Faculty of Mechanical Engineering
BSc Degree

Curriculum of BSc Subjects
Process Engineering Specialization

Subject			lectures/practical lectures/laboratory								
Name	**Code**	**Credits**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Requisities**
1st semester, Fall											
Compulsory English I.	BMEGT63A301	2	0/4/0								p
Descriptive Geometry	BMETE90AX06	3	1/2/0								e
Introduction to Mechanical Engineering	BMEGEVGAG01	4	2/1/1								e
Information Systems	BMEGERIA31I	4	2/0/2								p
Macro- and Microeconomics	BMEGT30A001	4	4/0/0								e
Mathematics A1a - Calculus	BMETE90AX00	6	4/2/0								e
Technical Chemistry	BMEVEKTAGE1	3	2/0/1								p
Statics	BMEGEMMAGM1	3	1/1/0								p
	Total credits:	*29*									
2nd Semester, Spring											
Compulsory English II.	BMEGT63A302	2		0/4/0							p
Materials Science and Testing	BMEGEMTAGK1	6		4/0/1							e
Fundamentals of CAD	BMEGEGEA3CD	4		1/0/2							p
Physics A2	BMETE15AX02	2		2/0/0							e
Fundamentals of Machine Design	BMEGEGEAGM1	4		2/2/0							p
Mathematics A2a - Vector Functions	BMETE90AX02	6		4/2/0							e
Software Engineering	BMEGERIA32P	2		0/2/0							p
Strength of Materials	BMEGEMMAGM2	5		2/2/0							e
	Total credits:	*31*									
3rd Semester, Fall											
Dynamics	BMEGEMMAGM3	5			2/2/0						e
Materials Engineering	BMEGEMTAGK2	4			3/0/1						e
Physics A3	BMETE15AX03	2			2/0/0						e
Machine Elements 1.	BMEGEGEAGG1	5			2/1/1						e
Environmental Management Systems	BMEGT42A003	3			3/0/0						p
Mathematics A3 for Mechanical Engineers	BMETE90AX10	4			2/2/0						p
Mathematics Global Exam	BMETE90AX23										ge
Analysis of Technical and Economical Data	BMEGEVGAG14	3			2/1/0						p
Measurement Technology	BMEGEMIAMG1	3			2/0/1						p
	Total credits:	*29*									
4th Semester, Spring											
Basics of Electrical Engineering	BMEVIAUA007	3				2/0/1					p
Machine Elements 2.	BMEGEGEAGG2	6				3/1/1					e
Manufacturing	BMEGEGTAG01	5				2/0/3					e
Control Engineering	BMEGEMIAGE1	4				2/2/0					e
Engineering Thermodynamics	BMEGEENAETD	3				2/1/0					p
Polymer Materials Science and Engineering	BMEGEPTAG0P	6				3/0/2					e
Vibrations	BMEGEMMAGM4	3				2/1/0					p
Mechanics Global Exam	BMEGEMMAGM0										ge
	Total credits:	*30*									
5th Semester, Fall											
Electromechanics	BMEVIAUA008	4					2/1/1				e
Fluid Mechanics	BMEGEÁTAG11	5					2/2/1				p
Heat Transfer	BMEGEENAEHK	4					2/2/0				e
Diffusion Processes	BMEGEVÉAG02	2					1/1/0				e

e - exam, p - practical mark, ge - global exam

Subject			lectures/practical lectures/laboratory								
Name	**Code**	**Credits**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Requisities**
Measurement at Energy and Environment Protection	BMEGEENAG51	3					0/1/2				p
Measurement Technique of Processes	BMEGEVGAG03	2					1/0/1				p
Fundamentals of FEM	BMEGEMMAGM5	3					1/1/1				p
Management and Business Economics	BMEGT20A001	4					4/0/0				p
Business Law	BMEGT55A001	2					2/0/0				p
Optional subject:		2									
Marketing (2 credits) OR	BMEGT20A002						2/0/0				p
Communication Skills - English (2 credits)	BMEGT63A061						0/2/0				p
	Total credits:	*31*									
6th Semester, Spring											
Technical Acoustics and Noise Control	BMEGEÁTAG15	3						2/0/1			e
Fluid Machinery	BMEGEVGAG02	4						2/1/1			e
Heat Engines	BMEGEENAEGK	4						2/1/1			e
Numerical Simulation of Fluid Flows	BMEGEÁTAG06	2						1/0/1			p
Processes and Equipments of Chemical Industry	BMEGEVÉAG03	5						3/2/0			e
Air Pollution, Wastewater and Solid Waste Man.	BMEGEÁTAG04	3						3/0/0			p
Independent Study 1	BMEGEVGAG06	4						0/0/4			p
Optional subject:		4									
Heating (4 credits) OR	BMEGEÉPAG61							3/1/0			e
Manager Communication (2 credits) AND	BMEGT63A081							0/2/0			p
Crosscultural Communication (2 credits)	BMEGT63A091							0/2/0			p
	Total credits:	*29*									
7th Semester, Fall											
Fluid Flow Systems	BMEGEVGAG07	3							2/1/0		p
Energy Processes and Equipm.	BMEGEENAG71	5							3/0/2		p
Volumetric Pumps and Compressors	BMEGEVGAG04	2							1/1/0		p
Measurement for Chemical and Environment Proc.	BMEGEVÉAG04	3							0/1/2		p
Final Project	BMEGEXXA4SD	15							0/10/0		p
Optional subject:		4									
Air-Conditioning (4 credits)	BMEGEÉPAG62								2/2/0		e
	Total credits:	*32*									

The Faculty of Mechanical Engineering offers additional and optional courses (30 credits - upgrade to 240) on BSc level to its students - who completed 210 credits - to take.

Optional subjects											
Modeling of Processes and Equipment	BMEGEÉEAG01	3								1/1/0	p
Laboratory	BMEGEÉEAG00	5								0/0/4	p
Independent Study 2	BMEGEVGAIP2	8								0/0/8	p
Heating	BMEGEÉPAG61	4								3/1/0	e
Manager Communication	BMEGT63A081	2								0/2/0	p
Crosscultural Communication	BMEGT63A091	2								0/2/0	p
English for Engineers	BMEGT63A051	2								0/4/0	p
Analytical Mechanics	BMEGEMMMW01	4								3/0/0	e
Advanced Fluid Mechanics	BMEGEÁTMW01	4								3/0/0	e
Advanced Thermodynamics	BMEGEENMWAT	4								2/1/0	e
Power Electronics	BMEVIAUA017	4								2/1/1	p
Motion Control	BMEVIAUA016	3								2/0/1	p

XX in the Final Project code varies from department to department e - exam, p - practical mark, ge - global exam

Curriculum of BSc Subjects
Engineering Design and Technology Specialization

Subject			lectures/practical lectures/laboratory								
Name	**Code**	**Credits**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Requisities**
1st semester, Fall											
Compulsory English I.	BMEGT63A301	2	0/4/0								p
Descriptive Geometry	BMETE90AX06	3	1/2/0								e
Introduction to Mechanical Engineering	BMEGEVGAG01	4	2/1/1								e
Information Systems	BMEGERIA31I	4	2/0/2								p
Macro- and Microeconomics	BMEGT30A001	4	4/0/0								e
Mathematics A1a - Calculus	BMETE90AX00	6	4/2/0								e
Technical Chemistry	BMEVEKTAGE1	3	2/0/1								p
Statics	BMEGEMMAGM1	3	1/1/0								p
	Total credits:	*29*									
2nd Semester, Spring											
Compulsory English II.	BMEGT63A302	2		0/4/0							p
Materials Science and Testing	BMEGEMTAGK1	6		4/0/1							e
Fundamentals of CAD	BMEGEGEA3CD	4		1/0/2							p
Physics A2	BMETE15AX02	2		2/0/0							e
Fundamentals of Machine Design	BMEGEGEAGM1	4		2/2/0							p
Mathematics A2a - Vector Functions	BMETE90AX02	6		4/2/0							e
Software Engineering	BMEGERIA32P	2		0/2/0							p
Strength of Materials	BMEGEMMAGM2	5		2/2/0							e
	Total credits:	*31*									
3rd Semester, Fall											
Dynamics	BMEGEMMAGM3	5			2/2/0						e
Materials Engineering	BMEGEMTAGK2	4			3/0/1						e
Physics A3	BMETE15AX03	2			2/0/0						e
Machine Elements 1.	BMEGEGEAGG1	5			2/1/1						e
Environmental Management Systems	BMEGT42A003	3			3/0/0						p
Mathematics A3 for Mechanical Engineers	BMETE90AX10	4			2/2/0						p
Mathematics Global Exam	BMETE90AX23										ge
Analysis of Technical and Economical Data	BMEGEVGAG14	3			2/1/0						p
Measurement Technology	BMEGEMIAMG1	3			2/0/1						p
	Total credits:	*29*									
4th Semester, Spring											
Basics of Electrical Engineering	BMEVIAUA007	3				2/0/1					p
Machine Elements 2.	BMEGEGEAGG2	6				3/1/1					e
Manufacturing	BMEGEGTAG01	5				2/0/3					e
Control Engineering	BMEGEMIAGE1	4				2/2/0					e
Engineering Thermodynamics	BMEGEENAETD	3				2/1/0					p
Polymer Materials Science and Engineering	BMEGEPTAG0P	6				3/0/2					e
Vibrations	BMEGEMMAGM4	3				2/1/0					p
Mechanics Global Exam	BMEGEMMAGM0										ge
	Total credits:	*30*									
5th Semester, Fall											
Electromechanics	BMEVIAUA008	4					2/1/1				e
Fluid Mechanics	BMEGEÁTAG11	5					2/2/1				p
Heat Transfer	BMEGEENAEHK	4					2/2/0				e
Injection Molding	BMEGEPTAGE2	3					1/0/1				p

Subject			lectures/practical lectures/laboratory								
Name	**Code**	**Credits**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Requisities**
Fundamentals of FEM	BMEGEMMAGM5	3					1/1/1				p
Manufacturing Processes	BMEGEGTAG91	4					2/0/1				e
Metal Forming	BMEGEMTAGE1	4					2/0/1				
Business Law	BMEGT55A001	2					2/0/0				p
Optional subject:		2									
Marketing (2 credits) OR	BMEGT20A002	2					2/0/0				p
Communication Skills - English (2 credits)	BMEGT63A061						0/2/0				p
	Total credits:	*31*									
6th Semester, Spring											
Novel Engineering Materials	BMEGEMTAGE3	3						2/0/0			p
Fluid Machinery	BMEGEVGAG02	4						2/1/1			e
Heat Engines	BMEGEENAEGK	4						2/1/1			e
Machine Design	BMEGEGEAGMD	4						2/1/0			e
Machine Tools and Manufacturing Systems	BMEGEGTAG92	3						2/0/0			p
Composites Technology	BMEGEPTAGE1	4						2/0/1			e
Project Work	BMEGEGEAGPW	3						0/1/2			p
Optional subject:		4									
Heating (4 credits) OR	BMEGEÉPAG61							3/1/0			e
Manager Communication (2 credits) AND	BMEGT63A081							0/2/0			p
Crosscultural Communication (2 credits)	BMEGT63A091							0/2/0			p
	Total credits:	*29*									
7th Semester, Fall											
CAD Systems	BMEGEGEAGCS	3							1/0/2		p
Non-Destructive Testing of Materials	BMEGEMTAGE2	3							2/0/0		e
CAD/CAM Applications	BMEGEGTAG93	3							1/0/2		p
Polymer Processing	BMEGEPTAGE3	3							1/0/1		p
Final Project	BMEGEXXA4SD	15							0/10/0		p
Optional subject:		4									
Air-Conditioning (4 credits)	BMEGEÉPAG62								2/2/0		e
	Total credits:	*31*									

The Faculty of Mechanical Engineering offers additional and optional courses (30 credits - upgrade to 240) on BSc level to its students - who completed 210 credits - to take.

Optional subjects											
Modeling of Processes and Equipment	BMEGEÉEAG01	3								1/1/0	p
Laboratory	BMEGEÉEAG00	5								0/0/4	p
Independent Study 2	BMEGEVGAIP2	8								0/0/8	p
Heating	BMEGEÉPAG61	4								3/1/0	e
Manager Communication	BMEGT63A081	2								0/2/0	p
Crosscultural Communication	BMEGT63A091	2								0/2/0	p
English for Engineers	BMEGT63A051	2								0/4/0	p
Analytical Mechanics	BMEGEMMMW01	4								3/0/0	e
Advanced Fluid Mechanics	BMEGEÁTMW01	4								3/0/0	e
Advanced Thermodynamics	BMEGEENMWAT	4								2/1/0	e
Power Electronics	BMEVIAUA017	4								2/1/1	p
Motion Control	BMEVIAUA016	3								2/0/1	p

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Description of BSc Subjects

Compulsory English I and II.

BMEGT63A301, BMEGT63A302

The courses are designed to enable students to communicate fluently and effectively in study environment. Receptive, productive and interactive activities and strategies are included in the curricula. By the end of the 2nd semester the overall language ability of the students is on level B2 (by the Common European Framework of Reference). 4 hours/2 credits.

Descriptive Geometry

BMETE90AX06

Mutual positions of spatial elements. Orthogonal projections in Monge's representation, auxiliary projections. Intersection of polygons and polyhedra. True measurements of segments and angles. Perpandicular lines and planes. Projection of the circle. Representation of rotational surfaces and their intersections with a plane. Axonometric view. Construction of the helix. 3 hours/3 credits.

Introduction to Mechanical Engineering

BMEGEVGAG01

Some definitions for machines. Basic and derived quantities. Transmission of mechanical work. Losses and efficiency. Uniformly accelerated motion of machines. Motion graphs. Absolute and gauge pressure. Bernoulli's equation. Venturi meter. Linear and rotational analogues. Thermal energy. The specific heat capacity and latent heat. Introduction into error estimation. Balance machines. Orifice and volume meter tank. Measuring pressure and moment of inertia. 4 hours/4 credits.

Information Systems

BMEGERIA31I

Introduction to informatics. Computer structures. Operating systems. Computer networks - Internet. Theoretical and practical data structures. Algorithms. Computer programs, program design, programming methods, program structures. Programming languages: basics, data types, variables, programming structures. Programming languages: subroutines and modules. Data bases: Relational data bases, normalized database design. Data bases: the SQL language. Basics and algorithms of computer graphics. 4 hours/4 credits.

Macro- and Microeconomics

BMEGT30A001

Introduction to macroeconomics. Output and aggregata demand. Fiscal policy and foreign trade. Money and banking. Interest rates and monetary transmission. Monetary and fiscal policy. Aggregate supply, prices and adjustment to shocks. Inflation, expectations, and credibility. Unemployment. Exchange rates and the balance of payments. Economic growth. Economics and the economy. Tools of economic analysis. Demand, supply and the market. Elasticities of demand and supply. Consumer choice and demand decisions. Introducing supply decisions. Costs and supply. Perfect competition and pure monopoly. Market structure and imperfect competition. The labor market. Factor markets and income distribution. 4 hours/4 credits.

Mathematics A1a - Calculus

BMETE90AX00

Algebra of vectors in plane and in space. Arithmetic of complex numbers. Infinite sequences. Limit of a function, some important limits. Continuity. Differentiation: rules, derivatives of elementary functions. Mean value theorems, l'Hospital's rule, Taylor theorem. Curve sketchig for a function, local and absolute extrema. Integration: properties of the Riemann integral, Newton-Leibniz theorem, antiderivatives, integration by parts, integration by substitution. Integration in special classes of functions. Improper integrals. Applications of the integral. 6 hours/6 credits.

Technical Chemistry

BMEVEKTAGE1

Thermodynamics of chemical reactions. Reaction kinetics and catalysis. Chemical equlibriums. Electrochemistry, galvanic cells, eletrochemical corrosion. Principles of combustion. Coal types and coal combustion. Petroleum and petroleum refining. Petroleum products. Automotive fuels. Lubrication and lubricants. Water for industrial use. Environmental protection in chemical engineering. Laboratory practices. 3 hours/3 credits.

Statics

BMEGEMMAGM1

Force, moment, force-couple. Fixed vector systems. Reduction of a force system. Equilibrium equations. Rigid body. Centroid. Plane constraints. Trusses. Method of joints and method of section. Combined plane structures. Principle of superposition. Stress resultants. Stress resultant diagrams and functions. Coulomb-friction. Belt friction. Rolling resistance. 2 hours/3 credits.

Materials Science and Testing

BMEGEMTAGK1

Atomic structure and inter-atomic bonding. The structure of crystalline solids. Crystallography. Imperfections in solids. Mechanical properties of metals. Diffusion. Phase diagrams. Phase transformation in metals. Recrystallization, precipitation hardening, strain hardening, solid solution hardening. Failure mechanism, fatigue, creep fracture. Basics of fracture mechanics. Failure case studies. 5 hours/6 credits.

Fundamentals of CAD

BMEGEGEA3CD

Definitons of CAD, CAM and CAE. Sequential engineering. Concurrent Engineering. Integration of CAD, CAM and CAE through database. The concurrent engineering process. The product model formed from aspect models. Product data management (PDM) systems. Component of CAD/CAM/CAE systems. Hardware configurations for CAD/CAM/CAE systems. Computer graphics. Typical graphics operations. Geometric modeling. Feature based modeling. Parametric modeling. CAD/CAM databases. 3 hours/4 credits.

Physics A2

BMETE15AX02

Properties of electric charges. Insulators and conductors. Coulomb's law. The electric field. Superposition. Electric field lines of forces. The electric flux. Gauss's law. Examples: the electric field of some specific charge distribu-

tions. The electric field inside and outside of conducting materials. Work and the electric potential. Capacitance and dielectrics. The electric current in various media. Microscopic interpretation of current density and resistivity. Classical and differential Ohm's law. Resistance and energy dissipation. Resistance and temperature. Low temperature behavior of conductors. Footprints of quantum mechanics: residual resistivity, superconductors, semiconductors. Batteries, electromotive force, internal resistance. Magnetic fields. The Lorentz law. Sources of magnetic fields. The non-existence of magnetic monopoles. The Biot-Savart law. Ampere's law. Examples: the magnetic field of some specific current distributions. Forces acting on current carrying conductors. Torque, magnetic moment, spin. Electric motor. The microscopic structure of ferro magnets. Faraday's law of induction. Generators, transformers. Inductance, self-inductance. Energy stored in magnetic fields. Displacement current, generalized Ampere's law. Maxwell's equations of the electromagnetic field. Electromagnetic waves. Properties of radio, infrared, visible, ultraviolet, X-ray and gamma radiation. 2 hours/2 credits.

Fundamentals of Machine Design

BMEGEGEAGM1

Projections. The orthographic drawing and sketching. Arrangement of views. Auxiliary and sectional views. Dimensions, notes, limits and accuracy. Representations of threaded parts and threaded fasteners, gears, splines, and keys. Drawing for engineering design and construction (detail, assembly and other drawings). Detail drawings of simple machine elements (stuffing box cover; clevis pin). Assembly drawing and partial assembly of the elements mounted on shafts (belt pulley assembly; shaft with bearings; stuffing box assembly). Set of working drawings of a valve (making sketches by freehand; pencilling of detail and assembly drawings). 4 hours/4 credits.

Mathematics A2a -Vector Functions

BMETE90AX02

Solving systems of linear equations: elementary row operations, Gauss- Jordan- and Gaussian elimination. Homogeneous systems of linear equations. Arithmetic and rank of matrices. Determinant: geometric interpretation, expansion of determinants. Cramer's rule, interpolation, Vandermonde determinant. Linear space, subspace, generating system, basis, orthogonal and orthonormal basis. Linear maps, linear transformations and their matrices. Kernel, image, dimension theorem. Linear transformations and systems of linear equations. Eigenvalues, eigenvectors, similarity, diagonalizability. Infinite series: convergence, divergence, absolute convergence. Sequences and series of functions, convergence criteria, power series, Taylor series. Fourier series: expansion, odd and even functions. Functions in several variables: continuity, differential and integral calculus, partial derivatives, Young's theorem. Local and global maxima/minima. Vector-vector functions, their derivatives, Jacobi matrix. Integrals: area and volume integral. 6 hours/6 credits.

Software Engineering

BMEGERIA32P

Modern programming methods. Object-oriented programming. Usage of components. Working with rapid application development environments. Structure of Windows applications. Components of Windows programs, elements of supporting program languages, data types, conversions, structures, parameter passing. Event-based multitasking strategies. Computer graphics. File management. Databases. 2 hours/2 credits.

Strength of Materials

BMEGEMMAGM2

Stress state and strain state in linear elastic bodies. Simple tension and compression. Simple Hooke's law. Area moments of inertia. Bending. Torsion. Combine loads: tension and bending, shear and bending. Bending of curved plane beams. Principal stresses and strains. Mohr's circles. Eigenvalues and eigenvectors of the stress tensor. Dimensioning for combined loads. Mohr- and von Mises-type equivalent stresses. Calculation of deflection and slope of beams. Work theorems of elasticity (Betti, Castigliano). Euler's theory of slender beams. Statically indeterminate structures and frames. Thin pressure vessels, - theory of membranes. 4 hours/5 credits.

Dynamics

BMEGEMMAGM3

Kinematics and kinetics of a particle. Constrained motion. Dynamics of a set of particles. Plane kinematics of rigid bodies. Motion of a wheel of a vehicle. Relative kinematics. Plane kinetics of rigid bodies. Mass moments of inertia. Work and power theorems. Kinetic energy. General plane motion. Rotation about a fixed axis. Static and dynamic balancing. Gyroscopic motion. 4 hours/5 credits.

Materials Engineering

BMEGEMTAGK2

Production technologies of materials. Connection between the structure and properties of materials. Iron and steel making technologies. Basics of plastic deformation and technologies. Hot working, semi-hot working. Effects of alloying elements on steels. Classification of steels. Welding processes. Casting and moulding processes for ferrous alloys. Ceramics and metal matrix composites. Materials selection. 4 hours/4 credits.

Physics A3

BMETE15AX03

Statistical thermodynamics. The kinetic theory of gases. Pressure, temperature, etc. Statistical physics. Probabilities. Statistical description of many-body systems. Specification of the states of a system. Ideal gases. Maxwell velocity distribution. Boltzmann distribution. Statistical temperature. Entropy. The stretched string in classical mechanics. Boundary conditions: traveling and standing waves. Atomic physics. Blackbody radiation. Photoelectric effect. Compton scattering. Spectral lines of atoms. Franck-Hertz experiment. Bohr's model of hydrogen. Schrödinger equation. Pauli's exclusion principle. Exact solutions for the harmonic oscillator and the hydrogen atom. Few applications to molecular and solid-state physics. 2 hours/2 credits.

Machine Elements 1

BMEGEGEAGG1

Design principles, loading cases, critical conditions, safety factor. Joints. Classification. Bolted joints. Threaded fasteners. Applications. Thread profiles. Bolt selections. Torque calculation. Bolt tightening. Power screws. Riveted joint. Elastic cushion (spring) model. Welded joint. Types, loading. Stress calculation. Shaft and hub joints. Torque transmission joints (key, flat key, spline). Interference fit. Transmittable torque. Cylindrical and taper joints. Elements of pipe networks. Pipe fittings. Pressure vessels. Standard and optimal design. Gaskets and Seals. High pressure, temperature and speed applications. Springs. Steel and rubber springs. Functional and stress design. Shafts and rotors. Stress analysis

of shafts and rotors for static combined loads. Fatigue and life of members. Dimensioning on strength at harmonically varying loads. 4 hours/5 credits.

Environmental Management Systems

BMEGT42A003

The course covers the topics relevant to the protection of environmental compartments, environmental pressures and pollution in a global context. Introduces the concepts, indicators and tools of environmental protection (air, water, noise and soil protection and waste management. Environmental management systems (EMS) at enterprises and other organizations. EMS topics include the assessment of environmental aspects and impacts, environmental audit, reporting, environmental performance evaluation, life cycle assessment and related international standards. 3 hours/3 credits.

Mathematics A3 for Mechanical Engineers

BMETE90AX10

Classification of differential equations. Separable ordinary differential equations, linear equations with constant and variable coefficients, systems of linear differential equations with constant coefficients. Some applications of ODEs. Scalar and vector fields. Line and surface integrals. Divergence and curl, theorems of Gauss and Stokes, Green formulae. Conservative vector fields, potentials. Some applications of vector analysis. Software applications for solving some elementary problems. 4 hours/4 credits.

Analysis of Technical and Economical Data

BMEGEVGAG14

Introduction. Data acquisition by sampling. Quality and reliability. Obtaining data from experiments, basic concepts of measurement methods. Measurement errors. Point estimation and statistical intervals. Statistical measurement theory. Correlation and regression analysis, regression models. Testing statistical hypotheses. Introduction to the techniques of variance analysis. Applications and examples. 3 hours/3 credits.

Measurement Technology

BMEGEMIAMG1

The measurement of geometric quantities of mechanical engineering. Statistical analysis and data acquisition of the measured values. Systematization of errors, according to their origin, character and form. Measurement methods. Electronic measurement of typical time-depending non-electric quantities of mechanical engineering and of mechatronics. Structure of the measurement chain, sensor and transducer types, the role of intermediate quantities. Dynamical errors, frequency transfer characteristics. Classification and Fourier analysis of signals. Digital measurement systems for length and angle. Basics of digital measurement of signals, digitization methods and sampling theorem. 3 hours/3 credits.

Basics of Electrical Engineering

BMEVIAUA007

Basics of stationary and time-varying electric and magnetic fields and their engineering applications. DC and single-phase AC circuit with lumped parameters. Complex quantities, and phasor diagram. Active, reactive and apparent powers. Modeling electromechanical systems. Basic electrical instruments and measurements. 3 hours/3 credits.

Machine Elements 2

BMEGEGEAGG2

Fundamentals of tribology. Friction, wear and lubrication. Bearings. Sliding (plain) bearings. Designing hydrodynamic and hydrostatic bearings. Rolling bearings, dimensioning for life and static loading. Couplings and clutches. Indirect drives. Friction and belt drives. Chain drives. Gear drives, geometry and strength. Drives for big gearing ratio: worm gear-, planetary gear-, harmonic gear- and cycloid gear drives. 5 hours/6 credits.

Manufacturing

BMEGEGTAG01

The basic model of the machining system (WFMTC system), introduction to the part modeling, to the fixturing the parts, to the machine tools and robotics, to the cutting tools and to the controlling of the machine tools. Mechanics of cutting, geometry of the cutting edge, chip breaking, stability of cutting. Tool wear and tool life. Tool materials and cutting fluids. Fundamentals of the measuring techniques and quality control. The main measuring devices. Fundamentals of metal cutting machine tools kinematics. Manually operated, cam controlled and computer controlled machine tools. Basic types of machine tools. Flexible manufacturing cells and systems. Manufacturing process planning. Computer-Aided Manufacturing. 5 hours/5 credits.

Fluid Mechanics

BMEGEÁTAG11

Theory and practical applications in the following topics: Newton's law of viscosity. Gas, steam, liquid. Cavitation, cavitation erosion. Comparison of gases and liquids. Lagrangian and Eulerian description of fluid motion. Pathline, streakline, streamline, stream surface, stream tube. Steady, unsteady, quasi-steady flow. Continuity. Free vortex. Dynamics. Euler equation. Bernoulli equation. Static, dynamic, total pressure and their measurement. Pitot probe, Prandtl probe. Volume flow rate measurements using contraction elements and deduced from velocity measurement. Comparison. Unsteady Bernoulli equation. Radial fan, Euler equation for turbomachines. Linear momentum equation, applications. Viscous fluids. Non-Newtonian fluids, rheology. Navier-Stokes equation. Similarity of flows. Hydraulics. Bernoulli equation extended to hydraulic losses. Pipe friction loss. BC, outlet, diffuser, bend, elbow, valve, inlet. Description of turbulent flows. Boundary layers and their effects. Fluid mechanical forces acting on bodies. Gas dynamics. Energy equation. Bernoulli equation for compressible fluids. Sound speed for gases and solids. Discharge of an air reservoir through a simple circular orifice, at various pressure ratios. Flow in a Laval nozzle. 5 hours/5 credits.

Engineering Thermodynamics

BMEGEENAETD

Basic concepts. Work, heat, entropy, specific heats. Zeroth Law of Thermodynamics. Temperature scales. Properties of pure substances. First Law of Thermodynamics, internal energy and enthalpy, closed and open systems. Simple processes with ideal gas. Gas power cycles: heat engines, refrigerators, heat pumps. Second Law of Thermodynamics, exergy, losses due to irreversibility. Liquids and vapors. Equations of state. Two-phase systems. Basic cycles of power generation. Mixtures of gases, atmospheric (moisten) air. 3 hours/3 credits.

Polymer Materials Science and Engineering

BMEGEPTAG0P

The main goal of the Materials Science and Engineering is to introduce the students to the polymers as structural materials with emphasis on their differences from traditional engineering materials. The role of polymers in the engineering materials. Classification of polymers, thermoplastics and thermosets, Crystal structure and morphology. Mechanical, dynamic mechanical and thermo-mechanical behaviour of polymers. Melt-rheology of thermoplastics. Polymer melts as non-Newtonian viscous liquids. Flow of polymer melts in tubes and rectangular ducts. Extrusion of thermoplastics. Manufacturing of polymer sheets on calanders. Polymer processing technologies of complex 3D parts and products. Main parts and function of reciprocating screw-injection moulding machines. Thermoforming. Processing technologies of thermosets. Rubber technology. Processing technologies of high strength, reinforced polymer composites. 5 hours/6 credits.

Vibrations

BMEGEMMAGM4

Impact. Single degree-of-freedom vibrating systems. Free, undamped vibrations. Pendula. Damped vibrations (dry friction, viscous damping). Forced vibrations, isolation of vibrations. Several degrees-of-freedom systems. Langrange-equation of the second kind. Natural frequencies and vibration modes. Energy and numerical methods (Rayleigh-Stodola, Dunkerley). 3 hours/3 credits.

Electromechanics

BMEVIAUA008

Multiphase circuits. Single and three-phase transformers. Rotating magnetic field. Induction machines and drives. Synchronous machines, drives and electric energy production. DC machines and drives. Transients in DC and AC circuits. Electric utility network. Electric safety. 4 hours/4 credits.

Control Engineering

BMEGEMIAGEI

Methods of system analysis. Modeling and analysis of linear systems. Non-linear systems, linearization methods, soft computing approaches. Stability analysis. Synthesis of systems. Simulation as the tool for operating mathematical models. Simulation methods and software for engineering applications. Control and its classification (open-loop and feedback control). Linear feedback control systems. Compensation methods: serial compensation, compensation with feedback, multi-loop control systems. Optimal control. 4 hours/4 credits.

Heat Transfer

BMEGEENAEHK

Basic forms of heat transfer. Fundamental equations. General differential equation of heat conduction. Steady state and transient conduction. Thermal resistance. Extended surfaces, fin performance. Continuously operating heat sources. Numerical methods. Convection; concepts and basic relations, boundary layers, similarity concept. Free convection, forced convection, boiling and condensation. Empirical formulas. Dimensioning of heat exchangers, efficiency. Radiation heat transfer. 4 hours/4 credits.

Diffusion Processes

BMEGEVÉAG02

Introduction to mass transfer. Phenomenological theory of molecular diffusion. Turbulent diffusion, mass transfer in turbulent flow. Analogies between mass, heat and momentum transfer. Two-film (Lewis-Whitman) theory. Principles of mass transfer in packed and tray columns. Industrial applications of diffusion. Methods, calculation and equipment of distillation. 2 hours/2 credits.

Measurement at Energy and Environmental Protection

BMEGEENAG51

The role of measurements in maintaining and controlling the energy conversion processes. Hardware and software tools of the control and measurement systems. Laboratory tests of different engines and equipments. Simultaneous determination of system variables (flow rates, pressures, temperatures, etc.). Methods of determination of performance, efficiency, exhaust gas composition. 3 hours/3 credits.

Measurement Technique of Processes

BMEGEVGAG03

Physical quantities of processes and their measurements, indirect measurements and errors. Noise as stochastic process variable. Density and distribution function, cross-correlation and autocorrelation. Fourier-transformation in data processing, spectrum, detection periodic signals and noise. Measurement of time-dependent quantities, digital sampling. Data acquisition and data processing. Measurements of characheristics of machines. Statistical hypothesis tests. 2 hours/2 credits.

Fundamentals of FEM

BMEGEMMAGM5

The minimum principle of the total potential energy for linear elastic continua. Ritz method for slender beams subjected to tension/compression and bending, matrix formulation. Basic algebraic operations in Maple/Mathematica. Function approximation, C0 and C1 continuity of line elements. Description of the TRUSS1D/2D and BEAM1D/2D elements. Local-global coordinate transformations. Lagrangian and Hermitian interpolation functions. Derivation of element and structural stiffness matrices, load vectors. Modeling examples: beams and frames, symmetric structures. Solution of the finite element equations. Postprocessing of the results: calculation of strain, stress and displacement. Develoment of simple codes in Maple/Mathematica. Comparison of the numerical and analytical solutions of beam problems. Convergence of displacement components and stress resultants with mesh resolution. The assembly process to create structural matrices, index mapping and freedom numbers. Longitudinal, torsional and bending vibration of linear elastic continua. Animation of wave propagation in elastic slender beams. Finite element analysis of free vibration problems, equation of motion, frequency and mode shape analysis. Lumped and consistent mass matrices. Eigenvalue problems in Maple/Mathematica. Convergence studies. Vibration of beams with disks. Basic equations of plane elasticity. FE solution of axisymmetric problems: rotating disks. Quadrilateral and linear triangle elements, stiffness matrix, load vector, modeling examples. Stress concentration effect. Vibration simulation of beams with plane elements. Solution of FE problems in Maple/Mathematica. Laboratory practices using Maple/Mathematica and ANSYS.

Management and Business Economics

BMEGT20A001

This course introduces the essentials of management as they apply within the contemporary work environment and gives a conceptual understanding of the role of management in the decision making process. Particular attention is paid to management theories, corporate finance, leadership, teamwork, quality management, management of technology, economics calculation and operations management. For problem formulation both the managerial interpretation and the mathematical techniques are applied. 4 hours/4 credits.

Business Law

BMEGT55A001

The problems of the area will be treated in two major parts. Part One introduces students to the general topics, for example the concept of law, the functions of the law in the socioeconomic life. Some basic legal problems, like the conception, characteristics and functions of the modern state and, in a comparative view, the characteristics of the Anglo-Saxon and continental systems of business law and the development of the Hungarian business law will be also discussed. The emphasis of Part Two is on the questions of company law and competition law presented in a European context. The lectures of this part outline not only the regulations of the Hungarian Company Act and Company Registry Act but they cover EU directives and regulations on companies and competition as well. 2 hours/2 credits.

Marketing

BMEGT201A002

Basic Marketing Expressions. Strategic Marketing Planning. Marketing Information System and Marketing Research. Market Segmentation, Targeting and Positioning. Consumer Behavior. Business-to-business Marketing. Product Strategy. Pricing Strategy. Distribution Strategy. Marketing Communication. 2 hours/2 credits.

Communication Skills - English

BMEGT63A061

It is designed to meet the language needs of students in academic and professional fields. Special emphasis is on the language of meetings and discussions, oral presentation and summary writing. 2 hours/2 credits.

Technical Acoustics and Noise Control

BMEGEÁTAG15

Concept of acoustics, classification of the subject. The concept of sound, two-fold nature of sound. Linear acoustic model, and speed of sound. Homogeneous wave equation, general solution, solutions in bounded space. Harmonic waves, trigonometric and complex representation. Model testing and similitude, Helmholtz-number. Standing wave and beat. Helmholtz-resonator. Harmonic analysis, sound spectra, octave band. Energetical relations of acoustic waves. Kinetic and potential energy density, sound intensity, sound power, RMS value and levels. Calculation with levels. Transmission loss, insertion loss, noise reduction. Impedances. Spherical waves, sound sources, monopole, dipole and quadrupole radiators. Far field approximation of point and line sources in free field, sound propagation in the atmosphere. Attenuation of sound waves. Normal transmission from one medium to another, and transmission of obliquely incident sound waves. Transmission loss of one-layer wall. Sound propagation in duct and higher order modes. The energetical model of closed sound space. Direct and reverberant sound fields. Room constant. The subject of noise control. Physiological effects of noise. Subjective measurement units, phon, dB(A), equivalent sound pressure level. The general methodology of noise control. Sound waves generated by mechanical, fluid mechanical and thermal processes and their reduction. Noise control in free and in bounded space. Personal noise protection. Acoustic measurements, microphones, analysers, calibrators, anechoic and reverberating chambers. 3 hours/3 credits.

Fluid Machinery

BMEGEVGAG02

Euler equation, specific work, head, performance characteristics of axial and centrifugal machines. Losses, efficiencies. Non-dimensional parameters, scaling laws, specific speed. Cavitation, NPSH. Operation (parallel, serial) and control of turbomachines. Thrust loads (axial, radial). Axial fan, axial compressor stage. 4 hours/4 credits.

Heat Engines

BMEGEENAEGK

Fuels, fuel technology. Different type of boiler constructions. Circulation in boilers. Steam and gasturbine cycles. Theoretical and real cycles. Impulse and reaction stages. Radial and axial turbines. IC engines. Otto/Diesel engines, crank mechanism, valve arrangement and constructions. Fuel systems of IC engines. Refrigerators and heat pumps. Mechanical construction, dimensioning. Control and operation. Environmental aspects. 4 hours/4 credits.

Numerical Simulation of Fluid Flows

BMEGEÁTAG06

Overview of numerical methods used in fluid mechanics. Conservation form of transport equations. Fundamental concept of finite volume method. Numerical approximation of fluxes, upwinding methods. Solution of pressure-velocity coupling in the case of incompressible flows. Solution methods for Poisson equation. Turbulent models: Reynolds averaged approximation, zero-, one- and two-equation models. Boundary layers, boundary conditions of turbulent models. Direct solution of Navie-Stokes equation and Large Eddy Simulation. Compressible flow models. One-dimensional, time dependent flow pipe systems. Errors and uncertainties in numerical models. 2 hours/2 credits.

Processes and Equipment of Chemical Industry

BMEGEVÉAG03

Theory of liquid mixing. Mixers for low- or medium-viscosity liquids. Separation of gas-solid and liquid-solid systems. Settling in gravity and centrifugal field. Theory of filtration, filters. Theory and practice of heat transfer. Heat exchangers and evaporators. Heat and mass transfer in drying processes. Drying rate and time. Belt, kiln and spray driers. Theory of absorption, method of transfer unit. Packed and tray columns. 5 hours/5 credits.

Air Pollution, Wastewater and Solid Wastes Management

BMEGEÁTAG04

Gaseous and particulate air pollutants. Source control of emissions. Waste gas treatment techniques for volatile organic compounds and inorganic compounds, for gaseous pollutants in combustion exhaust gases and for particulate matter. Wastewater characteristics, pre-treatment. Primary

separation or clarification wastewater treatment techniques. Physical, chemical, and water treatment techniques. Biological treatment techniques for biodegradable waste water. Wastewater sludge treatment techniques, sludge disposal. Types, sources, properties, quantities, and qualities of solid wastes. On-site handling, storage and processing of solid wastes. Collection, transfer and transport of solid wastes. Solid wastes processing techniques. Biological, chemical and energetic resource recovery processes. Ultimate disposal. 3 hours/3 credits.

Independent Study 1

BMEGEVGAG06

One-semester long individual project work. 4 hours/4 credits.

Heating

BMEGEÉPAG61

Practical heat transfer calculations for buildings. Heat load calculations. Energy performance of buildings. Calculation of energy consumption. Human thermal comfort, energy balance. Elements and structure of typical heating systems. Basic system design. Hydraulic sizing and balancing of pipe systems. Low temperature heating systems. Condensing boilers. Application of renewable energy. 4 hours/4 credits.

Manager Communication

BMEGT63A081

It is designed to establish and update basic language skills, and competences required by acting in management fields. 2 hours/2credits

Crosscultural Communication

BMEGT63A091

It is designed to make students aware of cultural differences, develop their intercultural competencies. Special emphasis is on verbal and non-verbal communication, language diversity, and socio-cultural factors. 2 hours/2 credits.

Fluid Flow Systems

BMEGEVGAG07

Operation of pumps and fans in systems. Selection of the proper turbomachine considering safety, cavitation free operation and efficiency of controlling the turbomachine. Stability of operation of fans and compressors in systems containing large air volumes - an investigation based on a simple linear theory of stability. Computation of the flow rate and pressure distribution in looped pipe networks. Flow in open channels. Optimisation of the operation of water distribution systems containing pumps and reservoirs for minimum electricity cost. Basics of hydraulic transients. 3 hours/3 credits.

Energy Processes and Equipments

BMEGEENAG71

Energy demands and sources. Basic processes of energy conversion: fossil, renewable, and nuclear sources. Steamand gasturbine, IC engines, fuel-cells, solar collectors, heat exchangers, storage tanks. power stations: gas, steam and nuclear. Combined heat and power generation. Decentralized power generation. Complex energy utilization systems. Energy saving consumer equipment. 5 hours/5 credits.

Volumetric Pumps and Compressors

BMEGEVGAG04

Positive displacement pumps. Pump characteristic and performance. Reciprocating and rotary types. Gear pumps. Performance of a gear pump. Characheristics. Pressure balancing. Bearing forces. Screw pumps. Screw pumps for delivery of higher viscosities fluid. Roots blower. Delivery, isentropic and adiabatic power. Reciprocating compressors. Compression efficiency. Valves. Regulation. Pressure-volume diagrams for different methods of regulating and governing compressors. Sliding vanes pump. Characteristic performance. Capacity and efficiency. Effect of viscosity. 2 hours/2 credits.

Measurement for Chemical and Environmental Processes

BMEGEVÉAG04

Introduction to instrumentation and measurement systems. Process instrumentation, measurement methods, instruments and techniques of various physical quantities. On-line measurement with modular multi-parameter measuring system. Laboratory exercises for monitoring of waste water and air pollutants. Receive practical hands on experience in the laboratory using dryer, filter and heater equipment. 3 hours/3 credits.

Final Project

BMEGEXXA4SD

One-semester long individual project work. 10 hours/15 credits. * XX in the code varies from department to department.

Air-Conditioning

BMEGEÉPAG62

Basis for ventilation, thermal comfort and indoor air quality. Heating and cooling load calculations. Calculation of supply airflow rate for ventilated rooms, pollution and energy balance. Layout of air conditioning systems. Air movement in rooms, air distribution systems. Elements and processes of air handling systems. Filtration of air, filters. Treatments of air, equipment of heating, cooling, heat recovery and humidification. Hydraulic sizing of airduct system. Psychrometric charts. Process and flow diagrams of several air-conditioning systems. 4 hours/4 credits
Additional and optional courses on BSc level Pre-requisites: BSc final exam (diploma)

Optional Subjects (upgrade to ECTS 240)

Modeling of Processes and Equipment

BMEGEÉEAG01

Generalized two- and three-phase stage model. Types of equations describing the operation of equipment. Number of degrees of freedom. Design and modeling algorithms.Vaporliquid and liquid-liquid equilibrium calculations. Simulation of countercurrent separation processes (distillation, absorption, stripping, extraction, extractive distillation) with a professional flow sheet simulator. 2 hours/3 credits.

Laboratory

BMEGEÉEAG00

Heat and material balance in spray drier. Overall heat transfer coefficient in tubular heat exchangers. Adsorption of gases (Breakthrough curve). Absorption in packed columns (Mass transfer coefficient, number of transfer units). Air vol-

ume flow rate measurement in an air technology system. The measurement of pressure relations of a ventilator on a Bernoulli bench. Thermal comfort related laboratory measurements. Measurement of combustion parameters and efficiency of gas boilers. 4 hours/5 credits.

Independent Study 2

BMEGEVGAIP2

One-semester long individual project work. 8 hours/8 credits

Heating

BMEGEÉPAG61

Practical heat transfer calculations for buildings. Heat load calculations. Energy performance of buildings. Calculation of energy consumption. Human thermal comfort, energy balance. Elements and structure of typical heating systems. Basic system design. Hydraulic sizing and balancing of pipe systems. Low temperature heating systems. Condensing boilers. Application of renewable energy. 4 hours/4 credits.

Manager Communication

BMEGT63A081

It is designed to establish and update basic language skills, and competences required by acting in management fields. 2 hours/2credits

Crosscultural Communication

BMEGT63A091

It is designed to make students aware of cultural differences, develop their intercultural competencies. Special emphasis is on verbal and non-verbal communication, language diversity, and socio-cultural factors. 2 hours/2 credits.

English for Engineers

BMEGT63A051

It is designed to meet the language needs of students in academic and professional fields. Special emphasis is on understanding complex technical texts, as well as producing clear paragraphs and essays on certain technical topics. 2 hours/2 credits.

Analytical Mechanics

BMEGEMMMW01

Classification of mechanical systems of assemble of particles and rigid bodies. Classifications of constraints, geometric and kinematic constraints. Virtual velocity, virtual power and general force. Lagrangian equations of the second kind. Examples. Approximations of the natural frequencies of continua. Longitudinal, torsional and bending vibrations of beams, standing wave and travelling wave solutions. Strings. Vibrations of rotors, critical speed of shafts, Campbell diagram. 3 hours/4 credits.

Advanced Fluid Mechanics

BMEGEÁTMW01

Main objective of the subject is to understand the physical phenomena occurring in various flow categories of technical relevance and to gain practical knowledge in analyzing flow phenomena. Detailed thematic description of the subject: Overview of the fundaments of fluid mechanics. Vorticity transport equation. Potential flows, solution methods based on analytical solutions. Percolation, Darcy flow. Wells. Boundary layers. Similarity solutions for laminar and turbulent boundary layers. Overview of computational fluid dynamics (CFD). Turbulence models. Fundaments of gas dynamics. Wave phenomena. Izentropic flow, Prandtl-Meyer expansion, moving expansion waves. Normal shock waves, oblique shock waves, wave reflection. Jets. Open surface flows, channel flows. Pipe networks. Transient flow in pipelines. Atmospheric flows. 3 hours/4 credits.

Advanced Thermodynamics

BMEGEENMWAT

General model structure of thermodynamics. Equation of state (gases, liquids and solids). Laws of thermodynamics. System of body and environment, heat, work, reservoirs, extended systems. Irreversible processes, availability, exergy analysis, entropy generation minimization. Multicomponentphase equilibrium. Reaction equilibrium. Basics of non- equilibrium thermodynamics. Second law. Linear laws. Onsager reciprocity. Local equilibrium. Heat conduction, diffusion, cross effects. Rheology. Poynting-Thomson body. 3 hours/4 credits.

Motion Control

BMEVIAUA016

Classification of electrical machines according to their operating principles, advantages, disadvantages of each type, typical areas of application. Requirement of electric servo drives. Modeling of electric machines, basics of unified electric machine theory. The basic equations of the two-phase universal motor. Cylindrical and salience pole machines. Torque production, cylindrical and reluctance torque. Transformations. Phase and commutator transformation. The concept of three-phase space vector. Positive, negative and zero sequence components. Derivation of the commutator DC motor equations. Control block diagrams. Per-unit model. Dynamic behaviour of the DC machine. Issues of basic speed and position control. P, PI, PD, PID controllers. The effects of the saturation blocks. The usage of anti-windup structures. Design of the cascade controller. The current control loop. The disturbing effect of the induced voltage and its compensation. Setting of the speed controller, symmetrical optimum method. Position control loop. Discrete time controller design in DC servo drives. Power supplies of electric drives. Switched-mode converters. Circuits of one, two and four-quadrant drives. Circuits of braking and regeneration. Converters for three-phase machines. Pulsed-Width-Modulation (PWM) techniques. Bipolar, unipolar modulation. Space vector modulation of three-phase converters. Space vector model of AC machines, the induction machine, permanent magnet synchronous machines. Field-oriented control of AC machines. Hysteresis controllers. Current controllers. Direct Torque Control. 3 hours/3 credits.

Power Electronics

BMEVIAUA017

Semiconductor devices, the basic power electronics (PE) circuits and their application to such an extent that makes the students capable of understanding the principle of operation of PE equipment, carry out their laboratory tests, diagnosing faults and solving the task of selection as well as operation. Topics: 1. Introduction, Definition of PE; 2. Applications of Power Electronics; 3. DC/DC Converters; 4. Characteristics of Semiconductor Switching Devices; 5. Diodes, Thyristors, Application of Thyristors, 6. Controllable Semiconductor Switches: BJT, MOSFET, IGBT, GTO, Emerging Devices; 7. Converters: Classification, Configurations, Properties; 8. Output Voltage Regulation Methods, Overview of PWM; 9. AC Voltage Controllers: On-Off Control, Phase Control, Applications; 10. DC motor types, DC motor drives, Fields of Application; 11. Characteristics of the DC

motors, Power Supplies for the DC Motor Drives, Transfer functions, Dynamic analysis; 12. Introduction to Space Vector Theory; 13. AC Motor Types, Characteristics, AC Motor Drives, Fields of Application; 14. Inverters for AC Motor Drives, Voltage Source Inverters, Current Source Inverters; 15. Control of AC Motor Drives, Control methods: Field Oriented Control, DTC, V/f. 4 hours/4 credits.

Engineering Design and Technology Specialization

The below courses make exclusive part of the Engineering Design and Technology Specialization.

Metal Forming

BMEGEMTAGE1

To present different processes in the field of cold, hot and sheet metal forming using the base-knowledge about material structure, mechanics and tribology taking into account the deformability of the material and other process parameters. Process design is based on the modeling of plastic deformation. Tools and equipments for the forming also are presented.
Lecture: Metal-forming process as a system. Dislocation theory of plastic flow. Mechanism of plastic deformation. Cold and hot deformation, recrystallization. Fundamentals of technical plasticity: Strain and stresses. Plastic flow conditions. Hardening materials. Constitutive equations of deformed body. Elements of Tribology. Deformability of metals at different state parameters (temperature, strain rate, stress state). Plastic instability and ductile fracture. Measurements of process parameters.
Base technologies and raw materials of cold forming processes: upsetting, heading, forward, backward and radial extrusion. Workability of materials. Die and process design of technology.
Open die forging. Forging operation: edging, piercing, punching, fullering, swaging. Design of technological processes for the formation of cavities. Closed die forging operations: billet, heating, preshaping, rough forging, finishing, trimming, final product, heat treatment. Forging with and without flash. Die materials, required properties. Effect of forging on microstructure. Fibrous microstructure Equipment for forging: Hammers, screw presses, presses controlled by stroke, hydraulic presses
Hot and cold extrusion. Die design and die materials. Cross sections to be extruded. Drawing process. Rode and tube drawing operations. Characteristic features of a typical die design for drawing. Die materials and lubrications.
Sheet metal forming processes and materials. Anisotropic properties of sheet metal. The basic shearing processes. Forming by bending. Spring back. Deep drawing. Design of technology.
Laboratory: Flow curve and friction factor determination, testing of cold forming processes, design of die and forming technology, modeling of plastic forming. (4 credits)

Non-Destructive Testing of Materials

BMEGEMTAGE2

The subject gives an experience-oriented overview to the up-to-date non-destructive testing and evaluation (NDT and NDE) methods and technologies applied in mechanical-, electrical- and electronic industries. The subject deals with the basic and special non-destructive material testing methods, equipment and techniques of material defect analysis.
Lectures: Classification of NDT and NDE methods. Visualization, liquid penetration investigation of cracks. Ultrasonic testing and monitoring methods. Properties of materials in X-ray radiation. X-ray methods (transmission and diffraction). Image forming systems, tomography. Magnetic properties of materials. Ordered magnetic structures, ordering of magnetic moments. Magnetic anisotrophy, magnetostriction, and their effects. Domain structure formation, effect on macroscopic magnetic properties. Basic types of magnetizing curves. Magnetic field detectors. Crack investigations by magnetic methods. Magnetooptical phenomenas and their applications. Special electromagnetic testing methods. Barkhausen-noise measurements, method of nonlinear harmonics. Eddy current methods. Special eddy-current methods (low frequency, remote field). Acoustic emission tests. Reliability of nondestructive testing methods. Statistical evaluation methods. Transmission electron microscope, electron diffraction. Electron-material interactions, scanning electron microscope. Electron beam microanalysis. Special microscopic techniques, environmental scanning electron microscope (ESEM), electron back scattering diffraction (EBSD), electron beam induced current (EBIC). Confocal laser scanning microscope. Possibilities of digital image processing.
Laboratories: liquid penetration crack investigation. Ultrasonic testing. Acoustic emission. Magnetic field detectors, magnetization curve measurement. Magnetooptical effects, domain structure investigation. Measurement of magnetic Barkhausen-noise, evaluation of spectra. measurement of nonlinear harmonics. Scanning electron microscopy, energy-dispersive spectroscopy. Electron back scattering diffraction. (3 credits)

Novel Engineering Materials

BMEGEMTAGE3

The structure, properties of novel structural and functional materials used in mechanical and electrical engineering applications and their testing methods are discussed. The technological processes and their practical aspects are discussed. Fundamental concepts of material structures and the principles of material properties and their relations. Special attention is paid to materials used in the electronics industries including their production and technological usability.
Basics of crystallography, crystal defects, dimensional effects, nano-, micro-, and macrostructures, multi-component systems. Thermal behavior, diffusion mechanisms. Phase transformations, heat treatments, recrystallization. Mechanical properties and their measurements.
Types and properties of novel structural and stainless steels. Fundamental new concepts in steel development. High entropy alloys.
Alloys used in biomedical engineering applications.
Materials deterioration processes such as corrosion, fracture, fatigue (mechanical, thermal, etc.), creep, migration. Microscopy, electron microscopy, X-ray diffraction.
Conduction properties, conductive, superconductive, resistive, and insulator materials. Semiconductor materials. Effects of material properties on semiconductor materials used in microelectronics and in integrated optoelectronics. Insulator, dielectric and ferro-electric materials. Production of semiconductor single crystals and the related measurement techniques (Hall, CV). Non-metallic materials in electrotechnics. Magnetic properties and the types of magnetic materials used in industrial applications. Intelligent materials. Shape memory and super elastic alloys. (3 credits)

Machine Design

BMEGEGEAGMD

Mechanical engineering design, development, behavior analysis (stress and stiffness analysis, reliability and service life estimates), knowledge of the behavior of mechanical structures, modeling opportunities, various aspects of the design. Learning the modeling of different characteristics, and of the finite element model creation process and the evaluation of the stress state practicing on simple structural elements. Introduction to CAE systems, and case studies. The structure analysis process. Finite element modeling. Basic element types. Modeling issues. Thermal tasks. Integrated CAD / FEM systems. Optimal design of machine structures. Optimization objectives and criteria. Economic issues. Dynamic simulation. The load-bearing structural features of the machine. Structure Types and Applications. The modeling process. Actual and approximate models, the accuracy of approximation. Design principles. Material Laws. Material types. Limit states and serviceability limit state characteristics. General design principles and methods. Models and standard features. Safety factors, stress categories for allowable stresses. Stress Concentration. Design of welded joints. Technologies. Structural design. Load Bearing seams. Examples welded structures and designs. Design of steel structures. Applications and structural design. Design methods and standards. Bar structure and node design. Tanks, piping, sheet metal and design of shell structures. Areas of application and operating conditions. . Type of structure. Design principles and methods. Application examples. Case studies. (4 credits)

CAD Systems

BMEGEGEAGCS

The course prepares the students to resolve complex task in the mechanical engineering with the tools of the computer aided design.
Lecture topics: Introduction, using of the intelliFiles. Theory of the TOP-DOWN design. Integrated CAD systems. Virtual product development. Parametric design. Design of the mechanisms. Topics of the labs: Introduction, overview on the 3D part modeling. TOP-DOWN design in static constructions. Issuing homework No.1. Overview on 3D assembly modeling. Design of the cast parts. 3D model based technical drafting. SW test (45 min). (3 credits)

Project Work

BMEGEGEAGPW

The course is to introduce the behavior analysis of machine construction and the optimal design using the tools of geometrical modeling and analysis. During the semester a machine design project should be worked out in small groups according to the following schedule. The task involves the conceptual and detailed designing of a machine structure, building a 3D-geometrical model in a CAD-System and, furthermore, the solving of several analysis problems.
The main steps and milestones of the project:
Fixing the aim of the project. Project scheduling. Collecting information. Requirements. Developing and evaluating of design concepts. Simplified modeling and analytical calculation of the construction. Building the structural model (simplified geometry, load cases, boundary conditions and material properties). Presentation 1 (in team, max. 10 points). Working out the 3D-solid model of the evaluated design concept. Numerical modeling of the problem (static, dynamic, thermal, kinematic analysis). Evaluating and critic of the first model. Presentation 2 (in team or individually, min. 10, max. 20 points). Finalizing the construction. Preparing the project documentation and the assembly drawing. Presentation 3 (in team and individually, 20 minutes, max. 20 points). Submitting the project documentation and drawings (individually max. 50 points). (3 credits)

Manufacturing Processes

BMEGEGTAG91

The aim of the subject is to present the generally applied machining processes of part manufacturing. The focus of the subject is introduction to the metal cutting theory and applications. The up to date advanced machining processes are also discussed. Students may study the practice of the metal cutting in the laboratory lessons.
Introduction. Collaboration of the product and production planning. Manufacturability of parts. Principles of cutting processes. Energetics of cutting processes, tool wear, tool life, surface roughness. Cutting tools. Tool materials. Geometries of single point tools. Cutting with single point tools. Turning, milling, drilling, reaming, sawing processes. Cutting with abrasive tools. Grinding tools, kinematics of grinding, grinding parameters, tool selection. Non-conventional technologies. Laser machining, waterjet machining, electrical discharge machining, electro chemical machining, electron beam machining, ion beam machining, coating technologies. Gear manufacturing. Manufacturing of cylindrical gears by cutting processes. Profiling, Maag, Fellows, Pfauter gear manufacturing technologies. Assembly. Dimension chains, Tolerance, design for assembly. Measurement technologies in industry. Principles, measuring methods, measurement systems, process measurement. Economics of manufacturing. Production time and costs. Manufacturing Process Planning. Levels of planning, planning methods. Computations in manufacturing. Calculations related to the cutting processes. Production time and cost calculation, production optimization. (4 credits)

Machine Tools and Manufacturing Systems

BMEGEGTAG92

The subject introduces structural elements, structural layout, and various types of the metal-cutting machine tools, their technological and operation characteristics, the basic concepts and layouts of manufacturing systems, and the most important material supply equipment needed to build up manufacturing systems.
The lectures include the following topics. Fundamentals of the kinematics of machine tools and the NC technology. Classification of metal-cutting machine tools. Selection criteria of machine tools. Structural building blocks: friction, rolling and hydrostatic guideways; ball screws; linear motors; rack and pinion mechanisms; hydrostatic screws; indexing and NC rotary tables; rotary actuators: gears, warm wheel, torque motor. Spindles: belt drive, gear drive, direct drive, integrated spindle; rolling, hydrostatic, aerostatic bearings; tool holders and tool clamping; lathe and milling spindles. Lathes and turning centres. Milling machines and machining centres. Automatic tool and workpiece changing peripheries. Multi-functional machine tools. Parallel and hybrid kinematics machine tools. Methods and tools for design and simulation of machine tools. Types and various layouts of manufacturing systems. Material supply principles. Material supply equipment: conveyors, forklifts, AGVs, robots. Flexible manufacturing systems. Methods and tools for planning, design and simulation of manufacturing systems. (3 credits)

CAD/CAM Applications

BMEGEGTAG93

The aim of the subject is to introduce students into computer aided design and manufacturing systems via industry proven tasks, application examples. Out through laboratory works they can learn the main principles of computer aided manufacturing programming techniques, the characteristics, advantages and limits of recent CAD and CAM systems and up to date developments. The focus of the subject is to teach manufacturing oriented computer modeling (preprocessing), applications and programming (post-processing).
Detailed thematic description of the subject: Product and production life cycle: Product, product workflow (lifecycle), production and manufacture, product design and production planning, modeling (models). Computer aided automation of process planning (engineering): manufacturing process planning and engineering models (CAD/CAM models); object and process oriented, integrated planning methods (CIM); manufacturing and manufacturability planning. CAD or/and CAM systems: principles of CAD and CAM system application, design for manufacture and assembly, feature based design and manufacturing process planning, manufacturing process oriented (generated) surface models and modeling, technology and quality controlled design and planning. CAM items and basic workflows: modeling of parts, assembly, environment (machine, device, tool, control, etc.) and technological process; CAD/CAM systems and elements (modules); CAM work- and data flows (interfaces, documents); manufacturing dimension; material, tool and technological databases; manufacturing strategies (roughing and finishing, path generation and combination, etc.); manufacturing levels and boundaries; 2.5-3D tasks, cycles, options. >3D manufacturing via CAM systems: manufacturing planning on lathes, mills and wire EDMs, spatial motion strategies, manufacturing sculptured and composed (combined) surfaces, applications of combined strategies, high speed machining (HSM) and special techniques. CAM-CNC interfaces, postprocessors: adaptation and transportation interface drivers (engine, processor), surfaces (HW/SW) and languages (formats), intermediate surfaces, languages, ISO CLDATA, ISO standard and advanced NC program languages, post processing (postprocessors and postprocessor generator), DME connections (DMIS) and NC auxiliary functions (in process measure, adaptive feed and/or path optimization, etc.) .Surveying knowledge: lecture's and supplementary labor's test.
Thematic of laboratories: Subject requirements and thematic, 2.5D multiple hollow part modeling, NASA CAD test laboratory, Test1 (CAD labor work), surface and solid modeling of complex surfaces and combined, assembled block, NASA CAM test milling, 2.5D milling of hollow part in EdgeCAM, 3D-s CAM modeling and manufacturing programming, Test2 (CAM labor work), Homework consulting, check and submission. (3 credits)

Composites Technology

BMEGEPTAGE1

Getting familiar with the matrices and reinforcing materials of polymer composites. Gaining knowledge about the manufacturing technologies of thermoplastic and thermoset matrix composites. Learning the basics of composite mechanics and composite specific design guidelines.
Lecture/seminar topics: Thermoset and thermoplastic composite matrix materials, properties and applications. Typical reinforcing materials of polymer composites. Reinforcing structures, properties and applications. Manufacturing technologies of thermoset matrix polymer composites: overview, typical products, tooling materials. Wet manufacturing technologies of thermoset matrix polymer composites: hand layup, spraying, RTM, pressing, pultrusion, filament winding, braiding, centrifugal casting. Dry manufacturing technologies of thermoset matrix polymer composites: autoclave curing of prepregs, out of autoclave prepreg curing, BMC pressing, SMC pressing, sandwich manufacturing. Manufacturing technologies of thermoplastic matrix polymer composites: extrusion, injection molding, pressing, vacuum forming, GMT. Damage and failure of polymer composites: testing and approving methodologies. Basics of composite mechanics: types of material behavior, rules of mixtures, laminate properties for different stacking sequences, composite plates under tension, composite plates under bending, failure criteria for composites. Example problem solving.
Laboratory practice topics: Tensile and flexural testing of the specimens. Test data evaluation. Calculating the expected mechanical properties of the specimen types, comparison with the test data, summarizing the results for the required technical report. (4 credits)

Injection Molding

BMEGEPTAGE2

Theoretical and practical understanding of the injection molding technology. Knowledge of production engineering and design aspects of modern plastic products. Understanding the most advanced design and simulation procedures.
Detailed description of the injection molding technology. Analysis of the process cycle diagram. Construction and operation of injection molding machines. Design for injection molding. Materials for injection molding, and fiber reinforced materials. Methods for the identification and elimination of molding defects. Injection mold design and injection molding simulation. (3 credits)

Polymer Processing

BMEGEPTAGE3

The aims of this subject is familiarizing the students with polymer processing technologies in details: preliminary techniques, extrusion, blow molding, thermoforming, rotational molding, polymeric foams and elastomers technology. Introduction. Classification of polymer processing technologies. Basic rheological aspects of polymers. Preliminary techniques of polymer processing (material conveying, drying, mixing, dosing etc.). Calendering. Extrusion. Extruder constructions, single and twin screw extruders. Compounding wit extruder. Extrusion dies (film blowing, flat film-, pipe, sheet, profile extrusion; extrusion blow molding; extrusion coating). Thermoforming: vacuum and pressure forming. Rotational molding. Foams technology: thermoplastic and thermoset foams. Elastomer technologies. Finishing and decoration. Joining technologies: welding and adhesive bonding. (3 credits)