Bulletin

Bachelor of Mechanical Engineering

Automotive Production Process Control Specialization

(BSc program)

University of Debrecen Faculty of Engineering
Department of Mechanical Engineering

2016

CONTENTS

Mechanical Engineering, BSc Program
Automotive production process control specialization

The aim of the teaching program includes preparing engineers to improve quality and use lean tools in the vehicle industry, enabling them to gain an understanding of the complete product development (from the supplier to the customer) and lead project teams. In cooperation with local vehicle suppliers students learn about completing cost estimation, utilizing computer softwares to solve manufacturing problems (like Tecnomatix), etc.

Program Outcomes

Our graduates will developed **competence or acquire knowledge** in the following areas:

- introducing and applying modern technologies, computational engineering methods and systems (manufacturing technologies, CAE)
- operating and developing mechatronical systems (electrotechnics and electronics, measuring and automatics, hydraulics and pneumatics)
- designing and redesigning plant layouts, checking KPI systems robot technology, automatization, etc.
- planning material handling and manufacturing processes
- analyzing, controlling and optimizing production processes
- applyingmodern manufacturing management philosophies (Lean management) in the vehicle industry

Program Educational Objectives

The aim for the teaching is to train mechanical engineers who are able to

- work with Computational Engineering Methods and Systems.
- work in vehicle industry improving the quality (ISO TS 16949, SWOT, FMEA, DMAIC etc.) and lean (TPS – Toyota Production System) tools of vehicle production systems
- use the necessary management skills
- redesign plant layouts
- check KPI systems robot technology
- be an expert of automatization

Subject Modules

The curriculum contains the following subject modules:

Basic science subjects: 48 credits

- Mathematics, Technical Mechanics, Engineering Physics, Operation and Theory of Machines, Thermodynamics and Fluid Mechanics, Technical Chemistry

Economics and humanities subjects: 20 credits

- Economics for Engineers, Microeconomics, Basics of Quality Management, Management for Engineers, State Administration and Law, Introduction to Ethics

Professional subjects: 117 credits

- Informatics, Machine Elements, CAD and CAE, 3D Computer-Aided Design, Materials Science, Technology of Structural Materials, Electrotechnics and Electronics, Thermal and Fluid Machines, Manufacturing Processes, Logistics, Industrial Safety, Computational Engineering Methods and Systems, Measuring and Automatics, Hydraulics and Pneumatics, Mechanical System Engineering, Quality Management, Safety Engineering, Material Handling and Robotics, CAM, Manufacturing Planning, Maintenance Engineering, PLC.

Optional subjects: 10 credits

Thesis: 15 credits

Duration of studies: 7 semesters, Contact hours: 2.352
ECTS credits: 210, Internship: 6 weeks

The State Examination

The conditions for taking the final examination

- 210 credit points as put down in the curriculum
- the diploma work, accepted by the consultants

Parts of the final examination

- Defending the thesis (oral presentation and discussion)
- Exam in two subject areas chosen by the student
    - Production Process and Control, Production Optimization, Logistics

The result of the final examination

The arithmetic mean of the mark given by the Final Examination Committee for

- the defending of the diploma work and
- the two marks of the professional oral exams
- the two marks of comprehensive exams of Mathematics and Technical Mechanics

The Classification of the Degree

The result of the final examination expressed by lettering

EXCELLENT
GOOD
SATISFACTORY
SUFFICIENT

The Thesis

The thesis is the solution of a mechanical engineering task which the student should solve relying on previous studies and specialized literature under the guidance of a tutor in one semester. The diploma work must prove that the author can apply the acquired theoretical knowledge. The student can choose any topic for the diploma work suggested by the faculty or in occasional cases individual topics acknowledged by the head of the department. The topics of the diploma work should be given in completely uniform manner and based on the system of requirements set up by the head of the institute and the head of the department responsible for the training. The diploma works are written with the close collaboration of the candidate and the tutor.

The formal requirements of the diploma work are detailed in the “Thesis formal requirements” which is handed out to every candidate when they decide upon their topic. The diploma works must be handed in to the department responsible minimum ten days before the beginning of the final exam period. The thesis paper is evaluated by an external graduate professional who gives a grade as well as a short written comment on it. The head of the department makes a proposal for the final evaluation of the diploma work based on the comments. The diploma work receives a grade from the final exam committee.

Mechanical Engineering BSc — University of Debrecen Faculty of Engineering

Automotive Production Process Control Specialization

	Nr.	Name of the Subject	Code	1st sem.				2nd sem.				3rd sem.				4th sem.				5th sem.				L
				L	P	E	C	L	P	E	C	L	P	E	C	L	P	E	C	L	P	E	C	
Basics of Natural Sciences	1	Basics of Engineering Calculations	MFTTA31X00-EN	0	2	s	*0*																	
	2	Mathematics I	MFMAT31S05-EN	2	3	ESE	*5*																	
	3	Mathematics II	MFMAT32S05-EN					2	3	ESE	*5*													
	4	Mathematics III	MFMAT33S03-EN									2	2	ESE	*3*									
	5	Mathematics Final Exam	MFMAT30X00-EN									0	0	FE	*0*									
	6	Technical Mechanics I	MFMMC31G04-EN	2	2	ESE	*4*																	
	7	Technical Mechanics II	MFMMC32G04-EN					2	2	ESE	*4*													
	8	Technical Mechanics III	MFMMC33G03-EN									1	1	ESE	*3*									
	9	Technical Mechanics IV	MFMMC34G02-EN													1	1	AW5	*2*					
	10	Technical Mechanics Final Exam	MFMMC30G00-EN													0	0	FE	*0*					
	11	Engineering Physics	MFMFI31G02-EN	2	0	ESE	*2*																	
	12	Operation and Theory of Machines	MFAGT31G03-EN	2	1	ESE	*3*																	
	13	Thermodynamics and Fluid Mechanics I	MFHOA31G05-EN					2	2	ESE	*5*													
	14	Thermodynamics and Fluid Mechanics II	MFHOA32G05-EN									2	2	ESE	*5*									
	15	Technical Chemistry	MFKEM31X03-EN	2	1	AW5	*3*																	
Economics and Humanities	16	Economics for Engineers	MFKGZ31X04-EN									3	0	ESE	*4*									
	17	Microeconomics	MFVGF31X04-EN													1	2	ESE	*4*					
	18	Basics of Quality Management	MFMIN31X04-EN																	1	1	AW5	*4*	
	19	Management for Engineers	MFMAM31X04-EN																					1
	20	State Administration and Law	MFJOG31X02-EN																	2	0	ESE	*2*	
	21	Engineering Ethics	MFTAI31X02-EN					2	0	ESE	*2*													
Specific Compulsory Subjects	22	Informatics for Engineers I	MFINF31X03-EN	0	2	AW5	*3*																	
	23	Informatics for Engineers II	MFINF32X03-EN					0	2	AW5	*3*													
	24	Technical Drawing I	MFMAB31G03-EN	1	2	AW5	*3*																	
	25	Technical Drawing II	MFMAB32G03-EN					2	1	AW5	*3*													
	26	Machine Elements I	MFGEP31G05-EN									3	2	ESE	*5*									
	27	Machine Elements II	MFGEP32G05-EN													2	2	ESE	*5*					
	28	CAD Systems I	MFCAR31G03-EN									1	1	AW5	*3*									
	29	Materials Science I	MFANI31G04-EN	2	2	ESE	*4*																	
	30	Materials Science II	MFANI32G04-EN					2	2	AW5	*4*													
	31	Technology of Structural Materials	MFSAT31G02-EN									1	1	ESE	*2*									
	32	CAD Systems II	MFCAR32G03-EN													0	2	AW5	*3*					
	33	Electrotechnics and Electronics I	MFELT31G03-EN									2	1	ESE	*3*									
	34	Electrotechnics and Electronics II	MFELT32G02-EN													2	1	ESE	*2*					
	35	Measurements and Automatics I	MFMET31R03-EN													2	1	ESE	*3*					
	36	Measurements and Automatics II	MFMET32R04-EN																	2	2	AW5	*4*	
	37	Thermal and Fluid Machines I	MFHOG31G03-EN													2	1	ESE	*3*					
	38	Thermal and Fluid Machines II	MFHOG32G03-EN																	2	1	ESE	*3*	
	39	Manufacturing Processes I	MFGYT31G04-EN					2	1	ESE	*4*													
	40	Manufacturing Processes II	MFGYT32G04-EN									2	1	AW5	*4*									
	41	Manufacturing Processes III	MFGYT33G03-EN													1	2	AW5	*3*					
	42	Logistics I	MFLOG31G02-EN									2	0	ESE	*2*									
	43	Environmental Protection	MFKOR31X02-EN					0	2	AW5	*2*													
	44	Industrial Safety	MFBIZ31X02-EN																					2
	45	Hydraulic and Pneumatic Machines	MFHIP31G04-EN													2	2	ESE	*4*					
	46	Material Handling	MFANM31G03-EN																	2	1	AW5	*3*	
	47	Process Optimization and Analysis I	MFFOP31G03-EN																	2	1	AW5	*3*	

Basic Science Subjects

Basics of Engineering Calculations

Code: MFTTA31X00-EN
ECTS Credit Points: 0
Year, Semester: 1st year/1st semester
Number of teaching hours/week:
Lecture: **0**
Practice: **2**
Prerequisites: -
Topics:
Numbers and Basic Operations: Fractions, decimals. A ratio, a proportion, a percentage. Calculations with fractions. Handling exponents. Rounding and estimating. Normal forms of numbers (scientific notation). Prime numbers, prime factorization.
Geometry: Points, lines, planes, segments, rays. Distance between points. Angles, types of angles. Parallel lines and transversals. Vectors, vector operations. Types of triangles (scalene, isosceles, equilateral, right). Congruent triangles. Centers of triangles. Polygons, interior and exterior angles of a polygon. Quadrilaterals. Characteristics of parallelograms. Kites and trapezoids. Transformations (reflection, rotation, translation). Similar polygons, a scale factor. Similar triangles. Right triangles. Pythagorean theorem. Parts of a circle, angles. Perimeter and area: triangle, quadrilaterals, general polygons, circles. Surface area and volume: polyhedral, prisms, cylinders, pyramids, cones, spheres. Constructing lines, angles, polygons, circles and arcs.
Functions, equations and inequalities: Basic functions (polynomial, power, exponential, logarithmic, trigonometric), graphs and properties. Shifting and scaling. Linear functions equations and inequalities. Graphical solution. Rates of change (examples in physics). Quadratic polynomials equations and inequalities. Factoring. Exponential, logarithmic, trigonometric equations and inequalities.
Statistics: Random events. Probability. Classical probability formulas. Conditional probability. Empirical probabilities based on specific sample data. Percentile rank of an item in a data set, first, second, and third quartiles. Histogram, cumulative frequency histogram, a box-plot diagram. A scatter plot. Discrete and continuous random variables. Mean, median, mode, standard deviation, variance. Linear regression models. Normal distribution.

Literature:

1. Mitas, P.J., Basic Math Quick Reference eBook, ISBN 978-0-615-27390-7
2. Zegarelli, M., Basic Math & Pre-Algebra for dummies, Wiley Publishing, Inc.
3. Freeman, C.M., Hand-On-Geometry, Prufrock Press Inc., ISBN-13: 978-1-59363-555-8
4. Alexander, D.C., Koeberlein, A., Elementary Geometry for College Students, BROOKS/COLE, 2011
5. Larson, R., Farber, B., Elementary Statistics - Picturing the World, Prentice Hall, 2012

Mathematics I

Code: MFMAT31S05-EN
ECTS Credit Points: 5
Year, Semester: 1st year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **3**
Prerequisites: -
Topics:

Arithmetic of real and complex numbers. Algebra of vectors in 2 and 3 dimensions. Coordinate systems. Functions and their graphs. Composition of functions. Inverse functions. Sequences and series of numbers, and convergence criteria. Sequences and series of functions, power series, convergence criteria.Real functions. Polynomials. Limits, continuity. Interpolation.Arithmetic of matrices. Determinants. Systems of linear equations. Cramer's rule. Linear space, subspace, generating systems, bases, orthogonal and orthonormal bases. Linear transformations, eigenvectors, eigenvalues.

Literature:

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

Mathematics II

Code: MFMAT32S05-EN
ECTS Credit Points: 5
Year, Semester: 1st year/2nd semester
Number of teaching hours/week:
Lecture: **2**
Practice: **3**
Prerequisites: Mathematics I, MFMAT31S05-EN
Topics:
Derivatives, linear approximation. Differentiation rules. Applications in physics. Taylor polynomials. Extreme values. Monotony and convexity testing. Mean value theorems, l'Hospital's rule, Taylor's theorem. Curve sketching for a function, local and absolute extrema.Antiderivatives. Integration by parts and by substitution. Integration in special classes of functions. The Riemann integral. The Newton-Leibniz theorem. Improper integrals. Applications of the integration in geometry and physics. Fourier series.Classification of differential equations. Initial value problems, boundary value problems. First order differential equations. Slope fields. Euler's and Runge-Kutta methods. Problems leading to differential equations. Separable differential equations. Second order differential equations. The theory of linear differential equations, method of variation of parameters, method of undetermined coefficients, application of the Laplace transform.

Literature:

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
3. M. D. Greenberg, Fundamentals of engineering analysis, Cambridge University Press, ISBN 978-0-521-80526-1

Mathematics III

Code: MFMAT33S03-EN
ECTS Credit Points: 3
Year, Semester: 2nd year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **2**
Prerequisites: Mathematics II, MFMAT32S05-EN
Topics:
Functions of several variables, and scalar fields. Continuity, differential and integral calculus, partial derivatives, gradients, and Young's theorem. Local and global extrema. Double and triple integrals. The Jacobian determinant.Vector-valued functions and curves. Derivatives. Linear

approximation. Curvature, torsion. Motion in space, velocity, acceleration.Vector fields. Derivatives. Divergence and curl. Line and surface integrals. The theorems of Gauss and Stokes, Green's formulae. Conservative vector fields, potentials. Applications in physics.

Literature:

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
3. M. D. Greenberg, Fundamentals of engineering analysis, Cambridge University Press, ISBN 978-0-521-80526-1

Technical Mechanics I

Code: MFMMC31G04-EN
ECTS Credit Points: 4
Year, Semester: 1st year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **2**
Prerequisites: -
Topics:
The fundamentals of mechanics and statics. Newton's three laws of motion. Force, moment, and couples. Reduction of a force system. Resultant forces and the classification of force systems. Equilibrium equations. Statics of material points. Statics of rigid bodies (moment of inertia, systems of planar forces). Static problems in planar systems. Internal force systems of rigid bodies. Loading of beams (cantilevers, freely supported beams, fraction lined beams). Determination of shear and moment functions, and diagrams of beams. Statically determined beam structures (hinged-bar systems, compound beams, truss systems). Practical structures (friction, pin-friction, rolling resistance, rope friction).

Literature:

1. Joseph F. Shelley (1990): 800 solvedproblemsinvectormechanicsforengineers, Volume I: Statics. (SCHAUM'S SOLVED PROBLEM SERIES), McGraw-Hill, 1990, ISBN 0-07-056835-9
2. Russel C. Hibbeler (2006): Engineering Mechanics – Statics and Dynamics, Prentice Hall, 2006. ISBN-13 9780132215091
3. Lakshmana C. Rao, J. Lakshminarasimhan, Raju Sethuraman, Srinivasan M. Sivakumar (2004): Engineering Mechanics: Statics and Dynamics, PHI Learning Pvt. Ltd., ISBN 8120321898, 9788120321892
4. Lawrence E. Goodman, Susan Goodman, William H. Warner (2001): Statics Courier Dover Publications, ISBN 0486420051, 9780486420059
5. Ferdinand P. Beer, E. Russell Johnston, Jr., (1987): University of Connecticut, Mechanics for Engineers: Statics and Dynamics (Package), 4th Edition, ©1987, ISBN-13 9780070045842

Technical Mechanics II

Code: MFMMC32G04-EN
ECTS Credit Points: 4
Year, Semester: 1st year/2nd semester
Number of teaching hours/week:
Lecture: **2**
Practice: **2**

Prerequisites: Technical Mechanics I MFMMC31G04-EN, Mathematics I MFMAT31S05-EN

Topics:

Statics review. Mathematical preliminaries (vector, matrix and tensor algebra). Fundamentals of the strength of materials. Physical interpretation of strain terms. State of deformation. State of stresses. Principal values of normal stresses, principal axes. Strain energy. Constitutive equation (Hooke's law). Simple loadings (tension, compression, bending, torsion, shear). Sizing methods. Area moment of inertia and product of inertia. A polar moment of inertia. Determination of principal axes. Mohr's circle. Combined loadings (tension and bending, inclined bending, excentric tension, tension and torsion, bending and torsion). Buckling of columns.

Literature:

1. Stephen Timoshenko (1955): Strength of Materials: Elementary Theory and Problems, Van Nostrand
2. LadislavCerny (1981): Elementary Statics and Strength of Materials, McGraw-Hill, ISBN 0070103399, 9780070103399
3. LászlóKocsis (1988): Brief Account of the Lectures of Mechanics, Strength of Materials, BME
4. Ferdinand P. Beer, E. Russel Johnston, Jr., John T. DeWolf (2006): University of Connecticut Mechanics of Materials, 4th Edition, © 2006, ISBN-13 9780073107950

Technical Mechanics III

Code: MFMMC33G03-EN

ECTS Credit Points: 3

Year, Semester: 2nd year/1st semester

Number of teaching hours/week:

Lecture: **1**

Practice: **1**

Prerequisites: Technical Mechanics II MFMMC32G04-EN, MATHEMATICS II MFMAT32S05-EN

Topics:

Kinematics of particles: description of motion with scalar and vector quantities, examples (free motion with constant acceleration, circular motion), the Frenet-Serret frame.

Kinetics of particles: Newton's laws for particles, force formulas (gravitational, spring, drag and reaction forces), the differential equation of motion, the impulse-momentum and work-energy theorems, homogeneous, central and conservative force fields, the concept and calculation of potential energy.

Kinematics of plane motion of rigid bodies: Basic concepts, velocity and acceleration analyses of translation, rotation and general plane motion, instantaneous centre of zero velocity and acceleration, rolling without slipping, presenting general plane motion as rolling.

Kinetics of plane motion of rigid bodies: basic concepts (centre of mass, momentum, angular momentum, moment of inertia and kinetic energy), the Huygens-Steiner theorem, calculation of moment of inertia, Newton's laws for bodies, impulse-momentum, angular momentum and work-energy theorem for the plane motion of rigid bodies, rotation about a fixed axis, rolling and sway motion.

Literature:

1. Joseph F. Shelley (1991): 700 solved problems in vector mechanics for engineers, Volume II: Dynamics. (SCHAUM'S SOLVED PROBLEM SERIES), McGraw-Hill, 1990, ISBN 0-07-056687-9

2. Russel C. Hibbeler (2006): Engineering Mechanics – Statics and Dynamics, Prentice Hall, 2006. ISBN-13 9780132215091
3. Ferdinand P. Beer, E. Russell Johnston, Jr., (1987): University of Connecticut, Mechanics for Engineers: Statics and Dynamics (Package), 4th Edition, ©1987, ISBN-13 9780070045842

Technical Mechanics IV.

Code: MFMMC34G02-EN
ECTS Credit Points: 2
Year, Semester: 2nd year/2nd semester
Number of teaching hours/week:
Lecture: **1**
Practice: **1**
Prerequisites: Technical Mechanics III MFMMC33G03-EN
Topics:
This course presents periodic motion machines and investigates harmonic vibratory motion mathematically. The series of lectures cover the following topics: properties of vibrating systems; single-degree-of-freedom vibrating systems; free, undamped vibrations; pendulums; damped vibrations (dry friction, viscous damping); forced (harmonically excited) vibrations of undamped and damped mechanical systems; isolation of vibrations; multiple-degrees-of-freedom systems; application of Langrange's equation; natural frequencies and vibration modes; normal mode analyses; approximate solutions to the equations of motion: the Runge-Kutta method; simulation methods for vibrating systems: usage of MATLAB Simulink; operation principle of the oscillation measuring apparatus.
Literature:
1. Meirovitch, Leonard; Fundamentals of Vibration; McGraw-Hill Publishing Company, 2000; ISBN 0071181741

Engineering Physics

Code: MFMFI31G02-EN
ECTS Credit Points: 2
Year, Semester: 1st year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **0**
Prerequisites: -
Topics:
The basics of kinematics and dynamics of particles. Giving the position of a particle. Position-time function, velocity and acceleration. Newton's laws. Types of forces. The concept of mechanical work, potential and kinetic energy. Work-energy theorem.
The basics of electricity and magnetism. Transport processes. Electrostatics, electrical potential, electric fields around conductors, capacity and capacitors. Transport processes. Electric current, AD circuits. A heat transfer: thermal conduction, convection and radiation. The fields of moving charges, magnetic fields, electromagnetic induction and Maxwell's equations, AC circuits, electric and magnetic fields in matter.
Literature:
1. Alvin Halpern (1988): 3,000 Solved Problems in Physics (SCHAUM'S SOLVED PROBLEM SERIES), McGraw-Hill, 1988, ISBN 0-07-025734-5
2. Michael Browne (1999): Physics for Engineering and Science, McGraw-Hill, 1999, ISBN 0-07-161399-6

3. Robert Balmer (2006) Thermo-dynamics, Jaico Publishing House, ISBN: 817224262X, 868 pages

Operation and Theory of Machines

Code: MFAGT31G03-EN
ECTS Credit Points: 3
Year, Semester: 1st year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **1**
Prerequisites: -
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:

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

Thermodynamics and Fluid Mechanics I

Code: MFHOA31G05-EN
ECTS CREDIT Points: 5
Year, Semester: 1st year/2nd semester
Number of teaching hours/week:
Lecture: **2**
Practice: **2**
Prerequisites: Mathematics I. MFMAT31S05-EN, Engineering Physics MFMFI31G02-EN
Topics:
Thermodynamic properties. Definitions and fundamental ideas of thermodynamics. Changing the state of a system with heat and work. Change of phase. The zeroth law of thermodynamics. The isotherm, isochore and isobar, adiabatic and polytropic processes. The first law of thermodynamics: conservation of energy. Generalized representation of thermodynamic cycles. The Carnot cycle. Entropy. The second law of thermodynamics. Reversibility and irreversibility in natural processes. Technical work. Enthalpy. Exergy. Gas mixtures: partial pressures, Dalton's law. Real gas types. Steam. Humid air. T-s diagrams. Energy cycles. Modes of heat transfer. Heat Flux, thermal conductivity. The general differential equation of heat conduction. Steady state and transient conduction. Thermal resistance. Conduction rectangular and cylindicar coordinates. Convection: concepts and basic relationships, boundary layers, the similarity concept. Heat transfer through gases, fluids and solids. Overall heat transfer coefficient. Moving heat sources. Extended surfaces, fin performances. Radiative heat transfers. Heat exchangers.
Literature:

1. LAKATOS A. Thermodynamics and Fluid mechanics. 2014.

Thermodynamics and Fluid Mechanics II

Code: MFHOA32G05-EN

ECTS CREDIT Points: 5
Year, Semester: 2nd year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **2**
Prerequisites: Thermodynamics and Fluid mechanics I. MFHOA31G05-EN
Topics:
Definitions, concepts and properties of fluids. Hydrostatics, pressure, density. Main equations (Continuity, Law of Impulse Navier-Stokes etc.) Velocity and acceleration representations. Euler and Bernoulli equations. Ideal and Real Fluids. Flows in piped, friction and fitting losses in pipe flow. Frictional Bernoulli equation.
Literature:
1. LAKATOS A. Thermodynamics and Fluid mechanics. 2014.

Economics and Humanities Subjects

Economics for Engineers

Code: MFKGZ31X04-EN
ECTS Credit Points: 4
Year, Semester: 2nd year/1st semester
Number of teaching hours/week:
Lecture: **3**
Practice: **0**
Prerequisites: -
Topics:
This course focuses on the theory and application of the following:
Measuring national income and output (real vs. nominal GNP, GDP, NNP, NDP, the problem of double counting). Consumption and Investment. IS model. Economic role of government (externalities). Fiscal policy and output determination. The role of money in the economy, the evolution of money, central bank, commercial banking, supply and demand for money. Monetary policy (varieties and problems of monetary policy). IS-LM analysis: the integration of the goods and money market models. Aggregate demand and supply. Labour market. Unemployment and inflation.
Literature:
1. T. KISS, J., Introduction to Macroeconomics for Engineers and technical Managers. University of Debrecen Faculty of Engineering. Debrecen University Press, 2014. ISBN: 978 963 318 416 5.
2. SAMUELSON P.A., NORDHAUS W.D.: Economics, 18th edition, Academic Internet Publishers Inc., 2006. ISBN: 0072872055
3. PARKIN, M., POWELL, M. & MATTHEWS, K. (2008) Economics. 7th ed. Harlow: Addison

Wesley. ISBN-13: 9780132041225

Microeconomics

Code: MFVGF31X04-EN
ECTS Credit Points: 4
Year, Semester: 2nd year/2nd semester
Number of teaching hours/week:
Lecture: **1**
Practice: **2**
Prerequisites: Economics for Engineers MFKGZ31X04-EN
Topics:

This course aims to make students familiar with the basic concepts of microeconomic analysis. In particular, the course will be focused on the analysis of how economic actors, consumers and firms choose between different alternatives. By the end of the course, the student should be able to use the basic tools and models of microeconomics, and apply them in solving problems. The course focuses on the theory and application of the following: The basics of supply and demand. Market equilibrium. Elasticity of demand (supply). Consumer behavior - Households' choices (Marginal utility theory, indifference (curve) analysis. Firm's production (factors), costs of production, profit-maximizing behavior. Market structures (perfect competition, imperfect competition: monopoly, oligopoly, monopolistic competition). Profit maximizing under perfect competition, and monopoly. Investment, interest, profits and capital.

Literature:

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

Basics of Quality Management

Code: MFMIN31X04-EN

ECTS Credit Points: 4

Year, Semester:3rd year/1st semester

Number of teaching hours/week:

Lecture: **1**

Practice: **1**

Prerequisites: -

Topics:

This course focuses on making the theories and principles of total quality both practical and useful ways. Practitioners in a corporate setting will find it a valuable guide in helping them to learn how to be effective agents of the total quality approach, to understand and implement total quality.

Literature:

1. Goetsch D. L. – Davis, S. (2006): Quality management: introduction to total quality management for production, Pearson Prentice Hall, ISBN 0131189298, 9780131189294
2. Dale, B. G. (2003): Managing Quality, Wiley-Blackwell, ISBN 0631236147, 9780631236146

Management for Engineers

Code: MFMAM31X04-EN

ECTS Credit Points: 4

Year, Semester: 3rd year/2nd semester

Number of teaching hours/week:

Lecture: **1**

Practice: **3**

Prerequisites: -

Topics:

In the Management for Engineers course students gain in sight into the key areas of leadership. During the course students become familiar with the new management trends, such as coaching authoritarian leadership, time- and energy management and with the importance of emotional

intelligence in effective leadership. In the framework of practical classes the students' leadership skills, emotional intelligence and their soft skills are measured and analyzed.

Literature:

1. McKeown, A. – Wright, R. (2011): Professional English in Use, Cambridge University Press, Cambridge
2. Gordon, T. (2001): Leader Effectiveness Training, New York, Widden Books
3. Schwart, T – Loehr, J. (2005): The Power of Full Engagement: Managing Energy, Not Time, Is the Key to High Performance and Personal Renewal, New York, Free Press
4. Mancini, M. (2003): Time management, New York, McGraw-Hill Companies
5. Taylor, J. (2012): Decision Management System, IBM Press, USA

State administration and Law

Code: MFJOG31X02-EN

ECTS Credit Points:2

Year, Semester: 3rd year/1st semester

Number of teaching hours/week:

Lecture: **2**

Practice: **0**

Prerequisites: -

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

Literature:

1. ZoltánHorváth: Handbook on the European Union, HVG-ORAC, Budapest, 2011.
2. PéterSmuk: The transformation of the Hungarian Legal System 2010-2013. Complex, 2013.

Engineering Ethics

Code:MFTAI31X02-EN

ECTS Credit Points: 2

Year, Semester: 1st year/2nd semester

Number of teaching hours/week:

Lecture: **2**

Practice: **0**

Prerequisites: -

Topics:

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

Literature:

1. Charles E. Harris, Michael S. Pritchard, Michael J. Rabins: Engineering Ethics: Concepts and Cases, 2008 - 313 pages

Professional Subjects

Informatics for Engineers I

Code: MFINF31X03-EN
ECTS Credit Points: 3
Year, Semester: 1st year/1st semester
Number of teaching hours/week:
Lecture: **0**
Practice: **2**
Prerequisites: -
Topics:
Introduction to informatics. Computer structures. Operating systems. Computer networks, the Internet. Theoretical and practical data structures. Algorithms.Spreadsheets: entering data, records, fields, creating a table, sorting and filtering data, expanding databases, formatting databases.Relational databases, SQL language, normalizing databases, securing databases (confidentiality, integrity and availability), keys, transactions.
Literature:

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

Informatics for Engineers II

Code: MFINF32X03-EN
ECTS Credit Points: 3
Year, Semester: 1st year/2nd semester
Number of teaching hours/week:
Lecture: **0**
Practice: **2**
Prerequisites: Informatics for Engineers I. MFINF31X03-EN

Descriptive Geometry

Code: MFMAB31G03-EN
ECTS Credit Points: 3
Year, Semester: 1st year/1st semester
Number of teaching hours/week:
Lecture: **1**
Practice: **2**
Prerequisites: -
Topics:
Monge's method of projecting: methods of projection, an image-plane system, representation of spatial elements, reconstruction. The fundamentals of intersections: line-plane and plane-plane intersections.
Metrical problems: distance and angle tasks, perpendicularity, rotation of a plane to parallel to an image plane, methods of replacing image-planes, constructing an illustrative picture using new image-planes, visibility. Polyhedrons: their representation, their intersection with a line, plane and the other polyhedron.
Curved surfaces: construction and representation of curved surfaces, their intersection with a line, a plane.
Literature:

1. Vlasta Szirovicza: Descriptive geometry, Self-published, Zagreb, Croatia, 2007, ISBN 978-953-95667-0-6

2. Animated ppt files used in lectures, their pdf versions, and worksheets (published on the website of the course)
3. Paré, E. G.: Descriptive geometry, Prentice Hall, 1997
4. Gordon, V. O.: A course in descriptive geometry, Mir, 1980

Technical Drawing

Code: MFMAB32G03-EN
ECTS Credit Points: 3
Year, Semester: 1st year/2nd semester
Number of teaching hours/week:
Lecture: **2**
Practice: **1**
Prerequisites: Descriptive Geometry MFMAB31G03-EN
Topics:
The series of lectures are based on the relevant standards.
It reviews the fundamental rules and formal requirements of the technical drawing, the drawing of projections, views and sections, auxiliary and sectional views. Representations of threaded parts, and threaded fasteners, gears, splines and keys. Drawing standardized machine elements and the concept of manufacturing tolerance and fitting, dimensional specification, geometrical and positioning tolerancing, surface roughness and the rules of elaboration of the workshop drawing and detailed drawings of simple machine elements.
In seminar there are six tasks to elaborate: workshop drawing of different machine elements and components.
Literature:

1. TIBA ZS.:Machine Drawing, ISBN 978-963-318-066-2, Debrecen University Press 2010.

Machine Elements I

Code: MFGEP31G05-EN
ECTS Credit Points: 5
Year, Semester: 2nd year/1st semester
Number of teaching hours/week:
Lecture: **3**
Practice: **2**
Prerequisites: Technical Mechanics II. MFMMC32G04-EN,Technical Drawing MFMAB32G03-EN
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:

1. TIBA ZS.: Machine Drawing, ISBN 978-963-318-066-2, Debrecen University Press 2010.
2. Joseph Shigley, Charles Mischke, Richard Budynas: Mechanical Engineering Design, 7th Edition Hardcover with access card, 1056 pages©2004, ISBN-13 9780072921939

3. Ansel Ugural, NEW JERSEY INSTITUTE TECH: Mechanical Design: An Integrated Approach, 1st Edition Hardcover with access card, ©2004, ISBN-13 9780072921854

Machine Elements II

Code: MFGEP32G05-EN
ECTS Credit Points: 5
Year, Semester: 2nd year/2nd semester
Number of teaching hours/week:
Lecture: **2**
Practice: **2**
Prerequisites: Machine Elements I. MFGEP31G05-EN
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:

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

CAD and CAE I

Code: MFCAD31G03-EN
ECTS Credit Points: 3
Year, Semester: 2nd year/1st semester
Number of teaching hours/week:
Lecture: **1**
Practice: **1**
Prerequisites: Informatics for Engineers II. MFINF32X03-EN
Topics:
The series of practice classes cover the following topics: introduction to AUTOCAD, creating drawings in AUTOCAD, manipulating objects, drawing organization and inquiry commands, altering objects, working with *Layouts*, annotating, dimensioning and hatching objects. Working with reusable content, plotting, creating 3D objects and parametric drawing in AUTOCAD.
Literature:

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

Materials Science I

Code: MFANI31G04-EN
ECTS Credit Points: 4
Year, Semester: 1st year/1st semester
Number of teaching hours/week:
Lecture: **2**

Practice: **2**
Prerequisites: -
Topics:
The lectures and practice classes cover the followings: structure and composition of materials, including the types of atoms and their arrangement, as viewed over a range of length scales (nano-, micro-, meso-, and macro-scale), crystalline structure of metals, crystal defects, solid solutions, compounds, alloys, equilibrium conditions of systems, binary systems, phase diagrams, the iron-carbon phase diagram, austenite transformations, principles of transformation diagrams (isothermal, continuous cooling), ferrous and non-ferrous metals, basic micro-structures, polymers, ceramics, composites, material properties (physical, mechanical, electrical, optical, magnetic), calculation tasks on crystalline systems, phase diagrams, transformation diagrams.
Literature:

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

Materials Science II

Code: MFANI32G04-EN
ECTS Credit Points: 4
Year, Semester: 1st year/2nd semester
Number of teaching hours/week:
Lecture: **2**
Practice: **2**
Prerequisites: Materials Science I. MFANI31G04-EN
Topics:
The performance of materials under various loading and environmental conditions. Static and dynamic material properties. Fatigue (low cycle, high cycle fatigue), fracture (ductile, non-ductile), plastic collapse. Corrosion (local, global, stress corrosion cracking, inter-crystalline, trans-crystalline, erosion-corrosion). Material testing. Destructive testing methods (tensile, impact, fatigue, fracture mechanics, hardness, etc.). Introduction to non-destructive testing (NDT) methods (visual, radiographic, ultrasonic, magnetic, eddy current, dye penetrant, acoustic emission, etc.) Physical principles and areas of application. Flaw detection and sizing. Automation of NDT processes. The performance and evaluation of various laboratory tests (tensile, fracture mechanics, hardness).
Literature:

1. William D. Callister and David G. Rethwisch: Materials Science and Engineering, John Wiley and Sons (2011) 9th Edison SI version ISBN 978-0-470-505861-1
2. Hellier, Chuck: Handbook of Nondestructive Evaluation, Second Edition McGraw-Hill (2012) ISBN 9780071777148
3. McEvily, Arthur J.; Kasivitamnuay, Jirapong: Metal Failure, John Wiley & Sons (2013) 2nd edition ISBN 9781118163962

Technology of Structural Materials

Code: MFSAT31G02-EN
ECTS Credit Points: 2
Year, Semester: 2nd year/1st semester
Number of teaching hours/week:
Lecture: **1**
Practice: **1**
Prerequisites: Materials Science II. MFANI32G04-EN

Topics:
Definition and classification of technological processes applied for engineering materials. Basic principles of heat treatments (phase transformations; transformation without diffusion). Hardening, tempering, annealing. Surface heat treatments (case hardening), thermo-chemical treatments (nitriding). Joining technologies and their applications. Classification of welding, major welding technologies. Heat sources, filler materials, machines for different welding technologies. Arc-welding processes (with consumable and non-consumable electrode), resistance welding, pressure welding, high energy welding, etc. Fusion welded joints (weld quality). Application fields of the various welding processes. Brazing and soldering.
Literature:

1. Mikell P. Groover: Fundamentals of Modern Manufacturing: Materials, Processes, and Systems

3D Computer Aided Design

Code: MF3DP31G03-EN
ECTS Credit Points: 3
Year, Semester: 2nd year/2nd semester
Number of teaching hours/week:
Lecture: **0**
Practice: **2**
Prerequisites: Machine Elements I. MFGEP31G05-EN, CAD and CAE I. MFCAD31G03-EN
Topics:
Introduction to parametric modelling systems. Properties of parametric modelling. Creating profiles and sketches (sketches, drawing tools, geometrical and dimensional constraints). Using features (protrusion, revolved protrusion, chamfers, fillets, etc.). Model history. Assembly designing (assembly configurations, exploded views). Creating technical drawings (view generation from parts, dimensions, section views, part list, symbols). Special environments (sheet models, welding design). Handling variables. Creating parts and assembly families. Importing standard parts. Interface between CAD systems. Integrated simulations (FEM analysis, dynamic simulation).
Literature:

1. www.solidedge.com
2. Getting Started with Solid Edge Version 20, ©2007 UGS Corp.

Electrotechnics and electronics I

Code: MFELT31G03-EN
ECTS Credit Points: 3
Year, Semester: 2nd year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **1**
Prerequisites: Mathematics II. MFMAT32S05-EN, Engineering Physics MFMFI31G02-EN
Topics:
The laws of electromagnetism. Superconductivity. Single- and three-phase AC circuits. Transformers. Induction, synchronous and DC motors. The principles of electric and electronic diagrams. Semiconductor devices. Integrated circuits: processors, controllers, memories. Power electronics. Basic electrotechnical laws. Electrotechnical and electronic materials. Basic concepts and theorems in circuit theories. Kirchhoff's and Ohm's laws. Thevenin's and Norton's theorems. The constant current. Other currents. RLC circuits. Unstable states, transient state analyses. Resonance circuits. Linking p-n-p and n-p-n.

The aim is to get to know the basic electrotechnical laws in the field of system theory. The structure of the basic electrotechnical circuits in computer systems. Basic concepts of the theory of analogue signals, its characteristics. Basic operations in linear signals.

Literature:

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

Electrotechnics and Electronics II

Code: MFELT32G02-EN

ECTS Credit Points: 2

Year, Semester: 2nd year/2nd semester

Number of teaching hours/week:

Lecture: **2**

Practice: **1**

Prerequisites: Electrotechnics and Electronics I.MFELT31G03-EN

Topics:

Introduction: electronics circuits, components, introduction to mechatronics systems. Signals: Sinusoidal waves, periodic and quasi-periodic signals. Amplifiers: a 4 port theory, transfer functions, feedback: positive and negative. Common emitter amplifier. Differential amplifiers: operational modes, circuits. Class A and AB amplifiers. Power amplifiers. Operational amplifiers: inverting and non-inverting types. Regulated power supplies: linear regulators, zener diode. AC-DC converter: a non-controlled one phase, a controlled three phase. DC-AC converters: one and three phase converters. Oscillators: RC and LC oscillators. Si oscillators. Filters: Low and high pass filters, band pass filter.

Literature:

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

Measurement and Automatics I

Code: MFMET31R03-EN

ECTS Credit Points: 3

Year, Semester: 2nd year/2nd semester

Number of teaching hours/week:

Lecture: **2**

Practice: **1**

Prerequisites: Electrotechnics and Electronics I. MFELT31G03-EN

Topics:

Basic Concepts of Measurement, measurement systems. Measuring instrument designs, measurement instruments. Electromechanical and electronic instruments. Digital instrumentation. Microelectronic sensors. Elastic deformation gauges. Temperature, light and radiation sensors. Fiber optic sensors. Signal processing systems. Pressure, temperature, strain and rotational movement measurement using National Instruments LabVIEW software.

Literature:

1. David G. Alciatore, Michael B. Histand: Introduction to mechatronics and measurement systems, McGraw-Hill, 2011, ISBN-13: 978-0073380230
2. U. A. Bakshi – V.U. Bakshi: Electronic Measurement and Instrumentation, Technical Publications Pune, 2009, ISBN: 9788184315295

Measurement and Automatics II

Code: MFMET32R04-EN
ECTS Credit Points: 4
Year, Semester: 3rd year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **2**
Prerequisites: Electrotechnics and Electronics II. MFELT32G02-EN,
Measurement and Automatics I. MFMET31R03-EN
Topics:
Different theoretical foundation of control engineering. Technical and application control functions. Programmable logic controllers. Members of the control loop. The members of the control loop steady state analysis. Linear transition state regulations. Linear members describing state transition. Control loop analysis. Stability and quality characteristics. Selection and setting of regulators. Digital controllers.
Literature:

1. Robert H. Bishop: Labview 2009 student edition, 2009, Prentice Hall, ISBN-13:978-0132141291
2. Travis, Jeffrey LabVIEW for everyone: graphical programming made easy and fun / Jeffrey Travis, Jim Kring 2007. p:1032

Thermal and Fluid Machines I

Code: MFHOG31G03-EN
ECTS Credit Points: 3
Year, Semester: 2nd year/2nd semester
Number of teaching hours/week:
Lecture: **2**
Practice: **1**
Prerequisites: Thermodynamics and Fluid Mechanics I. MFHOA31G05-EN
Topics:
Energy conversion processes. Heat loss in different energy transformation processes. Thermal analysis of gas and steam turbines, gas motors. The Schema and its operation. Cycles and efficiency of these machines. Boilers: their structures, operation and heat loss, efficiency of a burning process. Efficiency of boilers at partial load. Heat exchangers: types, parameters, efficiency, heat transfer processes, heat loss. Dimensioning of heat exchangers. Heat pumps: operation principles, types, parameters, coefficient of their performances. Compressors: types, thermodynamic parameters, efficiency. Chillers. Absorption and adsorption machines.
Literature:

1. M. J. MORAN, H. N. SHAPIRO, J. WILEY: Fundamentals of Engineering Thermodynamics, ISBN: 978-0-471-78735-8, 944 pages, 2004.
2. W. M. ROHSENOW, J. P. HARTNETT, Y. I. CHO: Handbook of Heat Transfer, ISBN: 0070535558 / 9780070535558, 1344 pages, New York McGraw-Hill 1998.
3. K. C. WESTON: Energy Conversion, ISBN-13: 978-0534938611, PWS Pub. Co. Har/Dsk edition July 1992.
4. J. HEYWOOD: Internal Combustion Engine Fundamentals, ISBN 978-0070286375, 930 pages, McGraw-Hill 1988.
5. C. FAYETTE TAYLOR: The Internal Combustion Engine in Theory and Practice: Vol. 1 - 2nd Edition, ISBN 978-0262700269, 584 pages, The MIT Press 1985.
6. C.FAYETTE TAYLOR: The Internal Combustion Engine in Theory and Practice: Vol. 2 - 2nd Edition, ISBN 978-0262700276, 800 pages, The MIT Press 1985.

7. K. HEROLD, R. RADERMACHER: Absorption Chillers and Heat Pumps, CRC-Press, ISBN 978-0849394270, 330 pages, Sanford A. Klein, 1996.
8. T. KUPPAN: Heat Exchanger Design Handbook, ISBN 978-0824797874, 1119 pages, CRC Publ. 2000.

Thermal and Fluid Machines II

Code:MFHOG32G03-EN
ECTS Credit Points: 3
Year, Semester: 3rd year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **1**
Prerequisites: Thermodynamics and Fluid Mechanics II. MFHOA32G05-EN
Topics:
It reviews the basic relationships of thermodynamics and fluid mechanics. Representations of the construction and operation of fluid machines. Fitting the suitable pumps, fans to the system characteristics. Calculating energy consumption. Fluid machines connected in series and parallel. Representations of system components.
Literature:

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

Manufacturing Processes I

Code: MFGYT31G04-EN
ECTS Credit Points: 4
Year, Semester: 1st year/2nd semester
Number of teaching hours/week:
Lecture: **2**
Practice:**1**
Prerequisites: Materials Science I. MFANI31G04-EN
Topics:
Basic principles of mechanical engineering. Overview of generally used raw materials manufacturingprocesses(steel-, copper-, alumina based and other alloys). Introduction of the basic material removal manufacturingprocesses. The basic concept of cutting, applicable tools and tool materials. Machining processes, turning,milling, drilling, planning, chipping, abrasiveprocesses, gearing, and thread cuttingtechnology. Methods of tool life analysis and management. Specialmachining, UP, HSC, electrochemical, laser-, and water-jet cutting.
Literature:

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

Manufacturing Processes II

Code: MFGYT32G04-EN

ECTS Credit Points: 4
Year, Semester: 2nd year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **1**
Prerequisites: Manufacturing Processes I. MFGYT31G04-EN
Topics:
Planning of technological methods in manufacturing. Introduction of the basic industrial design and operation documentation procedure in manufacturing. Primary forming processes (casting, powder metallurgy, metallurgical, hot forming processes). Sheet metal forming processes and its technology (volumeshaping, material separationprocesses, sheet forming). The main methods of forging and its manufacturing processes,forgingmachines. Manufacturing of forming plastic, ceramic, composite, its technologies and applicable tools and machines.
Literature:
1. L. Edwards, M. Endean: Manufacturing with Materials, Butterworths, London, 1990., ISBN 0-408-02770-3
2. M. F. Ashby: Materials Selection in Mechanical Design. 3.rd edition. Elsevier. London, 2005. ISBN 0-7506-6168-2.
3. S. Kalpakjian, S.R. Schmid, Chih-WahKok: Manufacturing Processes for Engineering Materials SI.
   John A. Schey:: Introduction to Manufacturing Processes (McGraw-Hill Series in Mechanical &Materialls Science)

Manufacturing Processes III

Code: MFGYT33G03-EN
ECTS Credit Points: 3
Year, Semester: 2nd year/2nd semester
Number of teaching hours/week:
Lecture: 1
Practice:**2**
Prerequisites: Manufacturing Processes II.MFGYT32G04-EN
Topics:
Introduction of material jointprocesses(welding,soldering, adhesive). Overview of welding processes and applicable technologies of designing and manufacturing of a welded joint. Weldabilityof metals and its alloys. Basic principles of industrial robots, and its basic kinematiccharacteristics. Designing the manufacturing process (in a CNC milling centre) of a product, applying the basic knowledge of Manufacturing processes I. & II. and using the EdgeCAM software to optimize the milling process.
Literature:
Required:
1. Modern Welding Technology (6th Edition) Howard B. Cary, Scott Helzer. Publication Date: November 20, 2004 | ISBN-10: 0131130293 | ISBN-13: 978-0131130296 | Edition: 6
2. A Guide to Lead-free Solders: Physical Metallurgy and Reliability, John W. EvansPublication Date: March 22, 2007 | ISBN-10: 1846283094 | ISBN-13: 978-1846283093 | Edition: 1st Edition.

Recommended:
1. Handbook of Adhesives and Sealants, Edward Petrie, Publication Date: December 12, 2006 | ISBN-10: 0071479163 | ISBN-13: 978-0071479165 | Edition: 2
2. Nonlinear Dynamics of Production Systems, Günter Radons, ReimundNeugebauer, Publication Date: March 26, 2004 | ISBN-10: 3527404309 | ISBN-13: 978-3527404308 | Edition: 1

Logistics I

Code: MFLOG31G02-EN
ECTS Credit Points: 2
Year, Semester: 2nd year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **0**
Prerequisites: -
Topics:
This series of lectures is based on the topics of logistics. It covers the areas of logistics, construction of logistics systems and major construction units. Logistic systems management levels, functions, levels of development. Material handling systems and their role in the logistics system. Material handling systems characterization, classification, material flow characteristics. The choice of material handling systems and equipment. Storage systems, processes and the interpretation of break bulk storage systems. Warehousing systems, transportation systems, controlling and information systems, supply chain management, industrial and manufacturing logistics.
Literature:

1. Alan Rushton, Phil Croucher, Peter Baker; The Handbook of Logistics and Distribution Management; Kogan Page, 2006; ISBN 0749446692
2. Michael B. Stroh; A Practical Guide to Transportation and Logistics; Logistics Network, 2001; ISBN 0970811500
3. Issa Baluch; Transport Logistics: Past, Present and Predictions; Winning Books, 2005; ISBN 9948031393

Environmental Protection

Code: MFKOR31X02-EN
ECTS Credit Points: 2
Year, Semester: 1st year/2nd semester
Number of teaching hours/week:
Lecture: **0**
Practice: **2**
Prerequisites: Technical Chemistry MFKEM31X03-EN
Topics:
This series of practice classes is based on the topics of environmental issues. The basic concepts of environmental protection and management.Characterization of environmental elements. Green chemistry. Chemicals in the environment: their fate and transport. Transport processes in the environment. Conservation of mass. Conservation of mass in integral (control volume) form. The differential form of conservation of mass. Groundwater hydrology. Diffusion of an instantaneous, point sources. Reactions and exchanges. Exchanges across an air-water interface. Partitioning of a solid. The transport of particles in the environment. Water resource systems. Aquatic chemistry. Water quality controls. Water and wastewater treatment technologies. Air chemistry. Air, water and soil pollution controls, waste management, recycling, noise and vibration problems, environmental health engineering. Pollution controlling through different methods.
Literature:

1. Andrew Farmer: Handbook of Environmental Protection and Enforcement: Principles and Practice (Hardcover), 294 pages, 2007, ISBN-13: 978-1844073092
2. MukeshDoble: Green Chemistry and Engineering (Hardcover), 381 pages, 2007, ISBN-13: 978-0123725325

Industrial Safety

Code: MFBIZ31X02-EN
ECTS Credit Points: 2
Year, Semester: 3rd year/2nd semester
Number of teaching hours/week:
Lecture: **2**
Practice: **0**
Prerequisites: -
Topics:
The Industrial Safety focuses on most of the real issues of future safety and health practitioners, such as dealing with enforcement, protecting workers from ergonomic hazards, and accommodating the latest advances in process technologies, health management, a modern perspective on compliance with mandatory standards for workplace safety and health, and a variety of solved problems. Topics covered include workers' compensation, fault tree analyses, hearing protection, environmental protection, fire protection, workers with disabilities, OSHA violation policy.
Literature:

1. C. Ray Asfahl, David W. Rieske: Industrial safety and health management 6th ed. (Intern. ed.) Boston Pearson, cop. 2010 ISBN-13 978-0-13-207650-0
2. Roger L. Brauer: Safety and health for engineers 2nd ed. John Wiley, cop. 2006

Field-Specific Vocational Subjects at Automotive Products and Processes Specialization

Assembly technology

Code: MFSZT31G03-EN
ECTS Credit Points: 3
Evaluation: mid-semester grade (AW5)
Year, Semester: 3rd year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **1**
Prerequisites: Manufacturing process II. MFGYT32G04-EN
Topics:
The main objective of the subject is that students learn about the correct planning of machine construction assembly. They are expected to be able to plan a fast and correct assembly plan for different machine elements. The students learn about the definition of parallel assembly. The dimensional chain and tolerance techniques are also part of the curriculum. The practices provide students with examples of the assembly processes of the most important machine elements which are used in the daily routine of a factory.
Literature:

1. Bruno L.: Manufacturing Assembly Handbook, London, 1989, ISBN 0-408-03561-7
2. Geoffrey B.: Product Design forManufacture and Assembly, ThirdEdition, United States, ISBN1420089277
3. John A. Schely: Intorduction to manufacturing processes, London, 1977, p. 392, ISBN 0-07055274-6
4. Molloy O., Tilley S.,Warman E. A.:Design forManufacturing and Assembly, Springer, 1998, ISBN 978-1-4613-7650-2
5. Svetan R.: Precision Assembly Technologies for Mini and Micro Products, Springer, 2016, ISBN 978-0387312767

6. Sukhan L., Raúl S.,Byung-Wook C.: Frontiers of Assembly and Manufacturing, Springer, 2010, ISBN 978-3-642-14115-7

Automotive Quality Assurance

Code: MFJMI31G03-EN
ECTS Credit Points: 3
Evaluation: mid-semester grade (AW5)
Year, Semester: 3rd year/2nd semester
Number of teaching hours/week:
Lecture: **2**
Practice: **1**
Prerequisites: MFMIN31X04-EN
Topics:
This course is an introduction to automotive quality assurance (ISO/TS 16949). Students learn about PFMEA, DFMEA, CP, CPK, CMK, Gage R and R, SPC and the first sample approval process. Lectures describe the main properties of APQP processes, control plans, flow charts and 8D documentation (quality complaint handling) like problem solving techniques and measuring methods. One of the goals is to deepen students' understanding of brainstorming, 5 why and paretoanalysisby the middle of the semester. The focusof the course is on how to create a quality management handbook and how to review management handbook processes and documentation. By the end of the semester students will acquire and will be able to use these kinds of methods.
Literature:

1. Roland Mader, Eric Armengaud, Gerhard Griessnig, Christian Kreiner, Christian Steger, Reinhold Weiss : Reliability Engineering & System Safety, December 2013.
2. 2. HervéRessencourt, Louise Trave-Massuyes, JéromeThomes: Fault Detection, Supervision and Safety of Technical Processes 2006, Volume 1, 2007.
3. Salman Taghizadegan: Essentials of Lean Six Sigma, 2006, Pages 107-174.
4. Ali Jahan, Kevin L. Edwards: Multi-criteria Decision Analysis for Supporting the Selection of Engineering Materials In Product Design, 2013.
5. 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.

Business Management Systems and IT

Code: MFVRI31G03-EN
ECTS Credit Points: 3
Evaluation: AW5
Year, Semester: 3rd year/2nd semester
Number of teaching hours/week:
Lecture: **0**
Practice: **4**
Prerequisites: -
Topics:
Nowadays companies use different types of business management systems. This course is an introduction to these business management systems and basic IT tools. The program which students use during this course is called SAP. Students will learn about stock queries, purchasing and controlling tools (like BANF), basic logistics (such as the definition of charge), and quality and production modules of SAP. Students will be able to use the basic SAP modules, adjustments and reporting methods by the end of the semester. The course also provides students with an insight into Microsoft Outlook and Microsoft One Note programs and the importance of business folder structures.

Literature:

1. Schicht, G. – Schmieden, A.: Flying Star with SAP R/3. Addison-Wesley-Longman Verlag GmbH, Germany, 1999.
2. V. Narayanan: SAP R/3 FI transactions. Infinity Science Press LLC, Hingham, 2007.
3. Jordan, J.: 100 Thing You Should Know About Controlling with SAP, Galileo Press Inc., Boston (2011.)
4. Akhart, J.: Quality Management with SAP, Rheinwerk Publishing, ISBN 978-1-4932-1203-3, 2015.
5. Krishnamoorthy, V., Murray, M., Reynolds N.: SAP Transaction Codes Your Quick Reference to Transactions in SAP ERP, Rheinwerk publishing, ISBN 978-1-59229-374-2, 2011.

Competence development for engineers

Code: MFKFM31G03-EN
ECTS Credit Points: 3
Year, Semester: 3rd year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **2**
Prerequisites: -
Topics:
The aim of the course is to help students make their own personality inventory. After gaining self-knowledge, students can learn about motivational methods that will enable them to motivate themselves. The course also introduces students to conflict management, problem solving, negotiation and flexibility and develops their collaborative competence. The students can find out more about their personality and motivation inventory.
Literature:

1. Schwart, T – Loehr, J. (2005): The Power of Full Engagement: Managing Energy, Not Time, Is the Key to
High Performance and Personal Renewal, New York, Free Press
2. Mancini, M. (2003): Time management, New York, McGraw-Hill Companies
3.Taylor, J. (2012): Decision Management System, IBM Press, USA

Computer aided manufacturing

Code: MFSSG31G03-EN
ECTS Credit Points: 2
Evaluation: mid-semester grade (AW5)
Year, Semester: 3rd year/2nd semester
Number of teaching hours/week:
Lecture: **1**
Practice: **2**
Prerequisites: Manufacturing Processes II. MFGYT32G04-EN;
Topics:
This subject is based on manufacturing processes. The lectures and practice classes would like to shape engineering thinking and the main focus is the use of computer aided tools in manufacturing. The students will learn about the basic steps of cutting, the administration of main and side movements as well as the simulation of billeting and finishing metal work, which are the base of CAD/CAM systems. By the end of the semester, the students will be prepared to work on different production preparation tasks at factories.
Literature:

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

Finite Element Method

Code: MFVEG31G04-EN
ECTS Credit Points: 4
Evaluation: mid-semester grade
Year, Semester: 3rd year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **1**
Prerequisites: CAD systems II.:MFCAR32G03-EN,
Technical Mechanics IV. MFMMC34G02-EN
Topics:
The finite element method in the product lifecycle. Mathematical and mechanical background of the finite element method. Fundamentals of linear elasticity (a displacement field, a strain field, a stress field). Basic equation systems (equilibrium equation, kinematic equation, constitutive equation). Boundary conditions. Boundary value problems. Strain energy and related principles. Linear spring. The Ritz method. Formulation of the finite element method. Truss and beam elements. Two-dimensional problems (plain strain, plane stress, axi-symmetric problems. Isoparametric finite elements. Numerical integration. General purpose of finite element programs. Application of Femap 9.3 FEM software. Modelling questions. Meshing. Post processing.
Literature:

1. 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.
2. Bathe, K.J. (1996): Finite Element Procedures, Prentice-Hall International, New Jersey, USA, p. 1037.
3. Kovács, Á.,Moharos, I., Oldal, I., Szekrényes, A. (2012): Finite Element Method, Typotex, Budapest, Hungary, p. 383.
4. Zienkiewicz, O.C., Taylor, R.L. (2000): The Finite Element Method: Solid Mechanics, Butterworth-Heinemann, London, England, ISBN: 0750650559, p. 477.

Hydraulic and Pneumatic Machines

Code: MFHPG31G04-EN
ECTS Credit Points: 4
Evaluation: exam
Year, Semester: 2nd year/2nd semester
Number of teaching hours/week:
Lecture: **2**
Practice: **2**
Prerequisites: Thermodynamics and Fluid Mechanics II. MFHOA32G05-EN
Topics:

Fundamentals of pneumatics. General structures of pneumatic systems. Control systems (directional control valves, dual-pressure valves, shuttle valves, pressure sequence valves, time delay valves). Simple pneumatic connections. Symbolic representation of pneumatic elements and devices. Building up of circuit diagrams. Applications of the FluidSIM-P program. Introduction to the Festo Didactic education system. Pneumatics in industry. Pneumatic machines. Hydraulic machine functions. Design and circuit diagrams of a hydraulic system. Physical principles of hydraulics. Parts of power supply systems. Pressure control valves. Stop valves. Flow control Valves. Hydraulic cylinders. Applications of the FluidSIM-H program.

Literature:

1. Peter Croser, Frank Ebel: Pneumatics Basic Level, Festo Didactic GmbH & Co., D-73770 Denkendorf 2002
2. D. Merkle, B.Schrader, M. Thomes: Hydraulics Basic Level, Festo Didactic GmbH & Co., D-73770 Denkendorf 2003
3. De Silva, Clarence W.: Mechatronics : an integrated approach, Boca Raton CRC Press, 2005

Logistic II

Code: MFLOG32G03-EN

ECTS Credit Points: 3

Evaluation: mid-semester grade (AW5)

Year, Semester: 3rd year/2nd semester

Number of teaching hours/week:

Lecture: **1**

Practice: **2**

Prerequisites: Material handling MFANM31G03-EN;

Topics:

The connection between logistics and a supply chain. The 7 rights of logistics. The aims of company logistics. A company logistics system (a strategic level, a tactical level, an operative level). The divisions of logistics (procurement, production, distribution, re-cycling). Supplier and distributer networks. Supply chain segmentation. Supply chain management. Procurement logistics. centralized and decentralized procurement. Direct and indirect purchasing. The process of purchasing. Methods used by purchasers; a demand analysis (ABC and XYZ analysis), a price analysis, evaluation and selection of a supplier, economic order quantity (EOQ). Production logistics. production systems. Push and pull type production systems. Computer integrated manufacturing. production control, scheduling. Material requirements planning (MRP). Manufacturing resource planning (MRP II.). Detail capacity planning (CRP). Just in time (JIT), just in sequence (JIS). Kanban, a milk run, warehousing, warehouse types. Storage technology. Inventory management. Storage of hazardous materials. Distribution logistics. Distribution requirements planning (DRP). Re-cycling logistics. Packaging technology. Costumers' services.

Literature:

1. Martin Christopher (2011): Logistics and Supply Chain Management, Financial Times Series, 4th edition
2. Lars Bedey, Sofia Eklund, NojanNajafi, William Wahrén, Karl Westerlund (2008): Purchasing Management, Chalmers, Department of Technology Management and Economics, http://publications.lib.chalmers.se/records/fulltext/90488.pdf
3. Peter Nyhuis, Hans-Peter Wiendahl (2009): Fundamentals of Production Logistics, Springer, ISBN 978-3-540-34210-6
4. DiCentral (2014): Inventory and Warehouse Managemenet Best Practices, SmartTurn Inc., 1st edition, http://www.smartturn.com/pdf/inventory-warehouse-management-best-practices-ebook.pdf

Material Handling

Code: MFARO31G03-EN
ECTS Credit Points: 3
Evaluation: AW5
Year, Semester: 3rd year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **1**
Prerequisites: MFGEP32G05-EN Logistics I.
Topics:
Basic concepts of handling and conveyance of materials. Classification of material handling systems.Fundamental elements of material handling systems. Properties of handled materials.Configurations and calculations ofcontinuous operating material handling equipment: belt conveyors, bucket elevators, overhead conveyors, rollerconveyors, screw conveyors, pneumatic conveyors. Powered industrial trucks and forklifts. Design and safety rules of cranes and lifting equipment. Introduction to unit load forming and container transporting technologies.Introduction to warehousing principles and technologies.Automatic storage warehouses with high racks and their equipment. Stacker cranes.
Literature:

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

Operation and Maintenance I.

Code: MFUKA31G04-EN
ECTS Credit Points: 4
Evaluation: exam
Year, Semester: 3rd year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **1**
Prerequisites: -
Topics:
Maintenance policies (run-to-failure, preventive, predictive, reliability-centred and total productive maintenance), functions, impact, benefits and effects of maintenance, overall maintenance strategy, maintenance organization objectives and responsibility, centralization vs. decentralization, in-house maintenance vs. outsourcing, maintenance forecasting and capacity planning, qualitative and quantitative forecasting techniques, strategic, medium range, and short range planning in maintenance, scheduling techniques, budgeting and costing planned maintenance services (control of maintenance costs while improving reliability), maintenance control, work order system, material and spare parts management, maintenance productivity and performance measurement, KPIs (budget, controlling equipments, planning etc.). Facility maintenance methods and tools (like energy management), failure statistics, failure modes and effect analyses, root cause analyses, Pareto Chart, cause and effect diagrams, 5 WHY method, Fishbone diagram.
Concept of safety, reliability and risk, reliability-centred maintenance, RCM Philosophy, methodology, and implementation, condition-based maintenance, fields and methods of technical diagnostics, integrated e-maintenance and intelligent maintenance systems, lean manufacturing, total productive maintenance, elements of TPM, TPM implementation, concept of maintainability, maintainability analyses, empirical data and maintainability measures, safety and maintenance, safety and risk assessment tools and techniques, work effectively in any safety- or reliability-critical environment, maintenance quality relationships, warranty and maintenance, industrial asset maintenance and sustainability performance, human reliability and errors in

maintenance, occupational stressors, human performance effectiveness, and human performance reliability functions.
Students learn about the tools of machinery condition monitoring: vibration measurement and analysis, infrared thermography, and tribology.

Literature:

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

Polymertechnology

Code: MFPOT31G03-EN
ECTS Credit Points: 3
Evaluation: exam
Year, Semester: 3rd year/2nd semester
Number of teaching hours/week:
Lecture: **2**
Practice: **1**
Prerequisites: -
Topics:
The students get acquainted with the texture of polymers, their mechanical properties, manufacturing processes and utilization. The main focus of the subject is the polymer components in vehicle industry and their manufacturing processes and recycling.

Literature:

1. L. Edwards, M. Endean: ManufacturingwithMaterials, Butterworths, London, 1990., ISBN 0-408-02770-3
2. M. F. Ashby: MaterialsSelectioninMechanical Design. 3rd edition. Elsevier. London, 2005. ISBN 0-7506-6168-2.
3. DeGarmo'sMaterials and ProcessesinManufacturing, 10th EditionDeGarmo, Black, Kohser, 2008.ISBN: 978-0-470-05512-0
4. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 3rd Edition, Groover, 2007. ISBN: 978-0-471-74485-6

Process optimization and analysis I

Code: MFFOP31G03-EN
ECTS Credit Points: 3
Evaluation: mid-semester grade (AW5)
Year, Semester: 3rd year/1st semester
Number of teaching hours/week:
Lecture: **2**
Practice: **1**
Prerequisites: -
Topics:
The series of lectures and practice classes are based on the topics of production management and business strategy development. Students learn about production strategies and product life time.

The lectures describe the properties of different production processes and the competitiveness of a production system, an aggregate planning and the typology of a forecast, and the components of production and operation management. Students learn about action management through a procedure of a company. The target of this subject is to describe company values and culture and to develop process thinking in engineering students. This kind of thinking has to be adapted to production environment. By the end of the semester students will acquire and will be able to use these kinds of methods.

Literature:

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

Process optimization and analysis II

Code: MFFOP32G03-EN
ECTS Credit Points: 3
Evaluation: exam
Year, Semester: 3rd year/2nd semester
Number of teaching hours/week:
Lecture: **1**
Practice: **2**
Prerequisites: MFFOP31G03-EN
Topics:
Students can acquire knowledge of resource calculation (MRP/SZTR), timing questions, supply and supply chain management. The curriculum includes the Toyota production system, the main properties of Just In Time (JIT) and the Japanese approach to production management with Lean methods and tools. (VSM, VSD, 5S, PFMEA, etc.). Students can also gain insights into new methods in LEAN office, Jidoka and production ergonomics. The target of this subject is to describe company values and culture and to develop process thinking in engineering students. This thinking has to adapt to the production environment. By the end of the semester the students will acquire and will be able to use these kinds of methods.

Literature:

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

Project task

Code: MFPRO31G42-EN

ECTS Credit Points: 2
Evaluation: mid-semester grade (AW5)
Year, Semester: 3rd year/2nd semester
Number of teaching hours/week:
Lecture: **0**
Practice: **2**
Prerequisites: Machine elements I. MFGEP32G05-EN; Manufacturing Processes III. MFGYT33G03-EN
Topics:
The students will work on different project tasks from a real industrial environment. The tasks involve planning of machines or machine parts, planning of manufacturing processes, measuring equipment, measuring process planning and measurement results processing. The students will be assigned their tasks by the factory where they are involved in the internship program or they can get a project task from a department of the university. The subject develops the students' individual problem-solving skills. This course prepares the students for later work on their thesis.
Literature:
-

Project management and controlling

Code: MFPRK31G03-EN
ECTS Credit Points: 3
Evaluation: exam
Year, Semester: 3rd year/2nd semester
Number of teaching hours/week:
Lecture: **2**
Practice: **2**
Prerequisites:
Topics:
The aim of this course is to make students familiar with the basic concepts of project management and controlling methods. By the end of the semester students will be able to carry out projects and moderate meetings. Students will develop their communication skills during team work and they will improve their problem solving and planning skills during the practice tasks. A presentation about Microsoft Project software and SWOT analyses will be part of the lectures and practice classes, which the students can use in their homework. The other target of this course is to help students improve their skills in economics.
Literature:

1. Meredith, J. R. – Mantel Jr. S. J. (2011): Project management: A Managerial Approach. John Wiley&Sons. ISBN: 0470533021, 9780470533024
2. PMBOOK GUIDE (2011): A Guide to the Project management Body of knowledge. Project management Institute. Four Campus Boulevard. ISBN: 1-880410-22-2.
3. Lock D. (2007): Project Management. Ninth Edition. Gower Publishing Limited, Hampshire, England.
   ISBN: 978-0-566-08769-1.

Robot technology

Code: MFARO32R33-EN
ECTS Credit Points: 3
Evaluation: a mid-semester grade (AW5)
Year, Semester: 3rd year/2nd semester
Number of teaching hours/week:
Lecture: **2**

Practice: **1**

Prerequisites: Logistics I. MFLOG31G02-EN

Topics:

Introduction to robotics and classification of robot systems, architectures, coordinate systems, and work spaces. The mechanical structure of robots, kinematic chains, and equations of motion. End effectors and tools. Programming robots: methods and technologies, internal and external information processing, and basic terms of programming. Description of robot motion by programming languages. General principles of moving paths, linear and curved paths, the interpolation of circles. Robot applications, the design of robot applications. Technological and work piece flow applications. Performance and safety issues. Scheduling with other systems. Introduction to robot operating systems. Introduction to robot operating functions: sensors, actuators and functions to network communication. Grading requirement: a working and accepted robot program.

Literature:

1. Reza N. Jazar: Theory of Applied Robotics: Kinematics, Dynamics, and Control, Springer, 2010, ISBN-13: 978-1441917492
2. Saeed B. Niku: Introduction to Robotics: Analysis, Control, Applications, Wiley, 2010, ISBN-13: 978-0470604465
3. Operating and programming manuals of KUKA Robots. 2014 Manual Book
4. Géza HUSI: Mechatronics Control Systems : Course Book, Debrecen : [University of Debrecen Faculty of Engineering], 2012, ISBN: 978 963 473 520 5, 322, p.
5. Géza HUSI: Mechatronics Control Systems : Laboratory Handbook, Debrecen : [University of Debrecen Faculty of Engineering], 2012, ISBN: 978 963 473 521 2, 184, p.

Internship

Code: MFTGY30G00-EN

Year, Semester: After the 2nd year/2nd semester in the summertime

Duration: 6 weeks

Number of working hours/week: 40

Students majoring in the Mechanical Engineering BSc have to carry out a 6 weeks internship involved in the model curriculum. The internship course must be signed up for previously via the NEPTUN study registration system in the spring semester (4th semester). Its execution is the criteria requirement of getting the leaving certificate (absolutorium).

Objective of the internship, competences

- Students get acquainted with professional work in conformity with their major at the company or institution and join in the daily working process. They have to resolve tasks independently assigned by their supervisor and gain experiences may be utilized later in the labour market.
- During the internship common and professional competences may be acquired.
  Common competences: precise working on schedule either individually or in team, talking in groups about correct technical terms.
  Professional competences: applying the professional skill gained during the training and acquiring new knowledge.

Places suitable for internship

All the organizations, institutions and companies, which provide students with the opportunity to acquire proficiency in accordance with their specialization in the field of operation, repairing technology, installation, management and development of different machines and vehicles, may be a suitable place.

Documents necessary for commencing and completing the internship

document	copy	signer(s)	submission deadline	receiver
Invitation Letter	1	company	last Friday in May at the end of 2nd academic year	secretariat (Ms. Judit Bak)
Internship Cooperation (Company abroad) **or** "Megállapodás" (Company in Hungary)	2 4	company, faculty company, supervisor faculty, major responsible	last Friday in May at the end of 2nd academic year last Friday in May at the end of 2nd academic year	secretariat (Ms. Judit Bak) secretariat (Ms. Judit Bak)
Evaluation Sheet and Certificate	1	company	second Friday in September at the beginning of 3rd academic year	Mr. András Gábora

Initiative of the internship at the company and providing for the documents from the company is the student's duty. If the student doesn't specify the receiving company or doesn't provide for the Invitation Letter or the initiative of the Agreement (or its signature) in time, the major responsible will refuse the Internship Certificate.

Requirements

A, for a signature:

1. The duration of the internship is 6 weeks and participation in it is compulsory. Student must complete the work hours altogether at the company. If student's behavior or conduct doesn't meet the requirements of active participation, the supervisor may evaluate their participation as an absence due to the lack of active participation in internship.
2. Besides completing the internship, students have to compile a 15-20 pages essay about the work done. The topic of the essay must be negotiated with the supervisor and attached to the activity actually done by the student. It is expedient to choose a topic which may be appropriate either for participating in the **NationalScientific Students' Associations Conference** ("OTDK") or a thesis.
3. The execution of the internship must be certified by the **Evaluation Sheet and Certificate** form can be downloaded from the website of the Department of Mechanical Engineering.

The deadline of submitting the Essay and the "Evaluation Sheet and Certificate":
second Friday in September at the beginning of 3rd academic year, office 301 (Mr. András Gábora)

Exemption

A partial exemption may be required by the student who has completed an internship in the secondary school and it is certified by the **secondary school certificate**. The request for partial exemption can be submitted till 31st May 2017. After this deadline requests are denied. The copy of the secondary school certificate and the written request addressed to Dr. Zsolt Tiba the major responsible must be submitted to Mr. András Gábora (office 301).

In case of any problems arising from the internship please contact Mr. András Gábora instructor (office 301, andrasbagora@eng.unideb.hu**) or Ms. Judit Bak secretary (office 304,** bakjudit@eng.unideb.hu**).**

FACULTY BACKGROUND, AND HISTORICAL FACTS

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 at the forefront of education and training of engineers in the North Great Plain Region and in the whole of Hungary. It is a dynamically developing Faculty with over 3.000 students and a highly-qualified and enthusiastic teaching staff of about 80 members. The teaching staff is involved in numerous domestic and international research and design projects. The Faculty of Engineering is practice oriented and develops skills required for the current conditions of the national and international labor market. 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 labor 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. 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 launched the engineering trainings in English in 2011.

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 was awarded by the Ministry of Education the Quality Prize in 2011 as a recognition of its efforts in this field.

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 labor market and enrich the world of engineering in Hungary and abroad with their knowledge and expertise.

FACILITIES AND INFRASTUCTURE OF THE TRAINING

Classrooms, auditoriums, laboratories and their instrumentation, workshops.

The available capacity of the lecture halls:

- 24 classrooms and drawing-rooms for training purposes (each with 16-70 seats, altogether 1.258 seats, measures 1.670 m^2)
- 18 auditoriums (each with 78-256 seats, altogether 1.281 seats, measures 1.396 m^2)
- The total capacity of full-time students: 3.250. Current number of students: approximately 2.860.

IT, Teaching technology and library supply etc.

- 3 **IT laboratories** for teaching graphics and CAD, seating 30 people each.

The *Faculty library* is a unit of the University and National Library of Debrecen University. The Library lays special emphasis on the extension of its electronic services. Most units of the Library worked with the integrated library system of Corvina (former Voyager) since 1992. The Library attaches great importance to collecting modern information carriers beside the traditional printed documents. Either by being a member of national consortia or by local subscription the library ensures that the citizens of the University be able to search in the bibliographic and full-text databases of the most important scientific periodicals of each discipline (EBSCO, WEB of Science, Elsevier periodicals, Biological Abstract, PsycINFO, Jstor etc.) It collects processes and services the specialized literature of the taught and researched fields of the sciences. It stores about 40,000 specialized books, textbooks and notes, 140 Hungarian and 25 foreign specialized journals, thousands of standards, extra materials for teaching and planning, product catalogues and brochures.

Language learning materials

The library provides students with language books, CDs and cassettes which help students fulfill the foreign language requirements necessary to finish the major. It pertains to the Hungarian teaching materials too in the case of training foreign students.

Different services and benefits which help students graduate

- Learning tools (course books and notes, technical books in Hungarian and in English)

- Textbook store where students can use their financial aid allocated for notes/textbooks
- Free wireless internet access in the Faculty buildings, including the dormitory

Administration unit

There is a Registry at the faculty, administration of courses is fully electronic with the NEPTUN system, the retrieval is helped by a register system.

LABORATORIES

Laboratory and tutorial workshop background of the *Mechanical Engineering and Mechatronics Engineering* fields

- **Biomechanical materials testing lab:** for testing prosthesis', plastics' and light metals' joints. Applied equipment: INSTRON 8874 universal biaxial materials testing machine.
- **LabView teaching room:** The basic teaching of LabView is carried out by 8 colleges trained by National Instruments (NI), in the teaching room supplied with 40 PCs. This lab is equipped with the latest technology of NI.
- **LEGO MINDSTORM teaching room:** Thanks to LEGO Hungary, 8 pieces of LEGO MINDSTORM robots are available for teaching the basics of the robot actuation and sensing technologies.
- **Machine elements lab:** oscilloscope, photo elastic bench, Spider 8 amplifier, DMC 9012 amplifier, CATMAN evaluating software, force transducer, torque transducer, inductive displacement transmitter, test pads.
- **Machining shop:** 5 machine lathes, 2 milling machines, gear-cutting machines, generating milling cutters, centre grinder, web-framed cross-cut saw, EMCO PC Mill type CNC drilling machine, CKE 6136i type CNC turning machine.
- **Material testing lab:** OLYMPUS GX41, NEOPHOT-2 and EPIGNOST-2 type metal microscopes.
- **Machine repairing lab:** hand tools, turning lathe, Castolin ROTOTEC type flame spraying pistol, EUTALLOY Super Jet type flame spraying pistol, column-type drilling machine.
- **Measuring lab:** calliper gauge, micrometer calliper gauge, base tangent length micrometer, optical dividing head.
- **Mechanical technology lab:** tensile-testing machine, ZD 20 type hardness tester, impact-tester, Brinell microscope, fatigue-testing machine.
- **Metallographic lab:** NEOPHOT type 2 and EPIGNOST type 2 microscopes, grinding- and polishing machines, power supply and auxiliary tools for electrolytic etching
- **SKF and diagnostics lab:** manual OILCHECK equipment, CMVP type 10 vibrometer pen, CMVP type 30 SEE pen, shock impulse analyzer with PRO32-2 and PRO46-2 software, Testo 816 type acoustimeter, infrared distance thermometer, UNIBALANCE 4 type balancing equipment, informatics background
- **X-Ray lab:** MXR type equipment, Liliput type radiation source, VA-J-15 type radiation-measuring assembly, densitometer, processing gauge, radiographic materials testing, magnetic crack detection, ultrasonic testing, liquid-penetrant testing.
- **Welding workshop:** 8 gas welder workstations, 6 manual arc welding workstations, 3 consumable-electrode welding workstations, 3 argon-shielded tungsten-arc welding workstations.

- **ZF Lenksysteme Hungary Automotive Laboratory**: the laboratory is equipped with ZF Lenksysteme Hungary's products, mountable steering systems and steering columns

Laboratories of the Building Mechatronics Research Center

- **Building mechatronics research laboratory:** The purpose of the laboratory is the elaboration of methods to carry out intelligent evaluation of measurements, intervention and planning. The competence of the laboratory includes the integrated parts of building automation, building supervision and security techniques, including the operation of necessary sensors, regulators and interveners, which is defined as building mechatronics.
- **Hydraulics laboratory:** Presentation of most modern hydraulic systems and research in the field of hydraulics, teaching of hydraulic subject-matters on the basis of the programs elaborated by FESTO Ltd. Didactic, resp. BOSCH-Rexroth. The laboratory has been set up and is sponsored by BOSCH-Rexroth Ltd. and FESTO Didactic Ltd.
- **Laboratory of electronic engineering and electronics (Rohde & Schwarz reference lab):** The main competence of the laboratory is the measuring of electric quantities in the field of mechatronics, mechanical engineering and chemical mechanical engineering by means of digital and analogue circuits. There are 10 measuring stations in the laboratory, which means that 20 students can carry out measurements at the same time.
- **Laboratory of re-configurable mechatronics controllers:** The purpose of the laboratory is the research and further development of intelligent controllers by using freely configurable digital electronic tools.
- **Measurement and Control Engineering Laboratory:** The following tools are of cardinal importance in the laboratory for the support of teaching and research activities:
  - storing oscilloscope
  - power-supply unit
  - digital manual instruments
  - plotter
  - function generator
  - data collection and signal conditioning unit
- **MPS manufacturing line laboratory:** Teaching of pneumatics on the basis of the program elaborated by FESTO Ltd. Didactic in the field of pneumatics, electro-pneumatics, hydraulics, electro-hydraulics, PLC technique, driving technique, mechatronics and sensor technique.
- **MPS PA laboratory:** Presentation and research processes based on the flow of industrial liquids. Study and research of the control of closed and opened systems. FestoDidactic's Learning System for process automation and technology is orientated towards different training and educational requirements.
- **NI Elvis (Educational Laboratory Virtual Instrumentation Suite) Lab:** The NI Educational Laboratory Virtual Instrumentation Suite (NI ELVIS) features an integrated suite of 12 of the most commonly used instruments in the lab - including the oscilloscope, digital multimeter, function generator, variable power supply, and Bode analyzer - in a compact form factor for the lab or classroom demonstrations. Based on NI LabVIEW graphical system design software, NI ELVIS, with USB plug-and-play capabilities, offers the flexibility of virtual instrumentation and allows for quick and easy measurement acquisition and display.

- **Pneumatics laboratory (FESTO FACT -Festo Authorized and Certified Training Center):** Teaching of pneumatics on the basis of didactic programs of FESTO Ltd. In the field of pneumatics, electro-pneumatics, hydraulics, electro-hydraulics, PLC technique, driving technique, mechatronics and sensor technique.
- **Robotics laboratory:** The lab contains 16 workstations of robot technology, allowing 32 students to work simultaneously. There are altogether 16 PLC controlled robots at the 16 workstations.
- **Schneider Electric knowledge center:** all teaching, research, expert and advisory activities concerning the products of Schneider Electric and the examination of the possibility of their non-conventional use. The laboratory is suitable for the following activities:
  - Teaching of industrial controls by means of small and medium PLCs and realization of real industrial processes on twido demonstration tables built with PLCs of type M340.
  - Regulation of driving technical models by programming frequency changers (ATV11, ATV31 and ATV71).
  - Complex engineering tasks by connecting operating models into the network.

IT laboratories and software

AutoCAD® Map 3D
AutoCAD®2010
Solid Edge
FEMAP v9.3
Autodesk® Inventor®
AutoCAD® Electrical
Autodesk® Robot™
ECOTECT
LabVIEW
RobotStudio
Fanuc Oi MATE TC Control

Air and Noise Protection Laboratory

Purpose of the laboratory

The Air and Noise Protection Laboratory provides the practical background for different courses such as Noise and Vibration Protection, Air Quality Protection, and Unit Operations. Numerous different specific software are introduced to students in the lab, which is also the place for result processing of field measurements.

Competence of the laboratory

The laboratory is suitable for carrying out and post-processing acoustic and vibration diagnostic tests. In addition, modeling noise and air pollution propagation and noise mapping are also important tasks of the lab, just like mathematical modeling of dynamical systems in the field of chemical and environmental methods. Numerous software are used for the determination of optimal operation of chemical and environmental systems.

Our partners

DKV Debrecen Transportation Services Ltd., Plánum 97 Ltd., TIKTVF (Green Authority)

Equipment in the laboratory

The laboratory boasts 20 personal computer with software for modeling noise and vibration measurements (IMMI, SAMURAI) and environmental processes (MATLAB, Control System Toolbox, Simulink Toolbox). The laboratory is also equipped with measurement systems and devices for in situ tests, such as a Soundbook universal multi-channel acoustic measuring system, four channel analyzers with Samurai software for vibration and noise measurements, a PDV 100 portable digital vibrometer, SINUS 3D seismometer and a Larson Davis 831 sound level meter. Additionally, other sound level meters are available for student measurements.

Cutting and CNC Workshop

Purpose of the laboratory

The laboratory is based on the common and latest production technologies, thanks to which students have the opportunity to see the material removal processes on the production machine in real time. The machinery and equipment used in the lab provide the scientific and technical background to education. The available technologies are identical with the latest technologies used in industry.

Competence of the laboratory

Students learn about the basic manufacturing procedures (lathe machining, milling, planning, sawing, grinding gear-tooth forming), the main parts of the equipment and their operation by working on the machines in small groups. They also have the opportunity to study the cutting edge geometry of the different tools.

Our partners

Optimum Hungary Ltd

Equipment in the laboratory

The workshop is equipped with five universal lathe machines, a universal milling machine with two planer machines each, a Fellow Gear machine, two saw machines, two grinding machines used to sharpen tools.
A type of OPTI M2 CNC milling machine, a CNC lathe L28 Opti and Opti D280x700 a type universal lathe.
CNC programming and simulation software are available for ten students.

Diagnostics Lab

Purpose of the laboratory
The purpose of the lab is to provide the technical background to different diagnostic tests and measurements applied in general mechanical engineering. Studying the application of measuring systems and special diagnostic devices is also emphasized in the lab. Students can practise how to set up and carry out measurements and draw the conclusion about technical problems.

Competence of the laboratory
Acquiring the basics of measurement techniques of machine fault diagnostics applied in machine repairing and maintenance engineering fields. With the up-to-date equipment and measuring systems students carry out different testing and structural analysis of structures and machine elements as research and scientific activities. Our lab also provides the scientific and technical background for PhD students.

Our partners
SKF Group, FAG Schaeffler Technologies AG & Co. KG · Deutschland,
GRIMAS Hungary Ltd., SPM Instrument Budapest Ltd., KE-TECH Ltd.

Equipment in the laboratory
The following measurement devices are available:

- Oilcheck oil tester
- CMVP 10 vibration tester
- CMVP 30 SEE tester
- SPM analysator with PRO32-2 and PRO46-2 software's
- VIB 10 vibrometer
- Testo 816 noise meter
- Center 320 noise meter
- Infrared thermal meter
- SPM Leonova Infinity universal vibration tester
- SPM Vibchecker
- SPM Bearingchecker
- Flir (ThermaCAM E45)
- Labview software
- Audacity acoustic software

Building mechatronics research laboratory

Purpose of the laboratory

The goal of the laboratory is the elaboration of methods for carrying out intelligent evaluation of measurements, intervention and planning. The international research carried out in the laboratory promotes the activity of practicing planners, operators and builders so that they can use more efficient building engineering and building supervision systems from an energetic aspect and for buildings to meet the comfort feeling of residents, especially their special requirements in case environmental conditions differ from normal circumstances.

Competence of the laboratory

The competence of the laboratory includes the integrated parts of building automation, building supervision and security techniques, including the operation of necessary sensors, regulators and interveners, which is defined as building mechatronics. Our researchers have a wide-ranging theoretical and practical experience in automation of building engineering systems of intelligent grounds, elaboration of their support by means of building information technology as well as elaboration of objectives relating to the cost-saving intelligent automation of systems.

Our partners

The laboratory was established thanks to the EU-funded project "HURO/0802/155_AFA „Hungarian-Rumanian Research and Development Platform for supporting the building of Intelligent Buildings" and with the co-operation of the European Regional Development Fund. Apparatus utilizing renewable energy were built with the co-operation of ENERGOTEST Ltd, while the measuring and automations objectives have been realized by means of instruments and software of National Instruments.

Equipment in the laboratory

The construction and embodiment of the apparatus manufactured individually and installed into the laboratory promotes the access for teaching, research, presentation and measurement.

Hot water supply system

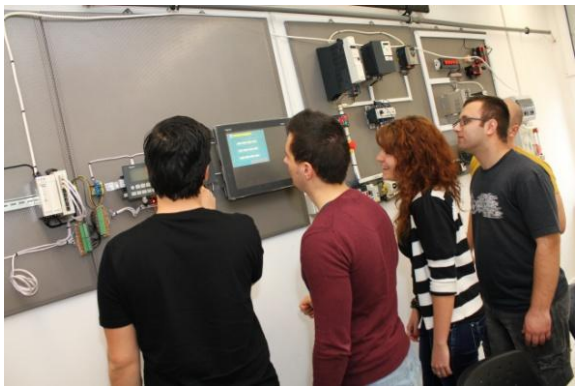
Vacuum-tube solar collector (1000W).

Flat solar collectors:

Buffer stores

6 pcs solar cells (PV) to be used for research.

Rotating stand



Biomechanics Laboratory

Purpose of the laboratory
The main purpose of the lab is the determination of mechanical properties of polymer structural materials and biomaterials in contrast with stress. The Laboratory of Biomechanics participates in material testing, particularly in tests of human bones. The Laboratory supports the following courses: Biomechanics, Material Testing Methods of Plastics and CAD-CAM, Rapid Prototyping. It is also used for various research activities.

Competence of the laboratory
The Biomechanical Material Testing Laboratory was founded in 2005 for accredited material testing activities with its quality management system. The main activity of the Material Testing Laboratory is research: various biomechanical nature experiments, measurements and tests. In accordance with the accredited activity orders from external companies are executed as well.

Our partner
DEKK (University of Debrecen, Clinical Center)

Equipment in the laboratory
The most important devices of the laboratory:

Instron 8874 biaxial material testing machine,
Instron AVE advanced video extensometer,
Instron 51 portable digital durometer,
Mitutoyo measuring devices,
Torque meters,
Connex three dimensional printer
Zprinter 310 three dimensional printer,
Cobra Fastscan three dimensional scanner.

Heat Treatment Lab

Purpose of the laboratory
Heat treating is a group of industrial and metalworking processes used to alter the physical, and sometimes chemical, properties of a material. The following basic heat treatment techniques take place in the laboratory: annealing, case hardening, precipitation strengthening, tempering and quenching processes for small groups (8-10 students).

Competence of the laboratory
The lab supports the teaching of the Materials Sciences and Manufacturing Engineering practice course, and presents the main heat treatment processes for small groups (8-10 people). With the up-to-date equipment and heat treatment techniques different heat treatment methods of different materials can be carried out as research and scientific activities.

Equipment in the laboratory
- Heat treatment furnaces: RE-60, KO-14, ET-2
- Quenching vessels: water, oil, salt
- Hardness testers
- Temperature measurement & management equipment
- Personal protection & safety equipment

Machine Elements Lab

Purpose of the laboratory
The machine elements lab practice is part of the Machine Elements course, which introduces machine elements and machine constructions built up of them to students, familiarizing them with the material taught at lectures. Machines and equipment in the lab are designed in the framework of the four designing tasks: Welded Machinery Base; Hydraulic Cylinder; External Double-Shoe Thruster Released Drum Brake; Counter drive, which may be dismantled and assembled with the guidance of the instructor.

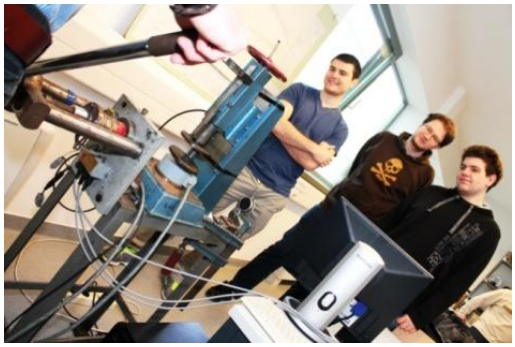
Competence of the laboratory
Students have the opportunity to gain hands-on experience with machine elements and parts and to study their construction and operation methods. The lab provides the background for the technical knowledge and hands-on skills required by the educational and outcome requirements of the training program. Students have the opportunity to design the four designing tasks, operate and maintain mechanical systems. The lab is equipped with test-benches instrumented with an

up-to-date measuring system comprising an amplifier and evaluating software, which issuitable for the fast, electrical measurement of mechanical parameters changing with time.

Our partner
Hottinger Baldwin Messtechnic Ltd. (HBM)

Equipment in the laboratory
Test benches for testing drive train vibration, bolted joints, spring operation, endurance limit of composite materials and friction phenomenon between surfaces, and so on.
The lab is instrumented with Spider 8 amplifier and CATMAN Easy software from HBM for acquisition and evaluation of the measurement signals provided by transducers for the measurement of force, pressure, acceleration, torque, and displacement. The Catman software package running under MS-Windows is applied for experimental stress analysis with strain gauges and an on-line measurement system.
The applied transducers and gauges:

- force transducers: measure static and dynamic tensile and compressive loads,
- torque transducers: in rotating and non-rotating version,
- pressure transducers: for absolute and differential pressure measurements,
- displacement transducers,
- strain gauges for determining the strain on the surface of components,
- piezoelectric accelerometer.



Hydraulics laboratory

Purpose of the laboratory
Presentation of most modern hydraulic systems and research in the field of hydraulics.

Competence of the laboratory
Teaching of hydraulic systems of different courses by means of software developed by FESTO Didactic Ltd, resp. BOSCH-Rexroth.

Our partners
The laboratory is sponsored by BOSCH-Rexroth Ltd and FESTO Didactic Ltd.

Equipment in the laboratory

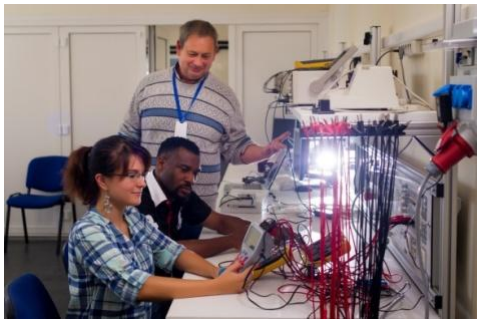
- Two-side stand system with hydraulic power-supply unit, slave cylinder, hose storage, oil tray, hydro-battery, cog-wheel motor, pressure limiter, stuffing-one-way valves, electronically controlled root changers, manometers,
- error locating system: electro-hydraulic elements operating defectively, manually controlled valves operating defectively,
- a set of mobile hydraulic elements, including the control block necessary for mobile hydraulic research,
- axial-piston hydro-motor, pre-controlling apparatus and loading simulator.

Laboratory of electronic engineering and electronics

Purpose of the laboratory
In the laboratory students obtain experience in the field of electronics and electronic engineering in the framework of the following courses: electrical engineering and electronics, technique and electronics and chemical science of mechanics.

Competence of the laboratory
Students measure electric quantities by means of digital and analogue circuits composed by the students themselves, which enables them to extend their experience. The examination of passive and active elements for understanding the operation of digital and analogue circuits is also possible, just as well as practising the search of electric errors. The laboratory takes part in the development of electric cars through activities such as the energy supply of vehicles, charging batteries, planning and building dashboard panels.

Equipment in the laboratory
There are 10 measuring stations in the laboratory, where 20 students can carry out measurements at the same time. The equipment of the stations includes 2-channel and 35-MHz oscilloscopes, 2-MHz function, direct-current double power-supply units, 3,5-digit multimeters, and measuring bags.



Mechanical Lab

Purpose of the laboratory
The laboratory is based on common testing methods of raw materials, technological materials and structures like welded joints. The devices in the lab follow the order of an ordinary material testing method. There are several devices for test sample preparation (cutting, grinding). Comprehensive analysis of materials is rendered possible by the tensile test machine and the Charpy impact testers.

Competence of the laboratory

Transferring the basic knowledge of lectures of material testing, technology of structural materials, fracture mechanics courses, representing the testing processes by specialized test machines. Our lab is a scientific and technical background for PhD students providing the facilities to carry out experimental tests for research and scientific activities.

Equipment in the laboratory

- Tensile test machine (with computer managed closed loop data storage & handling)
- Charpy impact tester machines (computer controlled from 0 to 450J impac5t range)
- Hardness tester (computer managed)
- Furnace up to 1300°C (computer managed heating & cooling curve)
- Personal protection & safety equipment

MPS PA laboratory

Purpose of the laboratory

- Presentation and research processes based on the flow of industrial liquids,
- study and research of the control of closed and open systems,
- FESTODidactic's Learning System for process automation and technology is orientated towards different training and educational requirements.

Competence of the laboratory

Teaching of pneumatics on the basis of didactic programs by FESTO Ltd. in the fields of pneumatics, electro-pneumatics, hydraulics, electro-hydraulics, PLC technique, driving technique, mechatronics and sensor technique.

The systems and stations of the modular Production System for Process Automation (MPS® PA) facilitate vocational and further training in line with industrial practice. The actual project phases can be taught in training projects which include: planning, assembly, programming, commissioning, operation, optimisation of control parameters, maintenance and fault finding.

Our partners

The laboratory was established within the framework of the project TÁMOP-4.1.1/A-10/1-KONV-2010-0016 and supported by FESTO Ltd Didactic.

Equipment in the laboratory

- instrumentation for measuring and evaluation of quality and technological data of filtering, mixing, reactor, charging (bottling), thermo and hydrodynamic measurements, control with opened and closed cycle,
- filtration, mixing, reactor station and bottling station.

MPS Manufacturing Line Laboratory

Purpose of the laboratory

- Teaching and research of industrial discrete processes;
- study and research of the control of closed and open systems.

Competence of the laboratory

Teaching of pneumatics on the basis of the program developed by FESTO Didactic Ltd. in the field of pneumatics, electro-pneumatics, hydraulics, electro-hydraulics, PLC technique, driving technique, mechatronics and sensor technique. The laboratory carries out research on the basis of contracts signed with FESTO Didactic Ltd.

Our partners

The laboratory is sponsored by FESTO DidacticLtd.

Equipment in the laboratory

- a5-cation manufacturing line built by FESTO Didactic Ltd.
- software programming of the production schedule, examination of the advance and automated quality monitoring between actions of the manufacturing

NI ELVIS laboratory

Purpose of the laboratory

The aim is to provide practical courses in basic electrotechnics and electronics, and to grant specialized knowledge and experience to mechatronics students in special areas like data acquisition, Labview programming and research on the system of NI ELVIS (Teaching Laboratory Virtual Instrumentation Suite).

Competence of the laboratory

Based on NI LabVIEW graphical system design software, NI ELVIS, with USB plug-and-play capabilities, offers the flexibility of virtual instrumentation and allows for quick and easy measurement acquisition and display in the field of control, telecommunication, fiber optics,

embedded design, bioinstrumentation, digital electronics, and field-programmable gate arrays (FPGAs). Besides our teaching duties, these NI tools enable us to conduct research and software development in different fields of sciences.

Our partners
The laboratory is maintained by National Instruments Hungary Ltd and financed by the project HURO-0901/028/ 2.3.1. „E-Laboratory Practical Teaching for Applied Engineering Sciences".

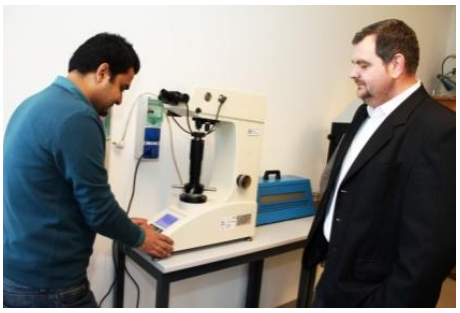
Equipment in the laboratory
The NI Educational Laboratory Virtual Instrumentation Suite (NI ELVIS) features an integrated suite of 12 of the most commonly used instruments in the lab (including the oscilloscope, digital multimeter, function generator, variable power supply, and Bode analyser) in a compact form factor for the lab or classroom demonstrations.

NDT (Metallographic) Lab

Purpose of the laboratory
The laboratory is based on NDT testing of raw materials, technological materials and structures like welded joints. The devices in the lab follow the order of an ordinary material testing method. There are several devices for test sample preparation (cutting, grinding, polishing and chemical conservation). Metallographic analysis of the prepared sample is rendered possible by a microscope. Besides, there are several NDT (metallographic) inspection equipment to create a comprehensive analysis of the material.

Competence of the laboratory
Supporting the education of basic lectures like material science, technology of structural materials, manufacturing technologies I-III. Supporting our student's measuring for scientific contests. With the up-to-date equipment and measuring techniques we are able to do different testing and structural analysis of special technological materials as research and scientific activities. Our lab is also a scientific and technical background for PhD students.

Equipment in the laboratory
- Cutting, grinding and polishing machines to create samples
- Hardness testers (computer managed HB, HRC, HV)
- Ultrasonic wall thickness measurement equipment
- Ultrasonic hardness tester
- Microscopes (Neophot with CCD & Olympus with CCD up to M=250x digital imaging)
- Image analysis software
- Furnace up to 1300°C (computer managed heating & cooling curve)
- Qualified measuring tools (callipers, gauges, micrometers)

Pneumatics laboratory

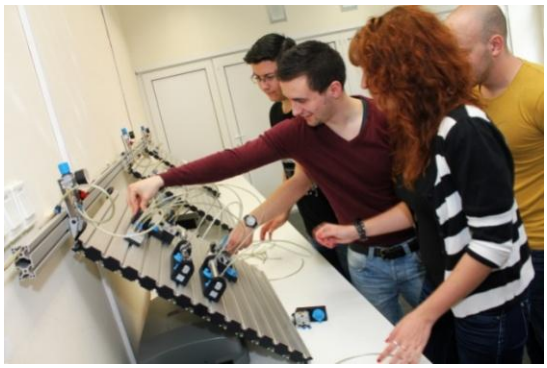
Purpose of the laboratory
Presentation of the most modern pneumatic systems used in industry and research in the field of pneumatics.

Competence of the laboratory
Teaching of pneumatics on the basis of didactic programs of FESTO Ltd in the field of pneumatics, electro-pneumatics, hydraulics, electro-hydraulics, PLC technique, driving technique, mechatronics and sensor technique.

Our partners
The laboratory is sponsored by FESTO Didactic Ltd.

Equipment in the laboratory

- FESTO teaching package (PLC, VEEP emulator, wires, tools, specifications…),
- two-side pneumatic stand system: pneumatic power-supply unit, hose storage,
- basic and electro-pneumatics, proportional pneumatic stock.



Robotics laboratory

Purpose of the laboratory
Teaching of robotics and research processes concerning the robotizing of industrial processes. Presentation of CIM systems and research of the possibilities of integration

Competence of the laboratory

- Use and programming of recycle bin robots, carrying out of examination concerning the operation of robots,
- examination of human-machine communication on intelligent grounds, where robots and humans are present at the same time and perhaps co-operate with each other in space.

Our partners
The laboratory is supported by KUKA Robotics Hungary Ltd, Robot-X Hungary Ltd, Flexlink Systems Ltd.

Equipment in the laboratory

- 3-axe TTT Q-robot multitasking robot, a KR5arc KUKA industrial robot, a KR5Sxx KUKA teaching robot and a SONY SCARA SRX-611 robot connected with a delivery track incorporated into a manufacturing cell,
- 8 pcs LEGO MINDSTORM robot and a sample manufacturing line consisting of 16 Fischertechnik elements developed by the university as well as a FESTO Robotino robot,
- KUKA.Sim Pro software developed for programming offline KUKA robots and their simulation.

Roller Power Test Bench and Diagnostics Lab for Passenger Cars

Purpose of the laboratory

The roller power test bench is appropriate for measuring and diagnosing the vehicle performance and its condition. The installed test bench makes wild range power measurements possible in different speed range in a safe environment.

Students can carry out a series of measurements in the laboratory about internal combustion engine performance, exhaust gas analysis and on-board diagnostic (OBD) systems. These measurements may support the degree theses of students.

Competence of the laboratory

The installed measuring equipment of Vehicle Engine Performance Measurement and Diagnostic Laboratory have official calibration and authentication, therefore performance measurements, exhaust gas analyses, emission measurement and diagnostic tests carried out in this laboratory are all certified.

Our partners

Energotest Ltd

Equipment in the laboratory

- Rolling road dynamometer (TMP-350) with CAN bus based measurement data logger unit. The equipment is suitable for performance measurement of two-wheel-drive passenger cars and light duty vans up to 350 kW. Our lab is able provides scientific and technical background for PhD students.
- Exhaust gas analyser instrument (AVL DiGas 480) which is capable of measuring the composition of exhaust gas. The measuring system is also equipped with Diagnostic Trouble Codes scanner, diagnostic software and an Autodata emission database.
- The laboratory is equipped with more wind generators and exhaust gas extractors.

Schneider Electric Knowledge Center

Purpose of the laboratory
The knowledge center established by Schneider Electric Ltd offers complete solutions in the field of energy management, electric energy distribution, control engineering and automation of processes of industry, building automation and security, energy supply and cooling as well as installation and the control of installation systems. The knowledge center is instrumented for the presentation of these systems as well as for carrying out research of building supervision systems.
Competence of the laboratory
The laboratory is suitable for the following activities:

- Teaching of industrial controls by means of small and medium PCs and realization of real industrial processes on twido demonstration tables built with PLCs of type M340.
- Regulation of driving technical models by programming frequency changers (ATV11, ATV31 and ATV71).
- Complex engineering duties by connecting operating models into the network.

Our partners
Schneider Electric Hungary Ltd

Equipment in the laboratory

- TAC system for realizing a complete building supervision A (TAC 302, 422, 731, 100, 452, 511 OPC panel) and terrain tools,
- let-in/let-out and camera system controlled by an Andover system,
- the laboratory is officially informed about any development carried out by Schneider Electric and given a sample of its products.
-

Water Quality Protection Laboratory

Purpose of the laboratory
The laboratory has all basic tools applied in environmental engineering to ensure a strong practical analytic background for field and laboratory measurements. Several research topics are also connected to the equipment of the laboratory (such as investigation of rain water or greywater reuse in households; thermal water final placement and the environmental effect of thermal water utilization; surface water analysis and environmental status assessment of watercourses surrounding Debrecen).

Competence of the laboratory
Environmental engineers get a good experience and knowledge on the prevention of environmental hazards, the abolition of environmental problems, the utilization of natural resources, cleaner technologies, analytical and monitoring methods. The lab is equipped with

modern and efficient instrumental analytical devices to get reliable and fast results for water or sludge samples.

Our partners
TIKTVF (Green Authority), Debrecen Waterworks Ltd., Hajdú-Bihar County Municipalities Water Works Co., Ltd. Analab Ltd., Scharlab Hungary Ltd., NNK Environmental Management, Information Technology, Sales and Service Ltd.

Equipment in the laboratory
Classical and instrumental analytical techniques for investigation of different water or sludge samples:
- DIONEX ICS3000 ion chromatographic system,
- Shimadzu Vcpn TOC instrument,
- Zetasizer Nano Z zeta potential analyser,
- WTW MultilineP4 electro-analytical set,
- BOD OXITOP IS 12 measurement, Thermostat cabinet,
- Nanocolor Linus spectrophotometer with thermoblock,
- TURB-555 IR Turbidimeter,
- Millipore Milli-Q Integral 3water purification unit,
- Classical analytical methods (gravimetry and titrimetry).

Welding Lab

Purpose of the laboratory
- Instruction, presentation and practice of advanced welding procedures used in industry all over the world,
- to ensure the proper technological environment for the construction of racing cars driven by compressed air or electric motors for student's competitions.

Competence of the laboratory
Introduction of the basic welding processes by welding joints of test specimens. The lab supports the Materials Sciences and Manufacturing Engineering courses.
The laboratory is equipped with eight welding dry boxes for electric arc-welding and one for gas-welding and metal cutting. Students learn and practise four different welding procedures:
- Manual metal arc welding (MMA)
- MIG-MAG gas-shielded arc welding (MIG -MAG)
- Wolfram electrode welding with argon shielding gas (GTAW -TIG, WIG)
- Gas welding, flame cutting , and plasma cutting.

Equipment in the laboratory
- MILLER Powcon-300 type welding machines for MMA welding,
- MILLER Synchrowave-250 type welding machines for TIG welding,
- MILLER MIGBLU-300 type welding machines for gas-shielded metal-arc welding,

- WELDI TIG-200i DC type welding machines for TIG and MMA welding,
- WELDI AMIGO-250, WELDI MIG-320 Plus, WELDI MIG-420 type welding machines for gas-shielded metal-arc welding.


ZF Lenksysteme Hungária Automotive Lab

Purpose of the laboratory

The ZF Lenksysteme Hungária Automotive Laboratory was established by ZF LenksystemeHungária Ltd. in 2014. The Laboratory is suitable for performing activities like electric vehicle construction and assembly for student competitions and for company related projects. Thanks to its modern equipment and top class steering systems, the lab ensures the appropriate background for related research.

Competence of the laboratory

The Laboratory is suitable for implementing modern engineering projects. The laboratory is equipped with the products of ZF Lenksysteme Hungária Ltd., mountable steering systems and steering columns. Students have the opportunity to investigate real steering systems in the lab, which is also a scientific and technical background for PhD students.

Our partners

ZF Lenksysteme Hungária Ltd

Equipment in the laboratory

- Turning lathe (OPTI TU 2807 – D280x700mm, 125-1200 f/p, 850W/400V)
- Welding machine (AC/DC AWI)
- Drillers, Cutters
- Hand tools
- Tool trolleys
- Measuring instruments

CONTACT INFORMATION

Coll. Prof. Dr. Zsolt TIBA PhD, Responsible for the Mechanical Engineering Training
e-mail: tiba@eng.unideb.hu

Zita SZILÁGYI, international relationship coordinator of the International Office
e-mail: programcoordinator@eng.unideb.hu

Erika THOMAS, international relationship coordinator of the International Office
e-mail: thomas.erikaveng.unideb.hu

International Office, Faculty of Engineering, University of Debrecen
H-4028, Debrecen, Ótemető utca 2-4, Room K3 (1st Floor).