University of Debrecen

Faculty of Engineering

Mechanical Engineering BSc Program

2017

TARTALOM

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

HISTORY OF THE UNIVERSITY

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 as in 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 programmes 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 programmes 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.

The history of the Faculty of Engineering dates back to 1965, when the Technical College was established. In 1972 it was named Ybl Miklós Polytechnic and in 1995 it became part of Kossuth Lajos University. In 2000 the Faculty of Engineering became part of the integrated University of Debrecen.

In 2005 the Bologna System was introduced, which aids the compatibility of the qualifications received at the University of Debrecen with universities all over Europe.

The Faculty of Engineering is practice oriented and develops skills required for the current conditions of the national and international labour market. The teaching staff is involved in numerous domestic and international research and design projects. The recently opened new building wing with its ultra-modern design hosts several lecture halls, seminar rooms and laboratories equipped with the latest technology. Our students are provided with practical knowledge, training and field practice with the help of the numerous prestigious domestic and multi-national industry partners. The internship periods are excellent opportunities for students to experience theory put into practice at the most renowned industry representatives and to become more successful in the labour market in this highly competitive sector. Students learn to operate in the working environment of multi-national companies and adapt to challenges easily. After graduation they will be able to operate at a strategic decision-making level, placing priority on efficiency and engineering ethics.

The Faculty of Engineering offers 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. The Faculty of Engineering launched the engineering trainings in English in 2011. In order to optimize the quality of training, the Faculty continuously strives to expand the number of industrial and educational partners at home and abroad.

The Faculty of Engineering has been a pioneer in the introduction of the Quality Management System at faculty level to measure and evaluate the efficiency of its

education and teaching staff in order to improve the quality of education and training from the feedback received.

The Faculty of Engineering has a vivid student life. There is a film club waiting for movie buffs and the door of the Faculty library is always open. The library is not only the host of the most recent technical books, exhibitions and tea afternoons with invited speakers, but students can also purchase theatre and concert tickets here from the staff. The Borsos József dormitory is also a hub of activities for students.

The increasing number of foreign students brings cultural and ethnic diversity to the faculty.

Our aim is to aid students to become efficient members of the labour market and enrich the world of engineering in Hungary and abroad with their knowledge and expertise.

ADMINISTRATION UNITS FOR INTERNATIONAL PROGRAMMES

COORDINATING CENTER FOR INTERNATIONAL EDUCATION

98, Nagyerdei Boulevard, Debrecen 4032
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Program Director (Non-Medical Programmes)	László Kozma
Administrative Assistant	Ms. Ágnes Czibere
Administrative Assistant	Ms. Ibolya Kun
Administrative Assistant	Ádám Losonczi
Administrative Assistant	Ms. Ágnes Szurmai

The Coordination Center for International Education supports the international degree programmes of University of Debrecen. It helps new students with information on admission and entrance exam. It serves promoting tasks and deals with several cases for students like enrolment, study contracts, modifying student status or major, activating student status, modifying students' personal data, requiring student cards and their updating, modifications, providing certificates for the Immigration Office and registration to residential permit, certificates about student status, certificates on credit recognition, making health insurance contract and Health Insurance Card, requirement for visa.

STUDENT ADMINISTRATION CENTER

1, Egyetem Square, Debrecen H-4032 (basement of Kossuth Lajos Dormitory II)

This administration unit provides students in such cases like receiving new students, checking students' FIR data, registration of tuition fees and other fees, transferring Stipendium Scholarship, handing out and certifying diploma information.

INTERNATIONAL OFFICE AT THE FACULTY OF ENGINEERING

2-4, Ótemető Street, Debrecen H-4028
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room 122	tiba@eng.unideb.hu

International Relations Officer room 123	Ms. Judit Bak bakjudit@eng.unideb.hu
International Relations Officer room 123	Ms. Erika Thomas thomas.erika@eng.unideb.hu
International Relations Officer room 124	Ms. Zita Popovicsné Szilágyi szilagyizita@eng.unideb.hu
International Relations Officer room 206	Ms. Ágnes György agnes@eng.unideb.hu

The International Office has been functioning since 2014 in order to ensure that the international degree programmes achieves smoothly. The office has the tasks like arranging students' study cases, providing certificates for students, accepting and considering requests, administration of late-coming students, solving problems of course registration, administration of Erasmus students, giving information about the Internship and the administration of transferred students

DEAN'S OFFICE

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Department of Basic Technical Studies
Department of Building Services and Building Engineering
Department of Chemical and Environmental Engineering
Department of Civil Engineering
Department of Electrical Engineering and Mechatronics
Department of Engineering Management and Enterprise
Department of Mechanical Engineering

DEPARTMENT OF ARCHITECTURE

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ACADEMIC CALENDAR

General structure of an academic year:

Study period	1st week	registration*	1 week
	2nd – 7th week	teaching block 1	6 weeks
	8th week	1st drawing week	1 week
	9th – 14th week	teaching block 2	6 weeks
	15th week	2nd drawing week	1 week
Exam period	directly after the study period	exams	7 weeks

*Registration is in the first week of September in the fall semester usually, and in the first week of February in the spring semester.

ACADEMIC CALENDAR OF THE FACULTY OF ENGINEERING 2017/2018

Opening ceremony of the academic year	10th September 2017
1st semester registration week	From 4th September till 8th September 2017
Repeat period of exam courses announced for the 1st semester of the academic year 2017/2018	From 4th September till 8th September 2017
1st semester study period of MSc and BSc programme	From 11th September till 15th December 2017 (14 weeks). In case of finalist courses: from 11th September till 10th November 2017 (9 weeks).
1st semester study period of BSc dual programme	From 11th September till 8th December 2017 (13 weeks).
Reporting period (Drawing week) of MSc, BSc and BSc dual programme	From 23rd October till 27th October 2017 (4 working days without scheduled lessons, consultation schedule announced previously).

Reporting period (Drawing week, term for elaborating tasks apart from the finalist courses) of BSc programme	From 11th December till 15th December 2017 (5 working days without scheduled lessons, consultation schedule announced previously).
1st semester exam period	From 18th December 2017 till 2th February 2018 (7 weeks). From 13th November till 15th December 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 January 2018. The departments shall advertise the date of the state exam until 15th September 2017.
2nd semester registration week	From 5th February till 9th February 2017
2nd semester study period of MSc and BSc programme	From 12th February till 18th May 2018 (14 weeks). In case of finalist courses: from 12th February till 13th April 2018 (9 weeks).
2nd semester study period of BSc dual programme	From 20th February till 19th May 2018 (13 weeks).
Reporting period (Drawing week) of MSc, BSc and BSc dual programme	From 26th March till 30th March 2018 (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 programme	From 14th May till 18th May 2018 (5 working days without scheduled lessons, consultation schedule announced previously).
2nd semester exam period	From 21st May till 6th July 2018 (7 weeks). From 16th April till 18th May 2018 (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 2018. The departments shall advertise the date of the state exam until 15th February 2018.

THE MECHANICAL ENGINEERING UNDERGRADUATE PROGRAM

INFORMATIONS ABOUT THE PROGRAM

Name of master's program:	Mechanical Engineering Undergraduate Program
Specializations available:	• Building Services Engineering Specialization • Automotive Production Process Control Specialization • Operation and Maintenance Specialization
Field, branch:	Engineering, Mechanical, transportation, mechatronic engineering
Level:	BSc
Qualification:	Mechanical Engineer
Mode of attendance:	Full-time
Faculty:	Faculty of Engineering
Program coordinator:	Dr Zsolt Tiba, College Professor
Person in charge of the specialization:	• Building Services Engineering Specialization: Department of Building Services and Building Engineering Dr Tünde Kalmár, Associate Professor • Automotive Production Process Control Specialization: Department of Mechanical Engineering Dr Tamás Mankovits, Associate Professor • Operation and Maintenance Specialization: Department of Mechanical Engineering Dr Zsolt Tiba, College Professor
Program length:	7 semesters
Credits total:	210 (thesis: 15, optional subjects: 10)

Aim of the undergraduate program and professional competencies

Aim of the program is to train mechanical engineers who are able to operate and maintain machines and mechanical systems, introduce and apply engineering technologies, organise and monitor work, solve tasks of average level of complexity in the field of technological development, research and design taking into account the needs of labour market, as well. The degree offers the opportunity to advance to master's level study.

Professional competencies to be acquired

a) knowledge

- He/she expansively knows basic facts, directions and borderlines of the subject area of the engineering field.
- He/she knows general and specific principles, rules, relations, procedures of mathematics, natural and social sciences necessary to work in the engineering field.
- He/she knows the conceptual system, the most essential relations and theories relating to the professional field.
- He/she expansively knows the epistemic and problem-solving methods of the main theories of his/her professional field.
- He/she expansively knows fundamentals of economic, entrepreneurial and legal rules and devices.
- He/she thoroughly knows the structural materials applied in the field of mechanical engineering, means of manufacturing, conditions on their applications.
- He/she fundamentally knows principles and means of machine design, procedures and operating processes of machine manufacturing, control techniques and operating processes.
- He/she expansively knows the operating principles and structural units of machine tools and prime movers, engineering facilities, devices.
- He/she has user-level knowledge of measurement procedures, their tools, devices, measurement facilities used in mechanical engineering.
- He/she has user-level knowledge of the requirements from the field of work- and fire safety, industrial safety, occupational health relating to his professional field and the regulations of environmental protection.
- He/she thoroughly knows fundamentals, borderlines and requirements of the professional fields of logistics, management, environmental protection, quality assurance, information technology, law and economics which are closely related to the field of mechanical engineering.
- He/she expansively knows learning, knowledge acquisition, data collection methods, including ethical challenges and problem-solving techniques from the field of mechanical engineering.
- He/she knows the means and methods of corporate finance and cost-profit-oriented analysis based on engineering grounds.

- He/she is capable of interpreting, characterizing, and modelling the structural units of mechanical systems, the structure and operation of their elements, the form and relationship of the applied system elements.
- He/she is capable of applying calculation and modelling principles and means relating to product, procedure and technological design in engineering.

b) abilities

He/she is capable of

- the basic analysis of disciplines which make up the epistemic system of the engineering field, clearly formulating relationships and adequate evaluation.
- applying the most important terminology, theories, procedures of the given engineering field when completing the relevant tasks.
- planning, organising and completing self-study.
- the identification of routine problems emerging in his/her professional field, solving them by detecting and formulating theoretical and practical background and the practical application of standard operations.
- understanding and using the literature, computer and library sources of his/her professional field.
- solving tasks in his/her professional field by using the acquired computer skills.
- creating fundamental models of engineering systems and processes.
- efficiently handling resources at his/her workplace by using his/her skills in a creative way.
- using and considering industrial safety, fire safety, hygienic rules, regulations.
- oral and written communication in a professionally adequate manner in his/her mother tongue and at least one foreign language.
- applying engineering regulations relating to the operation of mechanical systems, principles and economical relations of installing and operating machines, mechanical systems.
- monitoring and controlling manufacturing processes by taking into account the elements of quality assurance and its regulations.
- diagnosing mechanical failures, selecting preventive mechanisms, solving machine repair technologies.

c) attitude

- He/she undertakes and represents the social role of his/her profession genuinely, his/her basic relationship to the world.
- He/she is open to learn and accept professional, technological improvement and innovation in his/her profession and convey it genuinely.
- He/she aspires to realize one of his/her aims as a means of his/her self-education.
- He/she makes a decision in complex and unexpected decision cases by completely taking into account legal and ethical norms.
- He/she aspires to solve problems preferably in cooperation with others.
- He/she aspires to have a continuous self-education in the field of mechanical engineering which should be in accordance with his/her professional endeavours.
- He/she aspires to solve tasks, make leadership decisions by taking into account his/her co-workers' opinion and cooperating with them.

- He/she has the perseverance and can endure the monotony of work to complete practical tasks.
- He/she is open to use IT devices, aspires to become familiar with and apply pieces of software from the field of mechanical engineering, he/she knows and can use at least one such software at user level .
- He/she is open and sensitive to applying new, modern and innovative procedures, methods pertaining to ecological management and health-consciousness.
- By applying the acquired engineering skills he/she aspires to get acquainted with the perceptible phenomena in the most thorough way, describe and explain their principles.
- During his/her work he/she considers and make his/her co-workers consider the requirements of safety at work, health protection, environmental protection, quality assurance and monitoring.

d) autonomy and responsibility

- Even in unexpected decision-making situations he/she is capable of considering complex, fundamental questions from his/her professional field and elaborating them on the basis of the given sources.
- He/she confesses and represents the value system of the engineering profession with responsibility. He/she is open to critical remarks which are professionally well-founded.
- During completing his/her professional tasks he/she is cooperating with experts from other professional fields (primarily that of engineering but also economics and law).
- He/she detects deficiencies of the applied technologies, risks of the processes and initiates the reduction of taking measures to reduce them.
- He/she keeps track of changes relating to legal, technical, technological and administrative changes of his/her professional field.
- Per instruction of his/her superior he/she is supervising the work of personnel he/she is in charge of, monitoring the operation of machines and facilities.
- He/she is evaluating the efficiency, successfulness and safety of his/her inferiors' work.
- He/she keeps track of facilitating the professional development of his/her co-workers, assists them with such endeavours by applying the principle of equal rights to accessibility.
- He/she shares experience with his/her co-workers to support their development.
- He/she takes the responsibility for the consequences of his/her engineering calculations, suggestions based on these calculations and his/her decisions.

MODEL CURRICULUM OF MECHANICAL ENGINEERING BSC – FOR ALL 3 SPECIALIZATIONS

Nr.		Subject	Neptun code	1. semester				2. semester				3. semester				4. semester				5. semester				6. semester				7. semester				Prerequisite
1.	Basics of Natural Sciences	Mathematics I.	MK3MAT1A08GX17-EN	4	4	m	8																									
2.		Mathematics II.	MK3MAT2A06GX17-EN					2	4	m	6																					MK3MAT1A08GX17-EN
3.		Mathematics comp. Exam	MK3MATSA00GX17-EN					0	0	c	0																					
4.		Engineering Physics	MK3MFIZA04GX17-EN	2	2	e	4																									
5.		Introduction of Mechanical Engineering	MK3GEPTG05GX17-EN	2	2	e	5																									
6.		Statics	MK3STATG04GX17-EN					2	2	e	4																					MK3MFIZA04GX17-EN
7.		Strength of Materials	MK3SZILG04GX17-EN									2	2	e	4																	MK3STATG04GX17-EN
8.		Dynamics and Vibration	MK3MREZG04GX17-EN													2	2	m	4													MK3SZILG04GX17-EN
9.		Technical Mechanics comp. Exam	MK3MECHG00GX17-EN													0	0	c	0													MK3MREZG04GX17-EN
10.		Technical Chemistry	MK3MKEMK04GX17-EN					2	1	e	4																					
11.	Economics and Humanities	Studies of Economy and Law	MK3GAZJM04GX17-EN									2	2	e	4																	
12.		Microeconomics	MK3MIKRM04GX17-EN									1	2	e	4																	
13.		Macroeconomics	MK3MAKRM04GX17-EN													1	2	e	4													MK3MIKRM04GX17-EN
14.		Basics of Engineering Management	MK3MMENM04GX17-EN																					2	2	e	4					
15.	Professional Compulsory Subjects	Engineering Informatics I.	MK3INF1A04GX17-EN	2	2	m	4																									
16.		Engineering Informatics II.	MK3INF2A04GX17-EN					0	3	m	4																					MK3INF1A04GX17-EN
17.		Descriptive Geometry	MK3ABRAA04GX17-EN	0	3	m	4																									
18.		Technical Drawing and Basics of CAD	MK3GEPRG05GX17-EN					2	3	m	5																					MK3ABRAA04GX17-EN
19.		CAD Systems	MK3CADRG04GX17-EN									0	3	m	4																	MK3GEPRG05GX17-EN
20.		Machine Elements I.	MK3GEP1G05GX17-EN													3	2	e	5													MK3SZILG04GX17-EN,MK3CADRG04GX17-EN
21.		Machine Elements II.	MK3GEP2G05GX17-EN																	2	2	e	5									MK3GEP1G05GX17-EN
22.		Materials Engineering	MK3ANISG05GX17-EN	3	1	e	5																									
23.		Materials Technology and Testing	MK3ANTVG05GX17-EN					2	3	e	5																					MK3ANISG05GX17-EN
24.		Manufacturing Processes I.	MK3GYT1G04GX17-EN																	2	2	e	4									MK3ANTVG05GX17-EN
25.		Manufacturing Processes II.	MK3GYT2G05GX17-EN																					2	3	e	5					MK3GYT1G04GX17-EN
26.		Electrotechnics and Electronics	MK3ETELR04GX17-EN									2	2	m	4																	MK3MFIZA04GX17-EN, MK3MAT2A06GX17-EN
27.		Measurement Technology	MK3MERTR04GX17-EN													2	2	m	4													MK3ETELR04GX17-EN
28.		Applied Automatization	MK3AAUTR04GX17-EN																	2	2	e	4									MK3MERTR04GX17-EN
29.		Thermodynamics	MK3MHOTL04GX17-EN									2	2	m	4																	MK3MFIZA04GX17-EN, MK3MAT2A06GX17-EN
30.		Fluid Mechanics	MK3ARATL05GX17-EN													3	2	e	5													MK3MHOTL04GX17-EN
31.		Thermal and Fluid Machines	MK3HOAGL05GX17-EN																	2	2	e	5									MK3ARATL05GX17-EN
32.		Environmental, Health, Safety and Ergonomy	MK3EHSAK04GX17-EN																									2	2	m	4	MK3MKEMK04GX17-EN

The curriculum of the program is available in excel format on the webpage of the Faculty of Engineering (www.eng.unideb.hu/en).

MODEL CURRICULUM OF MECHANICAL ENGINEERING BSC – AUTOMOTIVE PRODUCTION PROCESS CONTROL SPECIALIZATION

Nr.		Subject	Neptun code	1. semester				2. semester				3. semester				4. semester				5. semester				6. semester				7. semester				Prerequisite
33.	Field-Specific Vocational Subjects	Automotive Process Analysis and Planning I.	MK3JFT1G04G317-EN																	2	1	e	4									MK3GYT2G05GX17-EN
34.		Finite Element Method	MK3VEMAG04G317-EN																	2	2	m	4									MK3SZILG04GX17-EN,MK3CADRG04GX17-EN
35.		Pneumatics and Hydraulics	MK3PNEUR04G317-EN																	0	3	m	4									MK3MERTR04GX17-EN
36.		Maintenance Engineering	MK3UZK1G05G317-EN																	2	2	m	5									MK3GYT2G05GX17-EN
37.		Automotive Process Analysis and Planning II.	MK3JFT2G04G317-EN																					2	2	e	4					MK3JFT1G04G317-EN
38.		CAM Systems	MK3CAMRG04G317-EN																					2	2	m	4					MK3GYT2G04GX17-EN
39.		Vehicle Constructions and Assembly Technology	MK3JSZTG05G317-EN																					2	2	m	5					MK3GYT2G05GX17-EN
40.		Material Handling and Logistics	MK3AMLOG04G317-EN																					2	2	e	4					
41.		Automotive Quality Assurance	MK3MINBG04G317-EN																					2	2	e	4					MK3JFT1G04G317-EN
42.		Competence Development for Engineers	MK3KOMPM04G317-EN																									2	2	m	4	
43.		Corporate Control Systems and IT Skills	MK3VITIM04G317-EN																									0	2	m	4	MK3INF2A04GX17-EN
44.		Mechanical Engineering Project	MK3GPROG04G317-EN																					0	2	m	4					MK3JFT1G04G317-EN
45.		Thesis	MK3SZDGG15G317-EN																									0	15	m	15	MK3GPROG04G317-EN
46.	Optional Subjects	Optional subject I.									3																					
47.		Optional subject II.													2																		
48.		Optional subject III.																	3														
49.		Optional subject IV.																														2	
50.		Internship	MK3SZGYG00G317-EN	6 weeks																													
			lectures/practises/credits in the semester:	13	14		30	10	16		31	11	15		30	13	13		30	12	14		31	12	14		29	4	21		29	Credits total:
		Criterium subject:	Exam:			3				3				4				4				4				4				0		210
		Internship (requirement: signature, period: 6	Mid-semester grade:			3				3				3				2				3				3				4		
		weeks after the 6th semester)	Number of subjects:			6				6				7				6				7				7				4		
			Number of contact hours:	27				26				26				26				26				26				25				

MODEL CURRICULUM OF MECHANICAL ENGINEERING BSC - BUILDING SERVICES ENGINEERING SPECIALIZATION

Nr.		Subject	Neptun code	1. semester				2. semester				3. semester				4. semester				5. semester				6. semester				7. semester				Prerequisite
33.	Field-specific Vocational Subjects	Building physics and acoustics	MK3EFIZL04G217-EN									2	2	e	4																
34.		Building energetics I.	MK3EEN1L04G217-EN													2	2	m	4												MK3EFIZL04G217-EN
35.		Gas and burning techniques	MK3GAZTL04G217-EN																	2	2	m	4								
36.		Heating systems I.	MK3FUT1L04G217-EN																	2	1	m	4								MK3EFIZL04G217-EN
37.		Ventilation and air conditioning systems I.	MK3LKT1L04G217-EN																	2	1	m	4								MK3EFIZL04G217-EN
38.		Water supply and canalization in buildings I.	MK3VCS1L04G217-EN																					2	2	e	4				
39.		Ventilation and air conditioning systems II.	MK3LKT2L05G217-EN																					2	3	e	5				MK3LKT1L04G217-EN
40.		Heating systems II.	MK3FUT2L05G217-EN																					2	3	e	5				MK3FUT1L04G217-EN
41.		Water supply and canalization in buildings II.	MK3VCS2L04G217-EN																									2	2	e	4	MK3VCS1L04G217-EN
42.		Cooling systems I.	MK3HTE1L04G217-EN																									2	2	e	4	MK3EFIZL04G217-EN
43.		Measurements and design of HVAC systems I	MK3EMT1L04G217-EN																					0	3	m	4					MK3FUT1L4G217-EN, MK3LKT1L04G217-EN
44.		District heating	MK3TFUTL04G217-EN																									2	2	m	4	
45.		Thesis	MK3SZDGL15G217-EN																									0	10	m	15	MK3EMT1L04G217-EN
46.	Optional Subjects	Optional subject I.													2																	
47.		Optional subject II.																	3													
48.		Optional subject III.																					2									
49.		Optional subject IV.																									3					
50.		Internship	MK3SZGYL00G217-EN	6 weeks																												

		lectures/practises/credits in the semester:	13	14		30	10	16		28	11	15		30	13	12		29	14	12		32	10	16		30	8	18		31	Credits total:
	Criterium subject:	Exam:			3				3				4				3				4				5				2			210
	Internship (requirement: signature, period: 6	Mid-semester grade:			3				3				3				3				3				1				3			
	weeks after the 6th semester)	Number of subjects:			6				6				7				6				7				6				5			
		Number of contact hours:	27				26				26				25				26				26				26					

MODEL CURRICULUM OF MECHANICAL ENGINEERING BSC - OPERATION AND MAINTENANCE SPECIALIZATION

Nr.		Subject	Neptun code	1. semester				2. semester				3. semester				4. semester				5. semester				6. semester				7. semester				Prerequisite
33.	Field-specific Vocational Subjects	Theory of Damage	MK3KAREG04G117-EN																	2	1	e	4									MK3GYT2G05GX17-EN
34.		Finite Element Method	MK3VEMAG04G117-EN																	2	2	m	4									MK3SZILG04GX17-EN,MK3CADRG04GX17-EN
35.		Pneumatics and Hydraulics	MK3PNEUR04G117-EN																	0	3	m	4									MK3MERTR04GX17-EN
36.		Maintenance Engineering I.	MK3UZK1G05G117-EN																	2	2	m	5									MK3GYT2G05GX17-EN
37.		Maintenance Engineering II.	MK3UZK2G05G117-EN																					2	2	e	5					MK3UZK1G05G117-EN
38.		Programable Manufacturing Cells	MK3PGYCR04G117-EN																					1	2	m	4					MK3AAUTR04GX17-EN
39.		Drivetrain Systems and Assembly Technology	MK3HSZTG05G117-EN																					2	2	m	5					MK3GYT2G05GX17-EN
40.		Material Handling and Logistics	MK3AMLOG04G117-EN																					2	2	e	4					
41.		Repairing Technology	MK3JAVTG05G117-EN																					3	2	e	5					MK3KAREG04G117-EN
42.		Diagnostics	MK3DIAGG06G117-EN																									2	4	m	6	MK3UZK2G05G117-EN
43.		Mechanical Engineering Project	MK3GPROG04G117-EN																					0	2	m	4					MK3UZK1G05G117-EN
44.		Thesis	MK3SZDGG15G117-EN																									0	15	m	15	MK3GPROG04G117-EN
45.	Optional Subjects	Optional subject I.									3																					
46.		Optional subject II.													2																		
47.		Optional subject III.																	3														
48.		Optional subject IV.																													2		
49.		Internship	MK3SZGYG00G117-EN	6 weeks																													
			lectures/practises/credits in the semester:	13	14		30	10	16		31	11	15		30	13	13		30	12	14		31	12	14		31	4	21		27	Credits total:
		Criterium subject:	Exam:			3				3				4				4				4				4				0		210
		Internship (requirement: signature, period: 6	Mid-semester grade:			3				3				3				2				3				3				3		
		weeks after the 6th semester)	Number of subjects:			6				6				7				6				7				7				3		
			Number of contact hours:	27				26				26				26				26				26				25					

COMPLETION OF THE ACADEMIC PROGRAM

Credit System

Majors in the Hungarian Education System have generally been instituted and ruled by the Act of Parliament under the Higher Education Act. The higher education system meets the qualifications of the Bologna Process that defines the qualifications in terms of learning outcomes: statements of what students know and can do on completing their degrees. In describing the cycles, the framework uses the European Credit Transfer and Accumulation System (ECTS).

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.

Regarding each major the Higher Education Act prescribes which professional fields define a certain training program. It contains the proportion of the subject groups: natural sciences, economics and humanities, subject-related subjects and differentiated field-specific subjects.

The following professional fields define the training program of the Mechanical Engineering BSc:

- Natural Sciences [Mathematics (at least 12 credit points), Mechanics, Engineering Physics, Technical Chemistry, General Engineering Skills] 35-50 credit points;
- Economics and Humanities (Economic and Management Skills, Quality Assurance, Environment-Consciousness and Energy Management, State Administration and Law, Humanities) 14-30 credit points;
- Field-specific professional skills for mechanical engineers (Information Technology, Materials Science, Mechanical Design and Modelling, Manufacturing Technology, Thermal- and Fluid Machines, Electrotechnics, Measurement and Automatics, Industrial Safety, Operation and Maintenance) 70-105 credit points.
- The specialization offered by the institution is worth at least 40 credit points.

Minimum of credit points assigned to optional subjects: 10

Credit points assigned to thesis: 15

Credits total: 210

During the program students have to complete a total amount of 210 credit points. It means approximately 30 credits pro semester. The curriculum contains the list of subjects (with credit points) and the recommended order of completing subjects which takes into account the prerequisite(s) of each subject. You can find the recommended list of subjects in chapter “Guideline”.

Guideline (Lisf of Subjects/Semesters)

The total number of credit points (210) of the training program can be obtained by completing the subjects of the curriculum. There is a certain degree of freedom in the order students can complete the subjects. However, it is recommended that the suggested order be followed because some subjects can only be taken after the completion of the prerequisite subject(s), and/or can be the prerequisites for other subjects.

The list of subjects you have to complete in the semesters according to the model curriculum of Mechanical Engineering BSc programme **Automotive Production Process Control specialization**:

1st semester	**2nd semester**
Mathematics I. Engineering Physics Introduction of Mechanical Engineering Engineering Informatics I. Descriptive Geometry Materials Engineering	Mathematics II. Mathematics comp. Exam Statics Technical Chemistry Engineering Informatics II. Technical Drawing and Basics of CAD Materials Technology and Testing Optional subject I.
3rd semester	**4th semester**
Strength of Materials Studies of Economy and Law Microeconomics CAD Systems Manufacturing Processes I. Electrotechnics and Electronics Thermodynamics Optional subject II.	Dynamics and Vibration Technical Mechanics comp. Exam Macroeconomics Machine Elements I. Manufacturing Processes II. Measurement Technology Fluid Mechanics

5th semester	6th semester
Machine Elements II. Applied Automatization Thermal and Fluid Machines Automotive Process Analysis and Planning I. Finite Element Method Pneumatics and Hydraulics Maintenance Engineering Optional subject III.	Basics of Engineering Management Automotive Process Analysis and Planning II. CAM Systems Vehicle Constructions and Assembly Technology Material Handling and Logistics Automotive Quality Assurance Mechanical Engineering Project
7th semester	
Environmental, Health, Safety and Ergonomy Competence Development for Engineers Corporate Control Systems and IT Skills Thesis Optional subject IV.	

The list of subjects you have to complete in the semesters according to the model curriculum of Mechanical Engineering BSc programme **Building Services Engineering Specialization**:

1st semester	2nd semester
Mathematics I. Engineering Physics Introduction of Mechanical Engineering Engineering Informatics I. Descriptive Geometry Materials Engineering	Mathematics II. Mathematics comp. Exam Statics Technical Chemistry Engineering Informatics II. Technical Drawing and Basics of CAD Materials Technology and Testing Optional subject I.
3rd semester	**4th semester**
Strength of Materials Studies of Economy and Law Microeconomics CAD Systems Manufacturing Processes I. Electrotechnics and Electronics Thermodynamics Building physics and acoustics Optional subject II.	Dynamics and Vibration Technical Mechanics comp. Exam Macroeconomics Machine Elements I. Manufacturing Processes II. Measurement Technology Fluid Mechanics Building energetics I.
5th semester	**6th semester**
Machine Elements II. Applied Automatization Thermal and Fluid Machines Gas and burning techniques Heating systems I. Ventilation and air conditioning systems I. Optional subject III.	Basics of Engineering Management Water supply and canalization in buildings I. Ventilation and air conditioning systems II. Heating systems II. Measurements and design of HVAC systems I. Optional subject IV.
7th semester	

Environmental, Health, Safety and Ergonomy Water supply and canalization in buildings II. Cooling systems I. District heating Thesis	

The list of subjects you have to complete in the semesters according to the model curriculum of Mechanical Engineering BSc programme Operation and Maintenance Specialization:

1st semester	2nd semester
Mathematics I. Engineering Physics Introduction of Mechanical Engineering Engineering Informatics I. Descriptive Geometry Materials Engineering	Mathematics II. Mathematics comp. Exam Statics Technical Chemistry Engineering Informatics II. Technical Drawing and Basics of CAD Materials Technology and Testing Optional subject I.
3rd semester	**4th semester**
Strength of Materials Studies of Economy and Law Microeconomics CAD Systems Manufacturing Processes I. Electrotechnics and Electronics Thermodynamics Optional subject II.	Dynamics and Vibration Technical Mechanics comp. Exam Macroeconomics Machine Elements I. Manufacturing Processes II. Measurement Technology Fluid Mechanics
5th semester	**6th semester**

Machine Elements II. Applied Automatization Thermal and Fluid Machines Theory of Damage Finite Element Method Pneumatics and Hydraulics Maintenance Engineering I.	Basics of Engineering Management Maintenance Engineering II. Programable Manufacturing Cells Drivetrain Systems and Assembly Technology Material Handling and Logistics Repairing Technology Mechanical Engineering Project
7th semester	
Environmental, Health, Safety and Ergonomy Diagnostics Thesis Optional subject IV.	

About the prerequisites of each subject please read the chapter “Course Descriptions”!

Work and Fire Safety Course

According to the Rules and Regulations of University of Debrecen a student has to complete the online course for work and fire safety. Registration for the course and completion are necessary for graduation. For MSc students the course is only necessary only if BSc diploma has been awarded outside of the University of Debrecen.

Subject code: MUNKAVEDELEM

Link: http://munkavedelem.unideb.hu/1_eves-ENg.htm

Login: Neptun ID plus password

Students have to read the material until the end to get the signature on Neptun for the completion of the course.

Internship

Internship is a mandatory and integral part of the course of studies and strongly related to thesis. The duration of internship is at least 6 weeks and undertaken at a production company.

Credit points: 0

Internship in Building Services Engineering Specialization

Aim of internship

To obtain specific practical skills from the field of mechanical engineering building services engineering, building energetics, mechanical design, maintenance and construction, which form the basis for the final semester of the training program, the efficiency of preparing thesis and the period after graduation.

Focal tasks during internship

Students can be involved in work on the basis of the skills acquired during their studies from the following fields: designing building services engineering systems and system elements; constructing building services engineering systems; system maintenance; calculations in building energetics and building physics; technological processes; measurements in building services engineering and energetic; diagnostics; controlling; monitoring; informatics for mechanical engineers; practical application of computer science; parameters and installation of building services engineering facilities (boilers, heat exchangers, convectors, ventilators, pumps, etc.); studies relating to the operation and maintenance of mechanical systems; building services engineering design documentation in which the employer certifies the task completed by the student; energy performance certificate of buildings; technical background material of tenders relating to building renovation.

Completion of internship

During internship and while working in a given field students prepare a report whose topic is selected by the student with the assistance of the intern's supervisor(s). The report can contain publicly available data on the company or information to which the company has given its consent before!

The following should be considered when evaluating student performance: professional, personal attitude, diligence, adaptive skills, successful completion of specific tasks.

Internship in Operation and Maintenance Specialization, Automotive Production Process Control Specialization

Aim of internship, competencies

Aim of the internship is to familiarize students with professional work done at the selected company (its profile is in accordance with the requirements for internship), involve them in the daily routine of the company, solve tasks individually assigned by the supervisor, gain

experience which makes it easier for them to enter the labour market later. During internship general and professional competencies can be acquired and improved.

General competencies: work to a deadline precisely depending on the task type (individually or in team showing cooperation), use language for academic purposes.
Professional competencies: practical application of professional skills gained during studies, acquiring new skills, gain proficiency (depending on the selected specialization) in the field of operation (machines, vehicles), machine repairing, installation and organisation, technological development.

Completion of internship

Students are expected to prepare a 15-20 page long report relating to the work done during internship. The topic should be negotiated with the employer and closely related to the work done during internship and the practical tasks students got acquainted with.

Physical Education

According to the Rules and Regulations of University of Debrecen a student has to complete Physical Education courses at least in two semesters during his/her Bachelor training. Our University offers a wide range of facilities to complete them. Further information is available from the Sport Centre of the University, its website: http://sportsci.unideb.hu.

Optional Courses

According to the Rules and Regulations of University of Debrecen a student has to complete elective courses during his/her Bachelor or Master training. These elective courses are opened by the Departments at the Faculty of Engineering at the beginning of the actual semester. A student can also select elective courses from other faculties of University of Debrecen to complete but these courses are accepted with less credits than they have originally. During your training you can complete elective subjects in any semester. There is no maximum limit of credits gained on elective courses but please note that courses completed on Erasmus scholarship often can be transferred as optional subjects into your curriculum. In the Mechanical Engineering BSc programme you have to gain at least 10 credits with completing elective subjects.

Pre-degree Certification

A pre-degree certificate is issued by the Faculty after completion of the master's (MSc) program. The pre-degree certificate can be issued if the student has successfully completed the study and exam requirements as set out in the curriculum, the requirements relating to Physical Education as set out in Section 10 in Rules and Regulations, internship (mandatory) – with the exception of preparing thesis – and gained the necessary credit points (120). The pre-degree certificate verifies (without any mention of assessment or grades) that the student has fulfilled all the necessary study and exam requirements defined in the curriculum and the requirements for Physical Education. Students who obtained the pre-degree certificate can submit the thesis and take the state exam.

Thesis

Precondition for taking the state exam for BSc students is to prepare the thesis. Requirements of the training program contain the content requirements for thesis, general aspects of the evaluation and the number of credits assigned to thesis (15).

Thesis is the creative elaboration of a professional task (scientific, engineering, design, development, research or research development) in written form as defined in the requirements of the training program. By solving the task the student relies on his/her studies using national and international literature under the guidance of an internal and external supervisor. By preparing and defending thesis students who complete the Mechanical Engineering undergraduate program prove that they are capable of the practical applications of the acquired skills, summarizing the work done and its results in a professional way, creatively solving the tasks related to the topic and doing individual professional work. The faculty academic calendar (issued by the Vice-Rector for Education) sets the thesis submission deadline.

The latest that thesis topics are announced by the departments is the end of Week 4 of the study period of the last semester. Thesis topic can be suggested by the student. The head of department decides on the acceptance of the topic. The conditions on the acceptance of thesis as National Conference of Scientific Students' Association (hereinafter NCSSA) topic are specified by the Faculty. The NCSSA work is supposed to meet the requirements in form and content for thesis. Furthermore, it is necessary that the committee of the Pre-NCSSA makes suggestions on the NCSSA work to become a thesis.

Formal requirements of thesis are announced in writing by the Department of Mechanical Engineering and by the Department of Building Services and Building Engineering.

Thesis is prepared under the guidance of an internal supervisor previously approved by the Department of Mechanical Engineering and with the assistance of an external supervisor also previously approved by the department.

The faculty academic calendar (issued by the Vice-Rector for Education) sets the thesis submission deadline, for want of this the deadline is the 21. day 12 noon before the first day of the state exam.

Precondition for thesis submission is the thesis review report completed and signed by the external supervisor. The internal supervisor decides whether the thesis can be accepted or not. Acceptance is verified by the signature of the internal supervisor.

Thesis is evaluated by the referee (internal or external), in Building Services Engineering Specialization the external referee in a five-point system. On the basis of the thesis review report the internal supervisor and the coordinator of the specialization and in Building Services Engineering Specialization the internal supervisor and the department make suggestions for the evaluation of thesis. The state exam board is notified by the department of the decision made on the three grades awarded for thesis.

Improving thesis with a fail mark:

If thesis is evaluated with a fail mark by the referee, the head of department may decide to allocate a new referee to review thesis.

If thesis is evaluated with a fail mark by the head of department, the student is not allowed to take the state exam and is supposed to prepare a new thesis.

Conditions on resubmitting the thesis are defined by the program coordinator, in case of Building Services Engineering Specialization the head of department who is in charge of the specialization.

State Exam

Students having obtained the pre-degree certificate will finish their studies in the Mechanical Engineering undergraduate (BSc) program by taking the state exam. State exam means the testing and evaluating of the knowledge (skill) necessary to obtain higher education qualification. In the state exam candidates prove that they can apply the acquired knowledge. State exam can be taken in the first state exam period after the award of the pre-degree certificate. State exam is conducted in front of a committee. If the candidate has an active student status, state exam can be taken in the first exam period after the award of the pre-degree certificate. State exam can be taken within 2 years after the termination of student status in any exam period according to the requirements of the training program. After the fifth year of the termination of student status the candidate is not allowed to take the state exam. Only students who do not have outstanding charges are allowed to take the state exam. Students who obtained a pre-degree certificate until 1 September 2016 can take the state exam until 1 September 2018.

A pre-degree certificate is issued by the Faculty after completion of the undergraduate (BSc) program. The pre-degree certificate can be issued if the student has successfully completed the study and exam requirements as set out in the curriculum, internship (mandatory) and gained the necessary credit points (210). The pre-degree certificate verifies (without any mention of assessment or grades) that the student has fulfilled all the necessary study and exam requirements defined in the curriculum. Students who obtained the pre-degree certificate can take the state exam.

State exam board

Committee chair and members of the committee are called upon and mandated by the dean with the consent of the Faculty Council. They are selected from the acknowledged internal and external experts of the professional field. Traditionally, it is the chair and in case of his/her absence or indisposition the vice-chair who will be called upon, as well. The board consists of – besides the chair – at least two members and the examiner.

State exam in Building Services Engineering Specialization

State exam takes place in the autumn exam period (first semester) of the given academic year.

State exam consists of two parts:

The candidate gives account of his/her knowledge in subjects of the state exam, presents and defends his/her thesis in front of a committee. Candidates are supposed to defend thesis and take the oral exam on the same day.

All candidates (independent from the order of candidates taking the state exam) are expected to arrive at the venue 15 minutes before the start of the state exam and the presentation of thesis. Dress code: Candidates are expected to wear something smart which reflects that this is a special and more formal occasion. The order of the candidates taking the state exam and the expected end of the state exam will be announced by the committee chair at the beginning of the state exam. Only one candidate is permitted to be examined at a time, simultaneous examination is not allowed.

Presenting thesis:

a. The candidate presents his/her thesis in 10 minutes in front of the state exam board. Presentation is mandatory, the examination room will be provided with computer and slide projector. In the presentation the candidate is supposed to highlight his/her own work and the research results.
b. Taking into account the thesis review report and the questions of the referee the committee chair and the members of the committee ask questions about thesis. Candidates are expected to answer without any preparation time.

State exam process:

The candidate is expected to select a topic randomly from the subjects listed below and will be examined after preparation:

a. Ventilation and Air Conditioning
b. Heating Systems
c. Water and Gas Supply Systems

The candidate is supposed to select two from the subjects marked with a,b and c (a+b, b+c or a+c).

The latest that the requirements of the oral part of the state exam are announced by the department is the last week of the study period. The oral exam is evaluated on a five-point scale by the members of the committee. Final grade for the state exam will be decided on by voting in a closed sitting. In case of equal votes the committee chair will take the decision. State exam results will be announced by the committee chair. Results of the state exam and thesis defence will be announced at the end of the given exam day (when all candidates finished state exam and thesis defence on the given day). A note of the state exam will be taken.

Improving failed state exam

State exam can be retaken if any of its part is a fail. The ensuing state exam period for Building Services Engineering Specialization is the soonest that the re-sit is allowed. State exam can be retaken twice.

State exam in Operation and Maintenance Specialization, Automotive Production Process Control Specialization

State exam can be taken both in the autumn and spring exam period.

The state exam consists of two parts:

1. defending thesis (presentation on thesis, then answers to questions and remarks),
2. oral exam in two subjects of the state exam depending on the specialization

Subjects of the state exam

Operation and Maintenance Specialization	
Obligatory:	Operation and Maintenance
Optional:	Machine Repairing *or*
	Diagnostics

Automotive Production Process Control Specialization	
Obligatory:	Process Optimization and Analysis
	Automotive Quality Assurance

The committee assesses performance in the state exam and awards mark for thesis. The committee decides on diploma grade and thesis grade in closed sitting after thesis defence. In controversial cases the chair takes the decision. After the end of the state exam the results are announced by the committee chair.

Improving failed state exam

State exam has to be retaken if any of its part is a fail. The ensuing state exam period is the soonest that the re-sit is allowed. In case the student successfully completes any part of the state exam (defending thesis or oral exam in subjects of the state exam), he/she is supposed to improve only the failed part. Retake state exam is allowed twice in each part.

COURSE DESCRIPTIONS FOR MECHANICAL ENGINEERING MSC

The order of subject follows the subject list in the model curriculum above.

Subject group “Basic Natural Sciences” (for all 3 specializations)

Mathematics I.

Code: MK3MAT1A8GX17_EN

ECTS Credit Points: 8

Evaluation: mid-semester grade

Year, Semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 4+4

Topics:

The basic notions of linear algebra, differentiation and integration for real functions; some applications in physics.

Literature:

Compulsory:

1. Thomas’ Calculus, Addison Wesley (11th edition, 2005), ISBN: 0-321-24335-8
2. S. Minton, Calculus Concept and Connections, McGraw Hill (2006), ISBN 0-07111200-6

Schedule

1st week Registration week	
2nd week: **Lecture:** *Real numbers* Axiom system. Boundary, inf, sup, min, max. Dedekind-complete, real line. Distance, neighbourhood, interior point, accumulation point. Intervals. The sets $\mathbb{R}$, $\mathbb{R}2$, $\mathbb{R}3$ and their geometric interpretations. Natural numbers, integer numbers, rational numbers. Coordinate systems	**3rd week:** **Lecture:** *Sequences of real numbers and their limit* The notion of real sequences. Limits and operations. Some important sequences and their properties. Monotone and bounded sequences.

Polar coordinate system. Spherical- and Cylindrical coordinate systems.
Some important sets on the plane and in the space.
Some way to give functions.
Real functions
Function, domain, range, restriction, composition.
Properties: zero set, sign, monotonity, boundedness, convexity, parity, periodicity.

Practice:
Sets
Operations of sets, Boole algebra. Logic values, logic operations, logic functions.
Cartesian product, 2-tuple, n-tuple.
Cardinality.
Illustrations of sets on the plane and in the space.

Real functions
Roots of polynomials, polynomial factorization, sign, tendency of the values at infinity.
Solutions of Polynomial equations.

4th week:
Lecture:
Series of real and complex numbers partial sums and convergence. Absolute convergence Geometric series, criteria of convergence.
(Comparison test,ratio test, root test).

Limits of real functions, continuity of real functions.

Practice:
Vector geomety, vector algebra
Unit vector in the direction of a vector, projections.

Elementary functions
The relation between a function and its inverse.
Exponential and logarithm functions, power functions. Trigonometric, hyperbolic functions and their inverses.

Practice:
Vector geomety, vector algebra
The algebra of vectors in 2 and 3 dimensions: operations, coordinate systems. The algebraic definition of the cross product. Geometric interpretations of the scalar product and the cross product. The mixed product.
Applications: Mechanical work, moment of a force with respect to a point, moment of a force with respect to an axis.
The investigation of rational fractions Determination of inverse functions.

5th week:
Lecture:
Series of real functions
The notion of series of real functions, the convergence domain, the radius of the convergence.
Power series. Power series of some elementary functions.
Differentiation
Notions of differentiation, applications in physics. Derivative function. Rules of differentiation.
Practice:
The set of thee complex numbers

Geometric applications: lines and planes in the space. The area of a triangle, the volume of a tetrahedron. The distance between a point and a line, or between a point and a plane. *Calculations of limits of real functions*	Complex plane, rectangular form, trigonometric form, exponential form, operations. **Application**: complex impedance *Differentiation* Applications of the differentiation rules.
6th week: **Lecture:** *Approximations of real functions* Lagrange interpolation. Linear regression. *Differentiation* Differential, Linear approximation, tangent line. L'Hospital's rule	**7th week:** **Lecture:** Summary, sample test *Differentiation* Taylor polynomials
Practice: *Sequences of real numbers* Limits and operations. Monotone and bounded sequences, convergence and relations among them. *Differentiation* Differential, Linear approximation, equation of tangent line. L'Hospital's rule	**Practice:** *Series of real numbers* Calculation of the sum of geometric series, determination of domain convergence of power series. *Differentiation* Taylor polynomials
8th week: 1st drawing week *Test 1 (20 points)* *Homework (Moodle): requirement of Test 2* Bonus point 3-times on the seminar (3×2 points) *Test 2 (30 points)*	*Test 3 (20 points)* *Homework (Moodle): requirement of Test 4* Bonus point 3-times on the seminar (3×2 points) *Test 4 (30 points)*
9th week: **Lecture:** *Matrices* The arithmetic of matrices, determinants and their properties: operations, the notions of symmetrical matrix, skew-symmetrical matrix, determinant, the inverse matrix *Differentiation* Investigations of differentiable functions:	**10th week:** **Lecture:** *Vector spaces* The notion of linear (or vector) space, linear combinations of vectors, linearly dependent and independent systems, basis, dimension, coordinates. Ranks of vector systems, ranks of matrices *The Riemann integral.* The notions and the properties of the integral.

Mean value theorems. Monotony and convexity testing. Curve sketching for a function, local and absolute extrema.	
Practice:	**Practice:**
Matrices	*Vector spaces*
Operations, determinants and inverses with adjoint matrices	Linearly independent and dependent systems, bases.
	Ranks of vector systems, ranks of matrices
Differentiation	*Differentiation*
L'HospitalS rule	Investigations of differentiable functions
Investigations of differentiable functions	
11th week:	**12th week:**
Lecture:	**Lecture:**
Systems of linear equations: Gauss elimination (addition method) and Cramer's rule.	*Systems of linear equations:* by the inverse of the coefficient matrix
Applications: Calculations for direct current using Kirchhoff's current and voltage laws.	
Primitive function (antiderivative), indefinite integral. Integration by parts and by substitution. Integration in special classes of functions.	Determinations of primitive functions
Practice:	**Practice:**
Systems of linear equations: Gauss elimination (addition method) and Cramer's rule.	*Systems of linear equations:* by the inverse of the coefficient matrix
Determinations of primitive functions.	Determinations of primitive functions
13th week:	**14th week:**
Lecture:	**Lecture:**
Linear functions	*Linear functions*
The notion of the linear function, the matrices of linear functions.	Bases transformations
Eigenvalues, eigenvectors.	
Riemann integral	*Riemann integral*
The Newton-Leibniz theorem. Improper integrals.	Applications of the integration in geometry and physics.
Numerical integration.	Improper integral.
Practice:	**Practice:**
Linear functions	*Linear functions*
Determinations of matrices of linear transzformations.	Bases transformations
Determinations of eigenvalues, eigenvectors.	
Riemann integral	*Riemann integral*

Applications.	Applications. Improper integrals.
15th week: 2nd drawing week	
Test 5 (20 points)	*Test 7 (20 points)*
Homework (Moodle): requirement of Test 6	*Homework (Moodle): requirement of Test 8*
Bonus point 3-times on the seminar (3×2 points)	Bonus point 3-times on the seminar (3×2 points)
Test 6 (30 points)	*Test 8 (30 points)*

A, for signature:

Attendance on the lectures is recommended, but not compulsory.

Participation at practice is compulsory. Student must attend the practices and my not miss more than three practice during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Student can't make up a practice with another group. The attendance on practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, to be discussed with the tutor. Active participation is evaluated by the teacher in every class. If student's behaviour 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 grade:

The course ends in exam 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)

Mathematics II

Code: MK3MAT2A06GX17-EN

ECTS Credit Points: 6

Evaluation: mid-semester grade

Year, Semester: 1st year, 2nd semester

Its prerequisite(s): Mathematics I.

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+4

Topics:

Differentiation and integration of multivariable and vector-valued functions, differential equations.

Literature:

Compulsory:

- Thomas' Calculus, Addison Wesley (11th edition, 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

Schedule

1st week Registration week	
2nd week:	**3rd week:**
Lecture: Metric, topology, sequences in $\mathbb{R}^n$. Linear functions.	**Lecture:** Parametric curves I. Notions of differentiation, linear approximation. Frenet-Serret frame. Some examples in physics
Practice:	**Practice:**
Limits of vectorsequences. Limits and continuity of multivariable functions. Linear functions.	Differentiation, linear approximation, tangent line. *Applications: velocity, acceleration*
Notions of differential equations, classification of differential equations, initial value problem.	Problems leading to differential equations. (Newton's second law, RLC, examples in economics).
4th week:	**5th week:**
Lecture: Curvature, torsion. Evolute, evolvent, conic sections.	**Lecture:** Differentiable functions of type $\mathbb{R}^n \to \mathbb{R}^m$.
Practice:	**Practice:**
Curvature, torsion. Determinations of conic sections in parametric form.	Derivatives of functions of type $\mathbb{R}^n \to \mathbb{R}^m$.
Differential equations which can be integrated on direct way. Separable differential equations.	First order linear differential equations (homogeneous and inhomogeneous, method of variation).
6th week:	**7th week:**

Lecture: Parametric surfaces Tangent plane, linear approximation. Surfaces of revolution, ruled surfaces.	**Lecture:** Scalar field, gradient. Young's theorem. Directional derivative.
Practice: Surfaces of revolution: ellipsoid and paraboloid in parametric form. Derivatives of functions of type $\mathbb{R}^2 \to \mathbb{R}^3$.The equation of the tangent plane.	**Practice:** The domains of functions of type $\mathbb{R}^2 \to \mathbb{R}$. Directional derivative and gradient.
Determination of solutions of inhomogeneous first order linear differential equations	Higher order linear differential equations, Wronski determinant.
8th week: 1st drawing week	
Test 1 (25 points), Homework (Moodle), Test 2 (15 points)	
9th week:	**10th week:**
Lecture: Local and global extrema.	**Lecture:** Vector fields. Derivatives. Divergence and curl. Potential function.
Practice: Local extremas of functions of type $\mathbb{R}^2 \to \mathbb{R}$, $\mathbb{R}^3 \to \mathbb{R}$	**Practice:** Determination of global extremas on boundary closed sets. Solution of linear homogeneous differential equations of order two having constant coefficients.
11th week:	**12th week:**
Lecture: The notion of double and triple integrals on 2 and 3 dimensional intervals. The extensions of the integrals.	**Lecture:** Integrals over general regions. *Applications: second moment of area, mass, center of gravity*
Practice: Vector fields. Derivatives. Divergence and curl. Potential function. Method of undetermined coefficients.	**Practice:** Double and triple integrals on 2 and 3 dimensional intervals. Special second order differential equations.
13th week:	**14th week:**
Lecture: The arc length of curves, surface area. Line and surface integrals. The theorems of Gauss and Stokes, Green's formulae. Applications in physics.	**Lecture:** Mathematical softwares

Practice:	**Practice:**
Integrals over general regions. *Applications: second moment of area, mass, center of gravity* The theorems of Gauss and Stokes, Green's formulae. Applications in physics.	The arc length of curves, surface area. Line and surface integrals.
The Laplace transform and its applications.	Slope fields, numerical methods. (Euler, Runge-Kutta).

15th week: 2nd drawing week

Test 3 (25 points), Homework (Moodle), Test 4 (15 points)

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.

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 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.

Mathematics Comprehensive Exam

Subjects of the comprehensive exam: Statics, Strength of Materials, Dynamics and Vibration

Engineering Physics

Code: MK3MFIZA04GX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Geometrical optics, kinematics and dynamics of particles, concept of mechanical work, kinetic and potential energy, electrostatics, electric fields around conductors, transport processes, steady-state transport of electric charge, steady-state heat transfer (conduction, convection and radiation)

Literature:

Compulsory:

1. Alvin Halpern: 3,000 Solved Problems in Physics, SCHAUM'S SOLVED PROBLEM SERIES (2011), ISBN-13: 978-0071763462
2. Jerry S. Faughn, Raymond A. Serway, Chris Vuille, Charles A. Bennett: Serway's College Physics, Published 2005 by Brooks Cole Print, ISBN 0-534-99723-6

Schedule

1st week Registration week	
2nd week: **Lecture:** Concept of geometrical optics, law of reflection and refraction (Snell's law), Brewster's angle, Optics of prisms and lenses, imaging properties and magnification, aberrations, compound lenses **Practice:** Solving problems for the reflection and refraction of light beams and for the imaging of lenses and compound lenses.	**3rd week:** **Lecture:** Description of the motion by scalar quantities: Scalar position, velocity and acceleration. Example: uniform and uniformly varying motion **Practice:** Solving problems for uniform and uniformly varying motions.
4th week: **Lecture:** Description of the motion by vector quantities:	**5th week:** **Lecture: Kinetics of a particles I**

Position vector, vector velocity and acceleration. Example: throwing problems, circular motion. **Practice:** Solving throwing and circular motion problems.	Inertial frame of reference, Newton's Laws, force formulas. Application of Newton's Laws in static and dynamic problems. **Practice:** Application of Newton's laws in kinetic problems.
6th week: **Lecture: Kinetics of a particles II** Concept of work and kinetic energy, work-energy theorem. Application of work-energy theorem in dynamic problems. **Practice:** Application of Newton's laws and the work energy theorem in kinetic problems.	**7th week:** **Lecture: Electrostatics I** Electric field strength and flux, Gauss's law for electricity (Maxwell's first equation), potential energy in electric fields. **Practice:** Calculation of the electric field strength and its flux in the electrostatic fields of different charge arrangements.
8th week: 1st drawing week, first midterm test	
9th week: **Lecture: Electrostatics II** Electric voltage and potential, capacitance, capacitance of planar, cylindrical and spherical capacitors, the energy of capacitors, capacitor circuits **Practice:** Calculating the capacitance and stored energy of different types of capacitors and capacitor connections	**10th week:** **Lecture:** Concept of physical system, current intensity and source strength, extensive and intensive physical properties, conduction and convection current. Equation for steady-state conduction. Thermal conductivity and conductive resistance. Conductive resistance circuits. **Practice:** Application of the equation of balance and steady-state conduction in different physical problems.
11th week: **Lecture: Steady state transport of electric charge (Direct electric current)** Electric current intensity, electrical conductivity and resistance, Ohm's law, electric work and power, characteristics of DC sources, Kirchhoff's circuit laws, solution of electric circuits **Practice:** Solution of DC circuits	**12th week:** **Lecture: Steady-state heat transfer I - Thermal conduction** Concept of heat current and thermal conduction, equation of steady-state thermal conduction, thermal conductivity and resistance, steady state temperature distribution in a one dimensional wall of thermal conductivity **Practice:** Solving thermal conduction problems
13th week: **Lecture: Steady-state heat transfer II - Thermal convection** Concept of thermal convection and heat transfer, equation of steady-state heat	**14th week:** **Lecture: Steady-state heat transfer III - Thermal radiation** Thermal radiation characteristics, concept of black body radiation, fundamental laws

transfer, heat transfer coefficient and resistance, overall heat transfer coefficient and resistance **Practice:** Calculating the steady state temperature distribution in a one dimensional wall of thermal conductivity	of thermal radiation (Planck distribution, Wien displacement law, Stefan-Boltzmann and Kirchhoff's law), gray body radiation **Practice:** Solving thermal radiation problems
15th week: 2nd drawing week, second midterm test	

Requirements

A, for a signature:

Participation at lectures is compulsory. Students must attend lectures and may not miss more than three of them during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at lectures will be recorded by the lecturer. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed lectures must be made up for at a later date, being discussed with the tutor.

Students have 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
Close fail (2)	40-50
Improvement needed (3)	51-60
Very good (4)	61-70
Excellent (5)	71-80

If somebody fails then he 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:

For their exam everybody will get an exam grade. 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).

Introduction of Mechanical Engineering

Code: MK3GEPTG05GX17

ECTS Credit Points: 5

Evaluation: Exam

Year, Semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses are built on it: No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

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.

Literature:

Compulsory:

- 1. Mechanical Engineers' Handbook, Volume 4 John Willey & Sons, 2006. ISBN: 9780471719885
- 2. M. R. Lindeburg: Mechanical Engineering Reference Manual 13th. Professional Publications Inc., 2006. ISBN-13: 978-1591264149 ISBN-10: 1591264146

Schedule

1st week Registration week	
2nd week: **Lecture:** SI units, basic and derived quantities, prefixes. **Practice:** Overview of The International System of Units (SI). Elaboration of kinetic and kinematic exercises.	3rd week: **Lecture:** Translational and rotational motion, moment of inertia, torque, work, power **Practice:** Elaborating exercises in the following topics: losses of machines, efficiency, specific consumption, economical efficiency.
4th week: **Lecture:** Efficiency, power loss of machines.	5th week: **Lecture:** Bernoulli's equation, law of continuity, Venturi tube, water jet force.

Practice: Elaborating exercises in the topic of flywheels and hydrostatics. Utilization of Bernoulli's principle.	**Practice:** Elaborating calculation exercises in the field of hydrodynamics.
6th week:	**7th week:**
Lecture: Entropy, specific heat capacity, latent heat, temperature-entropy diagram for steam.	**Lecture:** Classification of machines, power drives. Drive gears, flywheels, breaks, springs,
Practice: Elaborating calculation exercises: the air as energy source.	**Practice:** Elaborating calculation exercises: machines transmitting fluid and the water vapor as energy source.
8th week: 1st drawing week	
9th week:	**10th week:**
Lecture: Otto engines, Diesel engines.	**Lecture:** Positive displacement pumps, centrifugal pumps and gear pumps.
Practice: Elaborating calculation exercises in connection with water vapor.	**Practice:** Elaborating calculation exercises: machines transmitting gas.
11th week:	**12th week:**
Lecture: Fans, compressors	**Lecture:** Steam boilers, steam turbines, steam power plants.
Practice: Elaborating calculation exercises: steam-engines, steam-boilers.	**Practice:** Elaborating calculation exercises: internal combustion engines.
13th week:	**14th week:**
Lecture: Water turbines, wind power plants.	**Lecture:** Adaptation of prime movers and driven machines
Practice: Elaborating calculation exercises: water turbines, topics of hydraulic and pneumatic machines.	**Practice:** Elaborating calculation exercises in the field of machine groups.
15th week: 2nd drawing week	

Requirements

A, for a signature:

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 grade:

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)

Statics

Code: MK3STATG04GX17_EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 2nd year, 2nd semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Newton's laws of motion. Force, moment, and couples. Reduction of a force system. Resultant and classification of force systems. Equilibrium equations. Statics of material points. Statics of rigid bodies. Static problems in planar systems. Practical structures (friction, pin-friction, rolling resistance, rope friction). 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).

Literature:

Compulsory:

- Russel C. Hibbeler (2006): Engineering Mechanics – Statics and Dynamics, Prentice Hall, 2006. ISBN-13 9780132215091
- Lakshmana C. Rao, J. Lakshminarasimhan, Raju Sethuraman, Srinivasan M. Sivakumar (2004): Engineering Mechanics: Statics and Dynamics, PHI Learning Pvt. Ltd., ISBN 8120321898, 9788120321892
- Lawrence E. Goodman, Susan Goodman, William H. Warner (2001): Statics, Courier Dover Publications, ISBN 0486420051, 9780486420059

- Ferdinand P. Beer, E. Russell Johnston, Jr., (1987): University of Connecticut, Mechanics for Engineers: Statics and Dynamics (Package), 4th Edition, ©1987, ISBN-139780070045842
- 5. Joseph F. Shelley (1990): 800 solved problems in vector mechanics for engineers, Volume I: Statics. (SCHAUM'S SOLVED PROBLEM SERIES), McGraw-Hill, 1990, ISBN 0-07-056835-9

Schedule

1st week Registration week	
2nd week: Mathematical introduction – Vector algebra **Lecture:** Concept of a vector, description of a vector with coordinates, vector operations and their applications in basic geometry, position vector **Practice:** Solving problems in vector algebra	3rd week: Newton's laws, force formulas. Equilibrium state of a particle **Lecture:** Newton's laws, force formulas (gravitational, spring and reaction forces), resultant of a force system acting on a particle and its determination with calculation and construction, equilibrium state of a particle, solution of equilibrium problems **Practice:** Calculating the resultant of 2 and 3 dimensional force systems acting on particles. Solving equilibrium problems of particles.
4th week: Equivalence and resultant of a force system. Classification of force systems **Lecture:** Moment of a force, resultant force and moment of a force system, connection between the resultant moments of a force system relative to different point of space, equivalence and resultant of force systems, classification of force systems **Practice:** Calculating the resultant force and moment of 3 dimensional force systems.	5th week: Analysis of coplanar force systems **Lecture:** Resultant of a coplanar force system, determination of the resultant with calculation and construction in case of intersecting and parallel force systems **Practice:** Calculating the resultant force and moment of 2 dimensional force systems, and determining its resultant with calculation. Constructing the resultant of intersecting and parallel force systems.
6th week: Centre of mass and gravity. Continuously distributed force systems **Lecture:** Concept of centre of mass and gravity and their calculation, continuously distributed force systems along a line, and over a surface area or volume. **Practice:** Calculating and constructing the centre of gravity of plane figures and arrangements build up from them.	7th week: Equilibrium state of a rigid body. Equilibrium equations. Calculation of reaction forces in statically determinate structures **Lecture:** Equilibrium state of a rigid body and its conditions, equilibrium equations for a 3 and 2 dimensional force system, statically determinate and indeterminate structure, support types: roller, simple, pinned and fixed support

	Practice: Calculating the reaction forces acting on a mechanical structure in equilibrium.
8th week: 1st drawing week First midterm test	
9th week: Construction of reaction forces in statically determinate structures **Lecture:** Methods for the construction of reaction forces in an intersecting and a parallel force system. **Practice:** Constructing the reaction forces acting on a mechanical structure in equilibrium.	**10th week: Analysis of practical structures** **Lecture:** Friction, pin-friction, rolling resistance, rope friction **Practice:** Determination of the possible values of reaction forces acting on a practical structure from the equilibrium conditions by calculation and construction.
11th week: Analysis of simple machines with friction **Lecture:** Wedge, groove, screw with flat and sharp thread, first and second class levers, pulley. **Practice:** Analysis of simple machines	**12th week: Internal force system of a rigid body and its resultant.** **Lecture:** General concept of normal and shear force, bending and torsional moment, calculation of the normal force, shear force and bending moment functions of beams. **Practice:** Calculation of the normal force, shear force and bending moment functions of supported beams and cantilevers.
13th week: Loading diagrams of beams. **Lecture:** Simple method for the drawing of the normal force, shear force and bending moment diagrams of beams. **Practice:** Drawing the loading diagrams of freely supported beams, cantilevers and fraction lined beams.	**14th week: Determined beam structures** **Lecture:** Hinged-bar systems, compound beams and truss systems **Practice:** Analysis of hinged-bar systems, compound beams and truss systems
15th week: 2nd drawing week, Second midterm test	

Requirements

A, for a signature:

Participation at lectures is compulsory. Students must attend lectures and may not miss more than three of them during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at lectures will be recorded by the lecturer. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed lectures must be made up for at a later date, being discussed with the tutor.

Students have 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
Close fail (2)	40-50
Improvement needed (3)	51-60
Very good (4)	61-70
Excellent (5)	71-80

If somebody fails then he 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:

For their exam everybody will get an exam grade. 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).

Strength of Materials

Code: MK3SZILG04GX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 2nd year, 1st semester

Its prerequisite(s): MK3STATG04GX17-EN (Statics)

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Statics review. Mathematical preliminaries (vector-, matrix- and tensoralgebra). Fundamentals of Strength of Materials. Elastic and plastic deformation. Physical interpretation of strain terms. State of deformation. State of stresses. Principal values of normal stresses, principal axes. Energy of strain. Constitutive equation (Hooke's law). Simple loadings (tension, compression, bending, torsion, shear). Sizing methods. Area moment and product of inertia. Polar moment of inertia. Determination of principal axes. Mohr's circle. Combined loadings (tension and bending, inclined bending, excentrical tension, tension and torsion, bending and torsion). Energy methods (Betti's theorem). Statically indetermined beams (Castigliano's theorem). Buckling of columns.

Literature:

Compulsory:

- Ladislav Cerny (1981): Elementary Statics and Strength of Materials, McGraw-Hill, ISBN 0070103399, 9780070103399
- László Kocsis (1988): Brief Account of the Lectures of Mechanics, Strength of Materials, BME
- Ferdinand P. Beer, E. Russel Johnston, Jr., John T. DeWolf (2006): University of Connecticut Mechanics of Materials, 4th Edition, © 2006, ISBN-13 9780073107950

Recommended:

- Stephen Timoshenko (1955): Strength of Materials: Elementary Theory and Problems, Van Nostrand
- Jacob Pieter Den Hartog (1961): Strength of Materials, Courier Dover Publications, ISBN 0486607550, 9780486607559

Schedule

1st week Registration week	
2nd week:	3rd week:
Lecture: Fundamentals of Strength of Materials. Statics review. Mathematical preliminaries (vector-, matrix- and tensoralgebra).	Lecture: Elastic and plastic deformation. Displacement fields. Physical interpretation of strain terms. State of deformation.
Practice: Determination of stress resultants.	Practice: Practical examples for strain calculations.
4th week:	5th week:
Lecture: State of stresses. Principal values of normal stresses, principal axes. Energy of strain. Constitutive equation (Hooke's law).	Lecture: Simple loadings I.: tension and compression of prismatic beams. Fundamentals of sizing and control.
Practice: Practical examples for stress calculations. Strain energy calculations in beams.	Practice: Practical examples for tension and compression.
6th week:	7th week:
Lecture: Simple loadings II.: bending of prismatic beams. Area moment and product of inertia.	Lecture: Simple loadings III.: torsion of prismatic beams with circular and ring cross sections. Shear. Polar moment of inertia.
Practice: Practical examples for bending. Application of Steiner's theorem.	Practice: Practical examples for torsion and shear. 1st test.

8th week: 1st drawing week	
9th week: **Lecture:** Combined loadings I.: tension and bending, inclined bending, excentrical tension. **Practice:** Practical examples for combined loadings.	**10th week:** **Lecture:** Mohr's circle. Determination of principal axes. **Practice:** Practical examples for determining principal stresses.
11th week: **Lecture:** Combined loadings II.: tension and torsion, bending and torsion. Sizing methods. **Practice:** Practical examples for combined loadings.	**12th week:** **Lecture:** Energy methods I.: Betti's theorem. **Practice:** Application of Betti's theorem for calculating deflections.
13th week: **Lecture:** Energy methods II.: Castigliano's theorem. **Practice:** Application of Castigliano's theorem for indetermined beams.	**14th week:** **Lecture:** Buckling of columns. **Practice:** Practical examples for buckling phenomena. **2nd test.**
15th week: 2nd drawing week	

Requirements

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 1st test in the 7th week and the 2nd test in the 14th week. Students have to sit for the tests.

B, for grade:

The course ends in an **examination**.

The minimum requirements of the 2 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).

Dynamics and Vibrations

Code: MK3MREZG04GX17-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 2nd year, 4th semester

Its prerequisite(s): Strength of Materials

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Motion of a particle:

position, velocity and acceleration and the mathematical relations between them, description of the motion of the particle in Cartesian coordinate system and Frenet-frame, Newton's laws and differential equation of the motion of the particle, theorems of kinetics, force fields, kinetic, potential and mechanical energy, constrained motion along a two or three dimensional curve

Motion of a rigid body:

description of the translational, rotational and general plane motion of a rigid body, concept and determination of the instantaneous centre of zero velocity and acceleration, rolling motion without slipping, description of the plane motion of a rigid body in a time interval,

centre of mass, momentum and angular momentum, moment of inertia and its calculation, mechanical work, Newton's laws and theorem of kinetics for rigid bodies, rotating and swinging of the body about an axis, rolling without slipping

Vibrations:

Description and classification of vibratory motions and vibrating systems. Basic definitions and properties of vibratory motion. Investigation of the elements of vibrating systems: masses and inertial elements, flexible and damping elements. Investigation of the dynamic models. Two ways for the generation of motion equations: the D'Alembert's principle and the Lagrange equations of motion. Investigation and properties of the free vibrations of single DOF undamped and damped systems. Solution of the homogenous motion equation. Investigation and properties of the forced vibrations of single DOF undamped and damped systems. Basic types of forced vibrating systems. Multiple DOF systems: introduction, basic properties, natural frequencies and modes, modal transform and decoupling.

Literature:

Compulsory:

- Russel C. Hibbeler: Engineering Mechanics – Statics and Dynamics, Prentice Hall, 2006. ISBN-13 9780132215091
- Jerry Ginsberg: Engineering Dynamics, 3rd edition, Cambridge University Press, 2007. ISBN-13: 978-0521883030
- Lakshmana C. Rao, J. Lakshminarasimhan, Raju Sethuraman, Srinivasan M. Sivakumar: Engineering Mechanics: Statics and Dynamics, PHI Learning Pvt. Ltd., 2004. ISBN 8120321898, 9788120321892
- Meirovitch, Leonard: Fundamentals of Vibration, McGraw-Hill Publishing Company, 2000. ISBN 0071181741

Recommended:

- Ferdinand P. Beer, E. Russell Johnston, Jr.: University of Connecticut, Mechanics for Engineers: Statics and Dynamics (Package), 4th Edition, ©1987, ISBN-13 9780070045842
- 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

Schedule

1st week Registration week	
2nd week:	3rd week:
Lecture: Kinematics of a particle	Lecture: Kinetics of a particle I
Scalar and vector position, velocity and acceleration and the mathematical relations between them. Description of the	Newton's laws and differential equation of the motion of the particle. Theorems of kinetics (impulse-momentum, work-energy

motion in Cartesian coordinate system and Frenet-frame. Special motion types: Motion with constant acceleration, circular motion. **Practice:** Particle kinematics problems	and angular impulse-angular momentum theorems). Mechanical Power. Force fields (homogeneous, central and conservative). Kinetic, potential and mechanical energy. **Practice:** Particle kinetics problems I
4th week: **Lecture: Kinetics of a particle II** Formulas for work and potential energy in homogeneous and central force fields. Motion of the particle in gravitational and elastic spring force fields. Constrained motion along a two or three dimensional curve. **Practice:** Particle kinetics problems II	**5th week:** **Lecture: Kinematics of a rigid body I** Basic concepts (rigid body and disc, planar, translational, rotational and general plane motion). Connections between the velocity and acceleration of the different points of a rigid body undergoing translational, rotational and general plane motion. Instantaneous centre of zero velocity and acceleration and procedure for the determination of them with calculation and construction. **Practice:** Rigid body kinematics problems I
6th week: **Lecture: Kinematics of a rigid body II** Rolling motion without slipping. Description of the plane motion of a rigid body in a time interval. Pole curves. **Practice:** Rigid body kinematics problems I	**7th week:** **Lecture: Kinetics of a rigid body I** Basic concepts: centre of mass, momentum and angular momentum, moment of inertia and its calculation, parallel axis theorem, mechanical work. **Practice:** Rigid body kinetics problems I
8th week: 1st drawing week	
9th week: **Lecture: Kinetics of a rigid body II** Newton's laws and theorem of kinetics for rigid bodies (impulse-momentum, angular impulse-angular momentum and work-energy theorems). Special motion types: Rotating and swinging about an axis, rolling without slipping. **Practice:** Rigid body kinetics problems II	**10th week:** **Lecture:** Description and classification of vibratory motions and vibrating systems. Basic definitions and properties of vibratory motion. Investigation of the elements of vibrating systems: masses and inertial elements, flexible and damping elements. **Practice:** Reduction of masses. Replacement of rigid bodies by lumped masses. Reduction of springs and damping elements.

11th week:	12th week:
Lecture:	Lecture:
Investigation of the dynamic models. Two ways for the generation of motion equations: the D'Alembert's principle and the Lagrange equations of motion.	Investigation and properties of the free vibrations of single DOF undamped and damped systems. Solution of the homogenous motion equation.
Practice:	Practice:
Generating the equations of motion for single- and multiple degrees of freedom (DOF) systems.	Calculation problems related to the free vibrations of single DOF undamped and damped systems.
13th week:	14th week:
Lecture:	Lecture:
Investigation and properties of the forced vibrations of single DOF undamped and damped systems. Basic types of forced vibrating systems.	Multiple DOF systems: introduction, basic properties, natural frequencies and modes, modal transform and decoupling.
Practice:	Practice:
Calculation examples of several kinds of forced vibrations in case of single DOF undamped and damped systems.	Calculation problems related to the free and forced vibrations of multiple DOF undamped and damped systems.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance on the **lectures** is recommended, but not compulsory.

Participation at **practice** is compulsory. Student must attend the practices and may not miss more than three practices 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.

During the semester there are two tests: the mid-term test is in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

B, for grade:

The course ends in **mid-semester grade** 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.

Technical Mechanics Comprehensive Exam

Subjects of the comprehensive exam:

Statics, Strength of Materials, Dynamics and Vibration

Technical Chemistry

Code: MK3MKEMK04GX17

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 1st year/2nd semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+1

Topics:

Basic definitions in chemistry: atoms, molecules, elements, compounds, mixtures, chemical symbols, chemical formulas, relative atomic and molecular mass, molar mass, the laws of definite and variable proportions, chemical equations, the classification of chemical reactions. Atoms and the atomic theory. Electron configurations and the periodic table. Chemical bonds. States of matter: ideal gases the gas laws. Avogadro's and Dalton's laws. The kinetic molecular theory of gases. Real gases and their behaviour, the van der Waals equation. A liquid state and its properties. A solid state and its properties. Units of concentration. Ideal and real solutions.

Acids and bases. Chemical kinetics. The rate of a chemical reaction. Chemical technologies, modelling. The chemical basis of engineering materials such as cement, adhesives, polymers, fuels, metals and semiconductors.

Literature:

Required:

- Tom Holme, Larry Brown: Chemistry for Engineering Student, Publisher: Brooks Cole, Hardcover: 653 pages, 2006, Paperback ISBN-10: 0534389740.

Recommended:

- James O. Glanville: General Chemistry for Engineers, Preliminary Edition (Paperback) Paperback: 663 pages, Publisher: Prentice Hall; Prl edition, 2000, ISBN-13: 978-0130325143.
- Darrell Ebbing, Steven D. Gammon: General Chemistry (Hardcover) Publisher: Brooks Cole; 9 edition, 2007, 1030 pages ISBN-13: 978-06188574871.

Recommended textbook:

- John McMurry – Robert C. Fay: Chemistry 6th ed., Prentice Hall ISBN: 0321704959. Available in the MEDICINA bookstore in the theoretical building on the medical campus. Price: HUF 22,000.

Schedule

1st week Registration week	
2nd week: **Lecture:** Sciences and chemistry, Quantitative laws in chemistry, basic concepts of stoichometry **Practice:**	**3rd week:** **Lecture:** Characterization of macroscopic chemical systems, states of matter **Practice:**
4th week: **Lecture:** Solutions **Practice:**	**5th week:** **Lecture:** Thermochemistry **Practice:**
6th week: **Lecture:** Reaction rates **Practice:**	**7th week:** **Lecture:** Equilibrium **Practice:**
8th week: 1st drawing week	
9th week:	**10th week:** **Lecture:** Redox reactions

Lecture: Acid-base equilibriums, Heterogeneous equilibriums **Practice:**	**Practice:**
11th week: **Lecture:** The structure of atoms and nucleus **Practice:**	**12th week:** **Lecture:** Quantum mechanical model of the atom The chemical bond Structures and bonding in chemical systems **Practice:**
13th week: **Lecture:** Principles of determination a chemical structure **Practice:**	**14th week:** **Lecture:** Theoretical models of solid materials: band theory and its applications to metals. Superconductivity and its applications. Commercial methods of metal production. **Practice:**
15th week: 2nd drawing week	

Practices in blocks!

Week 1 (2 hours)

1. General rules of laboratory work and using of laboratory equipment

1.1. Laboratory work and safety training

1.2. Introduction to laboratory equipment

Week 2 (6 hours)

1. Determination of BOD (Biochemical Oxygen Demand) values for different water samples by OxiTop® IS 12 BOD measuring system (Starting of measurement).

2. Investigation of water samples by MultiLine P4 portable electroanalytical set

Week 3 (6 hours)

1. Determination of BOD (Biochemical Oxygen Demand) values for different water samples by OxiTop® IS 12 BOD measuring system (Finishing and evaluation of measurement).

2. Mass and volume measurement

2.1. Introduction into the mass measurements with the overview of the metric and SI units and introduction into the concepts of precision and accuracy

2.2. Introduction into the volume measurements with determination of hydrochloric acid solution's precise concentration by acid-base titration

Requirements

A, for a signature and lab grade:

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.

The Lab Manual is available to the students at the webpage of Dr. Ildikó Bodnár, the head of the Department of Chemical and Environmental Engineering: (http://www.eng.unideb.hu/kvt)

The weekly syllabus covers the particular topics and gives a full description of the experiments.

Each week the laboratory session begins or closes with a short test (no more than 20 minutes) based exclusively on the preparatory material of that week and the previous week and the results of the experiments carried out the previous week. There are two short tests (2. and 3. week) during the semester. Lab grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (average), 4 (good), 5 (excellent) calculated from as an average of the tests' results (the average of two short test) and measurement reports (the average of four measurement reports). The minimum requirement for the short tests is 50%.

B, for a grade:

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.

Subject group “Economics and Humanities” (for all 3 specializations)

Studies of Economy and Law

Code: MK3GAZJM04GX17_EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 2nd year, 1st semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

This unit aims to introduce the student to a study of the law in the business environment. It introduces sources of law and legal method, business organizations and legal relationships, contracts including the supply of goods and services, agency agreements and civil wrongs in the business environment including negligence.

Students will learn the principles of contract, consumer, and company law. Connections to real-world business situations will help students understand the relevance and importance of legal issues in business. Students will identify ethical questions in business, consider resolutions, and choose and defend a course of action. An understanding of the rights and responsibilities of organizations is an essential requirement in the study of business operations at home and those involved in international business transactions and trade.

Literature:

Compulsory:

- KENJI UCHINO, Entrepreneurship for Engineers (2009) ISBN-13: 9781439800638
- ROBERT MELLOR, Entrepreneurship for Everyone (2010) Student textbook ISBN-13: 9781412047756
- Robert W. Emerson: Business Law – Fifth Edition, Business Review Books, 2010.
- Study materials provided by the lecturer

Schedule

1st week Registration week	
2nd week: **Lecture:** The definition of the entrepreneurship. The meaning of insiders and outsiders and their interests. The definition of production and services.	3rd week: **Lecture:** The structure and the leading of the entrepreneurships, and companies.

Practice: The grouping of the entrepreneurship. Individual and social entrepreneurship.	**Practice:** Case study of an existing company, helping tge students to understand the forms of entrepreneurship.
4th week:	**5th week:**
Lecture: The organization and developing process of the entrepreneurship.	**Lecture:** The designing features of entrepreneurship.
Practice: A complex task is solved by using the lessons learned so far and the topics to be studied during the semester by understanding strategic examples.	**Practice:** The relationship between costs, expenses and expenditures through a concrete example..
6th week:	**7th week:**
Lecture: The economic features of the companies and entrepreneurships.	**Lecture:** The overview of financial accounting. Legal frameworks. The aim of accounting law (IFRS accounting, according to standards.
Practice:. Practical application of coverage analysis in a numerical example. The contact of the resource and capacity through exercises.	**Practice:** The annual report (financial statement IFRS). Balance structure, relationship with account classes. Structure of the profit and loss account and its relationship with the account classes.
8th week: 1st drawing week	**Midterm test I**
9th week:	**10th week:**
Lecture: The basic legal principles and guidelines. The sources of law, the actors of legal relationships.	**Lecture:** The most important features and legal rules of the legal person. The founding documents, the common rules of legal persons(entrepreneurships), the organization of legal persons.
Practice: The working and development of the law system and sources of law in practice.	**Practice:** Practical questions of legal persons in Hungarian and EU Law.
11th week:	**12th week:**
Lecture: The most important features and rules of contracts in Hungarian and EU Law. The rules of the freedom of the contracts.	**Lecture:** The modifying of the contract, the expiry of contracts, the breaching of a contract.
Practice: The freedom of contracts and the breaching of a contract in practice, while examining examples	**Practice:** Introducing special cases of contract modifying and expirying.
13th week:	**14th week:**
Lecture: Most important individual contracts in Hungarian and EU Law, especially sales contract, entrepreneurship	**Lecture:** The rules of tort law, introducing the the main legal solutions for compensation.

contract, employment contract, designing, engineering contract. **Practice:** The practical introduction of the individual contracts, explaining the common rules and the differences.	
15th week: 2nd drawing week, End-term test II.	

Requirements

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. During the semester there are two tests: the mid-term test on the 7th week and the end-term test on the 14th week. Students must sit for the tests. Solving team tasks on the exercises, pre-published themes for presentation.

B, for a grade:

Marks offered based on both test and team tasks, otherwise written exam.

Microeconomics

Code: MK3MIKRM04GX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 2nd year, 1st semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week: 1+2

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: Microeconomic processes, The basics of supply and demand. Market equilibrium. Elasticity of demand (supply). Consumer behaviour - Households' choices (Marginal utility theory, indifference (curve) analysis. Firm's production (factors), costs of production, profit-maximizing behaviour.

Market structures (perfect competition, imperfect competition: monopoly, oligopoly). Profit maximizing under perfect competition, and monopoly. Pricing rules. The value of money.

Literature:

Required literature:

- Besanko, David – Breautigam, Ronald R. (2014): Microeconomics. Fifth Edition (International Student version). John Wiley and Sons, Inc., New York, ISBN: 978-1-118-71638-0
- Besanko, David – Breautigam, Ronald R.: Microeconomics. Study Guide. Third Edition. John Wiley and Sons, Inc., New York, 2008.
- Judit T. Kiss (2015): Introduction to Microeconomics for Engineers and Technical Managers. Debrecen University Press. ISBN: 978-963-318-469-1.

or

- N. Gregory Mankiw – Mark P. Taylor (2011): Microeconomics, 2nd edition. South-Western Cenagage Lerrning.
- Gregory Mankiw (2006): Principles of Microeconomics - Study Guide. South-Western College Pub.

Recommended literature:

- Samuelson P.A., Nordhaus W.D.: Economics, 18th edition, Academic Internet Publishers Inc., 2006. ISBN: 0072872055
- Parkin, M., Powell, M. & Matthews, K. (2008) Economics. 7th ed. Harlow: Addison Wesley. ISBN-13: 9780132041225.

Schedule

1st week Registration week	
2nd week: Lecture: *Basic concepts of Economics and Microeconomics* Introduction to Microeconomics and Macroeconomics, models in Economics. Key analytical tools (Comparative statics, Equilibrium analysis, Constrained optimization). Efficiency and use of resources. Main economic problems. Practice: Case study examination	3rd week: Lecture: *Demand and supply* Demand curves, Supply curves; Market equilibrium. 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. Practice: Calculation exercises: equilibrium price and quantity; market demand and individual demand; shifts versus movements along the demand curve (supply curve).

4th week:

Lecture: *Consumer Behaviour*

Consumer theory, consumer preferences, Cardinal and ordinal approach. Total utility function, marginal utility function and calculation method. Principle of diminishing marginal utility. Relationship between individual and market demand functions. Consumer surplus. Ordinal ranking.

Practice: Calculation/team problems: marginal utility, relationship between total utility and marginal utility. Principle of diminishing marginal utility.

5th week:

Lecture: *Types of elasticity of demand*

Demand and supply together, market equilibrium. 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. Increase in total revenue. Taxes and elasticity.

Practice: Case study examination and calculation/team problems: Application of elasticity of demand. Energy and price elasticity. Types of goods (substitutes, complements, independents).

6th week:

Lecture: *Production*

Factors of production. Inputs, outputs and production function. Total product function. Technically efficient and inefficient. Marginal product of labour and average product of labour. Law of diminishing marginal returns to labour (capital).

Practice: Calculation/team problems; (average product of labour (capital), marginal product of labour (capital), relationship between marginal product and average product.

7th week:

Lecture: *Costs of production*

Costs of production. (Total, fixed and variable costs, marginal and variable cost). The relationship between marginal and average cost. Total revenue, total profit curves. Calculating problems (types of cost, relationship between cost and profit. opportunity cost).

Practice: Midterm test I

8th week: 1st drawing week

9th week:

Lecture: *Condition of profit maximization*

Main Condition of profit maximization under competitive market. Main characteristics of the competitive market. Marginal cost, average costs of production, profit-maximizing output, shut down and breakeven point, profit and loss. The competitive firm's supply curve.

Practice: Calculation/team problems: types of cost, relationship between cost and profit. The opportunity cost.

10th week:

Lecture: *Firm Behaviour*

Firms objectives. Stakeholder and shareholders of the firm. Key Performance indicators. Models of the firm's pricing decisions, costs estimation and decision. Sources of Cost efficiency. Economical analysis of investments.

Practice: Calculation/team problems: marginal cost, total, variable and fixed cost, average costs. Determination of the shut down and breakeven point.

11th week: Lecture: *Perfect and Imperfect competition* Monopoly (the profit-maximization condition; average revenue, marginal revenue, total revenue curves). Profit-maximization. Relationship between marginal revenue and linear demand curve). **Practice:** Calculation/team problems_ marginal average revenue, total revenue, average and marginal profit, profit-maximizing output, marginal cost curve and supply curve. Determination of the shut down and breakeven point.	12th week: Lecture: *Monopoly* Monopoly, perfect and monopolistic competition. Pricing decision - Price discrimination. The welfare cost of monopoly. Consumer and producer surplus. Deadweight loss. Monopsony. **Practice:** Calculation/team problems: Profit maximization condition (Monopoly), consumer and producer surplus. Relationship between marginal revenue and linear demand curve.
13th week: Lecture: *Imperfect competition* Strategic behaviour, market barriers. Main characteristics of oligopoly. Main characteristics of cartels, welfare and oligopoly. Products differentiation. **Practice:** Calculation/team problems: The monopoly equilibrium versus the perfectly competitive equilibrium.	14th week: **Lecture:** The markets for the factors of production. Taxes and efficiency. Earnings and discrimination. Game theory. Physical and human capital. Investment in capital. **Practice:** Calculation/team problems: Monopoly, perfect competition and oligopoly.
15th week: 2nd drawing week	

Requirements

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 7th 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 **examination.**

The minimum requirement of the mid-term, the end-term test and the teamwork is 50% separately. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

The grade is given according to the following table:

%	Grade
0-49	fail (1)
50-62	pass (2)
63-75	satisfactory (3)
76-89	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.

An offered grade: It may be offered for the students if the average of the mid-term test, end-term tests and the teamwork is at least good (4). The offered grade is the average of them.

Macroeconomics

Code: MK3MAKRM04GX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 2nd year, 2nd semester

Its prerequisite(s): Microeconomics

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 1+2

Topics:

This course is intended to help students to understand important macroeconomic issues such as macroeconomic processes, national income, fiscal policy, monetary policy, main characteristics of labour and money market. To introduce students to the fundamental context and terminology of economy at macro level, to introduce the main concepts and theories about economic science so that they become able to realize economic processes and relationships.

This course focuses on the theory and application of the following:

Measuring macroeconomic output (real vs. nominal Gross Domestic Product, Gross output, the problem of double counting). Consumption and Investment. Household and firm sector.

Investment multiplier. 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, the supply and the demand for money. Monetary policy. The integration of the goods and money market models. Aggregate demand and supply. Labour market. Unemployment and inflation. Economic growth and environmental awareness, energy efficiency and sustainable development.

Literature:

Required literature:

- Mankiw, Gregory: Principles of Economics. Fifth Edition. South-Western, Mason, USA, 2009. ISBN:9780324589979.
- Mankiw, Gregory (2015): Principles of Economics. Study Guide. Seventh Edition. Cengage Learning, ISBN-13:978-1-285-86421-1.
- Judit T. Kiss (2014): Introduction to Macroeconomics for Engineers and Technical Managers. Debrecen University Press. ISBN: 978-963-318-416-5.

Recommended literature:

- K. E. Case – R. C. Fair – S. M. Oster (2012): Principles of Macroeconomics, Tenth Edition. Prentice Hall, ISBN 13: 978-0-13-139140-6.
- Samuelson P.A., Nordhaus W.D.: Economics, 18th edition, Academic Internet Publishers Inc., 2006. ISBN: 0072872055
- Parkin, M., Powell, M. & Matthews, K. (2008) Economics. 7th ed. Harlow: Addison Wesley. ISBN-13: 9780132041225
- Parkin, M (2005) Economics, 7th edn, Addision Wersley: Pearson. ISBN: 0321248449.

Schedule

1st week Registration week

2nd week:

Lecture: *The Scope and Method of Macroeconomics*

The scope and method of macroeconomics. The difference between Microeconomics and Macroeconomics. Main macroeconomic problems. Models in Macroeconomics. The components of the Macroeconomics. The circular flow Diagram. Market sectors – commodity, money and labour market.

Practice: Calculation/team problems: Circular flow of income. Case study examination.

3rd week:

Lecture: *Measuring Macroeconomic Output*

Circular flow – market sectors. Output and Income. Price level, Consumer price index. Measuring macroeconomic output (Gross Output, Gross Domestic Product, calculating GDP, real versus nominal GDP, the components of the GDP, GDP deflator and Produce price index).

Practice: Calculation/team problems: measuring macroeconomic income and output.

4th week:

Lecture: *The Keynesian Theory – Aggregate demand*

Consumption function, marginal propensity to consume. Saving function, marginal propensity to saving. Economic role of investment, Mathematical and geometrical derivation of the equilibrium output. Investment multiplier, main influencing factors of investment. Derivation of investment – saving curve. IS curve.

Practice: Calculation/team problems: consumption and saving function, Investment multiplier.

5th week:

Lecture: *Government in the economy*

Government expenditures and revenues. Types of taxes, disposable income, government budget, determination of equilibrium output, fiscal policy, the government spending multiplier, the tax multiplier. Average tax rate, tax wedge, and marginal tax rate.

Practice: Calculation/team problems: the role of the government. Tax burden and tax multiplier.

6th week:

Lecture: *Open Economy*

Balance payments. International sector and aggregate planned expenditure. Equilibrium output in an Open Economy, net exports (exports and imports). Price Feedback and Trade Feedback effect. Openness of an economy. International trades.

Practice: Calculation/team problems: measuring openness of an economy. Case study examination.

7th week:

Lecture: *Money market*

The meaning of money, the functions of money, measuring the supply of money. The creation of money, required reserve ratio. Banking system, Commercial banking. The money multiplier. Open market operations. Fisher effect (nominal and real interest rate).

Practice: Mid-term test I.

8th week: 1st drawing week

9th week:

Lecture: *Money market*

The demand for money. Supply and demand in the money market. The equilibrium interest rate. Mathematical and geometrical derivation of the LM curve. The equilibrium output and price-level.

Practice: Calculation/team problems: The equilibrium output and price-level. Case study examination.

10th week:

Lecture: *The aggregate demand and aggregate supply*

Aggregate demand curve and aggregate supply curve. Movements along the demand and supply curve, shift in aggregate demand, the Equilibrium. The IS-LM model. Changes in Fiscal and Monetary policy.

Practice: Calculation/team problems: Equilibrium analysis.

11th week:

Lecture: *The labour market*

12th week:

The demand for labour, the supply of labour. The labour force, working-age population, active and inactive population, labour participation rate. Supply curve and demand curve, equilibrium. Employed population. **Practice:** Calculation/team problems: Supply of labour function and demand for labour function, equilibrium analysis.	Lecture: *Main macroeconomic problems - Unemployment* Measurement of Unemployment, the unemployment rate, the employment and activity rate. Types of unemployment (voluntarily and involuntarily unemployment; structural, frictional and cyclical unemployment), Okun law. **Practice:** Calculation/team problems: measurement of unemployment. Case study examination.
13th week: Lecture: *Main macroeconomic problems - Inflation* Inflation; (Price level, inflation rate, definition and measuring of inflation, types and causes of inflation, moderate, galloping and hyperinflation, demand side and supply side inflation, The relationship between unemployment rate and inflation rate – Philips curve). **Practice:** Case study examination and team problems: Reasons for inflation, Philips curve.	**14th week:** **Lecture:** Growth (sources of economic growth, human capital, investment in human capital), Economic growth, Welfare and Sustainable development. Population and poverty. **Practice:** Calculation/team problems
15th week: 2nd drawing week	

Requirements

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 7th 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 **examination.**

The minimum requirement of the mid-term, the end-term test and the teamwork is 50% separately. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

The grade is given according to the following table:

%	Grade
0-49	fail (1)
50-62	pass (2)
63-75	satisfactory (3)
76-89	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.

An offered grade: It may be offered for the students if the average of the mid-term test, end-term tests and the teamwork is at least good (4). The offered grade is the average of them.

Basics of Engineering Management

Code: MK3MENMO4GX17-EN

ECTS Credit Points: 4

Year, Semester: 3 year, 1 semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

The aim of the course is to provide students with a comprehensive picture of the organization's operations and the associated management and organizational roles and tasks. Additionally, providing training that contributes to the successful employment of students

Literature:

Compulsory:

1. James C. Collins: Good to Great: Why Some Companies Make the Leap...and Others Don't, HarperBusiness, 2001
2. P. Hawken: Growing a Business, Simon and Shuster, 1988

Schedule

1st week Registration week	
2nd week:	3rd week:

Lecture: The company's core resources and processes **Practice:** Case study	**Lecture:** The company as an organization **Practice:** Case study
4th week: **Lecture:** Management functions, manager roles, tasks **Practice:** Case study	**5th week:** **Lecture:** Organization theory **Practice:** Case study
6th week: **Lecture:** Theoretical basics of management methodology **Practice:** Case study	**7th week:** **Lecture:** Flow of information in the organization **Practice:** Communication training
8th week: 1st drawing week	
9th week: Motivational Fundamentals, Motivation Theories **Lecture:** Training **Practice:** Integration model	**10th week:** **Lecture, practice:** Organizational culture
11th week: **Lecture:** Human resource management **Practice:** CV, interview techniques, training plan	**12th week:** **Lecture:** Conflict Management **Practice:** Training
13th week: **Lecture:** Stress management **Practice:** Training	**14th week:** **Lecture:** Time Management **Practice:** Training
15th week: 2nd drawing week	

Requirements

A, for a signature:

Participation at lectures is compulsory. Students must attend lectures and may not miss more than three of them during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at lectures will be recorded by the lecturer. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed lectures must be made up for at a later date, being discussed with the tutor.

Students have 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
Close fail (2)	40-50
Improvement needed (3)	51-60

Very good (4)	61-70
Excellent (5)	71-80

If somebody fails then he 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:

For their exam everybody will get an exam grade. 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).

Subject group "Professional Subjects" (for all 3 specializations)

Engineering Informatics I.

Code: MK3INF1A04GX17-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

History of computers, Number systems, number representations, bit, byte, ASCII, Unicode, Hardware, CPU, I/O, Operating systems (BIOS, DOS…), Network architectures (topologies, router, gateway, DNS, IP address), Internet security (https, digital signature…), Databases (basic concepts, database model,DBMS …), Databases (SQL) , Data structures (datatypes, array, list, stack, tree…), Algorithms (sorting, searching…), Computer programming (history of programming, programming languages, Pseudo code, flowchart, development models), Computer programming (variable declarations, datatypes (C), control structures, loops…)

Literature:

Compulsory:

- Microsoft Excel 2016 Bible: The Comprehensive Tutorial Resource
- Microsoft Access 2016 Bible: The Comprehensive Tutorial Resource

Schedule

1st week Registration week

2nd week:

Lecture: History of computers

Practice: Excel 1.

Introducing Excel.

Basics concepts and functionalities:

- Parts of the user interface (workbook, worksheet, cell, range…)
- Entering and editing data, data types.
- Fill a Range with Series.

Basic functions:

- SUM, AVERAGE, COUNT, COUNTA, COUNTIF, MIN, MAX

Trigonometric functions:

- SIN, COS, TAN, PI, RADIANS

Logical functions:

TRUE, FALSE, AND, OR

3rd week: Excel 2.

Lecture: Number systems, number representations, bit, byte, ASCII, Unicode

Practice: Formatting and editing Worksheet:

- Font type and size.
- Align Text.
- Number Format.
- Column With, Row Height.
- Borders.
- Wrap Text.

AutoSum functionality.

Conditional formatting.

4th week: Excel 3.

Lecture: Hardware, CPU, I/O

Practice: Formulas:

- Building Formulas.
- Move or copy a Formula.
- Reference another Range in a Formula.
- Naming groups of data.

Conditional and database functions:

- IF, SUMIF, CHOOSE
- VLOOKUP, HLOOKUP

5th week: Excel 4.

Lecture: Operating systems (BIOS, DOS…)

Practice: Analyzing data:

- Ordering, summarizing, a range.
- Filter a Range.

Summarize data with subtotals.

6th week: Excel 5.

Lecture: Network architectures (topologies, router, gateway, DNS, IP address)

Practice: Graphical representation in Excel:

- Creating Charts.
- Chart types.
- Chart Elements.

7th week: Excel 6.

Lecture: Internet security (https, digital signature…)

Practice: Practice for the test.

• Format and customize Excel Charts.	
8th week: 1st drawing week: Excel test	
9th week: Acces 1. **Lecture:** Databases (basic concepts, database model,DBMS …) **Practice:** Database basics, relational database model Tables, records, fields, keys, primary keys, indexes. Relationship between tables, relationship types. Design and create a database from a dataset.	**10th week: Acces 2.** **Lecture:** Databases (SQL) **Practice:** User interface of the software. Database manipulation: • Create a new database. • Data types. • Create and import tables. • Insert, delete, update records, fields. Create relation between tables, referential Integrity.
11th week: Acces 3. **Lecture:** Data structures (datatypes, array, list, stack, tree…) **Practice:** Data manipulation: Format. Input masks. • Fast finding, filtering, and sorting data. SQL basics. Select query: • WHERE, AND, OR, ORDER BY, GROUP BY	**12th week: Acces 4.** **Lecture:** Algorithms (sorting, searching…) **Practice:** Queries: • Crosstab • Make table • Append • Update • Delete Calculated fields. Summarizing data.
13th week: Acces 5. **Lecture:** Computer programming (history of programming, programming languages, Pseudo code, flowchart, development models) **Practice:** Forms. Reports.	**14th week: Acces 6.** **Lecture:** Computer programming (variable declarations, datatypes (C), control structures, loops…) **Practice:** Practice for the test.
15th week: 2nd drawing week: Acces test	

Requirements

A, for a signature:

- participation on the practices,
- at least satisfactory result on both midterm tests.

B. Requirements for the grade:

- same as above,
- final grade = average of the two grades of the midterm tests.

Engineering Informatics II.

Code: MK3INF2A04GX17-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 1st year, 2nd semester

Its prerequisite(s): Engineering Informatics I

Further courses are built on it: Yes/No (for Automotive Production Process Control spec.)

Number of teaching hours/week (lecture + practice): 0+3

Topics:

C programming language (Windows), Basics (development environment, compiler), Types, operators, and terms, Control structures, Functions and program structures, Pointers and arrays, Structures, I/O

Literature:

Compulsory:

- B. W. Kernighan - D. M. Ritchie : The C programming language
- C.L. Tondo – S.E. Gimpel : C answer book

Schedule

1st week Registration week	
2nd week: **Practice:** C programming language (Windows)	**3rd week:** **Practice:** Basics (development environment, compiler)
4th week: **Practice:** Types, operators, and terms	**5th week:** **Practice:** Types, operators, and terms
6th week: **Practice:** Control structures	**7th week:** **Practice:** Control structures
8th week: 1st drawing week	
9th week: **Practice:** Functions and program structures	**10th week:** **Practice:** Functions and program structures
11th week:	**12th week:**

Practice: Pointers and arrays	**Practice:** Structures
13th week:	**14th week:**
Practice: I/O	**Practice:** I/O
15th week: 2nd drawing week: Test	

A, for a signature:

- participation on the practices,
- at least satisfactory result on both midterm tests.

B. Requirements for the grade:

- same as above,
- final grade = average of the two grades of the midterm tests.

Descriptive Geometry

Code: MK3ABRAA04GX17-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 0+3

Topics:

Descriptive geometry is a branch of geometry in which the three-dimensional figures (spatial objects) are represented on a plane using one of projecting methods and we must solve some geometrical problems of them in the image plane. The consisting positions, intersecting positions, metrical problems will be investigated.
Introduction to the Monge's method of projecting, projection of the space-elements. Points and lines in the plane. Intersection of a line with the plane. Intersection of two planes. Method of the replacing image-planes (transformation of views). Metric tasks. New views of a polyhedron (using transformation). Intersection of the polyhedrons with lines and planes. Intersection of two polyhedrons. Curved surfaces

Literature:

Compulsory:

- Church, A. E.: Elements of Descriptive Geometry, American Book Company, University of Michigan
- Ledneczky, P.: Descriptive Geometry I., BUTE
- Pare, E. G.,- Loving, R. O. - Hill, I. L. - Pare, R. C.: Descriptive Geometry, Amazon

Schedule

1st week Registration week	
2nd week:	3rd week:
Practice: Axonometry, perspective; Introduction to multiview projection	Practice: Introduction to the Monge's method of projecting Projection of the space-elements (points, lines, segments, planes), Relative position of two straight lines, Special positions of a straight line to image planes, Special positions of the planes to the image planes
4th week:	5th week:
Practice: Points and lines in the plane Line in a plane, point in a plane First mainline and second mainline in a plane Point in a first/second projecting plane	Practice: Intersection of a line with the plane Intersection of a line with the projecting plane Intersection of a line with the plane (in general position). Visibility
6th week:	7th week:
Practice: Intersection of two planes The intersection line of projecting planes The intersection line of planes, if one of them is in projecting position Intersection line of two planes	Practice: Method of the replacing image-planes (transformation of views) Introduction of new image planes, the method of the replacing of an image plane with a new plane
8th week: 1st drawing week	
9th week:	10th week:
Practice: Metric tasks I. Determining distances and angles of the objects Distance between two points. Lenght of the line-segment. Distance from a point to a plane. Distance from a point to a line. Angle of inclination of a line to the image-planes. Angle formed by two planes.	Practice: Metric tasks II. Determining distances and angles of the objects Distance between two parallel lines. Distance between two skew lines. Distance between two parallel planes. Angle formed by two lines.

Perpendicularity	
11th week:	**12th week:**
Practice: Intersection of the polyhedrons with lines and planes Prisms and pyramids	**Practice: Intersection of two polyhedrons I.** Intersection of prisms and pyramids
13th week:	**14th week:**
Practice: Intersection of two polyhedrons II. Intersection of prisms and pyramids	**Practice: Curved surfaces** (Cylinders, Cones, Spheres) Intersection of the Curved surfaces with planes. Development of a curved surfaces and intersections, Kochanski's Approximation.
15th week: 2nd drawing week	

Requirements

A, for a signature: Regular attendance (Minimum 70 %). Successful accomplishment of three drawings.

B, for grade: Grades will be a composite of homework (30%), mid-term test (35%), end-term test (35%). The homework will be issued five times in the semester. Minimum requirements to pass the semester: Successful accomplishment of the drawings and tests (Minimum 50%).

Technical Drawing and Basics of CAD

Code: MK3GEPRG05GX17-EN

ECTS Credit Points: 5

Evaluation: mid-semester grade

Year, Semester: 1. year, 2. semester

Its prerequisite(s): MK3ABRAA04GX17

Further courses are built on it: Yes

Number of teaching hours/week (lecture + practice): 2+3

Topics:

Students get acquainted with basic rules of preparation of technical documentation. They acquire the specifications and get routine in preparation and application of technical drawings. They get acquainted with CAD systems, and get routine in the use of AutoCAD software.

Drawing standards, formal requirements of machine drawings. Drawing sheet dimensions, line types and thickness groups. Projection views, sections and sectional views, revolved- and removed sections. Drawings of standardized machine elements: threads and thread symbols, bolted joint, gears, sprocket-wheel, splined shaft, bearings. Representation of welded joints. General prescriptions for dimensioning. Conventional dimensioning methods. Tolerance system. Defining fits: clearance, transition and interference fit. ISO Tolerance system. Form and position tolerances. Defining the surface roughness.

General properties of AutoCAD. Utilization of commands, menu bar options and icons. The layer-system of the AutoCAD, operations with layers. Use of outer references and blocks. Dimensioning possibilities, building up dimensional chains, representation of tolerances.

Literature:

Compulsory:

- Tiba Zsolt, Machine drawing, Debreceni Egyetemi Kiadó – Debrecen University Press, 2013
- Learning AutoCAD 2010, Autodesk Official Training Guide Edition, 2010

Recommended:

- Flender, Technical Handbook
- Szerkesztési atlasz. Szerk.: Nagy Géza. GTE. Budapest, 1991

Schedule

1st week Registration week	
2nd week: **Lecture:** Drawing standards, formal requirements of machine drawings. Drawing sheet dimensions, title block, defining the line types and thickness groups. Standardized letter and figure shape and sizes, scales, full size, reduction scales, enlarged scales. **Practice:** issuing the task 1: Lettering	**3rd week:** **Lecture:** Defining the surfaces of a part. Views, auxiliary view, local view, sectional views and sections. Complex sectional views, removed sections, specific sectional views and sections. **Practice:** issuing the task 2: Drawing Machine Parts. Practicing the presentation methods. Introduction of CAD systems, general properties of AutoCAD.
4th week: **Lecture:** General prescriptions for dimensioning, choosing basis surfaces. Conventional dimensioning methods.	**5th week:** **Lecture:** ISO Tolerance system. Basic size, actual size, limits, deviations, fundamental deviation. Defining the tolerance IT grades.

Specific dimensioning, defining and giving conical taper and flat taper **Practice:** submitting the task 1 and 2, issuing the task 3: Shaft drawing. Practicing the presentation methods. User interface of AutoCAD. Utilization of commands, menu bar options and icons.	**Practice:** Applying the dimensioning methods to dimensioning parts. "Modify" commands in AutoCAD. Effect of constructional commands on efficiency.
6th week:	**7th week:**
Lecture: Hole-base system, shaft base system. Defining fits: clearance, transition and interference fit. **Practice:** submitting the task 3, issuing the task 4: Designing Fitting Pieces. Applying the cutting plane and the cutting sphere method to construct the intersection lines of interpenetrating surfaces. The layer-system of the AutoCAD, operations with layers.	**Lecture:** ISO Tolerance system. Form and position tolerances. Free dimensional tolerance. **Practice:** Designing Fitting Pieces. Applying the triangulation and parallel line methods to develop fitting pieces. Representing tolerances and calculating its dimensions. Insertion of texts in AutoCAD. Loading and modification of letter types.
8th week: 1st drawing week	
9th week:	**10th week:**
Mid-term test **Lecture:** Defining the surface roughness. Feasible roughness with different processing methods. Correlation between the surface roughness and the IT grade of dimension. **Practice:** elaborating the shop drawing of pattern development of fitting pieces. Hatching, loading of styles, indication of areas to hatch in AutoCAD.	**Lecture:** Standardized Thread forms and its main features. Threads and thread symbols in drawing. Threaded joints: bolted joint, studded joint, screw fastening. **Practice: :** submitting the task 4, issuing the task 5: Screw Fastening and Joints. Presentation of tolerances and fits in drawing. Presentation of surface roughness in drawing. Use of outer references and blocks in AutoCAD.
11th week:	**12th week:**
Lecture: springs: standardized representation of helical spring, Belleville spring, buffer spring, annular spring, multi-leaf spring. Keyed joints with saddle keys,	**Lecture:** Gears and toothed parts. Spur and helical gears, bevel gears, worms, rack and pinion gears, sprockets.

sunk keys, parallel keys and woodruff keys. Splined shaft joint. **Practice:** elaborating the task 5, Drawing threaded joints in section and on view. Dimensioning possibilities in AutoCAD, building up dimensional chains, representation of tolerances.	**Practice:** issuing the task 6: Gearing. Drawing keyed joints and splined shaft joint in section and on view. Drawing in AutoCAD.
13th week: **Lecture:** rolling bearings: ball and roller bearings. Riveted joints. Welding symbols and welded joints: butt joint, lap joint, tee joint, corner joint. **Practice:** submitting the task 5, elaborating task 6. Drawing in AutoCAD.	**14th week:** **Lecture: End-term test** **Practice:** submitting the task 6. Drawing bearings, riveted and welded joints in section and on view. Drawing in AutoCAD.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance on the **lectures** is recommended, but not compulsory.

Participation at **practice** is compulsory. Student must attend the practices and my not miss more than three practice during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Student can't make up a practice with another group. The attendance on practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments for the course with them to each practice. Active participation is evaluated by the teacher in every class. If student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate their participation as an absence due to the lack of active participation in class.

Students have to **submit all the six drawing tasks** made manually as well as with AutoCAD as scheduled minimum on a sufficient level.

During the semester there are two tests: the mid-term test is in the 9th week and the end-term test in the 14th week. Students have to sit for the tests.

B, for grade:

The course ends in **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:

- average grade of the six drawing tasks
- average grade of the two tests

The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

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

CAD Systems

Code: MK3CADRG04GX17-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 2nd year, 1st semester

Its prerequisite(s): Technical Drawing and Basics of CAD

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 0+3

Topics:

Computer aided product development. Product Lifecycle system. Introduction to parametric modelling systems. Properties of parametric modelling. Creating profiles and sketches (sketch, drawing tools, geometrical and dimensional constraints). Using features (protusion, revolved protusion, holes, 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 part and assembly families. Importing standard parts.

Literature:

Compulsory:

- https://www.ptc.com/en/cad/creo
- www.solidedge.com
- Getting Started with Solid Edge Version 20, ©2007 UGS Corp.

Schedule

1st week Registration week	
2nd week: Lecture: Practice: Computer aided product development. Product Lifecycle system. Introduction to parametric modelling systems. Properties of parametric modelling. Solid part creation.	3rd week: Lecture: Practice: Creating profiles and sketches (sketch, drawing tools, geometrical and dimensional constraints).
4th week: Lecture: Practice: Usage of features I.: protrusion, revolved protrusion. Practical examples.	5th week: Lecture: Practice: Usage of features II.: cutout, revolved cutout. Practical examples.
6th week: Lecture: Practice: Usage of features III.: holes, chamfers, fillets. Practical examples.	7th week: Lecture: Practice: Usage of features IV.: creating ribs, web networks, thin wall, patterns. Practical examples. 1st test.
8th week: 1st drawing week	
9th week: Lecture: Practice: Assembly designing. Creating relationships between assembly components. Practical examples.	10th week: Lecture: Practice: Exploding assemblies. Rendering and animating. Practical examples.
11th week: Lecture: Practice: Creating technical drawing. Usage of drawing view wizard. View generation from parts. Practical examples.	12th week: Lecture: Practice: Cutting planes, section views generation. Practical examples.

13th week:	14th week:
Lecture:	Lecture:
Practice: Creating part lists. Handling of engineering symbols (weld symbol, surface texture symbol, feature control symbol). Practical examples.	Practice: Dimensions, handling of special characters. Smart dimensions. Practical examples. 2nd test.
15th week: 2nd drawing week	

Requirements

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 1st test in the 7th week and the 2nd test in the 15th week. Students have to sit for the tests.

B, for 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 table:

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.

Machine Elements I.

Code: MK3GEP1G05GX17-EN

ECTS Credit Points: 5

Year, Semester: 2nd year, 2nd semester

Its prerequisite(s): MK3SZILG04GX17, MK3CADRG04GX17

Further courses are built on it: Yes

Number of teaching hours/week (lecture + practice): 3+2

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.

Literature:

Compulsory:

- TIBA ZS.: Machine Drawing, Debrecen University Press 2010. ISBN 978-963-318-066-2,
- Joseph Shigley, Charles Mischke, Richard Budynas: Mechanical Engineering Design, 7th Edition Hardcover with access card, 1056 pages©2004, ISBN-13 9780072921939
- Ansel Ugural, NEW JERSEY INSTITUTE TECH: Mechanical Design: An Integrated Approach, 1st Edition Hardcover with access card, ©2004, ISBN-13 9780072921854

Recommended:

- Tiba Zsolt: Drivetrain Optimization, Lambert Academic Publishing, 2016. (ISBN:9783659859274)

Schedule

1st week Registration week	
2nd week:	3rd week:

Lecture: Requirements against components, stressing theories. **Practice:** issuing task 1: Designing a welded machinery base.	**Lecture:** Theory of a fatigue failure, designing a simple and a combined fluctuating load. Goodman diagram, Smith diagram. **Practice:** Scathing different constructions for a welded base. Measuring the dimension of parts, calculating the tolerance and fit dimensions.
4th week:	**5th 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. **Practice:** Design of welded constructions. Dimensioning a welded base. Determining the friction coefficient in a bolted joint by measurement.	**Lecture:** Riveted joints. Welded joints, strength of a butt and lap joint subjected to a constant load, a fatigue load and an eccentric load. **Practice:** Constructing a welded base. Dimensioning the position of the frame parts, prescribing the welded joints. Dimensioning the hole system of the prime mover and machine. Dimensioning the hole system of the frame fixing to the floor.
6th week:	**7th week:**
Lecture: Positive and frictional torque transmitting connections. Torque capacity of keyed joints, spline joints, clamped joints. **Practice:** Submitting a welded base design. Issuing a hydraulic cylinder designing task.	**Lecture:** Seals, operation principles. Contacting and non -contacting seals and their application fields. **Practice:** Studying the operation method of a hydraulic cylinder, determining its main dimensions.
8th week: 1st drawing week	
9th week:	**10th week:**
Lecture: Springs, tasks and operation principles of springs. Stressing of bar springs, leaf springs, multi-leaf springs, Belleville springs. **Practice:** Sketching different constructions for a piston, a cap and a cover regarding sealing.	**Lecture:** Helical springs, designing and stressing for a fatigue load. **Practice:** Sketching different constructions for a piston, a cap and a cover regarding sealing, studying similar constructions. Determining a spring diagram by measuring.
11th week:	**12th week:**
Lecture: Rubber springs, features and spring diagrams. Designing and stressing	**Lecture:** Bearings, lubrication principles and methods. Heat balance and application fields of journal bearings.

block and cylindrical rubber springs for compression, shear and torsion load. **Practice:** Constructing the assembly drawing of a hydraulic cylinder.	**Practice:** Constructing the assembly drawing of the hydraulic cylinder.
13th week: **Lecture:** Rolling bearings, features of different types of bearings. Separable, non separable bearings, bearing clearances (initial, mounting, working). **Practice:** Elaborating the shop drawings of the parts: a piston, a piston rod, a head, and a cover.	**14th week:** **Lecture:** Bearing arrangements. Locating, non locating bearing arrangement. Cross located bearing arrangements with adjusted or floating bearings. Selection of ball and roller bearings for service life. **Practice:** Elaborating the records of stressing and design.
15th week: 2nd drawing week	

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. 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 grade:

The course ends in an **examination**. Based on the average of the grades of the designing tasks and the examination, the exam grade is calculated as an average of them:

- the average grade of the two designing tasks
- the result of the examination

The minimum 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 students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

Machine Elements II.

Code: MK3GEP2G05GX17-EN

ECTS Credit Points: 5

Evaluation: exam

Year, Semester: 3rd year, 1st semester

Its prerequisite(s): Machine Elements I

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

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.

Literature:

Compulsory:

- TIBA ZS.: Machine Drawing, Debrecen University Press 2010. ISBN 978-963-318-066-2,
- Joseph Shigley, Charles Mischke, Richard Budynas: Mechanical Engineering Design, 7th Edition Hardcover with access card, 1056 pages©2004, ISBN-13 9780072921939
- Ansel Ugural, NEW JERSEY INSTITUTE TECH: Mechanical Design: An Integrated Approach, 1st Edition Hardcover with access card, ©2004, ISBN-13 9780072921854

Recommended:

- Tiba Zsolt: Drivetrain Optimization, Lambert Academic Publishing, 2016. (ISBN:9783659859274)

Schedule

1st week Registration week	
2nd week: **Lecture:** Energy equilibrium of braking processes. A mechanical model of a winch crane. **Practice:** Issuing task 1: Designing an external double-shoe thruster released a drum brake.	**3rd week:** **Lecture:** Calculation of an external shoe drum brake, a serviceable diagram. Designing a brake spring and choosing its thruster. **Practice:** Scathing different constructions for brake actuation.
4th 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. **Practice:** A service diagram of a brake: maximum brake moment, maximum drum speed, checking for heat generation. Designing the brake spring, selecting the brake thruster.	**5th week:** **Lecture:** Designing steps of an external shoe thruster released drum brake. **Practice:** Constructing a brake assembly drawing.
6th week: **Lecture:** Couplings, rigid couplings, flexible couplings, universal joints. Supplementary loads on shafts having misalignment. **Practice:** Submitting a brake design. Issuing a counter drive designing task.	**7th 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. **Practice:** Designing the layout of a counter drive. Dividing the total speed ratio for a belt drive and for a chain drive.
8th week: 1st drawing week	
9th week: **Lecture**: A chain drive. Types and application fields of chains, chordal action. Designing a chain drive, selecting a chain from brand catalogue. **Practice:** Designing a belt and a chain drive of a counter drive.	**10th week:** **Lecture:** A shaft and its associate parts. Designing a shaft and stressing against fatigue, plastic deformation, elastic deflection and critical speed. **Practice:** Designing a counter shaft and its keyed joints. Stressing a shaft and checking against fatigue and plastic deformation.

11th week: **Lecture:** Gears, types of gears. Nomenclature of a spur gear. Involving gears. A standard basic rack tooth profile. **Practice:** Designing a counter shaft bearing. Selecting ball bearings.	**12th week:** **Lecture:** Unmodified, modified gear pairs, addendum modification. **Practice:** Constructing an assembly drawing of a counter drive.
13th week: **Lecture:** Definition of a modified gear's dimensions. Checking gears for crest width, contact ratio and undercut. **Practice:** Elaborating an assembly drawing. Designing a chain drive chasing.	**14th week:** **Lecture:** Load bearing capacity of a gear. Resistance to pitting, tooth root bending. **Practice:** Elaborating the shop drawing of the parts: a shaft, a pulley, a sprocket, a bearing house.
15th week: 2nd drawing week	

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. 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 grade:

The course ends in an **examination**. Based on the average of the grades of the designing tasks and the examination, the exam grade is calculated as an average of them:

- the average grade of the two designing tasks
- the result of the examination

The minimum 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 students if the average grade of the two designing tasks is at least good (3) and the average of the mid-term and end-term tests is at least good (3). The offered grade is the average of them.

Materials Engineering

Code: MK3ANISG05GX17-EN

ECTS Credit Points: 5

Year, Semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses are built on it: Yes

Number of teaching hours/week (lecture + practice): 3+1

Topics:

The structure and composition of a material, including the types of atoms and their arrangement, as viewed over a range of length scales (nano-, micro-, meso-, and macro-scale). The 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, and magnetic).Calculation tasks for crystalline systems, phase diagrams, transformation diagrams.

Literature:

Compulsory:

- William D. Callister, David G. Rethwisch: Fundamentals of materials science and engineering : SI version, John Wiley and Sons, 2013., ISBN 978 1 118 32269 7

Recommended:

- ASM Handbook, Vol. 3: Alloy Phase Diagrams, ASM International, 1992., ISBN-10: 0871703815

Schedule

1st week Registration week	
2nd week: **Lecture:** Introduction to material science. The classes and functions of materials and their properties. **Practice:** Overview of periodic system.	3rd week: **Lecture:** Production of metals. Chemical reactions during the production of iron. Steel, aluminium and copper production. **Practice:** Classification of steels and cast iron.
4th week: **Lecture:** Crystal structures. Crystalline and noncrystalline materials. Imperfections in solids. Defects type: point, line, bulk, surface. **Practice:** Crystallographic points, directions, and planes	5th week: **Lecture**: Mechanical properties of metals. Concepts of stress and strain. Elastic, plastic deformation. **Practice:** Tension Tests. Computation of Load to produce specified diameter change.
6th week: **Lecture:** Dislocations and strengthening mechanisms. Mechanisms of strengthening in metals **Practice:** Failure: fracture, fatigue, creeps.	7th week: **Lecture:** Phase diagrams. Basic concepts, binary and multi-component systems, the Gibbs phase rule. Development of microstructure in isomorphous alloys. **Practice:** Determination of phase amounts, Lever rules, types of phase diagrams
8th week: 1st drawing week	
9th week: **Lecture:** Development of microstructure in iron–carbon alloys. **Practice:** Determination of iron – iron carbide phase diagram.	10th week: **Lecture:** Types of metal alloys. Classification scheme for the various ferrous alloys and alloying elements. **Practice:** Structure of alloyed steels
11th week: **Lecture:** Phase transformations: Microstructural and Property Changes in Iron–Carbon alloys. **Practice:** TTT diagrams - Microstructural Determinations for Isothermal Heat Treatments	12th week: **Lecture:** Structures, characteristics, applications and processing of polymers. **Practice:** Production and design of ceramics
13th week:	14th week:

Lecture: Structures, characteristics, applications and processing of polymers.	**Lecture:** The classes and functions of composite materials and their properties.
Practice: Production and design of polymers.	**Practice:** Production and design of composites
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance on the lectures is recommended, but not compulsory. Participation at practice is compulsory. Student must attend the practices and 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.

During the semester there are two tests: the mid-term test is in the first drawing week and the end-term test in the 2nd drawing week. Students have to sit for the tests. If the score of any test is below 60%, the student once can take a retake test covering the whole semester material.

B, for grade:

The course ends in a state 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)

Materials Technology and Testing

Code: MK3ANTVG05GX17-EN

ECTS Credit Points: 5

Year, Semester: 1st year, 2nd semester

Its prerequisite(s): Materials Engineering

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+3

Topics:

Definition and classification of technological processes applied for engineering materials. Basic principles of heat treatment. Hardening, tempering, annealing. Surface heat treatment (case hardening), thermo-chemical treatment (nitriding). Joining technologies and their applications. Classification of welding, the major welding technologies. Heat sources, filler materials, machines for different welding technologies. Arc-welding processes, resistance welding, pressure welding, high energy welding, etc. The fusion welded joint. Application fields of the various welding processes. Material testing. Destructive testing methods 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). Metallography and relevant testing methods.

Literature:

Compulsory:

- William D. Callister, David G. Rethwisch: Fundamentals of materials science and engineering : SI version, John Wiley and Sons, 2013., ISBN 978 1 118 32269 7
- Hellier, Chuck: Handbook of Nondestructive Evaluation, 2nd Edition McGraw-Hill, 2012, ISBN 9780071777148
- Mikell P. Groover: Principles of modern manufacturing : SI version, Wiley, 2013, ISBN: 9781118474204
- James L. McCall, William M. Mueller ed.: Metallographic specimen preparation: optical and electron microscopy, Springer, 2012, ISBN 9781461587101

Schedule

1st week Registration week	
2nd week: Lecture: Introduction to manufacturing and manufacturing processes. Production Systems Practice: Introduction to safety laboratory work. Introduction to basic welding processes.	3rd week: Lecture: Overview of Welding Technology. The Weld Joint. Physics of Welding. Features of a Fusion-Welded Joint. Types of Arc welding: Practice: Are welding
4th week:	5th week:

Lecture: Energy Beam welding. (laser, electron beam, plasma) Oxyfuel gas welding. Solid state welding. Resistance Welding	**Lecture**: Other Fusion-Welding Processes. Solid-State Welding. Weld Quality. Weldability. Machines of welding technology.
Practice: Oxyfuel gas welding.	**Practice:** Gas tungsten arc welding (GTAW)
6th week:	**7th week:**
Lecture: Direct Hardening: Annealing methods: full annealing, stress relief annealing. Austenitizing and quench, selective hardening.	**Lecture:** Surface heat treating process: carburizing, nitriding, carbonitriding. Equipment for heat treating operations
Practice: TTT diagrams - Microstructural determinations for isothermal heat treatments	**Practice:** Heat treating method for steel.
8th week: 1st drawing week	
9th week:	**10th week:**
Lecture: Destructive testing methods: Mechanical properties of metals. Concepts of stress and strain. Elastic, plastic deformation.	**Lecture:** Destructive testing methods: Comparison of materials harnesses. The difference between the theoretical and practical strength of the materials and their reason.
Practice: Tensile Testing. Computation of Load to produce specified diameter change.	**Practice:** Hardness test methods.
11th week:	**12th week:**
Lecture: Charpy impact test. Crack theory: Fracture mechanism, Failures.	**Lecture:** Metallographic examination of metals. Interpretation of metals microstructure. Specimen preparation process.
Practice: Charpy impact tests.	**Practice:** Optical microscopy investigations.
13th week:	**14th week:**
Lecture: Non-destructive testing methods: visual, radiographic, ultrasonic, magnetic, eddy current, dye penetrant, acoustic emission.	**Lecture:** Microscopic Examinations: Scanning electron microscopy, EDS-Energy Dispersive Spectroscopy
Practice: Non-destructive testing.	**Practice:** SEM examination.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance on the lectures is recommended, but not compulsory. Participation at practice is compulsory. Student must attend the practices and not miss more than three practices 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.

During the semester there are two tests: the mid-term test is in the first drawing week and the end-term test in the 2nd drawing week. Students have to sit for the tests. If the score of any test is below 60%, the student once can take a retake test covering the whole semester material.

B, for grade:

The course ends in a state 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)

Manufacturing Processes I.

Code: MK3GYT1G04GX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 2nd year, 1st semester

Its prerequisite(s): Materials Technology and Testing

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

During this semester the students learn the types of cutting machines, devices and tools. The edge geometry of the cutting tool is important for the surface quality of the workpiece and the selection of the appropriate technological parameters. The students will know the types of basic cutting technologies (turning, drilling, milling, planning, grinding, etc.) and their characteristics. After that they will know designing basic manufacturing tasks and calculate the necessary technological parameters for a given workpiece. At the end of the semester they can practice the basic measuring methods and solve measuring tasks.

Literature:

Compulsory:

- Dudás I.: Gépgyártástechnológia I. A gépgyártástechnológia alapjai. Műszaki Könyvkiadó, 2011., p. 583
- Dudás I.: Gépgyártástechnológia II. Forgácsoláselmélet, technológiai tervezés alapjai., Műszaki Könyvkiadó, 2011., p. 313, ISBN 978-963-16-6003-6
- Bali J.: Forgácsolás, Tankönyvkiadó, Budapest, 1988., p. 538.
- Fritz Klocke: Manufacturing Processes I, Cutting, RWTH Edition, RWTH Aachen University, p. 524, ISBN 978-3-642-11978-1
- John A. Schey: Introduction to Manufacturing Processes, McGraw – Hill Book Company, 1977., p. 392., ISBN 0-07-055274-6
- J. T. Black, Ronald A. Kohser: Materials and Processes in Manufacturing, Tenth Edition, United States of Amerika, p. 1033, ISBN 978-0470-05512-0
- Mikel P. Groover: Fundamentals of Modern Manufacturing, Materials, Processes and Systems, Third Edition, United States of Amerika, p. 520, ISBN 978-0-471-74485-6

Recommended:

- James G. Bralla: *Handbook of Manufacturing Processes,* First Edition, Industrial Press Inc., New York, 2007, ISBN 0-831 1-3179-9
- Helmi A. Youssef, Hassan El – Hofy: *Machining Technology, Machine tools and operations,* CRC Press, United States of Amerika, p. 672, ISBN 978-1-4200-4339-6
- J. Beddoes, M. J. Bibby: *Principles of Metal Manufacturing Processes,* 1999, p. 337, ISBN 0 340 73162 1

Schedule

1st week Registration week	
2nd week: **Lecture:** The basic definitions of manufacturing processes, the types of machine tools	3rd week: **Lecture:** Basic studies of cutting, the quality of the cutting surface **Practice:** Analysis of manufacturing technologies *(cutting laboratory)*

Practice: Introducing of the cutting laboratory and machine tools *(cutting laboratory)*	
4th week:	**5th week:**
Lecture: The edge geometry of cutting tools **Practice:** Construction of the edge geometry of cutting tools	**Lecture:** Dimension chains, locating elements, calculation of allowance for machining **Practice:** Task solutions for dimension chains
6th week:	**7th week:**
Lecture: Process of chip formation, tool wear and tool life **Practice:** Calculation tasks for tool wear and tool life	**Lecture:** The process and tools of turning technologies **Practice:** Designing of turning technology
8th week: 1st drawing week	
9th week:	**10th week:**
Lecture: The process and tools of drilling and counterbore technologies **Practice:** Designing of drilling and counterbore technologies	**Lecture:** The process and tools of milling technologies **Practice:** Designing of milling technologies
11th week:	**12th week:**
Lecture: The process and tools of grinding technologies **Practice:** Designing of grinding technologies	**Lecture:** The process and tools of planning, slotting and pull broaching technologies **Practice:** The basic studies of manufacturing operation planning
13th week:	**14th week:**
Lecture: The basic studies of measuring methods **Practice:** Measuring technique practice I. (SKF laboratory)	**Lecture:** Text for the signature **Practice:** Measuring technique practice II. (SKF laboratory)
15th week: 2nd drawing week	

Requirements

A, for a signature:

1. Students have to create an own technical drawing for the edge geometry of cutting tool and they have to solve an easy measuring task.
2. Students have to visit the lectures and seminars. Three misses are permissive for the seminar.
3. At the end of the semester they have to write a test from the seminar tasks (technological calculations).

B, for grade:

Students have to take a written and oral exam for the lecture. They will receive the questions topics. They will get the final grade on the exam (1 - 5).

Manufacturing Processes II.

Code: MK3GYT2G05GX17-EN

ECTS Credit Points: 5

Evaluation: exam

Year, Semester: 4th semester

Its prerequisite(s): Manufacturing Processes I

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+3

Topics:

Economical and flexible, advanced metal-forming processes form the core of modern industrial production. The Manufacturing Processes II. presents the most important metal-working and shearing processes and the related machines and tooling. 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 form plastics, ceramics, composites, technologies and applicable tools and machines.

Literature:

Compulsory:

- L. Edwards, M. Endean: Manufacturing with Materials, Butterworths, London, 1990., ISBN 0-408-02770-3

- Heinz Tschaetsch: Metal Forming Practise: Processes - Machines – Tools, Springer-Verlag Berlin Heidelberg, 2006., ISBN 978-3-642-06977-2
- Mikel P. Groover: Fundamentals of Modern Manufacturing, Materials, Processes and Systems, Third Edition, John Wiley & Sons, 2007, ISBN 978-0-471-74485-6

Recommended:

- M. F. Ashby: Materials Selection in Mechanical Design. 3.rd edition. Elsevier. London, 2005. ISBN 0-7506-6168-2.
- James G. Bralla: *Handbook of Manufacturing Processes,* First Edition, Industrial Press Inc., New York, 2007, ISBN 0-831 1-3179-9
- J. T. Black, Ronald A. Kohser: DeGarmo's Materials and Processes in Manufacturing, John Wiley & Sons, 2011., ISBN 978-0-470-92467-9

Schedule

1st week Registration week	
2nd week:	3rd week:
Lecture: History of metal forming. Definitions, advantages of metal forming. Bulk deformation processes. Sheet metal forming processes. Practice: Technological planning of thread manufacturing *+ 30 minutes cutting laboratory*	Lecture: Properties of materials. The uniaxial tensile test. Engineering and true elongations. Practice: The manufacturing process of toothed gears (Sunderland, Fellows and Pfauter methods) *+ 30 minutes cutting laboratory*
4th week:	5th week:
Lecture: Industrial materials. Upsetting test. Types of stress-strain relationships. Practice: The basic studies of technological planning on CNC machines, cutting tool selection	Lecture: Classification of different forming processes. Types of rolling. Rolling operations. Equipment of rolling, rolling mills. Thread rolling, ring rolling. Practice: Designing of blanking technologies
6th week:	7th week:
Lecture: Fundamental concept of metal rolling. Forces and geometrical relationships in rolling. Roll bit condition. Practice: Designing of bending technologies	Lecture: Extrusion (direct and indirect). Classification of forging operations. Types of forging dies. Wire and bar drawing. Practice: Designing of drawing technologies
8th week: 1st drawing week	
9th week:	10th week:

Lecture: Overview of metal forming of sheet metals. Stresses and shape modification during metal forming. Sheet metal cutting and forming processes. **Practice:** Designing of setting technology	**Lecture:** Bending and deep drawing. Standard parts, basic rules of design these elements, tool types. **Practice:** Analysis of cutting technologies on the cutting laboratory *(cutting laboratory)*
11th week:	**12th week:**
Lecture: Classification of manufacturing processes (casting, forming, material removal, joining). Advantages of casting. Casting terminology. Sand casting. **Practice:** Workpiece production on CNC machine *(cutting laboratory)*	**Lecture:** The formation of cast structure. Shell-mold casting. Permanent mold casting. **Practice:** The basic studies of device designing *+ 30 minutes cutting laboratory*
13th week:	**14th week:**
Lecture: Manufacturing of polymers. Major processes (extrusion, injection molding, blow molding, thermoforming, rotomolding). **Practice:** Basic studies of Computer Aided Manufacturing (CAM)	**Lecture:** Test for the signature **Practice:** The types of manufacturing systems
15th week: 2nd drawing week	

Requirements

A, for a signature:

- Students have to visit the lectures and seminars. Three misses are permissive for the seminar.
- At the end of the semester they have to write a test from the seminar tasks (technological calculations).

B, for grade:

Students have to take a written and oral exam for the lecture. They will receive the questions topics. They will get the final grade on the exam (1 - 5).

Electrotechnics and Electronics

Code: MK3ETELR04GX17-EN

ECTS Credit Points: 4

Year, Semester: 2 year, 1 semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Introduction to DC circuits: voltage, current, basic components. Network analysis: Ohm's Law, Kirchhoff's Law, current and voltage divider, superposition, Thevenin and Norton's Law. Alternating current circuits: sinusoidal wave, calculation on the complex plane, power and effective values. Transient signals in the AC circuits: series and parallel RLC circuits. 3 phases circuit.

Introduction to electronics: features of electronic circuits, solid state devices. Transistors, unipolar and bipolar transistors. Operation, characteristics, and basic circuits. Amplifiers: 4 port theory, transfer functions, feedback: positive and negative. Semiconductors, diode, special diode. Common emitter amplifier. Differential amplifier: operational modes, circuit. Class A and AB amplifiers. Power amplifiers. Operational amplifiers: inverting and non-inverting type. Filters: Low and high pass filter, band pass filter.

Literature:

Compulsory:

- Electronic Circuits: Handbook for Design and Application, U. Tietze, Ch. Schenk, 2nd edition, 2008, ISBN-10: 3540004297

Schedule

1st week Registration week	
2nd week: Lecture: Electrostatics, DC networks: basic electrical concepts of electric charge, electric current (amperage), electric field, electric field work, electric voltage (potential), electric circuit Practice: General description, laboratory regulations, Safety regulations and safety instruction	3rd week: Lecture: Power source (ideal real), Power Source (ideal for real), Consumer, Ohm's Law, Resistance - design, characteristic data, division, marking according to IEC standard. Passive resistance of bipolar networks, Star-delta, delta-star conversion, Electrical work, electric power, efficiency Practice: introduction to measurements and instrumentation (measuring error, power supply, digital multimeter, signal generator)
4th week: Lecture: Network analysis: Kirchhoff's laws, Voltage divider, potentiometer, extending measuring range of a Volt meter current divider, extending measuring range of an	5th week: Lecture: Network analysis: superposition theory, Northon and Thevenin theory.

Amp meter, Wheatstone bridge. Nodal analysis, Mesh analysis. **Practice:** 1st measurement: measuring the characteristics of DC voltage (U, I, RB, P) using Ohm's Law. Measuring the values of DC circuit. Using Kirchhoff's lows. Report writing.	**Practice:** Perform a complex DC measurement and calculation task. Report writing.
6th week: **Lecture:** AC circuit, complex number, AC circuit mean value (RMS). Behavior of a resistance in AC circuit, inductance behavior in AC circuit, capacitance behavior in AC circuit. **Practice:** introduction to AC measurements and instrumentation (AC type digital multimeter, signal generator, oscilloscope, LRC meter). Report writing.	**7th week:** **Lecture:** Performance of AC circuits, power factor correction, Three-phase systems **Practice:** measurements of AC power. Report writing.
8th week: 1st drawing week	
9th week: **Lecture:** Pure and doped semiconductor characteristics, PN junction behavior at forward and reverse bias conditions. **Practice:** Silicon diode opening and closing characteristics measurements. Analysis of rectifier circuits. Report writing.	**10th week:** **Lecture:** Characteristics and applications of semiconductor diodes, the rectifier circuit operation, the one-way, two-way rectifier circuits operation. **Practice:** Analysis of rectifier circuits. Report writing.
11th week: **Lecture:** Bipolar transistor structure, gain, transistor parameters and characteristics, the FE connection, adjusting the set point. Areas of application of bipolar transistor, circuits transistor basic (CB, CC circuits), **Practice:** Analysis of common emitter basic circuit. Report writing.	**12th week:** **Lecture:** Principles of operation of field-effect transistors. **Practice:** Analysis of common source basic circuit. Report writing.
13th week: **Lecture:** Operation and characteristics of basic operational amplifier circuits (inverting, non-inverting, follower, summing, differential, differentiator and integrator basic circuit) **Practice:** Analysis of summing operational amplifier basic circuit. Report writing.	**14th week:** **Lecture:** Filters: Low and high pass filter, band pass filter. **Practice:** Analysis of filters basic circuit. Report writing.
15th week: 2nd drawing week	

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 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. During the semester there are one test. Students have to sit for these tests.

Preparing measurement reports until deadline.

B, for grade:

At the end of the course a test must be taken. The minimum requirement for end-term test is 41%. Score Grade 0-40 fail (1) 41-55 pass (2) 56-70 satisfactory (3) 71-85 good (4) 86-100 excellent (5)

Measurement Technology

Code: MK3MERTR04GX17-EN

ECTS Credit Points: 4

Evaluation: Mid-Semester Grade, measurement report

Year, Semester: 2nd year, 2nd semester

Its prerequisite(s): Electrotechnics and Electronics

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Detectors (sensors) and transducers. Grouping the sensors. The measuring device structure and characteristics. Unit of measurement systems. Measurement error. Measurement methods. Electro-mechanical - and electronic instruments. Digital instruments. Microelectronic sensors. Elastic deformation measuring devices. Temperature, light and radiation detectors. Thermocouples, thermometers metal, semiconductor thermometers-; Optical gates-; Capacitive proximity switches-; Ultrasonic sensors-; structure, operating principles and properties. Foil Version strain gauges, semiconductor strain gauges, strain sensor wire, one, two and four-sensor bridge circuit. Fiber optic sensors. Signal processing systems. Pressure, temperature, strain and measurement of rotary motion using National Instruments LabVIEW software.

Literature:

Compulsory:

- Aciatore, David G.: Introduction to mechatronics and measurement systems, Boston, 2007, ISBN:007 125407 2
- Ed. Robert H. Bishop: The Mechatronics Handbook, Section III: Sensors and actuators

Recommended:

- 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

Schedule

1st week Registration week	
2nd 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.	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: 1st drawing week	Mid-term 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:** National Instrumnets with hardware and software. Edit VI. Measuring system construction, Troubleshooting practice	14th week: **Lecture:** Structure of the NI data acquisition systems. DAQ connecting to your computer. **Practical:** Recording and evaluation of data measured by National Instruments Hardware
15th week: 2nd drawing week: End-term 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 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 are two tests: the mid-term test is in the 8th week and the end-term test in the 15th week.

B, for grade:

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 (50 %) - the grade of the tests (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)

Applied Automatization

Code: MK3AAUTR04GX17-EN

ECTS Credit Points: 4

Evaluation: Exam, measurement report

Year, Semester: 3rd year, 1st semester

Its prerequisite(s): Measurement Technology

Further courses are built on it: Yes/No (On Operational and Maintenance specialization)

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Different theoretical foundation of control engineering. Technical and application control functions. Programmable logic controllers (PLC). Tags of the control loop. The tags 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.

Literature:

Compulsory:

- Ed. Robert H. Bishop: The Mechatronics Handbook, Section IV: Systems and Controls, CRC Press; 2nd edition 2007, ISBN: 978-0849392573
- Uday A.Bakshi, S.C.Goyal: Feedback Control Systems,Technical Publications Pune, 2nd edition 2008, ISBN: 978-8189411077

Recommended:

- Uday.A.Bakshi,Varsha.U.Bakshi: Control System Engineering, Technical Publications Pune, 1th edition 2008, ISBN: 978-8184314632

Schedule

1st week Registration week	
2nd week: **Lecture:** The theoretical bases of control technology. Basic concepts, symbols and allocation. Comparison of control and	3rd week: **Lecture:** Feedback control. Signs and characteristics of a control loop. Loop tags (a sensor, a signal generator, subtraction,

feedback control. Subdivision of control and feedback control. **Practical:** General description about laboratory regulations. Accident prevention and safety education.	signal processing, an amplifier, an actuator). **Practical:** Realization of logic functions "AND, OR, NAND, NOR, XOR, XNOR" with relays.
4th week: **Lecture:** Control systems. Boolean algebra, basic operations (And, Or, Not). Basic identity of Boolean algebra. **Practical:** Relationship between Relay and Ladder Diagramming Programming Language.	**5th week:** **Lecture:** De Morgan's theorems. Two-variable logic functions (Nor, Inhibition, Antivalency, Equivalency, Implication). **Practical:** Operation of programmable logic controllers. Basic programming tasks with PLC.
6th week: **Lecture:** Functions to simplify algebraic and graphical way. Operation and programming of freely programmable logic controllers (PLCs). **Practical:** Operation of programmable logic controllers. Basic programming tasks with PLC. Measuring internal timers and counters.	**7th week:** **Lecture:** Linear Control Systems. Test methods (time domain, frequency domain, and transfer functions method). **Practical:** PLC programming. Measuring internal timers and counters.
8th week: 1st drawing week: Self control Test	
9th week: **Lecture:** Linear control steady-state operation. Linear terms (P, I, D) and transmission coefficient. Linear coupling of tags (serial, parallel, feedback). **Practical:** Application of different programming languages for programmable logic controllers Medium programming tasks with PLC.	**10th 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.
11th 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.	**12th 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.
13th week: **Lecture:** Transition, transfer function and differential equations of a proportional and	**14th week:** **Lecture:** Continuous (P, PI, PD, PID) controllers. Non-electrical quantities

integral tag. Transition, transfer function and differential equations of a derivate and dead time tag. **Practical:** Proportional Integral (PI) tags transfer function analysis of the function using MULTISIM software.	electrical measuring. Control loops stability criterion with Routh-Hurwitz and high-quality specifics. **Practical:** The Proportional-Integral-Derivative (PID) tag recording its transition function and function analyzing. Optimization of measurement of different types of controllers.

15th week: 2nd drawing week: End-term 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 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 one test: the end-term test in the 15th week. Students have to sit for these tests.

B, for grade:

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)

Thermodynamics

Code: MK3MHOTL04GX17-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 2nd year, 1st semester

Its prerequisite(s): Engineering Physics, Mathematics II

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Definitions and Fundamental Ideas of Thermodynamics. Changing the State of a System with Heat and Work. Zeroth Law of Thermodynamics. The isotherm, isochor, isobar, adiabatic and polytrophic process. The First Law of Thermodynamics: Conservation of Energy. Corollaries of the First Law. Generalized Representation of Thermodynamic Cycles. The Carnot Cycle. Entropy. The second law of Thermodynamics. Reversibility and Irreversibility in Natural Processes. Technical work. Enthalpy. Exergy. Mixtures: Partial pressure, Dalton's laws. Gas mixtures. Gas mixtures. Real gases. Steam. Humid air. T-s diagram. Energy cycles.

Heat transfer. Basic forms of heat transfer. Fundamental equations. General differential equation of heat conduction. Steady state and transient conduction. Thermal resistance. Conduction (plane walls, cylindrical walls, spherical walls). Convection: concepts and basic relations, boundary layers, similarity concept. Free convection, forced convection (the Reynolds, Grasshof, Prandtl, Nusselt numbers).

Literature:

Compulsory:

- Lakatos Á. Basics of heat transfer and fluid mechanics. 2014, Terc Kft.
- Robert Balmer (2006) Thermo-dynamics, Jaico Publishing House, ISBN: 817224262X, 868 pages
- James R. Ogden (1998) Thermodynamics Problem Solver, Research and Education Association, ISBN: 0878915559, 1104 pages.
- Warren M. Rohsenow, James P. Hartnett, Young I. Cho (1998), Handbook of Heat Transfer, McGraw-Hill New York, ISBN: 0070535558 / 9780070535558, 1344 pages.

Schedule

1st week Registration week	
2nd week: **Lecture:** Definitions and Fundamental Ideas of Thermodynamics. Changing the State of a System with Heat and Work. Zeroth Law of Thermodynamics **Practice:** 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 **Practice:** Solving problems in the theme of the lecture
4th week: **Lecture**: Corollaries of the First Law. Generalized Representation of Thermodynamic Cycles. **Practice:** Solving problems in the theme of the lecture	**5th week:** **Lecture:** The Carnot Cycle. Entropy. The second law of Thermodynamics. **Practice:** Solving problems in the theme of the lecture

6th week:	7th week:
Lecture: Reversibility and and Irreversibility in Natural Processes. Technical work. Enthalpy. Exergy.	Lecture: Mixtures: Partial pressure, Dalton's laws. Gas mixtures. Gas mixtures. Real gases.
Practice: Solving problems in the theme of the lecture	Practice: Solving problems in the theme of the lecture
8th week: 1st drawing week	
9th week:	10th week:
Lecture: Steam. Humid air. T-s diagram.	Lecture: Energy cycles. Carnot's Cycle, Joule' s cycle.
Practice: Solving problems in the theme of the lecture	Practice: Solving problems in the theme of the lecture
11th week:	12th week:
Lecture: Heat transfer. Basic forms of heat transfer	Lecture: Fundamental equations. General differential equation of heat conduction. Steady state and transient conduction.
Practice: Solving problems in the theme of the lecture threaded joints in section and on view.	Practice: Solving problems in the theme of the lecture
13th week:	14th week:
Lecture: Thermal resistance. Conduction (plane walls, cylindrical walls, spherical walls). Convection: concepts and basic relations, boundary layers, similarity concept.	Lecture: Free convection, forced convection (the Reynolds, Grasshof, Prandtl, Nusselt numbers).
Practice: Solving problems in the theme of the lecture	Practice: Solving problems in the theme of the lecture
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance on the lectures is recommended, but not compulsory.

Participation at practice is compulsory. Student must attend the practices and my not miss more than three practice during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Student can't make up a practice with another group. The attendance on practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments for the course with them to each practice. Active participation is evaluated by the teacher in every class. If student's behavior or conduct doesn't meet the requirements of active participation,

the teacher may evaluate their participation as an absence due to the lack of active participation in class.

During the semester there are two tests: the mid-term test is in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

B, for grade:

The course ends with exam grade. Based on the average of the test results x 0.3 + the exam grade from the theory x 076 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)

Fluid Mechanics

Code: MK3ARARL05GX17-EN

ECTS Credit Points: 5

Evaluation: exam

Year, Semester: 2nd year, 2nd semester

Its prerequisite(s): Thermodynamics

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 3+2

Topics:

Introduce concepts, principles, laws, observations, and models of fluids at rest and in motion. Provide basis for understanding fluid behavior and for engineering design and control of fluid systems. Develop competence with mass, energy and momentum balances for determining resultant interactions of flows and engineered and natural systems. Develop basis for correlating experimental data, designing tests, and using scale models of fluid flows. Learn nature of rotation, circulation, resistance (viscous, turbulent),boundary layers, and separation with applications to drag and lift on objects. Learn methods for computing headlosses and flows in simple pipes and channels. Classification of Fluid Machines; Energy Transfer in Fluid Machines, in Turbomachines; Impulse and Reaction machines. Gas Turbines and Propulsion systems. Centrifugal Compressor, Compressor characteristics. Axial Flow Compressors,

Velocity diagrams, Compressor characteristics. Steam Turbines. Introduction, Flow through nozzles, Stagnation properties, sonic properties and isentropic expansion through nozzles.

Literature:

Compulsory:

- Lakatos Á. Basics of heat transfer and fluid mechanics. 2014, Terc Kft.
- Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, (2009) Fundamentals of Fluid Mechanics, John Wiley and Sons, ISBN 978-0470262849, 776 pages
- Robert W. Fox, Alan T. McDonald, Robert W Fox, (1998) John Wiley and Sons, ISBN 978-0471124641, 762 pages
- Shashi Menon (2004) Piping Calculations Manual, ISBN 978-0071440905 666 pages
- Paul Hanlon (2001), Compressor Handbook, McGraw-Hill Professional, ISBN 978-0070260054, 720 pages
- Tony Giampaolo (2006) Gas Turbine Handbook: Principles and Practice, Fairmont Press, ISBN 978-0849390562, 437 pages

Schedule

1st week Registration week	
2nd week: Introduce concepts, principles, laws, observations, and models of fluids at rest and in motion Lecture: Provide basis for understanding fluid behavior and for engineering design and control of fluid systems. Practice: Solving problems in the theme of the lecture	3rd week: Lecture: Develop competence with mass balances for determining resultant interactions of flows and engineered and natural systems. Practice: Solving problems in the theme of the lecture
4th week: Lecture: Develop competence with energy balances for determining resultant interactions of flows and engineered and natural systems. Practice: Solving problems in the theme of the lecture	5th week: Lecture: Develop competence with momentum balances for determining resultant interactions of flows and engineered and natural systems. Practice: Solving problems in the theme of the lecture
6th week: Lecture: Develop basis for correlating experimental data, designing tests, and using scale models of fluid flows. Practice: Solving problems in the theme of the lecture	7th week: Lecture, practice: Solving problems in the theme of the lecture
8th week: 1st drawing week	
9th week:	10th week:

Lecture: Learn nature of rotation, circulation, resistance (viscous, turbulent),boundary layers, and separation with applications to drag and lift on objects. **Practice:** Solving problems in the theme of the lecture	**Lecture:** Learn methods for computing headlosses and flows in simple pipes and channels. **Practice:** Solving problems in the theme of the lecture
11th week: **Lecture:** Classification of Fluid Machines; Energy Transfer in Fluid Machines, in Turbomachines; Impulse and Reaction machines. **Practice:** Solving problems in the theme of the lecture.	**12th week:** **Lecture**: Gas Turbines and Propulsion systems. Centrifugal Compressor, Compressor characteristics. **Practice:** Solving problems in the theme of the lecture
13th week: **Lecture:** Axial Flow Compressors, Velocity diagrams, Compressor characteristics. Steam Turbines. **Practice:** Solving problems in the theme of the lecture	**14th week:** **Lecture:** Introduction, Flow through nozzles, Stagnation properties, sonic properties and isentropic expansion through nozzles. **Practice:** Solving problems in the theme of the lecture
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance on the lectures is recommended, but not compulsory.

Participation at practice is compulsory. Student must attend the practices and my not miss more than three practice during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Student can't make up a practice with another group. The attendance on practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments for the course with them to each practice. Active participation is evaluated by the teacher in every class. If student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate their participation as an absence due to the lack of active participation in class.

During the semester there are two tests: the mid-term test is in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

B, for grade:

The course ends with exam grade. Based on the average of the test results x 0.3 + the exam grade from the theory x 076 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)

Thermal and Fluid Machines

Code: MK3HOAGL05GX17-EN
ECTS Credit Points: 5
Evaluation: exam
Year, Semester: 3rd year, 1st semester
Its prerequisite(s): Fluid Mechanics
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:

Velocity triangles. Pump curves, shut-off Head, maximum flow. Flat and steep characteristic curves. System characteristics. Duty point. Open system, closed system. Pump efficiency, efficiency curves. Resistances connected in series and parallel. Pumps connected in series and parallel. Power and efficiency calculations. Pump control methods. Similarity laws. Laws of affinity. Cavitation. NPSH. Review selection of pumps. Compressors. Water turbines. Heat exchangers: types, parameters, efficiency, heat transfer processes, heat losses. Dimensioning of heat exchangers. Heat pumps: operation principle, types, parameters, coefficient of performance. Compressors: types, thermodynamic parameters, efficiency. Chillers. Absorption and adsorption machines. Boilers: Structure, operation heat losses, efficiency of burning process. Gas and oil burners. Efficiency of boilers at partial load.

Literature:

Compulsory:

- D. Yogi Goswami, Frank Kreith (2008), Energy conversion, CRC PressINC, ISBN: 9781420044317, 686 pages.
- Charles Fayette Taylor (1985) The Internal Combustion Engine in Theory and Practice: Vol. 1 - 2nd Edition, The MIT Press, ISBN 978-0262700269, 584 pages.

- Keith Herold, Reinhard Radermacher, Sanford A. Klein, (1996) Absorption Chillers and Heat Pumps, CRC-Press, ISBN 978-0849394270, 330 pages.
- Arthur P. Fraas (1989), Heat Exchanger Design Wiley, 9780471628682, 560 pages.

Schedule

1st week Registration week	
2nd week: **Lecture:** Energy conversion, phase diagrams. Heat losses in different energy transformation processes. Power cycles. Powerplants. **Practice:** The practical application of the theoretical curriculum said during the lecture.	**3rd week:** **Lecture:** Heat exchangers: types, parameters, efficiency, heat transfer processes, heat losses. Dimensioning of heat exchangers. **Practice:** The practical application of the theoretical curriculum said during the lecture.
4th week: **Lecture:** Heat pumps: operation principle, types, parameters, coefficient of performance. **Practice:** The practical application of the theoretical curriculum said during the lecture.	**5th week:** **Lecture:** Chillers. Absorption and adsorption machines. **Practice:** The practical application of the theoretical curriculum said during the lecture.
6th week: **Lecture:** Cooling towers **Practice:** The practical application of the theoretical curriculum said during the lecture.	**7th week:** **Lecture:** Combustion technology **Practice:** The practical application of the theoretical curriculum said during the lecture.
8th week: 1st drawing week	
9th week: **Lecture:** Boilers: Structure, operation heat losses, efficiency of burning process. Gas and oil burners. Efficiency of boilers at partial load. **Practice:** The practical application of the theoretical curriculum said during the lecture.	**10th week:** **Lecture:** Velocity triangles. Turbomachine equation. Pump curves, shut-off Head, maximum flow. Flat and steep characteristic curves. **Practice:** The practical application of the theoretical curriculum said during the lecture.
11th week: **Lecture:** System characteristics. Duty point. Open system, closed system. Pump	**12th week:**

efficiency, efficiency curves. Resistances connected in series and parallel. Pumps connected in series and parallel. Power and efficiency calculations. Pump control methods. **Practice:** Exercises in connected pumps.	**Lecture:** Similarity laws. Laws of affinity. Cavitation. NPSH. Review selection of pumps. **Practice:** Compare the methods of adjusting pump performance.
13th week:	**14th week:**
Lecture: Centrifugal and axial fans. Forward curved impellers, radial impellers, backward curved impellers. Compressors. **Practice:** Calculating energy consumption Affinity laws.	**Lecture:** Tube axial fans, vane axial fans. Fan selection. Fan curves. Fans connected in series and parallel. Turbines **Practice:** Fans selection. Calculating duty point. Turbine choosing and efficiency calculation
15th week: 2nd drawing week	

Requirements

A, for signature:

Attendance on the lectures is recommended, but not compulsory.

Participation at practice is compulsory. Student must attend the practices and may 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. 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 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 grade:

The course ends in 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 minimum requirement for the 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 covering the whole semester material.

Examination, consisting of two parts:

1. Two exercise tests during the semester.

2. 60 minute theory test.

Environmental, Health, Safety and Ergonomy

Code: MK3EHSAK4KXX17-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 4th year, 1st semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

The subject covers three main topics:

Environment (E): In connection with environment protection the most important topics are introduced to the students. The subject includes air quality, noise protection, water protection, soil protection, and waste management side topics.

Health (H): Basics of labor and health are discussed. The impact of work on health and the health impact on working ability is also a side topic. The fundamentals of occupational health and work hygiene are also involved.

Safety (S): It involves the basics of labor safety and fire protection. The lectures discuss the personal, material and organizational requirements for safe work, ergonomic fundamentals, personal protective equipment, work safety reviews, employer checks, and workplace risk assessment. Industrial safety and security is also a side topic.

The lectures introduce the most important aspects and the practices focus on examples and plant visits.

Literature:

Recommended:

- Gilbert M. Masters, Wendell P. Ela: Introduction to Environmental Engineering and Science, Pearson New International Edition, 3/E, Pearson, 2013, ISBN: 9781292025759
- David L. Goetsch, Occupational Safety and Health for Technologists, Engineers, and Managers, 8th Edition, Pearson, 2015, ISBN: 9780133484175
- Richard T. Wright, Environmental Science, Pearson, 2017, ISBN: 9780134011271

Schedule

1st week Registration week	
2nd week: Basics of Environmental Protection and Environmental Management **Lecture:** Introduction to environmental protection **Practice:** Global issues on environmental protection	3rd week: Air Quality Control **Lecture:** Basics of air pollution control, processes in the atmosphere, greenhouse gases, ozone layer, smog, acid rain **Practice:** Exercises in connection with air pollution
4th week: Environmental Noise **Lecture:** The basics of environmental noise **Practice:** Noise measuring devices and techniques	5th week: Water Protection **Lecture:** Water protection and quality, pollutants **Practice:** Practice in connection with water protection (plant visit: wastewater treatment plant)
6th week: Soil Protection **Lecture:** Protection of soil quality **Practice:** Practice in connection with soil protection	7th week: Waste Management **Lecture:** Waste management, possibilities, disposal, techniques and hazardous waste **Practice:** Practice in connection with waste management (plant visit)
8th week: 1st drawing week	
9th week: Basics of labor safety and fire protection **Lecture:** Personal, material and organizational requirements for safe work, ergonomic fundamentals **Practice:** Practice in connection with labor safety I. (plant visit)	10th week: Occupational Safety **Lecture:** Personal protective equipment, work safety reviews, employer checks, workplace risk assessment **Practice:** Practice in connection with labor safety II. (plant visit)
11th week: Labor and Health **Lecture:** The impact of work on health and the health impact on working ability **Practice:** Practice in connection with occupational health I.	12th week: Occupational Health and Work Hygiene **Lecture:** Fundamentals of occupational health and work hygiene **Practice:** Practice in connection with occupational health II.
13th week: Industrial Safety and Security **Lecture:** Main goals of industrial safety and security	14th week: Mid-semester TEST **Lecture:** **Practice:**

Practice: Practice in connection with industrial safety and security	

15th week: 2nd drawing week

Requirements

A, for a signature:

Attendance to the practices (absence up to the permissible level)

B, for grade:

Test grade (2: from 50%)

Subject group "Differentiated Professional Subjects" for Automotive Production Process Control Specialization

Automotive Process Analysis and Planning I.

Code: MK3JFT1G04G317-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 3. year, 1. semester

Its prerequisite(s): MK3GYT2G05GX17

Further courses are built on it: Yes

Number of teaching hours/week (lecture + practice): 2+1

Topics:

The goal of the subject is to develop a process-oriented view in the students. During the lectures and practices the students get acquired with the operation management and the processes of a company. They acquire the methods of process development. During the practices they get routine in data collection techniques as well as process analysis and valuation.

General properties of production processes. Key indicators to represent the operation of a productive system. Components of operational management. Sorting of various processes. Product life cycle stages. The product-process matrix. Forecast, constant- and trend demands. Short term and long term capacity planning. Inventory management. Determination of the optimal product mix, determination of the optimal level of resources. Calculation of the resource demand. Principles of JIT production.

Literature:

Compulsory:

- William J. Stevenson: Operations management 10th ed. Boston : McGraw-Hill/Irwin

Recommended:

- James P.W.: Lean thinking, Free press, 2003

Schedule

1st week Registration week	
2nd week: Lecture: Evolution of operation management. General properties of production processes. Practice: Introduction to the methods of process analysis. Simulation in teamwork.	3rd week: Lecture: Key indicators to represent the operation of a productive system. Relationship between the key indicators Practice: Case-study: properties of production processes.
4th week: Lecture: Components of production- and operational management. Functions of production and management. Practice: Case-study: relationship between the key indicators.	5th week: Lecture: Sorting of various processes based on volume of production. Product life cycle stages. Practice: Elaboration of calculation exercises in the field of sorting of various processes.
6th week: Lecture: Production-strategies. The product-process matrix. Factors defining the competitiveness of a production system. Practice: Relationship between the product life cycle stages and the tasks of the operation management.	7th week: Lecture: Typology of forecast. Constant- and trend demands. Failures of forecast. Practice: Methods of forecast
8th week: 1st drawing week	
9th week: Lecture: Capacity planning techniques. Short term and long term capacity planning.	10th week: Lecture: Inventory management. Classical mechanisms of inventory. Sensitivity analysis. Practice: Elaboration of calculation exercises in the field of capacity planning

Practice: Elaboration of calculation exercises in the field of capacity planning	
11th week:	**12th week:**
Lecture: Inventory management. Determination of the safety stock. The "make or buy" decision	**Lecture:** Determination of the optimal product mix, determination of the optimal level of resources.
Practice: Elaboration of calculation exercises in the field of Inventory management	**Practice:** Elaboration of calculation exercises in the field of Inventory management
13th week:	**14th week:**
Lecture: Calculation of the resource demand. The basics of Material Requirements Planning	**Lecture:** Principles of JIT production. Control of material flow. Pull-principle.
Practice: Elaboration of calculation exercises in the field of Material Requirements Planning	**Practice:** Test
15th week: 2nd drawing week	

Requirements

A, for a 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. If student's behavior 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 is one test in the 14th week.

B, for grade:

The course ends in **exam.**

Finite Element Method

Code: MK3VEMAG04G117-EN, MK3VEMAG04G317-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 3rd year, 1st semester

Its prerequisite(s): Strength of Materials, CAD Systems

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

The finite element method in the product lifecycle. Mathematical and mechanical background of the finite element method. Fundamentals of linear elasticity (displacement field, strain field, stress field). The basic equation system (equilibrium equation, kinematic equation, constitutive equation). Boundary conditions. Boundary value problems. Strain energy and related principles. Linear spring. 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 finite element programs. Application of commercial FEM software. Modelling questions. Meshing. Postprocessing.

Literature:

Compulsory:

- Mankovits, T. (2014): Numerical Analysis of Engineering Structures (Linear Elasticity and the Finite Element Method), University of Debrecen, Debrecen, Hungary, ISBN: 978-963-473-797-1, p. 181.

Recommended:

- Bathe, K.J. (1996): Finite Element Procedures, Prentice-Hall International, New Jersey, USA, p. 1037.
- Kovács, Á., Moharos, I., Oldal, I., Szekrényes, A. (2012): Finite Element Method, Typotex, Budapest, Hungary, p. 383.
- Zienkiewicz, O.C., Taylor, R.L. (2000): The Finite Element Method: Solid Mechanics, Butterworth-Heinemann, London, England, ISBN: 0750650559, p. 477.

Schedule

1st week Registration week	
2nd week:	3rd week:
Lecture: Brief overview of the finite element method, historical background.	Lecture: Fundamentals of linear elasticity. Displacement field, strain field, stress field.
Practice: Industrial application of the finite element method.	Practice: Calculation of strain and stress measures. Principal values of normal stresses, scalar invariants and equivalent stresses.
4th week:	5th week:

Lecture: The basic equation system of linear elasticity (equilibrium equation, constitutive equation, kinematic equation). Boundary conditions (kinematical boundary condition, dynamical boundary condition).

Practice: Analytical solution of a one-dimensional boundary value problem.

Lecture: Strain energy. Total potential energy. Variational principles. Principle of minimum total potential energy. Linear spring as a finite element.

Practice: Calculation of strain energy and the application of total potential energy. Examples for linear spring structures. Derivation of the stiffness matrices.

6th week:

Lecture: Theory of Ritz method. Kinematically admissible displacement field.

Practice: Examples for Ritz method (linear approximation, quadratic approximation).

7th week:

Lecture: Formulation of the finite element method. General derivation of the displacement based finite element equilibrium equations.

Practice: Solution of a numerical example by programming (prismatic bar problem). **1st test.**

8th week: 1st drawing week

9th week:

Lecture: Properties of truss element. Local approximation.

Practice: Solution of numerical examples by the usage of Femap 9.3 (prismatic bar problem, truss structure).

10th week:

Lecture: Properties of beam element. Analytical solution of a statically indetermined beam problem.

Practice: Solution of numerical example by the usage of Femap 9.3 (statically indetermined beam).

11th week:

Lecture: Finite element formulations for two-dimensional problems (plain strain, plane stress, axi-symmetric problems).

Practice: Solution of numerical examples by the usage of Femap 9.3 (plate with a hole, tube under internal pressure, analyzing pressure vessel).

12th week:

Lecture: Isoparametric finite elements. One-, two- and three-dimensional mapping. Truss element. Quadrilateral and triangular elements. Brick and tetrahedron elements.

Practice: Calculation of Jacobian of non-distroted and distorted quadrilateral elements.

13th week:

Lecture: Numerical integration. The Gaussian quadrature.

Practice: The usage of one-point, two-point and three-point formulas.

14th week:

Lecture: General purpose finite element programs. Modelling questions. Meshing, postprocessing. Error analysis.

	Practice: Solution of a numerical example by the usage of Femap 9.3 (analysis of an assembly). **2nd test.**

15th week: 2nd drawing week

Requirements

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 1st test in the 7th week and the 2nd test in the 15th week. Students have to sit for the tests.

B, for 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 table:

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.

Pneumatics and Hydraulics

Code: MK3PNEUR04G117-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 3rd year, 1st semester

Its prerequisite(s): Measurement Technology

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 0+3

Topics:

Preparation and preparation of compressed air. Application of pneumatic working and control elements. Use of way valves, closing and flow control elements. Pneumatic implementation of logical basic functions, counters and timers. Application and implementation of the standard symbol system of pneumatic elements and switches. FluidSIM-P program use. Hydraulic power generation, hydraulic energy converters and their operation. Physical concepts and hydraulic calculations, power and efficiency. Use of hydraulic working and control elements. Directional valves, closing and flow control elements, pressure regulators, sliding and seat elements. Instrumentation measurements and measuring circuits. Use of piping sections, hoses, oil filters. Application and implementation of a standard symbol system for hydraulic elements. FluidSIM-H program use. Energy saving applications.

Literature:

Compulsory:

- D. Merkle, B.Schrader, M. Thomes: Hydraulics Basic Level Festo Didactic GmbH and Co., 2003.
- Peter Croser, Frank Ebel: Pneumatics Basic Level Festo Didactic GmbH and Co., 2002.

Recommended:

- De Silva, Clarence W.: Mechatronics: an integrated approach CRC Press, 2005.

Schedule

1st week Registration week	
2nd week: **Practice:** Development of pneumatics. Compressed air properties. Pneumatic equipment economy. State equation of gases.	**3rd week: Practice:** Compressed air production. Compressed air supply. Compressed air preparation.
4th week: **Practice:** Pneumatic actuators (structurecylinder, rotary actuators, sizing cylinders).	**5th week:** **Practice:** Generally about valves (way-, closing-, pressure managing-, stop-, time-).
6th week:	**7th week:**

Practice: Basic circuit (single- and double acting cylinder controlling, control with And- Or elements, increase speed)	**Practice:** Functions of hydraulic equipment. Symbols and drawing techniques.
8th week: 1st drawing week	**1st Mid-term test**
9th week: **Practice:** Structure and circuit diagrams (control, power supply) of hydraulic systems.	**10th week:** **Practice:** Physical basics of hydraulics (pressure transmission, force transmission, way transmission, pressure ratio). Kind of flows.
11th week: **Practice:** Equipment representation (layout drawings, wiring diagrams, operating charts). Power supply system components (gear motor, pump, filter, tank).	**12th week:** **Practice:** Valves (method of construction, the nominal value, slide). Pressure control valves. Way valves (2/2, 3/2, 4/2, 4/3).
13th week: **Practice:** Shut-off valves (check valve, controlled check valve). Flow control valves (one way control valves, 2 way flow control valve).	**14th week:** **Practice:** Hydraulic cylinders (single, doubleacting, sealing, venting, buckling). Hydraulic motors.
15th week: 2nd drawing week: 2nd mid-term 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 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.

B, for grade:

Students have to fulfill a mid-term exercise at least for 50% to take part on the next practice classes. All students, who failed the mid-term exercise will not get a mid-semester grade. At the end of the semester, all students have to solve a real life problem in programming. Also a task, to make a complete documentation of the project file, using all the methods, mentioned during the semester. The course ends in a mid-semester grade. Based on the average of the grades of the tasks. The grade for the test is given according to the following table: Score Grade 0-50 fail (1) 51-65 pass (2) 66-75 satisfactory (3) 76-85 good (4) 86-100 excellent (5)

Maintenance Engineering

Code: MK3UZK1G05G317-EN

ECTS Credit Points: 5

Evaluation: mid-semester grade

Year, Semester: 3rd year, 1st semester

Its prerequisite(s): Manufacturing Processes II

Further courses are built on it: No

Number of teaching hours/week (lecture + practice): 2+2

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. Concept of safety, reliability and risk. The concept and basics of reliability-centred maintenance (RCM) and total productive maintenance (TPM). Avoid or mitigate of the impact of operational failures. Root cause analysis (5WHY, FISH BONE etv.) and Root cause failure analysis. The control of maintenance costs while improving reliability. KPI system (budget, controlling equipments, planning etc.). Students will learn about Facility maintenance methods and tools, like energy management. 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. The students will learn about thermal cameras, on-line and off-line vibration diagnostic and tribology.

Literature:

Compulsory:

- R. K. Mobley, An Introduction to Predictive Maintenance, Butterworth-Heineman, 2002. ISBN: 9780750675314
- R. K. Mobley, Maintenance Fundamentals 2nd Editions, Butterworth-Heineman, 2004. ISBN: 9780750677981
- R. K. Mobley, L. R. Higgins, D. J. Wikoff: Maintenance Engineering Handbook, McGraw-Hill, 2008.
- J. Moubray: Reliability-Centered Maintenance: Industrial Press Inc., 2001. ISBN-13: 978-0831131463 ISBN-10: 0831131462

Recommended:

- D. J. Smith: Reliability, Maintainability and Risk: Practical Methods for Engineers, Elsevier, 2011. ISBN: 978-0-08-096902-2

- R. Smith, R. K. Mobley: Rules of Thumb for Maintenance and Reliability Engineers, Elsevier, 2007. ISBN: 9780750678629

Schedule

1st week Registration week	
2nd week: Lecture: Maintenance Policies, Impact, Benefits and Effects of Maintenance, Principles of Maintenance Practice: Examples, case studies	3rd week: Lecture: Organization and Management of a Maintenance Function, The importance of an overall maintenance strategy, Operating Policies of Effective Maintenance Practice: Examples, case studies
4th week: Lecture: The concept and basics of total productive maintenance (TPM) Practice: The concept and basics of total productive maintenance (TPM). Examples	5th week: Lecture: The overall efficiency of the equipment. Practice: The overall efficiency of the equipment. Examples
6th week: Lecture: Concept of safety, reliability and risk. Practice: Concept of safety, reliability and risk. Examples	7th week: Lecture: Economic Aspects of Maintenance, Life Cycle Costing, Maintenance Costs, Maintenance Budget, Cost Control, Maintenance Audit Practice: Examples, case studies
8th week: 1st drawing week	
9th 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. Practice: Examples, case studies	10th week: Lecture: Measuring and improvement of productivity. Terotechnology. Practice: Measuring and improvement of productivity. Terotechnology. Examples
11th week: Lecture: Maintenance and TQM, quality control in maintenance	12th week: Lecture: Root cause analysis (RCA) and Root cause failure analysis (RCFA)

Practice: Maintenance and TQM, quality control in maintenance. Examples.	**Practice:** Root cause analysis (RCA) and Root cause failure analysis (RCFA). Examples.
13th week:	**14th week:**
Lecture: Job evaluation.	**Lecture:** Company visit
Practice: Job evaluation. Examples	**Practice:** Company visit
15th week: 2nd drawing week	

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 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 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.

Automotive Process Analysis and Planning II

Code: MK3JFT2G04G317-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 3. year, 2. semester

Its prerequisite(s): MK3JFT1G04G317

Further courses are built on it: No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

The goal of the subject is to develop a process-oriented view in the students. During the lectures and practices the students get acquired with the operation management and the processes of a company. They acquire the methods of process development. During the practices they get routine in data collection techniques as well as process analysis and valuation.

Lean management, the Toyota production system. Waste in the production processes. The process of the value, value stream analysis. Introduction of Lean tools in the production: exploration of cause and effect relationships, Pareto diagram, Kaizen, PDCA cycle, Poka-yoke, TPM, problem solving techniques. Determination of process-data, valuation of processes. Determination of time-data. Quality management. Process control. Basics of ergonomics.

Literature:

Compulsory:

- William J. Stevenson: Operations management 10th ed. Boston : McGraw-Hill/Irwin

Recommended:

- James P.W.: Lean thinking, Free press, 2003

Schedule

1st week Registration week	
2nd week: **Lecture:** Basics and principles of the Lean management. **Practice:** Introduction into the principles of the Lean philosophy. Simulation in teamwork.	3rd week: **Lecture:** The Toyota production system **Practice:** Making of Process flow charts.
4th week: **Lecture:** Definition of waste. Waste in the production processes. **Practice:** Identification of waste in production processes.	5th week: **Lecture:** The value, the process of the value, value stream analysis. **Practice:** Introduction of Poka-yoke techniques through case-studies.
6th week:	7th week:

Lecture: Lean tools in the production. Exploration of cause and effect relationships, Pareto diagram. **Practice:** Elaboration of exercise in the topic of Ishikawa diagram.	**Lecture:** Lean tools in the production. Kaizen, PDCA cycle, Poka-yoke, TPM. **Practice:** 5-Why method in the practice.
8th week: 1st drawing week	
9th week: **Lecture:** Problem solving techniques. **Practice:** Effective problem solving techniques in the practice.	**10th week:** **Lecture:** Valuation of processes, Key indicators. **Practice:** Analysis of production processes, FMEA.
11th week: **Lecture:** Determination of process-data **Practice:** Analysis of production processes. Realization pull-principle, cycle time calculation.	**12th week:** **Lecture:** Time recording techniques. System of predefined times. **Practice:** Time recording techniques in the practice.
13th week: **Lecture:** Quality management. Process control. **Practice:** Test	**14th week:** **Lecture:** Ergonomics. Introduction to the principles of ergonomically correct workplace-design. **Practice:** Ergonomic-valuation. Introduction to the ergonomically correct workplace-design through case-studies.
15th week: 2nd drawing week	

Requirements

A, for a 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. If student's behavior 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 is one test in the 13th week.

B, for grade:

The course ends in **exam.**

CAM systems

Code: MK3CAMRG04G317-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 3rd year, 2nd semester

Its prerequisite(s): manufacturing Processes II

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

The aim of the subject is to know the technological process of the workpiece production. The examination of the technical drawing is important before production. Knowing of the manufacturing process of typical machine workpieces is important for the technological designing of the complex workpiece and the type- and group technological process. Based on more technological variation the selection of the optimal technological possibility is important because of the tool wear, the norm time and manufacturing costs, etc. The real production has to be organized for the optimal technological process.

During the seminars the students creates the total technological plan of a concrete workpiece and the necessary manufacturing operations. The modern manufacturing softwares will be used for the task solution (SolidWorks, SolidCAM).

Literature:

Compulsory:

- Dudás I.: Gépgyártástechnológia I. A gépgyártástechnológia alapjai. Műszaki Könyvkiadó, 2011., p. 583
- Dudás I.: Gépgyártástechnológia II. Forgácsoláselmélet, technológiai tervezés alapjai., Műszaki Könyvkiadó, 2011., p. 313, ISBN 978-963-16-6003-6
- Pálinkás S., Balogh G., Gyönyörű A.: Számítógéppel segített gyártás (CAM), Debreceni Egyetem Műszaki Kar, ISBN 978-963-473-911-1, 2015. (elektronikus jegyzet)
- Mátyási Gy., Sági Gy.: Számítógéppel támogatott technológiák, CNC, CAD, CAM, Műszaki Kiadó, Budapest, 2012, 3. kiadás, ISBN 978-963-16-6048-7

- Medland, A.J.: CAD/CAM in Practice, A Manager's Guide to Understanding and Using CAD/CAM, Springer Verlag, 2012, ISBN 9789401171229
- Kim, Yong Soo, Ryoo, Young J., Chang, Moon-soo, Bae, Young-Chul: Advanced Intelligent Systems, Springer Verlag, 2014, ISBN 9783319054995

Recommended:

- Grabowski, Hans, Anderl, Reiner, Pratt, Michael J.: *Advanced Modelling for CAD/CAM Systems,* Springer Verlag, ISBN 9783540539438
- Wang, P.C.C.: *Advances in CAD/CAM Workstations,* Case Studies, Springer Verlag, ISBN 9781461294030
- Gardan, Y., Lucas: *Interactive Graphics in CAD,* Springer Verlag, 2012, ISBN 9789401089586

Schedule

1st week Registration week	
2nd week: Lecture: The aim of technological designing, technological documents Practice: Task edition. Examination of the technological conditions of the given workpiece. Working out of the technological process.	3rd week: Lecture: Working out of the technological process of workpiece production, determination of the production quantity Practice: Determination of the operation ranking. Calculation of allowance for machining.
4th week: Lecture: Analysis of the functional and technological corrective of production, selection of the blank type Practice: Blank selection. CAD modeling of the blank. Determination of the technological parameters of the cutting and the rough-cutting operations.	5th week: Lecture: Type- and group technological processes, selection of measuring devices Practice: Cutting tool selection from tool standard.
6th week: Lecture: Production of typical machine workpieces Practice: CAM simulation of rough – cutting turning operation.	7th week: Lecture: Determination of the ranking of technological operations and manufacturing steps Practice: Determination of the technological parameters of finishing cutting operations.
8th week: 1st drawing week	
9th week:	10th week:

Lecture: Position determination of workpieces, the device elements	**Lecture:** Determination of the operation structure in more variations
Practice: CAM simulation of finishing turning operation.	**Practice:** Determination of the technological parameters of drilling and milling operations.
11th week:	**12th week:**
Lecture: The structure of the norm time, cost calculation	**Lecture:** Technological process planning for complex workpieces
Practice: CAM simulation of drilling and milling operations.	**Practice:** CAM simulations of the total manufacturing process. CNC program generation.
13th week:	**14th week:**
Lecture: Examination of constructions in assembly case	**Lecture:** Final text
Practice: Creation of the technological documentations.	**Practice:** Solving of an own technological designing task.
15th week: 2nd drawing week	

Requirements

A, for a the practice mark:

- Students have to visit the lectures and seminars. Three misses are permissive for the seminar.
- They have to solve an own technological designing task in CAM software.
- At the end of the semester they have to write a text from the lecture. Based on these result they will get the final practice mark.

Vehicle Constructions and Assembly Technology

Code: MK3JSZTG05G317-EN

ECTS Credit Points: 5

Evaluation: mid-semester grade

Year, Semester: 3rd year, 2nd semester

Its prerequisite(s): Manufacturing Processes II

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

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).

In the second part of the subjects the students learn the assembly operations and the theorem of designing assembly systems. They will learn the assembly possibilities of machine elements. On the seminar they will use CAD software for geometric modelling and assembly operation planning.

Literature:

Compulsory:

- Julian Happian-Smith PhD, MSc, BTech (Editor) An Introduction to Modern Vehicle Design, ISBN 07506 5044 3, Cert Ed HE, MSAE Oxford, Reed Educational and Professional Publishing Ltd, 2002
- Peter Girling (Editor): Automotive Handbook, VDI-Verlag GmbH, ISBN 3-1-419115-X, 1993
- Ho, William, Ji, Ping: Optimal Production Planning for PCB Assembly, Springer Verlag, 2010, ISBN 9781849966139
- Botti, Vicent; Giret, Adriana: ANEMONA: A Multi-agent Methodology for Holonic Manufacturing Systems, Springer Verlag, 2008, ISBN 9781848003095
- Wu, Bin: Handbook of Manufacturing and Supply Systems Design: From Strategy Formulations to System Operation, Taylor & Francis, 2001, ISBN 9780415269025

Recommended:

- Fritz Klocke: *Manufacturing Processes I, Cutting,* RWTH Edition, RWTH Aachen University, p. 524, ISBN 978-3-642-11978-1
- John A. Schey: *Introduction to Manufacturing Processes,* McGraw – Hill Book Company, 1977., p. 392., ISBN 0-07-055274-6
- J. T. Black, Ronald A. Kohser: *Materials and Processes in Manufacturing,* Tenth Edition, United States of Amerika, p. 1033, ISBN 978-0470-05512-0
- Mikel P. Groover: *Fundamentals of Modern Manufacturing, Materials, Processes and Systems,* Third Edition, United States of Amerika, p. 520, ISBN 978-0-471-74485-6
- James G. Bralla: *Handbook of Manufacturing Processes,* First Edition, Industrial Press Inc., New York, 2007, ISBN 0-831 1-3179-9
- Helmi A. Youssef, Hassan El – Hofy: *Machining Technology, Machine tools and operations,* CRC Press, United States of Amerika, p. 672, ISBN 978-1-4200-4339-6

Schedule

1st week Registration week	
2nd week: **Lecture:** Integral body and frame, drivetrain layouts, crumpling zones, energy absorbing solutions. **Practice:** Suspension systems and springs: independent and depended suspension.	3rd week: **Lecture:** Steering system: steering linkage, tie rods, control arms, ball joints, power steering system. **Practice:** Rack-and-pinion steering, recirculating-ball steering, electronic power steering systems
4th week: **Lecture:** Brake systems. Drum and disc brakes, master cylinders, brake boosters. **Practice:** Assembling and adjusting steering gears, and suspensions	5th week: **Lecture:** Parking brake systems. Bleeding brakes. Anti-lock brake systems, brake assist. **Practice:** Tire construction, tire codes. Balancing wheels. Aligning wheels: caster, camber, toe-in, toe-out, turning radius.
6th week: **Lecture:** Internal combustion engines (ICE). Major engine components. A four-stroke and a two-stroke power cycle. Gasoline and diesel engines. **Practice:** Lubrication and fuel systems. Supercharging and turbochargers, emissions control devices.	7th week: **Lecture:** The Cooling system of ICE: a radiator, a fan, a water pump, a thermostat, and their operation. **Practice:** Electrical system and main parts of it. Starter, alternator, ignition system.
8th week: 1st drawing week	
9th week: **Lecture:** The place and ponderosity of assembly in the manufacturing process. The property of an assembly system. **Practice:** Computer aided modelling of the parts of assembly devices I. (Solidworks software)	10th week: **Lecture:** Manufacturing devices for assembly. The main types of assembly devices. The types of position determination. **Practice:** Computer aided modelling of the parts of assembly devices II. (Solidworks software)
11th week: **Lecture:** Examination of assembly dimension chains (total and particular variation methods) **Practice:** Task solutions for assembly dimension chains	12th week: **Lecture:** Assembly operations. Typical assembly systems. Assembly tree. **Practice:** Computer aided planning of assembly tasks I. (Solidworks software)

13th week:	14th week:
Lecture: Assembly of machine elements I.	Lecture: Assembly of machine elements II.
Practice: Computer aided planning of assembly tasks II. (Solidworks software)	Practice: Computer aided planning of assembly tasks III. (Solidworks software)
15th week: 2nd drawing week	

Requirements

A, for a the practice mark:

- Students have to visit the lectures and seminars. Three misses are permissive for the seminar.
- They have to solve an own technological designing task.
- Students have to write two tests from the two parts of the lecture. They have to write them for minimum sufficient marks. Based on these result they will get the final practice mark.

Material Handling and Logistics

Code: MK3AMLOG04G117-EN, MK3AMLOG04G317-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 3rd year, 2nd semester

Its prerequisite(s):

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

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. Basic calculations of continuous operating materials handling equipment. Belt conveyors, bucket elevators, screw conveyors, overhead conveyors, roller conveyors and pneumatic conveyors. Hoisting machinery. Simple hoisting appliances. Crane crabs and trolleys. Overhead cranes. Gantry cranes. Jib cranes. Loader machinery. Loaders for piece-goods, powered industrial trucks and forklifts. Loaders for bulk materials, continuous operating loaders, bucket loaders. Introduction to warehousing principles and technologies. Automatic storage warehouses with high racks and their equipment. Stacker cranes.

The connection between the logistics and the supply chain. The 7 rights of the logistics. The aims of company logistics. Company logistics system (strategic level, tactical level, operative level). The divisions of logistics (procurement, production, distribution, re-cycling). Supplier and distributer networks. Supply chain management. Procurement logistics. Centralized and decentralized procurement. Direct and indirect purchasing. The process of purchasing. Methods used by purchasers; demand analysis (ABC and XYZ analysis), price analysis, supplier evaluation and selection, economic order quantity (EOQ). Production logistics. Production systems. Push and pull type production systems. Material requirement planning (MRP). Manufacturing resource planning (MRP II.). Distribution logistics. Distribution requirements planning (DRP). Re-cycling logistics. Packaging technology. Dangerous goods.

Literature:

Compulsory:

- Martin Christopher (2011): Logistics and Supply Chain Management, Financial Times Series, 4th edition
- Lars Bedey, Sofia Eklund, Nojan Najafi, William Wahrén, Karl Westerlund (2008): Purchasing Management, Chalmers, Department of Technology Management and Economics, http://publications.lib.chalmers.se/records/fulltext/90488.pdf

Recommended:

- Peter Nyhuis, Hans-Peter Wiendahl (2009): Fundamentals of Production Logistics, Springer, ISBN 978-3-540-34210-6
- DiCentral (2014): Inventory and Warehouse Managemenet Best Practices, SmartTurn Inc., 1st edition, http://www.smartturn.com/pdf/inventory-warehouse-management-best-practices-ebook.pdf

Schedule

1st week Registration week	
2nd week:	3rd week:
Lecture:	Lecture:
Basic concepts for the handling and conveyance of materials. Classification of material handling systems. Fundamental elements of material handling systems. Properties of handled materials.	Continuous operating materials handling equipment I.: basic calculations of continuous operating materials handling equipment, belt conveyors, bucket elevators, screw conveyors.
Practice:	Practice:
Selection the elements of material handling systems. Basic calculations of handled materials.	Calculation the transport capacity of belt conveyors, bucket elevators and screw conveyors.
4th week:	5th week:

Lecture: Continuous operating materials handling equipment II.: overhead conveyors, roller conveyors, pneumatic conveyors. **Practice:** Calculation the transport capacity of overhead conveyors, roller conveyors and pneumatic conveyors.	**Lecture:** Hoisting machinery. Simple hoisting appliances. Crane crabs and trolleys. Overhead cranes. Gantry cranes. Jib cranes. **Practice:** Calculation problems related to cranes.
6th week: **Lecture:** Loader machinery. Loaders for piece-goods, powered industrial trucks and forklifts. Loaders for bulk materials, continuous operating loaders, bucket loaders. **Practice:** Calculation problems related to trucks and forklifts.	**7th week:** **Lecture:** Introduction to warehousing principles and technologies. Automatic storage warehouses with high racks and their equipment. Stacker cranes. **Practice:** Calculation of the parameters of warehouses.
8th week: 1st drawing week	
9th week: **Lecture:** The definition of logistics. The connection between the logistics and the supply chain. Company logistics system. **Practice:** Supplying and distributing networks.	**10th week:** **Lecture:** Supply chain management. **Practice:** Analysis of the supply chain of an original equipment manufacturer (OEM) and a supplier (TIER).
11th week: **Lecture:** Procurement logistics. Make or buy decisions. Inventory management. Economic order quantity (EOQ). **Practice:** Demand analysis. Examples for ABC and XYZ analyses. Examples for supplier evaluation. Examples for economic order quantity determination.	**12th week:** **Lecture:** Production logistics. Push and pull type production control. **Practice:** Examples for material requirement planning (MRP) and manufacturing resource planning (MRP II.)

13th week: **Lecture:** Distribution logistics. Distribution systems and technologies. Distribution requirements planning (DRP). Re-cycling logistics. **Practice:** Examples for distribution requirements planning.	**14th week:** **Lecture:** Packaging technology. Dangerous goods. **Practice:** Case studies for packaging technology. Handling of dangerous goods. **2nd test.**
15th week: 2nd drawing week	

Requirements

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 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 1st test in the 7th week and the 2nd test in the 14th week. Students have to sit for the tests.

B, for grade:

The course ends in an **examination**.

The minimum requirement of the 2 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).

Automotive Quality Assurance

Code: MK3MINBG04G317-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 3rd year, 1st semester

Its prerequisite(s): Automotive Process Analysis and Planning I

Further courses are built on it: No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

This course is an introduction to automotive quality assurance (IATF 16949). The students learn about PFMEA, DFMEA, CP, CPK, CMK, Gage R and R, SPC and the first sample approval process. The 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 the students' understanding of brainstorming, 5 why and pareto analysis by the middle of the semester. The focus of the course is on how to create the quality management handbook and how to review the management handbook processes and documentation. By the end of the semester the students will acquire and will be able to use these kinds of methods.

Literature:

Compulsory:

- Roland Mader, Eric Armengaud, Gerhard Griessnig, Christian Kreiner, Christian Steger, Reinhold Weiss: Reliability Engineering & System Safety, December 2013. ISSN 0951-8320
- Hervé Ressencourt, Louise Trave-Massuyes, Jérome Thomes: Fault Detection, Supervision and Safety of Technical Processes 2006, Volume 1, 2007. ISBN 978-0080-0444-857

- Salman Taghizadegan: Essentials of Lean Six Sigma, 2006, Pages 107-174. ISBN 978-0080-4623-325

Recommended:

- Ali Jahan, Kevin L. Edwards: Multi-criteria Decision Analysis for Supporting the Selection of Engineering Materials In Product Design, 2013. ISBN 978-0081-0053-61
- 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. ISBN 1-932828-00-1

Schedule

1st week Registration week	
2nd week:	**3rd week:**
Lecture: Lean Manufacturing, Wates, Lean Terminology and Metrics	**Lecture:** TQM, Definition of Quality, Elements for Success, History of QM
Practice: KPI numbers of Quality, Supplier Evaluation	**Practice:** Case studies about different quality systems
4th week:	**5th week:**
Lecture: 5S method, 5+1S, Plant Layouts	**Lecture:** Continuous Improvement, Kaizen
Practice: 7 wastes	**Practice:** PDCA, Idea Management System
6th week:	**7th week:**
Lecture: ISO system, Definition of Standards, ISO 9000, ISO 9001	**Lecture:** IATF 16949, Certification, VDA 6.3
Practice: General Management Systems	**Practice:** Comparing IATF 16949 with ISO 9001
8th week: 1st drawing week	
9th week:	**10th week:**
Lecture: Techniques to Support IATF 16949, Statistical Analysis, SPC, Measurement System Analysis, MSA	**Lecture:** Techniques to Support IATF 16949, Failure Modes & Effects Analysis, FMEA, Control Plans
Practice: SPC and MSA Calculation	**Practice:** FMEA example, Control Plan example
11th week:	**12th week:**
Lecture: Problem Solving Techniques, Fishbone (Ishikawa) diagram, 5W2H	**Lecture:** Quality Complaints, 3D and 8D documents
Practice: Problem Solving Techniques case studies	**Practice:** Quality Complaint process, 8D report

13th week:	14th week:
Lecture: Production Part Approval Process, PPAP **Practice:** Production Part Approval Process documentations	**Lecture:** Capability indices, CP, CPK, PPK **Practice:** CP, CPK, PPK calculation
15th week: 2nd drawing week	

Requirements

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 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)

Competence Development for Engineers

Code: MK3KOMPM04G317-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 4th year, 1st semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

The aim of the course is to enable students to evaluate competences, the areas where they need development. In this connection, we develop existing competences through trainings, personal development and competence measurement.

Literature:

Compulsory:

- James C. Collins: Good to Great: Why Some Companies Make the Leap...and Others Don't, HarperBusiness, 2001
- Seema Sanghi: The Handbook of Competency Mapping: Understanding, Designing and Implementing Competency Models in Organizations 2nd Edition, New Delhi, 2007

Schedule

1st week Registration week	
2nd week:	3rd week:
Lecture: The concept of self-knowledge, levels, personality tests	Lecture: Motivational Fundamentals, Motivation Theories
Practice: Dr. Helen Fisher's Four Personality Types, Interactions of Different Personality Types (Enneagram)	Practice: Training
4th week:	5th week:
Lecture: Organizational culture	Lecture: Human resource management
Practice: Integration model	Practice: CV, interview techniques, training plan
6th week:	7th week:
Lecture: Conflict Management	Lecture: Stress management
Practice: Training	Practice: Training
8th week: 1st drawing week	
9th week:	10th week:
Lecture: Time Management	Lecture: Leadership tasks and roles
Practice: Training	Practice: Case study
11th week:	12th week:
Lecture: Psychology in leadership	Lecture: Career Plan
Practice: Use the psychology methodology to use situations and case studies	Practice: Developing specific career plans

13th week:	14th week:
Lecture: Strategy	Lecture: Specific Group Method
Practice: Develop a specific strategic plan	Practice: Brain storming, Delphi method
15th week: 2nd drawing week	

Requirements

A, for a signature:

Participation at lectures is compulsory. Students must attend lectures and may not miss more than three of them during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at lectures will be recorded by the lecturer. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed lectures must be made up for at a later date, being discussed with the tutor.

Students have 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
Close fail (2)	40-50
Improvement needed (3)	51-60
Very good (4)	61-70
Excellent (5)	71-80

If somebody fails then he 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:

For their exam everybody will get an exam grade. 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).

Corporate Control Systems and IT Skills

Code: MK3VITIM04G317-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 4th year, 1st semester

Its prerequisite(s): Engineering Informatics II.

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 0+2

Topics:

After completion of the course, students will be able to understand tha major reasons to adopt ERP systems and navigate through the SAP user interface to work on business processes and case studies on their own. Furthermore, this material serves as a reference for occasional users of SAP R/3 systems.

The course contains the following elements: the SAP R/3 systems main features and functions of user interface; the navigation in menus; the data searching; printing reports, finance and accounting practices.

Literature:

Compulsory:

- Mazzulo, J. – Wheatley, P. (2006): SAP R/3 for Everyone: Step-by-Step Instructions, Practical Advice, and Other Tips and Tricks for Working with SAP, Prentice Hall *

Recommended:

- Anderson, G. (2011): Teach Yourself SAP in 24 Hours, Fourth Edition, Sams publisher George Anderson.
- Narayanan, V. (2006): SAP R/3 FI Transactions. SAP R/3 FI Transactions.
- Nicholas G. Carr (2003): Does IT matter? Harvard Business Review.
- Schicht, G. – Schmieden, A. (1999): Flying Start with SAP R/3. Addison-Wesley-Longman Verlag GmbH, Germany.

Schedule

1st week Registration week	
2nd week: **Practice:** Determining the requirements of course	3rd week: **Practice:** Introduction to the ERP Systems, the history of SAP AG
4th week: **Practice:** SAP Business Processes	5th week: **Practice:** SAP Easy Access Screen, Navigation in the Menu
6th week: **Practice:** Favorites, User Profile Data	7th week: **Practice:** Basics of Reports, Screen Variants
8th week: 1st drawing week	
9th week: **Practice:** Layouts, Export Reports	10th week: **Practice: Midterm Test A (50%)**
11th week:	12th week:

Practice: Introduction to Asset Management	**Practice:** Asset Management: creating/changing/reporting Assets
13th week:	**14th week:**
Practice: Introduction to Material Management	**Practice:** Consultation, **Midterm Test B (50%)**
15th week: 2nd drawing week	

Requirements

A, for a signature and grade:

Students have to take two midterm tests (A and B) during the semester. Failed tests can be rewritten as regulated by the Statutes of Examination and Teaching. Personal attendance is required.

The exam evaluated according to the following grading schedule:

0 - 50% – 1

50% - 60% – 2

60% - 70% – 3

70% - 80% – 4

80% - 100% – 5

Mechanical Engineering Project

The course is designed to create the basis for writing thesis. By completing the course requirements national and international literature relating to the thesis topic will be viewed through, a list of sub-tasks will be made and the preliminary content of thesis will be defined. Students will give account of the work done in front of a committee.

Subject group "Differentiated Professional Subjects" for Building Services Engineering Specialization

Building Physics and Acoustics

Code: MK3EFIZL04G217-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 2nd year, 1st semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Internal and solar gains of a building. Balance point temperature. Degree-day curve and calculation. Solar radiation. Irradiance. Global radiation. Beam radiation. Diffuse radiation. Solar constant. Analysis of temperature field in case of one dimensional steady state heat conduction. Temperature field. Thermal conductivity. Specific heat. Thermal diffusivity. Unsteady state heat transfer. Steady state heat transfer. Heat transfer by convection. Temperature variation in a multi layer building element. Heat transfer by radiation. Planck's law. Wien's law. Kirchoff's law. Stefan Boltzmann's law. Lambert's law. Air gaps. Built-in heat conductivity of insulating materials. Thermal bridges. Humid air. Psichrometer. Enthalpy of humid air. Dew point temperature. Surface and capillary condensation. Sorption. Interstitial condensation. Thermal storage. Decrement factor and time lag. Sunspace and Trombe wall. Prediction of thermal comfort in buildings. PMV and PPD values. Introductory wave motion concepts – an elastic continuum viewpoint, Introductory multiple, discrete, mass–spring–damper oscillator concepts – a macroscopic viewpoint, Introductory concepts on natural frequencies, modes of vibration, forced vibrations and resonance, The dynamics of a single oscillator – a convenient model, Undamped free vibrations, Energy concepts The homogeneous acoustic wave equation – a classical analysis, Conservation of mass, Conservation of momentum, Acoustics, The linearised acoustic wave equation, The acoustic velocity potential, The propagation of plane sound waves, Sound intensity, energy density and sound power, Noise and vibration measurement units – levels, decibels and spectra, Objective noise measurement scales, Subjective noise measurement scales, Vibration measurement scales, Addition and subtraction of decibels, Frequency analysis bandwidths, Noise and vibration measurement instrumentation, Noise measurement instrumentation, Vibration measurement instrumentation, Relationships for the measurement of free-field sound propagation Acoustic barriers, Sound-absorbing materials, Phon, Son, WHO directives

Literature:

Compulsory:

- Hugo L. Hens, Building Physics and Applied Building Physics – Package, Wiley, 2012, ISBN: 978-3-433-03031-8, 568 pages.
- Gudni A. Jóhannesson, Building Physics, Terc Kft., 2013, 978-963-9968-86-8, 104 pages.
- M. P. Norton, D. G. Karczub, Fundamentals Of Noise And Vibration Analysis For Engineers, Cambridge University Press, 2003, Online ISBN:9781139163927

Schedule

1st week Registration week	
2nd week: **Lecture:** Internal and solar gains of a building. Balance point temperature. Degree-day curve and calculation. Solar radiation. Irradiance. Global radiation. Beam radiation. Diffuse radiation. Solar constant. **Practice:** Solving problems based on the theme of the lecture.	3rd week: **Lecture:** Analysis of temperature field in case of one dimensional steady state heat conduction. Temperature field. Thermal conductivity. Specific heat. Thermal diffusivity. Steady state heat transfer. Heat transfer by convection. Temperature variation in a multi layer building element. **Practice:** Solving problems based on the theme of the lecture.
4th week: Heat transfer by radiation. Planck's law. Wien's law. Kirchoff's law. Stefan Boltzmann's law. Lambert's law. **Practice:** Solving problems based on the theme of the lecture.	5th week: **Lecture:** Air gaps. Built-in heat conductivity of insulating materials. Humid air. Psichrometer. Enthalpy of humid air. Dew point temperature. **Practice:** Solving problems based on the theme of the lecture. Solving problems based on the theme of the lecture.
6th week: **Lecture:** Thermal bridges. Surface and capillary condensation. Sorption. Interstitial condensation. **Practice:** Solving problems based on the theme of the lecture.	7th week: **Lecture:** Thermal storage. Decrement factor and time lag. Air tightness of buildings. Sunspace and Trombe wall. **Practice:** Solving problems based on the theme of the lecture.
8th week: 1st drawing week	
9th week: **Lecture:** Introduction to wave motion concepts – an elastic continuum viewpoint, Introductory multiple, discrete, mass–spring–damper oscillator concepts – a macroscopic viewpoint, Introductory concepts on natural frequencies, modes of vibration, forced vibrations and resonance, **Practice:** Solving problems based on the theme of the lecture.	10th week: **Lecture:** The dynamics of a single oscillator – a convenient model, Undamped free vibrations, Energy concepts The homogeneous acoustic wave equation – a classical analysis, Conservation of mass, Conservation of momentum, **Practice:** Solving problems based on the theme of the lecture.
11th week:	12th week:

Lecture: Acoustics, The linearised acoustic wave equation,The acoustic velocity potential,The propagation of plane sound waves, Sound intensity, energy density and sound power **Practice:** Solving problems based on the theme of the lecture.	**Lecture:** Noise and vibration measurement units – levels, decibels and spectra, Objective noise measurement scales, Subjective noise measurement scales, Vibration measurement scales, Addition and subtraction of decibels, Frequency analysis bandwidths **Practice:** Solving problems based on the theme of the lecture.
13th week: **Lecture:** Noise and vibration measurement instrumentation, Noise measurement instrumentation, Vibration measurement instrumentation **Practice:** Solving problems based on the theme of the lecture.	**14th week:** **Lecture:** Relationships for the measurement of free-field sound propagation Acoustic barriers, Sound-absorbing materials, Phon, Son, WHO directives **Practice:** Test 2.
15th week: 2nd drawing week	

Requirements

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:

$FG=0.25\times T1+0.25\times T2+0.5\times E$

T1 – grade obtained at Test 1 (>2)

T2 – grade obtained at Test 2 (>2)

E – grade obtained at the written or oral exam (>2)

Building Energetics I.

Code: MK3EEN1L04G217-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 2nd year, 2nd semester

Its prerequisite(s): Building Physics and Acoustics

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

The relations between the energy, the economy, the society and the environment. The basic definitions of the energy management, the systems of the energy supply and the different kinds of converters. The importance of the building energetics, the EPBD directive and the Hungarian regulations. The energy model of the building. The energy performance of the building (method of calculation). The relevant regulations, requirements, rules. Energy performance certification. Improving the energy efficiency of the building and possibilities of reducing the energy need and energy use of the building. The cost optimal level - methods and requirements. The nearly zero energy buildings.

Literature:

Compulsory:

- Al-Shemmeri, T. Energy Audits, Willey-Blackwell, 2011.
- EPBD recast (http://eur-lex.europa.eu)
- Richarz, C. and Schulz, C. Energy efficiency refurbishments, FSC, 2013.
- Hugo L. Hens, Building Physics and Applied Building Physics – Package, Wiley, 2012, ISBN: 978-3-433-03031-8, 568 pages.
- Gudni A. Jóhannesson, Building Physics, Terc Kft., 2013, 978-963-9968-86-8, 104 pages.
- M. P. Norton, D. G. Karczub, Fundamentals Of Noise And Vibration Analysis For Engineers, Cambridge University Press, 2003, Online ISBN:9781139163927
-

Recommended:

- Hodge, B. Alternative Energy Systems and Applications, Wiley, 2009.
- Kalmár, F. Energy concious heating, Akadémia Kiadó, 2011.
- Moss, J. K. Energy Management in Buildings, Taylor & Francis, 2006.
- Moss, J. K. Heat and Mass Transfer in Buildings, 2nd edition, Taylor & Francis, 2007.
- Littler, J. and Thomas, R. Design with energy The conservation and use of energy in buildings, Cambridge University Press, 2003.

Schedule

1st week Registration week	
2nd week: Lecture: The relations between the energy, the economy, the society and the environment. The basic definitions of the energy management, the systems of the	3rd week: Lecture: The importance of the building energetics, the EPBD directive and the Hungarian regulations. The relevant regulations, requirements, rules

energy supply and the different kinds of converters. **Practice:** Semester project work hand-out.	**Practice:** Heat transfer calculations.
4th week: **Lecture:** The energy model of the building. The energy balance of the building. Components of the energy balance. **Practice:** Examples of calculation.	**5th week:** **Lecture:** Degree-day method. **Practice:** Examples of calculation.
6th week: **Lecture:** Net energy need for heating. Summer overheating of a building. **Practice:** Examples of calculation.	**7th week:** **Lecture:** Heating primer energy use calculation methods. **Practice:** Examples of calculation.
8th week: 1st drawing week	
9th week: **Lecture:** Ventilation primer energy use calculation methods. **Practice:** Examples of calculation.	**10th week:** **Lecture:** Cooling primer energy use calculation methods. **Practice:** Examples of calculation.
11th week: **Lecture:** DHW and lighting systems primer energy use calculation methods. **Practice:** Examples of calculation.	**12th week:** **Lecture:** The cost optimal level - methods and requirements. **Practice:** Examples of calculation.
13th week: **Lecture:** The nearly zero energy buildings. Energy performance certification. **Practice:** Examples of calculation.	**14th week:** **Lecture:** Improving the energy efficiency of the building and possibilities of reducing the energy need and energy use of the building. **Practice:** Examples of calculation.
15th week: 2nd drawing week	

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. 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. Student have to submit the semester project work as scheduled minimum on a sufficient level.

B, for a grade:

The course ends in a midyear grade based on the average grade of the two tests and the drade of semester project work. The minimum requirement of the mid-term, the end-term test and the semester project work is 60% separately. The grade for each test is given according to the following: percent 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 percent, the student once can take a retake test of the whole semester material.

Gas and Burning Techniques

Code: MK3GAZTL04G217-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 3rd year, 1st semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Natural gas properties. Combustion technology properties. Operation of measuring devices. Process of the measurement. Prescriptions, standards. European scheme for classification of gas appliances according to the method of evacuation of the combustion products. Type A, B, C combustion product.

Flue gas. Calculation of combustion air volume flow and flue gas volume. Function of draught diverter. Combustion circuit. Vertical and horizontal terminal. Separate terminals. Eco design requirements for space heaters and combination heaters. Main components of the chimney. Classification of the chimney according to EN 1443:2003. Temperature classes. Costum-built chimney – system chimney. Theoretical draught available due to chimney. Pressure resistance of the chimney. Temperature requirements. Location of the chimney outlet.

Literature:

Compulsory:

- 1. Nils R. Grimm, Handbook of HVAC Design, McGraw Hill Publishing Company, 1990
- 2. Reddy, T. Agami (2017) Heating and cooling of buildings : principles and practice of energyefficient design. ISBN: 9781439899892, 859 p.

Schedule

1st week Registration week	
2nd week: Lecture: Natural gas properties. Seminar: Determination of the natural gas properties.	3rd week: Lecture: Combustion technology properties. Seminar: Combustion technology calculations.
4th week: Lecture: Prescriptions, standards. Seminar: Operation of measuring devices. Process of the measurement	5th week: Lecture: Classification of gas appliances according to the method of evacuation of the combustion products Seminar: Type A, B, C combustion product.
6th week: Lecture: Function of draught diverter. Combustion circuit. Seminar: Mid-term test.	7th week: Lecture: Vertical and horizontal terminal. Separate terminals. Seminar: Calculation of combustion air volume flow and flue gas volume.
8th week: 1st drawing week	
9th week: Lecture: Ecodesign requirements for space heaters and combination heaters. Seminar: Choosing the main components of the chimney.	10th week: Lecture: Classification of the chimney according to EN 1443:2003. Seminar: Choosing the main components of the chimney.
11th week: Lecture: Costum-built chimney – system chimney Seminar: Elaborating the homework.	12th week: Lecture: Temperature classes. Temperature requirements. Seminar: Location of the chimney outlet.
13th week: Lecture: Theoretical draught available due to chimney. Seminar: Calculations for the theoretical draught available due to chimney.	14th week: Lecture: Pressure resistance of the chimney. Seminar: Calculations for the Pressure resistance of the chimney.
15th week: 2nd drawing week: End-term test.	

Requirements

A, for signature:

Attendance on the lectures is recommended, but not compulsory.

Participation at practice is compulsory. Student must attend the practices and may 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. 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 grade:

The course ends in 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:

- grade of the end-term test
- 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 covering the whole semester material.

The exam is a 60 minute theory test.

The grade for the exam is given same as to given for the end-term test. (upper table)

Heating Systems I.

Code: MK3FUT1L04G217-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 3rd year, 1st semester

Its prerequisite(s): Building Physics and Acoustics

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+1

Topics:

Heat demand calculation. Heat distribution devices in heating systems, heating capacity of radiators, logarithmic temperature difference. Classification of boilers, constructions,

choosing boilers, boiler efficiencies: combustion, standard and seasonal efficiency. Efficiency of non-condensing and condensing boilers. Annual fuel demand. Pipe sizing, dimensioning the pump, pump efficiency, law of affinity, parallel connected pumps, pump performance control, elements in speed controlling. Operation and sizing of thermostatic valves, choice of control unit, pre-setting of thermostatic valves. Open and closed heating systems. Water content of heating systems, pressure calculations, choosing expansion vessels. Basic of heating system design, schematic symbols, schematic flow diagram of a boiler house. Vertical and horizontal arrangement.

Literature:

Compulsory:

- Harvey, Leslie Daryl Danny (2006) A handbook on low-energy buildings and district-energy systems: fundamentals, techniques and examples, ISBN: 1844072436, 9781844072439, 701 pages.
- Petitjean, Robert (1997) Total hydronic balancing: A handbook for design and troubleshooting of hydronic hvac systems, ISBN: 9163080796, 529 pages
- Ferenc, Kalmár (2011) Energy conscious heating, ISBN: 9789630590587, 142 pages.

Schedule

1st week Registration week	
2nd week: Lecture: Heat demand calculation. Basic relationships. Seminar: Heat demand calculation for a room.	3rd week: Lecture: Heat distribution devices in heating systems. Seminar: Logarithmic temperature difference. Calculations of heating capacity of radiators.
4th week: Lecture: Classification of boilers. Boiler efficiencies: combustion, standard and seasonal efficiency. Seminar: Choosing of boilers.	5th week: Lecture: Annual fuel demand. Condensing boilers. Seminar: Pipe sizing. Calculation of the mass flow. Major and minor losses.
6th week: Lecture: Pump efficiency. Energy Efficiency Index. Seminar: Dimensioning the pump.	7th week: Lecture: Pumps connected in parallel and series. Adjusting pump performance. Throttle control, speed control. Law of affinity. Seminar: Exercises in connected pumps. Pump curves, duty point.
8th week: 1st drawing week	
9th week:	10th week:

Lecture: Operation of thermostatic valves. Pre-setting.	**Lecture:** Open and closed heating systems. Water content of heating systems.
Seminar: Sizing of thermostatic valve. Pre-setting calculations.	**Seminar:** Pressure calculations, choosing expansion vessels.
11th week:	**12th week:**
Lecture: Basic of heating system design. Schematic symbols.	**Lecture:** Schematic flow diagram of a boiler house.
Seminar: Elaborating the homework.	**Seminar:** Elaborating the homework.
13th week:	**14th week:**
Lecture: Vertical and horizontal arrangement.	**Lecture:** Current situation in energetics.
Seminar: Elaborating the homework.	**Seminar:** Visitation of the Sustainable Building Energetics Information Centre.
15th week: 2nd drawing week: submitting the homework, end-term test	

Requirements

A, for signature:

Attendance on the lectures is recommended, but not compulsory.

Participation at practice is compulsory. Student must attend the practices and may 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. 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 grade:

The course ends in 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:

- grade of the end-term test
- 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 covering the whole semester material.

The exam is a 60 minute theory test.

The grade for the exam is given same as to given for the end-term test. (upper table)

Ventilation and Air Conditioning Systems I.

Code: MK3LKT1L04G217_EN
ECTS Credit Points: 4
Evaluation: mid-semester grade exam
Year, Semester: 3rd year, 1st semester
Its prerequisite(s): MK3EFIZL04G217_EN
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+1

Topics:

Physical Properties of Air, h-x diagram, cooling load calculation. Determination of air flow demand for ventilation. Determination of fresh air in ventilation and air conditioning systems. Space requirements. Air distribution in the space. Hydraulic, acoustic planning of the air duct. Ventilation and air conditioning systems and equipment. Solving problems based on the theme of the lecture. Measurements in the laboratory of ventilation. Air temperature and velocitie measurement in case of mixing air distribution systems I.

Literature:

Compulsory:

- 2015 ASHRAE Handbook HVAC Applications, ASHRAE, 1791 Tullie Circle, N.E., Atlanta, GA 30329, ISBN 978-1-936504-94-7 (SI Edition)
- ASHRAE Handbook - Fundamentals (SI Edition)
- ASHRAE Handbook HVAC Systems and Equipment (SI Edition)

Schedule

1st week Registration week	
2nd week: **Lecture:** Physical Properties of Air **Practice:** Solving problems based on the theme of the lecture.	**3rd week:** **Lecture:** Structure of the h-x diagram. Equation **Practice:** Solving problems based on the theme of the lecture.
4th week: **Lecture:** Cooling load, heating load calculation of the building.	**5th week:** **Lecture:** Determination of air flow demand for ventilation.

Practice: Solving problems based on the theme of the lecture. Elaborating the ventilation and air conditioning plan.	**Practice:** Solving problems based on the theme of the lecture.
6th week: **Lecture:** Determination of fresh air in ventilation and air conditioning systems. **Practice:** Solving problems based on the theme of the lecture.	**7th week:** **Lecture:** Space requirements from MSZ CR 1752:2000. Definition of PMV, PPD, Tu, DR. **Practice:** Solving problems based on the theme of the lecture. Consultation about plans. Working with plans in team. Self Control Test.
8th week: 1st drawing week	
9th week: **Lecture:** Air distribution in the space. **Practice:** Solving problems based on the theme of the lecture. Measurements in the laboratory of ventilation. Air temperature and velocitie measurement in case of mixing air distribution systems I.	**10th week:** **Lecture:** Hydraulic planning of the air duct. **Practice:** Solving problems based on the theme of the lecture. Consultation about plans. Working with plans in team.
11th week: **Lecture:** Acoustic planning of the air duct scales. **Practice:** Solving problems based on the theme of the lecture.	**12th week:** **Lecture:** Ventilation and air conditioning systems I. **Practice:** Solving problems based on the theme of the lecture. . Consultation about plans. Working with plans in team.
13th week: **Lecture:** Ventilation and air conditioning equipment. **Practice:** Solving problems based on the theme of the lecture.	**14th week:** **Lecture:** Self Control Test. **Practice:** Deadline for the plan.
15th week: 2nd drawing week	

Requirements

A, for signature:

Attendance at **lecture** is recommended, but not compulsory.

Attendance on the **seminar** is compulsory.

Student must attend on the seminar and may not miss more than three lectures during the semester. In case a student misses more than three, 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. Active participation is evaluated by the teacher in every class. If student's behaviour 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 is one test. Deadline for the plan.

B, for grade:

The course ends with exam **grade**. 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)

Water Supply and Canalization in Buildings I.

Code: MK3VCS1L04G217-EN
ECTS Credit Points: 4
Evaluation: exam
Year, Semester: 3rd year, 2nd semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:

Cold water and supply systems, rain cycle, sources of water supply, acidity and alkalinity in water, filtration of water, sterilisation and disinfection, storage and distribution of water. Water mains, valves and taps, joints on water pipes, pipe jointing materials, direct system of cold water supply, indirect system of cold water supply. Hard and soft water, water softening, water conditioning and treatment. Backflow protection, secondary backflow protection, cold water storage cisterns, cold water storage calculations, boosted cold water systems, delayed action float valve. Pump laws, pipe sizing, hydraulics and fluid flow. Drainage systems and

sewage treatment systems, combined and separate systems, partially separate system, rodding point system, sewer connection. 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. Garage drainage, drainage pumping, subsoil drainage, tests on drains, soakaways, cesspools and septic tanks, drainage fields and mounds, rainwater management, drainage design. Sanitary fitments and appliances, flushing cisterns, troughs and valves, water closets, bidets, showers, baths, sinks, wash basins and troughs, unplugged appliances. Thermostatic temperature control, urinals, hospital sanitary appliances, sanitary conveniences, sanitary conveniences for disabled people, traps and waste valve. Single stack system and variations, one- and two-pipe systems, pumped waste system, wash basins, waste arrangements, waste pipes from washing machines and dishwashers, air test, sanitation data, offsets, ground floor appliances, high rise buildings.

Literature:

Compulsory:

- Fred Hall and Roger Greeno (2011) Building Services Handbook, Sixth edition, Elsevier Limited, ISBN: 978-0-08-096982-4, 694 pages
- David V. Chadderton (2007) Building Services Engineering, Fifth edition, Taylor & Francis, ISBN 0-203-96299-0, 427 pages.
- F. Porges (2001) HVAC Engineer's Handbook, Eleventh edition, ISBN 0 7506 4606 3, 288 pages

Schedule

1st week Registration week	
2nd week: Lecture: Cold water and supply systems, rain cycle, sources of water supply, acidity and alkalinity in water, filtration of water, sterilisation and disinfection, storage and distribution of water Practice: Giving and introducing the task for the semester	3rd week: Lecture: Water mains, valves and taps, joints on water pipes, pipe jointing materials, direct system of cold water supply, indirect system of cold water supply Practice: Making the design of the semester task step 1
4th week: Lecture: Hard and soft water, water softening, water conditioning and treatment Practice: Examples and solutions for calculation of water softening	5th week: Lecture: Backflow protection, secondary backflow protection, cold water storage cisterns, cold water storage calculations, boosted cold water systems, delayed action float valve Practice: Examples and solutions for calculation of water storage
6th week:	7th week:

Lecture: Pump laws, pipe sizing, hydraulics and fluid flow **Practice:** Examples and solutions for calculation of , pipe sizing	**Lecture:** Drainage systems and sewage treatment systems, combined and separate systems, partially separate system, rodding point system, sewer connection **Practice:** Making the design of the semester task step 2
8th week: 1st drawing week	
9th 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 **Practice:** Examples and solutions for calculation of drainage ventilation.	**10th week:** **Lecture:** Garage drainage, drainage pumping, subsoil drainage, tests on drains, soakaways, cesspools and septic tanks, drainage fields and mounds, rainwater management, drainage design **Practice:** Examples and solutions for calculation of drainage
11th week: **Lecture:** Sanitary fitments and appliances, flushing cisterns, troughs and valves, water closets, bidets, showers, baths, sinks, wash basins and troughs, unplugged appliances **Practice:** Making the design of the semester task step 3	**12th week:** **Lecture:** Thermostatic temperature control, urinals, hospital sanitary appliances, sanitary conveniences, sanitary conveniences for disabled people, traps and waste valve **Practice:** Making the design of the semester task step 4
13th week: **Lecture:** Single stack system and variations, one- and two-pipe systems, pumped waste system, wash basins, waste arrangements, waste pipes from washing machines and dishwashers, air test, sanitation data, offsets, ground floor appliances, high rise buildings **Practice:** Examples of pumped waste system and making the design of the semester task step 5	**14th week:** **Lecture:** Fire stops and seals, flow rates and discharge units, sanitation design, discharge stack sizing **Practice:** Examples and solutions for calculation of storm sewer water collection and disposal. Making the design of the semester task step 6
15th week: 2nd drawing week	

Requirements

A, for a signature and a grade: 2 tests and an exam

Ventilation and Air Conditioning Systems II.

Code: MK3LKT2L05G217_EN

ECTS Credit Points: 5

Evaluation: exam

Year, Semester: 3rd year, 2nd semester

Its prerequisite(s): MK3LKT1L04G217_EN

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+3

Topics:

Properties of fabric filter. Heat exchanger in the ventilation and air conditioning systems. Heating and cooling coils, fans in the ventilation and air conditioning systems. Diffusers and jet nozzles used in the ventilation and air conditioning systems. Fire and smoke control. Fire preventation, fire dampers. Based on air conditioning. Humidifier. Ventilation and air conditioning systems and equipment for comfort applications, industrial applications. Solving problems based on the theme of the lecture. Measurements in the laboratory of ventilation. Temperature and velocity measurement in case of mixing air distribution systems II. Temperature and velocity measurement in case of displacement air distribution systems.

Literature:

Compulsory:

1. 2015 ASHRAE Handbook HVAC Applications, ASHRAE, 1791 Tullie Circle, N.E., Atlanta, GA 30329, ISBN 978-1-936504-94-7
2. ASHRAE Handbook - Fundamentals (SI Edition)
3. ASHRAE Handbook HVAC Systems and Equipment (SI Edition)

Schedule

1st week Registration week	
2nd week: **Lecture:** Design the fabric filter in ventilation and air conditioning systems. **Practice:** Solving problems based on the theme of the lecture. Elaborating the ventilation and air conditioning plan.	3rd week: **Lecture:** Design the heat exchanger in ventilation and air conditioning systems. **Practice:** Solving problems based on the theme of the lecture.
4th week: **Lecture:** Design the fans in ventilation and air conditioning systems. **Practice:** Solving problems based on the theme of the lecture.	5th week: **Lecture:** Design the heating coils in ventilation and air conditioning systems. **Practice:** Solving problems based on the theme of the lecture.

	Consultation about plans. Working with plans in team.
6th week: **Lecture:** Diffusers and jet nozzles **Practice:** Solving problems based on the theme of the lecture. Temperature and velocity measurement in case of mixing air distribution systems II.	7th week: **Lecture:** Fire preventation, fire dampers in ventilation and air conditioning systems. **Practice:** Solving problems based on the theme of the lecture. Consultation about plans. Working with plans in team. Temperature and velocity measurement in case of displacement air distribution systems. Self Control Test.
8th week: 1st drawing week	
9th week: **Lecture:** Base of air conditioning. Air conditioning equipment. **Practice:** Solving problems based on the theme of the lecture.	10th week: **Lecture:** Design the cooling coils, humidifier in air conditioning systems. **Practice:** Solving problems based on the theme of the lecture. Consultation about plans. Working with plans in team.
11th week: **Lecture:** Air conditioning systems for comfort applications **Practice:** Solving problems based on the theme of the lecture.	12th week: **Lecture:** Air conditioning equipment for comfort applications **Practice:** Solving problems based on the theme of the lecture.
13th week: **Lecture:** Air conditioning systems for industrial applications. Air conditioning equipment for industrial applications Consultation about plans. Working with plans in team. **Practice:** Solving problems based on the theme of the lecture.	14th week: **Lecture:** Self Control Test. **Practice:** Deadline for the plan.
15th week: 2nd drawing week	

Requirements

A, for signature:

Attendance at **lecture** is recommended, but not compulsory.

Attendance on the **seminar** is compulsory.

Student must attend on the seminar and may not miss more than three lectures during the semester. In case a student misses more than three, 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. Active participation is evaluated by the teacher in every class. If student's behaviour 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 is one test. Deadline for the plan.

B, for grade:

The course ends with exam **grade**. 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)

Heating Systems II.

Code: MK3FUT2L05G217-EN

ECTS Credit Points: 5

Evaluation: exam

Year, Semester: 3rd year, 2nd semester

Its prerequisite(s): Heating Systems I.

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+3

Topics:

Wood-fuelled heating systems (pellet, wood chips, log). Boiler protection, accessories for boilers (thermostatic mixing valve, heat exchanger, safety valve). Sizing of thermal storage tanks. Temperature and mass flow control of radiator loops, mixing and diverting valves. 2- and 3-way control valve calculations, Kv value, authority. Surface heatings: floor-, ceiling-, wall-heating. Dry and wet surface heating systems. Outdoor temperature control. Hydraulic balancing, problems caused by improper balance, splitting into hydronic modules, unfavourable circuit, proportion rule, balancing methods (proportional, compensated), troubleshooting, measuring devices. Deaeration in heating systems, Henry's law, microbubbles, dirt in water, air and dirt removals, filters. Advanced of heating system design. Energy conscious heating.

Literature:

Compulsory:

- Harvey, Leslie Daryl Danny (2006) A handbook on low-energy buildings and district-energy systems: fundamentals, techniques and examples, ISBN: 1844072436, 9781844072439, 701 pages.
- Petitjean, Robert (1997) Total hydronic balancing: A handbook for design and troubleshooting of hydronic hvac systems, ISBN: 9163080796, 529 pages
- Ferenc, Kalmár (2011) Energy conscious heating, ISBN: 9789630590587, 142 pages.

Schedule

1st week Registration week	
2nd week: **Lecture:** Wood-fuelled heating systems. Pellet, wood chips. **Seminar:** Boiler protection: thermostatic mixing valve.	3rd week: **Lecture:** Wood-fuelled heating systems. Wood log boilers. **Seminar:** Boiler protection: heat exchanger, safety valve.
4th week: **Lecture:** Thermal storage tanks. **Seminar:** Sizing of thermal storage tanks.	5th week: **Lecture:** Temperature and mass flow control of radiator loops. **Seminar:** 2- and 3-way control valve calculations.
6th week: **Lecture:** Mixing and diverting valves. **Seminar:** Choosing the suitable regulating valve.	7th week: **Lecture:** Kv values. Authority. **Seminar:** Calculations of Kv values. Authority calculations.
8th week: 1st drawing week	
9th week: **Lecture:** Surface heatings: floor-, ceiling-, wall-heating. Outdoor temperature control. **Seminar:** Sizing of floor heating. Hydronic calculations.	10th week: **Lecture:** Hydraulic balancing: Effect of the improper balance. Unfavourable circuit. proportion rule. Balancing methods. (proportional, compensated) **Practice:** Sizing of wall-heating. Hydronic calculations. Balancing calculations.
11th week: **Lecture:** Deaeration in heating systems, Henry's law. Microbubbles. Dirt in water, air and dirt removals, filters.	12th week: **Lecture:** Advanced of heating system design. **Seminar:** Elaborating the homework.

Seminar: Balancing measing device. Troubleshooting.	
13th week: **Lecture:** Energy conscious heating. **Seminar:** Elaborating the homework.	**14th week:** **Lecture:** Visitation of the Sustainable Building Energetics Information Centre. **Seminar:** Elaborating the homework.
15th week: 2nd drawing week: Submitting the homework, End-term test.	

Requirements
for grade: exam

Water Supply and Canalization in Buildings II.

Code: MK3VCS2L04G217-EN
ECTS Credit Points: 4
Evaluation: exam
Year, Semester: 4th year, 1st semester
Its prerequisite(s): Water Supply and Canalization in Buildings I.
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:
Hot water supply systems, demands. Direct system of hot water supply, indirect system of hot water supply, unvented hot water storage system. Expansion and temperature relief valves, hot water storage cylinders. Primatic hot water storage cylinder, medium and high rise building supply systems. Sealed indirect hot water system for a high rise building. Primary thermal stores. Types of boiler. Secondary circulation, duplication of plant, electric and gas water heaters. Solar heating of water. Hot water storage capacity, Boiler rating, pipe sizing, pressurized systems. Circulation pump rating. Legionnaires' disease in hot water systems. Ecodesign requirements for water heaters and hot water storage tanks.

Literature:
Compulsory:

- Fred Hall and Roger Greeno (2011) Building Services Handbook, Sixth edition, Elsevier Limited, ISBN: 978-0-08-096982-4, 694 pages
- David V. Chadderton (2007) Building Services Engineering, Fifth edition, Taylor & Francis, ISBN 0-203-96299-0, 427 pages.
- F. Porges (2001) HVAC Engineer's Handbook, Eleventh edition, ISBN 0 7506 4606 3, 288 pages.

Schedule

1st week Registration week	
2nd week: **Lecture:** Hot water supply systems, demands. Direct system of hot water supply, indirect system of hot water supply, unvented hot water storage system. **Practice:** Giving and introducing the task for the semester	3rd week: **Lecture:** Expansion and temperature relief valves, hot water storage cylinders. **Practice:** Making the design of the semester task step 1
4th week: **Lecture:** Primatic hot water storage cylinder, medium and high rise building supply systems. Sealed indirect hot water system for a high rise building **Practice:** Examples and solutions for calculation of expansion of hot water. Making the design of the semester task step 2	5th week: **Lecture:** Primary thermal stores, Types of boiler **Practice:** Examples of hot water systems
6th week: **Lecture:** Ecodesign requirements for water heaters and hot water storage tanks **Practice:** Making the design of the semester task step 3	7th week: **Lecture:** Hot water storage capacity, boiler rating, pipe sizing, pressurized systems, circulation pump rating. **Practice:** Examples of seasonal efficiency of domestic boilers.
8th week: 1st drawing week	
9th week: **Lecture:** Legionnaires' disease in hot water systems. **Practice:** Making the design of the semester task step 4	10th week: **Lecture:** Solar, electric and gas heating of water. **Practice:** Examples and solutions for calculation of solar collector system's elements
11th week: test	

Requirements

A, for a signature and grade: test and exam

Cooling Systems I.

Code: MK3HTE1L04G217-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 4th year, 1st semester

Its prerequisite(s): Building Physics and Acoustics

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Calculation of heat load. Overview of cooling systems. Vapor-compression refrigeration systems. The structure of cooling machine: compressor, evaporator, condenser, expansion valves. Refrigerant. The structure of log p-h (pressure-enthalpy) diagram: isobar, isothermal, isenthalpic, isentropic curves. Ideal and actual vapor-compression refrigeration cycle. Single- and multistage vapor-compression refrigeration cycle. Operation of cooling machines. Fan-coil systems. Parts of cooling hydraulic system: Pump, flow-switch, pipe insulation. Calculation of cooling hydraulic system. Ceiling and Wall cooling

Literature:

Compulsory:

- Harvey, Leslie Daryl Danny (2006) A handbook on low-energy buildings and district-energy systems: fundamentals, techniques and examples, ISBN: 1844072436, 9781844072439, 701 pages.
- Hundy G.F., Trott A.R., Welch T.C. (2008) Refrigeration and Air-conditioning (fourth edition), ISBN:978-0-7506-8519-1, 381 pages
- Ferenc, Kalmár (2011) Energy conscious heating, ISBN: 9789630590587, 142 pages.

Schedule

1st week Registration week	
2nd week: Lecture: Calculation of heat load. Overview of cooling systems. Practice: The particular application of the theoretical curriculum said during the lecture	3rd week: Lecture: Fan-coil systems. Practice: The particular application of the theoretical curriculum said during the lecture
4th week: Lecture: Ceiling and Wall cooling	5th week:

Practice: The particular application of the theoretical curriculum said during the lecture	**Lecture:** Parts of cooling hydraulic system: Pump, flow-switch, pipe insulation Calculation of cooling hydraulic system. **Practice:** The particular application of the theoretical curriculum said during the lecture
6th week: **Lecture:** Vapor-compression refrigeration systems. **Practice:** The particular application of the theoretical curriculum said during the lecture	**7th week:** **Lecture:** Refrigerant **Practice:** The particular application of the theoretical curriculum said during the lecture
8th week: 1st drawing week	
9th week: **Lecture:** The structure of log p-h (pressure-enthalpy) diagram. Ideal and actual vapor-compression refrigeration cycle. **Practice:** The particular application of the theoretical curriculum said during the lecture	**10th week:** **Lecture:** Single stage vapor-compression refrigeration cycle. **Practice:** The particular application of the theoretical curriculum said during the lecture
11th week: **Lecture:** Multistage vapor-compression refrigeration cycle. **Practice:** The particular application of the theoretical curriculum said during the lecture	**12th week:** **Lecture:** The structure of cooling machine: compressor, condenser. **Practice:** The particular application of the theoretical curriculum said during the lecture
13th week: **Lecture:** The structure of cooling machine: evaporator, expansion valves. **Practice:** The particular application of the theoretical curriculum said during the lecture	**14th week:** **Lecture:** Operation of cooling machines. **Practice:** The particular application of the theoretical curriculum said during the lecture
15th week: 2nd drawing week	

Requirements

A, for signature:

Attendance on the **practice** is compulsory.

Student must attend on the lecture and may not miss more than three lectures during the semester. In case a student misses more than three, 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 student's behaviour 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 one test: the end-term test in the 15th week. Students have to sit for the tests.

B, for grade:

The course ends with exam **grade**, the grade for the exam is given according to the following table:

Score	Grade
0-50	fail (1)
51-60	pass (2)
61-80	satisfactory (3)
81-90	good (4)
91-100	excellent (5)

Measurements and Design of HVAC Systems I.

Code: MK3EMT1L04G217-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 3rd year, 2nd semester

Its prerequisite(s): Heating Systems I., Ventilation and Air Conditioning Systems I.

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 0+3

Topics:

Content and form requirements of HVAC design. Design: Gas and Water supply system, Heating and cooling system, Air-conditioning system. Measure: Analysis of flue gas, Characteristic curve of a valve , Static and dynamic hydronic balancing, Temperature distribution in case of floor heating, Air temperature and velocities in case of displacement ventilation systems.

Literature:

Compulsory:

- Harvey, Leslie Daryl Danny (2006) A handbook on low-energy buildings and district-energy systems: fundamentals, techniques and examples, ISBN: 1844072436, 9781844072439, 701 pages.

- Wiltshire, Robin (2016) Advanced District Heating and Cooling (DHC) systems, ISBN 9781782423744, 346 pages
- Hundy G.F., Trott A.R., Welch T.C. (2008) Refrigeration and Air-conditioning (fourth edition), ISBN:978-0-7506-8519-1, 381 pages
- Ferenc, Kalmár (2011) Energy conscious heating, ISBN: 9789630590587, 142 pages.

Schedule

1st week Registration week	
2nd week: Practice: Content and form requirements of HVAC design	3rd week: Practice: Analysis of flue gas
4th week: Practice: Gas supply system design	5th week: Practice: Characteristic curve of a valve
6th week: Practice: Heating system design	7th week: Practice: Static hydronic balancing
8th week: 1st drawing week	
9th week: Practice: Cooling system design	10th week: Practice: Dynamic hydronic balancing
11th week: Practice: Water supply system design	12th week: Practice: Temperature distribution in case of floor heating
13th week: Practice: Air-conditioning system design	14th week: Practice: Air temperature and velocities in case of displacement ventilation systems
15th week: 2nd drawing week	

Requirements

A, for signature:

Attendance on the practice, hours is compulsory.

Student must attend on the lecture and may not miss more than three lectures during the semester. In case a student misses more than three, 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. Active participation is evaluated by the teacher in every class. If student's behaviour 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 one test: (the end-term test in the 15th week) and 6 test report.

B, for grade:

The course ends in a mid-semester **grade,** based on the test report and the end-term test.
The grade for the exam is given according to the following table:

Score	Grade
0-50	fail (1)
51-60	pass (2)
61-80	satisfactory (3)
81-90	good (4)
91-100	excellent (5)

District heating

Code: MK3TFUTL04G217-EN
ECTS Credit Points: 4
Evaluation: mid-semester grade
Year, Semester: 4th year, 1st semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:

Comprehensive overview of DHC systems and the technologies and energy resources utilized within these systems. Analyses the various methods used for harnessing energy to apply to DHC systems, Ideal resource for those interested in district cooling, Heat networks, distributed heating. Thermal energy, cogeneration, combined heat and power, and CHP. Reviews the application of DHC systems in the field, including both the business model side and the 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. 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. Basic energetics. Purpose of district heating and cooling. Power plants. Trigeneration. Fluids. Pressure relations. Track of the district heating and cooling. Basic elements of the system. Basics of system design. Common issues of the system. Dilation. Circulation. Buildings with connection with the system. Static, hydraulic and caloric calculation. Caloric centre. Utility tunnel. Direct indirect system. Constant and variable mass flow.

Literature:

Compulsory:

- Committee on District Heating and Cooling, National Research Council (1985) District Heating and Cooling in the United States ISBN: 978-0-309-03537-8 168 pages
- Sven Werner (2013) District Heating and Cooling, Studentlitteratur AB, ISBN-13: 978-9144085302, 588 pages
- Robin Wiltshire (2015) Advanced District Heating and Cooling (DHC), Woodhead Publishing ISBN: 978-1-78242-395-9

Schedule

1st week Registration week	
2nd 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. Practice: The practical application of the theoretical curriculum said during the lecture.	3rd week: Lecture: Purpose of district heating and cooling. Comprehensive overview of DHC systems and the technologies and energy resources utilized within these systems. Practice: The practical application of the theoretical curriculum said during the lecture.
4th week: Lecture: Analyses the various methods used for harnessing energy to apply to DHC systems, Ideal resource for those interested in district cooling. Practice: The practical application of the theoretical curriculum said during the lecture.	5th week: Lecture: Track of the district heating and cooling. Heat networks, distributed heating. Thermal energy, cogeneration, combined heat and power, and CHP. Trigeneration. Practice: The practical application of the theoretical curriculum said during the lecture.
6th week: Lecture: Building of the distribution lines. Utility tunnel.	7th week: Lecture: Direct indirect system. Reviews the application of DHC systems in the field,

Practice: The practical application of the theoretical curriculum said during the lecture.	including both the business model side and the 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. **Practice:** The practical application of the theoretical curriculum said during the lecture.
8th week: 1st drawing week	
9th week: **Lecture:** Constant and variable mass flow. **Practice:** The practical application of the theoretical curriculum said during the lecture.	10th week: **Lecture:** Basics of system design. Common issues of the system. Dilation. Circulation. Buildings with connection with the system. Static, hydraulic and caloric calculation. Caloric centre. System schematics. **Practice:** The practical application of the theoretical curriculum said during the lecture. The practical application of the theoretical curriculum said during the lecture

Requirements

A, for a signature:

Attendance on the lectures is compulsory.

Student must attend on the lecture and may not miss more than three lectures during the semester. In case a student misses more than three, 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 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.

B, for grade:

The course ends with exam grade. The grade for the exam 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)

Subject group “Differentiated Professional Subjects” for Operation and Maintenance Specialization

Theory of Damage

Code: MK3KAREG04G117-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 3rd year, 1st semester

Its prerequisite(s): Manufacturing Processes II

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+1

Topics:

The aim of the course is to describe the damage to the materials based on the exact mathematical mechanical and physical background. A description of the changes in the errors in the materials and, based on this, an estimation of the lifetime of a given fault. From now on, demonstration of destruction-free tests and procedures to detect errors in the structure.

Students will get acquainted with the compilation of tribological science and the most common tribotechnical problems. Understanding the Tribological Processes of Interconnected, Interdependent Technical Surfaces. Designing aspects of the tribological environment that are favorable for the operation of machines and machine elements. Deeper knowledge of friction, wear and lubrication processes.

Literature:

Compulsory:

- Tóth L.: A törésmechanika alapelvei. http://mek.oszk.hu/01100/01190/
- G. Pluvinage: Linerás törésmechanika. http://mek.oszk.hu/01100/01182/
- Zolnay,G., Tóth,L.(szerk.): Fémek és szerkezetek törése, Alkalmazott törésmechanika, Gépipari Tudományos Egyesület. Budapest, 1986.
- Broek, D.: The Practical Use of Fracture Mechanics, Kluwer Academic Publishers, London, 1988.
- Blumenauer,H. - Pusch,G.: Műszaki törésmechanika, Műszaki Könyvkiadó, Budapest, 1987.
- Panasjuk, V.V.: Mekhanika razrushenija i prochnost' materialov, Tom 1-4. Naukogo Dumka, Kiev, 1988-90

- Singh, R. (eds): Weld Cracking in Ferrous Alloys, Woodhead Publishing, Cambridge, 2009.
- NDT Handbook, American Society for Nondestructive Testing, Vol. 1-7, Third edition,
- Non-destructive testing: A Guidebook for Industrial Management and Quality Control Personnel, IAEA, Vienna, 1999.
- Mix, P. E.: Introduction to Nondestructive Testing: A Training Guide, John Wiley & Sons, 2005.
- Valasek, I. (szerk.): Tribológia, 1-7 kötet. Tribotechnik Kft, Budapest, 2002.
- Neale, M. J.: The Tribology. Handbook, Butterworth, Oxford, 1996. ISBN 0750611987, 9780750611985, p640.
- Bharat Bhushan Modern Tribology Handbook, CRC Press, 2010, ISBN 0849377870, 9780849377877, p 1760
- Valasek István, Törös Mihályné: Tribológia, Műszaki Kiadó, Budapest, 2007

Schedule

1st week Registration week	
2nd week: **Lecture:** The development and development of breakthrough mechanics The importance of fracture mechanics in estimating the reliability of structures. **Practice:** Issue a semiannual assignment. Presentation of the solution steps of the problem.	3rd week: **Lecture:** Types and Methods of Fracture Mechanical Examinations. Comparison of the fracture toughness of different materials. The basic correlations of linearly flexible breakdown mechanics, the voltage intensity factor, and the concept of fracture toughness. **Practice:** Material Testing - Perform Charpy's Impact Test for semester task
4th week: **Lecture:** Principles of fracture mechanics control. The plastic deformation of the crack peak environment and its role in the description of breakdown processes. The basic methods of nonlinear flexible resilient mechanics. Concept and measurement of COD. **Practice:** Completion of non-destructive material tests for semester task	5th week: **Lecture:** The plastic deformation of the crack peak environment and its role in the description of breakdown processes. The basic methods of nonlinear flexible resilient mechanics. Concept and measurement of COD. The plastic deformation of the crack peak environment and its role in the description of breakdown processes. **Practice:** Calculation practice
6th week: **Lecture:** The basic methods of nonlinear flexible resilient mechanics. Concept and measurement of COD. The role of residual tensions in the spread of cracks. The principles of breakthrough mechanical	7th week: **Lecture:** Possible principles of error detection methods. Chronological overview of their development and industrial introduction. Grouping of tests, physical constraints, detection and probability of

controls (R9, EPRI, COD, leak-before-break, etc.) and its software **Practice:** Calculation practice	error probability. Methods for detecting surface defects, their physical bases, reliability, constraints. **Practice:** Calculation practice
8th week: 1st drawing week	
9th week: **Lecture:** Radiological and isotope examinations, their physical bases, reliability, constraints, Ultrasound tests, their physical bases, reliability, constraints. **Practice:** Task finalization	**10th week:** **Lecture:** Structural fracture sensitivity in quasi-static and repetitive loads. Summary overview is the location of the break mechanism and its role in assessing the safety of structures. Numerical examples for evaluating the hazards of errors. Report on the issues that are issued **Practice:** Re-take Task finalization
11th week: **Lecture:** Elements of the Tribological System; Factors influencing friction, wear and lubrication processes. **Practice:** Issue a semester task. Discussing the tasks related to the lecture	**12th week:** **Lecture:** Wearing processes. Categorization and characterization of wear processes. Wearing of machine elements **Practice:** Presentation of the solution steps of the problem.
13th week: **Lecture:** Lubrication of lubrication and lubrication of machine parts. Dry, Bound, Mixed and Fluid Detection. Lubricating greases, lubricating oils. **Practice:** Determination of oily wear rates by dielectric constant change using OILCHECK.	**14th week:** **Lecture:** Tribology of sliding and rolling bearings. Tribological aspects of the design of sliding and rolling bearings. Tribological failure of bearings. Tribology of toothed wheels and seals. **Practice:** Re-take Task finalization
15th week: 2nd drawing week	

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.

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 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 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.

Finite Element Method

Code: MK3VEMAG04G117-EN, MK3VEMAG04G317-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 3rd year, 1st semester

Its prerequisite(s): Strength of Materials, CAD Systems

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

The finite element method in the product lifecycle. Mathematical and mechanical background of the finite element method. Fundamentals of linear elasticity (displacement field, strain field, stress field). The basic equation system (equilibrium equation, kinematic equation, constitutive equation). Boundary conditions. Boundary value problems. Strain energy and related principles. Linear spring. 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 finite element programs. Application of commercial FEM software. Modelling questions. Meshing. Postprocessing.

Literature:

Compulsory:

- Mankovits, T. (2014): Numerical Analysis of Engineering Structures (Linear Elasticity and the Finite Element Method), University of Debrecen, Debrecen, Hungary, ISBN: 978-963-473-797-1, p. 181.

Recommended:

- Bathe, K.J. (1996): Finite Element Procedures, Prentice-Hall International, New Jersey, USA, p. 1037.
- Kovács, Á., Moharos, I., Oldal, I., Szekrényes, A. (2012): Finite Element Method, Typotex, Budapest, Hungary, p. 383.
- Zienkiewicz, O.C., Taylor, R.L. (2000): The Finite Element Method: Solid Mechanics, Butterworth-Heinemann, London, England, ISBN: 0750650559, p. 477.

Schedule

1st week Registration week	
2nd week:	3rd week:
Lecture: Brief overview of the finite element method, historical background.	Lecture: Fundamentals of linear elasticity. Displacement field, strain field, stress field.
Practice: Industrial application of the finite element method.	Practice: Calculation of strain and stress measures. Principal values of normal stresses, scalar invariants and equivalent stresses.
4th week:	5th week:
Lecture: The basic equation system of linear elasticity (equilibrium equation, constitutive equation, kinematic equation). Boundary conditions (kinematical boundary condition, dynamical boundary condition).	Lecture: Strain energy. Total potential energy. Variational principles. Principle of minimum total potential energy. Linear spring as a finite element.
Practice: Analytical solution of a one-dimensional boundary value problem.	Practice: Calculation of strain energy and the application of total potential energy. Examples for linear spring structures. Derivation of the stiffness matrices.
6th week:	7th week:
Lecture: Theory of Ritz method. Kinematically admissible displacement field.	Lecture: Formulation of the finite element method. General derivation of the displacement based finite element equilibrium equations.
Practice: Examples for Ritz method (linear approximation, quadratic approximation).	Practice: Solution of a numerical example by programming (prismatic bar problem). 1st test.
8th week: 1st drawing week	

9th week: **Lecture:** Properties of truss element. Local approximation. **Practice:** Solution of numerical examples by the usage of Femap 9.3 (prismatic bar problem, truss structure).	**10th week:** **Lecture:** Properties of beam element. Analytical solution of a statically indetermined beam problem. **Practice:** Solution of numerical example by the usage of Femap 9.3 (statically indetermined beam).
11th week: **Lecture:** Finite element formulations for two-dimensional problems (plain strain, plane stress, axi-symmetric problems). **Practice:** Solution of numerical examples by the usage of Femap 9.3 (plate with a hole, tube under internal pressure, analyzing pressure vessel).	**12th week:** **Lecture:** Isoparametric finite elements. One-, two- and three-dimensional mapping. Truss element. Quadrilateral and triangular elements. Brick and tetrahedron elements. **Practice:** Calculation of Jacobian of non-distroted and distorted quadrilateral elements.
13th week: **Lecture:** Numerical integration. The Gaussian quadrature. **Practice:** The usage of one-point, two-point and three-point formulas.	**14th week:** **Lecture:** General purpose finite element programs. Modelling questions. Meshing, postprocessing. Error analysis. **Practice:** Solution of a numerical example by the usage of Femap 9.3 (analysis of an assembly). **2nd test.**
15th week: 2nd drawing week	

Requirements

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 1st test in the 7th week and the 2nd test in the 15th week. Students have to sit for the tests.

B, for 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 table:

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.

Pneumatics and Hydraulics

Code: MK3PNEUR04G117- EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 3rd year, 1st semester

Its prerequisite(s): Measurement Technology

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 0+3

Topics:

Preparation and preparation of compressed air. Application of pneumatic working and control elements. Use of way valves, closing and flow control elements. Pneumatic implementation of logical basic functions, counters and timers. Application and implementation of the standard symbol system of pneumatic elements and switches. FluidSIM-P program use. Hydraulic power generation, hydraulic energy converters and their operation. Physical concepts and hydraulic calculations, power and efficiency. Use of hydraulic working and control elements. Directional valves, closing and flow control elements, pressure regulators, sliding and seat elements. Instrumentation measurements and measuring circuits. Use of piping sections, hoses, oil

filters. Application and implementation of a standard symbol system for hydraulic elements. FluidSIM-H program use. Energy saving applications.

Literature:

Compulsory:

- D. Merkle, B.Schrader, M. Thomes: Hydraulics Basic Level Festo Didactic GmbH and Co., 2003.
- Peter Croser, Frank Ebel: Pneumatics Basic Level Festo Didactic GmbH and Co., 2002.

Recommended:

- De Silva, Clarence W.: Mechatronics: An Integrated Approach CRC Press, 2005.

Schedule

1st week Registration week	
2nd week:	3rd week:
Practice: Development of pneumatics. Compressed air properties. Pneumatic equipment economy. State equation of gases.	Practice: Compressed air production. Compressed air supply. Compressed air preparation.
4th week:	5th week:
Practice: Pneumatic actuators (structurecylinder, rotary actuators, sizing cylinders).	Practice: Generally about valves (way-, closing-, pressure managing-, stop-, time-).
6th week:	7th week:
Practice: Basic circuit (single- and double acting cylinder controlling, control with And- Or elements, increase speed)	Practice: Functions of hydraulic equipment. Symbols and drawing techniques.
8th week: 1st drawing week	
9th week:	10th week:
Practice: Structure and circuit diagrams (control, power supply) of hydraulic systems.	Practice: Physical basics of hydraulics (pressure transmission, force transmission, way transmission, pressure ratio). Kind of flows.
11th week:	12th week:
Practice: Equipment representation (layout drawings, wiring diagrams, operating charts). Power supply system components (gear motor, pump, filter, tank).	Practice: Valves (method of construction, the nominal value, slide). Pressure control valves. Way valves (2/2, 3/2, 4/2, 4/3).
13th week:	14th week:
Practice: Shut-off valves (check valve, controlled check valve). Flow control valves	

(one way control valves, 2 way flow control valve).	**Practice:** Hydraulic cylinders (single, doubleacting, sealing, venting, buckling). Hydraulic motors.

15th week: 2nd drawing week

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 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.

B, for grade:

Students have to fulfill a mid-term exercise at least for 50% to take part on the next practice classes. All students, who failed the mid-term exercise will not get a mid-semester grade. At the end of the semester, all students have to solve a real life problem in programming. Also a task, to make a complete documentation of the project file, using all the methods, mentioned during the semester. The course ends in a mid-semester grade. Based on the average of the grades of the tasks. The grade for the test is given according to the following table: Score Grade 0-50 fail (1) 51-65 pass (2) 66-75 satisfactory (3) 76-85 good (4) 86-100 excellent (5)

Maintenance Engineering I

Code: MK3UZK1G05G117-EN

ECTS Credit Points: 5

Evaluation: mid-semester grade

Year, Semester: 3rd year, 1st semester

Its prerequisite(s): MK3GYT2G05GX17

Further courses are built on it: Yes

Number of teaching hours/week (lecture + practice): 2+2

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.

Literature:

Compulsory:

- 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. ISBN: 9780750677981
- R. K. Mobley, L. R. Higgins, D. J. Wikoff: Maintenance Engineering Handbook McGraw-Hill, 2008

Recommended:

- J. Moubray: Reliability-Centered Maintenance Industrial Press Inc., 2001. ISBN-13: 978-0831131463 ISBN-10: 0831131462
- R. Smith, R. K. Mobley: Rules of Thumb for Maintenance and Reliability Engineers Elsevier, 2007. ISBN: 9780750678629

Schedule

1st week Registration week	
2nd week: **Lecture:** Maintenance Policies, Impact, Benefits and Effects of Maintenance, Principles of Maintenance **Practice:** KIPA method in practice	3rd week: **Lecture:** Organization and Management of a Maintenance Function, The importance of an overall maintenance strategy, Operating Policies of Effective Maintenance **Practice:** Case studies
4th week: **Lecture:** Maintenance management methods, Maintenance Engineering Roles and Responsibilities, Performance Measurement and Management, Development of Maintenance Engineering Practices	5th week: **Lecture:** Maintenance Equipment and Facilities, Maintainability and its costs, Maintainability Analysis. **Practice:** Maintenance Facilities and Rooms in industrial environment

Practice: Human Resources of Maintenance Organization	
6th week:	**7th week:**
Lecture: Economic Aspects of Maintenance, Life Cycle Costing, Maintenance Costs, Maintenance Budget, Cost Control, Maintenance Audit **Practice:** Life cycle calculation and costs	**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 **Practice:** KPI system in practice
8th week: 1st drawing week	
9th week:	**10th week:**
Lecture: Types of Maintenance Systems, Corrective Maintenance, Reliability-Based Preventive Maintenance, Predictive Maintenance **Practice:** Visual Management	**Lecture:** Organizational Structure for Maintenance, Effective maintenance organizations, Maintenance Levels, Responsibilities of Maintenance Department **Practice:** Case studies from industrial environment
11th week:	**12th 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 **Practice:** Supply Chain Management	**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 **Practice:** Ergonomy
13th week:	**14th week:**
Lecture: Maintenance Evaluation, Reliability in Maintenance, Economics of Reliability, Quality and Reliability, Reliability Improvement, Reliability Testing, Design for Reliability **Practice:** Maintainability. Design for Maintainability, Terotechnology, Objectives of terotechnology, Principles of terotechnology	**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 **Practice:** Costs of implementing terotechnology, Introducing terotechnology to an organization
15th week: 2nd drawing week	

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 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 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 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.

Maintenance Engineering II

Code: MK3UZK2G05G117-EN

ECTS Credit Points: 5

Evaluation: exam

Year, Semester: 3rd year, 2nd semester

Its prerequisite(s): MK3UZK1G05G117

Further courses are built on it: Yes

Number of teaching hours/week (lecture + practice): 2+2

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.

Literature:

Compulsory:

- R. K. Mobley, L. R. Higgins, D. J. Wikoff: Maintenance Engineering Handbook McGraw-Hill, 2008. 2. J. Moubray: Reliability-Centered Maintenance Industrial Press Inc., 2001. ISBN-13: 978-0831131463 ISBN-10: 0831131462
- R. Smith, R. K. Mobley: Rules of Thumb for Maintenance and Reliability Engineers Elsevier, 2007. ISBN: 9780750678629

Schedule

1st week Registration week	
2nd week: **Lecture:** Organization and Management of the Maintenance Function. Environmental impacts. Corrective, Preventive, Predictive Maintenance **Practice:** Case studies	3rd week: **Lecture:** Concept of safety, reliability and risk **Practice:** Safety equipments, Safety engineering
4th week: **Lecture:** The concept and basics of reliability centered maintenance (RCM) **Practice:** RCM in practice	5th week: **Lecture:** The concept and basics of total productive maintenance (TPM) **Practice:** TPM plan design
6th week: **Lecture:** The overall efficiency of the equipment (OEE) **Practice:** Calculation of overall efficiency of the equipment and OEE losses	7th week: **Lecture:** The control of maintenance costs while improving reliability. Avoid or mitigate of the impact of operational failures **Practice:** Introduction to FMEA
8th week: 1st drawing week	
9th week: **Lecture:** Company visit **Practice:** Company visit	10th week: **Lecture:** Root cause analysis (RCA) and Root cause failure analysis (RCFA)

	Practice: RCFA in practice
11th week:	**12th week:**
Lecture: Computerized maintenance management system (CMMS)	**Lecture:** Measuring and improvement of productivity. Terotechnology
Practice: Industry 4.0	**Practice:** Industry 4.0
13th week:	**14th week:**
Lecture: Maintenance and TQM, quality control in maintenance	**Lecture:** Company visit
Practice: Maintenance and product quality	**Practice:** Company visit
15th week: 2nd drawing week	

Requirements

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.

B, for 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)

Programmable Manufacturing Cells

Code: MK3PGYCR04G117-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 3rd year, 2nd semester

Its prerequisite(s): Applied Automatization

Further courses are built on it: No

Number of teaching hours/week (lecture + practice): 1+2

Topics:

General introduction to the history of Programmable Manufacturing Cells, background of robotics. Concept and classification of Programmable Manufacturing Cells s. Architecture of robot, coordinate systems, workspaces of robots, restrictions/constraints on workspaces. Structure of Programmable Manufacturing Cell, installing robots. Mechanical structure of Programmable Manufacturing Cells s, characteristics of the mechanical structure of robot, kinetic chains, constraint equations. Programmable Manufacturing Cells programming and information technology, principles of Programmable Manufacturing Cells programming, basic concepts in programming. Fundamentals of robot programming.

Material handling, combined application of technological and material handling systems, synchronizing tasks. Introducing the concept of „Intelligent Space": Programmable Manufacturing Cells in human spaces. Programmable Manufacturing Cells simulation.

Literature:

Recommended:

- Mikell Groover: Automation, Production Systems, and Computer-Integrated Manufacturing, Global Edition, 4/E ISBN-10: 1292076119 • ISBN-13: 9781292076119 ©2016 • Pearson • Paper, 816 pp
- Alasdair Gilchrist: Industry 4.0: The Industrial Internet of Things Google Book

Schedule

1st week Registration week	
2nd week: **Lecture:** Geometric and kinematic characteristics of Programmable Manufacturing Cells. Denavit-Hartemberg parameters. Jacobi matrix. **Practice:** Accident prevention. Solving tasks using Denavit-Hartemberg parameters, Jacobi matrix.	3rd week: **Lecture:** Industry 4.0, industrial manipulators in production processes. Concept of robots, structure of robots. **Practice:** Solving tasks using Denavit-Hartemberg parameters, Jacobi matrix.
4th week: **Lecture:** 6DOF robots: structural elements, drives. **Practice:** Robot control (6DOF or 4 DOF) – operator level.	5th week: **Lecture:** 6DOF robots: coordinate systems, installing coordinate systems.

	Practice: Programmable Manufacturing Cells control (6DOF or 4 DOF) – operator level.
6th week: **Lecture:** Point-to-point and continuous path controls. Point-to-point control. **Practice:** Programmable Manufacturing Cells control (6DOF or 4 DOF) – operator level.	**7th week:** **Lecture:** 6DOF Programmable Manufacturing Cells s: Singularity of s. **Practice:** Programmable Manufacturing Cells control (6DOF or 4 DOF) – operator level.
8th week: 1st drawing week	
9th week: **Lecture:** 4DOF (Scara) robots: structural elements, coordinate control, point-to-point control, continuous path control. **Practice:** Robot control (6DOF or 4 DOF) – operator level.	**10th week:** **Lecture:** Offline Programmable Manufacturing Cells programming. **Practice:** Mid-term test (theoretical), Robot control – classified.
11th week: **Lecture:** Offline Programmable Manufacturing Cells programming. **Practice:** Offline Programmable Manufacturing Cells programming.	**12th week:** **Lecture:** "Intelligent Space": Programmable Manufacturing Cells in human spaces. **Practice:** Offline Programmable Manufacturing Cells programming.
13th week: **Lecture:** Programmable Manufacturing Cells and their simulation. **Practice:** Programmable Manufacturing Cells simulation.	**14th week:** **Lecture:** Programmable Manufacturing Cells simulation. **Practice:** Programmable Manufacturing Cells simulation.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance in practical classes (see Rules and Regulations). Submitting homework assignments until the deadline. Passing mid-term test.

B, for grade:

Oral exam in the theoretical part.

Drivetrain Systems and Assembly Technology

Code: MK3HSZTG05G117-EN

ECTS Credit Points: 5

Evaluation: mid-semester grade

Year, Semester: 3rd year, 2nd semester

Its prerequisite(s): Manufacturing Processes II.

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

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 the second part of the subjects the students learn the assembly operations and the theorem of designing assembly systems. They will learn the assembly possibilities of machine elements. On the seminar they will use CAD software for geometric modelling and assembly operation planning.

Literature:

Compulsory:

- Zsolt Tiba: Dynamic driveline modeling, ISBN 978-963-318-044-0, Kiadó: Debrecen University Press 2010., 109 pages
- Zsolt Tiba, Géza Husi: Mechanical Design of a Mechatronics Systems: Laboratory Handbook, Debrecen: [University of Debrecen Faculty of Engineering], 2012, ISBN: 978 963 473 525 0, 152 pages
- Ho, William, Ji, Ping: Optimal Production Planning for PCB Assembly, Springer Verlag, 2010, ISBN 9781849966139
- Botti, Vicent; Giret, Adriana: ANEMONA: A Multi-agent Methodology for Holonic Manufacturing Systems, Springer Verlag, 2008, ISBN 9781848003095
- Wu, Bin: Handbook of Manufacturing and Supply Systems Design: From Strategy Formulations to System Operation, Taylor & Francis, 2001, ISBN 9780415269025

Recommended:

- Fritz Klocke: Manufacturing Processes I, Cutting, RWTH Edition, RWTH Aachen University, p. 524, ISBN 978-3-642-11978-1
- John A. Schey: Introduction to Manufacturing Processes, McGraw – Hill Book Company, 1977., p. 392., ISBN 0-07-055274-6
- J. T. Black, Ronald A. Kohser: Materials and Processes in Manufacturing, Tenth Edition, United States of Amerika, p. 1033, ISBN 978-0470-05512-0
- Mikel P. Groover: Fundamentals of Modern Manufacturing, Materials, Processes and Systems, Third Edition, United States of Amerika, p. 520, ISBN 978-0-471-74485-6
- James G. Bralla: Handbook of Manufacturing Processes, First Edition, Industrial Press Inc., New York, 2007, ISBN 0-831 1-3179-9
- Helmi A. Youssef, Hassan El – Hofy: Machining Technology, Machine tools and operations, CRC Press, United States of Amerika, p. 672, ISBN 978-1-4200-4339-6

Schedule

1st week Registration week	
2nd week:	3rd week:
Lecture: Prerequisite of performing the planned service life of a drive train.	Lecture: Prerequisite of smooth running of a drive train.
Practice: Load situations acting on a drive train.	Practice: Electric motors and internal combustion engine characteristics.
4th week:	5th week:
Lecture: Motion equation of a drive train.	Lecture: Features of the equation of motion of a forked type drive train.
Practice: A gear drive transmission system. A belt drive transmission system.	Practice: Forked transmission systems.
6th week:	7th week:
Lecture: Determination of the bearing stiffness.	Lecture: Application of a dynamic model for general drive train cases.
Practice: Calculation of the bearing stiffness of different type of rolling bearings.	Practice: A dynamic simulation computer programs and its application.
8th week: 1st drawing week	
9th week:	10th week:
Lecture: The place and ponderosity of assembly in the manufacturing process. The property of an assembly system.	Lecture: Manufacturing devices for assembly. The main types of assembly devices. The types of position determination.

Practice: Computer aided modelling of the parts of assembly devices I. (Solidworks software)	**Practice:** Computer aided modelling of the parts of assembly devices II. (Solidworks software)
11th week:	**12th week:**
Lecture: Examination of assembly dimension chains (total and particular variation methods)	**Lecture:** Assembly operations. Typical assembly systems. Assembly tree.
Practice: Task solutions for assembly dimension chains	**Practice:** Computer aided planning of assembly tasks I. (Solidworks software)
13th week:	**14th week:**
Lecture: Assembly of machine elements I.	**Lecture:** Assembly of machine elements II.
Practice: Computer aided planning of assembly tasks II. (Solidworks software)	**Practice:** Computer aided planning of assembly tasks III. (Solidworks software)
15th week: 2nd drawing week	

Requirements

A, for a the practice mark:

- Students have to visit the lectures and seminars. Three misses are permissive for the seminar.
- They have to solve an own technological designing task.
- Students have to write two tests from the two parts of the lecture. They have to write them for minimum sufficient marks. Based on these result they will get the final practice mark.

Material Handling and Logistics

Code: MK3AMLOG04G117-EN, MK3AMLOG04G317-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 3rd year, 2nd semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

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. Basic calculations of continuous operating materials handling equipment. Belt conveyors, bucket elevators, screw conveyors, overhead conveyors, roller conveyors and pneumatic conveyors. Hoisting machinery. Simple hoisting appliances. Crane crabs and trolleys. Overhead cranes. Gantry cranes. Jib cranes. Loader machinery. Loaders for piece-goods, powered industrial trucks and forklifts. Loaders for bulk materials, continuous operating loaders, bucket loaders. Introduction to warehousing principles and technologies. Automatic storage warehouses with high racks and their equipment. Stacker cranes.

The connection between the logistics and the supply chain. The 7 rights of the logistics. The aims of company logistics. Company logistics system (strategic level, tactical level, operative level). The divisions of logistics (procurement, production, distribution, re-cycling). Supplier and distributer networks. Supply chain management. Procurement logistics. Centralized and decentralized procurement. Direct and indirect purchasing. The process of purchasing. Methods used by purchasers; demand analysis (ABC and XYZ analysis), price analysis, supplier evaluation and selection, economic order quantity (EOQ). Production logistics. Production systems. Push and pull type production systems. Material requirement planning (MRP). Manufacturing resource planning (MRP II.). Distribution logistics. Distribution requirements planning (DRP). Re-cycling logistics. Packaging technology. Dangerous goods.

Literature:

Compulsory:

- Martin Christopher (2011): Logistics and Supply Chain Management, Financial Times Series, 4th edition
- Lars Bedey, Sofia Eklund, Nojan Najafi, William Wahrén, Karl Westerlund (2008): Purchasing Management, Chalmers, Department of Technology Management and Economics, http://publications.lib.chalmers.se/records/fulltext/90488.pdf

Recommended:

- Peter Nyhuis, Hans-Peter Wiendahl (2009): Fundamentals of Production Logistics, Springer, ISBN 978-3-540-34210-6
- DiCentral (2014): Inventory and Warehouse Managemenet Best Practices, SmartTurn Inc., 1st edition, http://www.smartturn.com/pdf/inventory-warehouse-management-best-practices-ebook.pdf

Schedule

1st week Registration week	
2nd week:	3rd week:
Lecture: Basic concepts for the handling and conveyance of materials. Classification	**Lecture:** Continuous operating materials handling equipment I.: basic calculations of

of material handling systems. Fundamental elements of material handling systems. Properties of handled materials. **Practice:** Selection the elements of material handling systems. Basic calculations of handled materials.	continuous operating materials handling equipment, belt conveyors, bucket elevators, screw conveyors. **Practice:** Calculation the transport capacity of belt conveyors, bucket elevators and screw conveyors.
4th week: **Lecture:** Continuous operating materials handling equipment II.: overhead conveyors, roller conveyors, pneumatic conveyors. **Practice:** Calculation the transport capacity of overhead conveyors, roller conveyors and pneumatic conveyors.	**5th week:** **Lecture:** Hoisting machinery. Simple hoisting appliances. Crane crabs and trolleys. Overhead cranes. Gantry cranes. Jib cranes. **Practice:** Calculation problems related to cranes.
6th week: **Lecture:** Loader machinery. Loaders for piece-goods, powered industrial trucks and forklifts. Loaders for bulk materials, continuous operating loaders, bucket loaders. **Practice:** Calculation problems related to trucks and forklifts.	**7th week:** **Lecture:** Introduction to warehousing principles and technologies. Automatic storage warehouses with high racks and their equipment. Stacker cranes. **Practice:** Calculation of the parameters of warehouses.
8th week: 1st drawing week	
9th week: **Lecture:** The definition of logistics. The connection between the logistics and the supply chain. Company logistics system. **Practice:** Supplying and distributing networks.	**10th week:** **Lecture:** Supply chain management. **Practice:** Analysis of the supply chain of an original equipment manufacturer (OEM) and a supplier (TIER).
11th week: **Lecture:** Procurement logistics. Make or buy decisions. Inventory management. Economic order quantity (EOQ). **Practice:** Demand analysis. Examples for ABC and XYZ analyses. Examples for supplier evaluation. Examples for economic order quantity determination.	**12th week:** **Lecture:** Production logistics. Push and pull type production control. **Practice:** Examples for material requirement planning (MRP) and manufacturing resource planning (MRP II.)
13th week:	**14th week:**

Lecture: Distribution logistics. Distribution systems and technologies. Distribution requirements planning (DRP). Re-cycling logistics. **Practice:** Examples for distribution requirements planning.	**Lecture:** Packaging technology. Dangerous goods. **Practice:** Case studies for packaging technology. Handling of dangerous goods. **2nd test.**
15th week: 2nd drawing week	

Requirements

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 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 1st test in the 7th week and the 2nd test in the 14th week. Students have to sit for the tests.

B, for grade:

The course ends in an **examination**.

The minimum requirement of the 2 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).

Repairing Technology

Code: MK3JAVTG05G117-EN

ECTS Credit Points: 5

Evaluation: exam

Year, Semester: 3rd year, 2nd semester

Its prerequisite(s): Theory of Damage

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 3+2

Topics:

The aim of the subject is expanding the knowledge in repairing technology acquired through bachelor program: use of up-to-date methods, application of reliability-based and risk-based approach in maintenance, effective identification of failures of machines and machine elements.

Literature:

Compulsory:

- Harris, C. M., Piersol, A. G. (ed.), Harris' Shock and Vibration Handbook, McGraw-Hill, 2002
- 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
- Moubray, J., Reliability-Centered Maintenance: Industrial Press Inc., 2001.
- Smith, D. J., Reliability, Maintainability and Risk: Practical Methods for Engineers, Elsevier, 2011

Recommended:

- Czichos, H. (ed.), Handbook of Technical Diagnostics (Fundamentals and Application to Structures and Systems), Springer, 2013.

Schedule

1st week Registration week

2nd week: Role of machine repairing. Machine lifetime, bathtub curve, wear periods, maintenance strategies, CM (Condition Monitoring). Methods for condition monitoring. Technical and economy aspects of repairing. **Practice:** Measurements in practice before repairing.	**3rd week:** Lecture: Fault analysis before repairing. Probabilistic risk assessment (PRA). Fault tree analysis (FTA), FTA analysis involves steps. Event Tree Analysis (ETA). Failure Mode and Effects Analysis (FMEA). Thermograpy and vibration analysis, non-destructive testing methods before repairing. SEM and AFM equipments. **Practice:** Fault analysis by modern methods before repairing.
4th week: **Lecture:** Friction, static friction, rolling friction, fluid friction, lubricated friction, Laws of dry friction, Coulomb's Law of Friction, coefficient of friction, Effect of Sliding Velocity on coefficient of friction. Tribology basics. **Practice:** Calculation of friction parameters. Measurements of friction ratios. Examples.	**5th week:** **Lecture:** Lubrication, Reducing friction, Hydrodynamic lubrication, Elastohydrodynamic lubrication, Boundary lubricationLubricants, characteristics and purpose of lubricants, liquid lubricants, Viscosity Petroleum Oils, Synthetic oils, Additives, Lubricant Specification, Performance, Operational tolerance, Longevity, Grease, Soaps . lubrication of specific equipment, Internal-combustion-engine oils, additives, SAE viscosity grade system for engine oil **Practice:** Analysis of lubricants applied in machines.
6th week: **Lecture:** Parts cleaning methods, Manual washing, Ultrasonic cleaning, type of Contaminations, Cleaning equipment and procedure, part washer Solvent degreasing, vapor degreasing, abrasive blasting. CO2 cleaning. **Practice: Case studies for cleaning technology.**	**7th week:** **Lecture:** Cutting processes in machine repairing: turning, boring, drilling, reaming, threading, broaching. milling, milling cutters, gear manufacturing. Abrasive processes, grinders, grinding wheels, selection of abrasive. **Practice: Calculations of cutting parameters.**
8th week: 1st drawing week	
9th week:	**10th week:**

Lecture: Soldering and brazing technologies, desoldering and resoldering. Welding and cutting. Heat and filler Metal, shielding and fluxing, Shielded Metal Arc Welding (SMAW). Flux Cored Arc Welding (FCAW), Gas Tungsten Arc Welding (GTAW). Submerged Arc Welding (SAW), Gas Metal Arc Welding (GMAW). Gas welding and repair welding.

Practice: Examples, case studies for welding repairing technology.

Lecture: Hot-dip galvanization, composition of the baths, plating, chrome plating, zinc plating, nickel plating. Paints and protective coatings, paint ingredients. Coating methods. Coating with plastic. Corrosion, Type of corrosion, Stress corrosion cracking. Galvanic corrosion. Electropotential series. Pitting corrosion. Crevice corrosion, Stress corrosion cracking (SCC). Protection from corrosion, Applied coatings, Shrink wraps. Biofilm coatings. Cathodic protection. Corrosion in nonmetals. Corrosion of polymers and glasses.

Practice: Case studies of corrosion and protection.

11th week:

Lecture: Adhesives, pressure-sensitive adhesives, contact adhesives, hot adhesives, multi-part adhesives. Synthetic adhesives, joining metal with adhesives. Surface enhancement technology.

Practice: Analysis of adhesives. Technology.

12th week:

Lecture: Heat treatment, annealing, normalizing, stress relieving, quenching, tempering, case hardening, induction hardening after machine repairing.

Practice: Practical examples for heat treatment, applied methods.

13th week:

Lecture: Repair and of maintenance mechanical equipment: diagnosis of used bearings. Normal Appearance and Wear. Reconditioning. Cold Mountings. Temperature Mountings. Induction heater, Dismounting. Repair, diagnosis and maintenance of precision chain drives, gear tooth wear and failure, tooth repair. Gear drives diagnosis and repair methods.

Practice: Case studies. Test rig analysis for bearing repairing technology, equipments.

14th week:

Lecture: Repair, diagnosis and maintenance of pumps, compressors, pneumatic and hydraulic systems, cylinders, pipeline networks, fittings and their repairing.

Practice: Case studies for repairing pneumatic and hydraulic systems.

15th week: 2nd drawing week

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.

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 **exam 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)

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

Diagnostics

Code: MK3DIAGG06G117-EN

ECTS Credit Points: 6

Evaluation: mid-semester grade

Year, Semester: 4th year, 1st semester

Its prerequisite(s): Maintenance Engineering II.

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+4

Topics:

Maintenance strategies. Role of technical diagnostics in maintenance, condition-based maintenance. The main fields of technical diagnostics: vibration diagnostics, acoustics, ultrasound analysis, thermography, endoscopy, oil analysis. Theoretical background of vibration: sources and types of vibration, statistical evaluation of vibration signals. Fourier spectrum of periodic and non-periodic signals, Fourier transform. Discrete Fourier transform,

FFT Short time Fourier transform. Wavelet transform. Sampling, information content in discrete signal (aliasing, leakage). Shannon sampling principle. Windowing, averaging, filtering. Characterisation of machinery vibration. Vibration measurement: methods, equipments. Vibration standards. Machine failures and related symptoms in the time signal and in the spectrum: unbalance, shaft alignment, looseness, and gear faults, electric motor failures. Types of bearings, bearing frequencies. Theoretical background of shock pulse measurement. Application of acoustics, ultrasound analysis, and thermography. Online monitoring systems.

Literature:

Compulsory:

- Czichos, H. (ed.), Handbook of Technical Diagnostics (Fundamentals and Application to Structures and Systems), Springer, 2013.
- Harris, C. M., Piersol, A. G. (ed.), Harris' Shock and Vibration Handbook, McGraw-Hill, 2002
- 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

Schedule

1st week Registration week	
2nd week: Lecture: Maintenance strategies. Role of technical diagnostics in maintenance, condition-based maintenance. Practice: Tools of vibration measurement. VibChecker, BearingChechker.	3rd week: Lecture: The main fields of technical diagnostics: vibration diagnostics, acoustics, ultrasound analysis, thermography, endoscopy, oil analysis. Practice: Introduction to the Condmaster Nova – Leonova Infinity condition monitoring system.
4th week: Lecture: Theoretical background of vibration: sources and types of vibration, statistical evaluation of vibration signals. Practice: Introduction to the Condmaster Nova – Leonova Infinity condition monitoring system.	5th week: Lecture: Fourier spectrum of periodic and non-periodic signals, Fourier transform. Practice: Vibration measurement.
6th week: Lecture: Discrete Fourier transform, FFT Practice: Balancing.	7th week: Lecture: Short time Fourier transform. Wavelet transform. Practice: Shaft alignment.
8th week: 1st drawing week	
9th week:	10th week:

Lecture: Sampling, information content in discrete signal (aliasing, leakage). Shannon sampling principle. Windowing, averaging, filtering. **Practice:** Bearing condition evaluation with shock pulse method.	**Lecture:** Characterisation of machinery vibration. Vibration measurement: methods, equipments. Vibration standards. **Practice:** Evaluation of machinery condition, case studies.
11th week: **Lecture:** Machine failures and related symptoms in the time signal and in the spectrum: unbalance, shaft alignment, looseness, and gear faults, electric motor failures. **Practice:** Evaluation of machinery condition, case studies.	**12th week:** **Lecture:** Types of bearings, bearing frequencies. **Practice:** Evaluation of machinery condition, case studies.
13th week: **Lecture:** Theoretical background of shock pulse measurement. **Practice:** Measurements with IR camera.	**14th week:** **Lecture:** Application of acoustics, ultrasound analysis, and thermography. Online monitoring systems. **Practice:** Measurements with IR camera.
15th week: 2nd drawing week	

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.

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 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.

Mechanical Engineering Project

The course is designed to create the basis for writing thesis. By completing the course requirements national and international literature relating to the thesis topic will be viewed through, a list of sub-tasks will be made and the preliminary content of thesis will be defined. Students will give account of the work done in front of a committee.

DIPLOM

Within 30 days of the successful state exam the diploma is issued and given out by the Faculty at the graduand's special request. Otherwise, the diploma will be awarded to him/her at the graduation ceremony of the Faculty.

The diploma is an official document decorated with the coat of arms of Hungary which verifies the successful completion of studies in the Mechanical Engineering undergraduate program. The diploma contains the following data: name of HEI (higher education institution); institutional identification number; serial number of diploma; name of diploma holder; date and place of his/her birth; level of qualification; training program; specialization; mode of attendance; place, day, month and year issued. Furthermore, it has to contain the original signature of the Dean (or in case of his/her indisposition the Vice-Dean) original signature and the seal of HEI. The University keeps a record of the diplomas issued.

At the graduand's special request a certificate on the completion of studies is issued. The document does not contain any reference to qualification, it merely proves that the candidate has taken a successful state exam. The Faculty keeps a record of the certificates issued.

Calculating diploma grade

Grade=(A+B+C)/3, where

A: Average of comprehensive exams

B: Average of the grades of the subjects of the state exam

C: Grade for defending thesis

Classification of the award:

Excellent	4,81 – 5,00
Very good	4,51 – 4,80
Good	3,51 – 4,50
Satisfactory	2,51 – 3,50
Pass	2,00 – 2,50

Award with Distinction

An award with Distinction is permitted where a student obtained grade 5 in all subjects of the state exam. The average of thesis grade, his/her exam grades and mid-semester grades during his/her studies is at least 4,00. Moreover, he/she is not permitted to have a grade worse than grade 3 during his/her studies.