: 0534389740
Darrell Ebbing, Steven D. Gammon: General Chemistry
9th. Brooks Cole, 2007. ISBN: 978-06188574871
James O. Glanville: General Chemistry for Engineers
Preliminary Edition . Prentice Hall, 2000. ISBN: 978-0130325143
John McMurry – Robert C. Fay: Chemistry
6th. Prentice Hall , ISBN: 0321704959

Economics and Humanities

Subject: **ECONOMICS FOR ENGINEERS**
Coordinator: **Judit T. Kiss**
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 testThe 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.

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

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.
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: **MICROECONOMICS**
Coordinator: **Judit T. Kiss**
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.

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

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: **MANAGEMENT FOR ENGINEERS**
Coordinator: **Andrea Emese Matkó**
Year, Semester: 3rd year/2nd semester
Lecture: **1**
Seminar: **3**

1st week:
Lecture: The history of managementLecture: A classical school, integrating management theories, emerging management positions
Seminar: group work, situational tasks, discussion with different dispute methods

2nd week:
Lecture: Organization structures
Seminar: Matrix, Functional, Divisional, LinePractice: SWOT analysis

3rd week:
Lecture: Management gurusFayol, Taylor, Mitzberg, Porter, Weber, Mayo
Seminar: Pest model

4th week:
Lecture: Functions of management, Leadership theoriesPlanning, 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 stylesAutocratic, Bureaucratic, Laissez-faire, Democratic, Transformational leadership
Seminar: Tests measuring leadership styles, discussion of the results

7th week:
Lecture: Leadership qualitiesMost 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 managementTaming 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-solvingstrategic 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 Performancedetermining work performance, analyze the problems, find solutions
Seminar: Test measuring Work Performance,, discussion of the results

11th week:
Lecture: Emotional Intelligencedetermining 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 leadershipdefining 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 ManagementISO 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.

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

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

Subject: **ENGINEERING ETHICS**
Coordinator: **Zsolt Tiba**
Year, Semester: 1st 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.

Specific Compulsory Subjects

Subject: **INFORMATICS FOR ENGINEERS I**
Coordinator: **Mária Krauszné Princz**
Year, Semester: 1st year/1st semester
Practical: **2**

1st week:
Practical: Introduction to informatics.

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

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

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

5th week:
Practical: Algorithms.

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

7th week:
Practical: Sorting and filtering data.

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

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

10th week:
Practical: Relational databases.

11th week:
Practical: SQL language.

12th week:
Practical: Normalizing databases.

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

14th week:
Practical: Keys, transactions.

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

Requirements

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: **INFORMATICS FOR ENGINEERS II**
Coordinator: **Mária Krauszné Princz**
Year, Semester: 1st year/2nd semester
Practical: **2**

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

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

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

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

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

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

7th week:
Practical: 1st Mid-term exam.
Self Control Test

8th week:
Practical: 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:
Practical: A data flow model.Troubleshooting and debugging. Decision making: using selection. Using case structure.

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

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

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

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

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

15th week:
Practical: Make up or improve grades: End-term exam.
Self Control Test

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: 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: **TECHNICAL DRAWING I**
Coordinator: **Zsolt Tiba**
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 homeworks in time.
B, for a grade: The course ends in a mid-semester-grade. 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 DRAWING II**
Coordinator: **Zsolt Tiba**
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: ISO 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.

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: **MACHINE ELEMENTS I**
Coordinator: **Zsolt Tiba**
Year, Semester: 2nd year/1st semester
Lecture: **3**
Seminar: **2**

1st week:
Lecture: Requirements against components, stressing theories.
Seminar: 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.
Seminar: 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.
Seminar: 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.
Seminar: Constructing a welded base.

5th week:
Lecture: Positive and frictional torque transmitting connections. Torque capacity of keyed joints, spline joints, clamped joints.
Seminar: 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.
Seminar: 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.
Seminar: Sketching different constructions for a piston, a cap and a cover regarding sealing.

8th week:
Lecture: Helical springs, designing and stressing for a fatigue load.
Seminar: Sketching different constructions for a piston, a cap and a cover regarding sealing, studying similar constructions. Determining a spring diagram by measuring.

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

10th week:
Lecture: Bearings, lubrication principles and methods. Heat balance and application fields of journal bearings.
Seminar: 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).
Seminar: 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.
Seminar: 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
Seminar: Elaborating the records of stressing and design.

14th week:
Lecture: Selection of ball and roller bearings for service life.
Seminar: 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 (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 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: **MACHINE ELEMENTS II**
Coordinator: **Zsolt Tiba**
Year, Semester: 2nd year/2nd semester
Lecture: **2**
Seminar: **2**

1st week:
Lecture: Energy equilibrium of braking processes. A mechanical model of a winch crane.
Seminar: 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.
Seminar: 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.
Seminar: 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.
Seminar: Constructing a brake assembly drawing.

5th week:
Lecture: Couplings, rigid couplings, flexible couplings, universal joints. Supplementary loads on shafts having misalignment.
Seminar: 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.
Seminar: 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.
Seminar: Designing a belt and a chain drive of a counter drive.

8th week:
Lecture: Mid-term testA shaft and its associate parts. Designing a shaft and stressing against fatigue, plastic deformation, elastic deflection and critical speed.
Seminar: 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.
Seminar: Designing a counter shaft bearing. Selectingball bearings.

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

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

12th week:
Lecture: Checking gears for crest width, contact ratio and undercut.
Seminar: 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.
Seminar: 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.
Seminar: 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: **CAD SYSTEMS I**
Year, Semester: 2nd year/1st semester
Lecture: **1**
Practical: **1**

1st week:
Lecture: Presentation of the history of CAD. Presentation of the screen.Usage of palettes and tools.
Practical: Presentation of the history of CAD. Presentation of the screen.Usage of palettes and tools.

2nd week:
Practical: Presentation of draw settings, customizing and settings. Detailed presentation of drop-down boxes and toolbars.Giving the coordinates and drawing with coordinates.

3rd week:
Practical: Introduction of draw (line, polygon, circle, arch, line chain, etc.) and draw modifying commands (erase, copy, mirror, array, move, rotate, etc.).

4th week:
Practical: Drawing practice.

5th week:
Practical: 1st test
Self Control Test

6th week:
Practical: Presentation of draw settings, customizing and settings, drawing slab plan.

7th week:
Practical: Presentation of draw settings, customizing and settings, drawing slab plan.

8th week:
Practical: 2nd test
Self Control Test

9th week:
Practical: Presentation of draw settings, customizing and settings for ground plan.

10th week:
Practical: Presentation of draw settings, customizing and settings, drawing ground plan.

11th week:
Practical: Presentation of draw settings, customizing and settings, drawing ground plan.

12th week:
Practical: Settings of printing.Semester summary.

13th week:
Practical: Drawing practice.

14th week:
Practical: 3rd test
Self Control Test

15th week:
Practical: Repeat test.

Requirements

Topics: Making construction plans in ArchiCAD software. Settings of the program, applying styles for construction plans. Making foundation, reinforced concrete, steel and wooden construction plans. Presentation of the history of CAD. Presentation of the screen. Giving the coordinates and drawing with coordinates. Introduction of draw (line, polygon, circle, arch, line chain, etc.) and draw modifying commands (erase, copy, mirror, array, move, rotate, etc.). Managing the layer and introduction of features, settings. Settings of the line type, context and dimension style. Usage of palettes and tools. Creating and using blocks and references. Introduction of inquiries. Presentation of draw settings, customizing and settings. Detailed presentation of drop-down boxes and toolbars. Usage of model space and paper space. Settings of printing and printing. Making construction plans in AutoCAD software. Settings of the program, applying styles for construction plans. Making foundation, reinforced concrete, steel and wooden construction plans. Presentation of the history of CAD. Presentation of the screen. Giving the coordinates and drawing with coordinates. Introduction of draw (line, polygon, circle, arch, line chain, etc.) and draw modifying commands (erase, copy, mirror, array, move, rotate, etc.). Managing the layer and introduction of features, settings. Settings of the line type, context and dimension style. Usage of palettes and tools. Creating and using blocks and references. Introduction of inquiries. Presentation of draw settings, customizing and settings. Detailed presentation of drop-down boxes and toolbars. Usage of model space and paper space. Settings of printing and printing.
A, for signature: 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.
B, for grade (AW5): The course ends in mid-semester grade. 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 can't take any repeat test.

Required reading materials

Autodesk: AutoCAD help URL: http://www.autodesk.com/

Subject: **MATERIALS SCIENCE I**
Coordinator: **István Budai**
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

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
J.-P. Mercier: Introduction to Materials Science
Elsevier, 2002.
Alloy Phase Diagrams (ASM Handbook, Vol. 3)
ASM International, 1992.

Subject: **MATERIALS SCIENCE II**
Coordinator: **István Budai**
Year, Semester: 1st year/2nd semester
Lecture: **2**
Seminar: **2**

1st week:
Lecture: Static and dynamic material properties.
Seminar: Study of phase-transformations.

2nd week:
Lecture: Ferrous metal: steel and types of alloy, cast iron.
Seminar: Microstructure of ferrous metals and their classification.

3rd week:
Lecture: Non-ferrous metals and types of alloy: light metals, heavy metals, noble metals.
Seminar: Microstructure of non-ferrous metals and their classification.

4th week:
Lecture: Non-destructive testing methods I.: visual, radiographic, ultrasonic.
Seminar: Application of the test methods.

5th week:
Lecture: Non-destructive testing methods II.: magnetic, eddy current, dye penetrating, acoustic

emission
Seminar: Application of the testing methods.

6th week:
Lecture: Destructive testing methods: tensile, impact, fatigue.
Seminar: Application of the testing methods.

7th week:
Lecture: Destructive testing methods: fracture mechanics, hardness.
Seminar: Application of the testing methods.

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

9th week:
Lecture: Structure and properties of ceramics: crystal structure, deformation.
Seminar: Application and processing of ceramics.

10th week:
Lecture: Polymers: structure, classification
Seminar: Application and processing of ceramics.

11th week:
Lecture: Corrosion and degradation of material.
Seminar: Corrosion tests.

12th week:
Lecture: Nanomaterial and nanotechnology and applicability.
Seminar: Producing technology of nanomaterial.

13th week:
Lecture: Composites. Particle-reinforced, fiber-reinforced, structural composites.
Seminar: Examination of composites.

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

15th week:
Lecture: making up for laboratory practice

Requirements

Topics: The performance of materials under various loading and environmental conditions. Static and dynamic material properties. Fatigue (low cycle, high cycle fatigue), fracture (ductile, non-ductile), plastic collapse. Corrosion (local, global, stress corrosion cracking, inter-crystalline, trans-crystalline, erosion-corrosion). Material testing. Destructive testing methods (tensile, impact, fatigue, fracture mechanics, hardness, etc.). Introduction to non-destructive testing (NDT) methods (visual, radiographic, ultrasonic, magnetic, eddy current, dye penetrant, acoustic emission, etc.) Physical principles and areas of application. Flaw detection and sizing. Automation of NDT processes. The performance and evaluation of various laboratory tests (tensile, fracture mechanics, hardness).
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, 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 and six laboratory practice classes. The students have to prepare the test reports of each measurement. 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. Students have to sit for the tests.

B, for a grade (AW5): The end-grade of the course is calculated as: The minimum requirement for passing is 60% (each test), 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

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
Hellier, Chuck: Handbook of Nondestructive Evaluation
2nd. McGraw-Hill , 2012. ISBN: 9780071777148
McEvily, Arthur J., Kasivitamnuay, Jirapong: Metal Failure
2nd. John Wiley & Sons , 2013. ISBN: 9781118163962

Subject: **TECHNOLOGY OF STRUCTURAL MATERIALS**
Coordinator: **István Budai**
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 powdersconventional and alternative pressing and sintering.
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.

Required reading materials

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

Subject: **CAD SYSTEMS II**
Coordinator: **Sándor Hajdu**
Year, Semester: 2nd year/2nd semester
Lecture: **0**
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: Dimensioning. Create and modify Dimension Styles to control the appearance of dimensions.

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 classess 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 (AW5): The course ends in a mid-semester grade 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

Subject: **ELECTROTECHNICS AND ELECTRONICS I**
Coordinator: **Sándor Piros**
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.

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.
Self Control Test

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: 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.

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

Subject: **ELECTRONICS AND ELECTROTECHNICS II**
Coordinator: **Sándor Piros**
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 networksbasic 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**
Coordinator: **János Tóth**
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: Practice: 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: **MEASUREMENT AND AUTOMATICS II**
Coordinator: **János Tóth**
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 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

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

Subject: **THERMAL AND FLUID MACHINES I**
Coordinator: **Ferenc Szodrai**
Year, Semester: 2nd year/2nd semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Energy conversion, phase diagrams. Heat losses in different energy transformation processes.
Practical: The practical application of the theoretical curriculum introduced on the lecture.

2nd week:
Lecture: Power cycles.
Practical: The practical application of the theoretical curriculum introduced on the lecture.

3rd week:
Lecture: Combustion technologies
Practical: The practical application of the theoretical curriculum introduced on the lecture.

4th week:
Lecture: Boilers: Burners
Practical: The practical application of the theoretical curriculum introduced on the lecture.

5th week:
Lecture: Boilers: their structures, operation heat loss, efficiency of the burning process.
Practical: The practical application of the theoretical curriculum introduced on the lecture.

6th week:
Lecture: Biomass and steam boilers.
Practical: The practical application of the theoretical curriculum introduced on the lecture.

7th week:
Lecture: Steam and gas turbines
Practical: The practical application of the theoretical curriculum introduced on the lecture.

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

9th week:
Lecture: Mid-term test
Practical: The practical application of the theoretical curriculum introduced on the lecture.
Self Control Test

10th week:
Lecture: Heat pumps: operation principles, types, parameters, coefficient of performances.
Practical: The practical application of the theoretical curriculum introduced on the lecture.

11th week:
Lecture: Chillers. Absorption and adsorption machines.
Practical: The practical application of the theoretical curriculum introduced on the lecture.

12th week:
Lecture: End-term test
Self Control Test

Requirements

Topics: Energy conversion processes. Heat loss in different energy transformation processes. Thermal analysis of gas and steam turbines, gas motors. The Schema and its operation. Cycles and efficiency of these machines. Boilers: their structures, operation and heat loss, efficiency of a burning process. Efficiency of boilers at partial load. Heat exchangers: types, parameters, efficiency, heat transfer processes, heat loss. Dimensioning of heat exchangers. Heat pumps: operation principles, types, parameters, coefficient of their performances. Compressors: types, thermodynamic parameters, efficiency. Chillers. Absorption and adsorption machines.
A, for a signature: Attending 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 take part a 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, being discussed with the tutor. Students are required to bring calculators to each practice class. In each class active participation is evaluated by the teacher. If a student's behavior or conduct doesn't meet the requirement 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 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 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 of the whole semester material.

Required reading materials

M. J. MORAN, H. N. SHAPIRO, J. WILEY: Fundamentals of Engineering Thermodynamics
2004. ISBN: 978-0-471-78735-8
W. M. ROHSENOW, J. P. HARTNETT, Y. I. CHO: Handbook of Heat Transfer
McGraw-Hill , 1998. ISBN: 0070535558 / 9780070
K. C. WESTON: Energy Conversion
Har/Dsk edition . PWS Pub. Co., 1992. ISBN: 978-0534938611
J. HEYWOOD: Internal Combustion Engine Fundamentals
McGraw-Hill , 1988. ISBN: 978-0070286375
C. FAYETTE TAYLOR: The Internal Combustion Engine in Theory and Practice: Vol. 1
2nd. The MIT Press , 1985. ISBN: 978-0262700269
C.FAYETTE TAYLOR: The Internal Combustion Engine in Theory and Practice: Vol. 2
2nd. The MIT Press , 1985. ISBN: 978-0262700276
K. HEROLD, R. RADERMACHER: Absorption Chillers and Heat Pumps
CRC-Press, 1996. ISBN: 978-0849394270
T. KUPPAN: Heat Exchanger Design Handbook
CRC Publishing, 2000. ISBN: 978-0824797874

Subject: **THERMAL AND FLUID MACHINES II**
Coordinator: **Sándor Hámori**
Year, Semester: 3rd year/1st semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: System components, system classification, basic relationships of thermodynamics, fluid flow, laminar flow, turbulent flow.
Practical: basic relationships of thermodynamics

2nd week:
Lecture: Basic relationships of fluid flow, continuity, Bernoulli equation, major and minor losses, friction coefficient, roughness, sudden enlargement and contraction, exit and entrance

losses, gradual enlargement and contraction. Valves and Kvs values.
Practical: basic relationships of fluid flow

3rd week:
Lecture: Centrifugal pumps, construction of pumps, pump operation, wet and dry runner pumps, materials.
Practical: Choosing regulating valves, turbo machinery system components.

4th week:
Lecture: Pump curves, shut-off Head, maximum flow. Flat and steep characteristic curves. System characteristics. A duty point. Open systems, closed systems.
Practical: Pump choosing. Calculating the mass flow.

5th week:
Lecture: Pump efficiency, efficiency curves. Resistances connected in series and parallel. Pumps connected in series and parallel. Non-return valve.
Practical: Pump choosing in case of open and closed systems (a heating system, a cooling tower system)

6th week:
Lecture: Adjusting pump performances. A throttle control, a bypass control, modifying an impeller diameter, a speed control
Practical: Exercises on connected pumps.

7th week:
Lecture: Laws of affinity. Cavitations. NPSH. Review selection of pumps.
Practical: Compare the methods of adjusting pump performance.

8th week:
Lecture: Centrifugal and axial fans. Forward curved impellers, radial impellers, backward curved impellers.
Practical: Calculating energy consumption Affinity laws.

9th week:
Lecture: Tube axial fans, vane axial fans. Fan selections. Fan curves. Fans connected in series and parallel.
Practical: Fan selections. Calculating a duty point.

10th week:
Lecture: Fan laws. Fan installation and maintenance. A standard drive. Noises.
Practical: Exercises in connected fans.

11th week:
Lecture: Gas turbines. The gas turbine cycle. Performance and efficiency. Engine sections. Inlet, compressors, diffuser, combustor.
Practical: Elaborating the homework.

12th week:
Lecture: Visitation of the Sustainable Building EnergeticInformation Centre. Introduction of the building.

13th week:
Lecture: The current situation in energetics.
Practical: Elaborating the homework.

14th week:
Lecture: Submitting the homework.
Practical: End-term test.
Self Control Test

Requirements

Topics: It reviews the basic relationships of thermodynamics and fluid mechanics. Representations of the construction and operation of fluid machines. Fitting the suitable pumps, fans to the system characteristics. Calculating energy consumption. Fluid machines connected in series and parallel. Representations of system components.
A, for a signature: Attending 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. 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 have to submit the homework as scheduled minimum at a sufficient level. During the semester there is one test in the 14th week. Students have to sit for the test.
B, for a grade: The course ends in an exam grade. The semester grade is based on the result of the test and the examt. The grade is calculated as an average of them: - the grade of the end-term test - the exam grade. The minimum requirement for the end-term test is 50%. The grade for the test is given according to the following table: Score Grade 0-50 fail (1) 51-60 pass (2) 61-70 satisfactory (3) 71-80 good (4) 81-100 excellent (5) If the score of the test is below 50%, the student once can take a retake test of the whole semester material. The examination consists of two parts: 1. Two exercise tests during the semester. 2. A 20-minute theory test.

Required reading materials

T. WRIGHT: Fluid Machinery: Performance, Analysis, and Design
CRC Press , 1999. ISBN: 978-0849320156
I. J. KARASSIK, J. P. MESSINA, P. COOPER, C. C. HEALD: Pump Handbook
McGraw-Hill Professional , 2000. ISBN: 978-0070340329

Subject: **MANUFACTURING PROCESSES I**
Coordinator: **Gábor Balogh**
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 machiningan 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: Design of milling tools, types,

usability.
Practical: Presenting the results of the task.

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.
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 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.
B, for a grade: The course ends with 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, 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
DeGarmo, Black, Kohser: DeGarmo's Materials and Processes inManufacturing
10th.2008. ISBN: 978-0-470-05512-0
Mikell P. Groover: Fundamentals of Modern Manufacturing: Materials, Processes, and Systems

Subject: **MANUFACTURING PROCESSES II**
Coordinator: **Gábor Balogh**
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: Cutout and punching tools. Standard parts, basic rules of designing these elements, tool types.
Practical: Presenting the results of the task.

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 thermosetting 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: Summary of forming technologies, industrial examples, case studies.

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 & Materialls Science)

Subject: **MANUFACTURING PROCESSES III**
Coordinator: **Gábor Balogh**
Year, Semester: 2nd year/2nd semester
Lecture: **1**
Practical: **2**

1st week:
Lecture: Basic principles of manufacturing and technology design in production
Practical: Reconciliation of the program and the tasks.

2nd week:
Lecture: The calculation method of technological parameters, manufacturing time calculation methods.
Practical: Basic steps and calculation methods of the deep drawing technology.

3rd week:
Lecture: Quality management. Failure modes and affect analysis.
Practical: Action planning practice.

4th week:
Lecture: Quality management. Failure modes and affect analysis.
Practical: Action planning practice tools)

5th week:
Lecture: Failures of base point selection and its dimensional problems.
Practical: Dimensional measuring practice, case studies.

6th week:
Lecture: Position definitions of workpieces, the attachments of positioning and its design methods.
Practical: Presenting the results of the task.

7th week:
Lecture: Position definitions of workpieces, the attachments of positioning and its design methods.
Practical: EdgeCAM pactice

8th week:
Lecture: Mid-term testFixer parts, and it's design methods.
Practical: EdgeCAM pactice
Self Control Test

9th week:
Lecture: Allowances design and calculation in different types of manufactured parts.
Practical: EdgeCAM pactice

10th week:
Lecture: Surface roughness definition, measurement and economical calculations.
Practical: EdgeCAM pactice

11th week:
Lecture: The inaccurate dimensions caused by manufacturing devices, tolerances and optimisation
Practical: EdgeCAM pactice

12th week:
Lecture: Simulation methods of manufacturing.
Practical: EdgeCAM pactice

13th week:
Lecture: Specialized simulation methods for different production types and it's application
Practical: Presenting the results of the task.

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

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

Requirements

Topics: Introduction of material joint processes (welding, soldering, adhesive). Overview of welding processes and applicable technologies of designing and manufacturing of a welded joint. Weldability of metals and its alloys. Basic principles of industrial robots, and its basic kinematic characteristics. Designing the manufacturing process (in a CNC milling centre) of a product, applying the basic knowledge of Manufacturing processes I. & II. and using the EdgeCAM software to optimize the milling process.
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 misses more than three, 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. 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 at 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

Howard B. Cary, Scott Helzer : Modern Welding Technology
6th.2004. ISBN: 0131130293, 978-0131
John W. Evans: A Guide to Lead-free Solders: Physical Metallurgy and Reliability
1st.2007. ISBN: 1846283094, 978-1846
Edward Petrie: Handbook of Adhesives and Sealants
2nd.2006. ISBN: 0071479163, 978-0071
Günter Radons, Reimund Neugebauer: Nonlinear Dynamics of Production Systems
1st.2004. ISBN: 3527404309, 978-3527

Subject: **LOGISTICS I**
Coordinator: **Tamás Mankovits**
Year, Semester: 2nd year/1st semester
Lecture: **2**

1st week:
Lecture: Definitions of logistics. Aims of logistics.

2nd week:
Lecture: Global logistics. Logistics performance. The effects of the logistics to economy.

3rd week:
Lecture: A material flow system. Material handling outside the company. External transportation (vehicular, railway, water, air, special, combined and multimodal transport).

4th week:
Lecture: Transit and waiting time. Economic geography.

5th week:
Lecture: Evolution of transport. Types of maritime and inland transport (waterways and ports).

6th week:
Lecture: Logistics divisions at a company I. Company logistics (strategic, tactical and operative levels).

7th week:
Lecture: Procurement logistics. Centralized and decentralized procurement. Direct and indirect procurement. Mid-term test No.1.
Self Control Test

8th week:
Lecture: A supplier performance. A supplier scoreboard. A supply chain management.

9th week:
Lecture: The make or buy decision, Just in time. Economic order quantity (EOQ).

10th week:
Lecture: Logistics divisions at a company II. Production logistics. Production design, material flow determination. Material handling systems.

11th week:
Lecture: Distributional logistics. Distributional networks. Direct and indirect distributional systems.

12th week:
Lecture: Distribution required planning (DRP). Packaging.

13th week:
Lecture: Unit load devices (pallets, containers). Recycling logistics.

14th week:
Lecture: Warehousing systems. Information logistics.Mid-term test No.2.
Self Control Test

Requirements

Topics: This series of lectures is based on the topics of logistics. It covers the areas of logistics, construction of logistics systems and major construction units. Logistic systems management levels, functions, levels of development. Material handling systems and their role in the logistics system. Material handling systems characterization, classification, material flow characteristics. The choice of material handling systems and equipment. Storage systems, processes and the interpretation of break bulk storage systems. Warehousing systems, transportation systems, controlling and information systems, supply chain management, industrial and manufacturing logistics.
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 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. 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 in the 7th and 14th week. Students have to sit for the tests.
B, for a grade: The course ends in an examination (ESE). The minimum requirements of 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, 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 mid-term tests is at least good (4).

Required reading materials

Alan Rushton, Phil Croucher, Peter Baker: The Handbook of Logistics and Distribution Management
Kogan Page, 2006. ISBN: 0749446692
Michael B. Stroh: A Practical Guide to Transportation and Logistics
Logistics Network, 2001. ISBN: 0970811500
Michael B. Stroh: Transport Logistics: Past, Present and Predictions
Winning Books, 2010. ISBN: 9781571975089

Subject: **ENVIRONMENTAL PROTECTION**
Coordinator: **Ildikó Bodnár**
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

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 wastewater 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

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

Subject: **INDUSTRIAL SAFETY**
Coordinator: **István Budai**
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 storageMachine guardingWelding

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.

Field Specific Vocational Subjects of Automotive Production and Process Control Speialization

Subject: **HYDRAULIC AND PNEUMATIC MACHINES**
Coordinator: **János Tóth**
Year, Semester: 2nd year/2nd semester
Lecture: **2**
Practical: **2**

1st week:
Lecture: Classification of power systems. Pneumatic power systems. Evolution of compressed air.
Practical: Examples on perfect gas laws (isothermal, isobaric and isochoric processes).

2nd week:
Lecture: Force transmission through fluid. Fluid pressure to mechanical force. Fluid power cylinders.
Practical: Sizing pneumatic cylinders. Load ratio. Angle of movement.

3rd week:
Lecture: Fundamentals of pneumatics. General structures of pneumatic systems.
Practical: Calculations on relative humidity determination. Receiver sizing. Sizing compressor air mains.

4th week:
Lecture: Control systems (directional control valves, dual-pressure valves, shuttle valves, pressure sequence valves, time delay valves).
Practical: Calculations on air consumptions and required air flow.

5th week:
Lecture: Simple pneumatic connections. Symbolic representation of pneumatic elements and devices. Build up of circuit diagrams.
Practical: Design of simple pneumatic systems.

6th week:
Lecture: Applications of the FluidSIM-P program. Introduction to the Festo Didactic education system.
Practical: Design of simple pneumatic systems using FluidSIM-P software.

7th week:
Lecture: Pneumatics in the industry. Pneumatic machines.
Practical: Design of a complex pneumatics system. Mid-term test 1.
Self Control Test

8th week:
Lecture: Functions of hydraulic equipment. Symbols and drawing techniques.
Practical: Understanding physical elements. Technical description of drawing symbols.

9th week:
Lecture: The structure and circuit diagram (control, power supply) of a hydraulic system.
Practical: Actuator elements operation in real environment and FluidSIM-H software. Bending machine exercises.

10th week:
Lecture: Physical basic of hydraulics (pressure transmission, force transmission, way transmission, pressure ratio). Kinds of flow. Working fluid (types of tasks, viscosity).
Practical: Operation actuator elements via indirect valves. Exercises on a roller track.

11th week:
Lecture: Equipment representation (layout drawings, wiring diagrams, operating charts).

Power supply system components (a gear motor, a pump, a filter, a tank).
Practical: Implementation of complex control exercises in real environment and Fluid SIM-H software. Exercises on lift tables. Exercises on lidded containers.

12th week:
Lecture: Valves (method of construction, nominal value, slides). Pressure control valves. Way valves (2/2, 3/2, 4/2, 4/3).
Practical: Exercises on a paint drying furnace, a holder, hydraulic tilting platform.

13th week:
Lecture: Shut-off valves (check valve, controlled check valve). Flow control valves (one-way control valves, two-way flow control valves).
Practical: Exercises on turning feeding machines. Exercises on grinding machines and drill machines.

14th week:
Lecture: Hydraulic cylinders (single, double-acting, sealing, venting, buckling). Hydraulic motors.
Practical: Design of complex hydraulic systems and realization in reality.Mid-term test 2.
Self Control Test

15th week:
Lecture: Re-take test.
Self Control Test

Requirements

Topics: Fundamentals of pneumatics. General structures of pneumatic systems. Control systems (directional control valves, dual-pressure valves, shuttle valves, pressure sequence valves, time delay valves). Simple pneumatic connections. Symbolic representation of pneumatic elements and devices. Building up of circuit diagrams. Applications of the FluidSIM-P program. Introduction to the Festo Didactic education system. Pneumatics in industry. Pneumatic machines. Hydraulic machine functions. Design and circuit diagrams of a hydraulic system. Physical principles of hydraulics. Parts of power supply systems. Pressure control valves. Stop valves. Flow control Valves. Hydraulic cylinders. Applications of the FluidSIM-H 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. Attendance at a 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 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 students' 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 in the 7th and 14th weeks. Students have to sit for the tests.
B, for a grade: The course ends in an examination (ESE). 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: 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, 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 mid-term tests is at least good (4).

Required reading materials

Peter Croser, Frank Ebel: Pneumatics Basic Level
Festo Didactic GmbH Co., 2002.
De Silva, Clarence W.: Mechatronics : an integrated approach
Boca Raton CRC Press, 2005.
D. Merkle, B.Schrader, M. Thomes: Hydraulics Basic Level
Festo Didactic GmbH Co., 2003.

Subject: **MATERIAL HANDLING**
Coordinator: **Géza Husi**
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.

2nd week:
Lecture: Fundamental elements of material handling systems. Properties of handled materials.
Seminar: Basic calculations of handled materials.

3rd week:
Lecture: Continuous operating materials handling equipment: belt conveyors. Configurations of belt conveyors.
Seminar: Basic calculations of belt conveyors.

4th week:
Lecture: Designing principles and safety equipments of belt conveyors.
Seminar: Designing principles and safety equipments of belt conveyors.

5th week:
Lecture: Continuous operating material handling equipment: bucket elevators. Configurations of bucket elevators.
Seminar: Designing calculations of bucket elevators.

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 testContinuous operating material handling equipment: pneumatic conveyors. Configurations of pneumatic conveyors.
Seminar: Designing calculations ofpneumatic 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.

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

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 practiceclasses 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 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: 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: **PROCESS OPTIMIZATION AND ANALYSIS I**
Coordinator: **István Budai**
Year, Semester: 3rd year/1st semester
Lecture: **2**
Seminar: **1**

1st week:
Lecture: A business process.
Seminar: Classification of APQC processes.

2nd week:
Lecture: The structure of a process management system.
Seminar: Case studies.

3rd week:
Lecture: Puss-based manufacturing.
Seminar: MRP I, MRP II.

4th week:
Lecture: Pull-based manufacturing.
Seminar: Process information flow.

5th week:
Lecture: BPM.
Seminar: Case studies.

6th week:
Lecture: BPR.
Seminar: Case studies.

7th week:
Lecture: CI continuous improvement.
Seminar: Case studies.

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

9th week:
Lecture: Process modeling I.
Seminar: Epc, eEPC.

10th week:
Lecture: Process modeling II.
Seminar: BPMN 2.0.

11th week:
Lecture: Process Performance Measurement.
Seminar: PPMF framework.

12th week:
Lecture: Two-level process analyses.
Seminar: Case studies.

13th week:
Lecture: Process Control.
Seminar: Case studies.

14th week:
Lecture: Process stability.
Seminar: Case studies.

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

Requirements

Topics: The series of lectures and practice classes are based on the topics of production management and business strategy development. Students learn about production strategies and product life time. The lectures describe the properties of different production processes and the competitiveness of a production system, an aggregate planning and the typology of a forecast, and the components of production and operation management. Students learn about action management through a procedure of a company. The target of this subject is to describe company values and culture and to develop process thinking in engineering students. This kind of thinking has to be adapted to production environment. By the end of the semester students will acquire and will be able to use these kinds of methods.
A, for a signature: Participation at practice classes is compulsory. Students must attend practice

classes and may not miss more than three occasions 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 on the 8th week and the end-term test on the 15th week. Students must sit for the tests.
B, for a grade (ESE): The course ends in an exam 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: 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

William J. Stevenson: Operations management
10th . McGraw-Hill/Irwin , 2009.
Olhager, Jan – Person, Fredrik: Advances in Production Management System
Springer-Verlager GmbH, 2007.
James P. Womack – Daniel T. Jones: Lean Thinking, Banish Waste and Create Wealth in Your Corporation
Revised an Updated. Touchstone, an Imrint of Simon & Schuster, Inc., 2003.
Clark, Kim – Takahiro, Fujimoto: Product Development Performance
Harvard Business School Prress, 1991.
Nishiguchi, Toshihiro: Strategis Industrial Sourcing:The Japanese Advantage
Oxford University Press, 1994.

Subject: **PROCESS OPTIMIZATION AND ANALYSIS II**
Coordinator: **József Menyhárt**
Year, Semester: 3rd year/2nd semester
Lecture: **1**
Practical: **2**

1st week:
Lecture: General information, Lean basics
Practical: Lean examples in industry. Elimination of waste within a manufacturing system.

2nd week:
Lecture: TQM, Continuous improvement, Six sigma.
Seminar: TQM and Six Sigma in manufacturing, case studies.

3rd week:
Lecture: 5S principles, 7 wastes
Seminar: 5S as Lean principle for Kaizen in practice.

4th week:
Lecture: Kaizen and continuous improvement
Seminar: Operation levels of Kaizen in automobile industry.

5th week:
Lecture: TPM, Traditional TPM model, The light pillars of TPM, OEE
Seminar: Maintenance strategies examples and Total Productive Maintenance I.

6th week:
Lecture: TPM roadmap, Additional TPM

activities.
Seminar: Maintenance strategies examples and Total Productive Maintenance I.

7th week:
Lecture: Key performance indicators.
Seminar: A global case study for revealing manufacturing and operational problems with Lean methods.

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

9th week:
Lecture: SMED, Implementing SMED
Seminar: Single-Minute Exchange of Die (SMED) and QCO principle to make production faster.

10th week:
Lecture: VSM-VSD, Definition of value, floes, symbols
Seminar: How to make value stream maps for real problems I. Examples.Process FMEA overview in practice.

11th week:
Lecture: VSM-VSD, Definition of value, flows, symbols, definition of value.
Seminar: How to make value stream maps for real problems I. Examples.Process FMEA overview in practice.

12th week:
Lecture: VSM-VSD, Definition of value, flows, symbols, definition of takt time.
Seminar: How to make value stream maps for real problems II. Examples.

13th week:
Lecture: Just in time and Kanban systems, Different types of Kanban systems, Jidoka and Heijunka
Seminar: JIT (TPS) in the automobile industry. Reducing flow times within production as well as response times from suppliers and to customers.

14th week:
Lecture: MRP (Material Requirements Planning), MRP II., Benefits and drawbacks of MRP.
Seminar: Production planning, scheduling, and an inventory control system by MRP. The lowest possible material principle. Plan manufacturing activities. Examples.

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

Requirements

Topics: Students can acquire knowledge of resource calculation (MRP/SZTR), timing questions, supply and supply chain management. The curriculum includes the Toyota production system, the main properties of Just In Time (JIT) and the Japanese approach to production management with Lean methods and tools. (VSM, VSD, 5S, PFMEA, etc.). Students can also gain insights into new methods in LEAN office, Jidoka and production ergonomics. The target of this subject is to describe company values and culture and to develop process thinking in engineering students. This thinking has to adapt to the production environment. By the end of the semester the students will acquire and will be able to use these kinds of methods. Requirements During the semester there are two tests: the 1st test in the 8th week and the 2nd test in the 15th week – and there are three design tasks. Attendance at lectures is strongly 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 misses more than three, 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 at practice classes will be recorded by the staff of the department. 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 and the printed materials of the lectures to each occasion (both lectures and practice classes). Active participation is evaluated by the teacher in every class. Students' activity and participation is required.
Students have to submit all the two tests and the design tasks as scheduled minimum on a sufficient level. The minimum point of the tests and a design task have to be taken. The minimum (required to have a mid-semester grade) and maximum points can be obtained are the follows: Two tests: Test 1: Maximum: 30 points Minimum: 18 points, Test 2: Maximum: 30 points Minimum: 18 points Summa: 60 points and minimum of 36 points for tests. A design task: Maximum: 40 points Minimum: 25 points Summa points: Maximum: 100 points Minimum: 61 points The course ends in an exam grade (ESE). The grade for the test is given according to the following: 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, a student once can take a retake test of the whole semester material.

Required reading materials

William J. Stevenson: Operations management
10th . McGraw-Hill/Irwin , 2009.
Olhager, Jan – Person, Fredrik: Advances in Production Management System
Springer-Verlager GmbH, 2007.
James P. Womack – Daniel T. Jones: Lean Thinking, Banish Waste and Create Wealth in Your Corporation
Revised and Updated. Touchstone, an Imrint of Simon & Schuster, Inc., 2003.
Jeffrey K. Liker: The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer
McGraw-Hill, 2004.
Womack, James P. – Daniel T. Jones – Daniel Roos: The Machine That Change The World: The Story of Lean Production
Harper Perennial, 1991.

Subject: **FINITE ELEMENT METHOD**
Coordinator: **Tamás Mankovits**
Year, Semester: 3rd year/1st semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Brief overview of the finite element method, historical background.
Practical: Industrial application of the finite element method.

2nd week:
Lecture: Fundamentals of linear elasticity. A displacement field, a strain field, a stress field.
Practical: Calculation of strain and stress measures.

3rd week:
Lecture: The basic equation system of linear elasticity (equilibrium equation, constitutive equation, kinematic equation).
Practical: Principal values of normal stresses, scalar invariants and equivalent stresses.

4th week:
Lecture: Boundary conditions (kinematic boundary condition, dynamical boundary condition).
Practical: Analytical solution of a one-dimensional boundary value problem.

5th week:
Lecture: Strain energy. Total potential energy. Variational principles. The principle of minimum total potential energy.
Practical: Calculation of strain energy and the application of total potential energy.

6th week:
Lecture: Linear spring as a finite element.
Practical: Examples for linear spring structures. Derivation of the stiffness matrices.

7th week:
Lecture: Theory of the Ritz method. Kinematically admissible displacement fields.
Practical: Examples for the Ritz method (linear approximation, quadratic approximation).

8th week:
Lecture: Mid-term testFormulation of the finite element method. General derivation of the displacement based finite element equilibrium equations.
Practical: Solution of a numerical example by programming (prismatic bar problem).
Self Control Test

9th week:
Lecture: Properties of truss elements. Local approximation.
Practical: Solution of numerical examples by the usage of Femap 9.3 (prismatic bar problem, truss structure).

10th week:
Lecture: Properties of beam elements. Analytical solution of a statically indeterminate beam problem.
Practical: Solution of numerical example by the usage of Femap 9.3 (statically indeterminate beams).

11th week:
Lecture: Finite element formulations for two-dimensional problems (plain strain, plane stress, axisymmetric problems).
Practical: Solution of numerical examples by the usage of Femap 9.3 (a plate with a hole, a tube under internal pressure, analyzing a pressure vessel).

12th week:
Lecture: Isoparametric finite elements. One-, two- and three-dimensional mapping. Truss element. Quadrilateral and triangular elements. Brick and tetrahedron element.
Practical: Calculation of Jacobian of undistorted and distorted quadrilateral elements.

13th week:
Lecture: Numerical integration. The Gaussian quadrature.
Practical: The usage of one-point, two-point and three-point formulas.

14th week:
Lecture: General purpose finite element programs. Modelling questions. Meshing, post-processing. Error analysis.
Practical: Solution of a numerical example by the usage of Femap 9.3 (analysis of an assembly).

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

Requirements

Topics: The finite element method in the product lifecycle. Mathematical and mechanical background of the finite element method. Fundamentals of linear elasticity (a displacement field, a strain field, a stress field). Basic equation systems (equilibrium equation, kinematic equation, constitutive equation). Boundary conditions. Boundary value problems. Strain energy and related principles. Linear spring. The Ritz method. Formulation of the finite element method. Truss and beam elements. Two-dimensional problems (plain strain, plane stress, axi-symmetric problems. Isoparametric finite elements. Numerical integration. General purpose of finite element programs. Application of Femap 9.3 FEM software. Modelling questions. Meshing. Post processing. A, for a

signature: Attendance at lectures is recommended, but not compulsory. Participation at practice 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 class 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 drawing tasks and drawing instruments to 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 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 test results. The minimum requirement for both 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: score/grade: 0-39 fail (1), 40-52 pass (2), 52-63 satisfactory (3), 64-71 good (4), 72-80 excellent (5). If the score of the sum of the two tests is below 40, the student once can take a retake test of the whole semester material.

Required reading materials

Mankovits, T. : Numerical Analysis of Engineering Structures (Linear Elasticity and the Finite Element Method)
University of Debrecen, 2014.
Bathe, K.J. : Finite Element Procedures
Prentice-Hall, 1996.
Kovács, Á., Moharos, I., Oldal, I., Szekrényes, A. : Finite Element Method
Typotex, 2012.
O. C. Zienkiewicz, Robert Leroy Taylor : The Finite Element Method: Solid Mechanics
Butterworth-Heinemann, 2000. ISBN: 0750650559, 97807506

Subject: **BUSINESS MANAGEMENT SYSTEMS AND IT**
Year, Semester: 3rd year/2nd semester
Practical: **4**

1st week:
Practical: Introduction to Microsoft Office Outlook (Historical background).

2nd week:
Practical: Basic functions of Microsoft Office Outlook, connecting to exchange accounts, connecting to internet email accounts, working in Outlook.

3rd week:
Practical: Meeting schedules and basic meeting protocols, sending and receiving emails, storing and accessing contact information, calendar managers.

4th week:
Practical: Introduction to Microsoft Office One Note (historical background).

5th week:
Practical: Creating a notebook and adding sections. Typing a note and formatting a test, inserting and modifying tables, tagging a note, Inserting a file and a link.

6th week:
Practical: Inserting video, sending to OneNote and changing a page background, inserting an Outlook Meeting, inserting audio, saving into different formats, sharing a notebook.

7th week:
Practical: Summarizing Office products preparing for the mid-term test.

8th week:
Practical: Mid-Term Test.
Self Control Test

9th week:
Practical: Introduction to Business management systems (SAP, Oracle).

10th week:
Practical: Terminology of SAP system.

11th week:
Practical: Logging in (walk through the SAP logon process), Basic navigation skills in SAP.

12th week:
Practical: Reporting lists and fundamentals, basic reporting in SAP (MMBE, QA32).

13th week:
Practical: Basic logistic and quality modules, process of quality complaints.

14th week:
Practical: BANF, Maintenance modules, Deviation permit, PPAP.

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

Requirements

Topics: Nowadays companies use different types of business management systems. This course is an introduction to these business management systems and basic IT tools. The program which students use during this course is called SAP. Students will learn about stock queries, purchasing and controlling tools (like BANF), basic logistics (such as the definition of charge), and quality and production modules of SAP. Students will be able to use the basic SAP modules, adjustments and reporting methods by the end of the semester. The course also provides students with an insight into Microsoft Outlook and Microsoft One Note programs and the importance of business folder structures. There are no lectures. Participation at practice classes is compulsory. A student must attend practice and may not miss more than three times during a 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. Active participation is evaluated by the teacher 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.
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: 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

Schicht, G. – Schmieden, A: Flying Star with SAP R/3
Addison-Wesley-Longman Verlag GmbH, 1999.
V. Narayanan: SAP R/3 FI transactions

Infinity Science Press LLC, 2007.
Jordan, J.: 100 Thing You Should Know About Controlling with SAP
Galileo Press Inc., 2011.
Akhart, J.: Quality Management with SAP
Rheinwerk Publishing, 2011. ISBN: 978-1-4932-1203-3
Krishnamoorthy, V., Murray, M., Reynolds N.: SAP Transaction Codes Your Quick Reference to Transactions in SAP ERP
Rheinwerk publishing, 2011. ISBN: 978-1-59229-374-2

Subject: **LOGISTICS II**
Coordinator: **Tamás Mankovits**
Year, Semester: 3rd year/2nd semester
Lecture: **1**
Practical: **2**

1st week:
Lecture: The definition of logistics. Connection between logistics and a supply chain.
Practical: Supplying and distributing networks.

2nd week:
Lecture: A company logistics system. A strategic level, a tactical level and an operative level.
Practical: The divisions of logistics. Procurement, production, distribution, re-cycling.

3rd week:
Lecture: Supply chain management. Supply chain segmentation.
Practical: Analysis of the supply chain of an original equipment manufacturer (OEM) and a supplier (TIER).

4th week:
Lecture: Procurement logistics. Centralized and decentralized procurement. Direct and indirect purchasing.
Practical: A demand analysis. Examples on ABC and XYZ analyses.

5th week:
Lecture: A price analysis. Supplier evaluation and selection.
Practical: Examples on supplier evaluation.

6th week:
Lecture: Economic order quantity (EOQ).
Practical: Examples on economic order quantity determination.

7th week:
Lecture: Production logistics. Production systems. Production control.
Practical: Examples on production scheduling.

8th week:
Lecture: Mid-term testPush and pull types of production control.
Practical: Examples on material requirements planning (MRP) and manufacturing resource planning (MRP II.)
Self Control Test

9th week:
Lecture: Detail capacity planning (CRP). Just in time (JIT), just in sequence (JIS). Kanban, a milk run.
Practical: Realization of Kanban.

10th week:
Lecture: Warehousing. Warehouse types. Storage technology.
Practical: Examples on warehouse design.

11th week:
Lecture: Inventory management. Storage of hazardous materials.
Practical: Inventory.

12th week:
Lecture: Distribution logistics.
Practical: Distribution systems and technologies.

13th week:
Lecture: Distribution requirements planning (DRP).
Practical: Examples for distribution requirements planning.

14th week:
Lecture: Re-cycling logistics. Packaging technology. A costumers' service.
Practical: Waste management and re-cycling technologies.

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

Requirements

Topics: The connection between logistics and a supply chain. The 7 rights of logistics. The aims of company logistics. A company logistics system (a strategic level, a tactical level, an operative level). The divisions of logistics (procurement, production, distribution, re-cycling). Supplier and distributer networks. Supply chain segmentation. Supply chain management. Procurement logistics. centralized and decentralized procurement. Direct and indirect purchasing. The process of purchasing. Methods used by purchasers; a demand analysis (ABC and XYZ analysis), a price analysis, evaluation and selection of a supplier, economic order quantity (EOQ). Production logistics. production systems. Push and pull type production systems. Computer integrated manufacturing. production control, scheduling. Material requirements planning (MRP). Manufacturing resource planning (MRP II.). Detail capacity planning (CRP). Just in time (JIT), just in sequence (JIS). Kanban, a milk run, warehousing, warehouse types. Storage technology. Inventory management. Storage of hazardous materials. Distribution logistics. Distribution requirements planning (DRP). Re-cycling logistics. Packaging technology. Costumers' services.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice 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 class 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 drawing tasks and drawing instruments to 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 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 test results. The minimum requirement for both 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: score/grade: 0-39 fail (1), 40-52 pass (2), 52-63 satisfactory (3), 64-71 good (4), 72-80 excellent (5). If the score of the sum of the two tests is below 40, the student once can take a retake test of the whole semester material.

Required reading materials

Martin Christopher : Logistics and Supply Chain Management, Financial Times Series 4th edition.2011.
Lars Bedey, Sofia Eklund, Nojan Najafi, William Wahrén, Karl Westerlund : Purchasing

Management
Chalmers, Department of Technology Management and Economics, 2008.
Peter Nyhuis, Hans-Peter Wiendahl : Fundamentals of Production Logistics
Springer, 2009. ISBN: 978-3-540-34210-6
DiCentral: Inventory and Warehouse Managemenet Best Practices
1st edition. SmartTurn Inc., 2009.

Subject: **OPERATION AND MAINTENANCE I**
Year, Semester: 3rd year/1st semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Maintenance policies (run-to-failure, preventive, predictive, reliability-centred and total productive maintenance), functions, impact, benefits and effects of maintenance, overall maintenance strategies.
Practical: Vibration measurement and applications.

2nd week:
Lecture: Maintenance Organization Objectives and Responsibility, Centralization vs. Decentralization, In-house Maintenance vs. Outsourcing.
Practical: Vibration measurement and applications.

3rd week:
Lecture: Maintenance forecasting and capacity planning, qualitative and quantitative forecasting techniques, strategic, medium range, and short range planning in maintenance, scheduling techniques.
Practical: Vibration measurement and applications.

4th week:
Lecture: Budgeting and costing planned maintenance services (control of maintenance costs while improving reliability), maintenance control, work order system.
Practical: Vibration measurement and applications.

5th week:
Lecture: Material and spare parts management, maintenance productivity and performance measurement, KPIs (budget, controlling equipments, planning etc.). Facility maintenance methods and tools (like energy management)
Practical: Vibration measurement and applications.

6th week:
Lecture: Failure statistics, failure modes and effect analyses, root cause analyses, Pareto Chart, cause and effect diagram, 5 WHY method, Fishbone diagram.
Practical: Vibration measurement and applications.

7th week:
Lecture: Concept of safety, reliability and risk, reliability centred maintenance, RCM philosophy, methodology, and implementation.
Practical: Vibration measurement and applications.

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

9th week:
Lecture: Condition-based maintenance, fields and methods of technical diagnostics, integrated e-maintenance and intelligent maintenance systems.
Practical: Infrared thermography and applications.

10th week:
Lecture: Lean manufacturing, total productive

maintenance, elements of TPM, TPM, implementation.
Practical: Infrared thermography and applications.

11th week:
Lecture: Concept of maintainability, maintainability analyses, empirical data and maintainability measures.Safety and maintenance, safety and risk assessment tools and techniques, work effectively in any safety- or reliability-critical environment.
Practical: Infrared thermography and applications.

12th week:
Lecture: Maintenance quality relationship, warranty and maintenance.
Practical: Tribology.

13th week:
Lecture: Industrial asset maintenance and sustainability performance.
Practical: Tribology.

14th week:
Lecture: Human reliability and error in maintenance, occupational stressors, human performance effectiveness, and human performance reliability functions.
Practical: Tribology.

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

Requirements

Topics: Maintenance policies (run-to-failure, preventive, predictive, reliability-centred and total productive maintenance), functions, impact, benefits and effects of maintenance, overall maintenance strategy, maintenance organization objectives and responsibility, centralization vs. decentralization, in-house maintenance vs. outsourcing, maintenance forecasting and capacity planning, qualitative and quantitative forecasting techniques, strategic, medium range, and short range planning in maintenance, scheduling techniques, budgeting and costing planned maintenance services (control of maintenance costs while improving reliability), maintenance control, work order system, material and spare parts management, maintenance productivity and performance measurement, KPIs (budget, controlling equipments, planning etc.). Facility maintenance methods and tools (like energy management), failure statistics, failure modes and effect analyses, root cause analyses, Pareto Chart, cause and fffect diagrams, 5 WHY method, Fishbone diagram. Concept of safety, reliability and risk, reliability-centred maintenance, RCM Philosophy, methodology, and implementation, condition-based maintenance, fields and methods of technical diagnostics, integrated e-maintenance and intelligent maintenance systems, lean manufacturing, total productive maintenance, elements of TPM, TPM implementation, concept of maintainability, maintainability analyses, empirical data and maintainability measures, safety and maintenance, safety and risk assessment tools and techniques, work effectively in any safety- or reliability-critical environment, maintenance quality relationships, warranty and maintenance, industrial asset maintenance and sustainability performance, human reliability and errors in maintenance, occupational stressors, human performance effectiveness, and human performance reliability functions. Students learn about the tools of machinery condition monitoring: vibration measurement and analysis, infrared thermography, and tribology.
A, for a signature: Participation at practice and submission of the measurement reports are compulsory (maximum three absences are accepted if a medical certificate is presented). Achievement of minimum 50% of scores in mid-term and end-term tests.
B, for a grade: The course ends in an exam grade. 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

M. Ben-Daya, S. O. Duffuaa, A. Raouf, J. Knezevic, D. Ait-Kadi: Handbook of Maintenance Management and Engineering
Springer, 2009.
R. K. Mobley, L. R. Higgins, D. J. Wikoff : Maintenance Engineering Handbook
McGraw-Hill, 2008.
R. K. Mobley: An Introduction to Predictive Maintenance
Butterworth-Heineman, 2002.
R. K. Mobley: Maintenance Fundamentals
Butterworth-Heineman, 2004.
J. Moubray: Reliability-Centered Maintenance
Industrial Press Inc., 2001.
D. J. Smith: Reliability, Maintainability and Risk: Practical Methods for Engineers
Elsevier, 2011.
J. Liker: The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer
McGraw Hill, 2004.

Subject: **AUTOMOTIVE QUALITY ASSURANCE**
Coordinator: **József Menyhárt**
Year, Semester: 3rd year/2nd semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: General information, Lean manufacturing, 7 wastes, Kaizen, 5S and TPM.
Practical: General overview of Lean manufacturing, 7 wastes, Kaizen, 5S and TPM.

2nd week:
Lecture: Total quality management, continuous improvement, history of TQM.
Practical: Reviewing TQM examples.

3rd week:
Lecture: 5S and standards on a shopfloor.
Practical: 5S examples, and solution of tasks.

4th week:
Lecture: Continuous improvement and Kaizen philosophy in quality.
Practical: Reviewing TQM example.

5th week:
Lecture: ISO, What is ISO standard? Definition of ISO 9000.
Practical: Requirements of ISO audition.

6th week:
Lecture: ISO TS 19949 (Historical background, Certificates), VDA 6.3.
Practical: Requirements of ISO TS audition.

7th week:
Lecture: Techniques to support ISO TS 16949, statistical process control and measurement system analyses.
Practical: ISO TS 16949 examples on an automotive part.

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

9th week:
Lecture: Failure modes and effects analyses, control plans.
Practical: FMEA matrix composition on an industrial example, APQP generation.

10th week:
Lecture: The Fishbone (Ishikawa) Diagram, 5W2H, Problem solving techniques.

Practical: FMEA matrix composition on an industrial example, APQP generation.

11th week:
Lecture: Introduction to 8D reports.
Practical: FMEA matrix composition on an industrial example, APQP generation.

12th week:
Lecture: Production part approval processes, PPAP submission levels, Production Warrant.
Practical: PPAP on a welded joint.

13th week:
Lecture: A process flow diagram, process FMEA (PFMEA), gage R&R steps.
Practical: Case studies.

14th week:
Lecture: An initial process study, Determining process capability, indices of capability, Cpk, Ppk, production parts of samples, warrant on part submission.
Practical: Case studies.

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

Requirements

Topics: This course is an introduction to automotive quality assurance (ISO/TS 16949). Students learn about PFMEA, DFMEA, CP, CPK, CMK, Gage R and R, SPC and the first sample approval process. Lectures describe the main properties of APQP processes, control plans, flow charts and 8D documentation (quality complaint handling) like problem solving techniques and measuring methods. One of the goals is to deepen students' understanding of brainstorming, 5 why and pareto analysisby the middle of the semester. The focusof the course is on how to create a quality management handbook and how to review management handbook processes and documentation. By the end of the semester students will acquire and will be able to use these kinds of methods.
During the semester there are two tests: the 1st test in the 8th week and the 2nd test in the 15th week – and there are three design tasks. Attendance at lectures is strongly 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 at lectures and at practice classes will be recorded by the staff of the department. 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 calculator and the printed materials of the lectures to each occasion (both lectures and practice classes). Active participation is evaluated by the teacher in every class. Students' activity and participation is required.
Students have to submit all the two tests and the design tasks as scheduled minimum on a sufficient level. The minimum point of test and design task has to be taken. The minimum (required to have mid-semester grade) and maximum points can be obtained are the follows: Two tests: Test I: Maximum: 30 points Minimum: 18 points Test II: Maximum: 30 points Minimum: 18 points Summa: 60 points 36 points Design task: Maximum: 40 points Minimum: 25 points Summa points: Maximum: 100 points Minimum: 61 points. The course ends with a mid-semester grade (AW5). Based on the summa points of the tests and the summa points of the design tasks, the mid-semester grade is defined by the following way: Score/Grade: 0 – 60 points: fail (no sign), 61 – 70 points: pass (2), 71 – 80 points: satisfactory (3), 81 – 90 points: good (4), 91 – 100 points: excellent (5).

Required reading materials

1. Roland Mader, Eric Armengaud, Gerhard Griessnig, Christian Kreiner, Christian Steger,

Reinhold Weiss : Reliability Engineering & System Safety
2013.
Hervé Ressencourt, Louise Trave-Massuyes, Jérome Thomes: Fault Detection, Supervision and Safety of Technical Processes 2006
Volume 1.2007.
Salman Taghizadegan: Essentials of Lean Six Sigma
2006.
Ali Jahan, Kevin L. Edwards: Multi-criteria Decision Analysis for Supporting the Selection of Engineering Materials In Product Design
2013.
Radley M. Smith, Roderick A. Munro, Ronald J. Bowen: The ISO/TS 16949 Answer Book: A Step-by-step Guide for Automotive Suppliers
Paton Professional, 2004.

Subject: **PROJECT MANAGEMENT AND CONTROLLING**
Coordinator: **Judit T. Kiss**
Year, Semester: 3rd year/2nd semester
Lecture: **2**
Seminar: **2**

1st week:
Lecture: Project definition, project environment, project management (a project manager vs. a general manager), the objectives of a project.
Seminar: Defining a project, types of projects, and the main characteristics of a project. Identifying stakeholders.

2nd week:
Lecture: Project phases and project life cycles, Project constraints (time, cost, resources availability, results). Project management processes.
Seminar: Examination of project constraints,Representative project life cycles, life cycle stages. Relationship among project management processes.

3rd week:
Lecture: Initiating and planning processes. Feasibility studies. Financial (cost-benefit) analyses, project costs, discounted cash flow, a net present value, a profitability index.
Seminar: Net present value calculation, profitability index, and evaluation of financial indicators. Computer applications.

4th week:
Lecture: A payback and discounted payback method, Internal rate of return calculation. Risk project management, risk identification, qualitative risk analyses, and quantitative risk analyses. Categories of insurance.
Seminar: Different types of risk, risk and probability. Risk analysis and financial calculations NPV, PI). Sensitivity analyses. Computer applications.

5th week:
Lecture: Project organization structures. External, internal project organizations, Group structures. Organizational responsibilities.
Seminar: Size and project organization, optimal organization. A responsibility matrix. A project team. Human factors and a project team.

6th week:
Lecture: Planning a project. Project time management I, Activity definition, work breakdown structures, activity sequencing. Activity lists, milestones. Activity duration estimating (inputs, tools and techniques, outputs).
Seminar: Work breakdown and coding, Types of task dependency. A precedence diagramming

method, an arrow diagramming method, a conditional diagramming method.

7th week:
Lecture: Project time management II, Schedule development (inputs, tools and techniques, outputs). A critical path method. Program evaluation and review techniques (PERT).
Seminar: Scheduling a project. Gantt chart and critical path analyzing. Computer application.

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

9th week:
Lecture: Project time management (inputs, tools - techniques, and outputs).
Seminar: Applications of a project management software. Case studies.

10th week:
Lecture: Project cost management I, Resource planning, cost estimating. Cost budgeting.
Seminar: Classification of costs. Estimating and analysis of costs.

11th week:
Lecture: Project cost management II, cost control. Earned value analyses.
Seminar: Calculation of a planned value, earned value, budgeted cost of work scheduled (performed), actual cost, and actual cost of work performed. Cost (schedule) variance, a cost (schedule) performance index.

12th week:
Lecture: Project control.
Seminar: Comprehensive analysis. A performance report. Computer applications.

13th week:
Lecture: Project communication management, communication planning, information distribution. Administrative closure.
Seminar: Communication requirements, a communication management plan. Status, progress reporting and forecasting.

14th week:
Lecture: Team management. Managing changes.
Seminar: Case studies. Computer applications.

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

Requirements

Topics: The aim of this course is to make students familiar with the basic concepts of project management and controlling methods. By the end of the semester students will be able to carry out projects and moderate meetings. Students will develop their communication skills during team work and they will improve their problem solving and planning skills during the practice tasks. A presentation about Microsoft Project software and SWOT analyses will be part of the lectures and practice classes, which the students can use in their homework. The other target of this course is to help students improve their skills in economics.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice is compulsory. Students must attend practice classes and may not miss more than three occasions 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. Active participation is evaluated by the teacher every class. If a student's behaviour 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 mark. During the semester there are two tests. Based on

the cumulative results of the 2 tests written in Project management and controlling and the average of the team work, students are offered an exam grade. 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. The minimum requirement of the mid-term and the end-term test is 50% separately. Exam: 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

Meredith, J. R. – Mantel Jr. S. J. : Project management: A Managerial Approach
John Wiley&Sons, 2011. ISBN: 0470533021, 978047
PMBOOK GUIDE : A Guide to the Project management Body of knowledge. Project management Institute
Four Campus Boulevard, 2011. ISBN: 1-880410-22-2
Lock D. : Project Management
Ninth Edition. Gower Publishing Limited, 2007. ISBN: 978-0-566-08769-1

Subject: **COMPETENCE DEVELOPMENT FOR ENGINEERS**
Coordinator: **Edit Szűcs**
Year, Semester: 3rd year/1st semester
Lecture: **2**
Seminar: **2**

1st week:
Lecture: LeadershipDefining leadership, the role or personality to be a leader, soft skills.
Seminar: Group work, situational tasks, discussion with dispute methods.

2nd week:
Lecture: Functions of leadershipPlanning, organizing, directing, controlling, innovation, representation and making a decision.
Seminar: Situational tasks in groups.

3rd week:
Lecture: Leadership stylesAutocratic, bureaucratic, laissez-faire, democratic, transformational leadership types.
Seminar: Tests measuring leadership styles, discussion of the results.

4th week:
Lecture: General leadership competenciesMost important leadership skills and qualities, generic leadership traits, what you have to know, what you need to know, what you need to do, how to return the core leadership functions into skills.
Seminar: Tests on measuring leadership qualities, discussion of the results.

5th week:
Lecture: Time managementWrong time management, time thieves, procrastination, planning, Eisenhower's principle, delegation.
Practical: Methods and techniques managing your time.

6th week:
Lecture: Conflict managementGrouping of conflicts, emergence of the conflicts, conflict management types.
Seminar: Steps of a problem-solving strategy test for defining the own conflict management style, situational tasks.

7th week:
Lecture: MotivationMotivation in leadership, Abraham Maslow's hierarchy, Herzberg model.
Seminar: Motivational leadership self-tests, situational tasks, how you can motivate your

colleagues as a leader.

8th week:
Lecture: Team managementWorking in teams, leading teams, differences between a team and a group.
Seminar: Competencies for team leading in practice.

9th week:
Lecture: Problem-solvingWhat is a problem? How can it be solved?
Seminar: Problem solving methods.

10th week:
Lecture: Emotional intelligenceDetermining emotional intelligence, highlighting the EM's role and its effect in leadership.
Seminar: Tests on measuring emotional intelligence, discussion of the results.

11th week:
Lecture: Making decisionsDecisiveness, decision-making styles.
Seminar: Optimum decisions for organizational goals.

12th week:
Lecture: CommunicationCommunication activities, most important communication skills as a leader.
Seminar: Supporting communication.

13th week:
Lecture: Managerial efficiencyPlanning and organization processes, control of activities.
Seminar: Case studies, team work.

14th week:
Lecture: Stress managementStability under stress, self-confidence,sturdiness, serenity.
Seminar: Situational tasks in groups.

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

Requirements

Topics: The aim of the course is to help students make their own personality inventory. After gaining self-knowledge, students can learn about motivational methods that will enable them to motivate themselves. The course also introduces students to conflict management, problem solving, negotiation and flexibility and develops their collaborative competence. The students can find out more about their personality and motivation inventory.
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 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: 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

Schwart, T – Loehr, J. : The Power of Full Engagement: Managing Energy, Not Time, Is the Key to
Free Press , 2005.
Mancini, M. : Time management
McGraw-Hill Companies , 2003.
Taylor, J. : Decision Management System
IBM Press, 2012.

Subject: **ROBOT TECHNOLOGY**
Coordinator: **Géza Husi**
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 testRobot programming applications, communication with other robots.
Practical: Robot programming applications, communication with other robots.
Self Control Test

9th week:
Lecture: Robot applications, the design of robot applications.
Practical: Robot applications, the design of robot applications. 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.

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

Subject: **COMPUTER AIDED MANUFACTURING**
Coordinator: **Sándor Pálinkás**
Year, Semester: 3rd year/2nd semester
Lecture: **1**
Practical: **2**

1st week:
Lecture: Introduction. The evolution of CAM (Computer aided manufacturing).
Practical: Introduction to Edgecam workflow environment, user interface, software preferences, part orientation for milling, part orientation for turning.

2nd week:
Lecture: Determination of different parameters of a product according to manufacturability viewpoints.
Practical: A tool store database, adding tools to a tool store, feeds and speeds.

3rd week:
Lecture: The place and role of CAM in the manufacturing process.
Practical: Working with solid CAD Models, opening models, defining a zero point, the feature of recognition, creating features manually.

4th week:
Lecture: Selection of material and geometry of a product, determination of tolerances. The aspects of product design.
Practical: Milling operations, face milling, roughing, a chamfering cycle, controlling start points, running simulation.

5th week:
Lecture: Calculation of technological data.
Practical: Milling operations, finish milling, hole drilling, creating CNC code.

6th week:
Lecture: The necessary equipment for manufacturing. The optimal selection of machine.
Practical: Turning operations, facing and turning, grooving, controlling starting points.

7th week:
Lecture: The areas of manufacturing design, the characteristics of manufacturing process, the conventional methods of design, methods of automated design.
Practical: Turning operations, threading, fixed hole drilling, creating a CNC code.

8th week:
Lecture: Mid-term test.
Practical: Introduction to a strategy manager, live job reports.
Self Control Test

9th week:
Lecture: The procedure of CAM, the method of application.
Practical: Introduction of CNC milling and turning machines, CNC controls, operating a CNC machine, services and diagnostics, Interface parameters.

10th week:
Lecture: The model of workpiece, a tool, a machine and a manufacturing process.
Practical: Introduction of Siemens 802S operator panel, turning on and reference point approaches, coordinate systems, jog modes, assigning hand wheels, MDA modes.

11th week:
Lecture: Practical application of CAM – industrial examples.
Practical: Creating a new tool, entering tool offsets, tool compensation data, determining tool offsets, determining the zero offset.

12th week:
Lecture: Communication channels, possibilities of optimization.
Practical: Part programming, entering a new

program, running programs.

13th week:
Lecture: The evaluation of results of manufacturing simulation, documentation of results.
Practical: Examples on programming: axis movements, linear interpolation at rapid traverse, linear interpolation at feed rate, circular interpolation, selection of tool radius offset.

14th week:
Lecture: Possibilities of a further development of process.
Practical: Examples on programming: cycles, thread cutting, drilling, deep hole drilling, row of holes.

15th week:
Lecture: End-term test.
Practical: Examples on programming: cutting square pockets, slots and circular pockets, subroutine techniques.
Self Control Test

Requirements

Topics: This subject is based on manufacturing processes. The lectures and practice classes would like to shape engineering thinking and the main focus is the use of computer aided tools in manufacturing. The students will learn about the basic steps of cutting, the administration of main and side movements as well as the simulation of billeting and finishing metal work, which are the base of CAD/CAM systems. By the end of the semester, the students will be prepared to work on different production preparation tasks at factories.
A, for a signature: Participation at practice classes is compulsory. Students must attend practice classes and may not miss more than three occasions 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 on the 8th week and the end-term test on the 15th week. Students must sit for the tests.
B, for a grade: The course ends in an exam based on the average grade of the two tests and one practical task. 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: 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

Thomas Childs - Katsuhiro Maekawa - Toshiyuki Obikawa - Yasuo Yamane: Metal Machining - Theory and Applications
Arnold, 2000.
Mikell P. Groover - Emory W. Zimmers: CAD/CAM: Computer-Aided Design and Manufacturing
Pearson Education, 1984.
Posinasetti Nageswara Rao: CAD/CAM: Principles and Applications
Tata McGraw-Hill Education, 2004.
P. Radhakrishnan, S. Subramanyan, V. Raju: CAD/CAM/CIM
New Age International, 2008.
Philip J. Thomas: Simulation of Industrial Processes for Control Engineers
Elsevier Science and Technology, 1999.

Subject: **ASSEMBLY TECHNOLOGY**
Coordinator: **Sándor Bodzás**
Year, Semester: 3rd year/1st semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: The place and ponderosity of assembly in a manufacturing process.
Practical: The basic theorem of an assembly.The impression of Homework I and II.

2nd week:
Lecture: Characteristics of assembly work. Basic definitions. Operations of an assembly process.
Practical: Basics of tolerance techniques. Fits.

3rd week:
Lecture: Sum of systematic and incidental errors. Examinations of dimension chains.
Practical: Solving tasks on tolerance techniques.

4th week:
Lecture: The method of total and particular interchangeability.
Practical: The method of selecting fits, subsequent fits and adjusting regulation.

5th week:
Lecture: Cutting processes in assembly.
Practical: Solving tasks on dimension chains.

6th week:
Lecture: Designing assembly technology.
Practical: Determination of technological conditions of assembly. Assembly corrected construction.

7th week:
Lecture: Designing assembly processes.
Practical: Solving tasks on assembly technology.

8th week:
Lecture: Assembly operations.
Practical: Designing assembly operations and manufacturing steps.

9th week:
Lecture: An assembly tree. The types of assembly trees.
Practical: Test - Written examination.
Self Control Test

10th week:
Lecture: Balancing. Assembly of machine elements.
Practical: Assembly of threaded joints. Assembly of friend joints.

11th week:
Lecture: Assembly of a bolt joint. Assembly of a key joint.
Practical: Assembly of a riveted joint.

12th week:
Lecture: Assembly of tooth gears.
Practical: Assembly of bevel gearings.

13th week:
Lecture: Assembly of a rolling bearing.
Practical: Setting of radial and axial rolling bearings.

14th week:
Lecture: Assembly automation. Quality assurance on assembly.
Practical: Submission of homework I and II.

15th week:
Lecture: Pre-exam.
Self Control Test

Requirements

Topics: The main objective of the subject is that students learn about the correct planning of machine construction assembly. They are expected to be able to plan a fast and correct assembly plan for different machine elements. The students learn about the definition of parallel assembly. The dimensional chain and tolerance techniques are also part of the curriculum. The practices provide students with examples of the assembly processes of the most important machine elements which are used in the daily routine of a factory.
A, for a signature: Students have to prepare Homework I and II. “Homework I” is on designing assembly technology. “Homework II” is on designing tolerance techniques.
B, for a grade: Students have to pass the exam. The exam questions will be given in advance.

Required reading materials

Bruno L.: Manufacturing Assembly Handbook
1989. ISBN: 0-408-03561-7
Geoffrey B.: Product Design for Manufacture and Assembly
Third Edition. United States, ISBN: 1420089277
John A. Schely: Intorduction to manufacturing processes
1977. ISBN: 0-07055274-6
Molloy O., Tilley S.,Warman E. A.: Design for Manufacturing and Assembly
Springer, 1998. ISBN: 978-1-4613-7650-2
Sukhan L., Raúl S.,Byung-Wook C.: Frontiers of Assembly and Manufacturing
Springer, 2010. ISBN: 978-3-642-14115-7
Svetan R.: Precision Assembly Technologies for Mini and Micro Products
Springer, 2016. ISBN: 978-0387312767

Subject: **POLYMERTECHNOLOGY**
Coordinator: **Gábor Balogh**
Year, Semester: 3rd year/2nd semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Position of polymers in materials world.

2nd week:
Lecture: Structures of polymers.
Seminar: Overview of polymer types and their production methods.

3rd week:
Lecture: Mechanical properties of Polymers.
Practical: Tensile test of different polymer types.

4th week:
Lecture: Affect of temperature changing on structure of polymers.
Practical: Bend test of different types of polymers.

5th week:
Lecture: Manufacturing technologies of polymers I.
Practical: Hardness of different types of polymers.

6th week:
Lecture: Manufacturing technologies of polymers II.

Practical: Izod's Impact test of polymers.

7th week:
Lecture: Manufacturing technologies of polymers III.
Practical: Fatigue tests of polymers.

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

9th week:
Lecture: 3D polymer products manufacturing technologies I.
Practical: Polymer composites.

10th week:
Lecture: 3D polymer products. manufacturing technologies II.
Practical: A mechanical test of polymer composites.

11th week:
Lecture: Rubber types.
Practical: A mechanical test of polymer composites.

12th week:
Lecture: Manufacturing technologies of automotive rubber parts.
Practical: A mechanical test of polymer composites.

13th week:
Lecture: Polymer composites.
Practical: Recycling of polymers.

14th week:
Lecture: Recycling of polymers.
Practical: Supplementation.

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

Requirements

Topics: The students get acquainted with the texture of polymers, their mechanical properties, manufacturing processes and utilization. The main focus of the subject is the polymer components in vehicle industry and their manufacturing processes and recycling.
A, for signature: Attendance at lectures is recommended, but not compulsory. Participation at practice is compulsory. Students must attend practice classes and may not miss more than three occasions 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 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. 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. 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 grade: The course ends with an exam. 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: 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

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: **PROJECT TASK**
Year, Semester: 3rd year/2nd semester
Practical: **2**

Requirements

Topics: The students will work on different project tasks from a real industrial environment. The tasks involve planning of machines or machine parts, planning of manufacturing processes, measuring equipment, measuring process planning and measurement results processing. The students will be assigned their tasks by the factory where they are involved in the internship program or they can get a project task from a department of the university. The subject develops the students' individual problem-solving skills. This course prepares the students for later work on their thesis.

Field Specific vocational Subjects of Building Services Specialization

Subject: **NOISE CONTROL**
Coordinator: **Tünde Klára Kalmár**
Year, Semester: 2nd year/2nd semester
Lecture: **2**

1st week:
Lecture: Introductory of wave motion concepts – an elastic continuum viewpoint.

2nd week:
Lecture: Introductory of multiple, discrete, mass–spring–damper oscillator concepts – a macroscopic viewpoint.

3rd week:
Lecture: Introductory of concepts on natural frequencies, modes of vibration, forced vibrations and resonance.

4th week:
Lecture: The dynamics of a single oscillator – a convenient model.

5th week:
Lecture: Undamped free vibrations, Energy concepts The homogeneous acoustic wave equation – a classical analysis.

6th week:
Lecture: Conservation of mass, Conservation of momentum, The thermodynamic equation of a state.

7th week:
Lecture: Acoustics, The linearised acoustic wave equation, The acoustic velocity potential.

8th week:
Lecture: The propagation of plane sound waves, Sound intensity, energy density and sound power.

9th week:
Lecture: Noise and vibration measurement units – levels, decibels and spectra. Objective noise measurement scales. Subjective noise measurement scales. Vibration measurement scales.

10th week:
Lecture: Addition and subtraction of decibels, Frequency analysis bandwidths.

11th week:
Lecture: Instrumentation of Noise measurement. Instrumentation of vibration measurement.

12th week:
Lecture: Instrumentation of noise and vibration measurement.

13th week:
Lecture: Relationships for the measurement of free-field sound propagation. Acoustic barriers.

14th week:
Lecture: Sound-absorbing materials, Phon, Son, WHO directives.

Requirements

A, for a signature: Attendance at lectures is compulsory. Students must attend at lectures and may not miss more than three occasions during a semester. In case a student does so, the subject will not be signed and the student must repeat the course. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. 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.
B, for a grade: The course ends with an exam grade. The grade for the exam is given according to the following: score/grade 0-50 fail (1), 51-60 pass (2), 61-74 satisfactory (3), 75-89 good (4), 90-100 excellent (5).

Required reading materials

A. G. Ambekar: Mechanical Vibrations And Noise Engineering
Phi Learning Pvt. Ltd., 2006.
M. P. Norton, D. G. Karczub: Fundamentals Of Noise And Vibration Analysis For Engineers
Cambridge University Press, 2003. ISBN: 9781139163927
David A. Bies, Colin H. Hansen: Engineering Noise Control: Theory and Practice
4th edition. CRC Press, 2009. ISBN: 9780415487078

Subject: **COOLING SYSTEMS I**
Coordinator: **Tünde Klára Kalmár**
Year, Semester: 3rd year/1st semester
Lecture: **2**
Practical: **2**

1st week:
Lecture: Calculation of heat load. Overview of cooling systems.
Practical: The particular application of the theoretical curriculum said during the lecture.

2nd week:
Lecture: Vapor-compression refrigeration systems.
Practical: The particular application of the theoretical curriculum said during the lecture.

3rd week:
Lecture: The structures of cooling machines: a compressor, an evaporator, a condenser, expansion valves.
Practical: The particular application of the theoretical curriculum said during the lecture.

4th week:
Lecture: A cooling tower.
Practical: The particular application of the theoretical curriculum said during the lecture.

5th week:
Lecture: Refrigerant.
Practical: The particular application of the theoretical curriculum said during the lecture.

6th week:
Lecture: The structure of log p-h (pressure-enthalpy) diagram: isobar, isothermal, isenthalpic, isentropic curves.
Practical: The particular application of the theoretical curriculum said during the lecture.

7th week:
Lecture: An ideal and actual vapor-compression refrigeration cycle.
Practical: The particular application of the theoretical curriculum said during the lecture.

8th week:
Lecture: A single stage vapor-compression refrigeration cycle.
Practical: The particular application of the theoretical curriculum said during

9th week:
Lecture: A multistage vapor-compression refrigeration cycle.
Practical: The particular application of the theoretical curriculum said during the lecture.

10th week:
Lecture: Operation of cooling machines.
Practical: The particular application of the theoretical curriculum said during the lecture.

11th week:
Lecture: Fan-coil systems.
Practical: The particular application of the theoretical curriculum said during the lecture.

12th week:
Lecture: Parts of a cooling hydraulic system: a pump, a flow-switch, a pipe insulation.
Practical: The particular application of the theoretical curriculum said during the lecture.

13th week:
Lecture: Calculation of a cooling hydraulic system.
Practical: The particular application of the theoretical curriculum said during the lecture.

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

Requirements

Topics: Cooling systems. Cooling machines. Refrigerant. Structure and operation of cooling machines. Fan-coil systems. Cooling hydraulic system.
A, for a signature: Attendance at practice is compulsory. Students must attend lectures and may not miss more than three lectures during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. 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 one test: the end-term test in the 14th week. Students have to sit for the test.
B, for a grade: The course ends with an exam grade. The grade for the exam is given according to the following: score/grade: 0-50 fail (1), 51-60 pass (2), 61-74 satisfactory (3), 75-89 good (4), 90-100 excellent (5).

Required reading materials

Harvey, Leslie Daryl Danny : A handbook on low-energy buildings and district-energy systems: fundamentals, techniques and examples
2006. ISBN: 1844072436, 97818440
Moran, Michael J. : Introduction to Thermal Systems Engineering: Thermodynamics, Fluid Mechanics, and Heat Transfer
2003. ISBN: 0-471-20490-0
Ferenc, Kalmár : Energy conscious heating
2011. ISBN: 9789630590587

Subject: **HEATING SYSTEMS I**
Coordinator: **Ferenc Kalmár**
Year, Semester: 3rd year/1st semester
Lecture: **1**
Practical: **2**

1st week:
Lecture: Heat demand calculation. Basic relationships.
Practical: Heat demand calculation for a room.

2nd week:
Lecture: Heat distribution devices in heating systems.
Practical: Logarithmic temperature difference. Calculations of heating capacity of radiators.

3rd week:
Lecture: Classification of boilers. Boiler efficiencies: combustion, standard and seasonal efficiency.
Practical: Choosing of boilers.

4th week:
Lecture: Annual fuel demand. Condensing boilers.
Practical: Pipe sizing. Calculation of the mass flow. Major and minor losses.

5th week:
Lecture: Pump efficiency. Energy Efficiency Index.
Practical: Dimensioning a pump.

6th week:
Lecture: Pumps connected in parallel and series.

Practical: Exercises on connected pumps.

7th week:
Lecture: Adjusting pump performance. Throttle control, speed control. Law of affinity.
Practical: Pump curves, a duty point.

8th week:
Lecture: Operation of thermostatic valves. Pre-setting.
Practical: Sizing of thermostatic valve. Pre-setting calculations.

9th week:
Lecture: Open and closed heating systems. Water content of heating systems.
Practical: Pressure calculations, choosing expansion vessels.

10th week:
Lecture: Basic of heating system design. Schematic sysmbols.
Practical: Elaborating the homework.

11th week:
Lecture: Schematic flow diagram of a boiler house.
Practical: Elaborating the homework.

12th week:
Lecture: Vertical and horizontal arrangement.
Practical: Elaborating the homework.

13th week:
Lecture: Current situation in energetics.
Practical: Visitation of the Sustainable Building Energetics Information Centre.

14th week:
Lecture: Submitting the homework.
Practical: End-term test.
Self Control Test

Requirements

Topics: Heat demand calculation. Heat distribution devices in heating systems. Boilers. Pumps. Thermostatic valves. Open and closed heating systems. Heating system design.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice 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. 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 have to submit the homework as scheduled minimum on a sufficient level. During the semester there is a test in the 14th week. Students have to sit for the test.
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B, for a grade: The course ends in an exam grade. The semester grade is based on the mark of test result and the exam result. The grade is calculated as an average of them: - the grade of the end-term test - the exam grade. The minimum requirement for the end-term test is 50%. The grade for the test is given according to the following: score/grade: 0-50 fail (1), 51-60 pass (2), 61-70 satisfactory (3), 71-80 good (4), 81-100 excellent (5). If the score of the test is below 50%, the student once can take a retake test covering the whole semester material. The exam is a 60 minute theory test. The grade for the exam is given in the same way as given for the end-term test.

Required reading materials

Harvey, Leslie Daryl Danny : A handbook on low-energy buildings and district-energy systems: fundamentals, techniques and examples
2006. ISBN: 1844072436, 97818440
Petitjean, Robert : Total hydronic balancing: A handbook for design and troubleshooting of hydronic hvac systems
1997. ISBN: 9163080796

Ferenc, Kalmár : Energy conscious heating
2011. ISBN: 9789630590587

Subject: **HEATING SYSTEMS II**
Coordinator: **Ferenc Kalmár**
Year, Semester: 3rd year/2nd semester
Lecture: **2**
Practical: **2**

1st week:
Lecture: Wood-fuelled heating systems. Pellet, wood chips.
Practical: Boiler protection: thermostatic mixing valve.

2nd week:
Lecture: Wood-fuelled heating systems. Wood log boilers.
Practical: Boiler protection: a heat exchanger, a safety valve.

3rd week:
Lecture: Themal storage tanks.
Practical: Sizing of thermal storage tanks.

4th week:
Lecture: Temperature and mass flow control of radiator loops.
Practical: 2- and 3-way control valve calculations.

5th week:
Lecture: Mixing and diverting valves.
Practical: Choosing a suitable regulating valve.

6th week:
Lecture: Kv values. Authority.
Practical: Calculation of Kv values. Authority calculation.

7th week:
Lecture: Surface heatings: floor-, ceiling-, wall-heating. Outdoor temperature control.
Practical: Sizing of floor heating. Hydronic calcuation.

8th week:
Lecture: Hydraulic balancing: Effects of an improper balance. Unfavourable circuits.
Practical: Sizing of wall-heating. Hydronic calcuations.

9th week:
Lecture: Hydraulic balancing: a proportion rule. Balancing methods. (proportional, compensated)
Practical: Balancing calculations.

10th week:
Lecture: Deaeration in heating systems, Henry's law. Microbubbles. Dirt in water, air and dirt removals, filters.
Practical: Balancing and measing devices. Troubleshooting.

11th week:
Lecture: Advanced of heating system design.
Practical: Elaborating homework.

12th week:
Lecture: Energy conscious heating.
Practical: Elaborating homework.

13th week:
Lecture: Visiting the Sustainable Building Energetics Information Centre.
Practical: Elaborating homework.

14th week:
Lecture: Submitting homework.
Practical: End-term test.
Self Control Test

Requirements

Topics: Overview of heating systems. Surface heatings. Hydraulic balancing. Heating system design.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice 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. 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 have to submit the homework as scheduled minimum on a sufficient level. During the semester there is a test in the 14th week. Students have to sit for the test.
B, for a grade: The course ends in an exam grade. The semester grade is based on the mark of the test result and the exam result. The grade is calculated as an average of them: the grade of the end-term test - the exam grade. The minimum requirement for the end-term test is 50%. The grade for the test is given according to the following: score/grade: 0-50 fail (1), 51-60 pass (2), 61-70 satisfactory (3), 71-80 good (4), 81-100 excellent (5). If the score of the test is below 50%, the student once can take a retake test covering the whole semester material. The exam is a 60 minute theory test. The grade for the exam is given in same calculation as for the end-term test.

Required reading materials

Harvey, Leslie Daryl Danny : A handbook on low-energy buildings and district-energy systems: fundamentals, techniques and examples
2006. ISBN: 1844072436, 97818440
Petitjean, Robert : Total hydronic balancing: A handbook for design and troubleshooting of hydronic hvac systems
1997. ISBN: 9163080796
Ferenc, Kalmár : Energy conscious heating
2011. ISBN: 9789630590587

Subject: **VENTILATION AND AIR CONDITIONING I**
Coordinator: **Ferenc Kalmár**
Year, Semester: 3rd year/1st semester
Lecture: **2**
Practical: **3**

1st week:
Lecture: Physical Properties of Air
Practical: Solving problems based on the theme of the lecture.

2nd week:
Lecture: Structure of the h-x diagram. Equation.
Practical: Solving problems based on the theme of the lecture.

3rd week:
Lecture: Cooling load, heating load calculation of a building.
Practical: Solving problems based on the theme of the lecture. Elaborating a ventilation and air conditioning plan.

4th week:
Lecture: Determination of air flow demanded for ventilation.
Practical: Solving problems based on the theme

of the lecture.

5th week:
Lecture: Determination of fresh air in ventilation and air conditioning systems.
Practical: Solving problems based on the theme of the lecture.

6th week:
Lecture: Space requirements from MSZ CR 1752:2000. Definition of PMV, PPD, Tu, DR.
Practical: Solving problems based on the theme of the lecture. Consultation about plans. Working with plans in a team.

7th week:
Lecture: Air distribution in the space.
Practical: Solving problems based on the theme of the lecture.

8th week:
Lecture: Hydraulic planning of an air duct I.
Practical: Solving problems based on the theme of the lecture. Consultation about plans. Working with plans in a team.

9th week:
Lecture: Hydraulic planning of an air duct II.
Practical: Solving problems based on the theme of the lecture.

10th week:
Lecture: Acoustic planning of an air duct scale.
Practical: Solving problems based on the theme of the lecture.

11th week:
Lecture: Ventilation and air conditioning systems I.
Practical: Solving problems based on the theme of the lecture.

12th week:
Lecture: Ventilation and air conditioning systems II.
Practical: Solving problems based on the theme of the lecture. Consultation about plans. Working with plans in a team.

13th week:
Lecture: Ventilation and air conditioning equipments.
Practical: Solving problems based on the theme of the lecture.

14th week:
Lecture: Self Control Test.
Practical: Deadline for the plan.
Self Control Test

Requirements

Topics: Physical Properties of Air. An h-x diagram. Cooling load, heating load calculation. Determination of air flow demand for ventilation, fresh air. Space requirements. Air distribution. Hydraulic, acoustic planning of air duct. Ventilation and air conditioning systems and their equipments.
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B, for a grade: The course ends with an exam grade. The grade for the exam is given according to the following: 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

ASHRAE: Handbook HVAC Systems and Equipment
SI Edition.
ASHRAE : Handbook - Fundamentals
SI Edition.
ASHRAE : Handbook HVAC Applications
SI Edition.
HVAC: The Handbook of Heating, Ventilation and Air Conditioning for Design and Implementation

Subject: **VENTILATION AND AIR CONDITIONING II**
Coordinator: **Ferenc Kalmár**
Year, Semester: 3rd year/2nd semester
Lecture: **2**
Practical: **3**

1st week:
Lecture: Design of fabric filters in ventilation and air conditioning systems.
Practical: Solving problems based on the theme of the lecture. Elaborating ventilation and air conditioning plans.

2nd week:
Lecture: Design of heat exchangers in ventilation and air conditioning systems.
Practical: Solving problems based on the theme of the lecture.

3rd week:
Lecture: Design of fans in ventilation and air conditioning systems.
Practical: Solving problems based on the theme of the lecture.

4th week:
Lecture: Design the heating coils in ventilation and air conditioning systems. Consultation about plans. Working with plans in a team.
Practical: Solving problems based on the theme of the lecture.

5th week:
Lecture: Diffusers and jet nozzles.
Practical: Solving problems based on the theme of the lecture.

6th week:
Lecture: Fire prevention, fire dampers in ventilation and air conditioning systems.
Practical: Solving problems based on the theme of the lecture. Consultation about plans. Working with plans in a team.

7th week:
Lecture: Bases of air conditioning. Air conditioning equipments.
Practical: Solving problems based on the theme of the lecture.

8th week:
Lecture: Design of cooling coils, humidifiers in air conditioning systems.
Practical: Solving problems based on the theme of the lecture.

9th week:
Lecture: Air conditioning systems for comfort applications.
Practical: Solving problems based on the theme of the lecture. Consultation about plans. Working with plans in team.

10th week:
Lecture: Air conditioning equipment for comfort applications.
Practical: Solving problems based on the theme of the lecture.

11th week:
Lecture: Air conditioning systems for industrial applications.
Practical: Solving problems based on the theme of the lecture.

12th week:
Lecture: Air conditioning equipments for industrial applications.
Practical: Solving problems based on the theme of the lecture. Consultation about plans. Working with plans in a team.

13th week:
Lecture: Natural ventilation.
Practical: Solving problems based on the theme of the lecture.

14th week:
Lecture: Self Control Test.
Practical: Deadline for the plan.

Requirements

Topics: Fabric filters, heat exchangers. Heating and cooling coils. Fans, diffusers and jet nozzles. Fire preventation, fire dampers. Humidifier. Air conditioning systems and equipment for comfort applications. Industrial applications. Natural ventilation.
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B, for a grade: The course ends with an exam grade. The grade for the exam is given according to the following: 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

ASHRAE : Handbook - Fundamentals
SI Edition.
ASHRAE: Handbook HVAC Systems and Equipment
SI Edition.
ASHRAE : Handbook HVAC Applications
SI Edition.
HVAC: The Handbook of Heating, Ventilation and Air Conditioning for Design and Implementation

Subject: **BUILDING PHYSICS**
Coordinator: **Ákos Lakatos**
Year, Semester: 2nd year/2nd semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Internal and solar gains of a building. Balance point temperature. Degree-day curve and calculation.
Practical: Solving problems based on the theme of the lecture.

2nd week:
Lecture: Solar radiation. Irradiance. Global radiation. Beam radiation. Diffuse radiation. A solar constant. Analyses of temperature fields in case of one dimensional steady state heat conduction. A temperature field. Thermal conductivity.
Practical: Solving problems based on the theme of the lecture.

3rd week:
Lecture: Specific heat. Thermal diffusivity. Unsteady state heat transfers. Steady state heat transfers. Heat transfers by convection. Temperature variation in a multi-layer building element.
Practical: Solving problems based on the theme of the lecture.

4th week:
Lecture: Heat transfers by radiation. Planck's law. Wien's law. Kirchoff's laws. Stefan Boltzmann's law. Lambert's law.
Practical: Solving problems based on the theme of the lecture.

5th week:
Lecture: Air gaps. Built-in heat conductivity of insulating materials.
Practical: Solving problems based on the theme of the lecture.

6th week:
Lecture: Thermal bridges.
Practical: Solving problems based on the theme of the lecture.

7th week:
Lecture: Humid air. Psichrometer. Enthalpy of humid air. Dew point temperature.
Practical: Solving problems based on the theme of the lecture.

8th week:
Lecture: Surface and capillary condensation. Sorption. Interstitial condensation.
Practical: Test 1.
Self Control Test

9th week:
Lecture: Air and vapour barrier.
Practical: Solving problems based on the theme of the lecture.

10th week:
Lecture: Thermal storage.
Practical: Solving problems based on the theme of the lecture.

11th week:
Lecture: A decrement factor and time lag.
Practical: Solving problems based on the theme of the lecture.

12th week:
Lecture: Air tightness of buildings.
Practical: Solving problems based on the theme of the lecture.

13th week:
Lecture: Sunspace and a Trombe wall.
Practical: Solving problems based on the theme of the lecture.

14th week:
Lecture: Prediction of thermal comfort in buildings. PMV and PPD values.
Practical: Test 2.
Self Control Test

Requirements

Topics: Internal and solar gains of a building. Radiation. Specific heat. Thermal diffusivity. Temperature variation in a multi layer building element. Heat transfer by radiation. Air gaps. Thermal bridges. Humid air. Surface and capillary condensation. Sorption. Interstitial condensation. Air and vapour barrier. Thermal storage. Decrement factor and time lag. Air tightness of buildings. Sunspace and Trombe wall. Prediction of thermal comfort in buildings.
To obtain the signature in the Neptun:

1. Attendance at the courses and seminars according to the regulation of UD.
2. At least grade 2 at two Tests (only exercises) written on 8th and 14th week of the Semester. Written or oral exam (only theoretical questions) in the exam period.
The final grade (FG) is calculated as follows: FG=0.25×T1+0.25×T2+0.5×E T1 – a grade obtained at Test 1 (>2) T2 – a grade obtained at Test 2 (>2) E – a grade obtained at the written or oral exam (>2) The grade for the test and the exam is given according to the following: score/grade: 0-50 fail (1), 51-60 pass (2), 61-74 satisfactory (3), 75-89 good (4), 90-100 excellent (5).

Required reading materials

Hugo L. Hens: Building Physics and Applied Building Physics
Wiley, 2012. ISBN: 978-3-433-03031-8
Carl Eric Hagentoft: Introduction to Building Physics
Studentlitteratur AB, 2001. ISBN: 978-9144018966
Carl Eric Hagentoft: Introduction to Building Physics
Studentlitteratur AB, 2001. ISBN: 978-9144018966

Subject: **WATER AND GAS SUPPLY SYSTEMS I**
Coordinator: **Tünde Klára Kalmár**
Year, Semester: 3rd year/1st semester
Lecture: **1**
Practical: **1**

1st week:
Lecture: Natural gas properties, gas laws, Gas combustion (natural gas, LPG, biogas), combusted gas analyses.
Practical: Examples and solutions for calculation of gas properties and gas combustion.

2nd week:
Lecture: Gas consumption, gas flow rates in pipes, gas pipe sizing.
Practical: Examples and solutions for calculation of pipe sizing.

3rd week:
Lecture: Main gas supply and installation, gas services pipe in-taking.
Practical: Giving and introducing the task for the semester.

4th week:
Lecture: Meter types, installation of gas meters.
Practical: Examples of installation of gas meters and making the design of the semester task, step 1.

5th week:
Lecture: Gas pressure regulators.
Practical: Examples of installation of gas pressure regulators, and how to choose it.

6th week:
Lecture: Gas burners, gas thermostats, gas boiler thermostats and relay valves, gas controls and safety features, flame failure safety devices, Gas ignition devices, purging and testing, purging new installations.
Practical: Graphical symbols for the semester task and making the design of the semester task, step 2.

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

8th week:
Lecture: Gas appliances, radiant tube heaters, convector heaters, balanced gas flue appliances, condensing boilers.
Practical: Making the design of the semester task, step 3.

9th week:
Lecture: Conventional open flues for gas burning appliances, draught diverters.
Practical: Examples and solutions for calculation of draught diverters, and making a design of the semester task, step 4.

10th week:
Lecture: Flue blocks, open flue terminals, stainless steel flue lining.
Practical: Examples and solutions for calculation of gas chimney.

11th week:
Lecture: Fan assisted gas flues, fan assisted balanced flues, shared flues – concentric duct.
Practical: Examples and solutions for calculation of ducting. Making a design of the semester task, step 5.

12th week:
Lecture: Ventilation requirements. Basics.
Practical: Making a design of the semester task, step 6.

13th week:
Lecture: Ventilation requirements.
Practical: Examples and solutions for calculation of ventilation requirements.

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

Requirements

Topics: Natural gas properties. Gases combustion (Natural gas, LPG, biogas). Kinds of main gas supply and installation. Gas services pipe intaking. Meters. Gas controls and safety features. Gas ignition devices. Purging and testing. Gas appliances. Balanced flue appliances. Open flue appliances. Flue blocks. Open flues terminals. Stainless steel flue lining. Shared flues. Fan assisted gas flues. Ventilation requirements. Combusted gas analysis. Gas laws. Gas consumption. Gas pipes and flue sizing. Graphical symbols. Gas system design.
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 the semester task as scheduled minimum on a sufficient level. During the semester there is a semester task and two tests, first one on the 7th week and the end-term test on the 14th 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 grade of the semester task and the examination, the exam grade is calculated as an average of them: - the grade of the semester task - the result of the examination The minimum requirements for the mid-term and end-term tests and the examination is 60% respectively. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following: score/grade: 0-50 fail (1), 51-60 pass (2), 61-75 satisfactory (3), 76-90 good (4), 91-100 excellent (5). If the score of any test is below 51, 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 semester task 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

Fred Hall and Roger Greeno : Building Services Handbook
Sixth edition. Elsevier Limited, 2011. ISBN: 978-0-08-096982-4
David V. Chadderton : Building Services Engineering
Fifth edition. Taylor & Francis, 2007. ISBN: 0-203-96299-0

Subject: **WATER AND GAS SUPPLY SYSTEMS II**
Coordinator: **Tünde Klára Kalmár**
Year, Semester: 3rd year/2nd semester
Lecture: **2**
Practical: **3**

1st week:
Lecture: Cold water and supply systems, a rain cycle, sources of water supply, acidity and alkalinity in water, filtration of water, sterilization and disinfection, storage and distribution of water.
Practical: Giving and introducing the task for the semester.

2nd week:
Lecture: Water mains, valves and taps, joints on water pipes, pipe jointing materials, direct systems of cold water supply, indirect systems of cold water supply.
Practical: Making the design of the semester task, step 1.

3rd week:
Lecture: Hard and soft water, water softening, water conditioning and treatment.
Practical: Examples and solutions for calculation of water softening.

4th week:
Lecture: Backflow protection, secondary backflow protection, cold water storage cisterns, cold water storage calculations, boosted cold water systems, delayed action float valves.
Practical: Examples and solutions for calculation of water storage.

5th week:
Lecture: Pump laws, pipe sizing, hydraulics and a fluid flow.
Practical: Examples and solutions for calculation of pipe sizing.

6th week:
Lecture: Drainage systems and sewage treatment systems, combined and separate systems, partially separated systems, rodding point systems, sewer connection.
Practical: Making the design of the semester task, step 2.

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

8th week:
Lecture: Drainage ventilation, unventilated spaces, drain laying, means of access, bedding of drains, drains under or near buildings, drain pipe materials, joints used on drain pipes, anti-flood devices.
Practical: Examples and solutions for calculation of drainage ventilation.

9th week:
Lecture: Garage drainage, drainage pumping, subsoil drainage, tests on drains, soakaways, cesspools and septic tanks, drainage fields and mounds, rainwater management, a drainage design.
Practical: Examples and solutions for calculation of drainage.

10th week:
Lecture: Sanitary fitments and appliances, flushing cisterns, troughs and valves, water closets, bidets, showers, baths, sinks, wash basins and troughs, unplugged appliances.

Practical: Making the design of the semester task step 3.

11th week:
Lecture: Thermostatic temperature control, urinals, hospital sanitary appliances, sanitary conveniences, sanitary conveniences for disabled people, traps and waste valves.
Practical: Making the design of the semester task, step 4.

12th week:
Lecture: Single stack systems and variations, one- and two-pipe systems, pumped waste systems, wash basins, waste arrangements, waste pipes from washing machines and dishwashers, air tests, sanitation data, offsets, ground floor appliances, high rise buildings.
Practical: Examples of pumped waste systems and making the design of the semester task, step 5.

13th week:
Lecture: Fire stops and seals, flow rates and discharge units, sanitation design, discharge stack sizing.
Practical: Examples and solutions for calculation of flow rates and discharge units. Making the design of the semester task step 6.

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

Requirements

Topics: Sources of water supply. Filtration of water. Sterilisation and disinfection. Storage and distribution of water. Water mains. Direct system of cold water supply. Indirect system of cold water supply. Hard and soft water. Water conditioning. Backflow protection. Pump laws. Pipe sizing. Drainage systems. Sewage treatment systems. Drainage ventilation. Drainage design. Sanitary fitments and appliances. Thermostatic temperature control.
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 the semester task as scheduled minimum on a sufficient level. During the semester there is a semester task and two tests, first one on the 7th week and the end-term test on the 14th week. Students have to sit for the tests.
B, for a grade: The course ends in an examination. Based on the average of the grade of the semester task and the examination, the exam grade is calculated as an average of them: - the grade of the semester task - the result of the examination The minimum requirements for the mid-term and end-term tests and the examination is 60% respectively. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following: score/grade: 0-50 fail (1), 51-60 pass (2), 61-75 satisfactory (3), 76-90 good (4), 91-100 excellent (5). If the score of any test is below 51, 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 semester task 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

Fred Hall and Roger Greeno : Building Services Handbook
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David V. Chadderton : Building Services Engineering
Fifth edition. Taylor & Francis, 2007. ISBN: 0-203-96299-0
F. Porges: HVAC Engineer's Handbook
Eleventh edition.2001. ISBN: 0 7506 4606 3

Subject: **WATER AND GAS SUPPLY SYSTEMS III**
Coordinator: **Tünde Klára Kalmár**
Year, Semester: 4th year/1st semester
Lecture: **1**
Practical: **2**

1st week:
Lecture: Hot water supply systems, demands.
Practical: Giving and introducing the task for the semester.

2nd week:
Lecture: Direct systems of hot water supply, indirect systems of hot water supply, unvented hot water storage systems.
Practical: Making the design of the semester task, step 1.

3rd week:
Lecture: Expansion and temperature relief valves, hot water storage cylinders.
Practical: Examples and solutions for calculation of expansion of hot water.

4th week:
Lecture: Primatic hot water storage cylinders, medium and high rise building supply systems.
Practical: Making the design of the semester task, step 2.

5th week:
Lecture: Sealed indirect hot water systems for a high rise building.
Practical: Examples of hot water systems.

6th week:
Lecture: Primary thermal stores, Types of boilers.
Practical: Making the design of the semester task, step 3.

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

8th week:
Lecture: Secondary circulation, Duplication of a plant, Electric and gas water heaters.
Practical: Examples and solutions for calculation of secondary circulation.

9th week:
Lecture: Solar heating of water.
Practical: Examples and solutions for calculation of the elements of a solar collector system.

10th week:
Lecture: Hot water storage capacity, boiler rating, pipe sizing, pressurized systems, circulation pump rating.
Practical: Making the design of the semester task, step 4.

11th week:
Lecture: Legionnaires' disease in hot water systems.
Practical: Making the design of the semester task, step 5.

12th week:
Lecture: Ecodesign requirements for water heaters and hot water storage tanks.
Practical: Examples of seasonal efficiency of

domestic boilers.

13th week:
Lecture: Galvanic or electrolytic actions.
Practical: Making the design of the semester task, step 6.

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

Requirements

Topics: Hot water supply systems. Direct and indirect systems of hot water supply. Primary thermal stores. Types of boiler. Secondary circulation. Electric and gas water heaters. Solar heating of water. Hot water storage capacity. Pipe sizing. Legionnaires' disease in hot water systems. Ecodesign requirements for water heaters and hot water storage tanks. Galvanic or electrolytic action.
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 the semester task as scheduled minimum on a sufficient level. During the semester there is a semester task and two tests, first one on the 7th week and the end-term test on the 14th week. Students have to sit for the tests.
B, for a grade: The course ends in an examination. Based on the average of the grade of the semester task and the examination, the exam grade is calculated as an average of them: - the grade of the semester task - the result of the examination The minimum requirements for the mid-term and end-term tests and the examination is 60% respectively. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following: Score/grade: 0-50 fail (1), 51-60 pass (2), 61-75 satisfactory (3), 76-90 good (4), 91-100 excellent (5). If the score of any test is below 51, 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 semester task 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

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David V. Chadderton : Building Services Engineering
Fifth edition. Taylor & Francis, 2007. ISBN: 0-203-96299-0
F. Porges: HVAC Engineer's Handbook
Eleventh edition.2001. ISBN: 0 7506 4606 3

Subject: **LABORATORY PRACTICE I**
Coordinator: **Imre Csáky**
Year, Semester: 3rd year/2nd semester
Practical: **3**

1st week:
Practical: A characteristic curve of a valve.

2nd week:
Practical: Hydronic balancing of heating circuits.

3rd week:
Practical: Temperature distribution in case of radiator heating.

4th week:
Practical: Temperature distribution in case of floor heating.

5th week:
Practical: Quantitative control of delivered heat in case of central heating systems.

6th week:
Practical: Air temperature and velocities in case of mixing air distribution systems I.

7th week:
Practical: Air temperature and velocities in case of mixing air distribution systems II.

8th week:
Practical: Air temperature and velocities in case of displacement ventilation systems.

9th week:
Practical: Air change rate measurement in case of natural ventilation.

10th week:
Practical: Thermal conductivity measurements I.

11th week:
Practical: Thermal conductivity measurements II.

12th week:
Practical: Specific heat measurements energy consumption of a circulation pump.

13th week:
Practical: Re-performance of measurements – if necessary.

14th week:
Practical: Re-performance of measurements – if necessary.

Requirements

Topics: Measurements of water supply systems, heating systems, gas supply systems, ventilation systems, building physics in a laboratory.
A, for a signature: Attendance at practice classes is compulsory. Students must attend at practice 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. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Students are required to bring calculators to each practice class. Active participation is evaluated by the teacher 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.
B, for a grade: The course ends in a mid-semester grade, based on preciseness of all measurements. The grade for preciseness is given according to the following: 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

Terry M. Tritt: Thermal Conductivity. Theory, Properties, and Applications
Springer-Verlag US, ISBN: 978-0-306-48327-1
Control Valve Handbook
4th Edition. Emerson Process Management,
ASHRAE: Principles Of Heating, Ventilating And Air-Conditioning
7th Edition.
John W. Mitchell, James E. Braun: Heating, Ventilation, and Air Conditioning in Buildings
1st Edition. Wiley, 2012. ISBN: 978-0-470-62457-9

Subject: **LABORATORY PRACTICE II**
Coordinator: **Imre Csáky**
Year, Semester: 4th year/1st semester
Practical: **3**

1st week:
Practical: Blower door test of closed spaces.

2nd week:
Practical: Diagnostics of thermal bridges with the help of a Thermocamera I.

3rd week:
Practical: Temperature distribution in case of wall heating.

4th week:
Practical: Temperature distribution in case of ceiling heating.

5th week:
Practical: Qualitative control of delivered heat in case of central heating systems.

6th week:
Practical: Turbulence measurements in case of mechanical ventilation systems I.

7th week:
Practical: Turbulence measurements in case of personal ventilation systems.

8th week:
Practical: Air change rate measurement in case of mechanical ventilation systems.

9th week:
Practical: Sorption curve measurements I.

10th week:
Practical: Sorption curve measurements II.

11th week:
Practical: Flues gas analysis in case of gas boilers.

13th week:
Practical: Re-performance of measurements – if necessary.

14th week:
Practical: Re-performance of measurements – if necessary.

Requirements

Topics: Measurements in a laboratory of water supply systems, heating systems, gas supply systems, ventilation systems, building physics.
A, for a signature: Attendance at practice is compulsory. Students must attend at practice classes and may not miss more than three occasions during a semester. In case a student does so, the subject will not be signed and the student must repeat the course. Being late is counted as an absence. In

case of further absences, a medical certificate needs to be presented. Students are required to bring calculators 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.
B, for a grade: The course ends in a mid-semester grade, based on preciseness of all measurements. The grade for preciseness is given according to the following: 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

Terry M. Tritt: Thermal Conductivity. Theory, Properties, and Applications
Springer-Verlag US, ISBN: 978-0-306-48327-1
Control Valve Handbook
4th Edition. Emerson Process Management,
ASHRAE: Principles Of Heating, Ventilating And Air-Conditioning
7th Edition.
John W. Mitchell, James E. Braun: Heating, Ventilation, and Air Conditioning in Buildings
1st Edition. Wiley, 2012. ISBN: 978-0-470-62457-9

Subject: **DISTRICT HEATING AND COOLING**
Coordinator: **Ferenc Kalmár**
Year, Semester: 3rd year/2nd semester
Lecture: **2**

1st week:
Lecture: Basic energetics. Power plants. As DHC systems are more efficient and less polluting than individual domestic or commercial heating and cooling systems, introduction to DHC, including its potential contribution to reducing carbon dioxide emissions, then reviews thermal energy generation for DHC, including fossil fuel-based technologies, those based on renewables, methods to improve the efficiency of DHC.

2nd week:
Lecture: Purpose of district heating and cooling. Comprehensive overview of DHC systems and the technologies and energy resources utilized within these systems.

3rd week:
Lecture: Analysing various methods used for harnessing energy to apply to DHC systems. Ideal resource for those interested in district cooling.

4th week:
Lecture: Track of the district heating and cooling.

5th week:
Lecture: Heat networks, distributed heating. Thermal energy, cogeneration, combined heat and power, and CHP. Trigeneration.

6th week:
Lecture: Building of distribution lines. An utility tunnel.

7th week:
Lecture: Direct and indirect systems. Reviews the application of DHC systems in a field, including both the business model side and planning needed to implement these systems, distribution of centrally generated heat or cold energy to buildings, usually in the form of space heating, cooling and hot water.

8th week:
Lecture: Fluids. Pressure relations. Basic

elements of a system.

9th week:
Lecture: Basics of system design. Common issues of a system. Dilation. Circulation.

10th week:
Lecture: Buildings in connection with the system. Static, hydraulic and caloric calculation. A caloric centre.

11th week:
Lecture: Constant and variable mass flow.

12th week:
Lecture: System schematics.

13th week:
Lecture: Visiting a District Heating Power Plant of Debrecen or a District heating refurbishment site.

14th week:
Lecture: A theoretical exam.
Self Control Test

Requirements

Topics: Introduction to DHC. Comprehensive overview of DHC systems. Heat networks, distributed heating. Application of DHC systems in the field. Basics of system design. Mass flow.
A, for a signature: Attendance at lectures is compulsory. Students must attend lectures 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. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. 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.
B, for a grade: The course ends with an exam grade. The grade for the exam is given according to the following: score/grade: 0-50 fail (1), 51-60 pass (2), 61-74 satisfactory (3), 75-89 good (4), 90-100 excellent (5).

Required reading materials

Committee on District Heating and Cooling, District Heating and Cooling in the United States
National Research Council , 1985. ISBN: 978-0-309-03537-8
Sven Werner : District Heating and Cooling
Studentlitteratur AB, 2013. ISBN: 978-9144085302
Robin Wiltshire : Advanced District Heating and Cooling
Woodhead Publishing, 2015. ISBN: 978-1-78242-395-9

Subject: **BUILDING ENERGETICS**
Coordinator: **Ferenc Kalmár**
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 generations 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: Mid-term test
Self Control Test

8th week:
Lecture: Renewable energy sources. PV systems.

9th week:
Lecture: Renewable energy sources. Wind energy.

10th week:
Lecture: Enhancing energy efficiency of heating systems.

11th week:
Lecture: Enhancing energy efficiency of ventilation and cooling systems.

12th week:
Lecture: Low-energy buildings, passive buildings: main technical aspects.

13th week:
Lecture: Building energy requirements.

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

Requirements

Topics: Energy policy, building-related energy directives and regulations in Hungary and EU. Renewable energy sources. Enhancing energy efficiency. Low-energy buildings, passive buildings. Building energy requirements.
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 7th week and the end-term test in the 14th 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.
• A 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: 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

KalmárF.: Energy concious heating
Akadémia Kiadó, 2011. ISBN: 978 963 05 9058
Hodge B. : Alternative Energy Systems and Applications
Wiley, 2009. ISBN: 0470142502
Keith J. Moss : Energy Management in Buildings
Taylor & Francis, 2006.

Field-Specific Subjects of Operation and Maintenance Specialization

Subject: **FRAME STRUCTURES**
Coordinator: **Sándor Hajdu**
Year, Semester: 2nd year/2nd semester
Lecture: **2**
Seminar: **1**

1st week:
Lecture: Steel usage in structural building. History of steel structures. Failure forms of steel structures.
Seminar: Classification of cross-sections. Specific effects on steel structures.

2nd week:
Lecture: Tensile, compressive, shear and combinated resistance of cross-sections.
Seminar: Tensile, compressive, shear and combinated resistance of cross-sections.

3rd week:
Lecture: Bolted joints of steel structures.
Seminar: Constructing bolted joints.

4th week:
Lecture: Welded joints of steel structures.
Seminar: Calculating welded joints.

5th week:
Lecture: Stability of structural elements. Design of bars under compression.
Seminar: Continue designing joints. Outgiving and discussion of the Design Task.

6th week:
Lecture: Design of structural elements under bending. Lateral torsional buckiling.
Seminar: Design of bars under compression.

7th week:
Lecture: Design of structural elements under bending. Design of second order structural elements under bending.
Seminar: Design of beams under bending.

8th week:
Lecture: TEST1
Self Control Test

9th week:
Lecture: Truss girders
Seminar: Design of beams under bending.

10th week:
Lecture: Design of buildings with steel structures.
Seminar: Lateral torsional buckling and local buckling.

11th week:
Lecture: Fabrication and installation of steel structures.
Seminar: Design of frame structures. Calculating imperfections.

12th week:
Lecture: Steel corrosion and fire protection.
Seminar: Consultation

13th week:
Lecture: Reserve week
Seminar: Consultation

14th week:
Lecture: TEST2
Self Control Test

15th week:
Lecture: Consultation
Seminar: Consultation Handing in of the Design Task

Requirements

Topics: Steel usage in structural building. History of steel structures. Failure forms of steel structures. Tensile, compressive, shear and combinated resistance of the cross-sections. Bolted joints of steel structures. Welded joints of steel structures. Stability of structural elements. Design of bars under compression. Design of structural elements under bending. Lateral torsional buckling. Design of second order structural elements under bending. Fabrication and installation of steel structures. Steel corrosion and fire protection.
During the semester there are two tests: the 1st test in the 8th week and the 2nd test in the 15th week – and there are three design tasks. Attendance at lectures is strongly 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 misses more than three, 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 lectures and at practice classes will be recorded by the staff of the department. 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 calculator and the printed materials of the lectures to each occasion (both lectures and practice classes). Active participation is evaluated by the teacher in every class. Students1 activity and participation is required.
Students have to submit all the two tests and the design tasks as scheduled minimum on a sufficient level. The minimum point of test and design task has to be taken. The minimum (required to have mid-semester grade) and maximum points can be obtained are the follows: Two tests: I. Test: Maximum: 30 points Minimum: 18 points II. Test: Maximum: 30 points Minimum: 18 points Summa: 60 points 36 ponits Design task: Maximum: 40 points Minimum: 25 points Summa points: Maximum: 100 points Minimum: 61 points The course ends with a mid-semester grade (AW5). Based on the summa points of the tests and the summa points of the design tasks, the mid-semester grade is defined by the following way: score/grade: 0 – 60 points: fail (no sign), 61 – 70 points: pass (2), 71 – 80 points: satisfactory (3), 81 – 90 points: good (4), 91 – 100 points: excelent (5).

Required reading materials

Eurocode: Basis of structural design
EN 1990:2002/A1:2005 .
Eurocode 1: Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings
EN 1991-1-1:2002 .
MSZ: Design of steel structures Part 1-1.:General rules and rules for buildings
EN 1993-1-1: 2009 .
MSZ: Design of steel structures Part 1-8.:Design of joints
EN 1993-1-8: 2005.

Subject: **HYDRAULIC AND PNEUMATIC MACHINES**
Coordinator: **János Tóth**
Year, Semester: 2nd year/2nd semester
Lecture: **2**
Practical: **2**

1st week: **Lecture:** Classification of power systems.	Pneumatic power systems. Evolution of compressed air.

Practical: Examples on perfect gas laws (isothermal, isobaric and isochoric processes).

2nd week:
Lecture: Force transmission through fluid. Fluid pressure to mechanical force. Fluid power cylinders.
Practical: Sizing pneumatic cylinders. Load ratio. Angle of movement.

3rd week:
Lecture: Fundamentals of pneumatics. General structures of pneumatic systems.
Practical: Calculations on relative humidity determination. Receiver sizing. Sizing compressor air mains.

4th week:
Lecture: Control systems (directional control valves, dual-pressure valves, shuttle valves, pressure sequence valves, time delay valves).
Practical: Calculations on air consumptions and required air flow.

5th week:
Lecture: Simple pneumatic connections. Symbolic representation of pneumatic elements and devices. Build up of circuit diagrams.
Practical: Design of simple pneumatic systems.

6th week:
Lecture: Applications of the FluidSIM-P program. Introduction to the Festo Didactic education system.
Practical: Design of simple pneumatic systems using FluidSIM-P software.

7th week:
Lecture: Pneumatics in the industry. Pneumatic machines.
Practical: Design of a complex pneumatics system. Mid-term test 1.
Self Control Test

8th week:
Lecture: Functions of hydraulic equipment. Symbols and drawing techniques.
Practical: Understanding physical elements. Technical description of drawing symbols.

9th week:
Lecture: The structure and circuit diagram (control, power supply) of a hydraulic system.
Practical: Actuator elements operation in real environment and FluidSIM-H software. Bending machine exercises.

10th week:
Lecture: Physical basic of hydraulics (pressure transmission, force transmission, way transmission, pressure ratio). Kinds of flow. Working fluid (types of tasks, viscosity).
Practical: Operation actuator elements via indirect valves. Exercises on a roller track.

11th week:
Lecture: Equipment representation (layout drawings, wiring diagrams, operating charts). Power supply system components (a gear motor, a pump, a filter, a tank).
Practical: Implementation of complex control exercises in real environment and Fluid SIM-H software. Exercises on lift tables. Exercises on lidded containers.

12th week:
Lecture: Valves (method of construction, nominal value, slides). Pressure control valves. Way valves (2/2, 3/2, 4/2, 4/3).
Practical: Exercises on a paint drying furnace, a holder, hydraulic tilting platform.

13th week:
Lecture: Shut-off valves (check valve, controlled check valve). Flow control valves (one-way control valves, two-way flow control valves).
Practical: Exercises on turning feeding machines. Exercises on grinding machines and drill machines.

14th week:
Lecture: Hydraulic cylinders (single, double-acting, sealing, venting, buckling). Hydraulic motors.
Practical: Design of complex hydraulic systems and realization in reality.Mid-term test 2.
Self Control Test

	Self Control Test
15th week: **Lecture:** Re-take test.	

Requirements

Topics: Fundamentals of pneumatics. General structures of pneumatic systems. Control systems (directional control valves, dual-pressure valves, shuttle valves, pressure sequence valves, time delay valves). Simple pneumatic connections. Symbolic representation of pneumatic elements and devices. Building up of circuit diagrams. Applications of the FluidSIM-P program. Introduction to the Festo Didactic education system. Pneumatics in industry. Pneumatic machines. Hydraulic machine functions. Design and circuit diagrams of a hydraulic system. Physical principles of hydraulics. Parts of power supply systems. Pressure control valves. Stop valves. Flow control Valves. Hydraulic cylinders. Applications of the FluidSIM-H 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. Attendance at a 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 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 students' 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 in the 7th and 14th weeks. Students have to sit for the tests.
B, for a grade: The course ends in an examination (ESE). 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: 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, 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 mid-term tests is at least good (4).

Required reading materials

Peter Croser, Frank Ebel: Pneumatics Basic Level
Festo Didactic GmbH □ Co., 2002.
De Silva, Clarence W.: Mechatronics : an integrated approach
Boca Raton CRC Press, 2005.
D. Merkle, B.Schrader, M. Thomes: Hydraulics Basic Level
Festo Didactic GmbH □ Co., 2003.

Subject: **FRACTURE MECHANICS**
Coordinator: **Gábor Balogh**
Year, Semester: 3rd year/2nd semester
Lecture: **2**
Practical: **1**

1st week: **Lecture:** Overviewing the basics of fracture mechanics and their history.	**Practical:** Introduction to fracture mechanics and giving personal tasks to solve it during the semester.

2nd week:
Lecture: Measuring techniques of fracture mechanics, linear mechanics basic laws, SIF & KIC calculation methods. The basic rules of checking these parameters.
Practical: Search results (by Internet) checking & comparing.

3rd week:
Lecture: Calculation methods of the deformation of the crack end area, and the importance of these phenomena in crack growing. Non linear calculation methods & techniques. COD and its measuring.
Practical: Searching results (by Internet) checking & comparing.

4th week:
Lecture: Calculation methods of the deformation of the crack end area, and the importance of these phenomena in crack growing. Non linear calculation methods & techniques. COD and its measuring.
Practical: Presenting the results of the task.

5th week:
Lecture: The importance of remaining stress in crack growing phenomena. Own-check methods of fracture mechanics (R9, EPRI, COD, leak-before-break, etc.) Measuring methods of COD.
Practical: Presenting the results of the task.

6th week:
Lecture: The importance of remaining stress in crack growing phenomena. Own-check methods of fracture mechanics (R9, EPRI, COD, leak-before-break, etc.). Measuring methods of COD
Practical: Presenting the results of the task.

7th week:
Lecture: The applicable material testing (NDT) methods to detect typical failures in raw material or welded joints. Overview of methods and its industrial applications.
Practical: Presenting the results of the task.

8th week:
Lecture: The typical testing methods to detect surface or mid surface failures in a structure. Physical basics of the methods.
Practical: Presenting the results of the task.
Self Control Test

9th week:
Lecture: The typical testing methods to detect surface or mid surface failures in a structure. Physical basics of the methods.
Practical: Presenting the results of the task.

10th week:
Lecture: X-ray and isotopic NDT methods. Physical basics of the methods.
Practical: Presenting the results of the task.

11th week:
Lecture: Ultrasonic testing methods, physical basics.
Practical: Presenting the results of the task.

12th week:
Lecture: Other NDT testing methods, physical basics, limitations.
Practical: Presenting the results of the task.

13th week:
Lecture: Crack sensitivity of different structures (case studies) by the affect of kvasi-statical and repetitive stresses.
Practical: Case studies and calculation methods, examples. Presenting the results of the task.

14th week:
Lecture: Summary of Fracture Mechanics and its importance in design, production and other engineering fields.
Practical: Presenting the results of the task

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

Requirements

Topics: Continuum mechanical approaches to describe the stress-strain circumstances in the vicinity of cracks where there are different constitutive laws. Possible fracture criteria. The plane (stress or strain) theory of elasticity. The basic principles of the theory of linear elastic fracture mechanics (LEFM). LEFM solutions, the concept of the stress intensity factor (SIF). Plastic field estimations at the crack tip. Non-linear fracture mechanics, J-integrals. Residual stress fields in fracture mechanics. Sources of residual stresses. Crack propagation sensitivity index concept and its practical use for quasi-static and cyclic loaded elements. Engineering procedures (R9, EPRI, COD, leak-before-break) for the handling of crack-like defects in engineering structures. NDT techniques and their reliability, applicability in detection of crack-like defects.
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 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. 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 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 with 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.

Required reading materials

Broek, D.: The Practical Use of Fracture Mechanics
Kluwer Academic Publishers, 1988.
Fred Nilson: Fracture Mechanics – from theory to Application
KTH, 1993.
Norman E. Dowling: Mechanical Behavior Materials. Engineering methods for deformation, fracture and fatigue
International . Prentice-Hall , 1993.
Richard Hertzberg: Deformation and Frature Mechanics of Engineering Materials
John Willey and Sons, 1989.
M. Kocak, A.Webster, J.J. Janos, R.A Ainsworth, R. Koers: FITNET Fitness-for Service. Vol. I. and II.
2008. ISBN: 978-3-940923-00-4

Subject: **MANUFACTURING PLANNING**
Coordinator: **Gábor Balogh**
Year, Semester: 3rd year/1st semester

Lecture: **2**
Seminar: **2**

1st week:
Lecture: Overview of different manufacturing principles. Selection of the best fitted manufacturing model.
Seminar: Giving personal tasks to make during the semester. Introducing basic calculation models for capacity planning.

2nd week:
Lecture: Custom manufacturing model (Basic rules, capacity calculation, storage solutions, optimization of the production, applicability in real industry)
Seminar: Case studies.

3rd week:
Lecture: An intermittent and batch manufacturing model (Basic rules, capacity calculation, storage solutions, optimization of the production, applicability in real industry)
Seminar: Case studies.

4th week:
Lecture: A continuous manufacturing model (Basic rules, capacity calculation, storage solutions, optimization of the production, applicability in real industry)
Seminar: Case studies.

5th week:
Lecture: A flexible manufacturing model (Basic rules, capacity calculation, storage solutions, optimization of the production, applicability in real industry).
Seminar: Case studies.

6th week:
Lecture: Capacity planning (Overview of different possibilities, calculation methods, applied methods in different industries)
Seminar: Calculation on a special case (for nuclear devices).

7th week:
Lecture: Quality management at a company (Measuring equipments, gauges & it's importance and design methods)
Seminar: Case studies, practical measuring.

8th week:
Lecture: CIM (How it works, - to design, -operate, -manage a system, maintenance)
Seminar: Case studies.

9th week:
Lecture: CNC (programming, control, documentation)
Seminar: Case studies.

10th week:
Lecture: CNC2 (types, design, production of a CNC machine)
Seminar: Case studies.

11th week:
Lecture: CNC programs.
Seminar: CNC programming and simulation.

12th week:
Lecture: CNC production modeling.
Seminar: Simulation.

13th week:
Lecture: Integrated material data processing systems.
Seminar: Case studies.

14th week:
Lecture: Integrated manufacturing systems. Summary of the semester.
Seminar: Case studies.

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

Requirements

Topics: This course is a study of the efficient and effective utilization of manufacturing resources. Course topics include: optimization of technological data. Material requirements planning. Capacity requirements planning. The design of (Go - No Go) gauges; the function of gauges in production; the main types of gauges and their principle of operation. Production planning supported by computers. CNC programming. CNC control. Parts of the CNC documentation. Types and construction of NC and CNC machine tools. Programming exercises. Integrated material data processing systems. Integrated manufacturing systems.
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. Students 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. 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 grades 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

B. Benhabib: Manufacturing
Marcel Dekker Inc. , 2003. ISBN: 0-8247-4273-7
S. Kalpakjian, S. R. Schmid: Manufacturing Engineering and Technology
4th. Prentice Hall , 2001. ISBN: 0-201-36131-0
Y. Altintas: Manufacturing Automation
Cambridge University Press , 2000. ISBN: 0-521-65973-6
Mikell P. Groover: Fundamentals of Modern Manufacturing
John Wiley & Sons, 2006. ISBN: 0471744859

Subject: **DIAGNOSTICS**
Coordinator: **Imre Kocsis**
Year, Semester: 3rd year/1st semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Basic maintenance philosophies and strategies.

Practical: Introduction to measuring equipment of the laboratory I.

2nd week:
Lecture: Diagnostics and condition based maintenance, predictive maintenance.
Practical: Introduction to measuring equipment of the laboratory II.

3rd week:
Lecture: Vibration analysis: oscillation, mass, spring, damper, sine waves, amplitude, frequency, phase.
Practical: Vibration measurement I.

4th week:
Lecture: Time and frequency domains, spectrum, displacement, velocity, acceleration, natural frequencies, resonance.
Practical: Vibration measurement II.

5th week:
Lecture: Fourier transform, DFT, FFT, FFT analyzers, frequency resolution, acquisition time, averaging.
Practical: Vibration measurement III.

6th week:
Lecture: Condition monitoring of machines: Dynamic behavior of rotating machinery, vibration based methods of data acquisition and analysis techniques.
Practical: Vibration analysis IV.

7th week:
Lecture: Vibration signal measurement and recording instrumentation, vibration level standards, rolling element and journal bearing faults, gear wear detection.
Practical: Vibration analysis V.

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

9th week:
Lecture: Typical vibration problems: unbalance, misalignment, structural weakness, loose parts.
Practical: Vibration analysis VI.

10th week:
Lecture: Sensors, transducers,the shock pulse method.
Practical: Application of the shock pulse method.

11th week:
Lecture: Balancing methods, trial weights, correction weights
Practical: Balancing.

12th week:
Lecture: Shaft alignment methods
Practical: Shaft alignment

13th week:
Lecture: Acoustics for machinery: Noise behaviour of a machinery, measurement of sound radiation of machines, determination of sound power, sound level meters and analyzers
Practical: Acoustic measurement

14th week:
Lecture: Infra-red thermography: Infrared radiation and its applications, thermal imaging for industrial inspections
Practical: Measurement with infra-red camera

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

Requirements

Topics: Basic maintenance philosophies and strategies: Diagnostics and condition based maintenance. Vibration analyses: oscillation, mass, spring, damper, sine waves, amplitude, frequency, phase, time and frequency domains, spectrum, displacement, velocity, acceleration, natural frequencies, resonance, Fourier transform, DFT, FFT, FFT analyzers, frequency resolution, acquisition time and averaging. Condition monitoring of machines: Dynamic behavior of rotating machinery, vibration based methods of data acquisition and analysis techniques, vibration signal measurement and recording instrumentation, vibration level standards, rolling element and journal

bearing faults, gear wear detection, typical vibration problems: unbalance, misalignment, structural weakness, loose parts, sensors, transducers, shock pulse methods. Balancing: balancing methods, trial weights, correction weights. Shaft Alignment. Acoustics for Machinery: Noise behavior of a machinery, measurement of sound radiation of machines, determination of sound power, sound level meters and analyzers. Infra-red thermography: Infrared radiation and its applications, thermal imaging for industrial inspections
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 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 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 because of the lack of active participation in class. During the semester there are two tests: the mid-term test on the 8th week and the end-term test on 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

Maldague, X. P.: Theory and Practice of Infrared Technology for Nondestructive Testing
Wiley, 2001.
Nagy, I.: Technical Diagnostics I. - Vibration Analysis
Delta3N Kft., 2010.
Taylor, J.: The Vibration Analysis Handbook
VCI, 2000.
Taylor, J.: The Gear Analysis Handbook
VCI, 2000.
Taylor, J., Kirkland, D.W.: The Bearing Analysis Handbook
VCI, 2000.

Subject: **FINITE ELEMENT METHOD**
Coordinator: **Tamás Mankovits**
Year, Semester: 3rd year/1st semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Brief overview of the finite element method, historical background.
Practical: Industrial application of the finite element method.

2nd week:
Lecture: Fundamentals of linear elasticity. A displacement field, a strain field, a stress field.
Practical: Calculation of strain and stress measures.

3rd week:
Lecture: The basic equation system of linear elasticity (equilibrium equation, constitutive equation, kinematic equation).
Practical: Principal values of normal stresses, scalar invariants and equivalent stresses.

4th week:
Lecture: Boundary conditions (kinematic boundary condition, dynamical boundary condition).
Practical: Analytical solution of a one-dimensional boundary value problem.

5th week:
Lecture: Strain energy. Total potential energy. Variational principles. The principle of minimum total potential energy.
Practical: Calculation of strain energy and the application of total potential energy.

6th week:
Lecture: Linear spring as a finite element.
Practical: Examples for linear spring structures. Derivation of the stiffness matrices.

7th week:
Lecture: Theory of the Ritz method. Kinematically admissible displacement fields.
Practical: Examples for the Ritz method (linear approximation, quadratic approximation).

8th week:
Lecture: Mid-term testFormulation of the finite element method. General derivation of the displacement based finite element equilibrium equations.
Practical: Solution of a numerical example by programming (prismatic bar problem).
Self Control Test

9th week:
Lecture: Properties of truss elements. Local approximation.
Practical: Solution of numerical examples by the usage of Femap 9.3 (prismatic bar problem, truss structure).

10th week:
Lecture: Properties of beam elements. Analytical solution of a statically indeterminate beam problem.
Practical: Solution of numerical example by the usage of Femap 9.3 (statically indeterminate beams).

11th week:
Lecture: Finite element formulations for two-dimensional problems (plain strain, plane stress, axisymmetric problems).
Practical: Solution of numerical examples by the usage of Femap 9.3 (a plate with a hole, a tube under internal pressure, analyzing a pressure vessel).

12th week:
Lecture: Isoparametric finite elements. One-, two- and three-dimensional mapping. Truss element. Quadrilateral and triangular elements. Brick and tetrahedron element.
Practical: Calculation of Jacobian of undistorted and distorted quadrilateral elements.

13th week:
Lecture: Numerical integration. The Gaussian quadrature.
Practical: The usage of one-point, two-point and three-point formulas.

14th week:
Lecture: General purpose finite element programs. Modelling questions. Meshing, post-processing. Error analysis.
Practical: Solution of a numerical example by the usage of Femap 9.3 (analysis of an assembly).

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

Requirements

Topics: The finite element method in the product lifecycle. Mathematical and mechanical background of the finite element method. Fundamentals of linear elasticity (a displacement field, a strain field, a stress field). Basic equation systems (equilibrium equation, kinematic equation, constitutive equation). Boundary conditions. Boundary value problems. Strain energy and related principles. Linear spring. The Ritz method. Formulation of the finite element method. Truss and

beam elements. Two-dimensional problems (plain strain, plane stress, axi-symmetric problems. Isoparametric finite elements. Numerical integration. General purpose of finite element programs. Application of Femap 9.3 FEM software. Modelling questions. Meshing. Post processing. A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice 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 class 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 drawing tasks and drawing instruments to 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 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 test results. The minimum requirement for both 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: score/grade: 0-39 fail (1), 40-52 pass (2), 52-63 satisfactory (3), 64-71 good (4), 72-80 excellent (5). If the score of the sum of the two tests is below 40, the student once can take a retake test of the whole semester material.

Required reading materials

Mankovits, T. : Numerical Analysis of Engineering Structures (Linear Elasticity and the Finite Element Method)
University of Debrecen, 2014.
Bathe, K.J. : Finite Element Procedures
Prentice-Hall, 1996.
Kovács, Á., Moharos, I., Oldal, I., Szekrényes, A. : Finite Element Method
Typotex, 2012.
O. C. Zienkiewicz, Robert Leroy Taylor : The Finite Element Method: Solid Mechanics
Butterworth-Heinemann, 2000. ISBN: 0750650559, 97807506

Subject: **PROGRAMMABLE LOGIC CONTROLLERS**
Coordinator: **Attila Vitéz**
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 PLC Simple switches, push buttons, 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 PLC Using internal memory spaces, merkers, merker words, merker flags

8th week:
Practical: Midterm exercise
Self Control Test

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

10th week:
Practical: Basic structures of PLC Subroutines

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

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

13th week:
Practical: End-term task
Self Control Test

14th week:
Practical: End-term task
Self Control Test

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

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. Modeling 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 (AW5). Based on the average of the grades of the tasks.

Subject: **MATERIAL HANDLING**
Coordinator: **Géza Husi**
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.

2nd week:
Lecture: Fundamental elements of material handling systems. Properties of handled materials.
Seminar: Basic calculations of handled

materials.

3rd week:
Lecture: Continuous operating materials handling equipment: belt conveyors. Configurations of belt conveyors.
Seminar: Basic calculations of belt conveyors.

4th week:
Lecture: Designing principles and safety equipments of belt conveyors.
Seminar: Designing principles and safety equipments of belt conveyors.

5th week:
Lecture: Continuous operating material handling equipment: bucket elevators. Configurations of bucket elevators.
Seminar: Designing calculations of bucket elevators.

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.

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

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 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: **ROBOTICS**
Coordinator: **Géza Husi**
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.
Self Control Test

9th week:
Lecture: Robot applications, the design of robot applications.
Practical: Robot applications, the design of robot applications. 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.

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

Subject: **DRIVE TRAIN OPTIMIZATION**
Coordinator: **Zsolt Tiba**
Year, Semester: 3rd year/2nd semester
Lecture: **2**
Practical: **2**

1st week:
Lecture: Prerequisite of performing the planned service life of a drive train.
Practical: Load situations acting on a drive train.

2nd week:
Lecture: Excitation effects, resonance phenomenon.
Practical: Electric motors and internal combustion engine characteristics.

3rd week:
Lecture: Prerequisite of smooth running of a drive train.
Practical: Machinery characteristics.

4th week:
Lecture: Motion equation of a drive train.
Practical: Features of the equation of motion of a chain type drive train.

5th week:
Lecture: Features of the equation of motion of a transmission type drive train.
Practical: A gear drive transmission system. A belt drive transmission system.

6th week:
Lecture: Features of the equation of motion of a forked type drive train.
Practical: Forked transmission systems.

7th week:
Lecture: Determination of the bearing stiffness.
Practical: Calculation of the bearing stiffness of different type of rolling bearings.

8th week:
Lecture: Mid-term testOperation characteristics of a cardan joint.
Practical: Quasi homokinetic joints, homokinetic joints.
Self Control Test

9th week:
Lecture: The dynamic model of torsion vibration. Motion equation of torsion vibration.
Practical: Frequency equation, determination of the natural frequencies of torsion vibration.

10th week:
Lecture: The dynamic model of bending vibration. Motion equation of bending vibration.
Practical: Matrix of motion parameters

11th week:
Lecture: Derivation of the Transform matrix.
Practical: Considering the cardan joint in the drive, connecting matrix for a cardan joint.

12th week:
Lecture: Considering the flexible suspension in the drive, connecting matrix for flexible suspension.
Practical: Connecting matrix for excitation effects and for general situations.

13th week:
Lecture: Application of a dynamic model for general drive train cases.
Practical: A dynamic simulation computer programs and its application.

14th week:
Lecture: A dynamic simulation computer program and its application.
Practical: A dynamic simulation computer program and its application.

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

Requirements

Topics: This series of lectures is based on the topics of technical mechanics and machine elements. The course is aimed at designing a drive train that runs smooth at a moderate vibration. It comprises: ascertaining the excitation effects that act on the drive train, ensuring stable operation of the engine and the coupled machine, deriving the equation of motion of the drive train and modeling its torsion and banding vibrations. In particular, the course focuses on the application of dynamic models using a computer simulation program based on the frequency equations, how to calculate the natural frequencies, and how to tune or detune the natural frequencies from the excitation frequency. In the laboratory, vibration measuring is introduced along with testing pieces of equipment like amplifiers (Spider 8), transducers, and the application of measuring software (Catman).
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 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 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 examination (ESE). 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, 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 of the mid-term and end-term tests is at least good (4). The offered grade is the average of them.

Required reading materials

Zsolt Tiba: Dynamic driveline modeling
Debrecen University Press , 2010. ISBN: 978-963-318-044-0
Zsolt TIBA, Géza HUSI: Mechanical Design of a Mechatronics Systems: Laboratory Handbook
University of Debrecen Faculty of Engineering, 2012. ISBN: 978 963 473 525 0

Subject: **MACHINE REPAIRING I**
Coordinator: **Krisztián Dák**
Year, Semester: 3rd year/1st semester
Lecture: **2**
Practical: **2**

1st week:
Lecture: Introduction to maintenance engineering, machine repairing and maintenance management: corrective, preventive, predictive methodsbath curve, machine lifetime and faults
Practical: CMMS, RBI in practice

2nd week:
Lecture: Tribology, wear, wear types, wear mechanism. Causes of machine faults.
Practical: tribotester test measurement

3rd week:
Lecture: Friction theories, sliding and rolling friction, dry, fluid, COF, hydrodynamic, lubricants
Practical: Lubricant test, SAE viscosity stages, COF calculation.

4th week:
Lecture: Lubricant stability, purposes, oil, grease, additives, locomotive and gearbox oils, surface roughness
Practical: An oil test, surface in SEM.wear particles analyses

5th week:
Lecture: Fatigue and initial cracks in machine operation, WEC, S-N curve, cyclic stress, probalistic nature, residual stresses. Corrossion theories. SCC problems.
Practical: Crack detection with ultrasonic its technique. A penetration test. Acid etching reagent to measure pitting corrosion.

6th week:
Lecture: ISO Protection from corrosion. Shrink wraps. Reactive coatings. Anodization. Hot deep galvanizing. Chatodic protection of steel structures.
Practical: A ferrit-oxid analysis with Olympus optical microscope. Software for image processing. Edge detection, filtering. Morphology.

7th week:
Lecture: Probabilistic risk assessment. A fault tree. An event tree. Failure mode and effect analyses in manufacturing and repairing. Ishikawa diagram before machine repairing.
Practical: A fault tree in practice. FMEA evaluation in practice in one significant mechanical engineering and machine repair problems.

8th week:
Lecture: Overview of methods. Machine fault diagnosis I.
Practical: Main tools for machine repairing. Mid-term test
Self Control Test

9th week:
Lecture: Machine fault diagnosis II. Vibration measurement methods. ISO 10816 standard. Bearings. Gear boxes. Misaligment. Fourier and wavelet transform. Neural networks. Artificial intelligence applications.
Practical: Devices to vibration diagnosis. Sensors. Vibration measuremet with NI DAQ and FPGA.

10th week:
Lecture: Thermography. An infrared theory. Endoscopy. Eddy-current testing. Acoustic emission. An X-ray tomography. A DPI test.SEM and AFM measurement in machine repairing.
Practical: measurement with thermocam, image processing software application.

11th week:
Lecture: Measuring instruments. Length. Angle. Velocity. Rpm. Force, strain gauge. Pressure. Current and voltage measurement.
Practical: Spider 8 force measurement with software application. Stroboscope to rpm of bearing test-rig.

12th week:
Lecture: Cleaning methods. Manual washing. Ultrasonic part washers. Solvents.
Practical: Contamination and grease removal in a special chemical bath.

13th week:
Lecture: Detergents. Contaminations. Immersion. Rinsing. Drying procedures. Wheel blasting.
Practical: Contamination and grease removal in a special chemical bath.

14th week:
Lecture: Basic machine repairing methods.

Repairing of bearings. Bearing faults. **Practical:** Bearing repair techniques. An induction heater.	**15th week:** **Lecture:** End-term test **Self Control Test**

Requirements

Topics: Basics concepts of machine failures and repairing. Requirements of reconditioned parts. The progress of failure inspections and analysis reports. Determinative factors of fraying. Types and measurement modes of fraying. Protecting machinery parts against loss of surface. Physical and chemical attritions. Optimizing the efficiency and reliability of machinery. Principles and techniques to reduce "self induced failures". Characteristics and nature of faults. Providing techniques and procedures that extend machinery life and achieve optimum machinery reliability. The most pertinent aspects of identifying and repairing faulty equipment. In laboratory practice students study defective disassembled machine parts, examine and reconditioning of worn components.
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 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. 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 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 a mid-semester grade (AW5). It is based on the average grade of the two tests. 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 0-50 fail (1) 50-60 pass (2) 60-75 satisfactory (3) 75-90 good (4) 90-100 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

Heinz P. Bloch, Fred K. Geitner: Machinery Component Maintenance And Repair
Elsevier, 2004.
Fred K. Geitner, Heinz P. Bloch: Maximizing Machinery Uptime
Gulf Professional Publishing, 2006.
Ricky Smith, R. Keith Mobley: Industrial Machinery Repair: Best Maintenance Practices Pocket Guide
Elsevier, 2003.

Subject: **MACHINE REPAIRING II**
Coordinator: **Krisztián Deák**
Year, Semester: 3rd year/2nd semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Advanced bearing repair techniques I. Plain bearing faults. Plastic bearing materials. Damages of plain bearings. Lubrication problems. Diagnosis before machine repairing.
Practical: Bearing repair and diagnosis. Optical, vibration, thermo measurements.

2nd week:
Lecture: Advanced bearing repair techniques II. Damages of ball and roller bearings. Wear traces. Damages of raceways, an inner ring, an outer ring, a cage. Typical fault frequencies. Diagnosis before machine repairing.
Practical: Bearing repair and diagnosis. Oil checking with devices. Optical, vibration, thermo measurements.

3rd week:
Lecture: Gear system repairing. Grinding. Welding practice. Typical fault frequencies. Diagnosis before machine repairing.
Practical: Gear repair and diagnosis. Supervision by endoscopes. Vibration, thermo measurements.

4th week:
Lecture: Techniques and technologies for machine repairing. Soldering and brazing. Desoldering. Materials.
Practical: Soldering practice.

5th week:
Lecture: Techniques and technologies for machine repairing. The role of heat treatment in machine repairing. Annealing. Stress relieving. Tempering. Induction to hardening of re-manufactured gears.
Practical: Heat treatment devices presentation in practice.

6th week:
Lecture: Machining processes and machining tools in machine repairing. Turning, boring, drilling, milling, grinding of re-manufactured machine elements. Tool condition monitoring. Cutting tool materials. Cutting fluids selections.
Practical: Tools and pieces of equipment in practice.

7th week:
Lecture: Machining processes and machining tools in machine repairing. Reaming. Threading. Gear re-manufacturing. Gear grinding. Shaving. Broaching. Polishing. Superfinishing of repaired shafts and other machine elements.
Practical: Tools and equipments in practice.

8th week:
Lecture: Machining processes and machining tools in machine repairing. Lapping. Honing. Debarring. Advanced machine processing. EDM, ECM, ECG technologies and machines. Ultrasonic machining. Chemical machining. WJM technologies. Abrasive jet machining. Laser beam machining.
Practical: Mid-term test
Self Control Test

9th week:
Lecture: Welding in machine repairing. Arc welding. Shielding and fluxing. Shielded metal arc welding. Flux Cored Arc Welding. Welding equipment selections for machine repairing.
Practical: Welding calculations.

10th week:
Lecture: Welding in machine repairing. Submerged arc welding. Gas metal arc welding. Gas Tungsten Arc welding. Gas welding. Thermal cutting processes. Repair welding. Recommended preheating temperatures. Hard facing.
Practical: Welding calculations.

11th week:
Lecture: Adhesives for machine repairing. Contact adhesives. Hot adhesives. UV reagent adhesives. Glueing of shafts, bearings, gears. Stress in adhesive joints. Traditional fastening methods rivets, pins.
Practical: Selection of adhesives for practice, types of glues in catalogues, calculations.

12th week:
Lecture: Repairing of shafts. Detection of failures. Diagnosis before and after repairing. Misalignment problems.

Practical: Shaft repair and diagnosis.

13th week:
Lecture: Surface hardening. Chrome coating. Galvanic chroming. Nitrid coating. Selectron methods. Resin coatings.
Practical: Measurement of coatings by contact and optical methods.

14th week:
Lecture: Summary of methods and technologies in machine repairing.
Practical: Summary.

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

Requirements

Topics: Reconditioning of holes, axes and gears. Types of ball bearings and plain bearings failures. Procedures of corrosion protection. Repair and recondition of steel structures and chassis. Systematically analyze and troubleshoot machinery distress and component problems. Preventive and predictive maintenance for major process units. Alignment, Balancing, Maintenance and Repairing of Machinery Components. Recondition of machinery parts with traditional methods, welding and thermal spraying. Repairing and Maintenance of Equipment Components. In laboratory practice the students study different kind of recondition task and failure analysis.
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 misses more than three, 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. 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 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). Average grade of the two tests. 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 0-50 fail (1) 50-60 pass (2) 60-75 satisfactory (3) 75-90 good (4) 90-100 excellent (5) If the score of any test is below 50%, the student once can take a retake test covering the whole semester material.

Required reading materials

Lotfi Tadj, Mohamed-Salah Ouali, Soumaya Yacout, Daoud Ait-Kadi: Replacement Models With Minimal Repair
Springer, 2011.
Fred K. Geitner, Heinz P. Bloch: Maximizing Machinery Uptime
Gulf Professional Publishing, 2006.
Heinz P. Bloch, Fred K. Geitner: Machinery failure analysis and troubleshooting: Practical Machinery Management for Process Plants
Elsevier Science & Technology, 2012.

Subject: **MAINTENANCE ENGINEERING I**
Coordinator: **Sándor Hajdu**

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

1st week:
Lecture: Maintenance Policies, Impact, Benefits and Effects of Maintenance, Principles of Maintenance
Practical: Examples, case studies

2nd week:
Lecture: Organization and Management of a Maintenance Function, The importance of an overall maintenance strategy, Operating Policies of Effective Maintenance
Practical: Examples, case studies

3rd week:
Lecture: Maintenance management methods, Maintenance Engineering Roles and Responsibilities, Performance Measurement and Management, Development of Maintenance Engineering Practices
Practical: Examples, case studies.

4th week:
Lecture: Maintenance Equipment and Facilities, Maintainability and its costs, Maintainability Analysis.
Practical: Examples, case studies

5th week:
Lecture: Economic Aspects of Maintenance, Life Cycle Costing, Maintenance Costs, Maintenance Budget, Cost Control, Maintenance Audit.
Practical: Examples, case studies.

6th week:
Lecture: The control of maintenance costs while improving reliability. Avoid or mitigate of the impact of operational failures, Estimating Repair and Maintenance Costs, Key Performance Indicators.
Practical: Examples, case studies

7th week:
Lecture: Types of Maintenance Systems, Corrective Maintenance, Reliability-Based Preventive Maintenance, Predictive Maintenance.
Practical: Examples, case studies

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

9th week:
Lecture: Organizational Structure for Maintenance, Effective maintenance organizations, Maintenance Levels, Responsibilities of Maintenance Department.
Practical: Examples, case studies

10th week:
Lecture: Maintenance Planning and Scheduling, Planning of Maintenance Function, Manpower Allocation, Long-range Planning, Development of Maintenance Department, Short-range Planning, Planning Techniques, Planning Procedure.
Practical: Examples, case studies

11th week:
Lecture: Estimation of Maintenance Work, Maintenance Control, Maintenance Scheduling, Work Order System, Work-order Procedure, Creating a Set of Priority Functions, Forecasting Maintenance Requirements, Planned Maintenance Procedure.
Practical: Examples, case studies

12th week:
Lecture: Maintenance Evaluation, Reliability in Maintenance, Economics of Reliability, Quality and Reliability, Reliability Improvement, Reliability Testing, Design for Reliability.
Practical: Examples, case studies

13th week:
Lecture: Root cause analysis (RCA) and Root cause failure analysis (RCFA), Failure-Mode and Effect Analysis (FMEA), Concept of safety, reliability and risk, Environmental impacts, Six

Sigma Safety, Zero-Injury Safety Culture.
Practical: Examples, case studies

14th week:
Lecture: Maintainability. Design for Maintainability, Terotechnology, Objectives of terotechnology, Principles of terotechnology, Costs of implementing terotechnology, Introducing terotechnology to an organization.
Practical: Examples, case studies

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

Requirements

Topics: Maintenance Policies, Impact, Benefits and Effects of Maintenance, Principles of Maintenance, Organization and Management of the Maintenance Function, The importance of an overall maintenance strategy, Operating Policies of Effective Maintenance, Maintenance management methods, Maintenance Engineering Roles and Responsibilities, Performance Measurement and Management, Development of Maintenance Engineering Practices, Maintenance Equipment and Facilities, Maintainability and Its Costs, Maintainability Analysis, Economic Aspects of Maintenance, Life Cycle Costs, Maintenance Costs, Maintenance Budget, Cost Control, Maintenance Audit.
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 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, 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 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5)

Required reading materials

Reinert Kenneth, A: An introduction to International Economics: New Perspectives on the World Economy
2nd. Cambridge University Press, 2011. ISBN: 1107003571, 97811070
R. K. Mobley: Maintenance Fundamentals
Butterworth-Heineman, 2004.
R. K. Mobley, L. R. Higgins, D. J. Wikoff : Maintenance Engineering Handbook
McGraw-Hill, 2008.
J. Moubray: Reliability-Centered Maintenance
Industrial Press Inc., 2001.
R. Smith, R. K. Mobley: Rules of Thumb for Maintenance and Reliability Engineers
Elsevier, 2007.

Subject: **MAINTENANCE ENGINEERING II**
Year, Semester: 3rd year/2nd semester
Lecture: **2**
Practical: **1**

1st week:
Lecture: Organization and Management of the Maintenance Function. Environmental impacts. Corrective, Preventive, Predictive Maintenance
Practical: Organization and Management of the Maintenance Function. Environmental impacts. Corrective, Preventive, Predictive Maintenance. Examples.

2nd week:
Lecture: Concept of safety, reliability and risk.
Practical: Concept of safety, reliability and risk. Examples.

3rd week:
Lecture: The concept and basics of reliability-centered maintenance (RCM).
Practical: The concept and basics of reliability-centered maintenance (RCM). Examples

4th week:
Lecture: The concept and basics of total productive maintenance (TPM).
Practical: The concept and basics of total productive maintenance (TPM). Examples.

5th week:
Lecture: The overall efficiency of the equipment.
Practical: The overall efficiency of the equipment. Examples.

6th week:
Lecture: The control of maintenance costs while improving reliability. Avoid or mitigate of the impact of operational failures.
Practical: The control of maintenance costs while improving reliability. Avoid or mitigate of the impact of operational failures. Examples.

7th week:
Lecture: Company visit
Practical: Company visit

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

9th week:
Lecture: Root cause analysis (RCA) and Root cause failure analysis (RCFA).
Practical: Root cause analysis (RCA) and Root cause failure analysis (RCFA). Examples.

10th week:
Lecture: Computerized maintenance management system (CMMS).
Practical: Computerized maintenance management system (CMMS). Examples.

11th week:
Lecture: Measuring and improvement of productivity. Terotechnology.
Practical: Measuring and improvement of productivity. Terotechnology. Examples.

12th week:
Lecture: Maintenance and TQM, quality control in maintenance.
Practical: Maintenance and TQM, quality control in maintenance. Examples.

13th week:
Lecture: Job evaluation.
Practical: Job evaluation. Examples.

14th week:
Lecture: Company visit
Practical: Company visit

Requirements

Topics: Organization and management of maintenance functions. Environmental impacts. Concept of safety, reliability and risk. The concept and basics of reliability-centered maintenance (RCM)

and total productive maintenance (TPM). The overall efficiency of the equipment. The control of maintenance costs while improving reliability. Avoid or mitigate of the impact of operational failures. Root cause analysis (RCA) and Root cause failure analysis (RCFA). This course provides students with safety and risk assessment tools and techniques they need to work effectively in any safety- or reliability-critical environment. In laboratory practice students are involved in installation projects and make reports of them.
A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice is compulsory. Students must attend the practice classes and may not miss more than three occasions 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 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 behaviour 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 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5)

Required reading materials

R. K. Mobley, L. R. Higgins, D. J. Wikoff : Maintenance Engineering Handbook
McGraw-Hill, 2008.
J. Moubray: Reliability-Centered Maintenance
Industrial Press Inc., 2001.
R. Smith, R. K. Mobley: Rules of Thumb for Maintenance and Reliability Engineers
Elsevier, 2007.

Optional Subjects

Subject: **INSTRUMENTAL TECHNIQUE**
Coordinator: **Sándor Piros**
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

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

Subject: **AUTOMOTIVE CONSTRUCTIONS**
Coordinator: **Zsolt Tiba**
Year, Semester: 2nd year/1st semester
Lecture: **2**

1st week:
Lecture: Internal combustion engines (ICE). Major engine components. A four-stroke and a two-stroke power cycle. Gasoline and diesel engines.

2nd week:
Lecture: Lubrication and fuel systems. Supercharging and turbochargers, emissions control devices. The electrical systems: ignition, starting, a charging system

3rd week:
Lecture: The Cooling system of ICE: a radiator, a fan, a water pump, a thermostat, and their operation.

4th week:
Lecture: Transmission system, construction of manual transmission. Drive train of a vehicle and its major parts. Differential and transfer case.

5th week:
Lecture: Automatic hydraulic transmissions, dual-clutch transmissions, continuously variable transmissions.

6th week:
Lecture: Steering system: steering linkage, tie rods, control arms, ball joints, power steering system.

7th week:
Lecture: Rack-and-pinion steering, recirculating-ball steering, electronic power steering systems.

8th week:
Lecture: Suspension systems and springs: independent and depended suspension. Control arms, rubber bushings, shock absorber, stabilizer bars.

9th week:
Lecture: Double-wishbone suspension, multi-link suspension, strut suspension, air suspension systems.

10th week:
Lecture: Brake systems. Drum and disc brakes, master cylinders, brake boosters.

11th week:
Lecture: Parking brake systems. Bleeding brakes. Anti-lock brake systems, brake assist.

12th week:
Lecture: Tire construction, tire codes. Balancing wheels. Aligning wheels: caster, camber, toe-in, toe-out, turning radius.

13th week:
Lecture: Traction Control System (TCS), Electronic Stability Control (ESC), Side Impact

Protection Systems (SIPS), Air Bags.

14th week:
Lecture: Hybrids. Parallel hybrids, series of hybrid, plug-in hybrid. Regenerative brakes. Electric vehicles, hydrogen and fuel cell vehicles.

15th week:
Lecture: Oral test
Self Control Test

Requirements

Topics: This series of lectures is based on the fundamental machine constructions taught in the machine elements course. It reviews the build-up of a road vehicle and the construction of main units such as a drive train with rear-wheel and a front-wheel drive and its parts (transmission, transaxle, clutch, differential), suspension and steering systems, braking systems (disc brake, drum brake, brake booster). After that the operation principles of internal combustion engines (a four stroke-power cycle of a gasoline engine and a diesel engine) are discussed. The classes focus on fuel management, cooling and lubrication systems and exhaust systems. After discussing the main structural members the course reviews basic electrical systems, the starting and ignition systems and the power supply respectively.
A, for a signature: Participation at lectures is compulsory. Students must attend the lectures 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 make up a lecture with another group. Attendance at lectures 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 lecture 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 may give one presentation about an automotive construction.
B, for a grade: The course ends in a mid-semester grade (AW5). At the end of the semester there is an oral test, based on assembly drawings of automotive constructions. Based on the marks of the presentation and the oral test, the mid-semester grade is calculated as an average of them. An offered grade: it may be offered for the students whose grade of the presentation is at least good (4).

Required reading materials

Reinert Kenneth, A: An introduction to International Economics: New Perspectives on the World Economy
2nd. Cambridge University Press, 2011. ISBN: 1107003571, 97811070
Peter Girling (Editor): Automotive Handbook
VDI-Verlag GmbH, 1993. ISBN: 3-1-419115-X

Subject: **ENGINEERING EXPERIMENTATION**
Year, Semester: 2nd year/1st semester
Practical: **2**

1st week:
Practical: Standard organizations, reliability of measurements, fundamental methods of measurements, direct and indirect comparison, calibration.Measurement devices overview in practice.

2nd week:
Practical: Source of errors, Bias and Random Errors, measurement stages, Data transmission,

DAQ, data store in practicePractice: Calculation of measurement errors

3rd week:
Practical: Periodic waves and its spectrum, Time Domain & Freq. Domain, frequency spectrum examples, Fourier transform, Square and Hanning window functions, Shannon law, Periodic Signals, Analog-Digital Conversion, resolution of an A/D ConverterSpecial signforms: sinus, triangle, sgn, saw, square in computer softwares practice. Tone generator.

4th week:
Practical: Measuring instruments, length, angle, thickness gauge, micrometers, dial test indicators, sine bars, pressure gauge, mass- or volume flow measurement, flow measurement, Venturi meter, tachometers, stroboscopesMeasurement with a micrometer, a stroboscope rpm measurement on bearing test-rig.

5th week:
Practical: Force measurement, force gauge, load cells, Wheatstone bridge configuration, torque measurement, dynamometer.Force measurement with load cells, Spider 8 system with Catman software.

6th week:
Practical: Tribometers, tribotesters, thermometers, thermocouples, pyrometers, bimetallic thermometers.Thermosensor measurement by getting voltage in Wheatstone bridge.

7th week:
Practical: Electrical voltage, current, resistance measurement.PC based Digital Oscilloscope measurement and measurement of current, impedance, voltage.

8th week:
Practical: Overview of methods.in engineering measurementsMain tools for measurements.Mid-term test
Self Control Test

9th week:
Practical: Acoustic and noise measurement. Fletcher-Munson curves. Sound pressure levels. A, B, C, D filtering. Microphones. Standards for measurement. Pink and white noises. Low/ High pass filtering, ultrasonic noise measurements to leakage detection.SPL measurement, mic recording then FFT spectrum analysis, filtering, denoising in Audacity software.

10th week:
Practical: Acceleration measurement, vibration transducers, displacement-velocity-acceleration conversion, calibration ISO 10816, assessment zones, fault frequenciesMeasurements with NI 9214 DAQ unit, PCB transducers. Soundbook system. SciLab.

11th week:
Practical: Thermography.Thermal radiation. Emission coefficient. Limitations and disadvantages of thermography. Black body theory.Thermography measurements of machine elements under operation, test-rig, bearings, gear-boxes

12th week:
Practical: Non-destructive measurements overview. Crack detection. Dye penetrant inspection. Optical microscopy. SEM scanning electrone microscopy.

13th week:
Practical: Destructive testing measurements. A hardness test. Charpy impact tests. Calculation of hardness and Charpy V-notch calculation.

14th week:
Practical: Summary of mechanical engineering measurements. General overview. Full sensor measurements.

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

Requirements

Topics: A laboratory to instruct students in the performance of basic mechanical engineering components and systems. Digital data acquisition. Applications include the measurement of strain, pressure, temperature, flow, force, torque, and vibration. Introduction to error analysis, and design and planning of experiments. Performance of experiments, application of theory and reporting.
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 equal 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. 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. The course ends in a mid-semester grade (AW5). 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 0-50 fail (1) 50-60 pass (2) 60-75 satisfactory (3) 75-90 good (4) 90-100 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

Zsolt TIBA, Géza HUSI: Mechanical Design of a Mechatronics Systems: Laboratory Handbook
University of Debrecen Faculty of Engineering, 2012. ISBN: 978 963 473 525 0
Jon S. Wilson (Editor-in-Chief): Sensor Technology Handbook
Elsevier Inc., 2005. ISBN: 0-7506-7729-5

Subject: **MECHATRONICS I**
Coordinator: **Géza Husi**
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.

3rd week:
Lecture: Pneumatic actuators (structure-cylinder, rotary actuators, sizing cylinders).
Seminar: Practice: 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: **3D COMPUTER AIDED DESIGN**
Coordinator: **Tamás Mankovits**
Year, Semester: 2nd year/2nd semester
Practical: **2**

1st week:
Seminar: Introduction to parametric modelling systems. Properties of parametric modelling.

2nd week:
Seminar: Creating profiles and sketches (sketch, drawing tools, geometrical and dimensional constraints).

3rd week:
Seminar: Using features (protusion, revolved protusion, chamfers, fillets, etc.). Model history.

4th week:
Seminar: Part modeling I.

5th week:
Seminar: Part modeling II.

7th week:
Seminar: Part design task.

8th week:
Seminar: Assembly designing (assembly comfigurations, exploded views).

9th week:
Seminar: Assembly design I.

10th week:
Seminar: Assembly design II.

11th week:
Seminar: Creating technical drawings (view generation from parts, dimensions, section views, part list, symbols).

12th week:
Seminar: Special environments (sheet models, welding design). Handling variables.

13th week:
Seminar: Importing standard parts. Interface between CAD systems. Integrated simulations (FEM analysis, dynamic simulation).

14th week:
Seminar: Practice: Assembly design task.

15th week:
Seminar: Re-take part and assembly design

Requirements

Topics: Introduction to parametric modelling systems. Properties of parametric modelling. Creating profiles and sketches (sketches, drawing tools, geometrical and dimensional constraints). Using features (protrusion, revolved protrusion, chamfers, fillets, etc.). Model history. Assembly designing (assembly comfigurations, exploded views). Creating technical drawings (view

generation from parts, dimensions, section views, part list, symbols). Special environments (sheet models, welding design). Handling variables. Creating parts and assembly families. Importing standard parts. Interface between CAD systems. Integrated simulations (FEM analysis, dynamic simulation).
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 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 class 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 their participation as absence because of the lack of active participation in class. During the semester there are two design tasks in the 7th and 14th week. Students have to sit for the design tasks.
B, for a grade: The course ends in a mid-semester grade (AW5) based on the part design and assembly design. The minimum requirement for the mid-semester grade is 50%. Based on the score of the two design tasks, the grade for the tasks is given according to the following: Score/Grade: 0-39 fail (1), 40-52 pass (2), 52-63 satisfactory (3), 64-71 good (4), 72-80 excellent (5). If the score of the sum of the two tests is below 40, the student once can take a retake design task of the whole semester material.

Required reading materials

Siemens: Solid Edge
URL: http://www.plm.automation.siemens.com/en_us/products/solid-edge/
Getting Started with Solid Edge
Version 20. UGS Corp, 2007.

Subject: **CALCULATIONS WITH MATLAB**
Year, Semester: 2nd year/2nd semester
Seminar: **2**

1st week:
Seminar: Starting MATLAB, Using MATLAB as a calculator, Quitting MATLAB, Creating MATLAB variables

2nd week:
Seminar: Overwriting variable, Error messages, Making corrections, Controlling the hierarchy of operations or precedence, Controlling the appearance of floating point number

3rd week:
Seminar: Managing the workspace, Entering multiple statements per line, Miscellaneous commands, Getting help

4th week:
Seminar: Mathematical functions, Basic plotting, Creating simple plots

5th week:
Seminar: Adding titles, axis labels, and annotations, Multiple data sets in one plot, Specifying line styles and colours

6th week:
Seminar: Matrix generation, Entering a vector, Entering a matrix, Matrix indexing

7th week:
Seminar: A colon operator, Linear spacing, A colon operator in a matrix

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

9th week:
Seminar: Creating a sub-matrix, Deleting a row or a column, Dimension, Continuation

10th week:
Seminar: Transposing a matrix, Concatenating matrices, Matrix generators, Special matrices

11th week:
Seminar: Array operations, Matrix arithmetic operations, Array arithmetic operations

12th week:
Seminar: Solving linear equations, Matrix functions

13th week:
Seminar: M-File Scripts, Script side-effects, M-File functions

14th week:
Seminar: Input and output arguments, Inputs to a script file, Output commands Control flow and operators, Saving output to a file

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

Requirements

Topics: Starting MATLAB, using MATLAB as a calculator, quitting MATLAB, creating MATLAB variables, overwriting variable, error messages, making corrections, controlling the hierarchy of operations or precedence, controlling the appearance of a floating point number, managing workspace, entering multiple statements per line, miscellaneous commands, getting help, mathematical functions, basic plotting, creating simple plots, adding titles, axis labels, and annotations, multiple data sets in one plot, specifying line styles and colours, a matrix generation, entering a vector, entering a matrix, matrix indexing, a colon operator, linear spacing, a colon operator in a matrix, creating a sub-matrix, deleting a row or a column, dimension, continuation Transposing a matrix, Concatenating matrices, matrix generators, special matrices, array operations, matrix arithmetic operations, array arithmetic operations, solving linear equations, matrix functions, M-File scripts, script side-effects, M-File functions, Input and output arguments, Input to a script file, Output commands control flows and operators, Saving outputs to a file.
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. Active participation is evaluated by the teacher in every class. If students' behaviour 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 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-term grade (AW5). 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

Hunt, Lipsman, Rosenberg: A Guide to MATLAB for Beginners and Experienced Users
Cambridge University Press,

Kiusalaas: Numerical methods in Engineering with MATLAB
Cambridge University Press,
S.E. Lyshevski: Engineering and Scientific Computations Using Matlab
John Wiley & Sons,

CHAPTER 9
INTERNSHIP

All the neccessary formal documents can be downloaded from the website of the Faculty of Engineering. www.eng.unideb.hu (English Page/Internship)
Students majoring in the Mechanical 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 document copy signer(s) submission deadline receiver Invitation Letter 1 company 30th May 2017 secretariat (Ms. Judit Bak) Internship Cooperation (Company abroad) 2 copies or “Megállapodás” (Company in Hungary) 4 copies signer: company, faculty signer company, supervisor faculty, major responsible 30th May 2017 deadline: 30th May 2017 secretariat (Ms. Judit Bak) Student Agreement 3 copies, signers: company, faculty, student deadline. 30th May 2017 to: secretariat (Ms. Judit Bak) Evaluation Sheet and Certificate 1 copy signer: company deadline. 9th September 2017 to: (Ms. Judit Bak, office 304) 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 Mechanical Engineering. The deadline of submitting the Essay and the “Evaluation Sheet and Certificate”: 9th September 2017, office 304.
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 2017. 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 2017.

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 31st May 2017. After this deadline requests are denied. The copy of the secondary school certificate and the written request addressed to Dr. Imre Kovács major responsible must be submitted to Mr. András Gábora (office 301). In the case of any problem arising from the internship please contact Mr. András Gábora instructor (office 301, andrasbagora@eng.unideb.hu).

CHAPTER 10
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 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 bakjudit@eng.unideb.hu address as soon as it is finalized but not later than 14th November. 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 state 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.
Deadlines of Submission:
For students who apply to MSc trainings
For students who intend to take State Exam
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 30th 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 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 get back to the student.
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 state exam (qv. state 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 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 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)