BULLETIN

Budapest University of Technology and Economics

2015–2016

An ECTS Guide

Engineering Programs in English
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Bulletin of the Budapest University of Technology and Economics
Engineering Programs in English

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This Catalogue provides information on the programs and services of the Budapest University of Technology and Economics. Curricula, courses, degree requirements, fees and policies are subjects to revision. Specific details may vary from the statements printed here without further notice.
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Dear Student,

You are reading the Bulletin of the **Budapest University of Technology and Economics.** Its direct predecessor, the Institutum Geometricum, was established in 1782 by Emperor Joseph II, as part of the Faculty of Liberal Arts at the University of Buda. During the past **233 years** the professors of the university have striven to provide an outstanding quality of education. This has earned the university an international reputation, attracting students and also professors from all over the world.

Our university has eight faculties. They are, in order of foundation: Civil Engineering, Mechanical Engineering, Architecture, Chemical Technology and Biotechnology, Electrical Engineering and Informatics, Transportation Engineering and Vehicle Engineering, Natural Sciences, Economic and Social Sciences.

"Live as if you were to die tomorrow. Learn as if you were to live forever."
This is a quotation from Mahatma Gandhi. I fully agree with him. Learning should be – and it really **can be** – enjoyable. Doing homework can be like solving a puzzle. Those who enjoy learning are also likely to enjoy working. I am a workaholic person, and spend on average 14 hours a day fulfilling my duties. My relatives and friends say that **this is not work** – because I like it. I agree with this opinion and I am also satisfied with it. You can become engineers or experts in business and management; you may also be able to enjoy your work as professionals. This is the difference between a **job** and a **profession**. Engineers have the power to create a better world. Sustainable energy, clean water, safe transport on roads and bridges producing less pollution, buildings for comfortable living and working, machines and robots for work and for amusement, fast and reliable communications, medical equipment that assure a good quality of life for the individual and can be financed by society, and healthy food for us all. All of these goals need engineering solutions to make the world a safer, better and more exciting place to be. **This is also your responsibility.** You can acquire the necessary knowledge and skills to make your own contribution. As a graduate you will certainly do your best for your colleagues, company and society.

Hungary is a member of the European Union. As a student in Budapest you will find general European as well as particular Hungarian cultural customs: food, fashion, folk art, music and dance.
Use this bulletin to help you consider our programs. Come to visit our campus. Better yet, come to study with us for one or two semesters or for an entire degree program. Should you decide to stay for only one semester, this bulletin will also help you choose from among the different semester programs.

The Budapest University of Technology and Economics extends a special welcome to students from abroad.

Ákos Jobbágy
vice-rector for education

Tuition Fees for 2015/2016 academic year

Course	For EU citizens	For non-EU citizens
Preparatory Course and General Course in Architecture	EUR 3,200 / semester	EUR 3,200 / semester
Undergraduate Tuition Fees, leading to B.Sc. degree	EUR 2,250 / semester	EUR 3,200 / semester
Undergraduate Tuition Fees, leading to B.Sc. degree in Civil Engineering	EUR 3,200 / semester	EUR 3,200 / semester
Graduate Tuition Fees, leading to M.Sc. degree for graduates of external higher education institutions	EUR 3,200 / semester	EUR 3,500 / semester
Graduate Tuition Fees, leading to M.Sc. degree for graduates of BME	EUR 2,850 / semester	EUR 3,200 / semester
Graduate Tuition Fees, leading to M.Sc. degree in Civil Engineering	EUR 3,800 / semester	EUR 3,800 / semester
Postgraduate Tuition Fees, leading to Ph.D. or DLA degree (Depending on the character of the research and course programs)	EUR 4,500 / semester	EUR 4,500 / semester
Tuition Fees for special students (courses leading to no degree)	EUR 110/credits (min. 12 lessons/week)	EUR 110/credits (min. 12 lessons/week)
Tuition Fees for special students (courses leading to no degree) in Civil Engineering	EUR 2,000 / semester minimum	EUR 2,000 / semester minimum

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Faculty of Architecture

The Faculty of Architecture at the Budapest University of Technology and Economics focuses on training highly professional experts in architectural engineering who are aware of the social and cultural implications of their profession. Versatility is emphasised so that students will gain fundamental knowledge and abilities in every possible field of architecture and be able to find work in a highly competitive job market, and in any building- or design-related area of consulting, construction, and management. The 5-year program in English leads directly to an MSc degree in Architecture and Architectural Engineering (Dipl. Ing. Arch.), but it is also possible to graduate as a Bachelor of Science in Architecture.

Graduates of the Faculty of Architecture are qualified for a broad spectrum of architectural occupations:

- Design, construction and maintenance of residential, public, industrial and agricultural buildings;
- Reconstruction and the preservation of historical monuments;
- Urban design and settlement planning; and
- Administration of all these activities.

The curricula were organised on Swiss and German models. The Faculty has maintained these traditions for the last 40 years but provides additional European and international dimensions through guest lecturers from abroad, topical short courses, workshop seminars and exchange programs.

The five year program of the Faculty of Architecture taught in English is in full conformity with the five-year program provided in Hungarian, which after two years practice and experience is accepted for access to EUR-ING title.

General course – Preparatory Course

The year program in English, called the General Course preceides the Degree Program. It is designed to develop the skills of students from abroad so they will be at no disadvantage in meeting the Faculty's exacting educational standards. Students are introduced to various aspects of the profession they have selected, and they concentrate on studying English and basic technical subjects such as mathematics and freehand drawing. Students who show enough skills at the Placement Test can automatically (immediately) start the Degree Program.

Academic Program of the Faculty of Architecture: BSc/MSc Studies

The two-level B.Sc, M.Sc training in the English speaking section of the Faculty of Architecture is realized in a split-up system, in full comformity with the Hungarian speaking section. For B.Sc degree students has to accumulate min 240 credit points, for M.Sc degree min 300 credit points by accomplishing the obligatory subjects and gathening the remaining credit points by accomplishing elective subjects too. B.Sc degree can be obtained in a minimum of four years, M.Sc degree in a minimum of five years of study.

Students, both international and Hungarian, who have a command of both languages can choose from either program. The participation of Hungarian students in the program given in English has obvious advantages. It eases the integration of international students into the society, which surrounds them during the years of their studies. It also attracts students from European, American and other universities worldwide to study in Budapest within the the framework of the International Student Exchange Program and otheragreements.

Hungarian students likewise gain the opportunity to study at schools of architecture abroad. These exchanges will become a powerful factor in achieving real convertibility among educational systemworldwise and, eventually, mutual international recognition of degrees.

Master's Program

Students who have earned BSc degrees in other schools of architecture can join the Master's Program. Programs will be tailored to their previous education and special needs. In general they are admitted to the last two years of the five years program, and they have to collect minimum 120 credits. These studies encompass a wide range of complex design topics and elective subjects grouped in three directions:

- Structural Design - buildings and other structures.
- Architectural Design - buildings with different functions, their interiors and sorroundings; the preservation of historical buildings.
- Town Planning - urban design, settlement planning and management.

Note: The Faculty of Architecture reserves the right of changing the Curricula.

Graduation

Graduation from the University is based on the successful completion of examinations in all subjects and on the successful defence of a diploma project before a Final Examination Board. The examinations are public and the Board consists of professors and eminent specialists in the profession. Diploma projects are prepared in the last semester under departmental guidance and can be submitted only by students with an "absolutorium" (university leaving certificate). The diploma project is expected to reflect its author's familiarity with technical and aesthetic knowledge fundamental to architectural practice, and his/her creativity in applying it. Currently, international agreements make it possible for certain Hungarian students to prepare and defend their diploma projects in the university of another country. Students from abroad can correspondingly prepare and defend their thesis projects under the guidance of the Faculty of Architecture at the Budapest University of Technology and Economics.

Departments

Department of Construction Technology and Management
Department of Architectural Representation
Department for History of Architecture and of Monuments
Department of Building Energetics and Building Services
  Laboratory of Thermal Physics
Department of Building Constructions
  Laboratory of Building Acoustics
Department of Industrial and Agricultural Building Design
Department of Public Building Design
Department of Residential Buildings
Department of Design
Department of Mechanics, Materials and Structures
Department of Urban Studies

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Vice-Dean of the Faculty: Dr. Gábor Nemes
Program Coordinator: Ms. Ágnes Dvorszki

General (Preparatory) Courses in Architecture

Subject			hours/week		
Name	Code	Credits	1	2	Requisities
Basic Mathematics 1	BMETETOPB22	-	4		
Computer Literacy 1	BMEEPAGG101	-	4		
Engineering Sciences	BMETETOP117	-	4		
Geometrical Construction 1	BMEEPAGG111	-	5		
Freehand Drawing 1	BMEEPRAG101	-	6		
Design Skills 1	BMEEPRAG111	-	2		
Basic Mathematics 2	BMETETOPB23	-		5	Basic Mathematics 1a
Computer Literacy 2	BMEEPAGG201	-		2	Computer Literacy 1a
Geometrical Constructions 2	BMEEPAGG211	-		3	Geometrical Constructions 1a
Freehand Drawing 2	BMEEPRAG201	-		6	Freehand Drawing 1a
Fundamental of Structures	BMEEPSTG201	-		4	
Basic Tools of Building Constructions	BMEEPESG201	-		2	
Design Skills 2	BMEEPRAG211	-		2	Freehand Drawing 1a
Fundamental of Architectural Design	BMEEPRAG221	-		2	
Compulsory English for Pre-Eng. Students I.	BMEGT63A201	-	0/6/0p		
Compulsory English for Pre-Eng. Students II.	BMEGT63A202	-		0/6/0p	BMEGT63A201a

a) can be taken parallelly in the same semester. For students of BME Faculty of Architecture only criteria subjects (no credit points)

Students can enter the BSc/MSc degree program only after completing all the subjects of the second semester of General Courses in Architecture.

Curriculum of BSc/MSc Subjects

Subject			lectures/practical lectures/laboratory							
Name	Code	Credits	1	2	3	4	5	6	7	Requisities
Mathematics 1	BMETE90AX33	4	2/2/0e							-
Philosophy	BMEGT411099	2	2/0/0p							-
Descriptive Geometry 1	BMEEPAGA102	5	3/2/0e							-
Introduction to Building construction	BMEEPESA101	2	2/0/0p							-
History of Architecture I. (The Beginnings)	BMEEPETA101	3	2/1/0e							-
Introduction to Structural Design	BMEEPSTA101	2	2/0/0e							-
Drawing 1	BMEEPRAA101	5	0/5/0p							-
Introduction to Architecture	BMEEPUIA101	2	2/0/0p							-
Space Composition	BMEEPKOA101	5	0/5/0p							-
Mathematics 2	BMETE90AX34	2		0/2/0p						BMETE90AX33
Descriptive Geometry 2	BMEEPAGA202	5		3/2/0e						BMEEPAGA102
Building Constructions 1	BMEEPESA201	4		2/2/0e						BMEEPESA101, BMEEPSTA101s
Statics	BMEEPSTA201	4		2/2/0e						BMEEPSTA101
History of Architechture 2 (Antiquity)	BMEEPETA201	3		2/1/0p						-
Drawing 2	BMEEPRAA201	4		0/4/0p						BMEEPRAA101
Residential Building Design 1	BMEEPLAA201	2		2/0/0e						BMEEPUIA101
Basics of Architecture	BMEEPLAA202	6		0/6/0p						BMEEPUIA101, BMEEPRAA101, BMEEPKOA101
Building Materials I	BMEEOEMA301	3			2/1/0p					-
Architectural Informatics 1 - IT Applications	BMEEPAGA301	2			1/1/0p					-
Building Physics	BMEEPEGA301	2			2/0/0p					BMEEPESA101
Strength of Materials 1	BMEEPSTA301	4			2/2/0e					BMEEPSTA201, BMETE90AX33
History of Architecture 3 (Medieval)	BMEEPETA301	3			2/1/0e					BMEEPETA201
Drawing 3	BMEEPRAA301	4			0/4/0p					BMEEPRAA201
Public Building Design 1	BMEEPKOA301	2			2/0/0e					BMEEPLAA201, BMEEPLAA202
Residential Building Design 2	BMEEPLAA301	6			0/6/0p					BMEEPLAA202, BMEEPAGA102s BMEEPLAA201
Building Constructions 2	BMEEPESA301	4			2/2/0e					BMEEPSTA101s, BMEEPAGA102, BMEEPESA101

Subject			lectures/practical lectures/laboratory							
Name	Code	Credits	1	2	3	4	5	6	7	Requisities
Sociology for Architects	BMEGT43A044	2				2/0/0e				-
Architectural Inf. 2 - Digital Representation	BMEEPAGA401	3				1/2/0p				BMEEPAGA202, BMEEPAGA301
Building Constructions 3	BMEEPESA401	4				2/2/0e				BMEEPESA201
Strength of Materials 2	BMEEPSTA401	6				4/2/0p				BMETE90AX34, BMEEPSTA301
Strength of Materials Global	BMEEPSTA499									BMEEPSTA401a
History of Architecture 4	BMEEPETA401	3				2/1/0e				BMEEPETA301
Drawing 4	BMEEPRAA401	2				0/2/0p				BMEEPRAA301
Design Methodology	BMEEPKOA402	2				2/0/0e				BMEEPLAA301, BMEEPKOA301
Architecture of Workplaces 1	BMEEPIPA401	2				2/0/0e				BMEEPLAA301, BMEEPK0A301
Public Building Design 2	BMEEPKOA401	6				0/6/0p				BMEEPLAA301, BMEEPK0A301
Architectural Inf. 3 - CAAD for Architects	BMEEPAGA501	3					1/2/0p			BMEEPAGA401, BMEEPLAA301, BMEEPESA301
Construction Man. 1 - Basics of Construction	BMEEPEKA501	2					2/0/0p			BMEEPESA301
Building Service Engineering 1	BMEEPEGA501	2					2/0/0p			BMEEPESA201
Building Constructions 4	BMEEPESA501	4					2/2/0p			BMEEPESA301
Global of Building Constructions Basic	BMEEPESA599									BMEEPESA401, BMEEPESA501a
Design of Load-Bearing Structures	BMEEPSTA501	6					4/2/0e			BMEEPAGA202, BMEEPSTA499a, BMEPSTA401
History of Architeture 5 (19th century)	BMEEPETA501	3					2/1/0p			BMEEPETA401, BMEEPETA101
Drawing 5	BMEEPRAA501	2					0/2/0p			BMEEPRAA401
Urban Design 1	BMEEPUIA501	2					2/0/0e			BMEEPKOA401
Architecture of Workplaces 2	BMEEPIPA501	6					0/6/0p			BMEEPKOA401, BMEEPIPA401
Design Global Basic	BMEEPKOA599									BMEEPIPA501a, BMEEPRAA401, BMEEPK0A402
Economics 1. (Microeconomics)	BMEGT301004	2						2/0/0p		-
Construction Management.2 * (Building Project Management)	BMEEPEKT601	2						2/0/0e		BMEEPEKA501
Construction Management.2 ** (Building Project Management)	BMEEPEKK601	4						2/2/0e		BMEEPEKA501
Building Service Engineering 2	BMEEPEGA601	2						2/0/0e		BMEEPEGA301
Building Constructions 5	BMEEPESA602	4						2/2/0e		BMEEPESA301, BMEEPESA401
Preservation of Historic Monuments *	BMEEPETT611	2						2/0/0p		BMEEPKOA599, BMEEPETA501
History of Achitecture 6 *	BMEEPETO601	3						2/1/0p		BMEEPETA401
Drawing 6	BMEEPRAA601	2						0/2/0p		BMEEPRAA501
Department's Design 1 *	BMEEPUIT601	3						0/3/0p		BMEEPKOA599
Urban Design 2	BMEEPUIA601	6						0/6/0p		BMEEPUIA501, BMEEPIPA501
Special Load-Bearing Structures *	BMEEPSTT601	4						2/2/0e		BMEEPSTA501
Building Materials 2 **	BMEEOEMK601	3						2/1/0e		BMEEOEMA301
History of Architecture Global* (basic)	BMEEPETO699									BMEEPETA401
Reinforced Concrete Structures I.**	BMEEPSTK601	6						4/2/0e		BMEEPSTA501
Economics 2. (Macroeconomics)	BMEGT301924	2							0/2/0/p	-
Construction Management 3 (Planning of Construction Technology)	BMEEPEKA701	4							2/2/0e	BMEEPEKA501
Building Constructions 6	BMEEPEST702	4							2/2/0p	BMEEPESA599
Steel and Timber Structures **	BMEEPSTB701	4							4/0/0e	BMEEPSTA501
History of Art 1 *	BMEEPETT721	2							2/0/0e	BMEEPKOA599
Drawing 7 *	BMEEPRAO702	2							0/2/0p	BMEEPRAA501, BMEEPKOA599
Department's Design 2 *	BMEEPRAT701	3							0/3/0p	BMEEPUIT601
Department design 3.*	BMEPExxT711	8							0/8/0p	BMEEPKOA599, BMEEPUIT601, BMEEPUIA601
Global In Structures *	BMEEPSTT799									BMEEPSTT601a
History of Hungarian Architecture **	BMEEPETB701	2							2/0/0p	BMEEPETA501
Soil Mechanics **	BMEEOGTK701	3							2/1/0e	BMEPESA301
BSc Diploma Studio 1 **	BMEEPxxB722	6							0/6/0p	BMEEPSTA499, BMEEPESA599 BMEPKOA599, BMEEPUIA601, BMEEPEKK601, BMEEPEGA501a

Curriculum of BSc/MSc Subjects (contd.)

Subject			hours/week			
Name	Code	Credits	8	9	10	Requisities
Building and Architectural Economics	BMEEPEKA801	2	2/0/0p			BMEEPLAA301
Facility Management *	BMEEPEK0633	2	2/060e			
History of Hungarian Achitecture 1. *	BMEEPETO801	2	2/0/0p			BMEEPKOA599, BMEEPETA501
Drawing 8 *	BMEEPRAO801	2	0/2/0p			BMEEPRAA501, BMEEPKOA599
Urbanism *	BMEEPUI0805	2	2/0/0p			-
Contemporary Arch. Offices *	BMEEPIP0893	2	0/2/0p			-
Res. Design and Cont. Competitions*	BMEEPLA0897	2	2/0/0e			BMEEPLAA301
Complex Design 1 *	BMEEPxxT811	10	0/10/0p			BMEEPxxT711, BMEEPSTA499, BMEEPESA599
Building Construction Global *	BMEEPEST899					BMEEPESA602, BMEEPEST702
Construction Management 4. ** (Controlling of Construction technology)	BMEEPEKK801	4	2/2/0e			BMEEPEKA701, BMEEPESA501
Building Constructions 7 **	BMEEPESK801	4	2/2/0e			BMEEPESA601
BSc Diploma 2**	BMEEPxxBD01	12	0/12/0p			All the subjects and globals of previous semesters
Construction Law *, **	BMEEPEKO901*	2		2/0/0p		-
	BMEEPEKB801 **	2	2/0/0p			
Design of Reinforced Concrete structures*	BMEEPST0655	2		2/0/0e		-
Drawing 9 *	BMEEPRAT901	2		0/2/0p		BMEEPRAA501
Architectural Interiors*	BMEEPKO0905	2		0/2/0p		BMEEPKOA401
The Form in Architecture *	BMEEPRA0404	2		0/2/0p		-
History of Theory of Architecture 1.*	BMEEPET0407	2		2/0/0e		-
Complex Design 2 *	BMEEPxxT911	10		0/10/0p		BMEEPxxT811, BMEEPEKA701, BMEEPEGA601
Theory of Architecture Design *	BMEEPETO921	2		2/0/0e		BMEEPKOA599
Contemporary Hungarian Architecture 2. *	BMEEPETO901	2		2/0/0p		BMEEPETA501, BMEEPETO601
History of Architecture Global *	BMEEPETT999					BMEEPETO601, BMEEPETO801, BMEEPETO901a
Diploma project studio * Min 270 credits all subjects and globals	BMEEPxxTD01	30			0/30/0e	

a) can be taken parallelly in the same semester
s) signature only
**: Obligatory for MSc / Elective for B. Sc. Degree*
***: Obligatory for B. Sc. / Elective for M. Sc. Degree*
Minimum number of credits for B. Sc. Degree: 240
Minimum number of credits for M. Sc. Degree: 300

Description of General Courses in Architecture

Design skills 1.

Mr. Gábor Nemes
The Basic formal components of Buildings: walls, beams, pillars, floors. Their appearance and formal varieties. The Basics of spatial compositions. The idea of the architectural space and its typology.

Design skills 2.

Mr. Gábor Nemes
Developing the skills of students to read 2D architectural drawings. To develop skills to transfer 2D drawings to 3D expression. To develop skills to transformtke 3D reality into 2D projection drawings.

Freehand Drawing 1-2.

DLA Balázs Balogh, Dr. Balázs Méhes
Introduction to the basic laws of perspective, the onevanising- point perspective, cubes and squares; simple body settings, cylindrical bodies, towers viewed from the ground, half-cylindrical rings, and more complicated settings and orthogonal pictures. Life drawing, shadow techniques, curved surfaces and rounded bodies. Tonus drills, draperies, plaster ornaments, flowers in ink, still life (plasters), coloured pencil techniques, aquarell and still-life interiors. Interiors and furniture, corridors, staircases, corridors or exteriors (weather permitting). (Criteria subject)

Fundamentals of Architectural Design 4

DLA Balázs Balogh
It is an attempt to explain the grammar of architectural design, to describe the basic factors on which the creative process of design depends. The course intends to give students a clear picture of the profession of architecture as they start their training and to give them some guidance on the attitude of mind that will help them in their approach to design problems. (Criteria subject)

Basic Tools of Building Constructions

Dr. Fülöp Zsuzsanna, Dr. Igaz György
Construction is the realization of architecture. Building construction classes will help students master the control of this realization process, through the learning of academic principles behind practical construction theory. Design must be realized through techniques founded on proper methods and principles of building construction. Course develops a basic understanding of building construction vocabulary, drafting symbolism, various building systems and building components and their interactions. To be able to select appropriate building systems and detail solutions for design tasks.

Computer Literacy 1

Mihály Szoboszlai PhD
General information about computing, computers, and peripheral devices. Input, output and data storage. Methods of problem solving on computers. Algorithms and programs. Basic elements of a programming language, such as symbols, datatypes, statements, control structures and elementary I/O. Practical work on a computer; development and running of small programs. Text editor and translator.

Computer Literacy 2

Mihály Szoboszlai PhD
Introduction to computers, operating systems and computer networks. Browsing and organizing information through Internet, use of Internet based communication. Computers in architectural office: word porcessing, using spreadsheets, creating presentations. Basics of pixelgraphics and image manipulation.

Geometrical Contrsuctions 1

Pál Ledneczki PhD I
ntroduction of drawing instruments, writing letters, text. Special lines and points of a triangle, theorems on right triangle. Parallel transversals. Circle power. Loci problems. Geometrical transformation: congruencies, similarity. Golden ratio, constructions on regular pentagon. Affine mapping, axial affinity, circle and ellipse. Osculating circles at vertices of an ellipse. Central-axial collineation.

Geometrical Contrsuctions 2

Pál Ledneczki PhD
Apollonian problems. Focal definitions of conic sections, tangents, asymptotes of hyperbola. Spatial elements and their relative positions. Angles and distances. 3D lici problems. Constructions in 3D, axonometric sketch. Orthogonal projection. Multi-view system. Recontruction of 3-dimensional object from 2-dimensional images. Development of polyhedral surfaces, paper models. Platonic solids. Calculation on angles distances, surface area and volume.

Fundamentals of Structures

BMEEPSTA001

Dr András Draskóczy, Dr Gábor Domokos
Introduction: requirements of the built environment. 1st site visit: an existing, functioning building. Parts of buildings. Discussion of experiences of the 1st site visit: functions and requirements of parts of buildings. 2nd site visit: a construction site. Loadbearing parts of buildings. Discussion of experiences of the 2nd site visit: functions and requirements of loadbearing parts of buildings. The notion of safety. 3rd site visit: laboratory testing of structural members (brickwork column, reinforced concrete beam). Loads and responses when beeing loaded. Discussion of experiences of the 3rd site visit: structural members; ways of becoming unfit for use: rupture, loss of stability (overturning, sliding, buckling), excessive cracking and deformations. 4th site visit: laboratorxy testing of structural materials. Yield and rupture. Collection of strength measurement data. Discussion of experiences of the 4th site visit: statistical evaluation of measurement data. The notion of safety, safety factors of materials and loads. 5th site visit: a project buro. Graphical presentations of buildings. Architecture and structure. Results of structural analysis. Discussion of experiences of the 5th site visit: Parts and kinds of documentations. Scales and graphical symbols. Modelling of structures, structural projects. 6th site visit: ready structure construction site. Discussion of experiences of the 5th site visit: modelling of structures. The static model.

Description of MSc Subjects

Mathematics 1

BMETE90AX24

Dr. Béla Barabás

Integration: Applications of definite integrals. Areas between curves. Volumes of solids of revolution. Areas of surfaces of revolution. Centers of mass. Differential equations. Seperable equations. Homogeneous equations. First order linear equations. Bernoulli-equations. Exact-equations. Integrating factors. Second order linear differential equations. Equations with constant coefficients. Method of undetermined coefficients. Numerical methods for solutions. Multiple integrals. Double integrals. Area, moments and center of mass. Double integral in polar form. Triple integrals. (4 credits)

Descriptive Geometry 1

BMEEPAGA102

Analisys of relative position of spatial elements in multiview system; intersection of line and plane, pair of planes. Auxiliary projections, intersection of polyhedron and plane, pair of polyhedrons, Representation of regular polyhedron by means of transformations. Revoluttion of plane, metrical problems. Contruction of shadow. Oblique and orthogonal axonometry. Perspective. Images of circle and sphere. Intersection of sphere and plane. (5 credits)

Introduction to Building construction

BMEEPESA101

This subject introduces all major building construction components (walls, foundations, floors, roofs, skeleton frames, stairs, ramps, doors and windows) and primary building engineering service systems. During lectures, the building is considered as a composition of spaces with different functions, separated by special surfaces. The course aims to introduce and explain the grammar of architectural design through practical tasks, such as the survey of one's own flat. Concurrently, the basic dependant factors of the creative design process are described. Students are acquanted with technical terminology as well as the role and use of various construction solutions including their classifications. The above shall assist students with both starting independent design exercise work and the continuing of building construction studies in greater detail. (2 credits)

History of Architecture I. (The Beginnings)

BMEEPETA101

The course gives an overview of the architecture in the first period of the evolution of human culture. The classes follow chronology – mainly in the first part of the course – with focusing on the development of building constructions and the development of settlements.

Prehistory: Palaeolithic human claim to space, from the cave to the hut. Building activity of Neolithic peasants, one-celled houses and fortified settlements. Introduction to building construction in the Near East and Europe.

In the second part the course gives an overview of the vernacular architecture of the world. Native architecture: comparative outline of the architecture of hunting, pastoral and farming peoples. Construction, building materials and decorations. Native American, African and European architecture.

The practical lessons show details were delivered in the lecture before. The drawings drawn by students help them to understand the colourful world of common and rural architecture. (3 credits)

Introduction to Structural Design

BMEEPSTA101

The most important methods of analysis and design of engineering structures are presented, together with their modelling, and the applied approximations. It is shown how high school statics (and math) can be applied to engineering structures. The understanding of the behaviour of structures is emphasized. (2 credits)

Drawing and Composition 1

BMEEPRAA101

The objective of this subject is to introduce students to the fundamentals of perspective spatial representation based on geometrical solids (e.g. cube, cylinder, quadratic and triangular prisms.) In the course of the semester, drawing tasks range from simple arrangements to complex spatial constructions, while representation techniques range from constructive line drawing to tinted drawing (showing light-shadows effects), applying lead pencil. (5 credits)

Introduction to Architecture

BMEEPUIA101

The subject intends to raise and maintain first-year students' professional interest and give a common architectural language preparing for further special courses. This subject intends to make students' attitude positive towards architecture; enlarge their intellectual capacities and get them understand the many-sided learning processes of architecture: lectures, texts, project analyses, films etc. (2 credits)

Space Composition

BMEEPKOA101

Space composition is the creative course of the first semester, during which the students study the basics of the composition of (architectural) space. The aim of the course on one hand is to develop one's creativity, on the other hand getting a deeper knowledge about the nature of creating architectural space through space-composition exercises. This knowledge will be the basis of the process of architectural design in the forthcoming semesters. (5 credits)

Mathematics 2

BMETE90AX34

Limit, continuity, partial derivatives and differentiability of functions of multiple variables. Equation of the tangent plane. Local extrema of functions of two variables. Gradient and directional derivative. Divergence, rotation. Double and triple integrals and their applications. Polar coordinates. Substitution theorem for double integrals. Curves in the 3D space, tangent line, arc length. Line integral. 3D surfaces. Separable differential equations, first order linear differential equations. Algebraic form of complex numbers. Second order linear differential equations with constant coefficients. Taylor polynomial of exp(x), sin(x), cos(x). Eigenvalues and eigenvectors of matrices.
(2 credits)

Descriptive Geometry 2

BMEEPAGA202

Curved lines and surfaces; guadratic surfaces, surfaces of revolution; developable surfaces, screw surfaces, ruled surfaces. Representation in multi-view system, axonometry and perspective. Construction of tangent plane, contour and shadow. Intersection of surface and plane, intersection of a pair of surfaces. Topographic map, projection with elevation, sections, earth works platform, road, cuts and fills. (5 credits)

Building Constructions 1

BMEEPESA201

This subject presents the details of the main load-bearing constructions (walls, floors, stairs) and the joints between them. Wall supported / skeleton frame, or mixed construction. Walls: Effects on walls, and how to fulfil the requirements. Sorting the walls by function, position, material, by layer-order. Walls built from elements, the development of walling elements. Floors: Functions, effects on floors, how to fulfil the requirements. Elements of floor construction. Types: plain floors (in details), arches (overview). The materials, construction lines, building methods, About the future of floors Joints between walls – floors, skeleton frames – floors. Methodology of the floor design. Stairs: Functions, effects on staires, how to fulfil the requirements, principles of stressing and how to choose construction. Sorting the constructions by material, load bearing method, building method etc. Design possibilities. (4 credits)

Statics

BMEEPSTA201

The basic laws and theorems of statics are presented and applied to engineering structures. Statically determinate trusses, beams, frames, and assembled structures are considered, the line of trust is presented. Internal forces are treated in 2D and 3D. (4 credits)

History of Architechture 2 (Antiquity)

BMEEPETA201

Basic topics: Ancient civilizations. The Sumer millenium. From Old Babylon to Parthians. Millenium of pyramids. New Kingdom, Ptolemaic age. Greek temenos, temple, town. Greek public buildings. Roman town, house types. Roman temples. Roman public buildings. Roman palaces. Practical themes: simplified column-orders, Ur house, zikkurat, temple, apadana – its elevation, akhaimendian rock grave, pyramid ensemble, Khonsu temple, Egyptian house. Ur towertemple – axonometric view, Khonsu temple – half-axonometric view, Greek Doric order – details. Greek temple – half axonometric view, Greek Ionic order – details. Colosseum type elevation, house-types, Greek Corinthian order – details, Roman vaults and domes. Pantheon. Basilical construction. (3 credits)

Drawing and Composition 2

BMEEPRAA201

This subject intends to inspire students to think creatively via free-hand drawing tasks. It is closely related to the material covered by preceding semester, however, spatial arrangements are complex, and students are expected to creatively supplement them and apply light-shadow effects. Classes present the basics of the theory of colours and its architectural application. After a crative model building task, students return to the pepresentation of complex spatial forms practised in the previous semster (e. g. furniture, drapery, details of space, drawing studio etc.) to apply and practise a wide range of drawing techniques (e.g. pencil, crayon, ink, washed drawing). (4 credits)

Residential Building Design 1

BMEEPLAA201

This class covers the theory and fundamentals of residence building design, which is the same as the fifth-year and BSc training. The time for enrolment is the second semester, and the prerequisite for admission is successful completion of the Introduction to Architecture course. The goal of the class is the mastery of basic knowledge concerning the formation of a dwelling environment, residential building design, and housing topics in general. The lecture series presents the historical and intellectual evolution in housing design – providing information on the historical precedents and intellectual roots for the formation of residential areas and apartment buildings, as well as a special perspective on last century's trends, which determine design practice to this day. Also presented are expectations (operative or otherwise) for the formation of dwelling areas, apartment arrangement methods, types of residential buildings in use and the specific requirements that apply, lessons of techniques used in professional practice, problems of apartment buildings' architectural formation and aesthetic appearance, as well as fundamental relationships in housing architecture. Planned lectures will only deal with the exact know-how as necessary, and this knowledge must be acquired through the class textbook (Residential Building Design by Dr. János Bitó). The class concludes with an oral exam, questions being derived in part from the lectures and in part from textbook material. (2 credits)

Basics of Architecture

BMEEPLAA202

Architectural planning is a creative process, typified mainly by an end result that is either one-of-a-kind in its details or uncommon as a whole. Hence, the design path is unique in and of itself. In the case of design activity, instruction does not only impart basic knowledge of the profession (the mastery and practice of which is a requirement of the design process), but also develops creative skills. The Fundamentals of Architecture class consists of weekly practice; before receiving each assignment, however, there is a general lecture held for all that year's students. Within the subject, architectural pupils encounter tasks that require architectural-based problem solving and creative trouble-shooting. Classes of 25-28 pupils are run by 3-4 main instructors. In the course of the semester, there are several small planning tasks to be solved, modelling, architectural drawing, and technical drawing with equipment. Design tasks are built around a unifying theme or motto. (6 credits)

Building Materials I

BMEEOEMA301

Material properties and classification of building materials (densities, mechanical properties, hydrotechnical properties, thermal properties). Detailed introduction of timber, masonry, mortar, concrete (and constituent materials), metals, polymers, glass used in architecture. Fields of application. Types of commercial products. Material testing methods for building materials (tensile, compressive and bending testing). Observation of basic natural stones and applications.Students work individually or in small groups during the laboratory sessions and study the physical and mechanical properties of building materials. (3 credits)

Architectural Informatics 1

BMEEPAGA301

Informatics in the architectural office. Solving common tasks of the architectural practice with the extemsive use of word-processors, spreadsheets, and other applications. Numerical solutions of mathematical problems in the architectural practice. Communications through Internet-based applications. Presence on the Internet. The subject excpects ECDL-level knowledge in Word processing and Spreadsheets. (2 credits)

Building Physics

BMEEPEGA301

One dimensional steady state heat transfer of composit slabs. Thermal condition for a room, balance temperature of a nonheated space, energy conservation approaches. Conduction: Fourier's equation, Concept of thermal conductivity, Range of thermal conductance of building materials, One-dimensional steady state conduction through a plane slab. Convection. Steady state heat transfer of composite slabs, overall heat transfer coefficient, temperature gradient. Modified conduction of insulations. Air gaps. Reverse tasks: Maximizing inner temperature different. fulfilling new U-value requirement for existing wall. Examples.
Linear heat transmission
Introduction to Thermal Bridges, Definition of Self-Scale Temperature, two applications of SST, Definition of Apparent Thickness, Generalized model of wall corner, generalized model of wall corner temperature, Example: estimation of wall corner temperature.
Moisture transfer
Definition of Moist air, Dalton's Law, Moisture content, Saturation vapour pressure, Relative humidity, dew point, dry and wet bulb temperatures, Specific Enthalpy, Moisture balance, Mechanism of vapour transfer, Scope of calculation, Vapour conductivity and resistance, Overall vapour resistance of multilayer wall, Overall vapour transfer, Design consideration, example.
Introduction to Solar Architecture
Indirect Solar collecting walls. Mass walls: principles, surface, shading, energetic operation, delaying, losses, operation in summer, irradiated solar energy, examples, simplified thermal model. Example: calculation of thermal balance of a mass wall
Solar Design Strategies
Sustainable future (global impact of buildings, energy crises, the 2030 challenge, sustainable future). Energy Conscious Design (historical overview - traditional and modern architecture, international style, energy conscious architecture and refurbishment). Energy Conscious Refurbishment. Building Energy Standards (building energy regulation, certifications, standards). Energy Consumption of Buildings (Low and Passive and "zero" energy buildings). Autonom buildings. Energy Conscious Architecture, Passive Solar Systems (smart conceptual design, building volumes, thermal mass, mass wall, Trombe wall, transparent insulation, sun space, green roofs). Active Solar Systems (pv-panesl, solar collectors, heat pump, wind turbine)
Acoustics. The acoustical quality of the built up environment. (2 credits)

Strength of Materials 1

BMEEPSTA301

Basic concepts of strength of materials. Behavior of solid bodies. Material laws, constitutive equations: elasticity and plasticity. Central tension and compression. Design criterion. Pure shear. Steel and carpenter joints. Pure bending. Second moment of inertia. Bending in elastic stress state. Symmetric bending and skew bending. Eccentric tension and compression. Core of section. Materials not having tensile strength. Bending in plastic stress state. Bending combined with shear. Calculation of shear stresses. Design for bending. Normal force – moment interaction curve. Torsion. Plane stress state. Possible failure conditions: rupture and yield. Elastic energy. (4 credits)

History of Architecture 3 (Medieval)

BMEEPETA301

The architecture of the Late Roman Empire. The born of Christianity and its Necessity architecture". The born of the monumental Christian architecture – Early Christian architecture in Rome. – Early Christian architecture in the eastern Provinces: Palestine, North Africa, Syria – Late Roman and Oriental traditions. Early Byzantine architecture in Thessalonica and in Constantinople. Load bearing structures of the Early Christian period. Different types of barrel vaults, Roman-type cross vault. – Syrian influences in Armenia. The Iconoclasm" and the aftermath in Greece. Architecture in the radius of influence of Byzantium. The comparison of the basilicas in Rome and in Syria. – Ravenna. The penetration of Christian architecture into barbarian Europe – Scattered monuments". Byzantine vaulting systems. The main stream of the Romanesque architecture: the Carolingian architecture with the evangelizer" Benedictine movements, the three periods of the German-Roman Empire. The Langobard architecture in North-Italy. The Romanesque vaulting systems: Romanesque cross vault, Sexpartite vaulting, groin-rib" vaulting. Squire-bayed and free vaulting systems – the pointed arch. Basilica and false basilica" type space organization. – The retrospective interregional influences in Romanesque architecture. – Antique influences. Byzantine influences. The progressive interregional influences in Romanesque architecture – monastic movements: Benedictine and Cistercian, Norman Imperial" Romanesque architecture. Morphology of medieval detailing. The Early French Gothic cathedrals. – The flourishing period of the French cathedrals, and its influences in South-France, in England, in Germany and in Italy. Interregional influences in gothic architecture: Cistercian gothic formations, the Franciscan and Dominican movements. – The special characteristics of English and German gothic architecture. Late gothic vaulting systems: Cylindrical (or net vaults) and Spherical (or stellar) vaults. Halls and false-halls – Civic movements in Late Gothic in Germany and the proto-renaissance in Italy. Medieval secular architecture. (3 credits)

Drawing and Composition 3

BMEEPRAA301

This subject introduces students to proffesional specific applications of the drawing skills they acquired so far. Classes present drawing methods for the representation of reality irrepective of the given point of view, from any other one. Students learn to consciously apply perspective in drawing samll-scale models as tall buildings, and develop various graphic skills by practising the architectural graphic representation of masonry, stone, wooden and glass surfaces and those of materials. A creative modeling task assigned to students is building an autonomous construction, which focuses on the relations of materials and volume, internal space and the phenomenon of transparency. During model building, problems of space, form and structural arrangement are investigated; while at graphic elaboration, great emphasis is laid on the representation of materials, fluency in perspective drawing and abstraction. (4 credits)

Public Building Design 1

BMEEPKOA301

Our basis for public building design methodology, the function of public buildings and technical requirements, achieved via a knowledge of architectural history and precedent of type. The course pattern will analyze important examples of Hungarian and International public buildings regarding architectural space, architectural form, the use of materials and structures, in relationship to various environmental factors. (2 credits)

Residential Building Design 2

BMEEPLAA301

This class covers the practice of residential house planning in studio, both for general students and BSc training. Prerequisites are the successful completion of Residence Building Design 1, Fundamentals of Architecture, and Descriptive Geometry 1 courses. Practice takes place once a week in the form of studio classes and consultations. The central elements of the course include the apartment, the main goal being the mastery of a basic knowledge of flats and their practical use, as well as an understanding of relationships between flat and building, building and environment. The flat, as a function of architectural engineering praxis, appears in countless forms. Obviously, we have no means to cover even all the basic cases in one semester – if the concept "teaching" even applies in the case of a creative activity. This is why the class focuses on developing the students' approach to design work – to develop in students a complex, yet practical standpoint towards spatial arrangement and formation, after they have acquired a thorough knowledge of function. We intend for students, upon completing this class, to be capable of recognizing in all its depths a function – in this case, a flat. Later, in the course of planning, they can make independent, professional decisions on the basis of information they know to be true. That means they can plan good flats with little outside assistance. (6 credits)

Building Constructions 2

BMEEPESA301

The subject deals mainly with pitched roof constructions, roof coverings and different types of foundations – the latter with consideration to waterproofing solutions. During seminar lectures the principles and details of shallow and deep foundations are introduced, according to functional and load bearing requirements of various building constructions as well as subsurface water and soil type effects. Also introduced are the functions and primary principles of different pitched roof constructions such as: traditional roof, rafter type (modern) roof, purlin and truss type roof as well as contemporary methods of carpentry. Further explanation is provided on occupied (built-in) attic constructions with focus on principles, layers, ventilation, windows and lighting. The main types of roof coverings are shown, such as concrete and clay tiles, flashings and metal roof coverings with special attention to principles and details. (4 credits)

Sociology for Architects

BMEGT43A044

Dr. János Farkas, Dr. Adrienne Csizmady

Benefits of sociology. Origins of sociology as a science. Principles and concepts of sociology. Formal organisations in the extension of human capabilities. Interaction in formal organisations. Culture, modernism, and computerisation. Public opinion. Statistical analysis. Change from country life to modern city life. Housing and public policy. Political ideology and housing policy. The home and social status. (2 credits)

Architectural Informatics 2

BMEEPAGA401

Fundamentals of vector graphics, two-dimensional (2D), and three-dimensional (3D) Computer Aided Design (CAD) systems. Application of Cartesian and polar coordinate systems. CAD principles from simple 2D drafting to the developing of architectural drawings with the use of layers and library elements (blocks). 3D modelling of geometrical shapes and architectural details. (3 credits)

Building Constructions 3

BMEEPESA401

General and detailed review of the structures of the elevation constructions. The most important aim of the subject is the analysis of the external separating constructions. Principles of the continuity of the protecting levels depending on the position in the structure. Multi-layer external separating walls, construction methods of the elevation claddings and elevation coverings, the ordinary and special external doors and windows. Complementary structures for the external doors and windows, especially the shading devices. Requirements for the external separating structures and performances of the different constructions. Building physics: heat and vapour physics, acoustic features of the external separating structures. (4 credits)

Strength of Materials 2

BMEEPSTA401

Strength of materials is a compulsory engineering subject for second year students in architecture. The goals of the subject are to show how to
- determine the deformations of load-bearing structures
- find the internal forces of statically indeterminate structures.

In addition to theoretical methods, we also show examples in structural engineering. (6 credits)

History of Architecture 4

BMEEPETA401

Brunelleschi and the early renaissance architecture in Tuscany. The evolution of the renaissance palace in Florence and in the Northern regions of Italy. The architect and scholar Leon Battista Alberti. Bramante and and the influence of his circle in the first half of the 16th century. Michelangelo Buonarroti architect. Renaissance in Lombardy and Venice. Mannerist architecture. The late sixteenth century: Palladio and Vignola. Urban development and early baroque architecture in Rome under Pope Sixtus V. The architecture of Lorenzo Bernini and Francesco Borromini. Baroque in Venice and in Piemont. Architecture in France in the 16-17th centuries. Baroque in central Europe: Austria, Bohemia and Germany. (3 credits)

Drawing and Composition 4

BMEEPRAA401

The main topic in the syllabus of the subject is the 'analytic'representation of external spaces: students learn how to recognise the invisible geometrical-structural relations beloww the surface of buildings through preparing 'X-ray drawings'. Not only the views but also the sections of buildings are studied in order to understand and grasp the gist of the architectural structure behind the view, and to

prepare such 'X-ray drawings'that represent more complex architectural compositions than what the eyes can see. Students prepare drawings on external sites (such as the Museum of Fine Arts, the Great Market Hall, and the assembly halls of BUTE and Corvinus University) to investigate the options of perspective drawing and the versions of plane representation of large spaces. (2 credits)

Design Methodology

BMEEPKOA402

Design Methodology deals with theoretical and practical methodology of architectural design flow. The point of theoretical Design Methodology is the design itself as a process that can be modeled. The process of architectural design thus can be compared to an informatics system, so for making the method more clear. Practical Design Methodology is closely connected to the Public Building Design 2 process itself, extending it with special design factors and details. Through analyzing existing buildings and fictional situations interesting practical problems and solutions can be discussed. With the help of invited practicing architects, special methods of new facilities and building- reconstructions are presented, along with the design of technologically or structurally determined buildings. Because of its importance, sustainability, free access and ecological design will be touched along whole study. (2 credits)

Architecture of Workplaces 1

BMEEPIPA401

The history of industrial architecture, the history of Hungarian industrial architecture. Load-bearing structures of halls and of multi-storey buildings. Size standardization. Constructions of space separation, facades, subsytems of space separation constructions (foundations, roof structures, intermediate floors, external wall systems, finishes. Characteristic architectural requirements, social facilities. Logistics: transport, storage. From location to layout, emplacement of industrial plants. Design methodology, re-use, reconstruction. Administrative workplaces. (2 credits)

Public Building Design 2

BMEEPKOA401

Target of the exercise, how to realize the general architectural design of a public building without loss of focus regarding the types collective characteristic. What does the studio hope to achieve? The architectural design of a smaller public building, with assistance from architect consultants. The student should learn the process from within regarding the architectural design process and the unusual stress placed upon development of space / manipulation of form whilst considering their approach to solving real environmental problems.
Communication of this architectural design is the key to making a successful presentation and your ideas should encompass dialogue with client (class tutors), relationship to the surrounding environment both built and natural, understanding of trends, financial awareness and understanding of intellectual property. It is expected that this work will involve a deeper research into project types and location - site visits, photographs, topographical mapping and land use mapping. (6 credits)

Architectural Informatics 3

BMEEPAGA501

Use of state-of-the-art CAAD software to develop professional architectural solutions. Extensive use of 3-D computer model development. Architectural documentation with computers. Computer animation and fly-throught pictures for architectural space analysis. (3 credits)

Contruction Management 1
Basis of Construction

BMEEPEKA501

The goal of the subject is to present basic information on the technologies and organization of construction work, with special respect on construction activities of sub and superstructures. Considering the character of the subject both theoretical and practical knowledge is essential, therefore besides the lectures the site visits play emphasized role as well.
Main topics: The construction process. Phases and participants of the construction process (roles, responsibilities, connections, etc.).
Technical preparation and controlling of the construction. Handover – take-over of the building (reviewing the constructions – quality and quantity – and the plans)
Introduction to construction technologies, conditions, requirements. Aspects of selecting the technology. Sequence of construction works (the follow-up of processes).
Main equipment of construction (earthwork, foundation work, construction of loadbearing structures, etc.) Material supply on site – to the site.
Informations about the construction site. Construction site planning.
Time scheduling. Types, realations. List of operations, survey for quantities, labour schedule, plant schedule, material schedule. (2 credits)

Building Service Engineering 1

BMEEPEGA501

Water supply
The physical and chemical properties of water. Obtaining of water from the nature. Mechanical, chemical and biological treatment of water. Water treatment process of swimming pools. Transport of water. Characteristics of water pumps. Fresh water demand and production, hydrofors and hydroglobes. Cold water distribution network in a building. Metering of water consumption. Pipe materials and appliancies: valves and taps, safety equipments. Fire protection networks. Domestic hot water demand and production. Domestic hot water networks in a building. Boiler types. Circulation. Appliancies: toilets, baths, showers, washing machines, etc. Legionella.
Waste water systems
Requirements of waste water networks. Traps and syphons. Sanitary rooms for disabled people. Waste water networks. Rain water networks. Pipe materials and fittings.
Gas supply
Physical properties of natural and PB gas. Dangers of gas supply. Safety requirements. Gas supply networks outside and inside the building. Gas meters. Materials and fittings of gas networks. Gas appliancies: boilers, stoves, ovens. Categorisation and safety requirements of appliancies. Chimneys: types and requirements. Parameters of drought. Drought diverter.
Artificial lighting
Visual environment and its components. Characteristics of the human vision. Essential ideas of lighting technique: luminous flux, luminous intensity, illuminance, luminance. Characterisation of surfaces: reflection and transmission, spreading of light, colour. Requirements concerning the lighting. Average illuminance and its uniformity. Colour rendering. Modelling – shadows effect. Limitation of glare. Colour appearance. Balanced ratio of luminance. Cost efficiency. Artificial light-sources. Incandescent lamps. Fluorescent tubes. Compact tubes. HID lamps: mercury lamps, metal halide lamps and sodium lamps. Meeting of requirements. Efficiency-method. Proposed setting of luminaries. Electric network of buildings Parts of the network. Characteristics of the network: form, nominal voltage. Typical installations: lighting, building services and technology. Connection of building to public network. Transformers and its placing. Required areas of switchboards and transformers. Indirect contact. (2 credits)

Building Constructions 4

BMEEPESA501

Flat roofs. Classification, general design aspects, basic construction principles (inclination and geometry of the water collecting areas) according to the impacts on the roofs. Arrangement of roofing layers. Requirements concerning to the different constructions, layers, materials, building physics. Waterproofing (membranes, coatings), applied materials and their features. Technologies and details. Tracking type and terrace roofs, green roofs. Flooring. Effects and requirements. Layers, subsystems, acoustical evaluation. Substructures of floor coverings and their technical features. Classification according to the materials, specifications. Waterproofing against domestic and industrial wet effects.
Drywalls, suspended ceilings, internal wall coverings. Labelling systems, design aspects, effects, requirements, basic structural principles. Internal separating structures of residential buildings satisfying acoustical requirements, connecting details of slabs, floorings and stairs.
Principles of primary building engineering service systems and building constructions of sanitary block. (4 credits)

Design of Load-Bearing Structures

BMEEPSTA501

Basic conceptual and computational design methods of load-bearing structures are discussed for reinforced concrete-, steel-, timber and masonry buildings.
The main goal is to gain knowledge about structural design problems and principles of structural design in order to understand how and why the load-bearing structure influences the work of an architect. (6 credits)

History of Architecture 5 (19th century)

BMEEPETA501

The period of this History of Architecture subject is the "long nineteenth century" from the 1750s to the 1910s. In this era the architecture and the art turned to the past, to the previous styles using them in a new approach. The architects had discovered the history of art and artistic liberty at the same time. At the turn of the 20th century the art and also the architecture searched for new ways instead of using historical architectural elements or motifs. The changes led to the Modern Movement when buildings were being erected without decoration or ornaments in the first quarter of the 20th century.
This period was divided into different eras, but these types of periodization were different in different countries and changed in the course of the 20th century. Beside the question of styles 19th century is important not only because of the appearing of new structures and materials in the architecture but because of the great development in the field of the functional planning. While following the timeline, the classes concentrate on the development of the styles in several areas of Europe (Great Britain, France, Germany, Russia) looking out to the United States of America too, because there the styles reflected the European ones. (3 credits)

Drawing and Composition 5

BMEEPRAA501

In this semester students apply their previously acquired skills in the most complex architectural representation: in drawing affter imagination. After practising the representation of reality and preparing creative perspective drawings (with the help of the real view, which could not be drawn from real points of view), students in this course prepare fully detailed, external and internal perspective views of buildings of various size, based on plans (e.g. ground plans, sections, elevations), using their experience and creative imagination, applying conventional graphic techniques. Students have to accomplish a modelling task during the semester, which improves creative thinking. (2 credits)

Urban Design 1

BMEEPUIA501

The subject is the theoretical course of the fifth semester, with 2 hours lecture weekly. The task of the course is to introduce students to the theoretical background of Urban Planning and Design with specially focusing on the knowledge and skills necessary for the successful participation in the Design courses later on in the curriculum. The course deals with the historical background, fundamental theories, basic typologies, most wide spread forms and basic sustainability aspects of urban design and planning. (2 credits)

Architecture of Workplaces 2

BMEEPIPA501

In an advanced society the world of labour is synonymous with order and being well-arranged. The aim of this one-semester course is to acquaint students with this world that not only suggests but also requires a lot of organizing and planning. The complexity of the topic manifests itself in the buildings designed to house certain activities with the attached architectural content such as space, stucture, and fabric as well as in the questions regarding the architectural formation of the surroundings by this world.
As Architecture of Workplaces 2. is the main designing course in the fifth semester, it has a significant position and task among the Bsc courses. It gives a chance to summarize the acquired architectural-technical knowledge at the midpoint of the education in the form of a last challenge right before the Global Design exam. This complex challenge foreshadows the desire of a real and complicated architectural thinking since it aims to create an equilibrium between the aesthetic and technical constituents of planning of a building.
This task of the semester is an organic part of the students' studies and is designed to be a realistic challenge for them regarding their age and level of professional knowledge. The task involves real architectural programs that contain building sites that are based on actual spots, thus the plans are ought to be highly commensurable resulting in a fair and matter-of-fact grading. (6 credits)

Economics 1. (Microeconomics)

BMEGT301004

Objectives and description of the course: The aim is to allow students to understand today's economic environment. After having finished the course, students should understand the key concepts of microeconomics (e.g. opportunity cost, supply and demand, market equilibrium, prices, cost functions, profit, competition and monopoly), master a basic set of tools of economic analysis and demonstrate the ability to apply them to simple practical problems. This course is primarily designed as an introduction to microeconomic theory for undergraduate students pursuing a bachelor's degree in engineering. Both the course and the recommended textbook are accessible to students without a strong math background. Integral calculus is not used and the most important ideas are also demonstrated in graphs. (2 credits)

Construction Management.2 * (Building Project Management)

BMEEPEKT601

The subject introduces the investment process from emerging the idea through tendering until the hand-over and use. It shows the role and tasks of an architect in different phases of a construction process. It gives an introduction of real estate investment, basics of project management. The relationship between costs, time and quality: scheduling, planning and estimating and the procurement methods are revealed. There are case studies in the field of construction projects, their preparation and performance, planning, organising leading and commanding of works.
Main topics: Building project management; Participants of the construction; Start-up of the construction project - architectural competition; Tendering and contracting; Scheduling, networks; Cost estimation; Post occupancy evaluation (2 credits)

Construction Management.2 ** (Building Project Management)

BMEEPEKK601

The subject introduces the investment process from emerging the idea through tendering until the hand-over and use. It shows the role and tasks of an architect in different phases of a construction process. It gives an introduction of real estate investment, basics of project management. The relationship between costs, time and quality: scheduling, planning and estimating and the procurement methods are revealed. There are case studies in the field of construction projects, their preparation and performance, planning, organising leading and commanding of works.
Main topics: Building project management; Participants of the construction; Start-up of the construction project - architectural competition; Tendering and contracting; Scheduling, networks; Cost estimation; Post occupancy evaluation (4 credits)

Building Service Engineering 2

BMEEPEGA601

Calculation of heat loss of buildings. Energy consumption of a heated space. Introduction to fluid flow. Classification of Heating. Central heating. Elements of water heating system. Pipe distributing networks Emitters and surface heating. Controlling. Renewable energy sources for heating and producing domestic dot water. Introduction to psychometrics. Psychometric processes. Ventilation (Classification, natural ventilation and mechanical one, fundamental systems of air inlet and extract) Estimation of the necessary air volume. Air heating and cooling systems. Air conditioning. (2 credits)

Building Constructions 5

BMEEPESA602

This subject introduces the students to the precast reinforced concrete, steel and the timber load bearing construction systems of the big span halls and their special additional structures by a system- and performance-based approach. Details both of heavy elevation and roof slab structures

made of prefabricated r.c. sandwich panels and lightweight external constructions are presented. Specific flooring, big size doors and partitions of industrial and commercial halls are shown.
It is also an objective to present the special construction rules and the service system aspects of the buildings of lightweight system and their particularities in the terms of building physics and fire protection.
Additional information is presented about multilevel precast r.c. skeleton frames, its typical technical details and the structural solutions of mass produced blocked and panel load bearing systems in case of residential buildings.
The main object of the course is to explain the constructions of one storey high big span halls. Students practice knowledge transmitted during the presentations and workshops in their semester projects on basis of the whole complexity of previous studies. (4 credits)

Preservation of Historic Monuments *

BMEEPETT611

The course gives an overview on history and theory of the architectural preservation in Europe and Hungary. Presents the evaluation of the way of thinking from purism to the modern practice of restoration. It is an important part, when national and international documents and theoretic papers are discussed, form Morris and Ruskin's work, over Boito's "Prima carta del restauro" (1883) to Krakow Charter 2000.
Following the historic part some technical aspects of preservation are discussed, i.e. surveying methods and techniques, non-destructive and destructive building archaeological methods etc. The brief introduction to building archaeology helps to understand the importance of theoretic reconstruction of independent building phases of the historic monument. The detailed discussion of the topic is part of the Preservation of historic buildings 2 – Building archaeology elective subject.
The third part is dealing with architectural and design-methodological questions of preservation. Especially the architectural problems of presentation of archaeological heritage, the reuse and functional problems of industrial and vernacular buildings for modern purposes. (2 credits)

History of Achitecture 6 *

BMEEPETO601

The course gives an overview of the architecture in the 20-21st centuries. The classes follow chronology with focusing on the works of some great architects: Modernism and Modern Movement. Architecture between the two world wars – De Stijl, Bauhaus, Russian Constructivism, Less is more – Architecture of Ludwig Mies van der Rohe, Toward a New Architecture – Architecture of Le Corbusier. The Nordic Classicist Tradition – Architecture of E. G. Asplund and S. Lewerentz. Alvar Aalto and the modern Finnish architecture. In the second part the course picks up some relevant architectural trends: New Empiricism, New Humanism, New Brutalism and the Team X, the way from large housing estates to architecture without architects. Unfolding post-modern architecture, participation and the Las Vegas strip, Colin Rowe's studio, Critical Regionalism. The third part concentrates on timely problems: new materials or the multi-sensorial experience of space and surface, Rem Koolhaas's Dirty Realism, new technology and digital perception, architecture of seduction. (3 credits)

Drawing and Composition 6

BMEEPRAA601

The main topic in the syllabus in this semester is the intuitive representation of internal and external spaces: this subject aims at teaching students perspective representation at a higher level (applying 3-6 vanishing points). While drawing the streets and squares of the Buda Castle and the internal spaces of some atmospheric old public building sin Budapest (e.g. Saint Stephen Cathedral, Opera House, Hungarian National Museum) students investigate invisible geometrical and structural relations and improve their drawing skills (applying lead pencil, ink and crayon techniques). The objective is not to simply represent a naturalistic view as a camera, but to prepare a drawing of the architectural structure of a real space after grasping the gist of the compostion. (2 credits)

Department's Design 1 *

BMEEPUIT601

Department Design 1: A special urban design course conducted by the Department of Urban Planning and Design focusing mainly on urban public space design with the help of invited lecturers and landscape designer consultants.
The course is a partly theoretical and partly practical course where students get acquainted with special issues and problems of public space definition, public spaces usage and public space design. In the design assignment all students deal with one area, where starting from the analysis of a greater urban entity we narrow down the design problems to handling the publicly attainable spaces in between buildings. (3 credits)

Urban Design 2

BMEEPUIA601

Urban Design 2. is the main practical course of the Department of Urban Planning and Design.
The design task: After the analysis of a bigger urban environment, the task is to prepare an urban design concept for a bigger urban unit and later develop it into an urban scaled architectural design (development plan).
The site of the design task is the same settlement or urban environment for all students - this oncoming spring semester it is the riversides of the Danube all the way inside the city limits of Budapest - since the studio work is accompanied by common site visits, lectures and project presentations, where the possibility to learn from each other is also an important factor. (6 credits)

Special Load-Bearing Structures *

BMEEPSTT601

The subject introduces the special load-bearing structures, such as large span, tall and spatial structures. We introduce the trusses, box-beams, wall-beams and arches as large span structures. We show the static behavior of tall buildings: the concept of the vertical and horizontal load-bearing structures. The behavior of spatial structures is the main topic of the semester. We introduce the RC shells, the brick-shells, the cable and textile membranes, space-trusses, grid shells (4 credits)

History of Architecture Global* (basic)

BMEEPETO699

The complex exam (BMEEPETO699) is mandatory for students following the new education system. The complex exam comprehends the architecture of classical antique, the medieval, the Early Modern (renaissance and baroque)

and the 19th century periods.
The main purpose of the exam is to summarise main tendencies in history of architecture that determined the forming of the architectural space in different historic periods. Exam topics are based on the History of Architecture 1 - 5 courses, a list is available in the department
(credits)

Reinforced Concrete Structures I.**

BMEEPSTK601

The most important methods of analysis and design of reinforced concrete (RC) structures are presented, together with their modelling, and the applied approximations. RC beams, columns, slabs, foundations and complete structures are considered. The understanding of the behaviour of RC structures is emphasized. (6 credits)

Economics 2. (Macroeconomics)

BMEGT301924

The aim is to allow students to understand today's economic environment. After having finished the course, students should understand the key concepts of macroeconomics (e.g. national income, unemployment, inflation, budget balance, exchange rates and the balance of payments), master a basic set of tools of economic analysis and demonstrate the ability to apply them to simple practical problems.
(2 credits)

Construction Management 3 (Planning of Construction Technology)

BMEEPEKA701

The goal of the subject is to present information on the planning of elementary construction technologies related to superstructures and finishing work.
The subject introduces how to apply recent innovations of building technologies during design and realisation. It gives a basic knowledge to evaluate construction options and make appropriate decisions about technology. There are case studies of building technologies used in construction of loadbearing structures, finishing and cladding works.
The practical part contains workshops on planning of construction technologies: connection of structures and technologies, volume calculation, resource estimation, scheduling antd construction site planning. (4 credits)

Building Constructions 6

BMEEPEST702

This subject introduces the students to the precast reinforced concrete, steel and the timber load bearing construction systems of the big span halls and their special additional structures by a system- and performance-based approach. Details both of heavy elevation and roof slab structures made of prefabricated r.c. sandwich panels and lightweight external constructions are presented. Specific flooring, big size doors and partitions of industrial and commercial halls are shown.
It is also an objective to present the special construction rules and the service system aspects of the buildings of lightweight system and their particularities in the terms of building physics and fire protection.
Additional information is presented about multilevel precast r.c. skeleton frames, its typical technical details and the structural solutions of mass produced blocked and panel load bearing systems in case of residential buildings.
The main object of the course is to explain the constructions of one storey high big span halls. Students practice knowledge transmitted during the presentations and workshops in their semester projects on basis of the whole complexity of previous studies. (4 credits)

History of Art 1 *

BMEEPETT721

Beginnings of the art: the pictures of the cavemen. – Ancient art of the East: Egypt. – Classical art of the Antiquity: Greek and Roman art. – Early Christian and Medieval art. – Renaissance and Baroque art. – The art at the age of Enlightenment: Gothic revival, Classical revival, Classicism. – Romanticism, Realism, Impressionism, Postimpressionism. (2 credits)

Drawing 7 *

BMEEPRAO702

Lecturing and practising the architecture oriented use of colours. Introduction to the theory of colours. Effect of colours on human beings. Investigation of relation between architectural forms and colours. Principles of colour design of the built environment. (2 credits)

Department's Design 2 *

BMEEPRAT701

This subject based on interior design. The design process focuses on abstract formal approach. Students create different 3D possibilities in the first half of the semester, then they analyse them. The project becomes in this way interior design. The design project based on the fundamental decisions and 3D modelling, which are completed by manual works. (3 credits)

Department's design 3. *

BMEPExxT711

Department Design 3 for students is a one semester design course in English, organized by the Departments of Design in. The object of the course is to introduce a multilevel design method for students from general urban concept to the design of an architectural element. A comprehensive urban-architectural design based on the analysis of the urban tissue, cultural heritage, architectural details is going to give a common frame for individual architectural proposals. Teamwork and individual work will constantly implement and define each other. The semester will also give space to work on some contemporary questions in architecture, like the sustainability of an established urban environment, the relationship and social aspects of public and private spaces, the effects of landscape design and design of public spaces buildings. (8 credits)

Soil Mechanics **

BMEEOGTK701

Dr. Géza Petrasovics, Dr. József Farkas
Fundamentals of soil mechanics, including information indispensable to architectural practice such as the interaction between subsoil and building, the importance of testing the subsoil, foundation costs, essential soil properties, soil explorationmethods, the design of spread foundations, drainage (3 credits)

Building and Architectural Economics

BMEEPEKA801

Aim: investigate the economic side of a real estate development emphasizing the Social cost and benefit of development.

This module concentrates economical computation models, theories dealing with real estate valuation. There is a homework concerning with calculation, valuation of a real estate development. Successful submission is required for the module acceptance. Written exam as indicated, minimum pass grade required. Two corrections are allowed.
Following main topics are discussed: construction cost, estimates, time value of money, building life cycle cost , measuring the worth of real estate investments. (2 credits)

Facility Management *

BMEEPEK0633

The goal of the subject is to present theory of Facility Management, introduction of Cost Efficiency concepts. Based on case studies and several site visits on commercial properties, list of managerial tasks will be indentified and explained as registration, maintenance, crisis management and others. The course also will cover related subjects as Workspace Planning and CAFM (Computer Aided Facility Management). (2 credits)

History of Hungarian Achitecture 1. *

BMEEPETO801

The subject History of Architecture in Hungary I. aims to present and analyze the architecture of historic Hungary in European and domestic context from the history of Pannonia to the end of Baroque. The principle of the presentation is the chronological interdependence, however, particular attention is given to the main trends within the different periods as the main stylistic tendencies or external and internal factors that determine the historical and architectural context. A great emphasis is given to the exploration of the connections between the European and Hungarian history of architecture.
Lecture topics include: The beginnings of architecture in the Carpathian Basin. Roman architecture in Hungary. Early medieval architecture in Hungary - Christian Architecture between West and East. The flourishing Romanesque and the beginnings of Gothic Architecture. The rise of Gothic Architecture - architecture in towns and Gothic architecture of the orders. The beginning and the first period of the renaissance till the middle of th 16th century. The architecture of fortified palaces and fortifications. The renaissance architecture in Transylvania. The beginnings of the baroque in Western Hungary in the 17th century. The High Baroque in Hungary. (2 credits)

Drawing 8 *

BMEEPRAO801

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Urbanism *

BMEEPUI0805

The goal of the course is to get students acquainted with the multidisciplinary characteristics of Urban Design, Urban Planning and Urban Studies. The semester is divided into three 4 lecture long blocks dealing with: the issues of contemporary urbanity; related fields of science and planning tools in various field of the profession. In the series of lectures professors of the Department of Urban Planning and Design and some invited experts of various fields are presenting lectures on various topics. (2 credits)

Contemporary Architect Offices *

BMEEPIP0893

The aim of the course is representing Hungarian architect studios and giving useful information about working method of practising, creative teams. Lectures are performed by different practising architects, displaying their works by presentations or by visiting building projects. There is also a possibilty to make informal conversation with architects. The lectures are organized in auditoriums or at building sites. To obtain the final mark, each student has to write an own essay of a defined topic. (2 credits)

Residental Design and Contemporary Competitions*

BMEEPLA0897

Through the study of actual, current public commissions, this class provides a perspective on contemporary Hungarian residential building design praxis. Also, through past projects, it presents the main changes over recent years. The aim is to complement lectures in the Residential Building Design 1 course by acquainting students with as many concrete examples as possible – of contemporary Hungarian architectural creations and, primarily, of the bubbling, fertile, and often controversial world of public commissions. The highlighted standpoint and aim is for students to observe architectural praxis in today's Hungary, even if that is through more or less successful answers to questions that are posed. Another goal is for students to develop a routine of following public commissions, as well as an understanding of the procurement system, where to find such opportunities, and the rules and methodology regarding tenders. The hidden aim, by engaging with the given public tenders within the course, is to develop an active discourse among pupils on the basis of the evaluation and 'judgment' that follows. (2 credits)

Complex Design 1 *

BMEEPxxT811

Students must develop a plan to the level requested for permit or for a large-scale project, to the depth of an investment program plan. Part of the building must be developed to the construction plan level. Students must also prepare dossiers of structural calculation, work details, mechanical installations and the organisation of the construction site and consult with staff members of various departments for assistance. Students can select their project as well as their Studio Master. (10 credits)

Construction Management 4. ** (Controlling of Construction Technology)

BMEEPEKK801

Subject obligatory for BSc degree - The goal of the subject is to present information on the controlling process of the whole construction activity and the applied technologies involving the legal environment, the quality management, the quality survey, the work safety and the fire protection. Site and company visits are integrated in the theoretical lectures.
Main topics: Regulations concerning to the construction; Building permission/building consent; Quality in construcion, Fire protection; Dry construction systems; The work of the quality surveyor; Health and safety during building construction; Controlling activities in Construction Projects (4 credits)

Building Constructions 7 **

BMEEPESK801

The goal of the subject to introduce the building methods and the presentation of their validation possibilities. Today, the social, environmental and energy crisis in Central Europe as well is forcing to take into account the requirements of sustainability. The task of the subject the description of the sustainable construction methods, of the technical means, "gentle techniques" and presentation of specific structural systems having preserve and utilize of the existing values and environmentally conscious design and facility management of new buildings. The aim is to educate architects who are able to comprehensively, the ecological, social, value-defense, engineering, energy, economic, aesthetic considerations are also taken into account and finding and accepting reasonable compromise, adopting individual decisions. (4 credits)

Construction Law *

BMEEPEKO901*

The subject introduces the legal environment of construction projects: contracts, building permit, permission of use, etc. (2 credits)

Construction Law **

BMEEPEKB801 **

The subject introduces the legal environment of construction projects: contracts, building permit, permission of use, etc. (2 credits)

Design of Reinforced Concrete structures*

BMEEPST0655

The subject introduces students into the way of design of approximate dimensions, joints and structural solutions of reinforced concrete structures. Invited lecturers expose some of the most significant recent investments in reinforced concrete in Hungary. The aim of the course is to develop the ability of students - on the basis of EUROCODE 2 - to adopt architectural dimensions and to evaluate the effect of the chosen architectural lay-out onto the structural solution. (2 credits)

Drawing 9 *

BMEEPRAT901

The course provides a wide selection of representation techniques from traditional pencil drawing to collage, and from architectural geometry to computer aided visual rendering. The offered courses cover variable areas of basic architectural graphics, from which students have the opportunity to choose. (2 credits)

Architectural Interiors*

BMEEPKO0905

The primary object of the Interior Architecture course is to examine the range of theories behind development of this spatial type, undertaken in the form of a lecture course and practical exams. Students will also be involved in a closed competition held in parallel with students on the Hungarian course. The lecture course is to be broken down into individual study areas which are to be introduced by visiting academics, architects and interior designers over a course of 12 - 13 weeks as follows:
- General concept of space.
- General concept of architectural space.
- Sacred / Communal / Personal space.
- Use of space / Conversion of space.
- Visual communication.
- Light / Sound / Surface.
- Application of subject / Form of subject.
- Design of University Spaces.

Successful candidates in the semester will be expected to attend lectures on a regular basis, complete written exams, practical tests and submit a valid entry to the closed competition. (2 credits)

The Form in Architecture *

BMEEPRA0404

The course introduces the basic theory of form to students of Architecture and Industrial Design. It gives a brief summary of the general concept of form and its bounding surfaces, while it classifies the main components of forms and their possible connections and relations to other forms. The course describes the detailed articulation of forms: textures, decorations and ornaments, extensions, perforations and coloration. During the semester, students will be assigned individual projects, each based on the thematic classification of forms. In these projects, students will demonstrate the implementation of the acquired theory, through a digital collection of examples from different parts of the world and various periods of history. Submitted projects will be uploaded to the department's database, thus, this continually developing comprehensive 'encyclopedia of forms' shall enrich the knowledge of future students as well.
(2 credits)

History of Theory of Architecture 1.*

BMEEPET0407

The subject History of Theory of Architecture I. follows the structure of preliminary architectural history courses focusing on the determinant theories of architecture of different periods. The exploration of the most important tendencies and notions of theory of architecture is based on the preliminary history of architecture studies in an essentially chronological structure, evaluating them in critical analysis and searching their role in the history of ideas. Lecture topics include: Categories and concepts of theory in the history of architecture from antiquity to the raise of modernism in the beginning of the 20th century. Vitruvius and his interpretations. Architectural theory in the Middle Ages from early Christianity to late Gothic period. Humanism and the revival of antique architecture in the 15th. The column orders and commentaries on Vitruvius; the theory of the ideal city. Baroque in the reform of the catholic church. Academic movement in France and Classicism in Italy in the 17th . Theory of architecture in France in the 18th century. Enlight-

enment and revolutionary architecture. 19th century theories in England, France and Germany; the interpretation of medieval and classical heritage. The dilemma of eclecticism. Pioneers of modernism and their manifests. The pluralism in the interpretation of architectural space; architecture and philosophy. (2 credits)

Complex Design 2 *

BMEEPxxT911

Students must develop a plan to the level requested for permit or for a large-scale project, to the depth of an investment program plan. Part of the building must be developed to the construction plan level. Students must also prepare dossiers of structural calculation, work details, mechanical installations and the organisation of the construction site and consult with staff members of various departments for assistance. Students can select their project as well as their Studio Master. (10 credits)

Architecture Design *

BMEEPETO921

The course aims at awakening and strengthening the students' abilities, interest, to reflect on architectural design, in accordance with their own cultural background, in the original spirit of theorizing: thinking of, looking at, with freedom and criticism. Considering the special and unique position of this continuous reflective activity as an operative and constitutive part of the architectural design practice, the course not only picks up special themes of history and contemporary discourses, but also concentrates on mobilizing the students practical and theoretical skills, already acquired during their previous studies. (2 credits)

Contemporary Hungarian Architecture 2. *

BMEEPETO901

The course gives an overview of Hungarian architecture from the end of the 18th century up to now. While following the timeline, the classes concentrate on the main problems of the investigated periods, like the question of historicism, international and national sources between the 2 Wars, socialist realism in the 1950s, technology and high-rise in the 1960s, built environment in the 1970s, post-modernism in the 1980s. As the problem of identity (national or regional architecture) is a recurrent theme through the whole period, the course pays a special attention to it. (2 credits)

Faculty of Chemical Technology and Biotechnology

The education of chemical engineers and chemists has a long-standing tradition in Hungary. Hungary's earliest chemistry department was established in 1763 at the Selmecbánya Mining School, the first school to offer practical instruction in the chemical laboratory. In 1769, a common department for chemistry and botany was founded at the University of Nagyszombat, which was resettled to Buda in 1777 and later to Pest. In 1846, the Department of General and Technical Chemistry was founded at Joseph II Industrial School, one of the Budapest University of Technology and Economics's predecessor institutions. Education of chemical engineers, separate from that of mechanical and civil engineers, reaches back to the 1863/64 academic year.

Royal Joseph Polytechnic became a technical university in 1871. The academic freedom introduced by this university-level status allowed students to freely select the subjects they wished to study. However, the need for an interrelated, logical sequence of subjects soon became evident, so in 1892 a compulsory curriculum and timetable was introduced. From the foundation of the Faculty until 1948, only a four-year-term of studies, without specialisations, was offered. Following the educational reforms of 1948, the departments of Inorganic Chemical Technology, Organic Chemical Technology, and Agricultural and Food Chemistry were established. The Inorganic Chemical Technology Department is no longer a part of the Faculty because in 1952 its tasks were taken over by the University of Chemical Industry in Veszprém. Further reforms in the 1960s extended chemical engineering studies to the MSc level and introduced the range of specialised studies identified below. A PhD program has also been established. Studies in English at the Faculty of Chemical Engineering began in the 1985/86 academic year.

Students in the BSc program receive a thorough introduction to areas basic to chemical engineering before they begin their specialisations in the fifth semester. Courses of the following specializations are available to students depending on the number of applicants (at least 3 applicants) both at the BSc (7 semesters) and MSc (4 semesters) levels:

- Analytical and Structural Chemistry
- Chemical and Process Engineering
- Industrial Pharmaceutics
- Polymer Technology
- Textile Technology

The Faculty of Chemical Technology and Biotechnology aims for its students to acquire a profound theoretical knowledge in mathematics, physics and physical chemistry. It also aims to have its students experience, during their studies, all the types of tasks that chemical engineers encounter in their practical everyday work. Students will acquire up-to-date laboratory skills, get acquainted with the machines and apparati used in the chemical industry, know the principles needed for their optimal operation, and develop expertise in a more specific technology within the chemical, food and light industries. Graduates of this Faculty will be versed in:

- The operations and personnel involved in chemical processes on an industrial scale,
- The development of the technology and products of industrial chemical processes,
- The design of industrial chemical processes,
- How a chemical product or application is introduced into the national economy, and
- The elaboration of new chemical processes, operations and technologies.

In a limited number a three-year PhD program is also available. Acceptance letter signed by a senior researcher or professor of the Faculty is an essential prerequisite of the application for PhD position.

Departments

Department of Inorganic and Analytical Chemistry
Department of Physical Chemistry and Materials Science
Department of Organic Chemistry and Technology
Department of Chemical and Environmental Process Engineering
Department of Applied Biotechnology and Food Science

Budapest University of Technology and Economics
Faculty of Chemical Technology and Biotechnology
Faculty Office:
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Mailing Address: Műegyetem rkp. 7-9.
H-1111 Budapest, Hungary
Phone: (+36-1) 463-4618
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Dean of the Faculty: Dr. Ferenc Faigl
Course Director: Dr. Zoltán Hell
Program Coordinator: Mrs Kinga Vass

Curriculum of BSc Subjects
General Subjects

Subject			lectures/practical lectures/laboratory							
Name	Code	Credits	1	2	3	4	5	6	7	Requisities
Compulsory English I.	BMEGT63A301	2	0/4/0p							
Compulsory English II.	BMEGT63A302	2		0/4/0p						
English for Engineers	BMEGT63A051	2			0/2/0p					
Communication Skills - English OR	BMEGT63A061	2				0/2/0p				
Manager Communication - English OR	BMEGT63A071	2				0/2/0p				
Intercultural Comm. - English	BMEGT63A091	2				0/2/0p				
Mathematics A1a - Calculus	BMETE90AX00	6	4/2/0e							
General Chemistry	BMEVESAA101	5	4/0/0e							
General Chemistry Calculations	BMEVESAA104	4	0/3/0p							
General Chemistry Laboratory Practice	BMEVESAA209	5		0/0/6p						BMEVESAA101, BMEVESAA104, BMEVESZA101
Computing	BMEVESAA103	2	0/2/0p							
Chemical Eng. Fundamentals	BMEGEVGAV03	2			2/0/0e					
Chemical Engineering Practice	BMEGEVGAV04	3			0/1/2p					
Macro- and Microeconomics	BMEGT30A001	4	4/0/0e							
Mathematics A2c	BMETE90AX17	6		4/2/0e						BMETE90AX00
Mathematics A3 for Chemical Engineers and Bioengineers	BMETE90AX18	4			2/2/0e					
Physics 1 - Mechanics	BMETE14AX15	4	2/2/0e							
Inorganic Chemistry	BMEVESAA208	3		3/0/0p						BMEVESAA101, BMEVESAA104
Inorganic Chemistry Laboratory Practice	BMEVESAA301	3			0/0/4p					BMEVESAA101, BMEVESAA104
Organic Chemistry I.	BMEVESZA301	5			3/2/0e					BMEVESAA101
Chemical Technology	BMEVEKFA203	3		2/0/0p						BMEVESAA101
Physics 1 Electrodynamics	BMETE14AX04	2		2/0/0e						BMETE14AX15
Physics Laboratory	BMETE14AX05	2		0/0/3p						BMETE14AX15
Organic Chemistry II.	BMEVESZA401	4				3/0/0e				BMEVESZA301
Analytical Chemistry	BMEVESAA302	5			4/0/0p					BMEVESAA101, BMEVESAA104
Physical Chemistry I	BMEVEFKA304	5		3/1/0e						BMEVESAA101, BMETE90AX17
Polymers	BMEVEFAA306	5			2/0/2p					BMEVESAA101
Organic Synthesis Laboratory Practice	BMEVESZA402	4				0/0/5p				BMEVESAA104, BMEVESAA209, BMEVESZA301
Analytical Chemistry Laboratory Practice	BMEVESAA403	4				1/0/4p				BMEVESAA209, BMEVESAA302
Physical Chemistry II	BMEVEFAA405	4			2/1/0e					BMEVEFKA304
Medicines	BMEVESZA403	3				2/0/0e				
Colloid chemical approach to nanotechnology	BMEVEFAA409	3				3/0/0p				BMEVEFKA304
Environmental Chemistry and Technology	BMEVEKFA403	4						3/0/0e		BMEVESAA208, BMEVESZA401, BMEVEKFA203
Organic Chemical Technology	BMEVESTA411	3				2/0/0e				BMEVESZA301
Organic Chemical Technology Practice	BMEVESZA412	3				0/0/4p				BMEVESZA301, BMEGEVGAV03
Chemical Unit Operations I	BMEVEKFA410	6				3/2/0p				BMEGEVGAV03, BMETE90AX17
Business Law	BMEGT55A001	2					2/0/0p			
Design of Experiments	BMEVEVMA606	3					2/1/0p			BMETE90AX18
Hydrocarbon Processing	BMEVEKFA506	3					2/0/1e			BMEVEKFA203, BMEVEFKA304, BMEVESZA401
Biochemistry	BMEVEBEA301	4					3/0/0e			BMEVESZA401
Physical Chemistry Lab. Prac.	BMEVEFAA506	3					0/0/4p			BMEVEFAA405, BMETE14AX05
Chemical Process Control	BMEVEVMA504	5						2/1/1p		BMEVEKFA410
Chemical Unit Operations II	BMEVEKFA512	6					2/1/4e			BMEVEKFA410
Managem. and Business Econ.	BMEGT20A001	4						4/0/0p		
Safety Technology in the Chemical Industry	BMEVESZA101	2	2/0/0p							
Quality Management	BMEVEKFA615	4							3/0/0p	
Chemical Unit Op. Practice	BMEVEKFA613	3						0/0/4p		BMEVEKFA512
Electives (humanities)	2 subjects	4								
Specialization		26								
Thesis	BMEVE..A999	15							0/0/14p	
Summer Practice	BMEVE..A888	0								6 weeks/s
Electives		10								
BSc total:		210								

Curriculum of BSc Subjects of Specialization

Subject			working hours / week			
Name	Code	Cre-dits	5	6	7	Requisities
Analytical and Structural Chemistry Specialization						
Analytical and Structure Determination Laboratory	BMEVESAA604	5		1/0/4p		BMEVESAA512, BMEVESAA403
Elemental Analysis	BMEVESAA701	3			2/0/0p	BMEVESAA403
Chemical and Biosensors	BMEVEAAA708	3	2/0/0e			BMEVESAA403
Chromatography	BMEVEAAA611	3	2/0/0e			BMEVESAA403
Elucidation of Organic Structures	BMEVESAA512	3	3/0/0p			BMEVESZA401
Theory of Testing Methods in Material Sciences	BMEVEFAA708	4			3/0/0e	BMEVESZA301, BMETE14AX15, BMETE90AX17
Organic Chemistry III	BMEVESKA504	2		2/0/0e		BMEVESZA401
Project Work	BMEVESAA777	3			0/1/0p	
Chemical and Process Engineering Specialization						
Hydrocarbon Technology and Catalysis	BMEVEKFA503	5		2/0/3p		BMEVESZA401, BMEVEKFA203, BMEVEKFA410
Process Engineering	BMEVEVMA605	5		3/0/2e		BMEVEKFA512
Environmental Benign Chemical Processes	BMEVEVMA607	4		3/0/0e		
Computer Process Control	BMEVEKFA709	3			2/0/1e	BMEVEVMA504
Chemical Production Control	BMEVEKTA707	3			2/0/1p	BMEVEKFA203, BMEVEKFA512
Radiochemistry and Nuclear Energetics	BMEVEKFA502	3	2/0/1p			BMEVESAA101
Project work	BMEVEKFA777	3			0/1/0p	
Industral Pharmaceutics Specialization		**26**				
Elucidation of Organic Structures	BMEVESAA512	3	3/0/0p			BMEVESZA401
Organic Chemistry III	BMEVESKA504	2		2/0/0e		BMEVESZA401
Organic Chemistry Laboratory Practice II	BMEVESKA605	5	0/0/6p			BMEVESZA401, BMEVESZA402
Pharmaceutical Technology I.	BMEVESTA704	2			2/0/0e	BMEVESTA606
Unit processes in Industrial Drug Synthesis Laboratory Practice	BMEVESTA705	4			0/0/5p	
Unit processes in Industrial Drug Synthesis	BMEVESTA606	2		2/0/0e		
Technology of Pharmaceutical Materials	BMEVESTA607	3		2/0/1e		BMEVESTA411
Unit Processes of Organic Chemistry	BMEVESTA508	2	2/0/0e			BMEVESTA411
Project work	BMEVESZA777	3			0/1/0p	
Polymer Technology Specialization		**26**				
Theory of Testing Methods in Material Sciences	BMEVEFAA708	4	3/0/0p			BMEVESAA208
Machines and Tools for Polymer Processing	BMEVEFAA705	4			2/0/1e	BMEVEMGA608
Polymer Processing	BMEVEMGA608	7		4/0/5e		BMEVEMGA511
Polymer Physics Laboratory Practice	BMEVEMGA509	3	0/0/4p			BMEVEFAA306
Polymer Additives	BMEVEMGA610	2		2/0/0e		BMEVEFAA306
Polymer Physics	BMEVEMGA511	3	2/0/0e			BMEVEFAA306
Project work	BMEVEFAA777	3			0/1/0p	
Textile Technology Specialization		**26**				
Theory of Testing Methods in Material Sciences	BMEVEFAA708	4	3/0/0p			BMEVESAA208
Fibre Forming Polymers	BMEVEMGA512	2	2/0/0p			BMEVESZA401
Chemistry of Dyes and Surfactants	BMEVESTA510	2	2/0/0p			BMEVESZA401
Colorimetry, Colormeasurement	BMEVEMGA515	2	2/0/0p			
Chemical Technology of Textiles I.	BMEVEMGA617	7		3/0/4e		BMEVEMGA512
Chemical Technology of Textiles II.	BMEVEFAA718	4			2/0/2p	BMEVEMGA617
Mechanical Technologies of Textiles	BMEGEPTAKV1	2		2/0/0p		
Project work	BMEVEFAA777	3			0/1/0p	

Curriculum of MSc Subjects

Subject			hours/week				
Name	**Code**	**Credits**	**1**	**2**	**3**	**4**	**Remarks**
General Subjects							
Mathematics M1C - Differential Equations	BMETE90MX44	3	2/1/0e				
Complex and Organometallic Chemistry	BMEVESAM101	2	2/0/0p				NOT in Pharm and Tex spec.
Organic Chemistry	BMEVESZM101	4	3/0/0e				NOT in Tex spec.
Materials Science:Traditional Structural Materials and Polymers	BMEVEAM110	4	2/0/1e				NOT in Pharm spec.
Structural Chemistry	BMEVEFAM204	4	3/0/0e				ONLY in Pharm spec.
Chemical Process Design and Control	BMEVEKFM101	4	2/0/2p				NOT in Tex spec.
Economic Analyses of Technology	BMEGT30MS07	2	2/0/0e		2/0/0e*		* in Anal spec.
Project Work I	BMEVE..M100	3	0/0/4p				NOT in Poly spec.
Theory of Analytical Testing Methods in Material Science	BMEVESAM202	4		2/0/2p			NOT in Pharm spec.
Design of Experiments 2	BMEVEKFM209	3		2/0/0p			
Modern Physics for Chemical Engineers	BMETE14MX00	3			3/0/0e		NOT in Tex spec.
Physical Chemistry and Structural Chemistry	BMEVEFAM201	5		5/0/0e			NOT in Pharm and Tex spec.
Technologies in Organic Chemical Industry	BMEVESZM201	5		2/0/2p			NOT in Pharm and Tex spec.
Environmentally Friendly Chemistry and Technology	BMEVESZM202	5		2/0/2p			ONLY in Pharm spec.
Environmentally Benign and Catalytic Processes	BMEVEKFM210	5		3/0/1e		3/0/1e*	NOT in Pharm and Tex spec.; *in Anal and Poly spec.
Project Work II	BMEVE..M200	3		0/0/4p			NOT in Poly spec.
Biology, Biotechnology	BMEVEMBM301	3			2/0/0p		
Computational Chemistry	BMEVESAM301	3			2/0/1p		
Social and Visual Communication	BMEGT43MS07	2	2/0/0p*		2/0/0p		* in Anal spec.
Thesis Project I	BMEVE..M300	15			0/0/11p		
Summer practice	BMEVE..M888				4 weeks/s		
Elective subjects		6					
Thesis Project II	BMEVE..M400	15				0/0/11p	
Specialization subjects							depends on the sepcialization
MSc total		*120*					
Chemical and Process Engineering (CPE) Specialization							
Process Engineering	BMEVEKFM211	4		1/0/4p			
Conventional and New Technologies of Energy Production	BMEVEKFM302	4			2/0/1p		
Modern Separation Technologies	BMEVEKFM104	3	2/0/1p				
Unit Processes of Organic Chemistry	BMEVESZM207	3				0/2/0p	
Petrochemistry	BMEVEKFM402	6				2/0/3e	
Technology Management	BMEGT20M005	2				2/0/0p	
Chemical Production Control	BMEVEKFM303	2			2/0/0e		
Quality Controll	BMEVESAM206	2				2/0/0p	
Analytical and Structural Chemistry (Anal) Specialization							
Analytical Chemistry III	BMEVESAM201	5		1/0/4p			
Sample Preparation and Sampling	BMEVESAM204	3	2/0/0p				
Structure Elucidation of Organic Substances II	BMEVESAM303	5			3/1/0e		
Modern Methods in Analytical Separation	BMEVESAM203	4		2/0/1e			
Bioanalytics and Metabolite Research	BMEVESAM304	3			2/0/0e		
Technology Management	BMEGT20M005	2				2/0/0e	
Intellectual Propety Management	BMEVEFAM103	2	2/0/0e				
Quality Controll	BMEVESAM206	2				2/0/0p	
Industrial Pharmaceutics Specialization							
Pesticide Chemistry	BMEVESZM203	3			2/0/0e		
Pharmaceutical Technology II	BMEVESZM303	5			2/1/0e		
Formulation of Biologically Active Materials	BMEVESZM105	4	2/0/1e				
Industrial Organic Chemistry	BMEVESZM106	4	2/0/0p				
Pharmaceutical Chemistry	BMEVESZM406	6				2/2/0e	
Computer Assisted Drug Discovery	BMEVESZM407	2				0/2/0p	
Technology Management	BMEGT20M005	2		2/0/0p			
Protecting Industrial Laws	BMEVESZM401	2		2/0/0p			
Quality Assurance in the Manufacture of Active Pharmaceutical Ingredients	BMEVESZM402	2		2/0/0p			
Innovation in the Pharmaceutical Industry	BMEVESZM205	2		2/0/0e			
Modern Synthetic Methods	BMEVESZM301	3				2/0/0e	

Subject			hours/week				
Name	Code	Credits	1	2	3	4	Remarks
Polymer Technology (Poly) Specialization							
Application of Plastics	BMEVEFAM403	5				3/0/1e	
Machines and Technologies in Polymer Processing	BMEVEFAM305	5			3/0/1p		
Polymer Physics	BMEVEFAM202	4		3/0/0e			
Polyreactions Chemistry	BMEVEFAM102	3	2/0/0p				
Plastics and Composites	BMEVEFAM301	3			2/0/0e		
Intellectual Propety Management	BMEVEFAM103	2	2/0/0e				
Quality Controll	BMEVESAM206	2				2/0/0p	
Technology Management	BMEGT20M005	2				2/0/0e	
Textile Technology (Tex) Specialization							
Polyreactions Chemistry	BMEVEFAM102	3	2/0/0p				
Project Work III	BMEVEFAM310	5			0/0/4p		
New Application and Technologies of Fibres	BMEVEFAM207	7	3/0/2p				
Basic Processes in Textile Chemical Technology	BMEVEFAM401	5				3/0/1p	
Economics in the Plastics Industry	BMEVEFAM205	4		3/0/0e			
Intellectual Propety Management	BMEVEFAM103	2	2/0/0e				
Theoretical basics of polymer physics	BMEVESAM208	4		3/0/0e			
Technology Management	BMEGT20M005	2				2/0/0e	
Biopolymers	BMEVEFAM212	4		2/0/1e			
Gels	BMEVEFAM308	2			2/0/0e		
Blends and composites	BMEVEFAM307	3			2/0/0e		
Phyiscal Chemistry	BMEVEFAM206	4		2/0/1e			
Physical chemistry of interfacial phenomenas	BMEVEFAM306	3		2/0/02			
Applied questions in the quality systems	BMEVEFAM406	2				0/0/2p	
Quality systems and quality assurance	BMEVEFAM405	3				3/3/0e	

ENVIRONMENTAL ENGINEERING

A MSc degree granted by the Budapest University of Technology and Economics.
The program will not start in the 2015-16 academic year.

One of the biggest and most reputed institutions of this kind in Europe, the Budapest University of Technology and Economics has educated generations of engineers since its foundation in 1782.

Its eight faculties of different engineering disciplines, sciences, economics and humanities actively participate in environmental education granting among others postgraduate degrees from 1974 onwards.

The aim of the course is to provide:

- Knowledge to identify and describe negative environmental and ecological changes and provide technological solution for the remediation
- Give solutions to manage natural resources and prevent pollution to help sustainable industrial and social development.

The Budapest University of Technology and Economics disposes of highly developed training facilities: laboratories, pilot plants, computer network and a wide system of international relations. During the (at least) 4 semesters of the education period, actually an MSc degree is to be granted in the specialisation branch of Environmental technology with special focus on applied environmental science and technology aspects.

The curricula are conceived carefully to meet the needs and challenges of the actual career opportunities in both developed and developing countries.

The curriculum (see tables) is of modular structure consisting of the following modules:

- science; economics and humanities 30%
- specialised core subjects 59%
- differentiated professional knowledge 11%

The program is organised in the credit system providing a relatively high degree of free subject selection. The condition of obtaining an MSc degree is the fulfilment of the total of 120 credit points including:

- comprehensive final exams and
- defence of an individual MSc thesis

Curriculum of MSc Subjects

Subject			hours/week			
Name	Code	Credits	1	2	3	4
Probability Theory and Statistics M1		4	2/2/0			
Physics K3M		4	3/0/0			
Applied Chemistry		4	2/2/0			
Environmental Microbiology and Biotechnology		3	2/0/0			
Engineering Ecology		3	2/0/0			
Economics		2	2/0/0			
Environmental Law		2	2/0/0			
Communication		2	2/0/0			
Risk Assessment, Recovery of Industrial and Environm. Disasters		3	2/0/0			
Transport Equations M11		4		3/1/0		
Technology Management		2		2/0/0		
Environmental Management		2		2/0/0		
Environmental Analytical Chemistry		3		2/0/1		
Design of Experiment		3		2/1/0		
Green Chemistry and Catalysis		3		2/0/0		
Biochemical Engineering Processes and Unit Operations		3		2/0/2		
Sustainable Environmental and Natural Resource Management		3		2/0/0		
Numerical Modelling of Fluid Flow in Environmental Technology		3		1/1/0		
Case Studies in Environmental Impact Assessment and Auditing		3			1/1/0	
Modelling of Environmental Systems		3			2/1/0	
Modern Environment-friendly Transportation Systems					2/0/0	
Environmental Toxicology		3			2/0/1	
Compulsory optional subjects		6			6/0/0	
Thesis Project		25				0/0/25

Curriculum of MSc Branch Subjects

Subject		
Name	Code	Credits
Branch of Environmental Management		
Local Sustainability Programs		3
Environmental Marketing		3
Waste Management		3
Environment Management Systems		3
Environmental Performance Evaluation		3
Environmental Strategic Planning		3
Environmental Valuation and Risk Assessment		3
Spatial Development		3
Branch of Environmental Technology		
Basics of Control Engineering		3
Sustainable Environmental Processes		3
Renewable Energy Sources		3
Environmental Process Instrumentation and Control		3
Surface water and Groundwater Monitoring		3
Technical Acoustic and Noise Control		3
Waste Management Techniques		3
Case Studies in Air Pollution Control		3

Description of BSc Courses

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 credits)

General Chemistry

BMEVESAA101

The subject of chemistry. Material, the structure of the material, mixtures, energy and mass conservation. Atoms, molecules, elements compounds, ions, mol. Chemical formula, stoichiometry, concentration and its measurement. Chemical reactions and their types. Redox reactions, oxidation number acid-base reactions, acid-base theories, pH. Characterisation of the gaseous state, gas laws. The liquid and the solid states. Phase transitions and their characterisation by phase diagramms. Crystallization, sublimation and distillation. Thermochemistry. Chemical equlibria. The Le Chatellier principle. Homogenous and heterogenous mixtures. Specific chemical equlibria, pH equlibria, solubility product constant. Basics of electrochemistry. Electrolysis, Faraday's law. Electrode potential, redox electrodes, metal electrodes, gas electrodes. Ionic conductivity. Galvanic cell and redox equilibria. Chemical kinetics, reaction rate, rate constant, activation barrier, Arrhenius' law. Thermodynamics and kinetics for a reaction. Basics of colloids, definitions.
Atoms electrons, atomic structure. Atomic orbitals, the hydrogen atom. Multielectron atoms, the Aufbau principle. The periodic table of the elements. The chemical bond in H_2. Covalent, ionic and dative bonds. Diatomic molecules the sigma and the pi-bond. Delocalization. Hybridization and molecular structure. VSEPR theory. Metals. Molecular movements, rotation, vibration. (5 credits)

General Chemistry Calculations

BMEVESAA104

Expression for the composition of solutions and their applications. Operations with solutions, crystallization, recrystallization. Gases. Properties of gases. Equation of state for ideal gas, and its versions. Boyle's law, Charles' laws. Gay-Lussac' law. Mixtures of gases, compositions. Partial pressure, and volume. Dalton's rule and Amagat's rule. Vapor pressure. Colligative properties of dilute solutions. Vapor pressure lowering, boiling-point elevation, and freezing-point depression, osmosis. Balancing equations. Oxidation numbers, redox equations. Stoichiometry and its applications. Yield. Avogadro's law. Calculation of titration.
Basic terms in thermochemistry. Energy, heat and enthalpy. Heat capacity, molar heat capacity. The heat of reactions and Hess's law. General description of chemical equilibria. Various forms of equilibrium constants and their connections. Application of LeChatelier's principle. The shift in the equilibrium composition by the change in the amount of reactants, in the pressure, and in the temperature. Heterogeneous equilibria. Acid-base equilibria, pH of solutions; Electrochemisty; (4 credits)

General Chemistry Laboratory Practice

BMEVESA209

Preparation: crystallisation, distillation, sublimation, preparation of precipitated compounds, solution of metals, preparation of complex compounds, electrochemical preparation; Measurements: determination of density by various methods, determination of boiling point, melting point, molecular weight (Meier-Victor method, decreasing of melting point), and pH (colorimetric method) (5 credits)

Computing

BMEVESAA103

EXCEL: working with spreadsheets (name of a cell, reference to a cell, type of data, moving data, calculation with cells, application of functions, representation of data, curve fitting to data: "trendline", Solver). VISUAL BASIC: basics of programming, concept of variable, type of variables, range of variables (local, module, global, static), determination of the value of a variable, flow chart, input and output of data, cycles (For – Next, For Each – Next, Do – Loop), the "if – then" construction, arrays, matrices, records, application of subroutines and functions, recording and rewriting macros. (2 credits)

Chemical Eng. Fundamentals

BMEGEVGAV03

Statics of rigid and elastic bodies. Materials of mechanical structures. Machine elements: fasteners, seals, vessels, pipes and pipe accessories, bearings, couplings, chain, belt, V-belt drive. Fluid mechanics. System approach. Basic law of fluid flow in pipes. Boundary layers. Compressible flow. Non-Newtonian fluids. Operation, performance and selection of pumps, compressors and vacuum pumps. Handling and transportation of solids in bulk. Characteristics of solids. Fluidization. Storage in silos. Pneumatic conveying. Belt and screw conveyors and bucket elevators. (2 credits)

Chemical Engineering Practice

BMEGEVGAV04

All drawings are made only on the practice hours and are made with free hand used the half ready worksheets. Fundamental rules of technical drawing. Arrangement of views by the European projection system. Sections. Threaded parts. Drawing of welded joints. Fits and tolerances. Reading and detailing training of assembly drawings by free hand sketches. Laboratory exercises: measurement of revolution per minute, measurement of pressure, of flow rate and velocity. Fan measurement. Friction losses in pipes and pipe fittings. Sieve analysis. (3 credits)

Macro- and Microeconomics

BMEGT30A001

Introduction to macroeconomics. Output and aggregata demand. Fiscal policy and foregn trade. Money and banking. Interest rates and monetray transmission. Monetray 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. Per-

fect competition and pure monopoly. Market structure and imperfect competition. The labor market. Factor markets and income distribution. (4 credits)

Mathematics A2c

BMETE90AX17

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 credits)

Mathematics A3 for Chemical Engineers and Bioengineers

BMETE90AX18

Outcomes, events, and probability, conditional probability and independence, discret and continuous random variables, distribution function, density function, expected values and variance, binomial, geometric, poisson, uniform, exponential, normal distribution, joint distributions, and independence, covariance and correlation, the law of large numbers, central limit theorem, exploraory data analysis, graphical and numerical summaries, estimators, unbiased estimators, the linear regression model, confidence intervals, testing hypotheses (4 credits)

Physics 1 - Mechanics

BMETE14AX15

Introduction. Models, theories and laws. Units, standards, SI system. Reference frames. Coordinate systems. Vectors and scalars. Kinematics: speed, displacement, average velocity, instantaneous velocity, acceleration. Uniform motion, uniformly accelerated motion, falling bodies projectile motion. Circular motions. Dynamics: interactions, force, Newton's laws of motion, mass. Applications of Newton's laws. Gravitation and Newton's synthesis. Weight and weightlessness. Kepler's laws. Work and energy. Work-energy theorem. Translational energy. Conservative forces. Potential energy. Mechanical energy and its conservation. Non-conservative forces. Law of energy conservation. Linear momentum and its relation to force. Conservation of the linear momentum. Many bodies problem. Center of mass. Conservation of momentum and the energy in collisions. Oscillations. Simple harmonic motion. Damped harmonic motion. Forced vibrations. Resonance. Simple pendulum. Rotational motion. Angular quantities. Moment of the force: torque. Angular momentum. Conservation of angular momentum. Rotational dynamics. Rigid bodies. Angular momentum and torque for a rigid body. Moment of inertia. Elasticity and elastic moduli. Stress and strain. Fluids at rest. Pressure. Pascal's principle. Fluids in gravitational field. Archimedes' principle. Characteristics of flow. Flow rate and equations of continuity. Laminar flow. Bernoulli's equation. Viscosity. Turbulent flow. Drag force. Dynamical lift. (4 credits)

Inorganic Chemistry

BMEVESAA208

General reactivity principles for the different elements and compounds. Reaction conditions with water, air, acids and bases. General principles in the synthesis of the different elements. Hydrogen, hydrides. The alkalies and their compounds. Alkaline earth metals. Group 13 elements. The carbon group and important compoundsof the heavier elements. The nitrogen group and important compounds. The oxygen group, oxides, sulfides. The halogens, halides. Noble gases. D-elements and their compounds. Early d elements. the chromium group. Manganese group, Iron, cobalt and nickel. The noble metals. The copper group. The zinc group. Lanthanides. (3 credits)

Inorganic Chemistry Laboratory Practice

BMEVESAA301

Reactions and properties of elements and their major compounds; Qualitative inorganic analysis: detecting the most important cations and anions: alkaline metals (Li^+, Na^+, K^+); alkaline earth metals (Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}); boron group (BO_3^{3-}, Al^{3+}); carbon group (CO_3^{2-}, HCO_3^-, SiO_3^{2-}, Sn^{2+}, Sn^{4+}, Pb^{2+}); nitrogen group (NH_4^+, NO_2^-, NO_3^-, PO_4^{3-}, As^{3+}, As^{5+}); oxygen group (OH^-, S^{2-}, SO_3^{2-}, SO_4^{2-}); halogens (F^-, Cl^-, Br^-, I^-); some transition metal ions (Cr^{3+}, Mn^{2+}, Fe^{2+}, Fe^{3+}, Ni^{2+}, Cu^{2+}, Zn^{2+}, Ag^+, Cd^{2+}, Hg^{2+}, Hg_2^{2+}); Analytical system of Fresenius and Bunsen, analysis of mixed cations, mixed anions, mixed compounds, and polluted compound (3 credits)

Organic Chemistry I.

BMEVESZA301

Structures of molecules; Stereochemistry, configuration, conformation; Theory of reactions, theories of acid and bases, HSAB and FMO theories; Theory of redox and radical reactions, chemistry of paraffins. Reactivity of olefines and acetylenes, electrophilic addition, oxidation and polymerization; Reactivity of monocyclic aromatic compounds, electrophilic substitution; The theory of substitution and elimination; The chemistry of halogen compounds, alcohols, phenols and ethers; The chemistry of nitro compounds and amines; Reduction and oxidation of alcohols, oxo compounds and carboxylic acid derivatives; Reactivity of oxo compounds, carboxylic acids and carboxylic acid derivatives; Oxo-enol tautomerism; Chemistry of carboxylic acids; Chemistry of carboxylic acid derivatives; (5 credits)

Chemical Technology

BMEVEKFA203

Technology, know-how, chemical technologies. Characteristics of chemical industry, chemical industry products. Inorganic chemical technologies; Chemical technology in metall production industries; Alkali electrolysis, chlorine. sodium-hydroxide and hydrogen production. Silicate industry; Microelectronic industry; Energy and energy production: resources and reserves. Water and its role in chemical technologies. The chemical technology of coal. Clean coal technologies. Fischer-Tropsch synthesis; Hydrocharbon chemistry and technologies, oil and gas. Fuels for transport vehicles; Crude oil refinery; Lubricating and cooling products from the oil industry. Laboratory practice: Water treatment ion exchaneg and membrane separation; Boiler efficiency, exhaust gas analysis; Hydrocarbon cheracteristics, viscosity and flash point determination; Engine exhaust gas analysis, catalytic conversion; Corrosion experiments; Catalytic reforming (dehydrogenization of cyclohexane); (3 credits)

Physics 1 Electrodynamics

BMETE14AX04

Maxwell equations: a qualitative introduction. Main chapters of Electrodynamics according to the Maxwell equations. Electrostatics. Coulomb's law. E the electric field strength and its measurement. D the electric induction and its measurement. Electric charge density. Local form of Gauss' law. Electric voltage and potential. Capacitors. Electric field and potential in conductors. Electric wind. The electric dipole and its potential field. Electric field and induction in dielectric materials. Polarization mechanisms. Piezo- and ferro-electricity. Magnetostatics. Para-, ferro- and diamagnetism. Stationary fields and direct current. Electric current and current density. Global and local forms of Ohm's law. Mechanisms of the electric conduction. Work and power of the electric current. Kirchhoff's current and voltage law. Batteries. Electromotive force. The magnetic field H of the electric current. The Oersted experiment and Ampére's law. Magnetic field of a solenoid and measurement of H by compensation. The force acting on a current and the torque acting on a current loop in a magnetic field. Measurement of the magnetic induction B. Moving point charge in a magnetic field. Forces between currents. Quasi-stationary fields and alternating currents. Faraday's law of electromagnetic induction. Eddy currents and Lenz' law. Self induction and mutual induction. Complex amplitude of the alternating current and voltage. AC circuits. Average power of AC. Rapidly changing electromagnetic fields and waves. Displacement current. Hertz' experiment. Summary of electrodynamics. (2 credits)

Physics Laboratory

BMETE14AX05

Introduction: Evaluation of measurement data; DC and AC circuits. Measurements, prctices: nonlinear curve fitting; mechanics: elastic force, periodic motions; DC circuit: control of electric current and voltage; geometrical optics: lenses, prism, refractory index; physical optics: diffraction, wave length, Brewster angle, polarization; AC circuit: resonance in series RLC circuit; semiconductor diodes; temperature measurement; logical circuits; dynamical systems (2 credits)

Organic Chemistry II.

BMEVESZA401

Derivatives of carbonic acid; Diazomethane, diazonium salts; Sulfur and phosphor-containing compounds; Unsaturated carboxylic acids, lipids; Substituted acids; α-, β-, γ-, and δ-halogen, hydroxy, and oxo acids and derivatives. Stereochemistry; Amino acids and proteins; Carbohydrates; Nucleic acids; Polycyclic aromatic compounds; Heterocycles; (4 credits)

Analytical Chemistry

BMEVESAA302

Fundamentals of chemical analysis: sampling and sample preparation, separation techniques, and error calculations. Evaluation of analytical data. Gravimetric methods of analysis. Titrimetric methods of analysis: precipitation, acid-base, complex formation, and oxidation-reduction titrations. Theory and applications of instrumental analytical methods: potentiometry, voltammetry, conductometry, thermal analysis, liquid and gas chromatography, flame photometry, atomic absorption spectrometry, ultraviolet and visible molecular spectroscopy, fluorometry, mass spectrometry, immunoassay methods. (5 credits)

Physical Chemistry I

BMEVEFKA304

Thermodynamics: Characterization of thermodynamic systems. Internal energy, the first law of thermodynamics. Enthalpy, thermochemistry. Ideal and real gases. Entropy, the second law of thermodynamics. Gibbs free energy and Helmoltz free energy. One component phase equilibria. Thermodynamics of solutions, the chemical potential. Two component liquid-vapor and solid-liquid equilibria, phase diagrams. Distribution equilibrium. Chemical equilibrium. (5 credits)

Polymers

BMEVEFAA306

Position and development of the plastics industry, role of plastics in economy. Definitions, classes of plastics, most important properties. Radical polymerization. Polycondensation, production of cross-linked polymers. A brief introduction to the plastics used the most often or in the larges quantities. Models of polymer physics. Polymer solutions. Phases and physical states. Behaviour of solid polymers, rubber elasticity. Uniaxial deformation, tensile testing, necking. Fracture, brittle and ductile failure. Relationship of molecular and macroscopic structure, characteristic temperatures, properties. Crystalline polymers. Melting, crystallization, polymorphism. Correlation between crystalline structure and properties. Structure of amorphous polymers. Polymer blends and composites, relationship between component properties and the characteristics of the composites. Physical states and processing modes. Processing in the melt and in the rubber elastic state. Machining. Application of plastics. Type and cause of degradation. Type of additives and their effect on polymer properties. Plastics and the environment. Plastics based on natural resources. Biodegradable polymers.

Laboratory practice: Demonstration of the most important processing technologies and quality control methods. (5 credits)

Organic Synthesis Laboratory Practice

BMEVESZA402

During this course the students learn the principles of experimental organic chemistry, the ways of safe handling and disposal of chemicals, the fast identification of the synthetized compounds and the organic chemistry literature searching. The students make themselves familiar with the function of the equipment used in the laboratory, the most important procedures to prepare, separate and purify organic compounds (crystallization, distillation both at atmospheric and reduced pressures, steam distillation, extraction, drying, thin layer and column chromatographies etc.). All these help to deepen their knowledge in organic chemistry and get acquainted with the properties of organic materials. (4 credits)

Analytical Chemistry Laboratory Practice

BMEVESAA403

Gravimetric and titrimetric (acid-base, argentometry, complexometry, redoxi) determinations of different inorganic ions and organic compounds. Determination of inorganic and organic compounds using various instrumental analytical (potentiometry, conductometry, liquid-, gas- and thin layer chromatography, flame photometry, atomic absorption spectrometry, fluorimetry, ultraviolet/visible spectroscopy,) methods. (4 credits)

Physical Chemistry II

BMEVEFAA405

Reaction kinetics: Homogeneous reactions. First order and second order reactions. Equilibrium reactions. Consecutive and parallel reactions. Temperature dependence of reaction rates. Kinetics of heterogeneous reactions. Transport processes: Thermodynamic driving forces. Laws of diffusion. Heat conductance. Viscosity. Electrochemistry: Equilibrium in electrolytes. Thermodynamics of galvanic
cells. Electrode potentials. Conductivity of electrolytes. Kinetics of electrode processes. (4 credits)

Medicines

BMEVESZA403

The subject gives a breaf introduction to the medicinal chemistry and pharmacology. The fundamental pharmacological definitions and ideas as well as a historical outline of drug discovery and design are presented. Selected examples of drug action at some common target areas demonstrate the importance of the special receptor-drug interactions and the improtance of chemical modifications of the leading molecules to produce highly selective medicines. Typical examples are also discussed for drug metabolism including several organic chemicals and solvents which are important for the organic chemists. (3 credits)

Colloid chemical approach to nanotechnology

BMEVEFAA409

Short history of colloid chemistry: from colloids to nanotechnology. Classification of colloid systems. Interfaces, surface tension. Curved surfaces, capillarity. Surface tension of solutions. Adsorption, adsorbents. Solution of macromolecules. Micelles and membranes. Biological aspects of colloids. Dispersions, micro- and macroemulsions, foams. Particle size measurements. Colloid stability. Rheology. Colloids in Nanotechnology. (3 credits)

Environmental Chemistry and Technology

BMEVEKFA403

Chemical properties, ways of formation, elimination ways, reaction kinetics, and control methods of environmental polluting materials (airborn pollutants: carbon dioxide, nitrogen oxides, sulfur oxides, hydrocarbons, and photochemical oxidants, particulates, dioxines, waterborn pollutants: organic materials, toxic organic materials, plant nutrients, mineral oil and fractions, detergents, pesticides, toxic metals). (4 credits)

Organic Chemical Technology

BMEVESTA411

The subject shows the typical fields, equipment and transformations of the organic chemical industry. The relevant fields discussed are: C_1-, C_2- and C_3- intermediates, as well as aromatic substrates; detergents, washing powders and environmental considerations; pesticides, such as insecticides, fungicides and herbicides, toxicity and environment; features of the pharmaceutical industry, typical syntheses and technologies illustrated by the examples of some drugs selected; principles of green chemistry, environmental-friend considerations; characteristics of the plastic and rubber industry, recycling of thermoplastics; the textile and dye industry, natural and synthetic dyes. (3 credits)

Organic Chemical Technology Practice

BMEVESZA412

In the framework of the laboratory practice, the students get acquainted with typical organic chemical transformations (eg. oxidations, hydrogenations, esterifications, Friedel-Crafts reactions, diazotation and coupling) carried out in suitable reactors, such as stirred tank reactor, tube reactor, autoclave, cascade reactor, ball- and tube mill and Mettler-Toledo intelligent reactor. Operation of the reactors should be optimized by studying the effect of the technological parameters, such as temperature, pressure and stirring. The reaction mixtures are analysed by up-to-date techniques. (3 credits)

Chemical Unit Operations I

BMEVEKFA410

Unit Operations of Chemical Engineering. Continuity equations, mass balance, component balance, energy equation, momentum balance, equations of motions, transport equations. Fluid mechanics, concepts of fluid behaviour, steady flow, rheology, viscosity, boundary-layer formation, friction factor. Navier-Stokes, Euler and Bernoulli equations. Transportation of fluids. Hydrodynamic models, flow in pipes and channels, pressure flow through equipment, pressure drop across packed towers.
Mechanical unit operations: mixing, sedimentation: thickeners, filtration. Electrical and magnetic methods, centrifugal separation, fluidization, pneumatic transport, gas cleaning: cyclones. Flow of heat, conduction, convection, radiation. Rate of heat transfer, heating and cooling: viscosity correlation. Dimensional analysis. Heat transfer of condensation, steady and unsteady-state heat transfer. Heat transfer in shell and tube heat exchangers. Evaporation, boiling point rise. Standard and multiple-effect evaporators, vapour compression. (6 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 credits)

Design of Experiments

BMEVEVMA606

Random variable, density and distribution function, expected value, variance. Continuous distributions: normal, standard normal, Chi-square, t and F distribution. Central limit theorem. Population and sample. Parameter estimation. Hypothesis testing, parametric tests. Mutual distribution of several random variables, correlation. Principles of regression, linear regression. Checking adequacy, weighted regression, parameter estimation, partition of SSQ, confidence intervals. Design of experiments. 2^p full factorial: the design, orthogonality and rotatability, estimation of parameters, significance tests. 2^{p-r} fractional factorials. (3 credits)

Hydrocarbon processing

BMEVEKFA506

Introduction, types and characteristics of hydrocarbons, resources. artificial hydrocarbon production, Fischer-Tropsch synthesis; Important crude oil treatment technologies: catalytic reforming, cracking of petrol, alkylation, polymerization, izomerization, thermal cracking, visbreaking, delayed coking, hydro-desulfuriztaion and refining, hydrocracking, transport fuel production, its trends, components, environmental effects. Alternative fuel production, lubricating oils, paraffine and bitumen production and characteristics; Production and use of selected aromatic hydrocarbons,aromatic raw materials, their extraction, BTX production and use; Transformation of aromatic hydrocarbons, dezalkylation, disproportioning, production and use of ethyl-benzene, styrole, cyclohexane and polymer-benzenes; Olefin production, pyrolysis technology and product separation, treatment and technologies of C_4-fraction, production and use of linear-α-olfins (3 credits)

Biochemistry

BMEVEBEA301

Introduction: structure of procariotic and eucariotic cells; major classes of biomolecules; C, H, N, O cycle; Properties of enzymes; classification of enzymes; role of cofactors; Fatty acid degradation (b-oxidation); Glycolysis; Pentose phosphate cycle; Amino acid catabolism (deamination, decarboxilation); Urea cycle; Conversation of pyruvate to acetyl-CoA; Citric Acid Cycle; Citrate cycle; Glyoxilate cycle; Electron ttansport, Oxidative phosphorilation; Photosynthesis (light reaction, Calvin cycle, Photorespiration); Fatty acid-, triacilglycerol-, phospholipid-, sphingolipid-, colesterol biosynthesis; Nitrogen fixation, amino acid biosynthesis; Nucleic acid biosynthesis (DNa, RNA); Protein biosynthesis; Regulation (molecular, cell and body level) (4 credits)

Physical Chemistry Laboratory Practice

BMEVEFAA506

i) Equilibrium states: One componenet liquid-vapor phase equilibrium. Apparent heat of evaporation; Two component liquid-liquid phase equilibrium. Critical temperature of miscibility; Electrochemical equilibrium and electromotive force of a galvanic cell. Nernstian operation; Calorimetry. Heat of an acid-base reaction. Specific heat of an organic liquid. ii) Reaction kinetics: Rate constant of iodination of acetone; Order of a component in kinetics of decomposition of hydrogen peroxide iii) Measurements in transport phenomena: Electrolyte conductivity. Molar conductivity. Dissociation constant of a weak electrolyte; Rheology. Viscosity of a Newtonian liquid. Flow curve of a thixotropic slurry. (3 credits)

Chemical Process Control

BMEVEVMA504

Areas and methods of process control, feed forward control, feed back control. Mathematical basics, dynamic behaviours. Transfer function, frequency function. Model and modeling of chemical units and process from control point of view. Stability, its definitions in time, frequency, and Laplace domain. Controllers, controller algorithms, different controls and their characterizations. Controller tuning. Actuators, control valves. Basic controls: level, flow, pressure, temperature controls. Cascade controls. Control of multivariable processes. Interaction among control loops. Examples and solutions for the control of chemical units and processes. (5 credits)

Chemical Unit Operations II

BMEVEKFA512

Mass transfer: diffusion, film theory, mass transfer coefficient, overall mass transfer. Phase equilibria: characterization and calculation of vapor-liquid, gas-liquid and liquid-liquid equilibria. (Antoine equation, Raoult-Dalton equation, relative volatility, phase distribution calculations, use of binary and ternary, phase plots). Distillation: Single stage equilibrium distillation and flash. Simple differential (batch) distillation, Rayleigh equation. Steam distillation, vapor consumption. Continuous multistage distillation (rectification). Reflux ratio. Upper and lower operating lines, q-line. Graphical determination of the number of theoretical stages (McCabe-Thiele method). Fenske equation. Plates (stage efficiency) and packings (HTU, NTU, HETP). Column capacity. Absorption: Kremser-Souders-Brown equation, McCabe-Thiele type determination of theoretical plates. Absorption columns. Liquid-liquid extraction: Distribution ratio and phase ratio. Single stage and multiple extractions. Continuous counter-current multistage extraction. Computation with constant equilibrium ratio, graphical construction with constant phase ratio, and with non-constant phase ratio. Extractors. Other processes: adsorption, drying, crystallization, membrane separations. Chemical reaction engineering: kinetics and chemical equilibria; classification of reactors; ideal reactors: batch, continuous stirred tank, tubular (basic design equations, isothermal, adiabatic and non-isothermal operation). Calculations; laboratory practice (6 credits)

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. It 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 credits)

Safety Technology in the Chemical Industry

BMEVESZA101

Definition of safety. Occupational safety. Occupational and environmental hazards. Risk management: hazard analysis and risk assessment. Over- and under-pressuring vessels. Toxicology. Defending against toxic substances. Fire and explosion. Basic concepts: burning, explosion, detonation. Explosion limits, flash point, ignition temperature. Fire and explosion, protection. Sources of ignition. Electrostatic hazards. R" and "S" phrases. Material Safety Data Sheet. Transport, storage, incompatible materials. Disaster concept. Major chemical disasters. The estimation and interpretation of biological risk. (2 credits)

Quality Management

BMEVEKFA615

Development stages of quality management, quality models quality systems (ISO 9000, QS900, ISO 140), TQM – customer in the centre, management of key processes, organisation background, techniques for continuous improvement; 6 sigma methods, fundamentals of reliability, stability and capability, variables control charts (xbar-range, individual), attributes control charts (effective and defect), process capability, measurement system analysis, acceptance sampling (4 credits)

Chemical Unit Operations Laboratory Practice

BMEVEKFA613

Pilot plant laboratory exercises: Investigation of the basic chemical reactor-types; Residence time distributions of packed bed and cascade reactor; Rectification on Raschig ring-packed tower; Rectification on structured packing tower; Batch rectification; Continuous extraction in mixer-settler extractor; Absorption; Determination of component transfer coefficient (ion exchange); Solid-liquid extraction (3 credits)

Description of BSc Courses - Specializations

Analytical and Structural Chemistry Specialization

Analytical and Structure Determination Laboratory

BMEVESAA604

The measurement of various samples by UV/VIS, infrared (IR), Raman, mass (MS) and nuclear magnetic resonance spectroscopy, powder and single crystal diffraction, scanning electron microscopy, SEM EDS and joint analytical (GC-MS, TG/DTA-MS, TG-IR,) methods. A brief summary of the above techniques. (5 credits)

Elemental Analysis

BMEVESAA701

Classification of element analysis methods and performances. Basic principles of atomic spectroscopic methods. Radiation sources and atom sources of analytical atomic spectroscopy. Characteristics and comparison of the different sources. Main processes taking place in sources. Emission methods of atomic spectroscopy: flame photometry, arc and spark methods, ICP-OES and GD-OES spectrometry. Atomic absorption methods: flame atomic absorption, graphite furnace atomic absorption. Cold vapor and hydride methods. Mass spectrometric methods: ICP-MS, GD-MS. Development and optimization of analytical methods. Methods and instrumentation of sample preparation. (3 credits)

Chemical and Biosensors

BMEVEAAA708

Introduction: Overview of chemical and biosensors; Fundamental elements of chemical and biosensor devices; Electrochemical sensors and methods: Potentiometric sensors (Ion-selective electrodes, gas sensors); Principle of voltammetric methods and sensors (Oxygen sensor, ultramicroelectrodes, interdigitated electrodes); Optical sensors:
Optical sensing modalities; Optodes, waveguide sensors, optical fiber sensors; Biosensors and bioanalytical systems: Basic molecular recognition principles; Miniaturization and fabrication technologies; Immobilization of biomolecules; Bioacatalytic sensors: Fundamental properties and mechanisms of biocatalysts; Electrochemical biosensors (Glucose biosensors, engineered charge transfer pathways); Other biocatalytic sensors;
Bioffinity and affinity sensors: Bioreceptors (antibodies, nucleic acids, aptamers, etc.) and synthetic receptors (molecularly imprinted polymers); Label-free bioaffinity sensors (quartz crystal microbalance, surface plasmon resonance, cantilever sensors, etc.); Assays based on labelled reagents; Signal amplification techniques for ultrasensitive analysis; Nanostructures and integrated bioanalytical systems for sensing. (3 credits)

Chromatography

BMEVEAAA611

Classification of separation methods, basic knowledge about the retention, selectivity and separation, van Deemter and Golay equation. Basic of gas chromatography and classification of columns, packed and capillary column. Detector are used in GC. Basic parameters adjusted to get separation. Basic of liquid chromatography, high performance liquid chromatography (HPLC), ultra high performance liquid chromatography (UHPLC), high temperature liquid chromatography. Particles packed column, monolith and pore-shell columns. Classification of liquid chromatography, normal-, reversed-, ion exchange and size exclusion methods. Instrumentation in liquid chromatography. Capillary electrophoresis and capillary electrochromatography. (3 credits)

Elucidation of Organic Structures

BMEVESAA512

Introduction into the theory of ultraviolet/visible, infrared, mass and nuclear magnetic resonance spectroscopy. Interpretation of ultraviolet/visible, infrared, EI-mass as well as one-dimensional ^{1}H and ^{13}C NMR spectra. Presentation of their application for the solution of practical problems. Presentation of their joint application in the elucidation of the structure of simple unknown compunds. (3 credits)

Theory of Testing Methods in Material Sciences

BMEVEFAA708

Introduction (the models of molecules, crystals, liquids, amorphous materials; interaction of materials with electromagnetic radiation); infrared and Raman spectroscopy; Absorption UV-Vis spectroscopy; optical and electronic properties of solids; photoelectron spectroscopy (UPS, XPS, AES); NMR spectroscopy (molecular and solid state), X-ray diffraction (crystal, liquid, small angle); microscopy (SEM, TEM, AFM) (4 credits)

Organic Chemistry III

BMEVESKA504

Stereochemistry, the stereostructure of organic compounds: Constitution, configuration, conformation and the order of chemical bonds. Chirality and symmetry elements. Configuration of stereocenters and bonds. Chiral and achiral conformations and molecules. Constitutional and stereoisomers. Enantiomerism and diastereomerism. Enantiomeric and diastereomeric conformations and molecules. Symmetry of groups and faces: diastereotopic, enentiotopic and homotopic relations. Physical and chemical requirements of enantiomerism: stereoselective and stereospecific reactions, optical activity. Relative and absolute configuration. Optical inactivity of the achiral molecules. Substitution reactions at centers of asymmetry: inversion, retention, racemization.Racemic and mezo compounds. Atropisomerism. Nitrogen inversion. Center of asymmetry, axis of asymmetry, pseudoasymmetric centers. Dynamic properties. Tutomerism. Effects influencing tautomeric equilibria. Types of tautomers. Mutarotation. Asymmetric synthetic methods: Definition and classification of stereoselective transformations. Background and methods of enentiomeric composition determination. Enantiomer selectivity. Principle of resolution. Chiral reagents and catalysts. Kinetic resolutions by biological systems. Dynamic kinetic resolutions by biological systems. Basics of diastereotopic and enentiotopic selectivity. Basic principles of asymmetric reactions by chemical and biological systems. Stoichiometric and heterogeneous catalytic asymmetric reactions. Asymmetric reactions by homogenous catalytic systems and by biological systems. Asymmetric reactions of industrial importance. (2 credits)

Chemical and Process Engineering Specialization

Hydrocarbon Technology and Catalysis

BMEVEKFA503

Catalytic reformation of naphtha, the starting material and product testing; Catalytic naphtha reformation, modeling calculation; Cracking of naphtha and diesel, production of olefins; Hidrogenation of toluene vapor on Ni catalyst; Alkylation of toluene with ethanol vapor on HZSM zeolite catalyst; X-ray measurements of Pd metal content on activated carbon catalysts; Oil and gas separation by molecule sieves (5 credits)

Process Engineering

BMEVEVMA605

Flowsheets and flowsheeting. Equation solving, sequential modular, and simultaneous modular approaches and related problems and algorithms. Assignment of design variables and computation sequences. Phase equilibria and computation problems. Computation and models of partial fugacity and acticity coefficients. Validity and extrapolation of models. Computation of equilibria and phase distribution. Evaluation of phase equlibrium measurement data. Rigorous modelling and computation of counter-current multistage separation processes. Distillation, absorption, extraction column calculations. Methods for computing transient processes. Basic computation practices. (5 credits)

Environmental Benign Chemical Processes

BMEVEVMA607

Green chemistry metrics: The concepts of green chemistry, green engineering and sustainability. The necessity of quantifying a green reaction/process/product/firm. E factor, EQ factor, CI. Atom selectivity, atom efficiency, stoechiometric factor, conversion, reaction mass efficiency, material recovery parameter. Metrics to be applied for a process/production: mass index; energy factors: life cycle, waste treatment, solvent recovery; intensity factors: solvent, waste, energy; Emission control – Example: Gas purification: Regulation aspects, Best available technology concept, Nitric acid production, environmental considerations in process development; Processes under vacuum: Sublimation, Freeze drying, lyophilization, Evaporation under vacuum, Short-path distillation, Molecular distillation; High-pressure processes: High-pressure distillation, Pressure-sensitive distillation (breaking azeotropes), High pressure processing of food; Supercritical fluid extraction and other processes: Supercritical fluids, properties, Solubility in supercritical fluids, Supercritical fluid extraction and fractionation, Chemical and biochemical reactions in supercritical fluids, Particle formation (crystallization) using supercritical fluids, Supercritical fluid chromatography; Biofuels (raw materials, by-products): Bioethanol, Biodiesel: trans-estherification; gasification; Fischer – Tropsch synthesis, Biogas: hydrolysis; fermentation/digestion; purification; Recovery of organics from water: Separation of ethanol: azeotropic distillation, extractive distillation, liquid-liquid extraction, adsorption, membrane separations; Separations in fine chemical – biochemical industry: Aqueous biphasic extraction, Chromatographic techniques (size exclusion, ion-exchange), Example: IgG purification from a fermentation broth. (4 credits)

Computer Process Control

BMEVEKFA709

Design of computer controlled structure. Controllability indeces. Theory of design of robust process control. Areas of application of computer for process control. Z-transformation. Its application. Hardware elements of computer process control. Stability of sampled control loops. Model based control. (3 credits)

Chemical Production Control

BMEVEKTA707

The managment and economics that are typical for the chemical indutry are presented in this course. The examples are taken from the pertrochemical industry. Consumer and producer behaviours. Chemical production. Financial system. Profit and investment analysis. Emerging Economic and business environment. (3 credits)

Radiochemistry and Nuclear Energetics

BMEVEKFA502

Energy and matter. Atomic structure and bounding forces. Basic knowledge in nuclear energy production, fission and fusion. Types of radioations, alpha, beta gamma, neutron radiations. Detectors and nuclear measuerements. Environmental radioactivity. Dosimetry and radiation protection. Nuclear power plants and nuclear fuel cycles. Radioactive wastes, waste treatments. Future of nuclear energy. (3 credits)

Industral Pharmaceutics Specialization

Elucidation of Organic Structures

BMEVESAA512

Introduction into the theory of ultraviolet/visible, infrared, mass and nuclear magnetic resonance spectroscopy.. Interpretation of ultraviolet/visible, infrared, EI-mass as well as one-dimensional ^{1}H and ^{13}C NMR spectra. Presentation of their application for the solution of practical problems. Presentation of their joint application in the elucidation of the structure of simple unknown compunds. (3 credits)

Organic Chemistry III

BMEVESKA504

Stereochemistry, the stereostructure of organic compounds: Constitution, configuration, conformation and the order of chemical bonds. Chirality and symmetry elements. Configuration of stereocenters and bonds. Chiral and achiral conformations and molecules. Constitutional and stereoisomers. Enantiomerism and diastereomerism. Enantiomeric and diastereomeric conformations and molecules. Symmetry of groups and faces: diastereotopic, enentiotopic and homotopic relations. Physical and chemical requirements of enantiomerism: stereoselective and stereospecific reactions, optical activity. Relative and absolute configuration. Optical inactivity of the achiral molecules. Substitution reactions at centers of asymmetry: inversion, retention, racemization.Racemic and mezo compounds. Atropisomerism. Nitrogen inversion. Center of asymmetry, axis of asymmetry, pseudoasymmetric centers. Dynamic properties. Tutomerism. Effects influencing tautomeric equilibria. Types of tautomers. Mutarotation. Asymmetric synthetic methods: Definition and classification of stereoselective transformations. Background and methods of enentiomeric composition determination. Enantiomer selectivity. Principle of resolution. Chiral reagents and catalysts. Kinetic resolutions by biological systems. Dynamic kinetic resolutions by biological systems. Basics of diastereotopic and enentiotopic selectivity. Basic principles of asymmetric reactions by chemical and biological systems. Stoichiometric and heterogeneous catalytic asymmetric reactions. Asymmetric reactions by homogenous catalytic systems and by biological systems. Asymmetric reactions of industrial importance. (2 credits)

Organic Chemistry Laboratory Practice II

BMEVESKA605

During laboratory practice students acquire the basics of synthetic organic chemistry, the ways of safe work, the simple and fast ways of the identification of the synthesized substances (TLC, IR, NMR and mass spectroscopy) and the use of the current organic chemical literature. They extend their organic chemical knowledge and acquire substantial practical experience in the field of organic chemical research (they join the research of their instructors and get acquainted with advanced preparative methods and chromatographic techniques). (5 credits)

Pharmaceutical Technology I.

BMEVESTA704

This subject gives an overview on the characteristic methods for the industrial synthesis of active pharmalogical ingredients based on known technologies of Hungarian and other producers. The relevant fields discussed are: choice of the synthesis strategy, development and permanent updating of the industrial technology from different aspects such as the protection of the environment, the assurance of the quality, the safety, the thrift and the protection of the copyright. Choice criteria of the appropriate equipment, technologies for separation of active pharmalogical ingredients and their intermediates from natural raw materials (plants, animals) are presented. Aspects of the diminution of the waste materials produced, waste treatment are also discussed. (2 credits)

Unit processes in Industrial Drug Synthesis Laboratory Practice

BMEVESTA705

In the framework of the practice typical industrial level synthetic technologies and processes are presented for the students The theoretical background of the unit processes applied in the presented technologies has been discussed in the lectures of Unit Processes in Drug Synthesis" and highlighted again during the practices. (4 credits)

Unit processes in Industrial Drug Synthesis

BMEVESTA606

The subject deals with the typical chemical transformations, isomer separation techniques and scale up processes of the pharmaceutical and fine chemical industry. Among the unit processes the special N-, O- and C-alkylations, C-C bond forming reactions (Claisen-, Dieckman-, Knoevanagel- és Darzens-condensation, Vilsmeyer-formylation, synthesis and reactions of polar organometallics), and selective reductions with inorganic and organic hydrides are discussed. The theory and methods for separation and enrichment optical isomers, as well as the rules of application dry technologies are discussed and illustrated by industrial examples. (2 credits)

Technology of Pharmaceutical Materials

BMEVESTA607

The subject covers the theoretical background and practice of the technology of pharmaceuticals and biopharmacy including the formulation of medicines, characteristics of the pharmaceutical excipients and carriers, the relevant structural and mechanistic relationships, main dosage forms, relevant analytical methods and machinery. Emphasis is put on the comparison of the capability and limitations of traditional and advanced analytical and processing tools. (3 credits)

Unit Processes of Organic Chemistry

BMEVESTA508

The subject gives an overview on the most important chemical transformations relevant to the pharmaceutical-, pesticide- and fine chemical industry. The following basic processes are discussed systematically: alkylation and acylation including the Friedel-Crafts reactions, halogenations, sulfonations, nitrations, diazotation and azo-coupling, oxidations, hydrogenations, CO-reactions and others. The stress is laid on the substrates, reagents, catalysts and optimum conditions, as well as on industrial examples and environmental-friend solutions. (2 credits)

Polymer Technology Specialization

Theory of Testing Methods in Material Sciences

BMEVEFAA708

Introduction (the models of molecules, crystals, liquids, amorphous materials; interaction of materials with electromagnetic radiation); infrared and Raman spectroscopy; Absorption UV-Vis spectroscopy; optical and electronic properties of solids; photoelectron spectroscopy (UPS, XPS, AES); NMR spectroscopy (molecular and solid state), X-ray diffraction (crystal, liquid, small angle); microscopy (SEM, TEM, AFM) (4 credits)

Machines and Tools for Polymer Processing

BMEVEFAA705

Extrusion: constitution of an extruder, operation of an extruder, extruder screws; choosing the proper screw for a polymer; Characteristics of an extruder screw and its optimal operational point, film blowing, sheet extrusion; Wire coating, profile extrusion, filament extrusion, coextrusion; Injection molding: Tool designing, simulation software; Particular injection molding techniques: Gas and water injection, Injection molding on films, Injection molding on textiles; Compression moulding machines and tools; Thermoforming machines and tools; Laboratory practice: Visits in plants. (4 credits)

Polymer Processing

BMEVEMGA608

Introduction; Rheology – flow, viscosity; The measurement of the characteristics of the melt (viscosity, elastic properties); Heat transfer processes; Extrusion – equipment, basic processes; Extrusion – dies, products; Injection molding – equipment, the mould filling process; Injection molding – the structure of injection molded products; molds; Extrusion and injection blow molding, rotational molding; Calendering; Welding and other operations; Processing of thermoset resins; Other processing technologies; Laboratory practice: Introduction; Processing of polymer blends and particulate filled polymers; Extrusion of thermoplastics; Injection molding of thermoplastics; Production of PVC compounds; Thermoforming; Thermo-retardation; Processing of thermoset resins: Epoxy resins, Compression molding, Time-temperature-conversion correlations; Standard testing of rubbers (7 credits)

Polymer Physics Laboratory Practice

BMEVEMGA509

Introduction; Preparation and reactions of polymers; Qualitative analysis of polymers, Rheology; IR spectroscopy; Thermal analysis I; Thermal analysis II; Impact testing; Mechanical properties of polymers; Fibre-reinforced composites; Polymer foams, Welding of polymers; (3 credits)

Polymer Additives

BMEVEMGA610

Introduction; Changes taking place during the processing and application of plastics, chemical reactions, degradation, ageing; Degradation and stabilization; Light stabilization; PVC degradation and stabilization; Degradation and stabilization of other polymers; Lubricants; Fillers, surfactants, coupling agents; Polymer additives (impact modifiers, processing aids). The purpose of their application, mechanism; Flame retardants; Blowing agents, colorants; Other additives; Further aspects of the application of additives, Additive packages, interaction of additives – PVC, polyolefins; (2 credits)

Polymer Physics

BMEVEMGA511

Introduction. Terms and definitions: monomer, polymer, homo- and copolymer. Structure of the polymer, segments, entanglement. Supermolecular structure, amorphous and crystalline materials. The individual chain. Shape, conformation, conformation distribution. The freely joined chain model. Interactions, solutions, determination of molecular weight. Phases and physical states, termomechanics. Rubber elastic state, thermodynamics, kinetics. Flow, rheology. Measurement of viscosity. Glassy state, fracture, polarization optics. Crystalline polymers, structure. Crystallization kinetics, melting. Structure-property correlations, plasticization. (3 credits)

Textile Technology Specialization

Theory of Testing Methods in Material Sciences

BMEVEFAA708

Introduction (the models of molecules, crystals, liquids, amorphous materials; interaction of materials with electromagnetic radiation); infrared and Raman spectroscopy; Absorption UV-Vis spectroscopy; optical and electronic properties of solids; photoelectron spectroscopy (UPS, XPS, AES); NMR spectroscopy (molecular and solid state), X-ray diffraction (crystal, liquid, small angle); microscopy (SEM, TEM, AFM) (4 credits)

Fibre Forming Polymers

BMEVEMGA512

General properties of the fibre forming polymers, physical and chemical structure of natural and man-made fibres, properties of the fibres in general, relation of the structure and the properties (2 credits)

Chemistry of Dyes and Surfactants

BMEVESTA510

Colouristic knowledge will be presented based upon the correlation between the colour and structure of dyes. Systems, production, chemical and technological characteristics and application of dyes and surfactants on the field of macromolecular systems as specially of fibrous ones will be presented. Methods of fastness property investigations of dyed systems (e.g. light fastness, rubbing fastness, wash fastness) are included. Optimal water and energy consumption as well as the reduction of environmental pollution will also be discussed. (2 credits)

Colorimetry, Colormeasurement

BMEVEMGA515

Colorimetry, optics, Areas of application; Characterization and systematization of colours. Hue, lightness, saturation. Munsell system; Colour expression; Light-sources, characterization of illuminants, spectral distribution of energy, spectral distribution of the light; Quantifying Colour, CIE colour system; CIE 1931 and CIE 1994 systems; Uniform colour spaces; XYZ tristimulus values, colour coordinates; Colour difference values: explanation and calculation; Modern colorimeters; Colour-matching functions, Kubelka-Munk equation, relations of reflection and dye concentration; Application of colour measurement for quality assurance; Measurement of whiteness, whiteness indices. Fluorescent or optical brighteners; (2 credits)

Chemical Technology of Textiles I.

BMEVEMGA617

Preparatory processes: desizing, scouring, bleaching, carbonizing; Mercerization and liquid ammonia treatment; Dyeing processes: fundamentals and methods; Textile printing; Laboratory practices: Identification of textile materials; Preparatory processes: desizing, scouring and bleaching; Dyeing of cellulosic fibres; Dyeing of wool; Dyeing of synthetic-polymer fibres; Textile printing; (7 credits)

Chemical Technology of Textiles II.

BMEVEFAA718

Introduction; Specific functional finishes (Crease resistance, Dimensional stability, Flame retardancy, Antimicrobial finishes, Shrinkproofing, Resistance to abrasion and pilling, Soil-release and repellent finishes); Laundering; Coatings; Environmental impact of textile wet processes; Quality insurance of textiles; (4 credits)

Mechanical Technologies of Textiles

BMEGEPTAKV1

Textile materials: Natural and synthetic textile fibres and their properties; Yarn production: Materials and equipment available for producing the various types of yarn; Spinning, opening, cleaning, carding, twist, drawing, blending, imparting order, reducing the unevenness of yarn mass, attenuation (draft), yarn formation, handling material; Ring spinning, post-spinning, open end spinning, different spinning techniques (ring spun yarns, rotor spun yarns, air-jet spun yarns, friction spun yarns, wrap spun yarns); Thread production: Thread construction; Characteristics of sewing threads; Thread-production methods' types of thread package; Woven fabric production: Preparation; Winding; Warping; Slashing (warp sizing); Drawing-in and tying-in; The fundamental of fabric structure. Woven fabric design; Shuttleless weaving systems; Knitted fabric production: Weft knitting: yarn delivery systems on circular and flat knitting machines. Warp knitted fabric production; Non-woven fabric production: Formation of dry, wet, spun laid and other types of non-wovens; Clothing technologies: (2 credits)

Faculty of Civil Engineering

The Faculty of Civil Engineering is the oldest Faculty of the Budapest University of Technology and Economics and can trace its history back to the University's predecessor, the Institutum Geometricum, founded by Emperor Joseph II in 1782. In the past 233 years, thousands of engineers have graduated from this Faculty to work worldwide as educators, international researchers and engineering project managers.

The most essential service of the faculty – education linked closely to research and engineering work – is reflected in the scientific activities of nearly 130 professors in 9 departments. They have contributed significantly to the scientific solution of diverse engineering problems. Out of the approximately 2200 students, who study at this Faculty, yearly 100 students from abroad participate in the English language program.

The BSc engineering program in English leads to a BSc degree in four years, in the Branch of Structural Engineering. The branch offers specific educational objectives: Graduates from the Branch of Structural Engineering create engineering structures by utilizing and designing structural materials. They are expected to design, construct and organize the investments of mechanically, structurally and technologically complex structures in cooperation with architects and transport and hydraulics specialists. Future structural engineers who graduate from this branch will be able to design and construct, among other things, bridges and underground passages for traffic networks; power stations, cooling towers, craneways, transmission line structures and telecommunication; storehouses, industrial plants, and multi-storey buildings as well as hydraulic engineering and water supply structures.

A new MSc course in Computational Structural Engineering was launched in September 2012. This MSc course provides advanced knowledge of structural analysis using advanced computer techniques, including the theoritical background of the methods. This course might be useful not only for those who are interested in research and consider continuing doctoral studies, but for leading engineers of the future: practicing engineers facing special structural problems.

Departments

Geodesy and Surveying
Construction Materials and Technologies
Photogrammetry and Geoinformatics
Engineering Geology and Geotechnics
Structural Engineering
Structural Mechanics
Highway and Railway Engineering
Hydraulic and Water Resources Engineering
Sanitary and Environmental Engineering

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Dean: Dr. László Dunai
Vice-dean: Dr. Sándor Ádány
Course-director: Dr. László Gergely Vigh
Program coordinator: Mrs Kinga Vass

Curriculum of BSc in Civil Engineering (8 semesters), Branch of Structural Engineering, Major of Buildings

Subject			lecture/seminar/laboratory/exam							
Name	Code	Credits	1	2	3	4	5	6	7	Requisities
Compulsory English 1.	BMEGT63A3E1	4	0/4/T							
Surveying I.	BMEEOAFAT41	3	1/2/T							
Chemistry of Construction Materials	BMEEOEMAT41	2	2/0/T							
Civil Engineering Representation and Drawing	BMEEOEMAT42	4	2/2/T							
CAD for Civil Engineers	BMEEOFTAT41	2	0/2/T							
Geology	BMEEOGMAT41	3	1/2/E							
Basis of Statics and Dynamics	BMEEOTMAT41	6	0/5/E							
Mathematics A1a - Calculus	BMETE90AX00	6	4/2/E							
Physics for Civil Engineers	BMETE11AX13	2	2/0/T							
Compulsory English 2.	BMEGT63A3E2	4		0/4/T						
Surveying II.	BMEEOAFAT42	4		2/2/E						EOAFAT41 EOFTAT41
Construction Materials I.	BMEEOEMAT43	5		2/0/2/E						EOEMAT41
Civil Engineering Informatics	BMEEOFTAT42	5		2/2/T						-
Soil Mechanics	BMEEOGMAT42	4		2/2/T						EOGMAT41
Introduction to Strength of Materials	BMEEOTMAT42	6		0/5/T						EOTMAT41 TE90AX00~
Hydraulics I.	BMEEOVVAT42	3		2/1/E						-
Mathematics A2a - Vector Functions	BMETE90AX02	6		4/2/E						TE90AX00
Surveying Field Course	BMEEOAFAT43	3			9 days					EOAFAT42~
Building Construction Study	BMEEOEMAT44	3			1/2/T					EOEMAT42 EOEMAT43
Geoinformatics	BMEEOFTAT43	3			2/1/T					EOAFAT42
Basis of Design	BMEEOHSAT41	3			2/0/T					EOTMAT41~
Structural Analysis I.	BMEEOTMAT43	4			4/0/E					EOTMAT42 TE90AX00
Railway Tracks	BMEEOUVAT41	3			3/0/E					EOAFAT41
Basics of Environmental Engineering	BMEEOVKAT41	3			2/0/T					-
Public Works I.	BMEEOVKAT42	3			2/1/E					EOVVAT42
Hydrology I.	BMEEOVVAT41	3			2/1/T					-
Mathematics A3 for Civil Engineers	BMETE90AX07	4			2/2/E					TE90AX02
Earthworks	BMEEOGMAT43	3				2/1/E				EOGMAT42
Steel Structures	BMEEOHSAT42	3				3/0/T				EOTMAT42 EOEMAT43~ EOHSAT41
Reinforced Concrete Structures	BMEEOHSAT43	3				3/0/T				EOTMAT42 EOEMAT43~ EOHSAT41
Roads	BMEEOUVAT42	2				2/0/T				EOAFAT41 EOUVAT41
Hydraulic Engineering, Water Manag.	BMEEOVVAT43	3				2/1/E				EOVVAT41 EOVVAT42
Construction Management	BMEEPEKAT41	3				2/1/T				EOEMAT44 EOGMAT42
Business Law	BMEGT55A001	2				2/0/T				-
Foundation Engineering	BMEEOGMAT44	4					2/1/E			EOGMAT43
Management and Enterprise	BMEGT20A001	4					4/0/T			-
Micro- and Macroeconomics	BMEGT30A001	4						4/0/E		-
Communication Skills for Civil Engineers	BMEGT60A6EO	2						0/2/T		-
Urban and Regional Development	BMEEOUVAT43	3							2/0/T	EOVVAT42
Elective subject		4							4/0/T	
Branch of Structural Engineering										
Building Construction I.	BMEEOEMAS42	3				1/2/E				EOEMAT44
Timber Structures	BMEEOHSAS44	3				2/0/T				EOTMAT42 EOEMAT43
Strength of Materials	BMEEOTMAS41	3				2/0/E				EOTMAT43
Construction Materials II.	BMEEOEMAS41	3					1/0/2/E			EOEMAT43
Building Construction II.	BMEEOEMAS43	3					1/2/E			EOEMAS42 EOHSAT41
Steel and Composite Structures	BMEEOHSAS41	4					2/1/T			EOHSAT42 EOHSAT43
RC and Masonry Structures	BMEEOHSAS42	4					2/1/T			EOHSAT43 EOEMAS42 EOTMAT43
Bridges and Infrastructures	BMEEOHSAS43	3					2/0/E			EOHSAT42 EOHSAT43
Laboratory Practice of Testing of Structures and Materials	BMEEOHSAS46	2					0/0/4/T			EOHSAT42 EOHSAT43
Structural Analysis II.	BMEEOTMAS42	4					3/1/T			EOTMAT43 EOTMAS41 TE90AX07
Rock Mechanics	BMEEOGMAS41	3						1/1/T		EOGMAT41
Underground Structures, Deep Found.	BMEEOGMAS42	3						2/1/T		EOGMAT44
3D Design	BMEEOHSAS45	3						0/2/T		EOHSAT42 EOHSAT43 EOFTAT41
Design of Structures Projectwork	BMEEODHAS41	6						0/0/T		EOHSAS41 EOHSAS42 EOGMAT44

Curriculum of BSc in Civil Engineering (8 semesters), Branch of Structural Engineering, Major of Buildings (contd.)

Subject			lecture/seminar/laboratory/exam							
Name	Code	Credits	1	2	3	4	5	6	7	Requisities
Theory of Administration, Real-estate Registration	BMEEOUVAT44	3							2/0/T	GT55A001
Field Course of Structural Geodesy	BMEEOAFAS42	1							0/0/2/T	EOAFAT43 EOHSAT42 EOHSAT43
Dynamics of Structures	BMEEOTMAS43	3							2/0/T	EOTMAT43 TE90AX07
Industrial Practice	BMEEODHAS42	0							20 days	EODHAS41
Major of Buildings										
Steel Buildings	BMEEOHSA-A1	5						3/1/E		EOHSAS41
Reinforced Concrete Buildings	BMEEOHSA-A2	5						3/1/E		EOHSAS42 EOHSAS44
Building Construction Methodology	BMEEOEMA-A1	2							1/1/E	EOEMAS43
Construction Technology	BMEEOHSA-K1	3							1/1/T	EOHSAS41 EOHSAS42
Building Design Projectwork	BMEEOHSA-AP	6							0/0/T	EODHAS41 EOHSA-A1 EOHSA-A2
Diploma Project	BMEEODHA-AD	24								EOHSA-AP + credit minimums

Curriculum of MSc in Structural Engineering, Major in Computational Structural Engineering

Subject			lectures/practical lectures/laboratory			
Name	Code	Credits	1	2	3	Requisities
Advanced Mathematics	BMETE90MX3	3	2/1/e/3			
Physic Laboratory	BMETE11MX2	2		0/1/t/1		
Numerical Methods	BMEEOFTMKT	2		1/2/e/3		
Database Systems	BMEEOFTMKT	3	2/0/t/2			
Advanced Mechanics	BMEEOTMMST	9	2/2/e/4			
Finite Element Method I.	BMEEOTMMST	0	2/0/e/2			
FEM Modelling of Structures	BMEEOHSMB0	1	5d/t/2			MST0!
Management Accounting and Controlling	BMEGT35M41	0			3/0/t/4	
Engineering Ethics	BMEGT41M00	4			2/0/t/2	
Decision Supporting Methods	BMEEPEKMST	4	2/0/t/2			
Structural Reliability	BMEEOHSMST	5	2/0/t/2			
Structural Dynamics	BMEEOTMMB0	2	2/2/t/5			
Stability of Structures	BMEEOTMMB0	3	2/2/e/5			
Material Models and Plasticity	BMEEOTMMB0	4		2/1/t/4		
Finite Element Method II.	BMEEOTMMB0	5		2/1/e/4		MB01
Differentiated Subjects			3 cr.	17 cr.		
Elective Subjects					5 cr.	
Diploma Project	BMEEODHMSDM				t/20	
Total credits			**30**	**29**	**31**	
Exams			**4**	**4**	**0**	
Differentiated Subjects						
Numerical Models for Structures	BMEEOTMMB0	6		2/0/t/3		
Structural Analysis Theory	BMEEOTMMB0	7	1/1/t/3			
Seismic Design	BMEEOHSMC0	3		1/1/t/3		MB02
Conceptual Design	BMEEOHSMB0	8		2/0/t/3		
FEM Based Structural Design	BMEEOHSMB0	9		1/2/t/4		MB01, MB03
Geotechnical Design	BMEEOGTMCT	1		2/1/e/4		
Numerical Modelling in Geotechnics	BMEEOGTMC0	5		1/1/t/3		
Extreme Actions of Structures	BMEEOHSMB1	0	2/0/t/3			
Fracture Mechanics and Fatigue	BMEEOHSMB1	1		3/0/e/4		

Faculty of Electrical Engineering and Informatics

The Faculty of Electrical Engineering founded in 1949 has been renowned for excellence in research and education throughout the years of changes in the scope of engineering. Over this period, the faculty has earned a wide-spread international reputation for its high academic standards and scientific achievements. Spearheading the movement to establish a modern education system, it has offered a comprehensive English curriculum since 1984. In 1992 the name of the faculty was changed to Faculty of Electrical Engineering and Informatics in order to give recognition to the growing importance of computer science. The education programmes in English include a 3.5-year BSc, a 2-year MSc and a 3-year PhD programme in the fields of electrical engineering and engineering information technology.

This Bulletin describes the curricula and the subjects being available for the 2014/2015 academic year, regarding the BSc, MSc and PhD programmes, respectively.

The undergraduate **BSc programme** (7 semesters) aims at providing a comprehensive knowledge with sound theoretical foundations in two areas: (1) Electrical Engineering including more specific studies in electronics, computer engineering and power engineering; and (2) Engineering Information Technology dedicated to the major domains of computer science. The major specializations in Electrical Engineering are infocommunication systems, embedded and controller systems and power engineering. Studies in Engineering Information Technology include specialization in infocommunication and software technology. Each specialization contains three courses focusing on the field of interest followed by a laboratory course and a project laboratory. In order to pursue studies in a given specialization the number of students must exceed a certain threshold, otherwise the interested students are kindly directed to another specialization.

The **MSc programme** (4 semesters) advances the knowledge in the following fields: (1) Electrical Engineering, offering specializations in (i) embedded systems, (ii) infocommunication systems, and (iii) electrical machines and drives; (2) Engineering Information Technology, offering specializations in (i) applied computer science, and (ii) system development; and (3) Business Information Systems, offering specialization in (i) Analytical Business Intelligence.

The post-graduate **PhD programme** is available in all domains offered in the MSc programme.

Since research and development requires innovative engineering expertise, one of the major concerns of the faculty is to endow students with high level mathematical skills in modeling complex engineering systems. This objective implies the use of system and algorithmic theory in addition to a thorough knowledge in physics. The search for optimal solutions in the highly complex architectures of electrical engineering and engineering information technology necessitates not only engineering but economical considerations, as well. As a result, the scope of the programme must include design, research and management expertise at the same time.

Several strategies have been designed to help students develop high level skills in mathematics, physics, and computation. Besides theoretical knowledge they need to carry out design and development activities in the field of communication, instrumentation, and power industries to further perfect their practical skills. The curriculum also includes solving tasks in the fields of production and operation.

Scientific groups are formed to encourage the students to do independent but supervised laboratory work. Project laboratory is one of the core parts of the studies which are dedicated to independent problem solving with the armoury of modern work stations and software packages. The expertise of handling these tools are inevitable in pursuing an engineering career.

In order to strengthen the transfer of knowledge and know-how between the university and industry, the faculty maintains close contact with well known multinational companies in the field of communication and computer industry. As a result, many industrial experts offer their experience and knowledge as part-time lecturers, project supervisors, members of examination committees.

Admission policy

To maintain a high educational standard is the basic interest of both the university and the students. Only a constant guard of quality can ensure that tuition fee is traded for a degree of high reputation bearing a competitive value in the global market. Therefore, the priority of our acceptance policy is sustaining the quality of education by selecting those students whose knowledge and previous qualifications are in match with the expertise required by the courses. This rule holds for all applicants, no matter the country or the educational institutions they came from. Only the implementation of this acceptance policy helps us to preserve the value of the degree, which the students rightly deserve in exchange of their tuition fee and in exchange of their continuous effort committed during the course. In order to implement the principles, our faculty has adopted the following terms of acceptance:

Practical guidelines for acceptance to the MSc programme

1. Applicants with BSc studies having a WGAP (Weighted Grade Average Point) equal or better than 'good' (more than 3.51 out of 5.00) will receive acceptance to the MSc course.

2. Applicants with a BSc qualification less than 'good' (less than 3.50 out of 5.00) are regretfully rejected to enter the MSc program.

3. Applicants should also submit two recommendations given by renowned academic personnel.

Practical guidelines for acceptance to the PhD programme

1. The primary condition of admission to postgraduate studies is that the applicant must hold a Master of Science (or Engineering) degree in Electrical and Electronic Engineering (or in some closely related fields) or Informatics. Admission to postgraduate studies will be considered if the qualification of previous studies is at least of level "good" (more than 3.51 out of 5.00) or equivalent.

2. Applicants are expected to have a definite scope of research in electrical engineering or computer science, where they would like to advance their knowledge. They are requested to present a proposal, specifying a domain of interest with some research objectives, milestones and deliverables during the postgraduate studies. The suggested topic should have sufficient preliminaries in their university studies.

3. Applicants with experience and initial results in the suggested research topic will have preference. A short summary of preliminary research activities together with relevant reports, published papers ... etc. would be of help in the admission process.

4. Applicants should also submit two recommendations given by renowned academic personnel

Each admission is valid only for the forthcoming academic year (starting right after the letter of acceptance). In the case of commencing studies later than the semester indicated in the letter of acceptance, or returning to studies after a passive semester, the faculty does not take responsibility for ensuring that the students can follow the same specialization which he or she studied prior to the passive semester, and reserves the right to direct the student to other specialization depending on the changes in the number applicants for specializations.

Departments

Automation and Applied Informatics
Electronics Technology
Electron Devices
Department of Networked Systems and Services
Control Engineering and Information Technology
Measurement and Information Systems
Computer Science and Information Theory
Broadband Infocommunications and Electromagnetic Theory
Telecommunications and Media Informatics
Electric Power Engineering

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Dean of the Faculty: Dr. László Vajta
Vice-Dean of the Faculty: Prof. Dr. János Levendovszky
Course Director: Dr. Bálint Kiss
Programme Co-ordinator: Ms. Margit Nagy

Curriculum of BSc Subjects in Electrical Engineering

Subject			lectures/practical lectures/laboratory							
Name	Code	Credits	1	2	3	4	5	6	7	Requisities
Fundametals in Natural Sciences (48 credits)										
Mathematics A1	TE90AX00	6	4/2/0/e							
Mathematics A2	TE90AX26	6		4/2/0/m						
Comprehensive exam on mathematics A1&A2	TE90AX16	0		0/0/0/ce						
Mathematics A3	TE90AX09	4			2/2/0/e					
Mathematics A4	TE90AX51	4			2/2/0/e					
Physics 1	TE11AX21	4	3/1/0/e							
Physics 2	TE11AX22	4		3/1/0/e						
Foundation of computer science	VISZAA02	4	2/2/0/e							
Informatics 1	VIIIAB04	5				4/1/0/m				
Informatics 2	VIAUAB01	5				4/0/1/e				
Electronics technology and materials	VIETAB00	6			4/0/2/m					
Economics and humanities (20 credits)										
Micro- and macroeconomics	GT30A001	4						4/0/0/e		
Management and business economics	GT20A001	4					4/0/0/m			
Business law	GT55A001	2						2/0/0/m		
Becoming an engineer	GT52A400	2	2/0/0/m							
Mandatory humanities & economics elective 1,2		2	2/0/0/m						2/0/0/m	
Mandatory humanities & economics elective 3,4		2		2/0/0/m					2/0/0/m	
Core electrical engineering knowledge (89 credits)										
Basics of programming 1	VIHIAA01	7	2/2/2/m							
Basics of programming 2	VIAUAA00	7		2/2/2/m						
Digital design 1	VIIIAA01	5	3/1/1/e							
Digital design 2	VIIIAA02	5		4/1/0/e						
Signals and systems 1	VIHVAA00	6		4/2/0/e						
Signals and systems 2	VIHVAB01	6			3/3/0/e					
Electrotechnics	VIVEAB00	5			4/0/1/m					
Introduction to electromagnetic fields	VIHVAC03	4					3/1/0/e			
Electronics 1	VIHIAB02	5			3/2/0/e					
Electronics 2	VIAUAC05	5					4/1/0/m			
Measurement technology	VIMIAB01	5				3/2/0/m				
Specialization prerequisite subject 11		5				3/p/l/e				
Specialization prerequisite subject 21		5				3/p/l/e				
Specialization prerequisite subject 31		5				3/p/l/e				
Specialization prerequisite subject 41		5						3/p/l/e		
Laboratory 1	VIMIAC05	5					0/0/4/m			
Laboratory 2	VIMIAC07	4						0/0/3/m		
Study specialization blocks (43 credits)										
Specialization subject 1		4					3/1/0/e			
Specialization subject 2		4					3/1/0/e			
Specialization subject 3		4					3/1/0/e			
Specialization subject 4		4						3/1/0/e		
Specialization laboratory		4						0/0/3/m		
Design laboratory		3					0/0/2/m			
Project laboratory	general	5						0/0/4/m		
BSc theses work	general	15							0/10/0/m	
Free electives (10 credits)[2]										
Free elective 1, 2		2						2/0/0/e	2/0/0/m	
Free elective 3		2							2/0/0/m	
Free elective 4		2							2/0/0/m	
Free elective 5		2							2/0/0/m	
Additional criterium										
Internship	general	0							6 weeks/s	
Totals										
Sum of hours per week			18/8/3	19/8/2	18/9/3	20/6/4	20/5/6	14/2/11	12/10/0	
Sum of credits per semester			30	30	30	30	33	30	27	
Number of exams[4]			4	4	4	4	4	4	0	

x/y/z/[e,ce,m,s]: x: contact hours of lectures per week, y: contact hours of classroom practices per week, z: contact hours of laboratory exercises per week, e: examination, ce: comprehensive exam, m: mid-semester mark, s: signature; credit: credit value according to ECTS – 1 credit represents 30 work hours (on average)

[1]The one (corresponsing to the specialization) of the specialization prerequisite courses (see below) must be finished to enter into the specialization starting in the 5th semester.

[2]10 credits of free electives could be substituted by any subjects available

[3]Internship is required and must be fulfilled to get the diploma. Internship possibilities are offered by Hungarian companies to international students with the help of BME

[4]Students should note that due to the early scheduling of the thesis defense session for students applying to MSc studies, the period for examination could be rather limited in the 7th semester

Subject			lectures/practical lectures/laboratory							
Name	Code	Credits	1	2	3	4	5	6	7	Requisities
Specialization prerequisite courses										
Control engineering	VIIIAB05	5				3/1/1/e/5				
Infocommunication	VITMAB03	5				3/2/0/e/5				
Microelectronics	VIEEAB00	5				3/0/2/e/5				
Power engineering	VIVEAB01	5				3/1/1/e/5				

Specializations

List of available specialization blocks depends on the number of students wanting to join. At least power engineering will be available. List of subjects are published on the website.

Curriculum of BSc Subjects in Engineering Information Technology

Subject			lectures/practical lectures/laboratory							
Name	Code	Credits	1	2	3	4	5	6	7	Requisities
Fundametals in Natural Sciences (40 credits)										
Calculus 1 for informaticians	TE90AX21	6	4/2/0/e							
Calculus 2 for informaticians	TE90AX22	6		4/2/0/m						
Comprehensive exam in Calculus 1&2 for informaticians	TE90AX20	0		0/0/0/ce						
Probability theory	VISZAB00	4			2/2/0/e					
Introduction to the theory of computing 1	VISZAA00	4	2/2/0/e							
Introduction to the theory of computing 2	VISZAA01	4		2/2/0/e						
Coding technology	VIHIAB00	4			3/0/0/e					
Theory of algorithms	VISZAB01	4				2/2/0/e				
Physics 1i	TE11AX23	4	3/1/0/e							
Physics 2i	TE11AX24	4		3/1/0/e						
Economics and humanities (20 credits)										
Micro- and macroeconomics	GT30A001	4					4/0/0/e			
Management and business economics	GT20A001	4				4/0/0/m				
Business law	GT55A001	2					2/0/0/m			
Becoming an engineer	GT52A400	2	2/0/0/m							
Mandatory humanities & economics elective 1		2						2/0/0/m		
Mandatory humanities & economics elective 2		2						2/0/0/m		
Mandatory humanities & economics elective 3		2							2/0/0/m	
Mandatory humanities & economics elective 4		2							2/0/0/m	
Core IT engineering knowledge (97 credits)										
System theory	VIHVAB00	4			3/1/0/m					
Technology of IT devices	VIEEAC00	4					3/0/1/m			
Digital design	VIMIAA01	7	3/1/2/e							
System modelling	VIMIAA00	4		2/1/0/m						
Computer architectures	VIHIAA00	5		3/1/0/e						
Communication networks 1	VIHIAB01	4			3/0/1/m					
Communication networks 2	VITMAB01	4				3/0/1/e				
Operating systems	VIMIAB00	5				3/0/1/e				
Basics of programming 1	VIEEAA00	7	2/2/2/m							
Basics of programming 2	VIIIAA00	7		2/2/2/m						
Basics of programming 3	VIIIAB00	5			2/0/2/m					
Databases	VITMAB00	5			3/1/0/e					
Databases laboratory	VITMAB02	2				0/0/2/m				
Software technology	VIIIAB01	4			3/0/0/e					
Software techniques	VIAUAB00	5				2/0/2/e				
Software project laboratory	VIIIAB02	2				0/0/2/m				
Web and mobile software	VIAUAC00	5					3/0/1/e			
Computer graphics	VIIIAB03	4				3/0/0/m				
Artificial intelligence	VIMIAC00	4					3/0/0/m			
IT security	VIHIAC01	3						3/0/0/m		
Management of information systems	VITMAC02	4						3/0/1/m		
Restricted electives1		3							3/0/0/m	
Study specialization blocks (43 credits)										
Specialization subject 1		4					3/1/0/e			
Specialization subject 2		4					3/1/0/e			
Specialization subject 3		4						3/1/0/e		
Specialization subject 4		4						3/1/0/e		
Specialization laboratory 1, 2		2						0/0/2/m	0/0/2/m	
Design laboratory	general	3					0/0/2/m			
Project laboratory	general	5						0/0/4/m		
BSc theses work	general								0/10/0/m	
Free electives (10 credits)[2]										
Free elective 1, 2		4						4/0/0/e	2/0/0/m	
Free elective 3		2							2/0/0/m	
Free elective 4		2							2/0/0/m	
Additional criterium										
Internship	general	0							8 weeks/s	

x/y/z/[e,ce,m,s]: x: contact hours of lectures per week, y: contact hours of classroom practices per week, z: contact hours of laboratory exercises per week, e: examination, ce: comprehensive exam, m: mid-semester mark, s: signature; credit: credit value according to ECTS – 1 credit represents 30 work hours (on average)

[1]One of the restricted electives (see below) must be finished.

[2]10 credits of free electives could be substituted by any subjects available

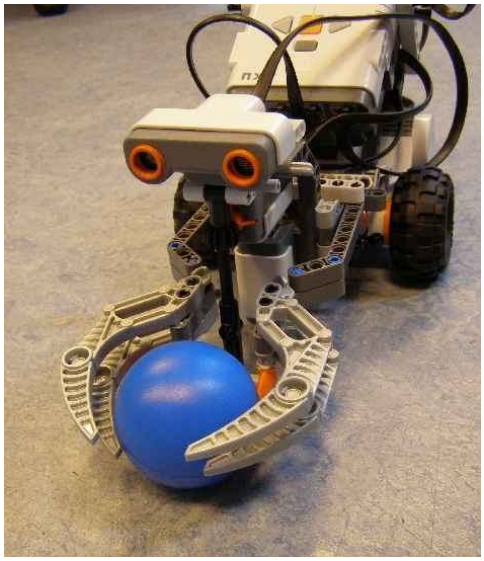
[3]Internship is required and must be fulfilled to get the diploma. Internship possibilities are offered by Hungarian companies to international students with the help of BME

[4]Students should note that due to the early scheduling of the thesis defense session for students applying to MSc studies, the period for examination could be rather limited in the 7th semester

Subject			lectures/practical lectures/laboratory							
Name	Code	Credits	1	2	3	4	5	6	7	Requisities
Totals										
Sum of hours per week			16/8/4	16/9/2	19/4/3	17/2/8	21/2/4	20/2/7	13/10/2	
Sum of credits per semester			30	30	30	30	30	30	30	
Number of exams[4]			4	4	4	4	4	3	0	
Restricted electives										
Embedded information systems	VIMIAD00	3							3/0/0/m	
Voice information systems	VITMAD00	3							3/0/0/m	
Declarative programming	VISZAD00	3							3/0/0/m	
Image processing	VIIIAD00	3							3/0/0/m	

Specializations

List of available specialization blocks depends on the number of students. At least software engineering will be available. List of subjects are published on the website.



Curriculum of MSc Subjects in Engineering Information Technology Applied Computer Science Specialization

Subject			lectures/practical lectures/ laboratory				
Name	Code	Credits	1	2	3	4	Requisities
Fundamentals in Natural Sciences (24 credits)							
System Optimization	BMEVISZM117	4	4/0/0/e				
Advanced Mathematics for Software Engineers D (Stochastics 1 - 2)	BMETE90MX43	4		4/0/0/e			
Formal Methods	BMEVIMIM100	4	3/0/0/p				
Data Security	BMEVIHIM102	4	3/0/0/p				
Languages and Automata	BMEVISZM104	4		3/0/0/p			
Software Architectures	BMEVIAUM105	4		3/0/0/p			
Subjects from Economic and Human Sciences (10 credits)							
Elective Subject 1	BMEGTxxMxxx	2			2/0/0/p		
Elective Subject 2	BMEGTxxMxxx	2			2/0/0/p		
Elective Subject 3	BMEGTxxMxxx	2			2/0/0/p		
Engineering Management	BMEVITMM112	4				4/0/0/e	
Basic Obligatory Subjects for the Specialization (28 credits)							
Distributed Systems	BMEVIAUM124	4	2/1/0/e				Excluded if BMEVIIIM140 was already taken
Mobil Software Development	BMEVIAUM125	4	2/1/0/e				
Model-Driven Paradigms	BMEVIAUM126	4	2/1/0/e				Excluded if VIMIM147 and VIIIM228 was already taken
Service-Oriented Systems	BMEVIAUM208	4		2/1/0/e			Excluded if BMEVIMIM234 was already taken
Integrated Information Systems	BMEVIAUM209	4		2/1/0/e			
Laboratory for Distributed Systems and Mobile Software Development	BMEVIAUM210	4		0/0/3/p			
Laboratory for Service-Oriented Systems and Model-Driven Paradims	BMEVIAUM302	4			0/0/3/p		
Basic Compulsory Elective Subjects for the Specialization (52 credits)							
Compulsory Elective Subject 1	BMEVIAUMxxx	4		2/1/0/e			
Compulsory Elective Subject 2	BMEVIAUMxxx	4			2/1/0/e		
Compulsory Elective Subject 3	BMEVIAUMxxx	4			2/1/0/e		
Project Laboratory 1	BMEVIAUM813	5	0/0/5/p				
Project Laboratory 2	BMEVIAUM863	5		0/0/5/p			Credits of BMEVIAUM813
Thesis Project 1	BMEVIAUM913	10			0/5/0/p		Credits of BMEVIAUM863
Thesis Project 2	BMEVIAUM963	20				0/10/0/p	Credits of BMEVIAUM913 and BMETE90MX43, and all credits of Basic Obligatory Subjects
Freely Elective Subjects (6 credits)							
Freely Elective Subject 1	BMExxxxxxxx	4				4/0/0/p	
Freely Elective Subject 2	BMExxxxxxxx	4				4/0/0/p	
Freely Elective Subject 3	BMExxxxxxxx	2				2/0/0/p	

Notes:

1. Subjects from Economic and Human Sciences: three subjects are selected by the Faculty from the following list before the actual semester							
Quality Management	BMEGT20M002	2			2/0/0/p		
Argumentation, Negotiation, Persuasion	BMEGT41MS01	2			2/0/0/p		
Investments	BMEGT35M004	2			2/0/0/p		
Management Accounting	BMEGT35M005	2			2/0/0/p		

2. Basic Compulsory Elective Subjects: *the three subjects will be determined before the actual semester.*

3. Freely Elective Subjects: *a list of these subjects is under construction.*

Notation: working hours/week: x/y/z/r

x = lecture hours

y = practice hours

z = laboratory hours

r = requirement (e = exam, p = continuous work for a mark, s = signature)

Curriculum of MSc Subjects in Engineering Information Technology System Development Specialization

Subject			lectures/practical lectures/ laboratory				
Name	Code	Credits	1	2	3	4	Requisites
Fundamentals in Natural Sciences (24 credits)							
System Optimization	BMEVISZM117	4	4/0/0/e				
Advanced Mathematics for Software Engineers D (Stochastics 1 - 2)	BMETE90MX43	4		4/0/0/e			
Formal Methods	BMEVIMIM100	4	3/0/0/p				
Data Security	BMEVIHIM102	4	3/0/0/p				
Languages and Automata	BMEVISZM104	4		3/0/0/p			
Software Architectures	BMEVIAUM105	4		3/0/0/p			
Subjects from Economic and Human Sciences (10 credits)							
Elective Subject 1	BMEGTxxMxxx	2			2/0/0/p		
Elective Subject 2	BMEGTxxMxxx	2			2/0/0/p		
Elective Subject 3	BMEGTxxMxxx	2			2/0/0/p		
Engineering Management	BMEVITMM112	4				4/0/0/e	
Basic Obligatory Subjects for the Specialization (28 credits)							
Distributed Systems	BMEVIAUM124	4	2/1/0/e				Excluded if BMEVIIIM140 was already taken
Mobil Software Development	BMEVIAUM125	4	2/1/0/e				
Model-Driven Paradigms	BMEVIAUM126	4	2/1/0/e				Excluded if VIMIM147 and VIIIM228 was already taken
Service-Oriented Systems	BMEVIAUM208	4		2/1/0/e			Excluded if BMEVIMIM234 was already taken
Integrated Information Systems	BMEVIAUM209	4		2/1/0/e			
Laboratory for Distributed Systems and Mobile Software Development	BMEVIAUM210	4		0/0/3/p			
Laboratory for Service-Oriented Systems and Model-Driven Paradims	BMEVIAUM302	4			0/0/3/p		
Basic Compulsory Elective Subjects for the Specialization (52 credits)							
Compulsory Elective Subject 1	BMEVIAUMxxx	4		2/1/0/e			
Compulsory Elective Subject 2	BMEVIAUMxxx	4			2/1/0/e		
Compulsory Elective Subject 3	BMEVIAUMxxx	4			2/1/0/e		
Project Laboratory 1	BMEVIAUM813	5	0/0/5/p				
Project Laboratory 2	BMEVIAUM863	5		0/0/5/p			Credits of BMEVIAUM813
Thesis Project 1	BMEVIAUM913	10			0/5/0/p		Credits of BMEVIAUM863
Thesis Project 2	BMEVIAUM963	20				0/10/0/p	Credits of BMEVIAUM913 and BMETE90MX43, and all credits of Basic Obligatory Subjects
Freely Elective Subjects (6 credits)							
Freely Elective Subject 1	BMExxxxxxxx	4				4/0/0/p	
Freely Elective Subject 2	BMExxxxxxxx	4				4/0/0/p	
Freely Elective Subject 3	BMExxxxxxxx	2				2/0/0/p	

Notes:

1. Subjects from Economic and Human Sciences: three subjects are selected by the Faculty from the following list before the actual semester							
Quality Management	BMEGT20M002	2			2/0/0/p		
Argumentation, Negotiation, Persuasion	BMEGT41MS01	2			2/0/0/p		
Investments	BMEGT35M004	2			2/0/0/p		
Management Accounting	BMEGT35M005	2			2/0/0/p		

2. Basic Compulsory Elective Subjects: *the three subjects will be determined before the actual semester.*

3. Freely Elective Subjects: *a list of these subjects is under construction.*

Notation: working hours/week: x/y/z/r

x = lecture hours

y = practice hours

z = laboratory hours

r = requirement (e = exam, p = continuous work for a mark, s = signature)

Curriculum of MSc Subjects in Electrical Engineering Embedded Systems Specialization

Subject			lectures/practical lectures/ laboratory				
Name	Code	Credits	1	2	3	4	Requisities
Fundamentals in Natural Sciences (24 credits)							
Physics 3	BMETE11MX01	5	3/1/0/e				
Measurement Theory	BMEVIMIM108	4	3/0/0/p				
Software Design	BMEVIIIM110	4	3/0/0/p				
Advanced Mathematics for Electrical Engineers A (Advanced Linear Algebra + Stochastics)	BMETE90MX30	6		4/2/0/e			
Nanoscience	BMEVIETM114	5		4/0/0/p			
Subjects from Economic and Human Sciences (10 credits)							
Elective Subject 1	BMEGTxxMxxx	2			2/0/0/p		
Elective Subject 2	BMEGTxxMxxx	2			2/0/0/p		
Elective Subject 3	BMEGTxxMxxx	2			2/0/0/p		
Engineering Management	BMEVITMM112	4				4/0/0/e	
Basic Obligatory Subjects for the Specialization (28 credits)							
System Architectures	BMEVIMIM149	4	2/1/0/e				
Software Technology for Embedded Systems	BMEVIMIM150	4	2/1/0/e				
Real-time and Safety-critical Systems	BMEVIMIM151	4	2/1/0/e				
Information Processing	BMEVIMIM237	4		2/1/0/e			
Embedded System Design	BMEVIMIM238	4		2/1/0/e			
Laboratory for System Architectures	BMEVIMIM239	4		0/0/3/p			
Laboratory for Information Processing	BMEVIMIM322	4			0/0/3/p		
Basic Compulsory Elective Subjects for the Specialization (52 credits)							
Interfacing Embedded Systems to Information Systems	BMEVIMIM343	4		2/1/0/e			
High-Performance Microcontrollers	BMEVIMIM342	4			2/1/0/e		
Digital Filters	BMEVIMIM278	4			2/1/0/e		
Project Laboratory 1	BMEVIMIM802	5	0/0/5/p				
Project Laboratory 2	BMEVIMIM852	5		0/0/5/p			Credits of BMEVIMIM802
Thesis Project 1	BMEVIMIM902	10			0/5/0/p		Credits of BMEVIMIM852
Thesis Project 2	BMEVIMIM952	20				0/10/0/p	Credits of BMEVIMIM902 and BME-TE90MX30, and all credits
Freely Elective Subjects (6 credits)							
Freely Elective Subject 1	BMExxxxxxxx	4				4/0/0/p	
Freely Elective Subject 2	BMExxxxxxxx	4				4/0/0/p	
Freely Elective Subject 3	BMExxxxxxxx	2				2/0/0/p	

Notes:

1. Subjects from Economic and Human Sciences: three subjects are selected by the Faculty from the following list before the actual semester							
Quality Management	BMEGT20M002	2			2/0/0/p		
Argumentation, Negotiation, Persuasion	BMEGT41MS01	2			2/0/0/p		
Investments	BMEGT35M004	2			2/0/0/p		
Management Accounting	BMEGT35M005	2			2/0/0/p		

2. Freely Elective Subjects: *a list of these subjects is under construction.*

Notation: working hours/week: x/y/z/r

x = lecture hours

y = practice hours

z = laboratory hours

r = requirement (e = exam, p = continuous work for a mark, s = signature)

Curriculum of MSc Subjects in Electrical Engineering
Infocommunication Systems Specialization

Subject			lectures/practical lectures/ laboratory				
Name	Code	Credits	1	2	3	4	Requisities
Fundamentals in Natural Sciences (24 credits)							
Physics 3	BMETE11MX01	5	3/1/0/e				
Communication Theory	BMEVIHVM107	4	3/0/0/p				
Software Design	BMEVIIIM110	4	3/0/0/p				
Advanced Mathematics for Electrical Engineers B (Combinatorial Optimization + Stochastics)	BMETE90MX38	6		4/2/0/e			
Photonic Devices	BMEVIETM113	5		4/0/0/p			
Subjects from Economic and Human Sciences (10 credits)							
Elective Subject 1	BMEGTxxMxxx	2			2/0/0/p		
Elective Subject 2	BMEGTxxMxxx	2			2/0/0/p		
Elective Subject 3	BMEGTxxMxxx	2			2/0/0/p		
Engineering Management	BMEVITMM112	4				4/0/0/e	
Basic Obligatory Subjects for the Specialization (28 credits)							
Wireline and Wireless Transmission Technologies	BMEVITMM155	4	2/1/0/e				
Convergent Networks and Services	BMEVITMM156	4	2/1/0/e				Excluded if BMEVIHIM244 was already taken
Network and Service Management	BMEVITMM157	4	2/1/0/e				
Human-Computer Interaction	BMEVITMM224	4		2/1/0/e			
Network Planning	BMEVITMM215	4		2/1/0/e			Excluded if BMEVIHIM354 was already taken
Laboratory for Infocommunications I.	BMEVITMM245	4		0/0/3/p			
Laboratory for Infocommunications II.	BMEVITMM311	4			0/0/3/p		
Basic Compulsory Elective Subjects for the Specialization (52 credits)							
Information and Network Security	BMEVITMM280	4		2/1/0/e			
Optical Networks	BMEVITMM347	4			2/1/0/e		
Performance Analysis of Infocommunication Systems	BMEVITMM325	4			2/1/0/e		
Project Laboratory 1	BMEVITMM807	5	0/0/5/p				
Project Laboratory 2	BMEVITMM857	5		0/0/5/p			Credits of BMEVITMM807
Thesis Project 1	BMEVITMM907	10			0/5/0/p		Credits of BMEVITMM857
Thesis Project 2	BMEVITMM957	20				0/10/0/p	Credits of BMEVITMM907 and BMETE90MX38, and all credits of Basic Obligatory Subjects
Freely Elective Subjects (6 credits)							
Freely Elective Subject 1	BMExxxxxxxx	4				4/0/0/p	
Freely Elective Subject 2	BMExxxxxxxx	4				4/0/0/p	
Freely Elective Subject 3	BMExxxxxxxx	2				2/0/0/p	

Notes:

1. Subjects from Economic and Human Sciences: three subjects are selected by the Faculty from the following list before the actual semester							
Quality Management	BMEGT20M002	2			2/0/0/p		
Argumentation, Negotiation, Persuasion	BMEGT41MS01	2			2/0/0/p		
Investments	BMEGT35M004	2			2/0/0/p		
Management Accounting	BMEGT35M005	2			2/0/0/p		

2. Freely Elective Subjects: *a list of these subjects is under construction.*

Notation: working hours/week: x/y/z/r

x = lecture hours

y = practice hours

z = laboratory hours

r = requirement (e = exam, p = continuous work for a mark, s = signature)

Curriculum of MSc Subjects in Electrical Engineering
Electrical Machines and Drives Specialization

Subject			lectures/practical lectures/ laboratory				
Name	Code	Cre-dits	1	2	3	4	Requisities
Fundamentals in Natural Sciences (24 credits)							
Physics 3	BMETE11MX01	5	3/1/0/e				
Alternating Current Systems	BMEVIVEM111	4	3/0/0/p				
Measurement Theory	BMEVIMIM108	4	3/0/0/p				
Advanced Mathematics for Electrical Engineers C (Advanced Linear Algebra + Analysis)	BMETE90MX39	6		4/2/0/e			
Electrical Insulations and Discharges	BMEVIVEM116	5		4/0/0/p			
Subjects from Economic and Human Sciences (10 credits)							
Elective Subject 1	BMEGTxxMxxx	2			2/0/0/p		
Elective Subject 2	BMEGTxxMxxx	2			2/0/0/p		
Elective Subject 3	BMEGTxxMxxx	2			2/0/0/p		
Engineering Management	BMEVITMM112	4				4/0/0/e	
Basic Obligatory Subjects for the Specialization (28 credits)							
Theory and Design of Electric Machines	BMEVIVEM173	4	2/1/0/e				
Electrical Equipment and Insulation	BMEVIVEM174	4	2/1/0/e				
Control of Electrical Drives	BMEVIVEM175	4	2/1/0/e				
Electrical Systems of Renewable Energies	BMEVIVEM262	4		2/1/0/e			
Electric Vehicles	BMEVIVEM263	4		2/1/0/e			
Laboratory for Electrical Machines and Drives 1	BMEVIVEM264	4		0/0/3/p			
Laboratory for Electrical Machines and Drives 2	BMEVIVEM319	4			0/0/3/p		
Basic Compulsory Elective Subjects for the Specialization (52 credits)							
Servo and Robot Drives	BMEVIVEM287	4		2/1/0/e			
Modeling and Simulation	BMEVIVEM365	4			2/1/0/e		
Microcomputer Controlled Drives	BMEVIVEM366	4			2/1/0/e		
Project Laboratory 1	BMEVIVEM819	5	0/0/5/p				
Project Laboratory 2	BMEVIVEM869	5		0/0/5/p			Credits of BMEVIVEM319
Thesis Project 1	BMEVIVEM919	10			0/5/0/p		Credits of BMEVIVEM869
Thesis Project 2	BMEVIVEM969	20				0/10/0/p	Credits of BMEVIVEM919 and BME-TE90MX39, and all credits of Basic Obligatory Subjects
Freely Elective Subjects (6 credits)							
Freely Elective Subject 1	BMExxxxxxxx	4				4/0/0/p	
Freely Elective Subject 2	BMExxxxxxxx	4				4/0/0/p	
Freely Elective Subject 3	BMExxxxxxxx	2				2/0/0/p	

Notes:

1. Subjects from Economic and Human Sciences: three subjects are selected by the Faculty from the following list before the actual semester							
Quality Management	BMEGT20M002	2			2/0/0/p		
Argumentation, Negotiation, Persuasion	BMEGT41MS01	2			2/0/0/p		
Investments	BMEGT35M004	2			2/0/0/p		
Management Accounting	BMEGT35M005	2			2/0/0/p		

2. Freely Elective Subjects: *a list of these subjects is under construction.*

Notation: working hours/week: x/y/z/r

x = lecture hours

y = practice hours

z = laboratory hours

r = requirement (e = exam, p = continuous work for a mark, s = signature)

Curriculum of MSc Subjects in Business Information Systems
Analytical Business Intelligence Specialization

Subject			lectures/practical lectures/ laboratory				
Name	Code	Credits	1	2	3	4	Requisities
Elements of Natural Sciences (10 credits)							
Mathematical Statistics	BMEVISZM102	5	3/0/2/e				
Operation Research	BMETE90MX50	5		3/1/0/e			
Economics and Human Science Studies (21 credits)							
Accounting	BMEGT35M400	5		3/1/0/e			
Controlling	BMEGT35M401	5				3/1/0/e	BMEGT35M400
E-Law	BMEGT55M400	3				2/0/0/p	
Project Management	BMEGT20M400	3			2/0/0/p		
Finances	BMEGT35M402	5	3/1/0/e				
Foundational Technical Studies (15 credits)							
Data Security	BMEVIHIM183	5	3/1/0/p				
Network and Database Technologies	BMEVITMM184	5	3/1/0/e				
Data Mining Techniques	BMEVISZM185	5		3/1/0/p			
Specialization Studies (24 credits)							
Business and Financial Analytics	BMEGT35M403	4	3/0/0/e				
Customer Analytics	BMEVITMM199	5		3/0/1/e			
Trend Analysis and Visualization	BMEVITMM246	5		3/0/1/e			
Media and Text Mining	BMEVITMM275	5			3/0/1/e		BMEVISZM185
Risk Analysis and Management	BMEVIHIM277	5			3/0/1/e		
Basic Compulsory Elective Subjects (8 credits)							
Processing of Personal and Public Data	BMEVIETM294	4			3/0/0/e		
Engineering Management	BMEVITMM112	4			4/0/0/e		
Open Elective Subjects (6 credits)							
Open Elective Subject	BMExxxxxxxx	2			2/0/0/p		
Open Elective Subject	BMExxxxxxxx	4			4/0/0/e		
Individual studies (40 credits)							
Project Laboratory 1	BMEVITMM376	4	0/0/4/p				
Project Laboratory 2	BMEVITMM388	6		0/0/6/p			BMEVITMM376
Diploma Thesis Design 1	BMEVITMM377	10			0/5/0/p		BMEVITMM388
Diploma Thesis Design 2	BMEVITMM389	20				0/10/0/p	BMEVITMM377and 84 credits from the previous subjects

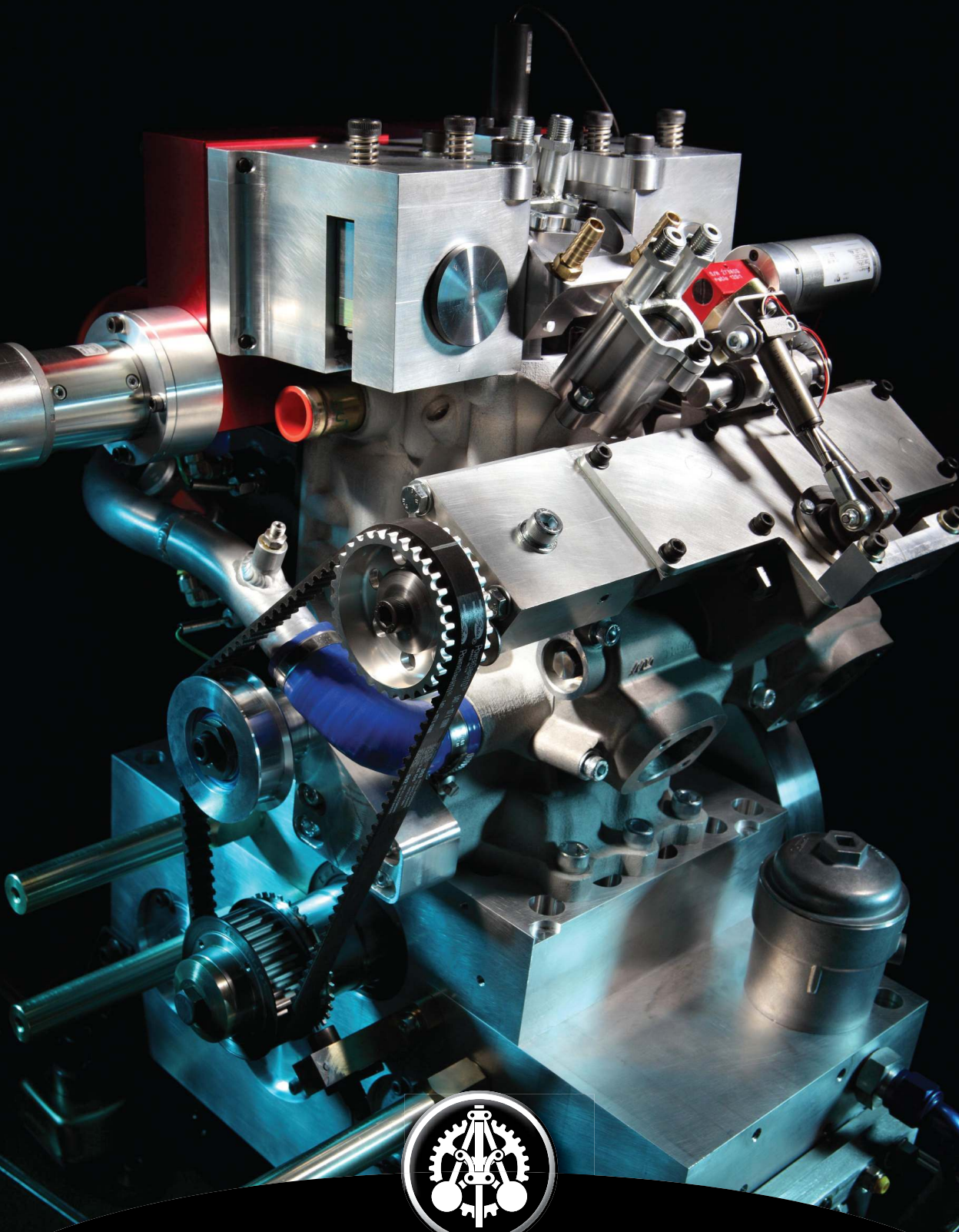
Notation: working hours/week: x/y/z/r

x = lecture hours

y = practice hours

z = laboratory hours

r = requirement (e = exam, p = continuous work for a mark, s = signature)



Faculty of Mechanical Engineering

Introduction

The Mechanical Engineering Program at the Budapest University of Technology and Economics began in 1863, and the Faculty of Mechanical Engineering was established soon afterward, beginning official operations in the 1871/72 academic year. The Faculty is justly proud of its continuous, progressive and more than 140-year history and now offers undergraduate and graduate programs in both Hungarian and English.

The Faculty of Mechanical Engineering offers a 7 semester undergraduate BSc degree program in English. Two specializations, 1) Engineering Design and Technology, 2) Process Engineering give the students alternatives from the 5th semester. A new two-year graduate program in English - Mechanical Engineering Modelling - leading to an MSc degree started in February 2009, and students can start their study either in the fall and in the spring semester. Individual postgraduate academic and research programs, which are usually completed in three to four years, are available for those who already have an MSc degree and wish to pursue a PhD degree.

The undergraduate BSc program of the Faculty of Mechanical Engineering is designed to continue a tradition of excellence by:

- providing well-grounded and broad knowledge that graduates of this Faculty can apply immediately in their work and also use as the basis for further studies; and
- graduating competent engineers who are not only masters of their profession, but also possess an ethical philosophy of engineering based on accuracy, punctuality and reliability as well as a respect for the human element.

The goals of our MSc and PhD programs are as follows:

- to train creative, inventive mechanical engineers who can apply the engineering skills and the knowledge they have gained from the natural sciences on a state-of-the-art level; and
- to foster the development of leaders in engineering research and development.

The courses in the Mechanical Engineering Modelling MSc-program deal with those time-dependent problems of mechanical engineering, which typically require the efficient modeling of tasks in order to access the continuously developing methods of computational engineering. As the joke says: 'One designed by a civil engineer starts moving that is bad, one designed by a mechanical engineer does NOT move that is bad, too.' Modern computational methods are very popular since they show their easy-to-use interface for engineers. This often causes misunderstanding and disappointment during the naive applications of engineering software. Computational methods are reliable if they are properly tested and the principles of their applied algorithms and procedures are understood. This is analogous to the modern cartoon industry: the 25 pictures of one second of a cartoon can be drawn by computers if the first and the last picture of that second are designed for them by the artist but the computers will totally fail if they have to draw the cartoon without any reference picture, or based on the first (or last) picture only.

The tasks of mechanical engineers that typically require the modeling of machines in motion and that of time-varying processes are based on solid and fluid mechanics, thermodynamics and electronics. Modeling means the understanding and active application of the related theories, which are supported by differential equations and numerical methods in mathematics. Modeling needs also experimental work during the research-development-innovation process in case engineers do not have enough information about the motions and processes they want to capture by a model. Finally, modeling is also affected by the engineers knowledge in design, technology, and informatics, since the model should not be so complex that the available software is unable to solve them within reasonable time and for reasonable cost.

The above principles affected the formation of this master course. After the brief summary of the required fundemental courses (mathematics, mechanics, thermodynamics, electronics, control and informatics), the students have to choose a major and a minor specialization from the following list of modules:

1. Solid Mechanics 2. Fluid Mechanics 3. Thermal Engineering 4. Design and Technology

The possible combinations provide flexibility among more research oriented knowledge (combinations of the first 3 modules), and the development oriented one (major from modules 1-3 and module 4 as minor or vice versa).

This course is running in English only. It is based on the foundations provided by the long-standing positive traditions of some former successful courses of the Faculty of Mechanical Engineering at BME.

This course is also compatible to many master courses in mechanical engineering in the European Union (see, for example, U Bristol, U Bath, ENS Cachan, TU Karlsruhe, U Hannover, TU Munich).

Our Faculty offers its engineering education excellence rooted in, and being fully aware of its unique position of training decision makers, and technological leaders of tomorrow. Our aim in the course of the training is to qualify our graduates to perform as competent problem solvers, good communicators, excellent team workers, successful project leaders, and - above all - ethical participants of the world around them – both locally and globally.

Departments:

Department of Materials Science and Engineering
Department of Fluid Mechanics
Department of Energy Engineering
Department of Building Service Engineering and Process Engineering
Department of Machine and Industrial Product Design
Department of Manufacturing Science and Engineering
Department of Hydrodynamics Systems
Department of Mechatronics, Optics and Information Engineering
Department of Applied Mechanics
Department of Polymer Engineering

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Faculty of Mechanical Engineering
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Dean: Prof. Dr. Tibor Czigány
Vice-Dean (scientific and international affairs): Dr. Ádám Kovács
Course Director: Mr. Axel Groniewsky
Program Co-ordinator: Ms. Eszter Rövid

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

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

Curriculum of MSc Subjects
Mechanical Engineering Modeling - Fluid Mechanics module

Subject		lecture/seminar/laboratory/requisite/credit							
		Beginning: spring				Beginning: fall			
Name	Code	1 Spring	2 Fall	3 Spring	4 Fall	2 Fall	1 Spring	4 Fall	3 Spring
Basic knowledge in natural sciences									
Differential Equations and Numerical Methods	BMETE90MX46	4/2/0/e/8					4/2/0/e/8		
Advanced Fluid Mechanics	BMEGEÁTMW01	3/0/0/e/4					3/0/0/e/4		
Advanced Thermodynamics	BMEGEENMWAT	2/1/0/e/4					2/1/0/e/4		
Analytical Mechanics	BMEGEMMMW01	3/0/0/e/4					3/0/0/e/4		
Laser Physics	BMETE12MX00		3/1/0/e/4			3/1/0/e/4			
Electronics	BMEVIAUM001		2/0/1/e/4			2/0/1/e/4			
Advanced Control and Informatics	BMEGEMIMW01		2/1/0/e/4			2/1/0/e/4			
Primary subjects									
Machine Design and Production Technology	BMEGEGEMW01		2/1/0/e/4			2/1/0/e/4			
Computational Fluid Dynamics	BMEGEÁTMW02		2/2/0/p/5			2/2/0/p/5			
Flow Measurements	BMEGEÁTMW03	2/1/1/p/5					2/1/1/p/5		
Teamwork Project	BMEGEÁTMWTP		0/0/3/p/3			0/0/3/p/3			
Diploma									
Final Project A	BMEGEÁTMWDA			0/13/0/p/15					0/13/0/p/15
Final Project B	BMEGEÁTMWDB				0/13/0/p/15			0/13/0/p/15	
Economics and human subjects									
Management	BMEGT20MW02				3/0/0/p/5			3/0/0/p/5	
Marketing	BMEGT20MW01			3/0/0/p/5					3/0/0/p/5
Differentiated proffesional subjects									
Minor Compulsory Subject I.		2/1/1/p/5					2/1/1/p/5		
Minor Compulsory Subject II.			2/1/1/p/5			2/1/1/p/5			
Minor Elective Subject I.				2/0/1/e/3					2/0/1/e/3
Minor Elective Subject II.					2/1/0/e/3			2/1/0/e/3	
Major Elective Subject I.				1/1/0/e/3					1/1/0/e/3
Major Elective Subject II.					2/1/0/e/3			2/1/0/e/3	
Major Elective Subject III.					2/0/1/p/3			2/0/1/p/3	
Elective subjects									
Further Elective Subject 1.					2/0/0/p/3			2/0/0/p/3	
Further Elective Subject 2.				2/0/0/p/3					2/0/0/p/3

Major Elective Subjects & Further Elective Subjects		
Biologically Inspired Systems	BMEGEMIMGBI	2/0/0/p/3
Large-Eddy Simulation in M.E.	BMEGEÁTMW05	1/1/0/p/3 spring
Multiphase and Reactive Flow Modeling	BMEGEÁTMW17	2/0/0/p/3 fall
Building Aerodynamics	BMEGEÁTMW08	2/0/1/p/3 fall
Aerodynamics and its Appplication for Vehicles	BMEGEÁTMW19	1/0/1/p/3 fall
Advanced Technical Acouistics and Measurement Techniques	BMEGEÁTMW10	2/0/0/p/3 fall
Open Source Computational Fluid Dynamics	BMEGEÁTMW11	1/1/0/p/3 spring
Unsteady Flows in Pipe Networks	BMEGEVGMW02	2/0/0/p/3 spring
Hemodynamics	BMEGEVGMW06	2/0/0/p/3 spring
Flow Stability	BMEGEVGMW07	2/0/0/p/3 fall
Theoretical Acoustics	BMEGEVGMW08	2/0/0/p/3 spring

The subjects for the final exam need to be chosen exclusively from the major module subjects (totaling 16 cr)			
Subjects		**Block**	**Subject group**
Computational Fluid Dynamics	BMEGEÁTMW02	Major Compulsory	Major Compulsory Subject I. (5cr)
Flow Measurements	BMEGEÁTMW03	Major Compulsory	Major Compulsory Subject II. (5cr)
select one subject from table of major elective & further elective subjects		Major Elective	Major Elective Subject I. (3cr)
		Major Elective	Major Elective Subject II. (3cr)

Curriculum of MSc Subjects
Mechanical Engineering Modeling - Solid Mechanics module

Subject		lecture/seminar/laboratory/requisite/credit							
		Beginning: spring				Beginning: fall			
Name	Code	1 Spring	2 Fall	3 Spring	4 Fall	2 Fall	1 Spring	4 Fall	3 Spring
Basic knowledge in natural sciences									
Differential Equations and Numerical Methods	BMETE90MX46	4/2/0/e/8					4/2/0/e/8		
Advanced Fluid Mechanics	BMEGEÁTMW01	3/0/0/e/4					3/0/0/e/4		
Advanced Thermodynamics	BMEGEENMWAT	2/1/0/e/4					2/1/0/e/4		
Analytical Mechanics	BMEGEMMMW01	3/0/0/e/4					3/0/0/e/4		
Laser Physics	BMETE12MX00		3/1/0/e/4			3/1/0/e/4			
Electronics	BMEVIAUM001		2/0/1/e/4			2/0/1/e/4			
Advanced Control and Informatics	BMEGEMIMW01		2/1/0/e/4			2/1/0/e/4			
Primary subjects									
Machine Design and Production Technology	BMEGEGEMW01		2/1/0/e/4			2/1/0/e/4			
Finite Element Analysis	BMEGEMMMW02	2/2/0/p/5					2/2/0/p/5		
Continuum Mechanics	BMEGEMMMW03		2/1/0/p/5			2/1/0/p/5			
Teamwork Project	BMEGEMMMWP1		0/0/3/p/3			0/0/3/p/3			
Diploma									
Final Project A	BMEGEMMMWDA			0/13/0/p/15					0/13/0/p/15
Final Project B	BMEGEMMMWDB				0/13/0/p/15			0/13/0/p/15	
Economics and human subjects									
Management	BMEGT20MW02				3/0/0/p/5			3/0/0/p/5	
Marketing	BMEGT20MW01			3/0/0/p/5					3/0/0/p/5
Differentiated proffesional subjects									
Minor Compulsory Subject I.		2/1/1/p/5					2/1/1/p/5		
Minor Compulsory Subject II.			2/1/1/p/5			2/1/1/p/5			
Minor Elective Subject I.				2/0/1/e/3					2/0/1/e/3
Minor Elective Subject II.				2/1/0/e/3					2/1/0/e/3
Major Elective Subject I.				1/1/0/e/3					1/1/0/e/3
Major Elective Subject II.					2/1/0/e/3			2/1/0/e/3	
Major Elective Subject III.					2/0/1/p/3			2/0/1/p/3	
Elective subjects									
Further Elective Subject 1.					2/0/0/p/3			2/0/0/p/3	
Further Elective Subject 2.				2/0/0/p/3					2/0/0/p/3

Major Elective Subjects & Further Elective Subjects		
Biologically Inspired Systems	BMEGEMIMGBI	2/0/0/p/3
Elasticity and Plasticity	BMEGEMMMW05	1/1/0/p/3 spring
Nonlinear Vibrations	BMEGEMMMW06	1/1/0/e/3 spring
Coupled Problems in Mechanics	BMEGEMMMW07	1/0/1/p/3 spring
Mechanisms	BMEGEMMMW08	1/1/0/p/3 fall
Beam Structures	BMEGEMMMW09	1/1/0/e/3 fall
Experimental Methods in Solid Mechanics	BMEGEMMMW10	1/0/1/p/3 fall

The subjects for the final exam need to be chosen exclusively from the major module subjects (totaling 16 cr)

Subjects		Block	Subject group
Finite Element Analysis	BMEGEMMMW02	Major Compulsory	Major Compulsory Subject I. (5cr)
Continuum Mechanics	BMEGEMMMW03	Major Compulsory	Major Compulsory Subject II. (5cr)
select one subject from table of major elective & further elective subjects		Major Elective	Major Elective Subject I. (3cr)
		Major Elective	Major Elective Subject II. (3cr)

Curriculum of MSc Subjects
Mechanical Engineering Modeling - Thermal Engineering module

Subject		lecture/seminar/laboratory/requisite/credit							
		Beginning: spring				Beginning: fall			
Name	Code	1 Spring	2 Fall	3 Spring	4 Fall	2 Fall	1 Spring	4 Fall	3 Spring
Basic knowledge in natural sciences									
Differential Equations and Numerical Methods	BMETE90MX46	4/2/0/e/8					4/2/0/e/8		
Advanced Fluid Mechanics	BMEGEÁTMW01	3/0/0/e/4					3/0/0/e/4		
Advanced Thermodynamics	BMEGEENMWAT	2/1/0/e/4					2/1/0/e/4		
Analytical Mechanics	BMEGEMMMW01	3/0/0/e/4					3/0/0/e/4		
Laser Physics	BMETE12MX00		3/1/0/e/4			3/1/0/e/4			
Electronics	BMEVIAUM001		2/0/1/e/4			2/0/1/e/4			
Advanced Control and Informatics	BMEGEMIMW01		2/1/0/e/4			2/1/0/e/4			
Primary subjects									
Machine Design and Production Technology	BMEGEGEMW01		2/1/0/e/4			2/1/0/e/4			
Combustion Technology	BMEGEENMWCT		2/1/1/p/5			2/1/1/p/5			
Energy Conversion Processes and its Equipment	BMEGEENMWEP	2/1/0/p/5					2/1/0/p/5		
Teamwork Project	BMEGEENMWPR		0/0/3/p/3			0/0/3/p/3			
Diploma									
Final Project A	BMEGEENMWDA			0/13/0/p/15					0/13/0/p/15
Final Project B	BMEGEENMWDB				0/13/0/p/15			0/13/0/p/15	
Economics and human subjects									
Management	BMEGT20MW02				3/0/0/p/5			3/0/0/p/5	
Marketing	BMEGT20MW01			3/0/0/p/5					3/0/0/p/5
Differentiated proffesional subjects									
Minor Compulsory Subject I.		2/1/1/p/5					2/1/1/p/5		
Minor Compulsory Subject II.			2/1/1/p/5			2/1/1/p/5			
Minor Elective Subject I.				2/0/1/p/3					2/0/1/p/3
Minor Elective Subject II.					2/1/0/p/3			2/1/0/p/3	
Major Elective Subject I.				1/1/0/p/3					1/1/0/p/3
Major Elective Subject II.					2/1/0/p/3			2/1/0/p/3	
Major Elective Subject III.					2/0/1/p/3			2/0/1/p/3	
Elective subjects									
Further Elective Subject 1.					2/0/0/p/3			2/0/0/p/3	
Further Elective Subject 2.				2/0/0/p/3					2/0/0/p/3

Major Elective Subjects & Further Elective Subjects		
Biologically Inspired Systems	BMEGEMIMGBI	2/0/0/p/3
Simulation of Energy Engineering Systems	BMEGEENMWSE	1/0/2/p/3 spring
Thermal Physics	BMEGEENMWTP	2/0/1/p/3 spring
Thermo-Mechanics	BMEGEMMMWTM	1/0/1/p/3 fall
Steam and Gas Turbines	BMEGEENMWTU	2/1/0/p/3 fall
Measurements in Thermal Engineering	BMEGEENMWM2	1/0/3/p/4 spring

The subjects for the final exam need to be chosen exclusively from the major module subjects (totaling 16 cr)		
Subjects	**Block**	**Subject group**
Combustion Technology	Major Compulsory	Major Compulsory Subject I. (5cr)
Energy Conversion Processes and its Equipment	Major Compulsory	Major Compulsory Subject II. (5cr)
select one subject from table of major elective & further elective subjects	Major Elective	Major Elective Subject I. (3cr)
	Major Elective	Major Elective Subject II. (3cr)

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

Curriculum of MSc Subjects
Mechanical Engineering Modeling - Design and Technology module

Subject		lecture/seminar/laboratory/requisite/credit							
		Beginning: spring				Beginning: fall			
Name	Code	1 Spring	2 Fall	3 Spring	4 Fall	2 Fall	1 Spring	4 Fall	3 Spring
Basic knowledge in natural sciences									
Differential Equations and Numerical Methods	BMETE90MX46	4/2/0/e/8					4/2/0/e/8		
Advanced Fluid Mechanics	BMEGEÁTMW01	3/0/0/e/4					3/0/0/e/4		
Advanced Thermodynamics	BMEGEENMWAT	2/1/0/e/4					2/1/0/e/4		
Analytical Mechanics	BMEGEMMMW01	3/0/0/e/4					3/0/0/e/4		
Laser Physics	BMETE12MX00		3/1/0/e/4			3/1/0/e/4			
Electronics	BMEVIAUM001		2/0/1/e/4			2/0/1/e/4			
Advanced Control and Informatics	BMEGEMIMW01		2/1/0/e/4			2/1/0/e/4			
Primary subjects									
Machine Design and Production Technology	BMEGEGEMW01		2/1/0/e/4			2/1/0/e/4			
Product Modeling	BMEGEGEMW02		2/0/1/p/5			2/0/1/p/5			
Advanced Manufacturing	BMEGEGTMW01	1/0/3/p/5					1/0/3/p/5		
Teamwork Project	BMEGEGTMWP1		0/0/3/p/3			0/0/3/p/3			
Diploma									
Final Project A	BMEGEGEMWDA			0/13/0/p/15					0/13/0/p/15
Final Project B	BMEGEGEMWDB				0/13/0/p/15			0/13/0/p/15	
Economics and human subjects									
Management	BMEGT20MW02				3/0/0/p/5			3/0/0/p/5	
Marketing	BMEGT20MW01			3/0/0/p/5					3/0/0/p/5
Differentiated proffesional subjects									
Minor Compulsory Subject I.		2/1/1/p/5					2/1/1/p/5		
Minor Compulsory Subject II.			2/1/1/p/5			2/1/1/p/5			
Minor Elective Subject I.				2/0/1/p/3					2/0/1/p/3
Minor Elective Subject II.					2/1/0/p/3			2/1/0/p/3	
Major Elective Subject I.				1/1/0/p/3					1/1/0/p/3
Major Elective Subject II.					2/1/0/p/3			2/1/0/p/3	
Major Elective Subject III.					2/0/1/p/3			2/0/1/p/3	
Elective subjects									
Further Elective Subject 1.					2/0/0/p/3			2/0/0/p/3	
Further Elective Subject 2.				2/0/0/p/3					2/0/0/p/3

Major Elective Subjects & Further Elective Subjects		
Biologically Inspired Systems	BMEGEMIMGBI	2/0/0/p/3
CAD Technology	BMEGEGEMW04	1/0/2/e/4 spring
Materials Science	BMEGEMTMW01	2/0/0/e/3 spring
Structural Analysis	BMEGEGEMW05	1/0/2/p/4 spring
Process Planning	BMEGEGTMW02	1/1/0/p/3 fall
NC Machine Tools	BMEGEGTMW03	1/1/0/p/3 fall
Fatigue and Fracture	BMEGEMTMW02	2/0/0/e/3 fall

The subjects for the final exam need to be chosen exclusively from the major module subjects (totaling 16 cr)			
Subjects		**Block**	**Subject group**
Product Modeling	BMEGEGEMW02	Major Compulsory	Major Compulsory Subject I. (5cr)
Advanced Manufacturing	BMEGEGTMW01	Major Compulsory	Major Compulsory Subject II. (5cr)
select one subject from table of major elective & further elective subjects		Major Elective	Major Elective Subject I. (3cr)
		Major Elective	Major Elective Subject II. (3cr)

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 engieneering. 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 elec- tric 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 ferromagnets. 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 gea-, 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 techiques 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 crecits.

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 characteristics of machines. Statistical hypothesis tests. 2 hours/2 credits.

Fundamentals of FEM

BMEGEMMAGM5

Short history of the finite element method. The principle of the total potential energy minimum. Ritz's method for slender beams, matrix formulation. Basic algebraic operations in Maple. The basics of the finite element discretization, element types. Detailed description of the TRUSS2D and BEAM2D 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. Longitudinal, torsional and bending vibration of slender beams. Finite element analysis of vibration problems, frequency and mode shape analysis. Eigenvalue problems in Maple. Critical angular velocities of rotating shafts with disks. Plane elasticity, linear triangle element, stiffness matrix, load vector, modeling example. Solution of FE problems in Maple. Laboratory practices using ANSYS and COSMOS/M. 3 hours/3 credits.

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 lec- tures 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. Physicalchemical 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. Energysave consumer equipments. 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 volume 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

BMEGEATMW01

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. Modelling 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, Transferfunctions, 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 fow. 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, modelling 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 nondestructive material testing methods, equipments 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, tomograpy. 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 superelastic 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 modelling. TOP-DOWN design in static constructions. Issuing homework No.1. Overview on 3D assembly modelling. 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 behaviour analysis of machine construction and the optimal design using the tools of geometrical modelling 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 modelling 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. Nonconventional 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, Tolerancing, 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 modelling (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 moulding, pressing, vacuum forming, GMT. Damage and failure of polymer composites: testing and approving methodologies. Basics of composite mechanics: types of material behaviour, 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, summarising 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 of 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)

Description of MSc Subjects

Mechanical Engineering Modeling

Basic Subjects for each module

Differential Equations and Numerical Methods

BMETE90MX46

First order ordinary differential equations, difference between linear and nonlinear equations. Elementary methods of solution (undetermined coefficients, variation of parameters, etc.) The existence and uniqueness theorem. Modeling with first order equations. First order difference equations. Introduction into numerical methods: explicit, implicit schemes, stability problems, multi-step methods. Second order linear ordinary differential equations, homogeneous and nonhomogeneous equations. Series solutions of second order equations, ordinary points, regular singular points, Bessel equations. Systems of first order ordinary differential equations. Classification of equilibrium points; Introduction into Lyapunov stability; almost linear systems. 2-dimensional autonomous systems. Linearization. Phase space analysis near equilibrium points (linearization, Poincaré theory), periodic orbits. Classification of abstract vector spaces, inner product spaces, generalized Fourier series. Orthogonal function systems, trigonometric Fourier series, Gibbs phenomenon. Sturm-Liouville problems, Vibrating string, heat transfer problem in Cartesian and in cylindrical coordinates, Bessel functions, vibrating drumhead.

Laser Physics

BMETE12MX00

Theory of laser oscillation, characteristics of laser light, laser applications. Interaction of photons with atoms, line-broadening mechanisms, coherent amplification, optical resonator, conditions of continous wave and transient laser oscillation. Properties of laser beams: monochromacity, coherence, directionality, brightness. Laser types: solid-state, semiconductor, gas, fluid (dye) and miscellaneous. Laser applications: industrial, medical, communication, measurement technique.

Analytical Mechanics

BMEGEMMMW01

Review of Dynamics, Strength of Materials and Vibrations. D'Alambert's Priciple. Dynamic effects in Strength of Materials. Maximum equivalent stress calculation in structures of large acceleration (ventilator and turbine blades, engine parts). Natural frequencies and vibration modes of multi DoF systems. Rayleigh's ratio, Stodola iteration and Dunckerley's formula. Calculation of natural frequencies in beam structures by means of analytical estimation and finite element code. Natural frequencies and vibration modes of continuum beams (bending, longitudinal). Vibrations of strings. Calculation of natural frequencies in beam structures subjected to bending vibrations by solving partial differential equations. Bending vibrations of rotating shafts. Variation of natural frequencies due to gyroscopic effects. Campbell diagrams.

Advanced Fluid Mechanics

BMEGEÁTMW01

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. Transition. Turbulent boundary layers. BL control. Overview of computational fluid dynamics (CFD). Turbulence models. Fundaments of gas dynamics. Wave phenomena. Isentropic flow. Normal shock waves. Oblique shock waves, wave reflection. Prandtl-Meyer expansion. Supersonic jets. Atmospheric flows. Aerosols. Aeroacoustics. Pipe networks. Case studies.

Advanced Thermodynamics

BMEGEENMWAT

Homogeneous systems - Ordinary (equilibrium) thermodynamics: Basic thermodynamic concepts. Models, theories and laws. Extensives and intensives. Gibbs relation.Thermodynamic potentials. Thermodynamic stability. Phases and phase equilibrium. Gases, liquids and solids. Math1: partial derivatives, Math2: Legendre transformations, differentials. Zeroth, First and Second Law – statics. Laws of thermodynamics. Math3: Differential equations, stability, Liapunov-functions. Gibbs relation and differential equations. Equilibrium. Quasistatic and irreversible processes. Single body in an environment. System of bodies and environments. Heat and work. Reservoirs, extended systems. Exergy analysis. Entropy generation minimization. Heat exchangers, power plants. Multicomponent phase equilibrium, solutions. Continua - Non-equilibrium thermodynamics: basics – balances of basic quantities. Math4: Tensor analysis, indices. Balances, partial diff. equations, constitutive functions, objectivity and second law. Second law. Entropy production. Linear laws. Onsager reciprocity. Isotropy. Local equilibrium. Heat conduction, diffusion and flow in one component fluids. Cross effects. Heat conduction and flow in isotropic solids. Cross effects. Out of local equilibrium. Internal variables. Heat conduction and flow in isotropic solids. Cross effects. Rheology. Poynting-Thomson body. Measurement of parameters, applications, etc., constructal theory, etc. Fuel cells.

Electronics

BMEVIAUM001

Electronic components: Diode, Zener diode, Transistors (bipolar and field effect transistors), Common-emmiter characteristics. Discrete circuits: Emitter-follower circuit, Amplification, Impedance matching, Series connection of amplifier stages, Feedback. Integrated circuits: Operational amplifier, Mathematical operations, Wave shape generation, Function generation, Filters, Power supply.

Advanced Control and Informatics

BMEGEMIMW01

Short overview of the classical design methods of PID controllers. Sensors and actuators of an internet based motion control system. Implementation of discrete time PID controller for an internet based motion control system. Linear Time Invariant systems. Controllability and Observability. Canonical forms, the Kalman decomposition, realization theory, minimal realizations. Sate feedback control: pole placement, Linear Quadratic Regulator (LQR), Linear Quadratic Gaussian (LQG) control designs. Discrete Time Systems. Robust Control, H infinity control, Sliding Mode Control, Implementation of sliding control desing for an internet based motion control system.

Fluid Mechanics module

Primary Subjects

Machine Design and Production Technology

BMEGEGEMW01

The goal of the course is to give a theoretical overview on the fields of machine design and production technology, according to the detailed topics below. Some elements of the methodology is covered on the seminars throughout a semester project.
Machine design: Design principles and methods. Requirements.Modern design techniques.Structural behavior and modeling.Design of frame structures.Polymer and composite components. Load transfer between engineering components. Structural optimization (object function, design variables, constrains, shape and size optimization).
Production: Machine-tools and equipment, devices and fixtures, kinematics, machining principles, production procedures and processes, production volume, batches and series. Manufacturability and tooling criteria, preliminary conditions and production analysis, methods of sequencing operations, production planning and scheduling. Production management (TQC and JIT), automated production; cellular manufacturing, machining centres and robots. Product data and technical document management (PDM, TDM), engineering changes and production workflow management (CE, ECM).

Computational Fluid Dynamics

BMEGEÁTMW02

Main objective of the subject is providing sufficient theoretical background and practical knowledge for professional CFD engineers. Detailed thematic description of the subject: Numerical approximations of derivatives and integrals. Discretisation of divergence, gradient and Laplace operator by means of finite volume method. Numerical modeling of incompressible flows, resolution of pressure-velocity coupling in terms of psi-omega method and pressure correction method. Characteristics of turbulence and turbulence modeling. Application of finite volume discretisation method in a one-dimensional case. Stability of the central differencing scheme, upwinding, and numerical diffusion.Solution of algebraic systems which are obtained by the discretisation of the governing equations of fluid flows. Iterative methods, multigrid methods. Compressible flow modeling. Method of characteristics, application of finite volume method.Introduction to multiphase flow modeling.Application of User Defined Functions (UDFs) in ANYSYS-Fluent simulation system. Seminars in CFD Laboratory: Generation of block-structured meshes with ICEM CFD software. Individual assignment. Convergence checking, mesh independency checking, comparison of results of various models with measured data. Handing in the report of the individual assignment. Group assignment (in groups of 3 students). Convergence checking, mesh independency checking, comparison of results of various models with measured data. Tutorial examples in multiphase flow modeling. Handing in the report of group assignment.UDF examples. Presentation of the results of group assignments.

Flow Measurements

BMEGEÁTMW03

Main objective of the subject is getting acquainted with the measurement principles, application areas, advantages and limitations of various flow measuring techniques applied in industrial practice as well as in research&development related laboratory activities. Detailed thematic description of the subject: Practical / industrial aspects of flow measurements. Measurement of temporal mean pressures: static, total, dynamic. Probes and methods. Manometers. Pressure-based measurement of velocity magnitude and direction. Anemometers, thermal probes. Measurement of unsteady pressures. Temperature measurements. Hot wire anemometry. Laser optical flow diagnostics: Laser Doppler Anemometry (LDA), Phase Doppler Anemometry (PDA), Particle Image Velocimetry (PIV). Flow visualization. Flow rate measurements with use of contraction elements and deduced from velocity data. Comparison. Flowmeters: ultrasonic, MHD, capacitive crosscorrelation technique, Coriolis, vortex, rotameter, turbine, volumetric. Industrial case studies. Collaboration of measurement technique and computational simulation. Laboratory exercise.

Teamwork Project

BMEGEÁTMWTP

Experimental and/or numerical (CFD) teamwork project proposals will be announced by the supervisors on the registration week or before for group of 2-3 students. The Teamwork Project proposals are defined as being complex problems for the 1st or 2nd semester, and also can be continued partly by a single student in course of the Final Project A or B (BMEGEÁTMWDA or BMEGEÁTMWDB) in the 3rd and 4th semester, hence resulting in a fully complex MSc Thesis of the student at the end of the curriculum. A so-called Evaluation Team (ET) is formed in that the group's supervisor + two advisors are participating, being the members of ET.

Final Project A

BMEGEÁTMWDA

The aim of the course is to develop and enhance the capability for complex problem solving of the students under advisory management of the so-called Evaluation Team. The student's supervisor and two advisors form the Evaluation Team (ET).
Detailed thematic description of the subject: various experimental and/or numerical (CFD) project proposals are announced by the supervisors well before the registration week. The project proposals are defined as being complex problems both for the 3rd and further on the 4th semester, since they are to be continued in course of the Final Project B (BMEGEÁTMWDB) in the 4th semester. The findings of the complex, two-semester long project will be summarised in the final Master (MSc) Thesis.
In course of the Final Project A and further on the Final Project B the student will work on one selected challenging problem of fluid mechanics.
1st ET meeting - 4th week:
1st project presentation by the student
2nd ET meeting - 8th week:
2nd project presentation by the student
3rd ET meeting - 14th week:
3rd project presentation by the student
15th week: submission of the major Project Report in printed and electronic format.
Evaluation Team members assess the students work, presentations & report.
Note, that for students taking the major in Fluid Mechanics of Mechanical Engineering Modeling MSc various Final Project A proposals are announced also by the Dept. Hydrodynamic Systems (under their own subject code BMEGEVGMWDA).

Final Project B

BMEGEÁTMWDB

The aim of the course is to develop and enhance the capability for complex problem solving of the students under advisory management of their project supervisor and two advisors. Each student's project is guided by the project supervisor and depending on the problem -if applicable- by two advisors. They form the so-called Evaluation Team (ET). ET meetings are organized 3 times per semester.
Detailed thematic description of the subject: Several experimental and/or numerical (CFD) final project proposals will be announced by the project leaders well before the registration week. The final project proposals are defined as being complex problems of mainly fluid mechanics, usually they must be the continuation of the major projects' proposals. The students will work on complex problems proposed in the 3rd semester in course of the Final Project A (BMEGEÁTMWDA). The Final Projects A and B together serves as a two-semester project that results in the Master (MSc) Thesis of the student. In course of the Final Project B one single student will work on the selected challenging problem of fluid mechanics.
1st ET meeting - 4th week:
1st project presentation by the student
2nd ET meeting - 8th week:
2nd project presentation by the student
3rd ET meeting - 14th week:
3rd final project presentation by the student
15th week: submission of the final Project Report (ie. the Master Thesis) in printed and electronic format. Evaluation team members assess the students work, presentations & report.
Note, that for students taking the Final Project A that was announced by the Dept. Hydrodynamic Systems (under subject code BMEGEVGMWDA) must continue their project in course of the Final Project B announced also by the Department of Hydrodynamic Systems (under code BMEGEVGMWDB).

Subjects in Economics and Human Sciences

Marketing

BMEGT20MW01

Marketing in the 21st century. Strategic marketing planning. The modern marketing information system. Consumer markets and buyer behavior. Business markets and business buyer behavior. Competitive strategies. Market segmentation, targeting, and positioning. Product strategy and newproduct development. Managing services. Designing pricing strategies. Marketing channels. Integrated marketing communication.

Management

BMEGT20MW02

The objectives of the course are that the students know the duties of management and the attributes of the manager job with the current formed perception in different ages. Over the set targets the students will understand the characteristic of human behaviour, the behaviour of managers and their employee, the team properties in the labour-environment and the corporations how develop their functional rules. The applicable (for previous) management methods and their expected effects on the members of corporation and their capacities are presented in the course of the discussed themes.

Major Elective and Further Elective Subjects

Biologically Inspired Systems

BMEGEMIMGBI

The design of engineering structures increasingly involves mimicking and improvement of natural, living structures to perfection. In addition to a more accurate understanding and systematization of living systems, it is increasingly important that both engineering students and engineers get acquainted with this topic. The basic goal of the course is the analysis of different biological systems and of the engineering structures mimicking them throughengineering and systems theory considerations. Specific solutions of biological systems for different materials, structures, sensor systems, motion and control can be properly applied.

Large-Eddy Simulation in Mechanical Engineering

BMEGEÁTMW05

The main objective of the subject is to get familiar with the concept of Large-Eddy Simulation and its widely used techniques. A secondary objective is to gain knowledge about post-processing techniques specially suited for instantaneous and steady 3D flow data. Applications from turbulent heat transfer and noise production will be shown. Detailed thematic description of the subject: Motivations why to use Large-Eddy Simulation (LES). Filtering of the incompressible Navier-Stokes equations, basic filter properties. Numerical requirements of the simulation. Subgrid scale modeling approaches. Interacting error dynamics. Practical aspect of the simulation (domain time and mesh requirements). Special LES boundary conditions: inlet turbulence generation. Hybrid and zonal LES/RANS approaches. Postprocessing of LES results: flow topology description, vortex detection methods. Case studies: internal cooling channel, flow around an airfoil, near field of a jet.

Multiphase and Reactive Flow Modeling

BMEGEÁTMW17

Physical phenomena, major concepts, definitions and modeling strategies. Mass transport in multi-component systems: diffusion and chemical reactions. Modeling chemical reactions: flames, combustion models, atmospheric reactions. Fluid dynamical and thermal phenomena in two-phase pipe flows: flow regimes in vertical, horizontal and inclined pipes. Advanced multi-phase flow instrumentation. Transport through deforming fluid interfaces: jump conditions at discontinuities. Single-fluid and interpenetrating media modeling approaches. Obtaining practical transport equations for multiphase pipe flows by cross sectional integration and cross sectional averaging. Closure relations. Mixture and multi-fluid models. Using experimental correlations. Relevant dimensionless numbers. Gravity and capillary waves. Dispersed particle transport. Sedimentation and fall-out, particle agglomeration and break-up. Bubble growth and collapse. Phase change and heat transfer in single-component systems: boiling, cavitation, condensation. Related heat transport problems and industrial applications. Computational Multi-Fluid Mechanics (CMFD): general methods and limitations, usage of general purpose computational fluid dynamics codes, design of specialized target software. Numerical modeling free surfaces and fluid-fluid interfaces. Review of applications in power generation, hydrocarbon and chemical industry.

Building Aerodynamics

BMEGEÁTMW08

Basics of meteorology: characteristics of atmospheric boundary layer and its modeling. Arising of wind forces, bluff-body aerodynamics: boundary layer separation, characteristics of separated flows, vortices, their effects on the flow description of complex 3-dimensional flow fields. Wind comfort, dispersion of pollutants in urban environment / Numerical simulation of dispersion of pollutants in urban environment by using MISKAM code. Numerical simulation of dispersion of pollutants in urban environment using the MISKAM code. Usage of wind tunnels in determination of wind loading. Flow visualization around buildings in wind tunnel. Static wind load on buildings and structures, prediction of static wind load by using EUROCODE and ASCE standards. Fundamentals and philosophy. Wind and structure interaction, aero-elasticity. Aerodynamics of bridges, prediction of dynamic wind load on buildings, structures by using EUROCODE, basics of numerical simulation using solid-fluid interaction. Design of cooling towers. Design and wind load of water spheres. Wind load on telecommunication masts - aerodynamic and related design issues, developments. Aerodynamics of membrane structures. CFD and wind tunnel case studies (large buildings, stadium roofs).

Aerodynamics and Its Application for Vehicles

BMEGEÁTMW19

Introduction, bluff body aerodynamics. Characteristics of atmospheric boundary layer. Basics of car design (in co-operation with MOME: Moholy-Nagy University of Arts and Design Budapest). Aerodynamics of automobiles. Aerodynamics of buses and trucks. Aerodynamics of racing cars. Wind tunnels and their use for vehicle aerodynamics. Definition of projects, forming groups of students. Measurement of car models evaluation of car bodies from aerodynamic and design point of view (in co-operation with MOME: Moholy-Nagy University of Arts and Design Budapest).
Individual project: passenger car modeling. 2-4 students form one group. Every group will receive two modeling wood of 3 various given dimensions. With the help of plasticine, a passenger car of M 1:20 scale can be created. The relative position of the pieces of woods can be freely chosen, as far as the model resembles a car. The ground clearance (underbody gap) is 11mm, the distance of the axes is 140mm. The diameter of the wheels is 30mm, their width is 8mm. Wheels can be formed of the plasticine provided. In the larger piece of wood – under the passenger compartment – four boreholes are created, in order to attach the model to the aerodynamic force measuring mechanism. The maximum length of the model is 250mm, its minimum height is 60mm, and its width is between 82 and 90mm. The perpendicular cross section of the model has to be determined (together with the wheels), in order to determine drag and lift coefficients. There is a possibility to place attachments on the car model, like spoilers, ski boxes, etc. Besides the force measurement, there will be a possibility for flow visualization around the car, during which the location and size of the separation bubbles, the size of the dead water region behind the car, effect of spoilers and other attachments, and soiling of the rear face of the car can be observed. The measurements groups have to prepare a project presentation on the last class. The groups have to send their presentation by e-mail 2 working days before the presentation at the latest.

Advanced Technical Acoustics and Measurement Techniques

BMEGEÁTMW10

3D homogeneous wave equation and the general solution. The 3D solution of the wave equation in bounded space, room modes. The sound propagation in tubes, the sudden cross-sectional area change and tube termination. The simple expansion chamber silencer, and the sound propagation in horns. Sound propagation in duct and higher order modes. The ray theory, sound propagation in non-homogeneous media. Spherical waves, and the point monopole, dipole and quadrupole sound sources, model laws. The flow generated sound, Lighthill's acoustic analogy and the inhomogeneous wave equation. The attenuation of sound waves. Acoustic measurements, microphones, analysers, calibrators. Anechoic and reverberating chambers. Basic acoustic measurement problems. The sound intensity measurement, the microphone array.

Open Source Computational Fluid Dynamics

BMEGEÁTMW11

Introduction to OpenFOAM including Linux basis, and other required software such as gnuplot and paraview. Installation of OpenFOAM on several Linux distributions and virtual linux systems (Ubuntu, Opensuse, Fedora) from packages and on other systems from source. Solution of simple 2D fluid dynamics problems using OpenFOAM (driven cavity flow, 2D boundary layer, Poiseuille flow) including the comparison with theoretical results. Detailed introduction to OpenFOAM software components including meshing tools, solvers and post-processing tools. Single phase stationary and transient flows, turbulence, compressible flows. Introduction to models, boundary conditions and solvers required for the simulation of these problems. Examples on these problems. Multiphase and reactive flows, including the introduction to models, boundary conditions and solvers required for the simulation of these problems. Examples on these problems. Extension of OpenFOAM capabilities by program code development in C++. Compiling code components, the implementation of boundary conditions, applications and models. Personalized projects using OpenFOAM. Further open source CFD tools (Code Saturn, Palabos).

Unsteady Flows in Pipe Networks

BMEGEVGMW02

Overview of the program, introduction. Overview of applied numerical methods (Newton-Raphson, Runge-Kutta). 1D instationary flow of quasy-constant density fluid, MOC. Method of characteristics (realisation). Dynamics of air wessel. Dynamical model of pumps. Water hammer, transient pipe network simulation, homework. Open channel flow, basic equations. Lax-Wendroff scheme. Application of MOC for open channel flow. Gasdynamics. 1D transient gas.

Hemodynamics

BMEGEVGMW06

Introduction to physiology. Circulation system, arterial and venous system. Blood flow measurement methods, invasive techniques. Non-invasive blood flow measurements, Transmission properties of cuff-systems, estimation of eigenfrequency. Introduction to the method of characteristics (MOC). MOC and Solution for rapid change, Alievi (Joukowsky)-wave. MOC and study of the transmission properties of invasive blood pressure measurement technique (arterial catheter). Models and methods for the de-

scription of blood flow in blood vessels, material properties, Streeter-Wiley Model 1 and Model 2. Characteristic physiological quantities and their influence in hemodynamics. Flow in aneurysms.

Flow Stability

BMEGEVGMW07

Mechanisms of instability, basic concepts of stability theory, Kelvin-Helmholz instability. Basics of linear stability for continuous and discrete systems with examples; stability of discretization techniques (explicit and implicit Euler technique, Runge-Kutta schemes) and linear stability analysis of surge in turbomachines. The Hopf bifurcation theorem with application to turbomachinery. Galerkin projection and its applications. Lorenz equations, derivation (Rayleigh-Bénard convection), linear and nonlinear stability, interpretation of the bifurcation diagram. Loss of stability of parallel inviscid and viscous flows. Instability of shear layers, jets, boundary layers. Compound matrix method.

Theoretical Acoustics

BMEGEVGMW08

Wave equation. Lighthill's theory, monopole, dipole, quadrupole sound sources. Green's functions on the example of the vibrating string. Free space Green's functions. Modification of Green's functions in the vicinity of solid bodies. Vortex sound equation.

Solid Mechanics module

Primary Subjects

Machine Design and Production Technology

BMEGEGEMW01

The goal of the course is to give a theoretical overview on the fields of machine design and production technology, according to the detailed topics below. Some elements of the methodology is covered on the seminars throughout a semester project.
Machine design: Design principles and methods. Requirements. Modern design techniques. Structural behavior and modeling. Design of frame structures. Polymer and composite components. Load transfer between engineering components. Structural optimization (object function, design variables, constrains, shape and size optimization).
Production: Machine-tools and equipment, devices and fixtures, kinematics, machining principles, production procedures and processes, production volume, batches and series. Manufacturability and tooling criteria, preliminary conditions and production analysis, methods of sequencing operations, production planning and scheduling. Production management (TQC and JIT), automated production; cellular manufacturing, machining centres and robots. Product data and technical document management (PDM, TDM), engineering changes and production workflow management (CE, ECM).

Finite Element Analysis

BMEGEMMMW02

The basic equations of linear elasticity. The principle of the total potential energy mimum. Finite element discretization. Shear effect in beams, Timoshenko beam theory. FE formulation of Timoshenko beams. Isoparametric Timoshenko beam element, shear locking, interpolation with exact nodal solution, examples. The basic equations in plane elasticity. Isoparametric quadrilateral elements, shape functions, Jacobian matrix and deteminant. Numerical integration, Gaussian rule. Stiffness matrix and load vectors of quadrilaterals. Stability of linear elastic systems, the method of Trefftz. FE formulation of stability problems, geometric stiffness matrix. Buckling, lateral buckling and lateral-torsional buckling of slender beams with symmetric cross section, examples. Torsion of straight prismatic beams. Free vibration analysis with FEM, vibration of Timoshenko beams. FE solution of damped forced vibrations, Duhamel integral. Direct time integration, central difference method, Newmark's method, numerical examples. Second order dynamics, buckling vibration of beams. Dynamic stability. Modeling examples in ANSYS including elasticity, plasticity, elastic stability, dynamics and thermomechanics problems.

Continuum Mechanics

BMEGEMMMW03

Historical overview. Mathematical background (Cartesian tensors, properties and representations, invariants, tensor fields, derivatives of tensors, integral theorems). Kinematics. Bodies and configurations. Lagrangian and Eulerian description of a continuum. Deformation gradient. Deformation of arc, surface and volume elements. Deformation and strain tensors. Polar decomposition: stretch and rotation tensors. Displacement, infinitesimal strain and rotation. Material time derivative. Rates of deformation: stretching and spin tensors. Conservation of mass, continuity equation. Concept of force. Cauchy's theorem on the existence of stress. First and second Piola-Kirchhoff stress tensors. Linear momentum principle. Equation of motion. Angular momentum principle. Balance of energy: concepts on stress power, rate of work, internal energy. First and second law of thermodynamics. Clausius-Duhem inequality. Dissipation function. Constitutive theory. Principles of determinism and local action. Material frame indifference and objectivity. Introduction of hyperelastic materials.

Teamwork Project

BMEGEMMMWP1

Solution of complex problems by forming group of students including the following topics: cutting processes, vibration measurements, robot control, stability theory.

Final Project A

BMEGEMMMWDA

The Final Project A subject is dedicated to the preparation of the first half of the MSc thesis. Each student must choose a proposal and a supervisor or supervisors. The proposals are available at the websites of the department or these can be requested from the professors in the course of a personal communication. The aim of the subject is to develop and enhance the problem solving capability of the students under advisory management of their supervisor. The requirement is a practical mark at the end of the semester, which is determined entirely by the supervisor.

Final Project B

BMEGEMMMWDB

The Final Project B subject is dedicated to prepare the second half of the MSc thesis. As the continuation of the Final Project B, the aim of the subject is to demonstrate the ability of the student to solve high level, practical engineering problems, based on acquired knowledge in the fields of mechanical engineering. In some special cases the students can choose a different topic than that of the Final Project A, however in this case the thesis should be prepared in the course of one semester. The projects have to be prepared by the students under the guidance of supervisors. The Final Projects include tasks in design, simulations, laboratory tests, manufacturing as well as controlling, interfacing and software tasks. The expected result is mostly a Final Report prepared according to written formal requirements. During the Final Exam, the results have to be explained in an oral presentation.

Subjects in Economics and Human Sciences

Marketing

BMEGT20MW01

Marketing in the 21st century. Strategic marketing planning. The modern marketing information system. Consumer markets and buyer behavior. Business markets and business buyer behavior. Competitive strategies. Market segmentation, targeting, and positioning. Product strategy and newproduct development. Managing services. Designing pricing strategies. Marketing channels. Integrated marketing communication.

Management

BMEGT20MW02

The objectives of the course are that the students know the duties of management and the attributes of the manager job with the current formed perception in different ages. Over the set targets the students will understand the characteristic

of human behaviour, the behaviour of managers and their employee, the team properties in the labour-environment and the corporations how develop their functional rules. The applicable (for previous) management methods and their expected effects on the members of corporation and their capacities are presented in the course of the discussed themes.

Major Elective and Further Elective Subjects

Biologically Inspired Systems

BMEGEMIMGBI

The design of engineering structures increasingly involves mimicking and improvement of natural, living structures to perfection. In addition to a more accurate understanding and systematization of living systems, it is increasingly important that both engineering students and engineers get acquainted with this topic. The basic goal of the course is the analysis of different biological systems and of the engineering structures mimicking them throughengineering and systems theory considerations. Specific solutions of biological systems for different materials, structures, sensor systems, motion and control can be properly applied.

Elasticity and Plasticity

BMEGEMMMW05

Introduction to the constitutive modeling in solid mechanics. Classification of the constitutive theories. Gradient, divergence and curl in cylindrical coordinate system. Small strain theory. Compatibility of strain. Governing equations of linear elasticity. Hooke's law. Plane stress and plane strain problems. Airy stress function.Torsion of prismatic bar. Analytical stress solution of rotating disc and of thick-walled tube with internal pressure. One-dimensional plasticity. Uniaxial extension and compression problems with hardening. Elastic-plastic deformation of thick-walled tube with internal pressure. Haigh-Westergaard stress space. Formulation of the yield criteria. Linear isotropic and kinematic hardening. Nonlinear hardenings. Formulation of the constitutive equation in 3D elastoplasticity. Radial return method.

Nonlinear Vibrations

BMEGEMMMW06

Nonlinearities in mechanical systems: springs, dampers, inertia. Phase plane analysis of 1 degree-of-freedom systems. Saddles, nodes and spirals, stable and unstable equilibria. Vibrations of conservative nonlinear systems. Catastrophe theory: typical bifurcations of equilibria. Construction of trajectories and their analysis in case of inverted pendulum supported by spring, pitchfork bifurcation. The dynamic effects of nonlinear damping. Forced vibration and resonances in systems of nonlinear springs. Analytical and numerical calculation of resonance curves in case of hardening and softening characteristics. Self-excited vibrations. Liénard and Bendixson criteria for limit cycles. Hopf bifurcation theory. Stick-slip oscillations, estimation of stable and unstable periodic motions.

Coupled Problems in Mechanics

BMEGEMMMW07

Coupled field problems. Diffusion equations. Coupled piezo-thermo-mechanical equations. Steady-state thermal analysis. Thermo-mechanical analysis. Micro-electromechanical systems. Beam and plate type microstructures. Sensors and actuators. Piezoelectric-thermo-mechanical analysis of an actuator. Electro-mechanical analysis of a capactive pressure sensor. Fluid-structure interaction. Fluid-structure coupled acoustic analysis. Contact problems. Contact simulation of two microcantilevers. Shape memory alloys, smart structures.

Mechanisms

BMEGEMMMW08

Overview of structural elements and kinematic fundamentals. Basics of synthesis of planar mechanisms. Fourbar mechanisms. Coupler curves. Single and double dwell mechanisms. Velocity and acceleration analysis. Apparent velocity, Aronhold-Kennedy theorem, coordinate partitioning method, and the method of appended driving constraints. Spatial representation of position and orientation. Parameterization of rotations, Euler angles, Tait-Briant angles, Roll-Pitch-Yaw angles, Axis-angle representation, Exponential mapping, Euler parameters. Joint- and operational space. Forward kinematics. The Denavit-Hartenberg convention. Equation of motion of robots, Euler-Lagrange method, Recursive Newton-Euler approach. The concept of natural coordinates. Dynamic equation of motion in terms of non-minimum set of generalized coordinates. Constrained systems. Service robot-, and haptic application examples. Impulsive dynamic analysis. Numerical simulation.

Beam Structures

BMEGEMMMW09

Free torsion of prismatic bars. Saint-Venant warping function, stress function. Torsion of single- and multi-cell sections. Warping of thin-walled sections, the sector area function, definition of shear center. Transformation of the sector area function. Examples for open and closed sections. Constrained torsion of thin-walled open sections, bimoment, torsional warping constant, warping statical moment. Governing differential equations and boundary conditions under constrained torsion, examples: U-section and I-section beams. Demonstration of the importance of shear center through real models. Shearing of thin-walled section beams. Shear-warp function, shear center. Engineering solutions for open and closed sections, modified statical moments. Advanced analysis of built-in beams, Saint Venant effect and Winkler elastic foundation models. The basic theory of sandwich beams with thin and thick facesheets. Definition of anti-plane core materials, application examples.

Experimental Methods in Solid Mechanics

BMEGEMMMW10

Strain measuring methods, theory and practice, strain gauges. Application to an aluminium block. Linear elastic fracture mechanics of composites, fracture model of Griffith. Manufacturing of composite specimens. Evaluation of fracture mechanical tests. Direct and indirect data reduction schemes. J-integral, improved beam theory schemes, elastic foundation beams, crack tip shear deformation in composite beams. Application of the virtual crack-closure technique. Mode-I and mode-II fracture tests. The mixed-mode bending problem. Mode partitioning in mixed-mode I/II tests. Fracture envelopes and fracture criteria. Test methods for the mode-III interlaminar fracture. Experimental equipments and measuring methods. Stability and vibration of delaminated beams.

Thermal Engineering module

Primary Subjects

Machine Design and Production Technology

BMEGEGEMW01

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Production: Machine-tools and equipment, devices and fixtures, kinematics, machining principles, production procedures and processes, production volume, batches and series. Manufacturability and tooling criteria, preliminary conditions and production analysis, methods of sequencing operations, production planning and scheduling. Production management (TQC and JIT), automated production; cellular manufacturing, machining centres and robots. Product data and technical document management (PDM, TDM), engineering changes and production workflow management (CE, ECM).

Combustion Technology

BMEGEENMWCT

Course is started with introduction of fuel properties and fuel supply systems. It is followed by calculation of mass and energy balance of combustion, stoichiometry and CO2 and pollutant emission, flue gas loss calculation, condensation of flue gas components. Heat transfer in combustion chamber has important role on energy balance and retention time formation. After that combustion process of different fuels, parameters of combustion will be presented as homogenous / heterogeneous reactions, flow type and concentration effects on chemical reactions. Nowadays application of catalysts in combustion process and flue gas cleaning has become important part of this technology. Anaerobe biogas generation, gas cleaning and features and gasification technology overview, features of generated gas, gas cleaning technologies, tar filtering and/or condensation, torrefaction and pirolysis will be discussed as well. Carbon capture and storage (CCS) technologies will be also presented. Int he end comparison of different thermal conversion technologies (combustion, gasification, etc.) on mass and energy balance will be presented.Finally solutions applied in firing technic will be demonstrated as firing system in general, control and regulation, firing system principals for liquid and gaseous fuels, andfor soild fuels, and waste material incineration.

Energy Conversion Processes and Its Equipement

BMEGEENMWEP

Basics. Cooling systems and main parameters. Absorption cooling systems and special cooling systems. Fuel cells. Combustion technology, parameters and emissions. Different hot water and steam generation systems. Different hot water and steam generation main parameters. Steam turbines, different steam turbine cycles. Steam turbines, different steam turbine constructions. Gas turbines, different gas turbine constructions and cycles. Main parameters and characteristic of internal combustion engines. Management of internal combustion engines. Gas engines. Cogeneration and tri-generation systems and parameters.

Teamwork Project

BMEGEENMWPR

The complex task covers a semester project in the diverse topics of energetics.

Final Project A

BMEGEENMWDA

In course of the Final Project A one student or group of 2 students will work on one selected challenging problem of mechanical engineering. Several experimental and/or numerical project proposals will be announced by the project leaders. The aim of the course is to develop and enhance the capability for complex problem solving of the students under advisory management of their project leader. At the end of each semester a written Project Report is to be submitted and the summary and findings of the investigations on the selected problem is to be presented as Project Presentation.

Final Project B

BMEGEENMWDB

The aim of the subject of is to demonstrate the ability of the student to solve high level, practical engineering problems, based on acquired knowledge in the fields of mechanical engineering. The projects have to be prepared by the students under the guidance of supervisors. The Final Projects include tasks in design, simulations, laboratory tests, manufacturing as well as controlling, interfacing and software tasks. The expected result is mostly a Final Report prepared according to written formal requirements. During the Final Exam, the results have to be explained in an oral presentation.

Subjects in Economics and Human Sciences

Marketing

BMEGT20MW01

Marketing in the 21st century. Strategic marketing planning. The modern marketing information system. Consumer markets and buyer behavior. Business markets and business buyer behavior. Competitive strategies. Market segmentation, targeting, and positioning. Product strategy and newproduct development. Managing services. Designing pricing strategies. Marketing channels. Integrated marketing communication.

Management

BMEGT20MW02

The objectives of the course are that the students know the duties of management and the attributes of the manager job with the current formed perception in different ages. Over the set targets the students will understand the characteristic of human behaviour, the behaviour of managers and their employee, the team properties in the labour-environment and the corporations how develop their functional rules. The applicable (for previous) management methods and their expected effects on the members of corporation and their capacities are presented in the course of the discussed themes.

Major Elective and Further Elective Subjects

Biologically Inspired Systems

BMEGEMIMGBI

The design of engineering structures increasingly involves mimicking and improvement of natural, living structures to perfection. In addition to a more accurate understanding and systematization of living systems, it is increasingly important that both engineering students and engineers get acquainted with this topic. The basic goal of the course is the analysis of different biological systems and of the engineering structures mimicking them throughengineering and systems theory considerations. Specific solutions of biological systems for different materials, structures, sensor systems, motion and control can be properly applied.

Simulation of Energy Engineering Systems

BMEGEENMWSE

Simple example, modeling approaches. Phases of setting up lumped theoretical mathematical models. Conservation laws of lumped theoretical mathematical models. Some constitutive equations. Using Matlab interactively. Example: Combustion kinetics. Using Simulink interactively. Simulation options in Simulink. Linearizing a model. Programming Matlab. Example: Handling big measured data set.

Thermal Physics

BMEGEENMWTP

Physical backgrounds, mechanism and models of heat conduction in solids; measurement of thermophysical properties; steady state and transient methods; numerical modeling of 1D and 2D heat conduction problems, inverse heat conduction problem. Heat conduction review (heat diffusion equation, boundary conditions). What are thermophysical properties? Different heat conduction models. Finite difference and control volume method for the solution of heat conduction problems. Measurement of the thermal conductivity. Measurement of the thermal diffusivity. Measurement of the specific heat capacity; direct determination of the temperature dependency of the properties. Inverse heat conduction problems. 2D steady-state heat conduction with contact boundary condition. Transient heat conduction with different boundary conditions (modeling the laser flash method). Transient heat conduction with contact boundary condition. Transient heat conduction with temperature dependent thermophysical properties (modeling the BICOND method).

Thermo-Mechanics

BMEGEMMMWTM

Temperature dependence of material properties. Governing equations of coupled thermal and mechanical fields. Thermal boundary conditions. Thermal stresses in beams, plane problems, plates, thick-walled tubes and rotating disks. Instationary heat conduction, transient thermal stresses. Numerical thermal stress analysis. Heat conductance and capacitance matrices. Computer simulation of thermal stresses.

Steam and Gas Turbines

BMEGEENMWTU

Preliminary, property of Parsons and Laval steam turbines, property of modern steam turbines. Properties of impulse stage. Curtis stage, negative reaction number evoluation, sonic speed, velocity bended, efficiency curve, properties of reaction stage, long blade bended criteria, equistress design, determination of steam turbine's main geometry, wet steam turbines, calculate pressure variation with Stodola constans. Reheated condensation steam turbine. Design of Package gas turbine. Uncool gas turbine cycle calculation. Real gas turbine cycle and optimum parameters. Properties of single shaft and dual shaft gasturbine, wing shape theory and compressor stage.

Measurements in Thermal Engineering

BMEGEENMWM2

Fundamentals of measurement theory. Emission components and analysers. Emission analysers. Temperature measurement. Power plant and measuring equipment, measurement, accreditation, quality assurance. Measurement procedures and data processing techniques. Dynamical process identification. Cooling system test. High speed pressure measurement. Discontinuous boiler test and calculations. Gas Engine test. Gas Turbine test.

Design and Technology module

Primary Subjects

Machine Design and Production Technology

BMEGEGEMW01

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Product Modeling

BMEGEGEMW02

The process of product modeling. Traditional and concurrent design. Product lifecycle management. Integrated product development. Conceptual design. Geometric models. Assembly models. Presentation techniques. Simulation models (Finite element analysis. Kinematic simulation. Behavior simulation). Optimization (object function, shape and size optimization(. Application models. Virtual prototyping. Rapid prototyping. Product costing models.

Advanced Manufacturing

BMEGEGTMW01

Introduction to Advanced Manufacturing. Visiting the manufacturing laboratory of the Department. Conventional machining operations. Fundamentals of machining operations. Mechanics of metal cutting. Machinability. Chip control. Fundamentals of advanced manufacturing (non-conventional machining). Reverse engineering. Rapid Prototyping. Mold design and manufacturing. Production Planning - Material Requirements Planning. Production Planning - Advanced models and algorithms. Consultation on semester essay. Electro Discharge Machining EDM), processes and application. Micro EDM machining. Laser Beam Machining. Laser marking. Rapid Prototyping. NC tool path planning by CAM system. Hard Cutting. Gear production.

Teamwork Project

BMEGEGTMWP1

The complex task covers a semester project in the diverse topics of manufacturing.

Final Project A

BMEGEGEMWDA

In course of the Final Project A one student or group of 2 students will work on one selected challenging problem of mechanical engineering. Several experimental and/or numerical project proposals will be announced by the project leaders. The aim of the course is to develop and enhance the capability for complex problem solving of the students under advisory management of their project leader. At the end of each semester a written Project Report is to be submitted and the summary and findings of the investigations on the selected problem is to be presented as Project Presentation.

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tems theory considerations. Specific solutions of biological systems for different materials, structures, sensor systems, motion and control can be properly applied.

CAD Technology

BMEGEGEMW04

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. Overview on 3D assembly modeling. Design of the cast parts. 3D model based technical drafting.Integration of the imported 3D data. Modeling of the parts with similar geometry. Design of the moving parts' kinematic. Modeling of the complex kinematic. Creating of kinematic analyses. TOP-DOWN design in moving constructions. Tolerancing in the CAD systems.

Material Science

BMEGEMTMW01

Structure of crystalline solids. Imperfections in crystals. Mechanical properties of alloys. Dislocations and strengthening mechanisms. Deterioration mechanisms of engineering materials. Phase diagrams. Phase transformations. Material characterization. Non-destructive evaluation techniques. Electrical properties of metals, alloys and semiconductiors. Superconductivity. Magnetic properties. Soft and hard magnetic materials.

Structural Analysis

BMEGEGEMW05

Structural analysis and machine design. Fundamentals of FEM. Basic element types of professional FE systems. Preparing FE models (symmetry conditions, mesh structure, boundary conditions, loading models and material properties). Material and geometric nonlinearity. Time-dependent behaviour. Steady state and transient heat transfer. Integrated CAD-FEM systems. Structure optimization.

Process Planning

BMEGEGTMW02

Introduction; demands and requirements of absolving mark in the subject; principles, concepts, terms, definitions concerning on manufacturing process planning and manufacturing processes, equipment, tooling and experience; The stages and steps of manufacturing process planning; deterministic and heuristic methods, issue of Type and Group Technology, methods of prevention and elimination; Production analysis; general sequencing problems; determination of all sequence variations; methods of matrix reduction and vector variants; abstract methods for process plans and production workflows; Scheduling; Process chains and diagrams; shop-floor programming and scheduling (GANTT diagrams), Network plans, leak control (Process graphs and trees), process chain representations, diagrams (Workflow techniques). Assembly (objects); definitions of assembly; units and items, object oriented assembly tree and documents Assembly and manufacturing (processes); assembly procedures, operations, methods and organisation structures; process oriented assembly tree and documents. Quality control (object and process oriented view of quality assurance); probability functions and distributions, dimensional chains and analysis; assembling methods and assurance; economic view of manufacturing; Quality assurance; Production strategies (TQC, JIT); statistical process control (SPC); measure and charts of process capability; charts attributes.

NC Machine Tools

BMEGEGTMW03

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 worcriece changing peripheries. Multi-functional machine tools. Parallel kinematics machine tools.The seminars support the design assignment and help the student in selecting the motion unit components (i.e. ball screw, rolling guideway, servo motor) and designing the main structural element i.e. frames, moving slides, tool changers) of machine tools.

Fatigue and Fracture

BMEGEMTMW02

Cyclic loading. High cycle fatigue. S-N curve. Fatigue limit. Low cycle fatigue. Manson -Coffin relation. Neuber theory. Linear elastic fracture mechanics. Energy concept. Stress field near the crack tip. Stress intensity factor. Fracture toughness. Fracture mechanical design. Non linear fracture mechanics. Crack opening displacement. J-integral. Stable crack growth. Testing techniques. Design philosophy in nonlinear fracture mechanics. Environment assested cracking. Case studies.

PhD Degree

The Faculty of Mechanical Engineering (GPK) at the Budapest University of Technology and Economics (BME) offers degree programs in both Hungarian and English. Most students from abroad choose to study in English.

The BME GPK is a strongly research-oriented university that has conferred doctoral degrees since the 19th century in various fields of engineering.

The academic staff of our Faculty are doing research in the most relevant fields of the mechanical engineereering discipline, and related applied sciences. PhD candidates are welcome to take part in this research work in order to prepare for the PhD procedure.

PhD at the BME GPK is a degree that can be earned by sufficiently proving the candidate's ability for selfstanding scientific work that must be demonstrated by writing a thesis summarising the candidate's research results. Furthermore, it is necessary to pass a set of qualifying examinations in some basic and applied sciences related to the field of the submitted thesis. Candidates are to publish their results prior to the submission of their theses.

Applicants for the PhD program must hold an MSc degree issued by an academic institution and must possess an overall understanding of, and a high competence in, their field of knowledge. They must also be capable of using research techniques. Admission requirements include excellent grades (mainly or exclusively A's), an excellent MSc (or equivalent) final project, and/or the achievement of good initial results in research. Besides their professional achievements, applicants should also demonstrate a sense of responsibility for the advancement of scientific knowledge.

PhD candidates carry out their studies and research on an individual basis under the guidance of a professor or a senior member of the academic staff at the faculty concerned. This research work must contribute to scientific knowledge in general, and it must be recognized as such by the international scientific community. In order to prove this, doctoral candidates must present their research results at national and international conferences and symposia, and they are expected to publish the significant and major achievements of their work in internationally referred professional periodicals.

Besides the research work, the PhD supervisor usually recommends the participation in various courses related to the research topic. In such a case, the appropriate examinations must be succesfully completed, the results of which will be documented in the transcripts of the candidate. Similarly, the advancement in individual study and research will be documented on a semester basis by the supervisor.

Working towards a PhD degree requires at least 3 years (6 semesters) of study. This time might be considerably longer, depending on the topic and the candidate's personal diligence. It is possible to set individual PhD study plans for candidates who spend certain parts of their preparation period at other insitution/s, e.g. their own original research-oriented affiliation or another university.

Upon completing all necessary work for the PhD thesis, this dissertation must be prepared according to the formal requirements in the Doctoral Code of the Budapest University of Technology and Economics.

According to the procedural code of our university, every PhD candidate individually must apply to the Doctoral Board of the faculty concerned. However, the recommendation of the supervising professor and department, including the attachment of the protocol of the departmental public presentation of the thesis (with the comments and recommendations of several departmental and/or internal referees, and other professional experts of the field) is a strong expectation.

The doctoral board will appoint an independent examination board for each candidate which consists of the President, two examiners and several jury members. Final decision lies on this board after hearing the public presentation and defense of the thesis work and the subject examination.

The conferred degree is declared and testified by a corresponding PhD diploma at the next solemn ceremony of the university by the Rector of the University concerned.

NOTE:

Individual research topics and their overall conditions are formulated in negotiations between candidates and supervisors at BME.

Faculty of Natural Sciences

The Faculty of Natural Sciences, one of the newest faculties at the Budapest University of Technology and Economics, was established in 1998 and now employs 190 full and part time faculty members. The Faculty provides classes in Physics, Mathematics and Cognitive Science and is designed to meet the needs of its own and other faculties.

Courses are offered on BSc and MSc degree levels. The Faculty provides post-graduate scientific training as well. Currently more than 100 PhD students are pursuing personal programs in different areas of sciences. The Faculty also offers short courses on specific topics of current interest.

The Faculty of Natural Sciences administers its own BSc and MSc programs in Physics, Mathematics, Applied Mathematics and Cognitive Science. A continuing educational program is also offered in Reactor Physics and Reactor Technology. For many years the "Eugene Wigner International Training Course for Reactor Physics Experiments" has also been organized on a yearly basis.

The **BSc in Physics Program**, a traditional curriculum, leads to a BSc degree in 6 semesters (currently available only in Hungarian). The facilities and scientific-tutorial background of the Institute of Physics and the Institute of Nuclear Techniques offer unique opportunities in areas like low temperature physics, acousto-optics, holography or the nuclear training reactor. A further advantage of our Physics BSc Program is the engineering background provided by the Budapest University of Technology and Economics. Two specializations can be chosen: "Physicist" and "Applied Physics".

In another 4 semesters an **MSc in Physics** degree can be earned; courses are given also in English. This program provides comprehensive knowledge, built upon strong theoretical and experimental bases in four areas of specialization. Students who choose the specialization "Physics" get acquainted with theoretical tools of modern physics and with state of the art experimental methods. Students in specialization "Applied Physics" study material testing techniques, material science, optics and R&D skills. Graduates from specialization "Nuclear Techniques" may become professionals in energetics, radiation and environment protection. The specialization "Medical Physics" transfers knowledge of creative use and development of modern medical instruments. A post-graduate PhD programme in Physics is available in all domains offered in the MSc programme.

The **BSc in Mathematics Program,** a traditional curriculum, leads to a BSc degree in 6 semesters (currently available only in Hungarian). In the fourth semester students are offered two options: specialization "Theoretical Mathematics" is recommended to those who are interested in a deeper understanding of some branches of mathematics and in doing theoretical research and are probably going to continue their studies in a Mathematics MSc Program. Specialization "Applied Mathematics" is recommended to students who are eager to apply their knowledge in industry or finance. Therefore, we have prepared courses related to infor-

mation technology, economical and financial mathematics, or technology. Graduated students from either specialization are allowed to continue their studies in one of our Mathematics Master programs.

In another 4 semesters an **MSc in Mathematics** or **MSc in Applied Mathematics** degree can be earned.

A large variety of subjects are offered in the **MSc in Mathematics Program**, covering the topics algebra and number theory, analysis, geometry, probability theory and statistics, discrete mathematics, operations research. There is a large flexibility in choosing subjects according to the personal interests of the student. From the available subjects we also offer two specializations called "Analysis" and "Optimization".

Students of the **MSc in Applied Mathematics Program** choosing the "Applied Analysis" specialization will meet applications of mathematical analysis in natural sciences, finance and industry. Graduates from the "Operations Research" specialization are able to create models for problems in controlling systems or optimization. Students who specialized in "Financial Mathematics" can analyze financial processes or insurance problems and are able to interpret the results. Graduates from the "Stochastics" specialization can recognize and study random laws in various phenomena. The language of courses of the specializations "Financial Mathematics" and "Stochastics" is English.

MSc in Cognitive Science. The aim of the master program is to train researchers skilled in complex analysis of human cognition and knowledge relying on the methods of science. Students may complete courses in all major domains of cognitive science including cognitive psychology, neuroscience, linguistics and the philosophy of science. Students will be equipped with both theoretical knowledge and practical skills such as statistical analysis and research ethics. Graduates will be able to carry out research in various areas of cognitive science combining theoretical insights and methods of biological (neuroscience, experimental psychology, developmental studies), and formal (mathematics, logic, philosophy of science, linguistics) disciplines. Graduates' competences allow them to undertake doctoral studies, and to work in a variety of applied domains including medicine, biotechnology and education.

Continuing educational program in reactor physics and technology is a four semester program offered to professionals working in the nuclear industry. The subjects include reactor physics, thermohydraulics, radiation protection, radiochemistry, reactor technology, nuclear safety and laboratory experiments.

The Institute of Nuclear Techniques organises - or participates actively in the organisation of - several international courses as well. Worth mentioning are the HUVINETT (Hungarian Vietnamese Nuclear Engineering Train the Trainers) courses, where more than 150 Vietnamese educational professionals attended in 2013 and 2014. Also the participants of the training courses offered by the international EERRI consortium (Eastern European Research Reactor Initiative) perform experiments in the Training Reactor of the BME INT. In this consortium institutes of 5 Eastern European countries cooperate, with the organisatory and financial aid of the International Atomic Energy Agency (IAEA).

Postgraduate program in Operations Research in four semesters is recommended to professionals - with MSc - who often meet problems related to optimization (economists, engineers, etc.). The program includes theoretical classes (bases of discrete, continuous and stochastic optimization) and practice oriented classes as well (modelling, software packages, algorithm implementation, etc.). In the second and third semester students carry out individual projects which help them to obtain the required knowledge and practice for the future.

Institutes

Institute of Mathematics
Department of Algebra
Department of Analysis
Department of Differential Equations
Department of Geometry
Department of Stochastics

Institute of Nuclear Techniques
Department of Nuclear Techniques
Department of Nuclear Energy

Institute of Physics
Department of Atomic Physics
Department of Physics
Department of Theoretical Physics

Department of Cognitive Science

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Vice-dean (finance): Dr. Imre Varga
Vice-dean (Scientific and International): Dr. György Károlyi
Vice-dean (education): Dr. István Prok

Curriculum of MSc in Physics

Subject			Lecture / Practice / Laboratory / Exam type / Credit				
Name	Code	Type	1	2	3	4	Requisities
Basic Courses	**6 credits**						
Computer Solution of Technical and Physical Problems	BMETE11MF01	K	0/0/2/f/2				
Investments	BMEGT35M004	K		2/0/0/f/2			
Problem Solving in Mathematics	BMETE95MF00	K	0/2/0/f/2				
Professional Courses	**23 credits**						
Atomic and Molecular Physics	BMETE15MF02	K	2/1/0/f/3				
Comprehensive Examination	0 credits	KR		0/0/0/s/0			
Computer Simulation in Statistical Physics	BMETE15MF03	K	2/0/0/v/3				
Nuclear Physics	BMETE80MF00	K		3/0/0/v/4			
Particle Physics	BMETE13MF00	K			4/0/0/v/4		
Physics Laboratory	6 credits	K	0/0/6/f/6				
Physical Materials Science	BMETE12MF02	K		2/0/0/f/3			
Professional Training	0 credits	KR			0/0/9/a/0		IndLab1
Physical Materials Science	BMETE12MF02	K		2/0/0/f/3			
Specialized Professional Courses	**85 credits**						
Seminar 1, 2, 3, 4	6 credits	K	0/2/0/f/2	0/2/0/f/2	0/2/0/f/2	0/2/0/a/0	
Independent Laboratory 1	7 credits	K		0/0/7/f/7			
Independent Laboratory 2	12 credits	K			0/0/12/f/12		IndLab1
Specialization Courses	30 credits	KV	7/0/0/v/10	7/0/0/v/10	7/0/0/v/10		
Diploma Work	30 credits	K				0/0/10/a/30	IndLab2, ComprExam
Optional Courses	6 credits	V					

Exam type: v = exam, f = midterm exam, a = signature, s = comprehensive exam

Subject type: K = obligatory, KV = elective , V = optional, KR = criterium

Curriculum of MSc in Mathematics

Subject			Lecture / Practice / Laboratory / Exam type / Credit				
Name	**Code**	**Type**	**1**	**2**	**3**	**4**	**Requisities**
Theoretical Foundations from BSc Courses	20 credits						
Primary Professional Courses	30 credits						
Group Theory	BMETE91MM03	KV		3/1/0/v/5			
Commutative Algebra and Algebraic Geometry	BMETE91MM01	KV			3/1/0/f/5		
Fourier Analysis and Function Series	BMETE92MM00	KV	3/1/0/v/5				
Partial Differential Equations 2	BMETE93MM03	KV		3/1/0/f/5			
Dynamical Systems	BMETE93MM02	KV		3/1/0/v/5			
General and Algebraic Combinatorics	BMEVISZM020	KV	3/1/0/f/5				
Combinatorial Optimization	BMEVISZM029	KV		3/1/0/v/5		3/1/0/v/5	
Theoretical Computer Science	BMETE91MM00	KV		3/1/0/f/5			
Differential Geometry and Topology	BMETE94MM00	KV	3/1/0/v/5				
Representation Theory	BMETE91MM02	KV				3/1/0/f/5	
Linear Programming	BMETE93MM01	KV			3/1/0/v/5		
Global Optimization	BMETE93MM00	KV				3/1/0/f/5	
Mathematical Statistics and Information Theory	BMETE95MM05	KV		3/1/0/v/5			
Stochastic Analysis and its Applications	BMETE95MM04	KV			3/1/0/v/5		
Professional Courses	**40 credits**						
Algorithms and Complexity	BMEVISZM031	KV		3/1/0/f/5		3/1/0/f/5	
Graphs, Hypergraphs and Their Applications	BMEVISZM032	KV			3/1/0/f/5		
Advanced Linear Algebra	BMETE91MM05	KV	2/0/0/v/3				
Homological Algebra	BMETE91MM06	KV	2/0/0/f/2				
Representations of Groups and Algebras	BMETE91MM04	KV				3/1/0/f/5	
Operator Theory	BMETE92MM05	KV	3/1/0/v/5				
Inverse Scattering Problems	BMETE92MM08	KV			2/0/0/v/3		
Matrix Analysis	BMETE92MM03	KV			2/0/0/v/3		
Numerical Methods 2 – Partial Diff. Equations	BMETE92MM07	KV				2/0/2/v/5	
Distribution Theory and Green Functions	BMETE92MM22	KV				2/0/0/v/2	
Potential Theory	BMETE92MM04	KV				2/0/0/f/3	
Non-Euclidean Geometry	BMETE94MM03	KV	3/1/0/v/5				
Combinatorial and Discrete Geometry	BMETE94MM02	KV		3/1/0/v/5			
Projective Geometry	BMETE94MM01	KV			2/2/0/f/5		
Stochastic Programming	BMETE93MM05	KV		3/1/0/v/5			
Nonlinear Programming	BMETE93MM04	KV				3/1/0/v/5	LinProg
Algebraic and Arithmetical Algorithms	BMETE91MM08	KV			3/1/0/f/5		
Analytic Number Theory	BMETE95MM13	KV				2/0/0/f/2	
Algebraic Number Theory	BMETE91MM07	KV				2/0/0/v/3	
Statistical Program Packages 2	BMETE95MM09	KV	0/0/2/f/2				
"Limit- and Large Deviation Theorems of Probability Theory"	BMETE95MM10	KV		3/1/0/v/5			
Markov Processes and Martingales	BMETE95MM07	KV			3/1/0/v/5		
Advanced Theory of Dynamical Systems	BMETE95MM12	KV				2/0/0/f/2	
Stochastic Models	BMETE95MM11	KV				2/0/0/f/2	
Stochastic Differential Equations	BMETE95MM08	KV				3/1/0/v/5	StochAnal, MarkovProc
Other Courses	**30 credits**						
Mathematical Modelling Seminar 1	BMETE95MM01	K	2/0/0/f/1				
Individual Projects 1	BMETE92MM01	K		0/0/4/f/4			
Report	BMETE90MM90	KR		0/0/0/a/0			
Preparatory Course for Master's Thesis	BMETE90MM98	K			0/2/0/f/5		Report
Mathematical Modelling Seminar 2	BMETE95MM02	K			2/0/0/f/1		
Individual Projects 2	BMETE92MM02	K			0/0/4/f/4		
Master's Thesis	BMETE90MM99	K				0/8/0/a/15	PrepMThesis

Exam type: v = exam, f = midterm exam, a = signature

Subject type: K = obligatory, KV = elective , V = optional

Curriculum of MSc in Applied Mathematics
Specialization in Applied Analysis

Subject			Lecture / Practice / Laboratory / Exam type / Credit				
Name	**Code**	**Type**	**1**	**2**	**3**	**4**	**Requisities**
Theoretical Foundations from BSc Courses	**20 credits**						
Primary Professional Courses	**30 credits**						
Commutative Algebra and Algebraic Geometry	BMETE91MM01	KV			3/1/0/f/5		
Differential Geometry and Topology	BMETE94MM00	KV	3/1/0/v/5				
Dynamical Systems	BMETE93MM02	K		3/1/0/v/5			
Fourier Analysis and Function Series	BMETE92MM00	K	3/1/0/v/5				
General and Algebraic Combinatorics	BMEVISZM020	KV	3/1/0/f/5				
Global Optimization	BMETE93MM00	KV				3/1/0/f/5	
Linear Programming	BMETE93MM01	KV			3/1/0/v/5		
Mathematical Statistics and Information Theory	BMETE95MM05	KV		3/1/0/v/5			
Partial Differential Equations 2	BMETE93MM03	K		3/1/0/f/5			
Representation Theory	BMETE91MM02	KV				3/1/0/f/5	
Stochastic Analysis and its Applications	BMETE95MM04	KV			3/1/0/v/5		
Theoretical Computer Science	BMETE91MM00	KV		3/1/0/f/5			
Courses of Specialization	**30 credits**						
Distribution Theory and Green Functions	BMETE92MM22	K				2/0/0/v/2	
Geometry of Classical Field Theories	BMETE94MM11	K	2/0/0/f/2				
Inverse Scattering Problems	BMETE92MM08	K			2/0/0/v/3		
Mathematical Chemistry	BMETE92MM09	KV				2/0/2/v/5	
Numerical Methods 2 - Partial Differential Equations	BMETE92MM07	KV				2/0/2/v/5	
Mathematical Methods of Classical Mechanics	BMETE93MM12	K		2/0/0/f/2			
Mathematical Methods of Statistical Physics	BMETE95MM27	K		2/0/0/v/3			
Mathematical Percolation Theory	BMETE95MM24	KV				2/0/0/f/3	
Potential Theory	BMETE92MM04	KV				2/0/0/f/3	
Matrix Analysis	BMETE92MM03	K			2/0/0/v/3		
Operator Theory	BMETE92MM05	K	3/1/0/v/5				
Vector Spaces in Physics	BMETE92MM21	K	2/0/0/f/2				
Other Courses	**40 credits**						
Mathematical Modelling Seminar 1	BMETE95MM01	K	2/0/0/f/1				
Individual Projects 1	BMETE92MM01	K		0/0/4/f/4			
Report	BMETE90MM90	KR		0/0/0/a/0			
Optional Courses	10 credits	V					
Preparatory Course for Master's Thesis	BMETE90MM98	K			0/2/0/f/5		Report
Mathematical Modelling Seminar 2	BMETE95MM02	K			2/0/0/f/1		
Individual Projects 2	BMETE92MM02	K			0/0/4/f/4		
Master's Thesis	BMETE90MM99	K				0/8/0/a/15	PrepMThesis

Exam type: v = exam, f = midterm exam, a = signature
Subject type: K = obligatory, KV = elective , V = optional

Curriculum of MSc in Applied Mathematics Specialization in Operation Research

Subject			Lecture / Practice / Laboratory / Exam type / Credit				
Name	Code	Type	1	2	3	4	Requisities
Theoretical Foundations from BSc Courses	**20 credits**						
Primary Professional Courses	**30 credits**						
Commutative Algebra and Algebraic Geometry	BMETE91MM01	KV			3/1/0/f/5		
Differential Geometry and Topology	BMETE94MM00	KV	3/1/0/v/5				
Dynamical Systems	BMETE93MM02	KV		3/1/0/v/5			
Fourier Analysis and Function Series	BMETE92MM00	KV	3/1/0/v/5				
General and Algebraic Combinatorics	BMEVISZM020	KV	3/1/0/f/5				
Global Optimization	BMETE93MM00	K				3/1/0/f/5	
Linear Programming	BMETE93MM01	K			3/1/0/v/5		
Mathematical Statistics and Information Theory	BMETE95MM05	K		3/1/0/v/5			
Partial Differential Equations 2	BMETE93MM03	KV		3/1/0/f/5			
Representation Theory	BMETE91MM02	KV				3/1/0/f/5	
Stochastic Analysis and its Applications	BMETE95MM04	KV			3/1/0/v/5		
Theoretical Computer Science	BMETE91MM00	KV		3/1/0/f/5			
Courses of Specialization	**30 credits**						
Combinatorial Optimization	BMEVISZM029	KV		3/1/0/v/5			
Control Systems	BMETE93MM07	K			2/0/0/v/3		
Econometrics	BMETE93MM10	K	0/0/2/f/2				
Game Theory	BMETE93MM09	K	2/0/0/f/3				
Introduction to Economic Dynamics	BMETE93MM08	K	3/1/0/v/5				
Nonlinear Programming	BMETE93MM04	K				3/1/0/v/5	LinProg
Operations Research Software	BMETE93MM06	K			0/0/2/f/2		
Stochastic Programming	BMETE93MM05	K		3/1/0/v/5			
Other Courses	**40 credits**						
Mathematical Modelling Seminar 1	BMETE95MM01	K	2/0/0/f/1				
Individual Projects 1	BMETE92MM01	K		0/0/4/f/4			
Report	BMETE90MM90	KR		0/0/0/a/0			
Optional Courses	10 credits	V					
Preparatory Course for Master's Thesis	BMETE90MM98	K			0/2/0/f/5		Report
Mathematical Modelling Seminar 2	BMETE95MM02	K			2/0/0/f/1		
Individual Projects 2	BMETE92MM02	K			0/0/4/f/4		
Master's Thesis	BMETE90MM99	K				0/8/0/a/15	PrepMThesis

Exam type: v = exam, f = midterm exam, a = signature
Subject type: K = obligatory, KV = elective , V = optional

Curriculum of MSc in Applied Mathematics
Specialization in Financial Mathematics

Subject			Lecture / Practice / Laboratory / Exam type / Credit				
Name	**Code**	**Type**	**1**	**2**	**3**	**4**	**Requisities**
Theoretical Foundations from BSc Courses	**20 credits**						
Primary Professional Courses	**30 credits**						
Commutative Algebra and Algebraic Geometry	BMETE91MM01	KV			3/1/0/f/5		
Differential Geometry and Topology	BMETE94MM00	KV	3/1/0/v/5				
Dynamical Systems	BMETE93MM02	KV		3/1/0/v/5			
Fourier Analysis and Function Series	BMETE92MM00	KV	3/1/0/v/5				
General and Algebraic Combinatorics	BMEVISZM020	KV	3/1/0/f/5				
Global Optimization	BMETE93MM00	KV				3/1/0/f/5	
Linear Programming	BMETE93MM01	K			3/1/0/v/5		
Mathematical Statistics and Information Theory	BMETE95MM05	K		3/1/0/v/5			
Partial Differential Equations 2	BMETE93MM03	KV		3/1/0/f/5			
Representation Theory	BMETE91MM02	KV				3/1/0/f/5	
Stochastic Analysis and its Applications	BMETE95MM04	K			3/1/0/v/5		
Theoretical Computer Science	BMETE91MM00	KV		3/1/0/f/5			
Courses of Specialization	**30 credits**						
Analysis of Economic Time Series	BMEGT30M400	K		2/0/0/f/2			
Biostatistics	BMETE95MM25	K	0/2/0/f/3				
Dynamic Programming in Financial Mathematics	BMETE93MM14	K	2/0/0/v/3				
Extreme Value Theory	BMETE95MM16	K		2/0/0/v/3			
Financial Processes	BMETE95MM14	K				2/0/0/f/3	
Insurance Mathematics 2	BMETE95MM17	K				2/0/0/f/2	
Markov Processes and Martingales	BMETE95MM07	K			3/1/0/v/5		
Multivariate Statistics with Applications in Economy	BMETE95MM18	K	2/0/0/f/2				
Nonparametric Statistics	BMETE95MM20	K	2/0/0/v/3				
Statistical Program Packages 2	BMETE95MM09	K	0/0/2/f/2				
Stochastic Differential Equations	BMETE95MM08	K				3/1/0/v/5	StochAnal, MarkovProc
Time Series Analysis with Applications in Finance	BMETE95MM26	K			2/0/0/f/3		
Other Courses	**40 credits**						
Mathematical Modelling Seminar 1	BMETE95MM01	K	2/0/0/f/1				
Individual Projects 1	BMETE92MM01	K		0/0/4/f/4			
Report	BMETE90MM90	KR		0/0/0/a/0			
Optional Courses	10 credits	V					
Preparatory Course for Master's Thesis	BMETE90MM98	K			0/2/0/f/5		Report
Mathematical Modelling Seminar 2	BMETE95MM02	K			2/0/0/f/1		
Individual Projects 2	BMETE92MM02	K			0/0/4/f/4		
Master's Thesis	BMETE90MM99	K				0/8/0/a/15	PrepMThesis

Exam type: v = exam, f = midterm exam, a = signature
Subject type: K = obligatory, KV = elective , V = optional

Curriculum of MSc in Applied Mathematics Specialization in Stochastics

Subject			Lecture / Practice / Laboratory / Exam type / Credit				
Name	Code	Type	1	2	3	4	Requisities
Theoretical Foundations from BSc Courses	**20 credits**						
Primary Professional Courses	**30 credits**						
Commutative Algebra and Algebraic Geometry	BMETE91MM01	KV			3/1/0/f/5		
Differential Geometry and Topology	BMETE94MM00	KV	3/1/0/v/5				
Dynamical Systems	BMETE93MM02	KV		3/1/0/v/5			
Fourier Analysis and Function Series	BMETE92MM00	KV	3/1/0/v/5				
General and Algebraic Combinatorics	BMEVISZM020	KV	3/1/0/f/5				
Global Optimization	BMETE93MM00	KV				3/1/0/f/5	
Linear Programming	BMETE93MM01	KV			3/1/0/v/5		
Mathematical Statistics and Information Theory	BMETE95MM05	K		3/1/0/v/5			
Partial Differential Equations 2	BMETE93MM03	K		3/1/0/f/5			
Representation Theory	BMETE91MM02	KV				3/1/0/f/5	
Stochastic Analysis and its Applications	BMETE95MM04	K			3/1/0/v/5		
Theoretical Computer Science	BMETE91MM00	KV		3/1/0/f/5			
Courses of Specialization	**30 credits**						
Advanced Theory of Dynamical Systems	BMETE95MM12	KV				2/0/0/f/2	
Financial Processes	BMETE95MM14	K				2/0/0/f/3	
Limit- and Large Deviation Theorems of Probability Theory	BMETE95MM10	K		3/1/0/v/5			
Markov Processes and Martingales	BMETE95MM07	K			3/1/0/v/5		
Multivariate Statistics	BMETE95MM15	K	3/1/0/v/5				
Nonparametric Statistics	BMETE95MM20	K	2/0/0/v/3				
Statistical Program Packages 2	BMETE95MM09	K	0/0/2/f/2				
Stochastic Differential Equations	BMETE95MM08	K				3/1/0/v/5	StochAnal, MarkovProc
Stochastic Models	BMETE95MM11	KV				2/0/0/f/2	
Other Courses	**40 credits**						
Mathematical Modelling Seminar 1	BMETE95MM01	K	2/0/0/f/1				
Individual Projects 1	BMETE92MM01	K		0/0/4/f/4			
Report	BMETE90MM90	KR		0/0/0/a/0			
Optional Courses	10 credits	V					
Preparatory Course for Master's Thesis	BMETE90MM98	K			0/2/0/f/5		Report
Mathematical Modelling Seminar 2	BMETE95MM02	K			2/0/0/f/1		
Individual Projects 2	BMETE92MM02	K			0/0/4/f/4		
Master's Thesis	BMETE90MM99	K				0/8/0/a/15	PrepMThesis

Exam type: v = exam, f = midterm exam, a = signature
Subject type: K = obligatory, KV = elective , V = optional

Curriculum of MSc in Cognitive Science

Subject			Lecture / Practice / Laboratory / Exam type / Credit				
Name	Code	Type	1	2	3	4	Requisities
Theoretical foundations							
Informatics	BMETE92MC19	K	0/2/0/f/3				
Introduction to Cognitive Science	BMETE47MC01	K	2/0/0/f/3				
Introduction to Experimental Psychology	BMETE47MC25	K	2/0/0/v/3				
Mathematics	BMETE92MC15	K	2/2/0/v/5				
Neurobiology 1 – Foundations and Neurobiology of Perception	BMETE47MC22	K	2/0/2/v/5				
Psycholinguistics	BMETE47MC36	K	2/0/0/v/3				
Statistics and Methodology	BMETE92MC20	K	2/0/2/v/5				
Advanced Courses							
Cognition and Emotion	BMETE47MC26	K		2/0/0/f/3			
Cognitive Psychology Laboratory	BMETE47MC27	K		0/0/8/v/9			
Epistemology	BMEGT41M410	KV		2/0/0/v/3			
Evolutionary Psychology	BMETE47MC07	K		2/0/0/f/3			
Intelligent Systems	BMEVITMM031	KV		2/0/0/f/3			Informatics
Neurobiology 2 – Sensory and Motor Processes	BMETE47MC23	K		2/0/0/v/3			Neuro-biology 1
Neuropsychology	BMETE47MC06	K		2/0/2/v/5			Neuro-biology 1
Philosophy of Science	BMEGT41M411	KV		2/0/0/v/3			
Specialized Courses							
Brain in Trouble	BMETE47MC34	K			2/0/0/f/2		
Cognitive Informatics in Human Vision	BMEVITMM032	KV			2/0/0/v/3		Informatics
Cognitive Neuropsychiatry	BMETE47MC30	K			2/0/0/v/3		Neuro-psichology
Historical Reconstruction of Scientific Thinking	BMEGT41M413	KV			2/2/0/v/5		
Introduction to Cultural Studies	BMEGT43M410	KV			2/0/0/f/3		
Introduction to Matlab Programming	BMETE92MC14	KV			0/2/0/f/3		Informatics
Memory and the Psychology of Learning	BMETE47MC29	K			0/3/0/f/3		Int.Exp.Sci.
Neurobiology 3 – Higher Cognitive Functions	BMETE47MC24	K			2/0/0/v/3		Neuro-biology 2
Philosophy of Mind	BMETE47MC18	KV			2/0/0/f/3		
Pragmatics and Cognitive Linguistics	BMETE47MC15	KV			2/0/0/f/3		Psycho-linguistics
Reading Seminar in Psycholinguistics 1	BMETE47MC31	K			0/2/0/v/3		Psycho-linguistics
Reading Seminar in Psycholinguistics 2	BMETE47MC32	K			0/2/0/v/3		Psycho-linguistics
Reading Seminar in Psycholinguistics 3	BMETE47MC33	K			0/2/0/f/3		Psycho-linguistics
Social Cognition	BMETE47MC28	K			2/0/0/v/3		
Speech Communication	BMEVITMJV62	KV			4/0/0/v/4		
Theory of Science	BMEGT41M412	KV			2/0/0/f/3		
Others							
Optional courses		V	2/0/0/f/3	2/0/0/f/3			
Preparatory Course for Master's Thesis	BMETE47MC35	K			0/12/0/f/12		
Research Seminar	BMETE47MC20	K				0/0/10/f/10	
Master's Thesis	BMETE47MC21	K				0/20/0/f/20	

Exam type: v = exam, f = midterm exam, a = signature
Subject type: K = obligatory, KV = elective , V = optional

Description of MSc Subjects in Physics

COMMON COURSES

Atomic and Molecular Physics

BMETE15MF02 – 2/1/0/f/3

Dr. István László

This course describes the quantum mechanical study of atoms and molecules building on quantum mechanical knowledge gained while earning a BSC degree in Physics. The following topics are discussed: Schrödinger equation of many particle systems, the Born-Oppenheimer approximation, variational principles, The Hartree-Fock method, the Roothaan equations, the choice of basis functions, electronic structure of atoms, the group theory and the symmetry of the wave function, the density matrix, the virial theorem, the Hellmann-Feynman theorem, electronic structure of molecules, the density functional method. (3 credits)

Computer Simulation in Statistical Physics

BMETE15MF03 – 2/0/0/v/3

Dr. János Kertész

This course builds on the knowledge acquired during the BSc studies in statistical physics and programming. It presents the basic simulation techniques and gives insight to the newer developments. Important topics are: Monte Carlo method (generation of random numbers, importance sampling, Metropolis algorithm, boundary conditions, ensembles, averages, characteristic times). Phase transitions (finite size scaling, critical slowing down, accelerating techniques). Algorithmic aspects of discrete models (percolation, magnetic models, lattice gases, cellular automata, growth models). Molecular dynamics (interactions, solvers, ensembles, event driven MD, instabilities). (3 credits)

Computer Solution of Technical and Physical Problems

BMETE11MF01 – 0/0/2/f/2

Dr. Gábor Varga

In the frame of this course several areas of technical and physical problems (e.g.: one and many particle problems, Poisson equation, fluid flow, sheet deformation, heat transport, wave equation, Schrödinger equation) are investigated applying the knowledge of BSC degree in Physics. Investigated problems can be described by ordinary or partial differential equations. For every problem computer program is written. During the computer implementation not only the physical models but the needed numerical methods are analysed. MATLAB program language is applied as a programming tool. The course is complemented at beginning of the semester with optional MATLAB training. (2 credits)

Investments

BMEGT35M004 – 2/0/0/f/2

Dr. Mihály Ormos

Markowitz's portfolio theory: maximization of expected utility, risk-aversion and rationality, diversification, diversifiable and non- diversifiable risk, efficient portfolios. CAPM by Sharpe: risk-free opportunity, homogeneous expectations, market portfolio and the capital market line, beta and the security market line. Market efficiency: efficient capital market, efficient market hypothesis (EMH), levels of market efficiency (weak form, semi-strong form, strong form). Market microstructure: theory and empirics. Behavioral finance: behavioral finance models, criticisms of behavioral finance, heuristics, framing, anomalies. (2 credits)

Nuclear Physics

BMETE80MF00 – 3/0/0/v/4

Dr. Dániel Péter Kis

This course describes the main chapters of the low-energy nuclear physics building on the experimental nuclear physics knowledge gained while earning a BSC degree in Physics. The following topics are discussed: measurement and systematics of the most important parameters of nuclei in ground state, nuclear models, nuclear forces, nuclear reactions, theoretical description of nuclear decay modes, nuclear fission, nuclear fusion and its use for energy production, nuclear cosmology, nuclear astrophysics. (4 credits)

Particle Physics

BMETE13MF00 – 4/0/0/v/4

Dr. Gábor Takács

The goal of this course is to provide a basic but comprehensive knowledge on modern particle physics, based on the lectures of the BSC training in Physics (electrodynamics and quantum mechanics). The topics covered are including: discovery, properties and classifications of particles; particle detectors, accelerators; gauge theory of quantum electrodynamics; Fermi theory and gauge theory of weak interaction, parity violation; description of strong interaction, QCD, properties; basics of quantum field theory; scattering theory; perturbation theory in scalar, Dirac-spinor and gauge theories. (4 credits)

Physical Materials Science

BMETE12MF02 – 2/0/0/f/3

Dr. Ferenc Réti

The course aims to give a modern knowledge in the materials science based on the fundamentals learned in physics (B.Sc.). The topics covered are: the process of solidification, defects in crystals, the diffusion, mechanical properties of the solids, phase diagrams, polymers, alloys, ceramics, composites, the corrosion process, electric and magnetic properties of the materials. (3 credits)

Problem Solving in Mathematics

BMETE95MF00 – 0/2/0/f/2

Dr. Márton Balázs

The course builds on the mathematics courses appearing in the physicist and engineering BSc programs. Basic mathematical tools (measure and integration, functional analysis, fundamentals of topology and differential geometry). Selected problems chosen from the topics below: partial differential equations: phenomena and solution methods. Stochastic processes: Markov processes in discrete and continuous time, examples. Problems in statistical physics. Mathematical theory of dynamical systems, fractals. Elements of algebra: group theory, symmetries, group actions. Combinatorics: graph theory. (2 credits)

COURSES OF SPECIALIZATION PHYSICS

Advanced Quantum Mechanics

BMETE13MF01 – 2/0/0/v/3

Dr. Péter Kálmán

This is an advanced course of quantum mechanics (QM) based on electrodynamical and quantum mechanical studies required to the BSC degree. The following topics are discussed: the Dirac-formalism of QM, canonical quantization, the momentum operator and its matrix elements, the coherent state and its characteristics, the time evolution operator, Schrödinger-, Heisenberg- and interaction picture, the life-time, time dependent perturbation calculation, ionization by x-ray absorption, gauge invariance in QM and the gauge independent transition probability, spin, the density operator and the basics of QM statistical physics, the semiclassical self-interaction of radiation, the elements of relativistic QM. (3 credits)

Charge- and Spin-Density Waves

BMETE11MF17 – 2/0/0/v/3

Dr. György Mihály

Quasi-one dimensional materials: instability of the 1d electron-gas (Linhard function, Kohn-anomaly, Peierls-distortion, spin-density waves). Low-dimensional fluctuations, phase transition in case of coupled chains (diffuse X-ray, NMR). Incommensurate density waves: slidind, deformation, pinning (Fukuyama-Lee-Rice model, narrow band noise). Collective excitations: phason and amplitudon, effective mass, optical properties. Nonlinear and frequency dependent phenomena: two-fluid model (I-V characteristics, dielectric relaxation, Hall-constant, Onsager relations). (3 credits)

Dynamical Systems

BMETE14MF02 – 2/0/0/v/2

Dr. Kristóf Kály-Kullay

This course studies the qualitative behavior of deterministic models applied in various fields of natural sciences like physics, chemistry or biology. Within this topic the course deals with systems which can be described by ordinary differential equations and maps. The following subjects are discussed: the Lotka-Volterra and the Brusselator model, conservative and limit cycle oscillations, attractors and bifurcations of dissipative systems, local and global stability, the logistic map, Lyapunov exponent, chaos. (2 credits)

Evolutionary Games

BMETE15MF11 – 2/0/0/v/3

Dr. László Szunyogh

This course gives an introduction to the multi-agent evolutionary games building on statistical physics knowledge gained while earning a BSC degree in Physics. The following topics are discussed: Concepts of traditional game theory (strategy, payoff, matrix game, Nash equilibrium, etc.); Evolutionary games with population dynamics; Evolutionary games on lattices and graphs; Generalization of dynamical pair approximation. Many interesting phenomena are described by considering the repeated multiagent Prisoner's Dilemma and Rock-Scissors-Paper games for different connectivity structures. (3 credits)

Group Theory in Solid State Research

BMETE11MF12 – 2/0/0/v/3

Dr. István Kézsmárki

Introduction: point groups, fundamental theorems on finite groups, representations, character tables. Optical spectroscopy: selection rules, direct product representations, factor group. Electronic transitions: crystal field theory, SO(3) and SU(2) groups, correlation diagrams, crystal double groups. Symmetry of crystals: space groups, International Tables of Crystallography. Electronic states in solids: representations of space groups, compatibility rules. (3 credits)

Foundations of Density Functional Theory

BMETE15MF15 – 2/0/0/v/3

Dr. János Pipek

Many-body Fock space and density operator. Reduced density operators. Exact equations and the independent particle approximation for the interacting electron gas in the density operator picture. N-representability. The Fermi hole and localized orbitals. The electron density. Kato's theorem and cusp conditions. The v- and N-representability of the electron density. The Hohenberg-Kohn theorems. Existence of the universal density functional. Levy's constrained search. Scaling properties. The Kohn-Sham equations. Fractional occupation numbers. The chemical potential and electronnegativity. Approximate methods. The gradient expansion. Recent functionals. (3 credits)

Electronic Structure of Solid Matter 1

BMETE15MF18 – 2/0/0/v/3

Dr. László Szunyogh

Building on the quantum mechanics and solid state physics studies of the Physics BSC education, this course aims to discuss modern theories and methods for the electronic structure of solid matter. The following topics will be outlined: Foundations of the static density functional theory. Variational and pseudopotential methods. The multiple scattering theory (Green function method). Ab initio methods for correlated systems (LDA+U, self-interaction correction, DMFT). Alloy theory, the coherent potential approximation. Metallic (itinerant) magnetism, method of the disordered local moments. Time-dependent density functional calculations. (3 credits)

Electronic Structure of Solid Matter 2

BMETE15MF19 – 2/0/0/v/3

Dr. László Szunyogh

Continuation of the Electronic structure of solid matter I. course by discussing specific methods and phenomena. Topics: Relativistic electronic structure calculations, magnetic anisotropy in solid matter. Systems in reduced dimension: surfaces, interfaces, one-dimensional chains, finite clusters. Interactions in solid matter: asymptotic analysis, RKKY interaction, Dzaloshinskii-Moriya interaction, pair- and cluster interactions in alloys, phase diagrams. Ab initio calculations of electronic and optical transport properties: Caroli-, Landauer, and Kubo-Greenwood formalism. (3 credits)

Introduction to Superconductivity

BMETE11MF11 – 2/0/0/v/3

Dr. Balázs Dóra

Phenomenology of superconductors. Meissner effect, London equations, electrodynamics of superconductors. Bardeen-Cooper-Schrieffer theory: ground state, thermodynamic and transport properties. Ginzburg-Landau theory:

free energy, GL equations and their solution, Abrikosov vortices, magnetic properties of Type II superconductors. Josephson effect and its applications. High-temperature superconductors. Prerequisites: Modern Solid State Physics. (3 credits)

Magnetic Resonance

BMETE13MF04 – 2/0/0/v/3

Dr. Titusz Fehér

The course discusses one of the most important investigation methods in physics, chemistry and medical sciences. It is based on the electrodynamics and quantum mechanics studies required for the BSC degree. Topics include experimental methods of electron and nuclear magnetic resonance, Bloch equations, dipole-dipole interaction, motional narrowing, crystal fields and fine structure, hyperfine splitting, chemical shift, magnetic resonance in metals, superconductors and magnetically ordered materials. (3 credits)

Many-Body Physics 1

BMETE15MF07 – 2/0/0/v/3

Dr. Gergely Zaránd

This course is the first and independent part of a two-semester many-body course. It gives an introduction to the basic machinery of field theoretical Green's function methods applied for interacting solid state physics systems at T=0 temperature, and demonstrates its power through applications for some simple cases. Although this is a basic course required for several advanced theoretical courses (The physics of one-dimensional systems, Many-body physics II, Localization theory, etc.), students taking this course must have a BSC level knowledge of quantum mechanics and statistical physics. The course focuses on the following topics: second quantized formalism, Green's functions and their connection to measurable quantities, Heisenberg-, Schrödinger-, and interaction picture, perturbation theory, diagram technique (Wick theorem, Feynman diagrams), resummation techniques (self-energy, Dyson equation, vertex function, skeleton diagrams), equation of motion methods. (3 credits)

Many-Body Physics 2

BMETE15MF08 – 2/0/0/v/3

Dr. Gergely Zaránd

This course is the second part of a two-semester many-body course. It gives an introduction to the finite temperature Green's function method applied for interacting solid state physics systems. This technology is one of the standard tools used in modern solid state physics. The course focuses on the following topics: Matsubara Green's functions (analytical properties, spectral functions, etc.), imaginary time perturbation theory, diagram technique (Wick theorem, self-energy, vertex function, skeleton diagrams), applications (quantum transport, polarons, Peierls instability, Hartree-Fock method, RPA). (3 credits)

Mesoscopic Systems

BMETE15MF16 – 2/0/0/v/3

Dr. Gergely Zaránd

The field of mesoscopic and nanoscale structures is one of the most intensely studied fields in modern solid state physics: Due to the development of lithographic procedures, one can build semiconducting and metallic structures in which electrons move coherently throughout the sample. This course gives an introduction to the theory of some of the novel phenomena that can be observed in such systems. The course builds upon the BSC courses Quantum mechanics, Solid state physics, and Statistical Physics, and focuses on the following subjects: description of small grains (Coulomb interaction, coherence, single particle levels), fundamentals of random matrix theory (level repulsion, universality classes), Coulomb blocade and spectroscopy (master equations, co-tunneling, Kondo effect), transport through open cavities and billiards (universal fluctuations, noise, spin transport, pumping), transport properties of quantum wires and localization. (3 credits)

Modern Solid State Physics

BMETE11MF15 – 2/2/0/v/5

Dr. Attila Virosztek

This course describes the behavior of interacting many body systems (mainly electron systems) building on solid state physics and statistical physics knowledge gained while earning a BSC degree in Physics. The following topics are discussed: identical particles, second quantization, interacting electron systems in Bloch and Wannier representation, itinerant ferromagnetism, linear response theory, susceptibility of metals, spin density waves, Bose liquid. (5 credits)

Molecular Physics 2

BMETE15MF06 – 2/0/0/v/3

Dr. László Udvardi

Based on the quantum mechanics and molecular physics studies of the physics BSC education the course intend to introduce the basic methods of the many body problem applied in modern quantum chemistry. The following topics will be outlined: second quantized formalism in molecular physics, time independent many body perturbation theory, method of configuration interaction, introduction to the coupled cluster theory. (3 credits)

Nanomagnetism

BMETE15MF17 – 2/0/0/v/3

Dr. László Szunyogh

This course serves to discuss different phenomena in magnetic nanostructures that became of primary importance during the past two decades concerning basic science and technology. Topics: Magnetism of surfaces, interfaces, thin films and finite atomic clusters. Magnetic anisotropy, reorientation phase transitions, magnetic patterns, spin-dynamics. The oscillatory interlayer exchange coupling. Magnetic domains, domain walls, micromagnetic modeling. Transport properties: giant magneto-resistance, anisotropic magneto-resistance, current induced magnetic switching, transport trough point contacts. Magneto-optical Kerr effect. (3 credits)

New Experiments in Nanophysics

BMETE11MF18 – 2/0/0/v/3

Dr. András Halbritter

On the nano-scale the coherent behavior and interaction of the electrons, and the atomic granularity of the matter cause various striking phenomena, which are widely investigated in the research field of nanophysics. The course gives an overview of recent fundamental achievements in nanophyics focusing on the demonstration and understanding of recent experimental results. The following topics are discussed: fabrication of semiconductor nanostructures; nanowires; Interference-phenomena in nanostructures; Shot noise; Quantized Hall effect; Quantum dots; Superconducting nanostructures, proximity effect. (3 credits)

Nonequilibrium Statistical Physics

BMETE15MF13 – 2/0/0/v/3

Dr. János Kertész

Linear response theory: correlation and response functions. Analytical properties, elementary excitations. Classical limit. Dissipation. Fluctuation-dissipation theorem. Consequences of the microscopic time reversal symmetry. Transport processes: electric conductance. Neutron scattering cross section. Characterization of stochastic processes, Markov processes. Diffusion processes: Fokker-Planck equation, stochastic differential equations. Physical applications: Brownian motion, hydrodynamic fluctuations, Onsager relations. Step processes: Master equation. Stability of the stationary distribution, H-theorem. Basics of the Monte Carlo method. Physical applications. Derivation of the Boltzmann equation. Relaxation time approximation. Physical applications. (3 credits)

Optical Spectroscopy

BMETE11MF16 – 2/0/0/v/3

Dr. István Kézsmárki

Electromagnetic waves in vacuum and in a medium; complex dielectric function, interfaces, reflection and transmission. Optical conduction in dipole approximation; linear response theory, Kramers-Kronig relation, sum rules. Simple optical models of metals and insulators; Drude model, Lorentz oscillator. Optical phonons, electron-phonon interaction. Optical spectroscopes: monochromatic- and Fourier transformation spectrometers. Optical spectroscopy of interacting electron systems: excitons, metal-insulator transition, superconductors. Magneto optics: methods and current applications. (3 credits)

Phase Transitions

BMETE15MF12 – 2/0/0/v/3

Dr. János Kertész

Stability of the thermodynamic state: equilibrium and transition of phases, symmetry braking, classification. Phase transitions of the condensed matter. Critical exponents. Models of phase transitions. Exact results. Long range correlations in symmetry braking phases of isotropic systems. Classical theories and their critique: Landau theory, mean field approximation. High temperature expansions. The static scaling hypothesis and consequences. The renormalization group transformation and its connection to critical behavior: fixed point, scaling, universality. Construction of the transformation in real and momentum space. Survey of the results. Dynamical critical phenomena: conventional theory, dynamic scaling hypothesis, examples. (3 credits)

Quantum Computer Physics 1

BMETE15MF24 – 3/0/0/v/3

Dr. Barnabás Apagyi

Tárgyfelelős / Responsible lecturer: Apagyi Barnabás

Axioms of quantum mechanics. Two state quantum systems. Qubit, q-register, quantum gates. Entanglement and superposition. 1- és 2-qubit gates. Bell-states. Quantum teleportation. Box potential q-computer, harmonic oscillator q-computer. Optical photon q-computer. Photon-atom q-computer. Jaynes-Cummings hamiltonian. Two-qubit entanglement for pure states. (Distinguishable particles.) Reduced density matrices, Schmidt decomposition, von Neumann entropy, concurrence. Two-qubit entaglement for mixed states. Peres-Horodecki criterion. Negativity. Wootters expression. Illustrative examples: Werner states, Gisin states. Positive operator valued measures, generalised measurement, Kraus representation, applications. Decoherence and the phase damping: double-slit, Stern-Gerlach experiments, Schrödinger cat. Operator sum in Kraus- és Bloch sphere representation: depolarisation, dephasing and amplitude damping channel. Master equation, Lindblad-equation , solutions. Quantum-Brown motion, phase space representation (Wigner- and Husimi-ffunctions), relation between grobe decompositon and decoherence. Fidelity and Loschmidt-echo. (3 credits)

Quantum Computer Physics 2

BMETE15MF24 – 3/0/0/v/3

Dr. Barnabás Apagyi

Axioms of quantum mechanics. Two state quantum systems. Ramsey interferometer. Quantum parallelism. Deutsch-Józsa algorithm. Ion-trap q-computer. Hamilton operator. Realisation of CNOT gate. Nuclear magnetic resonance q-computer. Hamilton operator. Realisation of CNOT gate and Bell-states. Majorization: Nielsen theorem. Many-particle entanglement for pure states, local measures for entanlement. Majorization and its applications: separability problem, entanglement catalysis, density operator multitudes. Hidden subgroup problem. Geometrical and topological q-computing, geometry of entanglement. Fermionic entanglement. Residual entropy and its geometric meaning, applications. Entangled chains and the tight binding model. Entanglement and phase transitions. State preparation and balanced bases. Solid state implementations. Quantum dots. Spintronics. Si-based qubit (Kane-) model. Application of superconductance: Josephson-transition and Cooper-pair box. Atoms in optical grid. Critical phenomena and entanglement. Internal decoherence in qubit systems, impurity effects. (3 credits)

Random Matrix Theory and Physical Applications

BMETE15MF10 – 2/0/0/v/3

Dr. Imre Varga

Random matrix theory provides an insight of how one can achieve information relatively simply about systems having very complex behavior. The subject based on the knowledge acquired in quantum mechanics and statistical physics together with some knowledge of probability theory provides an overview of random matrix theory. The Dyson ensembles are defined with their numerous characteristics, e.g. the spacing distribution, the two-level correlation function and other quantities derived thereof. Then the thermodynamic model of levels is obtained together with several models of transition problems using level dynamics. Among the physical applications the universality classes are identified in relation to classically integrable and chaotic systems. The problem of decoherence is studied as well. Then the universal conductance fluctuations in quasi-onedimensional disordered conductors are investigated. Other models are investigated: the disorder driven Anderson transition and the random interaction model of quantum dot conductance in the Coulomb-blockade regime. We use random matrix models to investigate chirality in two-dimensional and Dirac systems and the normal-superconductor interface. The remaining time we cover problems that do not belong to strictly physical systems: EEG signal analysis, covariance in the stock share prize fluctuations, mass transport fluctuations, etc. (3 credits)

Scaling and Criticality

BMETE15MF14 – 2/0/0/v/3

Dr. Gergely Zaránd

Understanding critical phenomena and their connection to renormalization group belongs to the basic knowledge of modern solid state physicists. The course 'Scaling and criticality' builds upon the BSC level statistical physics and quantum mechanics courses and introduces the notions of scale invariance and renormalization group while avoiding the usual heavy field theoretical formalism. The course is organized along the following topics: critical phenomena (simple systems, universality, mean field theory), the renormalization group (The one-dimensional Ising model, Wilson's renormalization group transformation, fixed points, critical dimensions, correlation functions), phase diagrams and scaling (cross-over phenomena, finite size scaling, dimensional cross-overs, quantum criticality), the perturbative scaling approach (fixed point Hamiltonian, operator product expansion, epsilon-expansion, anisotropy), low-dimensional systems (lower critical dimension, the XY model, Kosterlitz-Thouless phase transition, the O(n) model in 2+ ε dimension). (3 credits)

Solitons and Inverse Problems

BMETE15MF09 – 2/0/0/v/3

Dr. Barnabás Apagyi

Inverse scattering theory, application to solution of nonlinear evolution equations. Formation of solitons (stable waves preserving shape and velocity for a long time), KdV equation. Physical application of solitons: nonlinear Schrödinger equation. Optical solitons. BEC solitons. (3 credits)

The Path Integral Method in Physics

BMETE13MF02 – 2/0/0/v/3

Dr. Antal Jakovác

A basic theoretical tool of physics is the path integral introduced by Feynman. Starting with simple stochastic models we arrive at the path integral formalism as it is used in quantum mechanics, statistical physics and field theory. Topics: Simple models of diffusion, generating function, Wiener measure. Diffusion with absorption, Schwinger-Dyson equations, harmonic approximation. Canonical partition with path integral. Feynman-Hibbs path integral. Path integral in the field theory, S-matrix, Feynman graphs. Lattice field theory. (3 credits)

The Physics of One-Dimensional Systems

BMETE15MF05 – 2/0/0/v/3

Dr. Gergely Zaránd

This course gives a basic introduction to the physics and theoretical description of interacting one-dimensional electron and spin systems. One-dimensional systems display basic phenomena such as charge- and spin density wave formation, antiferromagnetism and exotic superconductivity, and are fundamental test-grounds for solid state physicists, since powerful field theoretical approaches can be used for them. Moreover, they are often realized in physical systems such as carbon nanotubes, quasi one-dimensional systems, or edge states. The course assumes the knowledge of basic Green's function methods (Many body physics I), and is organized along the following topics: one-dimensional systems in nature (the Hubbard model, instabilities within the random phase approximation, spin and charge density waves, mapping to the Heisenberg model), basic properties of spin chains (Haldene's conjecture, spin coherent states, spin liquids, the basics of Bethe Ansatz), the continuum limit (renormalization group and the Tomonaga-Luttinger model), bosonization (spin-charge separation, the Luttinger liquid phase), effects of disorder. (3 credits)

Theory of Magnetism 1

BMETE11MF13 – 2/0/0/v/3

Dr. Attila Virosztek

Magnetic phenomena are considered as electron correlation effects. The Hubbard model is used to interpret the Mott metal-insulator transition. A variational theory is given which allows the understanding of heavy fermion behavior. The antiferromagnetic Heisenberg model is introduced as the effective hamiltonian of the large-U Hubbard model at half filling. Other kinetic exchange processes, including ring exchange with application to the magnetism of solid He3, are discussed. A detailed treatment of the two-site Coulomb processes allows the introduction of direct exchange. The survey of various mean field theories of magnetic order begins with the Stoner theory. Weak itinerant ferromagnets like ZrZn2 and MnSi are discussed in some detail. (3 credits)

Theory of Magnetism 2

BMETE11MF14 – 2/0/0/v/3

Dr. Attila Virosztek

The basic concepts and results from the first part of the course are assumed to be familiar. The variety of magnetic ordering phenomena is surveyed, the conditions of ordering, and the nature of the excited states over ordered ground states are discussed in various theoretical frameworks. The concept of the quantum critical point is used for rare earth systems with non-fermi-liquid behavior. Localized-spin order and spin wave theory is described both for ferromagnets and antiferromagnets. A detailed discussion of quantum fluctuations in the ground state is given, including recent results on the possibility of spin liquid ground states. A particular kind of magnetic cooperative behavior is shown to give rise to the integer and the fractional quantum Hall effect. (3 credits)

Transport Processes

BMETE14MF02 – 2/0/0/v/2

Dr. Ferenc Márkus

During physical and chemical processes various quantities are transported and the understanding of these processes is important for the practice. The following topics are covered: balance equations, equations of state, constitutive equations, conservation laws, mass and component balances, balance of the internal energy, Fourier's law, equation of heat conduction and its analytical solutions, Green-function, diffusion, membranes, thermo-diffusion, multi-component diffusion, chemical reactions. (2 credits)

Variational Principles in Physics

BMETE13MF03 – 2/0/0/v/3

Dr Gábor Takács

This theoretical physics course gives a review over variational principles formulating basic laws in mechanics, relativity, electrodynamics and quantum mechanics. Its aim is to present a mathematical basis for use in disperse areas of physics as well as to demonstrate the unity of physics in the way of theory making. Topics: The principle of virtual work (statics), D'Alambert, Gauss, Lagrange and Hamilton principles, action (dynamics), Maupertuis principle, geodetic motion, Einstein-Hilbert action (relativity), electric and magnetic field energy conditioned by the Gauss and Biot-Savart laws, electric – magnetic duality, waves and gauge

symmetry as reflected in the variational principle (electrodynamics), the Schrödinger equation as the minimal break with the classical Hamilton-Jakobi equation (quantum mechanics). (3 credits)

Wavelets, Coherent States and Multiresolution Analysis

BMETE15MF20 – 2/0/0/v/3

Dr. János Pipek
Characterization of complex distributions using simply interpretable component functions. Fourier analysis. Time-frequency analysis, window Fourier transformation. Gábor transformation. Uncertainty principle, Shannon's theorem. Continuous wavelet transformation. Coherent states. The Weyl-Heisenberg and the affine group. The generalization of Hilbert space basis sets: frames. Discrete wavelet transformation. Riesz bases. Multiresolution analysis. The refinement equation. Biorthogonal and orthogonal scaling functions. Compactly supported wavelets: Daubechies' construction. Continuity, differentiability, vanishing momenta. Matrix elements of physical operators in wavelet bases. (3 credits)

COURSES OF SPECIALIZATION APPLIED PHYSICS

Basic Physics of Optical Communication

BMETE11MF20 – 2/0/0/v/3

Dr. Zsolt Papp
This course gives an introduction to physics of optical communication building on knowledge of optics gained on a BSc course program in Physics. The following topics will be treated: optics (ray propagation in lenslike media, dispersion, etc.), laser physics (fiber-laser, optical fiber-amplifiers, DFB laser, etc.), nonlinear optics (nonlinear effects, phase-modulation, soliton, etc.), optical fibers – wave guiders (optical fibers, modes, dispersion, photonic crystals, couplers, etc.). (3 credits)

Crystalline and Amorphous Materials

BMETE15MF21 – 2/0/0/v/3

Dr. Sándor Kugler
Crystalline, amorphous and glassy states. Classifications of amorphous semiconductors and chalcogenide glasses. Preparations. Phillips theory. Structure investigations: diffractions and computer modeling. Mott's (8-N) rule. Electronic structures. DOS, Charge fluctuations, doping. Defects, dangling bonds, voids, coordination defects. Photoinduced effects. Optical properties. Applications: solar cells, Xerox, DVD, etc. Equilibrium and non-equilibrium phases. Quenching, glass transition, kinetics. Structures of alloys. Methods. Electronic structure and magnetic properties of amorphous alloys. (3 credits)

Electrical and Optical Properties of Solids

BMETE12MF26 – 2/0/0/v/3

Dr. Ádám Gali
This course prescribes the knowledge of fundamental solid state physics and quantum mechanics from BSC education in Physics. In this course it is schematically explained how the structure is formed in different type of solids due to the different type of forces that bind them. The electronic structure of typical metals and semiconductors is reviewed and explained how that can be measured or calculated. The semiconductors are defined from technological point of view. Typical carriers in semiconductors are defined and explained how they can be measured or calculated. The dynamics of Bloch-electrons is reviewed within semi-classical treatment, and the basic definitions needed for understanding the function of semiconductor devices are explained (Fermi-level, n and p-type conduction, excitonic states). It is shown how the point defects influence the electronic band structure of the semiconductors: definition of doping, thermal point defects. The electronic structure and the density of states of low-dimensional systems as well as the amorphous solids are examined. Finally, the interaction of the electromagnetic radiation with the matter is explained for metals, semiconductors and insulators. (3 credits)

Electron- and Ion Optics

BMETE12MF22 – 2/0/0/v/3

Dr. György Hárs
The course deals with the discussion of generating, analyzing and detecting charged particles, as well as the overview of the applications is provided. In the course the following subjects are discussed: electron and ion sources, energy analyzers, mass analyzers, general considerations of the trajectories in case of electric and magnetic fields, particle accelerators, space charge effects, detection modes of charged particles. (3 credits)

Experimental Methods in Material Science 1, 2

BMETE12MF31, 32 – 3/0/2/f/5

Dr. György Hárs
The objective of the course is to provide a broad prospective of the experimental methods used for the characterization of the materials, with a special respect to the practical applications. In the lectures the principle of the specific method is discussed first. Later the technical details of the measuring equipment, the preparation of the sample, evaluation of the information generated in the measurement are treated, Practical case studies are presented at most of the methods. Each presentation is held by the appreciated expert of the specific measuring method. The demonstrative laboratory practicum is presented by the most up to date experimental equipment available in Budapest. (5 credits)

Holography and Applications

BMETE11MF19 – 2/0/0/v/3

Dr. Ferenc Gyimesi
This course describes the theory of holography, the several display and measurement techniques and their application examples. The main topics: holographic imaging, types of holograms, practical holography, applications of display holography and security holograms, holographic optical elements and memories, measurement applications (deformation, vibration and shape measurements; refractive index change measurement for transparent objects), digital holography. The course is based on the general optics knowledge provided by a BSC degree in Physics. (3 credits)

Introduction to Optics

BMETE12MF13 – 2/1/0/v/3

Dr. Péter Richter
This course is an introduction for MSc students, who have not taken Optics during their BSc studies. It is based upon the BSc level Electrodynamics. Main topics discussed include: models of light, transmission and reflection, geometrical/paraxial optics, interference, thin films, diffraction, optical grating, polarization, propagation in anisotropic media, waveguides, light and matter interaction, absorp-

tion, emission, operation of lasers, coherence, electro- and acousto-optics. (3 credits)

Laser Physics

BMETE12MF17 – 2/0/0/v/3

Dr. Pál Maák

Fenomenological, semiclassical (interaction of quantized material with classical electromagnatic field) and quantum theory (interaction of quantized material and field) of continous wave and pulsed laser oscillation. Properties of laser light. Laser types and laser applications. Problem solving on practices helps to develop a better understanding of the theory. (3 credits)

Light Sources

BMETE12MF14 – 2/0/0/v/3

Dr. László Kocsányi

The goal of the course is to introduce physicist-, electrical engineer- and chemical engineer students to the science and technology of light sources. The thematic includes the overview of the usual photometric parameters, the survey of the development of lamps from incandescent light sources, through discharge lamps to LEDs, the basic physical processes, and the comparison of the advantages, disadvantages and possible fields of application of different lamp types. (3 credits)

Optical Design

BMETE12MF39 – 2/2/0/v/4

Dr. Gábor Erdei

Based on the fundamental knowledge in optics obtained while earning the Applied physics BSc degree, this course describes the concepts and models used for designing optical imaging systems, presents their usual evaluation methods and the theory of operation of the most significant imaging devices. In the frame of this course students discover the possibilities of optical design software and learn their usage on a basic level, as well as practice the steps of the design process. Though incompletely, we also deal with taking into account the effects of fabrication errors, and learn the basic concepts of lens mounting techniques. (3 credits)

Optical Information Processing and Data Storage

BMETE12MF19 – 2/0/0/v/3

Dr. Pál Maák

This course is based on the knowledge gained in the BSc physics courses and in the Optics course. Students get a detailed overview of the classical and modern optical image and information processing methods and systems. The course starts from the classical coherent and incoherent image processing, correlating and comparison techniques, giving a detailed description of the many different systems developed for this purpose, including their physical basis, parameters, advantages and limitations. As a result of further development started from the classical information processing, new applications of the former techniques are presented in detail: optical data storage, optical computing and optical radar systems. Basic building blocks, like acousto-optic, magneto-optic, electro-optic devices, whereas different SLM-s, optical switches and scanners are treated in detail. The technology and broad application area of ultrashort pulsed lasers is also part of this course. (3 credits)

Optical Metrology

BMETE11MF21 – 2/0/0/v/3

Dr. János Kornis

The goal is to present an overview of the methods of optical metrology and present the most recent techniques and results. Topics: Elements of the optical measuring systems. Light sources, detectors, recording materials. Measurement of optical properties of the optical elements. Measurement of angle, length, and flatness by classical methods and using coherent optics. Heterodyne and phase stepping interferometry. Holography and speckle metrology. Digital holography. Application of optical signal processing in speckle metrology. Photo elasticity. Optical fiber sensors. Color measurement, optical metrology based on detection in different colors. (3 credits)

Optical materials and technologies 1, 2

BMETE12MF33, 34 – 2/0/0/v/3

Dr. László Kocsányi

These MSc courses based on electromagnetic light theory and solid state physics makes students acquainted with the real interaction of light and matter. It discusses the most important optical materials, their production technologies and tools including the technologies of material modification (diffusion, ionexchange, protonexchange) and surface manufacturing (polishing grinding etc.) of bulk glasses or crystals. Our students will learn the basic design, production and measuring methods of optical thin film elements (e.g. antireflection layer, interference filter). The purpose is to make candidates qualified for the speculative production of simple optical elements (bulk or thin film) e.g. lenses, prisms, antireflection layer, and combined optical devices like optical integrated circuits. (3 credits)

Optoelectronic Devices

BMETE12MF21 – 2/0/0/v/3

Dr. Attila Barócsi

This course describes the principles and operation of modern optoelectronic devices built on knowledge in solid state physics and optics gained during a BSc study in Physics. The following topics are discussed: foundations of radiometry and photometry, external photoeffect based detectors, semiconductor photon detectors, matrix detectors, spatial light modulators, special architecture (electro-, acousto- and nonlinear optical) devices. (3 credits)

Problemsolving in Physics

BMETE12MF01 – 2/2/0/f/4

Dr. Péter Rchter

The aim of this course is to help Msc students with qualifications other than a BSc in Physics to acquire the necessary skills required for specialization in applied physics. The course covers most of classical and modern physics with emphasis on practical application of physical knowledge. The form of study is solving physical problems. Areas of physics included are: mechanics, dynamics, waves, optics, statistical mechanics, electromagnetism, introduction to quantum mechanics and to solid state physics. (3 credits)

Quantumelectronics

BMETE12MF16 – 3/0/0/v/4

Dr. Attila Barócsi

The course based on the course of quantummechanics and classical electrodynamics. Topics: Susceptibility of atomic gas (semiclassical treatment), quantization of free electromagnetic field, vacuum fluctuation Lamb shift, photoeffect

on H-atom, Thomson scattering interaction picture, time evolution operator, Raman scattering, frequency doubling, parametric amplification, phase conjugation, free-electron-laser. (4 credits)

Semiconductor Physics 1, 2

BMETE11MF26, 27 – 2/0/0/v/3

Dr. Szabolcs Csonka

This course describes the behavior of modern semiconductor physics, - mostly those properties (electrical and optical), which provides understanding of present day electronics, - building on solid state physics and statistical physics knowledge gained while earning a BSC degree in Physics. Emphasize is paid to those new phenomena, which are unique of semiconductor materials and/or structures and provides much help for our understanding of condensed materials. The following topics are discussed: crystal structure and bonding, electron states, effective mass approximation, localized states, statistics of semiconductors, transport: phenomenological and microscopic, magnetic and high frequency transport, quantum hall Effect, thermal properties, inhomogeneous semiconductors, p-n junction, MOS structures, transport instabilities and Gunn effect, semiconductor lasers and light emitting diodes, principles of different applications: solar cell, optical communication, modern experimental techniques: deep level spectroscopy, lifetime measurements. (3 credits)

Spectroscopy and Structure of Matter

BMETE12MF25 – 2/0/0/v/3

Dr. Péter Richter

This course organizes the knowledge obtained during the BSc training (electrodynamics of media, quantum mechanics, group theory, statistical physics, optics, optical measurement techniques) regarding the use of spectroscopy in materials characterization and structure elucidation. The methods covered are mainly optical techniques (infrared and visible/UV absorption and reflectance spectroscopy, Raman scattering, ellipsometry, optical rotation dispersion, circular dichroism) but other topics, as excitations of inner shells (X-ray and photoelectron spectroscopy, Mössbauer spectroscopy) will also be mentioned. The purpose of the course is to prepare the students to decide which spectroscopic methods to use for a given specific problem, and to be abel to basically interpret the results. (3 credits)

Surface Physics and Thin Layers 1, 2

BMETE12MF35, 36 – 2/0/0/v/3

Dr. Olga Homokiné Krafcsik

This course treats the main fields of the physics of surfaces and thin layers, basing on the solid state physics fundamentals. A detailed description is given on the structure of surfaces, their lattice vibrations and electron structure. It is also treated the problem of the space charge region, work function, semiconductor/semiconductor, semiconductor/metal and semiconductor/isolator interfaces, adhesion at different interfaces, adsorption, surface reactions and transport phenomena. (3 credits)

Trends in Materials Science

BMETE12MF27 – 1/0/0/v/2

Dr. Gábor Kiss

The goal of this course is to give knowledge on the materials science processes, the tasks and possibilities of the materials science, the requirements of the national and international market on the basis of the lectures given by invited lecturers, coordinated by the lectures of the coordinator. The main point of view is to demonstrate the connection of modern life to the materials science, to present its importance. Topics of special interest: material- and energy-economic processes in bulk, alloying, metallic, non metallic and composite structural materials, corrosion, special requirements towards semiconductors, plastics, organic and biomaterials etc. The thematic is flexible. The lectures: Problems of the nanoscience, Metallic nanocomposites, Nanotechnology in microsystems, Corrosion processes by scanning needle method, Thin layers, Mechanical alloying and its application with special regard on the preparation of nanostructured materials, Semiconductors, Emission materials, Technological and materials science aspects of light sources, Solid electrolyte capacitors, Integrated optics and its applications, Oxide semiconductor based chemical gas sensors. (2 credits)

Vacuum Physics and Technology

BMETEMF28 – 2/0/0/v/3

Dr. György Hárs

Vacuum environment is necessary at some of the experimental techniques and manufacturing process. Physics of vacuum as well as the related technological skills (pumping, maintaining and measuring) are needed to operate and to construct vacuum systems. In the course the following subjects are discussed: laws of the gas phase, concept of vacuum, transport phenomena in vacuum, interaction between gaseous and condensed phase, pumps, vacuum measurements, leak testing, materials used in vacuum technology. (3 credits)

COURSES OF SPECIALIZATION NUCLEAR TECHNOLOGY

Calculations in Thermohydraulics

BMETE80MF28 – 3/1/0/v/5

Dr. Attila Aszódi

Introduction of thermal hydraulic system codes, focused on VVER applications; Main features of RELAP5, CATHARE, APROS codes; Preparation of the application; Modelling of primary and secondary side systems; Modelling of operational and accidental states and transients; methods for code validation; Simulation practices with APROS and RELAP5 codes. (5 credits)

Chemistry in Nuclear Power Plants

BMETE80MF16 – 2/1/0/v/3

Dr. Imre Szalóki

The major types of chemical and radiochemical processes of the nuclear power plants (NPP) are discussed according to the following topics: water chemistry of NPPs, radioisotopes in the fuel and the coolant, fuel performance evaluation, corrosion processes, water purification systems, decontamination, radioactive waste treatment, environmental monitoring, radioanalytics in NPPs. Visit to Paks NPP will be organized. (3 credits)

Introduction to Fusion Plasma Physics

BMETE80MF19 – 2/0/0/v/2

Dr. Gergő Pokol

Introduction, basics of fusion, classification, Debye length, plasma frequency. Motion of particle in magnetic field, one and two fluid model; Atom physics in plasma, energy levels Electromagnetic waves in plasma, dispersion MHD waves, instability transport effects, kinetic theory to plasma distri-

bution functions Boltzman equation, Vlasow equation Scaling in space and in time, MHD theory, drifts Larmor radius and effects, generalized Ohm-.law. Application of MHD theory in practice. (2 credits)

Laboratory in Plasma Physics

BMETE80MF40 – 0/0/4/f/4

Dr. Gábor Pór

Low-pressure plasma is used in a tube. Using Langmuir probes the temperature and density will be estimated at different levels of ionization. Fluctuations are investigated using Langmuir probes, and finally high-resolution spectroscopy helps to find the spectral density of the discharge at different intensity and different plasma parameters. Participants have to program also the data collection and data evaluation system. (4 credits)

Material Testing in Nuclear Power Plants

BMETE80MF15 – 2/0/0/v/2

Dr. Attila Aszódi

Inspection methods of primary and secondary side main equipments of PWR power plants. Testing methods, fault detecting techniques. Testing methods of reactor pressure vessel and steam generator. Visual inspection methods, manipulation techniques, application of telemechanics. Special methods for checking the shape- and size adequacy. Inspection of fresh and irradiated fuel bundles (tightness testing, thermal hydraulic investigation, tomography methods). Inspection methods for radwaste containers. Nuclear material testing methods (radiography, tomography etc.). (2 credits)

Migration of Radioactive Species in Environmental and Biological Matter

BMETE80MF32 – 2/2/0/v/4

Dr. Péter Zagyvai

This course describes the transport processes of radionuclides taking place in environmental and biological media based on nuclear physics and environmental physics knowledge gained while attending a BSC course in Physics. Topics discussed: appearance of radioactivity in the environment – features of source terms. Static and dynamic transport equations, modeling. Dispersion of radioactive species in atmosphere, surface waters, soil, geological structures. Biological transport processes. (4 credits)

Neutron and Gamma Transport Methods

BMETE80MF23 – 2/2/0/v/5

Dr. Szabolcs Czifrus

The course helps students practically apply their knowledge gained during the Reactor physics" course in Physics BSc. In the lectures and exercises of the course we first present simple radiation shielding problems the solution of which can be performed using approximate methods. Here students familiarize themselves with the MicroShield program. As proceeding to more advanced and complicated problems, students learn to use some of the features of the internationally acknowledged, Monte Carlo based, coupled neutron-photon-electron transport code MCNP. Students have to solve radiation shielding design problems, as well as reactor physics problems using the code. (5 credits)

Nuclear Power Plants

BMETE80MF14 – 3/1/0/v/5

Dr. Attila Aszódi

Introduction of Gen. II, III and IV reactors. Comparison of thermal circuit schemes of different NPP types, introduction of primary and secondary side systems and components. Corrosive and erosive processes in the primary and secondary circuits, theory and implementation of primary and secondary side water chemistry. Air filtering and venting systems. Buildings and rooms receiving technology equipment. Build-up of the control room, implementation of ergonomic and accident management aspects. Special aspects of electric systems' construction. Different types of operational and emergency cooling systems. Aspects of NPP siting. (5 credits)

Nuclear Power Plants Operation

BMETE80MF18 – 3/1/0/v/3

Dr. Szabolcs Czifrus

The course focuses on the parameters of an NPP important for the operation. Students study the reactivity feed-back effects and their influence on the operation and safety of NPPs, the operational aspects of xenon and samarium poisoning, the spatial power density distribution and related thermal and operational limits, parameter changes during a cycle, special operational aspects at the end-of-cycle. We present the on-line core monitoring methods and the in-core and ex-core detectors applied. Furthermore, the core analysis codes, the methods of data acquisition, the basics of data processing and on-line fuel condition monitoring are discussed in detail. The course is closed with the introduction to reactor pressure vessel problems and monitoring, and the operation of reactor control instrumentation. (3 credits)

Nuclear Power Simulation Exercises

BMETE80MF17 – 0/0/2/f/3

Dr. Sándor Fehér

The aim of the course is to deepen the knowledge about the reactor physical and thermohydraulical processes taking place in nuclear power plants, using the simulators available at the Institute of Nuclear Techniques and the KFKI Atomic Energy Research Institute. During the course the following simulators are used: PC2 primary circuit simulator; SSIM secondary circuit simulator; STEGENA steam generator analyser; APROS one-dimensional thermohydraulics advanced process simulator; CFX three-dimensional thermohydraulics code; full-scope simulator of the Paks NPP. (3 credits)

Physical Principles of Radiological Methods

BMETE80MF25 – 3/0/0/v/4

Dr. Szabolcs Czifrus

In the frame of the course students study the physical principles of radiological imaging techniques applied in medicine. The main subjects are the following: Principal characteristics of radiation sources used for medical imaging, properties of radiation-matter interaction, physics and modelling of radiation detection, physical modelling of the imaging process, characterization of the image, imaging techniques, projection radiology, and physical principles of tomography techniques. The physics of CT, SPECT and PET, furthermore, the worldwide trends of radiology techniques, such as multimodality techniques) are described. The last topic of the course is the basic principles of image processing algorithms. (4 credits)

Radiation Protection 2

BMETE80MF30 – 2/0/2/v/4

Dr. Péter Zagyvai

This course describes the determination of external and internal dose due to natural and – occasionally – artificial sources of generally low radioactivity based on nuclear physics and radiation protection knowledge gained while attending a BSC course in Physics. Topics discussed: detailed analysis of dose concepts, special problems (KERMA versus absorbed dose, equivalent and effective dose for assessing stochastic radiation effects), health physics control and regulation based on dose/risk dependence, principles and practice of dose and dose rate measurement, calculation of internal exposure, nuclear analysis for determining internal dose, compound radiation measurements: radon analysis, nuclear environmental monitoring. (4 credits)

Radioanalytics

BMETE80MF24 – 2/0/3/v/5

Dr. Imre Szalóki

The course describes the fundamentals of radioanalytics based on the knowledge about radiochemistry gained while earning a BSC degree in Physics. The major topics to be discussed are the following: analysis of radionuclides by means of radiochemical procedures and nuclear measuring techniques, application of nuclear methods for the analysis of the elemental composition and material structure. During the laboratory exercises difficult-to-determine" nuclides e.g. uranium and transuranium isotopes, strontium-90 will be analysed. (5 credits)

Reactor Control and Instrumentation

BMETE80MF35 – 2/1/0/v/3

Dr. Gábor Pór

From details of temperature, pressure, vibration sensors and nuclear detectors applied in contemporary nuclear power plants via problems of building and maintaining measuring chains to data collection and data processing, to data evaluation. Safety consideration including principles of two from three, and independence of signals, international standards including recommendations of IAEA and nuclear authorities, man-machine interface including nuclear power plants control room and operator support systems. Detailed studies in high-tech nuclear measuring methods and systems like VERONA, C-PORCA, PDA, core diagnostics, loose parts monitoring, vibration monitoring, leakage monitoring, acoustic monitoring ageing monitoring systems built in NPP. Short survey of future trends like wireless measuring systems, testing of digital software for I&C, artificial intelligence for operator support systems. (3 credits)

Reactor Physics

BMETE80MF26 – 2/0/0/v/2

Dr. Mihály Makai

Interaction of nuclei with neutrons, descriptions of the reaction. Characteristics of the neutron gas. Nuclear cross-sections. Boltzmann equation. Time dependence, criticality. Diffusion theory. Reactor kinetics. Measurement of reactivity. Numerical methods. Neutron spectrum. Slowing down of neutrons. Resonance, thermalization. Thermal reactors. Reactivity coefficients. Adjoint function and its applications. Perturbations. Burn-up. (2 credits)

Safety of Radioactive Wastes

BMETE80MF31 – 3/0/1/v/4

Dr. Péter Zagyvai

This course describes regulation and control pertaining to radioactive wastes and key issues of safe waste management based on radiation protection knowledge gained while attending a BSC course in Physics. Topics discussed: international and national regulations – theory and practice, detailed studies on safe processing, immobilization and disposal of radioactive wastes, reprocessing of certain waste types, waste analysis. (4 credits)

Simulation Techniques

BMETE80MF27 – 2/0/1/f/4

Dr. Sándor Fehér

In the course the knowledge required to the development of real-time, interactive simulators used for the education and training in the field of nuclear energy is discussed according to the following topics: simulation principles; design and development of real-time interactive simulators; simulation techniques for systems modeled with ordinary differential equations; numerical methods for real-time integration; simulator interface design; software and operational system issues; types of nuclear power plant simulators; simulation of nuclear reactor kinetics; simulation of thermohydraulic processes taking place in the primary circuit of PWR type power plants; simulation of the operation of the main components of a nuclear power plant. (4 credits)

Sustainable Development and Nuclear Energy

BMETE80MF21 – 2/0/0/v/3

Dr. Attila Aszódi

Definition of sustainable development, international agreements, development of electricity production methods, their role in the sustainable development, energy source supply, fossil energy sources and their mining, security of energy supply, relation of energy supply and economic independence, global warming, Kyoto protocol, climate protection, role of renewable sources and nuclear energy in a healthy energy-mix, structure and types of nuclear reactors, comparison of different energy production methods, nuclear energy systems, radioactive wastes, safety of nuclear power plants and environmental effects, Tsernobyl. (3 credits)

Description of MSc Subjects in Mathematics

Advanced Linear Algebra

BMETE91MM05 – 2/0/0/v/3

Dr. Erzsébet Horváth

Tensor product (Kronecker product), symmetric and alternating product. The Hom functor, adjoint functors. Constructions of group representations via linear algebra. Differential forms and tensors in geometry and physics. Normal forms over number rings and fields. Nilpotent and semisimple endomorphisms, Jordan–Chevalley decomposition. Nonnegative matrices, elements of Frobenius–Perron theory. Singular value decomposition (SVD) and applications. (3 credits)

Algebraic and Arithmetical Algorithms

BMETE91MM08 – 3/1/0/f/5

Dr. Attila Nagy

Fundamental methods: operations with integers, polynomials, matrices. Fast Fourier transformation and applications. Elements of bilinear complexity. Chinese remainder theorem, modular arithmetic. Primality testing. Algorithms for factoring integers, and for discrete logarithms. Applications to cryptography. Efficient decomposition of polynomials over finite fields and algebraic number fields. Elliptic curves, their basic algorithms, applications. Modular algorithms and interpolation. Hermite, Cauchy, Padé approximation. Gröbner bases. (5 credits)

Algebraic Number Theory

BMETE91MM07 – 2/0/0/v/3

Dr. Ferenc Wettl

Motivation: Gaussian integers and Lagrange's theorem; real quadratic fields and the Pell equation. Algebraic numbers, algebraic integers, number fields, trace and norm. Lattices, orders, integral closure, fractional ideals. Dedekind rings, their basic properties, factorization of ideals, factorization in extensions. Introduction to the theory of valuations, valuations in number fields. The log map of Dirichlet, the unit theorem, Pell equations. Minkowski's theorem for lattices. Norm of ideals, finiteness of the class group. Integers in cyclotomic fields, Fermat's last theorem for regular prime exponents. The Hasse principle for quadratic forms. A glimpse into class field theory. (3 credits)

Algorithms and their Complexity

BMEVISZM031 – 3/1/0/f/5

Dr. Katalin Friedl

Algorithmic questions of coding theory. Geometric algorithms: closest pair of points, convex hull. Basic parallel algorithms: PRAM, Brent-principle. Distributed algorithms on reliable networks, the consensus problem on unreliable networks: link failures, benign but unreliable processors, Byzantine processors. Interactive proofs, IP=PSPACE. On-line algorithms. Parametric complexity: search trees with bounded depth, consequences of the graph minor theorem, W[1]-completeness. Basics of quantum computing. (5 credits)

Anaysis of Economic Time Series

BMEGT30M400 – 2/0/0/f/2

Dr. Dietmar Meyer

The course starts with a short introduction, which is followed by the generalization of the already known growth and conjuncture models. We discuss the issues of financing growth, the role of human capital, the dynamics of the budget deficit, endogenous population growth, healthcare economics and renewable resources. It is followed by the problem of the time consistency (both in finance and in budget policy), which – through different expectations – lead to the dynamic game theoretical approaches. This allows us to give the microeconomic background of the discussed macroeceonomic events. The course concludes with the discussion of the models of economic evolution. (2 credits)

Analytic Number Theory

BMETE95MM13 – 2/0/0/f/2

Dr. Csaba Sándor

The aim of the course is to present some of the most important results and methods in this area. Topics included are: Partitions, additive problems, representation functions. The method of generating functions. Average of additive representation functions: Erdős–Fuchs theorem. The density of sequences without 3-term arithmetic progressions. The Hardy–Ramanujan partition theorem. The Waring problem. Dirichlet series. L-series and their zeroes. Proof of prime number theorem. (2 credits)

Biomathematics

BMETE93MM11 – 2/0/0/f/2

Dr. Krisztina Kiss

Population dynamics: Lotka–Volterra and Kolmogorov models (a brief revision). Population genetics: Hardy–Weinberg, Fisher and Kimura laws, equations of selection, recombination, and mutation. Selection-migration models. Models for epidemics. HIV. Propagation of epidemics in space. Morphogenesis. Turing bifurcation. Pattern formation. (2 credits)

Combinatorial and Discrete Geometry

BMETE94MM02 – 3/1/0/f/5

Dr. Zsolt Lángi

The theorem of Helly, Radon and Caratheodory. The convex hull of points. Euler–Poincare formula for n-dimensional polyhedra. The diameter of a set of points. The theorem of Erdos–Szekeres and its consequences. Triangulation of simple polygons. Brower theorem on the fixpoint of a mapping, the Borsuk–Ulam theorem. Euler–Poincare formula for simplicial complexes. On the basis reduction problem of lattices. Algorithmic point of view, the reductions of Minkowski, Hermite, Korkine–Zolotareff and Lovász. Dirichlet–Voronoi cells and the short vectors of a lattice. Applications in coding theory. (5 credits)

Combinatorial Optimization

BMEVISZM029 – 3/1/0/v/5

Dr. Dávid Szeszlér

Basic concepts of matroid theory (independence, bases, circuits, rank). Dual, minors, direct sum, graphic and cographic matroids. Vector matroids, representability, binary and regular matroids, the theorems of Tutte and Seymour. Sum of matroids, the matroid partition algorithm, complexity of the matroid intersection problem. Polymatroid rank function, Lovász' theorem on polymatroid matching. Approximation algorithms. Scheduling problems. Applications in engineering: constructing reliable telecommunication networks, disjoint trees, connectivity augmentation, detailed routing of VLSI circuits, solvability of active linear networks, rigidity of bar-and-joint frameworks. (5 credits)

Commutative Algebra and Algebraic Geometry

BMETE91MM01 – 3/1/0/f/5

Dr. Alex Küronya

Closed algebraic sets and their coordinate rings, morphisms, irreducibility and dimension, Hilbert Nullstellensatz, the correspondence between radical ideals and subvarieties of affine space. Monomial orders, Gröbner bases, Buchberger algorithms, computations in polynomial rings. From regular functions to rational maps, local rings, fundamentals of sheaf theory, ringed spaces. Projective space and its subvarieties, homogeneous coordinate ring, morphisms, the image of a projective variety is closed. Geometric constructions: Segre and Veronese embeddings, Grassmann varieties, projection from a point, blow-up. Dimension of affine and projective varieties, hypersurfaces. Smooth varieties, Zariski tangent space, the Jacobian condition. Hilbert function and Hilbert polynomial, examples, computer experiments. Basic notions of rings and modules, chain conditions, free modules. Finitely generated modules, Cayley-Hamilton theorem, Nakayama lemma. Localization and tensor product. Free resolutions of modules, Gröbner theory of modules, computations, Hilbert syzygy theorem. (5 credits)

Control Systems

BMETE93MM07 – 2/0/0/v/3

Dr. Éva Gyurkovics

Basic notions of control systems. Examples of control systems. Properties of linear control systems: controllability, observability, stabilizability. Canonical forms, structure of linear systems. State observes. Realization. The problem of optimal control. Dynamic programming for finite control systems. Dynamical programming for general control systems. Hamilton-Jacobi-Bellman equations. Linear-quadratic optimal control problems. The tracking problem. Problems on infinite time intervals. (3 credits)

Differential Geometry and Topology

BMETE94MM00 – 3/1/0/v/5

Dr. Szilárd Szabó

Smooth manifolds, differential forms, exterior derivation, Lie-derivation. Stokes' theorem, de Rham cohomology, Mayer–Vietoris exact sequence, Poincaré duality. Riemannian manifolds, Levi–Civitá connection, curvature tensor, spaces of constant curvature. Geodesics, exponential map, geodesic completeness, the Hopf–Rinow theorem, Jacobi fields, the Cartan–Hadamard theorem, Bonnet's theorem. (5 credits)

Dynamic Programming in Financial Mathematics

BMETE93MM14 – 2/0/0/v/3

Dr. József Fritz

Optimal strategies, discrete models. Fundamental principle of dynamic programming. Favourable and unfavourable games, brave and cautious strategies. Optimal parking, planning of large purchase. Lagrangean mechanics, Hamilton–Jacobi equation. Viscous approximation, Hopf–Cole transformation, Hopf–Lax infimum-convolution formula. Deterministic optimal control, strategy of optimal investment, viscous solutions of generalized Hamilton-Jacobi equations. Pontryagin's maximum principle, searching conditional extreme values in function spaces. Optimal control of stochastic systems, Hamilton-Jacobi-Bellman equation. (3 credits)

Dynamical Systems

BMETE93MM02 – 3/1/0/v/5

Dr. Károly Simon

Continuous-time and discrete-time dynamical systems, continuous versus discrete: first return map, discretization. Local theory of equilibria: Grobman–Hartman lemma, stable-unstable-center manifold, Poincaré's normal form. Attractors, Liapunov functions, LaSalle principle, phase portrait. Structural stability, elementary bifurcations of equilibria, of fixed points, and of periodic orbits, bifurcation curves in biological models. Tent and logistic curves, Smale horseshoe, solenoid: properties from topological, combinatorial, and measure theoretic viewpoints. Chaos in the Lorenz model. (5 credits)

Econometrics

BMETE93MM10 – 0/0/2/f/2

Dr. Zsanett Orlovits

Introduction into econometrics. Bivariate connections: linear regression, least-square (LS) estimation and its statistical properties. Theorem of Gauss–Markov, forecasting. Multivariate linear regression, generalized Gauss-Markov theorem, forecasting, multicollinearity. Generalized LS, methods of instrumental variables. Time series analysis: stationarity, autocorrelation, white noise process, AR, MA, ARMA models. Parameter estimation (ML-estimation), forecasting. ARIMA models, trend and seasonality. Spectral representation, periodogram and its estimation, spectrum estimation. Multivariable models: VAR(1), ARMA, stationarity, stability, Lyapunov equation. Fractional integrated processes, ARFIMA models, long memory processes and their estimation. Stochastic volatility models: ARCH, GARCH, bilinear models, stationarity, estimation and state space representation. Applications: financial markets, biological data analysis. (2 credits)

Ergodic Theory and Dynamical Systems

BMETE95AM22 – 2/0/0/f/2

Dr. Domokos Szász

Measure-preserving transformations. Examples. Poincaré recurrence theorem. Ergodic maps. Examples. Stationary sequences as dynamical systems. Bernoulli-sequences. Kinetics and mixing. Algebraic automorphisms of the torus. Condition of mixing. Hopf's geometric method. Existence of invariant measures: Krylov–Bogolyubov theorem. Markov-maps: existence of invariant density. Kolmogorov–Arnold–Moser theorem. The homological equation. Formal equations for the invariant torus. Exercises. (2 credits)

Extreme Value Theory

BMETE95MM16 – 2/0/0/v/3

Dr. Béla Barabás

Review of the limit theorems, normal domain of attraction, stable low of distributions, alpha-stable domain of attractions. Max-stable distributions, Fisher–Tippet theorem, standard extreme value distributions, regularly varying functions and their properties, Frechet and Weibull distributions and characterization of their domain of attraction. Gumbel distribution. Generalized Pareto distribution. Peak over threshold. Methods of parameter estimations. Applications in economy and finance. (3 credits)

Financial Processes

BMETE95MM14 – 2/0/0/f/3

Dr. József Fritz

Discrete models. Optimal parking, strategy in advantageous and disadvantageous situations. Self-financing portfolio, arbitrage, completeness of a market model. American, European, Asian option. Binary model. Pricing non-complete market in discrete model. Balck–Scholes' theory: B-S formula via martingales. Itő representation theorem. Applications, admissible strategies. Capital Asset Pricing Model (CAPM). Portfolios. The beta coefficient, security market line, market and capital-market equilibrium. Option pricing by using GARCH models. Problems of optimal investments. Extreme value theory, maxima, records. (3 credits)

Fourier Analysis and Function Series

BMETE92MM00 – 3/1/0/v/5

Dr. Miklós Horváth

Completeness of the trigonometric system. Fourier series, Parseval identity. Systems of orthogonal functions, Legendre polynomials, Haar and Rademacher systems. Introduction to wavelets, wavelet orthonormal systems. Fourier transform, Laplace transform, applications. Convergence of Fourier series: Dirichlet kernel, Dini and Lischitz convergence tests. Fejer's example of divergent Fourier series. Fejér and Abel-Poisson summation. Weierstrass-Stone theorem, applications. Best approximation in Hilbert spaces. Müntz theorem on the density of lacunary polynomials. Approximations by linear operators, Lagrange interpolation, Lozinski-Harshiladze theorem. Approximation by polynomials, theorems of Jackson. Positive linear operators Korovkin theorem, Bernstein polynomials, Hermite-Fejér operator. Spline approximation, convergence, B-splines. (5 credits)

Fractals and Geometric Measure Theory

BMETE95MM06 – 2/0/0/f/3

Dr. Károly Simon

Introduction: Basics form general measure theory and from set theoretical topology. Covering and differerentiation. Vitali's and Besicovitch's covering theorems. Differentiation of measures. Fractals in space and on the plane: the most famous self similar and self-affine fractals. Box dimension and Hausdorff dimension. The dimension of self-similar fractals. Potential theoretic characterization of the Hausdorff dimension. Local dimension of measures. Multifractal analysis of self-similar measures. Dimension of random Cantor sets and Mandelbrot percolation. Brownian paths as random fractals. The dimension of the graph of the Brownian motion. The dimension and Lebesgue measure of Brownian paths in higher dimension. Intersection of independent Brownian paths starting from different points. A fractal geometry approach. (3 credits)

Game Theory

BMETE93MM09 – 2/0/0/f/3

Dr. Tibor Illés

Introduction into Game theory, especially into its non-cooperative variant. Game theory models such economic, political, military etc. situations where more than one actor optimizes his utility function, whose value also depends on the others' decisions. By now game theory has become the fundament of economics, which helps modelling monopoly, the design of auctions and other problems. The structure of the lectures is as follows: Non-cooperative game theory (Nash-equilibrium, Bayesian equilibrium). Cooperative game theory: Shapley value. Introduction into econometrics. Bivariate connections: linear regression, least-square (LS) estimation and its statistical properties. Theorem of Gauss–Markov, forecast. Multivariate linear regression, generalized LS, multicollinearity. Time series analysis. Applications: financial markets, biological data analysis. (3 credits)

General and Algebraic Combinatorics

BMEVISZM020 –3/1/0/v/5

Dr. Katalin Friedl

Combinatorics of the Young tableaux, tableau rings. Pieri formulas, Schur polynomials, Kostka numbers. Robinson–Schensted–Knuth correspondence. Littlewood-Richardson numbers, Littlewood–Richardson theorem. Important symmetric polynomials, their generating functions. Cauchy–Littlewood formulas. Garsia's generalization of the fundamental theorem on symmetric polynomials. Bases of the ring of symmetric functions. Topics from combinatorial optimization: greedy algorithm, augmenting methods. Matroids, their basic properties, matroid intersection algorithm. Approximation algorithms: set cover, travelling salesman, Steiner trees. Scheduling algorithms: single machine scheduling, scheduling for parallel machines, bin packing. (5 credits)

Global Optimization

BMETE93MM00 – 3/1/0/f/5

Dr. Boglárka Gazdag-Tóth

Different forms of global optimization problems, their transformation to each other, and their reduction to the one-dimensional problem. Comparison of the complexity of global optimization and linear programming problems. Classifications of the global optimization methods. Lagrange function, Kuhn–Tucker theorem, convex and DC programming. Basic models and methods of stochastic programming. Multi-start and stochastic methods for global optimization, their convergence properties and stopping criteria. Methods based on Lipschitz constant and their convergence properties. Branch and Bound schema, methods based on interval analysis, automatic differentiation. Multi-objective optimization. (5 credits)

Graphs, Hypergraphs and their Applications

BMEVISZM032 – 3/1/0/f/5

Dr. Gábor Simonyi

The theorems of Tutte and Vizing, application to the general factor problem, stable matchings, the theorem of Gale and Shapley, Dinitz's problem, list colouring, list colouring conjecture, Galvin's theorem, list colouring of planar graphs, the theorems of Thomassen and Voigt. Hypergraphs as generalizations of graphs, as set systems, as sets of 0-1 sequences. Generalizations of results from graph theory, Baranyai's theorem, Ryser's conjecture, Results of extremal set systems, Sperner's theorem, LYM inequality, Ahlswede–Zhang-identity, the theorems of Erdös–Ko–Rado and Kruskal–Katona. Ramsey's theorem for graphs and hypergraphs, applications in geometry. Applications of linear algebra, odd city theorem, Graham–Pollak theorem. Further geometric applications, Chvátal's art gallery theorem, Kahn–Kalai–Nilli's disproof of Borsuk's conjecture. Polyhedric description of problems of combinatorial optimization, polytope characterization of perfect graphs. (5 credits)

Group Theory

BMETE91MM03 – 3/1/0/f/5

Dr. Erzsébet Horváth

Permutation groups, group actions. Conjugacy classes, normalizer, centralizer, centre. Class equation, Cauchy's theorem. Group authomorphisms, semidirect product, wreath product. Group extensions. Sylow theorems. Finite p-groups. Solvable and nilpotent groups. Characterization of finite nilpotent groups. Transfer, normal p-complement theorems. Free groups, presentations. Free abelian groups, Fundamental theorem of finitely generated abelian groups, applications. Linear groups, classical groups. Elements of representation theory. (5 credits)

Homological Algebra

BMETE91MM06 – 2/0/0/f/2

Dr. Alex Küronya

Basic notions: chain complex, exactness, homology modules, homotopy, long exact sequences, functors, 3x3 lemma, 5-lemma, snake lemma, applications. Multilinear algebra over general rings, hom and tensor product, limits, p-adic numbers, profinite groups, adjoint functors. Derived functors, cohomological delta functors, projective and injective modules, resolutions. Tor and Ext: calculation of Tor for Abelian groups, flatness. Tor and Ext for some important rings, Künneth formulas, universal coefficient theorem, homological dimension, rings with small dimension. Cohomology of groups. Shapiro lemma, Hilbert's Theorem 90 for finite Galois extensions, the first cohomology group, blow up, restriction, transfer. Spectral sequences: definition, boundedness, the Lyndon–Hochschild–Serre spectral sequence, application to calculating group cohomology. (2 credits)

Individual Projects 1, 2

BMETE92MM01, 02 – 0/0/4/f/4

Dr. Márta Lángné Lázi

Within the framework of the subject the student is working on an application oriented research subject based on stochastic mathematics lead by an external supervisor. At the end of each semester the student writes a report about his results which will be also presented by him to the other students in a lecture. The activities to be exercised: literature research, modelling, computer aided problem solving, mathematical problem solving. (4 credits)

Insurance Mathematics 2

BMETE95MM17 – 2/0/0/f/3

Dr. Béla Barabás

Fundamental types of insurance: life and non-life. Standard types of non-life insurance, models. Individual risk model. Claim calculation and approximations. Most important distributions of the number of claim. Most important distributions of the claims payments. Complex risk model, recursive method of Panjer, compound Poisson distributions. Premium principles. Classical principles: Expected value, maximum loss, quantile, standard deviation, variance. Theoretical premium principles: zero utilizes, Swiss, loss-function. Mathematical properties of premium principles. Credibility theory, Bühlmann model. Bonus, premium return. Reserves, IBNR models. (3 credits)

Introduction to Economic Dynamics

BMETE93MM08 – 3/1/0/v/5

Dr. András Simonovits

The traditionally static economic theory has recently paid more and more attention to modelling dynamic economics. In comparison with physical and chemical systems, here the role of discrete time approach is much more important. The dynamic optimization is not only a technique but for many economists, it is the only valid approach. A further distinguishing feature that the present is determined not only by the past, by via expectations, by the future as well. In addition of the exposition of the necessary mathematical methods, the course stresses the most important economic models: optimal growth and overlapping generations. (5 credits)

Inverse Scattering Problems

BMETE92MM08 – 2/0/0/v/3

Dr. Miklós Horváth

The seeing process, radar, ultrasound-based medical investigations, geological prospecting of the Earth, investigation of interactions between elementary particles are just a few examples of inverse scattering problems. The course aims to present the mathematical background of such problems, on an introductory level. The main topics include: Time dependent description: wave operator, scattering operator, scattering matrix. Time independent description: scattering amplitude, Lippmann-Schwinger equation, Dirichlet-to-Neumann map, Sylvester-Uhlmann theorem. Acoustic and electromagnetic scattering. One- and three-dimensional quantum scattering problems. The many-body problem. (3 credits)

Limit- and Large Deviation Theorems of Probability Theory

BMETE95MM10 – 3/1/0/v/5

Dr. Bálint Tóth

1. Limit theorems: Weak convergence of probability measures and distributions. Tightness: Helly-Ptohorov theorem. Limit theorems proved with bare hands: Applications of the reflection principle to random walks: Paul Lévy's arcsine laws, limit theorems for the maximum, local time and hitting times of random walks. Limit theorems for maxima of i.i.d. random variables, extremal distributions. Limit theorems for the coupon collector problem. Proof of limit theorem with method of momenta. Limit theorem proved by the method of characteristic function. Lindeberg's theorem and its applications: Erdős–Kac theorem: CLT for the number of prime factors. Stable distributions. Stable limit law of normed sums of i.i.d. random variables. Characterization of the characteristic function of symmetric stable laws. Weak convergence to symmetric stable laws. Applications. Characterization of characteristic function of general (non-symmetric) stable distributions, skewness. Weak convergence in non-symmetric case. Infinitely divisible distributions:. Lévy–Hinchin formula and Lévy measure. Lévy measure of stable distributions, self-similarity. Poisson point processes and infinitely divisible laws. Infinitely divisible distributions as weak limits for triangular arrays. Applications. Introduction to Lévy processes: Lévy–Hinchin formula and decomposition of Lévy processes. Construction with Poisson point processes (a la Ito). Subordinators and Lévy processes with finite total variation, examples. Stable processes. Examples and applications. 2. Large deviation theorems: Introduction: Rare events and large deviations. Large deviation principle. Computation of large deviation probabilities with bare hands: application of Stirling's formula. Combinatorial methods: The method of types. Sanov's theorem for finite alphabet. Large deviations in finite dimension: Bernstein's inequality, Chernoff's bound, Cramer's theorem. Elements of convex analysis, convex conjugation in finite dimension, Cramer's theorem in Rd. Gartner–Ellis theorem. Applica-

tions: large deviation theorems for random walks, empirical distribution of the trajectories of finite state Markov chains, statistical applications. The general theory: general large deviation principles. The contraction principle and Varadhan's lemma. large deviations in topological vector spaces and function spaces. Elements of abstract convex analysis. Applications: Schilder's theorem, Gibbs conditional measures, elements of statistical physics. (5 credits)

Linear Programming

BMETE93MM01 – 3/1/0/v/5

Dr. Tibor Illés

Convex polyhedra. Minkowski theorem, Farkas theorem, Weyl theorem, Motzkin's decomposition theorem. The problem of linear programming, examples for linear programming problems, graphical solution and interpretation. The concept of feasible solutions, basic solutions, the simplex algorithm. Cycling and techniques for exclusion of cycling: lexicographical simplex method, Bland's rule. Finding starting feasible basis, the two phase simplex method. Explicit basis inverze simplex method, modified simplex method. The duality theory of the linear programming. Complementarity theorems. Game theory. Two persons, zero sum games, Neumann's theorem. The dual simplex method and cutting plane algorithms. Gomory's cutting plane algorithm for the solution of integer programming problems. Special linear programming problems. Transportation problem, the main concepts of graph theory and their application for the solution of transportation problems by simplex algorithm (stepping stone algorithm). The method of dual variables for pricing in transportation problems. Assignment problem, theorem of Kőnig-Egerváry and the Hungarian method. Hiperbolic programming and the solution algorithm by Martos. Separable programming problem. Upper bounding techniques. The Dantzig–Wolfe decomposition, elements of the inner point algorithms. (5 credits)

Markov Processes and Martingales

BMETE95MM07 – 3/1/0/v/5

Dr. Márton Balázs

1. Martingales: Review (conditional expectations and tower rule, types of probabilistic convergences and their connections, martingales, stopped martingales, Doob decomposition, quadratic variation, maximal inequalities, martingale convergence theorems, optional stopping theorem, local martingales). Sets of convergence of martingales, the quadratic integrable case. Applications (e.g. Gambler's ruin, urn models, gambling, Wald identities, exponential martingales). Martingale CLT. Azuma-Höffding inequality and applications (e.g. travelling salesman problem). 2. Markov chains: Review (definitions, characterization of states, stationary distribution, reversibility, transience-(null-) recurrence). Absorbtion probabilites. Applications of martingales, Markov chain CLT. Markov chains and dynamical systems; ergodic theorems for Markov chains. Random walks and electric networks. 3. Renewal processes: Laplace transform, convolution. Renewal processes, renewal equation. Renewal theorems, regenerative processes. Stationary renewal processes, renewal paradox. Examples: Poisson process, applications in queueing. 4. Point processes: Definition of point processes. The Poisson point process in one and more dimensions. Transformations of the Poisson point process (marking and thinning, transforming by a function, applications). Point processes derived from the Poisson point process. 5. Discrete state Markov processes: Review (infinitesimal generator, connection to Markov chains, Kolmogorov forward and backward equations, characterization of states, transience-(null-)recurrence, stationary distribution). Reversibility, MCMC. Absorption probabilities and hitting times. Applications of martingales (e.g. compensators of jump processes). Markov processes and dynamical systems; ergodic theorems for Markov processes. Markov chains with locally discrete state space: infinitesimal generator on test functions. (5 credits)

Mathematical Chemistry

BMETE92MM09 – 2/0/2/v/5

Dr. János Tóth

A few tools of the applied mathematician. Special functions, Laplace transform, qualitative investigations, nonlinear systems, mathematical program packages, looking for the optimum, beyond elementary statistics, estimating the parameters of differential equations. Model types: static and dynamic, discrete and continuous, stochastic and deterministic, linear and nonlinear models. Problems of physical chemistry. Models and problems of homogeneous reaction kinetics. Stoichiometry: applied linear algebra and number theory. Mass action type kinetics: differential equations on graphs. Stationary points, oscillation, chaos. Sensitivity analysis. Reduction of models, lumping. Stochastic models of chemical reactions: Markovian pure jump processes. Applications in biochemistry, enzyme kinetics, pharmacokinetics, drug dosage and drug design. Quantitative structure activity relationships. Applying quantum chemistry. Neurobiological models. Reaction diffusion models. Pattern formation in chemical, biological and economic models. (5 credits)

Mathematical Modelling Seminar 1, 2

BMETE95MM01, 02 – 2/0/0/f/1

Dr. Domokos Szász

The aim of the seminar to present case studies on results, methods and problems from applied mathematics for promoting. the spreading of knowledge and culture of applied mathematics; the development of the connections and cooperation of students and professors of the Mathematical Institute, on the one hand, and of personal, researchers of other departments of the university or of other firms, interested in the applications of mathematics. The speakers talk about problems arising in their work. They are either applied mathematicians or non-mathematicians, during whose work the mathematical problems arise. An additional aim of this course to make it possible for interested students to get involved in the works presented for also promoting their long-range carrier by building contacts that can lead for finding appropriate jobs after finishing the university. (1 credit)

Mathematical Methods of Classical Mechanics

BMETE93MM12 – 2/0/0/f/2

Dr. Gábor Etesi

The basic problem of the calculus of variations. Euler–Lagrange differential equations. Geometrical methods in mechanics. Lagrange and Hamilton systems. Legendre transformation. Hamilton equations. Symmetries and conservation laws. (2 credits)

Matrix Analysis

BMETE92MM03 – 2/0/0/v/3

Dr. Dénes Petz

Vector spaces and linear operators, Hilbert spaces, orthonormal basis, the matrix of a linear operator, matrix norms, self-adjoint and unitary matrices, localization of eigenval-

ues and singular values, positive definite matrices, tensor product and Hadamard product, Schur theorem and applications, functional calculus, derivation, the exponential function, Lie-Trotter formula, matrix monotone functions, means of positive matrices, block-matrices, applications to differential equations, matrices with positive entries. (3 credits)

Multivariate Statistics

BMETE95MM15 – 3/0/1/v/5

Dr. Marianna Bolla

Multivariate central limit theorem and its applications. Density, spectra and asymptotic distribution of random matrices in multivariate statistics (Wishart-, Wigner-matrices). How to use separation theorems for eigenvalues and singular values in the principal component, factor, and correspondence analysis. Factor analysis as low rank representation, relations between representations and metric clustering algorithms. Methods of classification: discriminatory analysis, hierarchical, k-means, and graph theoretical methods of cluster analysis. Spectra and testable parameters of graphs. Algorithmic models, statistical learning. EM algorithm, ACE algorithm, Kaplan–Meier estimates. Resampling methods: bootstrap and jackknife. Applications in data mining, randomized methods for large matrices. Mastering the multivariate statistical methods and their nomenclature by means of a program package (SPSS or S+), application oriented interpretation of the output data. (5 credits)

Multivariate Statistics with Applications in Economy

BMETE95MM18 – 2/0/0/f/2

Dr. Marianna Bolla

Multivariate central limit theorem and its applications. Density, spectra and asymptotic distribution of random matrices in multivariate statistics (Wishart-, Wigner-matrices). How to use separation theorems for eigenvalues and singular values in the principal component, factor, and correspondence analysis. Factor analysis as low rank representation, relations between representations and metric clustering algorithms. Methods of classification: discriminatory analysis, hierarchical, k-means, and graph theoretical methods of cluster analysis. Spectra and testable parameters of graphs. Algorithmic models, statistical learning. EM algorithm, ACE algorithm, Kaplan—Meier estimates. Resampling methods: bootstrap and jackknife. Applications in data mining, randomized methods for large matrices. Mastering the multivariate statistical methods and their nomenclature by means of a program package (SPSS or S+), application oriented interpretation of the output data. (2 credits)

Non-Euclidean Geometry

BMETE94MM03 – 3/1/0/f/5

Dr. Ákos G. Horváth

Hyperbolic space: Models and their relations (Cayley-Klein-, Poincaré-, halfspace-, complex, vector-model). d = 2: trigonometry, area, scissor-congruence, area of ideal triangles, calculations. Hyperbolic discrete groups, Coxeter groups and tilings. d = 3: planes, spheres, horo- and hyperspheres in analytical form. Polyhedra, volume problem, Lobachevski function, Coxeter honeycombs. Spherical space: Analogous problems in d = 2,3 dimensions. Relativity theory: Linear space-time in 1+1 dimensions. Galilei space-time in affine plane, Galilei transform and speed addition. Lorentz space-time and Minkowski plane. Lorentz transform and speed addition. Time shortening. Space-time manifold: Differentiable manifold and tangential spaces (repetition). Riemann and pseudo-Riemann manifold. Tensors. Covariant derivative and curvature tensor. Ricci tensor and Einstein equation. Schwarzschild solution: Mercure precession, light deviation, red spectrum translation. (5 credits)

Nonlinear Hyperbolic Equations

BMETE93MM13 – 2/0/0/v/3

Dr. Katalin Nagy

Single conservation laws, the method of characteristics. The Burgers equation, shock waves, weak solutions. Hopf-Cole transformation, Hopf–Lax solution. The Oleinik entropy condition, convergence of the Lax–Friedrich scheme. Systems of conservation laws, the method of compensated compactness. (3 credits)

Nonlinear Programming

BMETE93MM04 – 3/1/0/v/5

Dr. Tibor Illés

1. Optimality conditions: first-order, second-order conditions (unconstrained optimization). Convexity, convex and concave functions. Point to set mappings, closed mapping, Global Convergence Theorem 2. Line search algorithms: order and rate of convergence, Armijo's rule. Fibonacci, harmonic division, Newton's method. Curve-fitting algorithms. 3. Unconstrained optimization: gradient method, Kantorovich-inequality, order of convergence. Newton's method. Conjugate gradient method, Fletcher–Reeves, PARTAN, Quasi-Newton methods. Gauss–Newton és Levenberg–Marquardt algorithms. 4. Constrained optimization: Constraint qualifications, First and Second Order Optimality Conditions. Primal methods, Zoutendijk's algorithm. Lagrange multipliers, Kuhn–Tucker theorem. Gradient pojection, reduced gradient method. Penalty, Barrier, and Augmented Lagrangian Methods. Duality. Interior Point Methods. (5 credits)

Nonparametric Statistics

BMETE95MM20 – 2/0/0/v/3

Dr. László Győrfi

Density function estimation. Distribution estimation, L1 error. Histogram. Estimates by kernel function. Regression function estimation. Least square error. Regression function. Partition, kernel function, nearest neighbour estimates. Empirical error minimization. Pattern recognition. Error probability. Bayes decision rule. Partition, kernel function, nearest neighbour methods. Empirical error minimization. Portfolio strategies. Log-optimal, empirical portfolio strategies. Transaction cost. (3 credits)

Numerical Methods 2 – Partial Differential Equations

BMETE92MM07 – 2/0/2/v/5

Dr. Róbert Horváth

Numerical methods of partial differential equations of elliptic type: finite difference method, multigrid method, finite element method. Numerical methods of time-dependent partial differential equations: finite element and finite difference methods for parabolic and hyperbolic problems, Ritz and Galerkin methods. Stability. CFL condition, von Neumann analysis. Lax equivalence theorem. Operator splitting methods with applications. Applications of partial differential equations and their numerical solutions: Maxwell's equations and their numerical solutions, pricing of financial derivatives, problems in solid mechanics, heat conduction equation and the qualitative investigation of the numerical solution, air-pollution transport models. (5 credits)

Operations Research Softwares

BMETE93MM06 – 0/0/2/f/2

Dr. Boglárka Gazdag-Tóth

The aim of this course is twofold. On the one hand it aims to advance the student's routine in programming by coding the basic algorithms of operations research. On the other hand its goal is to give perfection in the use of operations research software. The standard description of linear programming problems, the MPS data structure, and the most important algebraic modelling languages (GAMS, AMPL, AIMMS). Introduction and usage of the most important software packages in linear, integer, non-linear, and stochastic programming (CPLEX, MINOS, SNOPT, LOQO, LGO). (2 credits)

Partial Differential Equations 2

BMETE93MM03 – 3/1/0/f/5

Dr. Márton Kiss

The Laplacian in Sobolev space (revision). Weak and strong solutions to second order linear parabolic equations. Ritz–Galerkin approximation. Linear operator semigroups (According to Evans and Robinson). Weak and strong solutions to reaction-diffusion (quasilinear parabolic) equations. Ritz–Galerkin approximation. Nonlinear operator semigroups (According to Evans and Robinson). Only in examples: monotonicity, maximum principles, invariant regions, stability investigations for equilibria by linearization, travelling waves (According to Smoller). Global attractor. Inertial manifold (According to Robinson). (5 credits)

Potential Theory

BMETE92MM04 – 2/0/0/f/3

Dr. Ágota G. Horváth

Motivation: a little electrostatics, Dirichlet problem and Brownian motion. An extremal problem: logarithmic potential, Chebyshev constant and transfinite diameter. Electrostatics with external fields, weighted energy integral and potential. Equilibrium measure and the modified Robin constant. How to solve the Dirichlet problem, when the boundary conditions are not "nice"? Modified Poisson kernel with respect to singularities, lower semicontinuity, Perron-Wiener-Brelot solution, harmonic measure. Regularity, balayage, generalized Poisson integral. Brownian motion and harmonic measures. (3 credits)

Projective Geometry

BMETE94MM01 – 2/2/0/f/5

Dr. Ákos G. Horváth

Perspectivity in the practice, harmonic division, cross-ratios, the projective scale. The addition and multiplication of points on the base of the Desargues's theorem. The field defined by the above operations. Structures based on incidences. Projective and affine planes. The Galois-type geometries. The n-dimensional spherical space, projective space and affin space. The classifications of collineations and polarities by the normal form of Jordan. The projective geometrical base of the visualization by computer. The central projection of figures of dimension 3 and 4 and its visualization on the monitor. (5 credits)

Representations of Groups and Algebras

BMETE91MM04 – 3/1/0/f/5

Dr. Erzsébet Lukács

Group algebra, Maschke's theorem, Shur's lemma, Wedderburn–Artin theorem. Characters of finite groups, orthogonality relations, induction, Frobenius reciprocity, Mackey's theorem. Clifford theory. Applications: Burnside's theorem, Frobenius kernel, character tables. Elements of modular representation theory: blocks, Brauer characters, projective irreducible characters. Indecomposable modules, Krull–Schmidt–Azumaya theorem. Radical, head, socle of a module. Brauer graph. Module categories. Representations of finite dimensional algebras: Auslander–Reiten theory. (5 credits)

Representation Theory

BMETE91MM02 – 3/1/0/f/5

Dr. Alex Küronya

Differentiable manifolds, atlas, maps, immersion, submersion, submanifold, tangent space, vector field, Lie-derivative, topological background. Vector bundles, alternating forms on linear spaces, differential forms, their integration, Stokes theorem. Multilinear algebra (tensors, symmetric and alternating spaces, contraction) and applications to vector bundles. Lie groups and their basic properties; exponential map, invariant vector field, Lie algebra. Matrix Lie groups and their Lie algebras, examples. Representations of groups in general, characters, linear algebraic constructions. Continuous representations of Lie groups, connections among representations of Lie groups and the representations of their Lie algebras. Basics about Lie algebras, derivations, nilpotent and solvable algebras, theorems of Engel and Lie, Jordan-Chevalley decomposition, Cartan subalgebras. Semisimple Lie algebras, Killing form, completely reducible representations. The representations of sl2, root systems, Cartan matrix, Dynkin diagram, classification of semisimple Lie algebras. Representations of matrix Lie groups, Weyl chambers, Borel subalgebra. (5 credits)

Statistical Program Packages 2

BMETE95MM09 – 0/0/2/f/2

Dr. Csaba Sándor

The goal of the course is to provide an overview of contemporary computer-based methods of statistics with a review of the necessary theoretical background. 1. How to use the SPSS (Statistical Package for Social Sciences) in program mode. Writing user's macros. Interpretation of the output data and setting the parameter values accordingly. Definition and English nomenclature of the dispalyed statistics. 2. Introduction to the S+ and R Program Packages and surveying the novel algorithmic models not available in the SPSS (bootstrap, jackknife, ACE). 3. Practical application. Detailed analysis of a concrete data set in S+. (2 credits)

Statistics and Information Theory

BMETE95MM05 – 3/1/0/f/5

Dr. Marianna Bolla

Multivariate statistical inference in multidimensional parameter spaces: Fisher's information matrix, likelihood ratio test. Testing hypotheses in multivariate Gauss model: Mahalanobis' distance, Wishart's, Hotelling's, Wilks' distributions. Linear statistical inference, Gauss–Markov theorem. Regression analysis, one- and two-way analysis of variance as a special case of the linear model. ANOVA tables, Fisher–Cochran theorem. Principal component and factor analysis. Estimation and rotation of factors, testing hypotheses for the effective number of factors. Hypothesis testing and I-divergence (the discrete case). I-projections, maximum likelihood estimate as I-projection in exponential families. The limit distribution of the I-divergence statistic. Analysis of contingency tables by information theoretical methods, loglinear models. Statistical algorithms based on information geometry: iterative scaling, EM algorithm. Method of maximum entropy. (5 credits)

Stochastic Analysis and Applications

BMETE95MM04 – 3/1/0/v/5

Dr. Károly Simon

Introduction. Markov processes, stochastic semi-groups, infinitesimal generators, martingales, stopping times. Brownian motion. Brownian motion in nature. Finite dimensional distributions and continuity of Brownian motion. Constructions of the Wiener process. Strong Markov property. Self-similarity and recurrence of Brownian motion, time reversal. Reflection principle and its applications. Local properties of Brownian path: continuity, Hölder continuity, non-differenciability. Quadratic variations. Continuous martingales. Definition and basic properties. Dubbins-Schwartz theorem. Exponential martingale. Lévy processes. Processes with independent and stationary increments, Lévy-Hintchin formula. Decomposition of Lévy processes. Construction by means of Poisson processes. Subordinators, and stable processes. Examples and applications. Stochastic integration I. Discrete stochastic integrals with respect to random walks and discrete martingales. Applications, discrete Balck-Scholes formula. Stochastic integrals with respect to Poisson process. Martingales of finite state space Markov processes. Quadratic variations. Doob-Meyer decomposition. Stochastic integration II. Predictable processes. Itő integral with respect to the Wiener process, quadratic variation process. Doob-Meyer decomposition. Itő formula and its applications. (5 credits)

Stochastic Differential Equations

BMETE95MM08 – 3/1/0/v/5

Dr. Bálint Tóth

Introduction. Itő integral with respect to the Wiener process and continuous martingale, multi-dimensional stochastic integral. Local time. Local time of random walks on the line. Inverse local time, discrete Ray–Knight theorem. Local time of Brownian motion and Ray–Knight theorem. Tanaka formula and its applications. Skorohod reflection, reflected Brownian motion, a theorem by P. Lévy. Stochastic differential equations. SDEs of diffusions: Ornstein–Uhlenbeck, Bessel, Bessel-squared, exponential Brownian motion. SDE of transformed diffusions. Weak and strong solutions, existence and uniqueness. SDE with boundary conditions. Interpretation of the infinitesimal generator. Applications to physics, population dynamics, and finance. Diffusions. Basic examples: Ornstein–Uhlenbeck, Bessel, Bessel-squared, geometrical Brownian motion. Interpretation as stochastic integrals, and Markov processes. Infinitesimal generator, stochastic semi-groups. Martingale problem. Connection with parabolic and elliptic partial differential equations. Feyman–Kac formula. Time-change. Cameron–Martin–Girsanov formula. One-dimensional diffusions. Scale function and speed measure. Boundary conditions. Time-inversion. Application to special processes. Special selected topics. Brownian excursion. Two-dimensional Brownian motion, Brownian sheet. SLE. Additive functionals of Markov processes. (5 credits)

Stochastic Models

BMETE95MM11 – 2/0/0/f/2

Dr. Márton Balázs

Coupling methods: stochastic dominance, coupling random variables and stochastic processes, examples: connectivity using dual graphs, optimization problems, combinatorial probability problems. Percolation: definitions, correlation inequalities, duality, contour methods. Strongly dependent percolation: Winkler percolation, compatible 0-1 sequences. Basics of statistical physics: Gibbs measure, a few basic models. Card shuffling: completely shuffled deck, how many times should one shuffle? Random graph models: Erdős–Rényi, Barabási-Albert; basic phenomena Variants of random walks: scenery reconstruction, self-avoiding and self-repelling walks, loop-erased walks, random walk in random environment. Queueing models and basic behavior; stationary distribution and reversibility, Burke theorem; systems of queues. Interacting particle systems: simple exclusion on the torus and on the infinite lattice, stationary distribution, Palm distributions, couplings, other models. Graphical construction of continuous time Markov processes: Yule model, Hammersley's process, particle systems. Self-organized criticality: sandpile models: questions of construction, commutative dynamics, stationary distribution in finite volume, power law decay of correlations. Linear theory of stationary processes: strongly and weakly stationary processes, spectral properties, autoregressive and moving average processes. Analysis of time series, long memory processes. Models of risk processes. (2 credits)

Stochastic Programming

BMETE93MM05 – 3/1/0/v/5

Dr. Tamás Szántai

Statistical decision principles. Petersburg's problem. Bernoulli-principle and the newsboy's problem, Dutch dike heightening problem, 'safety first' principle, Marschak's decision principle, the Bayesian decision principle, Markowitz's principle, game theory, Neumann's theorem. Convexity theorems. The theory of logconcave measures. General convexity theorems. Concavity and logconcavity of multivariate probability distribution functions. Statical stochastic programming models. Maximalizing the probability. Single and joint probabilistic constraints in the stochastic programming problems, solution methods. Models containing conditional expected values. Models with random objective functions. Penalty models of stochastic programming and their solution techniques: cases of discrete and uniform probability distributions. Dynamical stochastic programming models. Two stage stochastic programming problem and its mathematical properties. Basis decomposition technique for the solution of two stage stochastic problems with discrete probability distributions. 'L-shaped' solution method by Wets. Stochastic decomposition and conditional stochastic decomposition. Stochastic quasigradient methods. Multi stage stochastic programming problems. The basis decomposition and the 'L-shaped' method in the case of multi stage stochastic programming problems. Some applications of stochastic programming. Production of electrical energy with random effects, capacity expanding. Reliability analysis of power-plants. Water level regulation of a lake. Optimal control of water reservoirs. The PERT problem. Financial models. (5 credits)

Theoretical Computer Science

BMETE91MM00 –3/1/0/f/5

Dr. Miklós Ferenczi

Foundations of logic programming and automated theorem proving. Finite models and complexity. Non classical logics in Computer Science: temporal dynamic and programming logics. Recursive functions and lambda calculus. Boole algebras, relational algebras and their applications. Some important models of computation. Basic notions of complexity theory, some important time and spaces classes. NP completeness. Randomised computation. Algorithm design techniques. Advanced data structures, amortised costs. Pattern matching in text. Data compression. (5 credits)

Theory of Operators

BMETE92MM05 – 3/1/0/v/5

Dr. Béla Nagy

The basic concepts of Hilbert spaces will be assumed to be known. Further: Closed and closable linear operators, closed graph theorem. The basics of the spectral theory for closed operators. Closed symmetric and self-adjoint operators. Symmetric operator and its self-adjoint extension. Operators defined by a Hermitian (sesquilinear) form. Closed normal operators. Finite rank and compact operators. Hilbert–Schmidt operators. Matrix operators. Integration with respect to a spectral measure. The spectral decomposition for closed self-adjoint operators and the properties of their spectra. The spectral decomposition of closed normal operators. The extensions of closed symmetric operators: deficiency indices and Cayley transforms. Extensions into a larger Hilbert space: theorem of M. Naimark. Self-adjoint extensions extensions and their spectra. Analytic vectors. Perturbation of self-adjoint operators. Scattering. The unilateral shift operator, Wold–Neumann decomposition. The bilateral shift. Contractions. Invariant vectors, canonical decomposition. Isometric and unitary dilation of a contraction. Operators in Banach spaces. Holomorphic functions and contour integrals. Holomorphic functional calculus for bounded and for closed operators. Compact operators. The Riesz–Schauder theory. Noether and Fredholm operators. Semi-groups of operators in Banach spaces. The operator theoretic foundations of linear systems. Banach algebras. Spectrum. Holomorphic functional calculus. Ideals. The Gelfand transform. The spectrum of an element in a C*-algebra. The commutative Gelfand–Naimark theorem. Representation of C*-algebras. (5 credits)

Wavelet Analysis

BMETE92MM06 – 2/0/0/f/2

Dr. Ky Nguyen Xuan

A wavelet is a kind of mathematical function used to divide a given function into different frequency components and study each component with a resolution that matches its scale. A wavelet transform is the representation of a function by wavelets. The wavelets are scaled and translated copies (known as "daughter wavelets") of a finite-length or fast-decaying oscillating waveform (known as the "mother wavelet"). Wavelet transforms have advantages over traditional Fourier transforms for representing functions that have discontinuities and sharp peaks, and for accurately deconstructing and reconstructing finite, non-periodic and/or non-stationary signals. In this course the theoretical background of all that and some applications will be presented as well. (2 credits)

Description of MSc Subjects in Cognitive Science

Brain in Trouble

BMETE47MC34 – 2/0/0/f/2

Dr. Márta Zimmer

Low-level deficits of the visual system – vision loss in eyes, visual field defects, blindsight. Deficits of object- and face perception. Deficits of space- and motion perception. Defects of the motor system – tic, Tourette syndrome, HD, MS. Sleep disorders, epilepsy, coma. Memory deficits. Deficits of higher cognitive functions (speach, reading, counting). Alcohol, drugs – short- and long-term effects in the central nervous system. Defects of the consciuos processes. Anxiety, mood disorder, depression. Schizophrenia, negative symptoms, hallucinations, psychopathies, multiple personality disorder. Eating disorders – anorexia, bulimia. Effect of aging – developmental disorders, aging, dementia. (2 credits)

Cognition and Emotion

BMETE47MC26 – 2/0/0/f/3

Dr. Gyula Demeter

The primary objective of the course is to present an overview of current research on basic emotional and cognitive processes and underlying brain function. We strive to illustrate the complex relationships between cognition and emotion by presenting specific examples and clinical cases, and by highlighting the underlying brain circuits. We focus also on the major clinical disorders with dysfunctional brain networks. We try to answer questions, such as: Thought or feeling- what is first? or sooner? What are the neural and evolutionary determinants of anxiety? How did our emotions and cognitive abilities evolve? – Introduction and examples. The psychology of emotions. Brain and emotion. Brain and cognition. Interactions of cognition and emotion. The development of cognition and emotion. Sleep and emotional information processing. Cognition and emotion after brain damage. Cognition and emotion in psychiatric disorders. (3 credits)

Cognitive Neuropsychiatry

BMETE47MC30 – 2/0/0/v/3

Dr. Szabolcs Kéri

History of psychopathology and classification of mental disorders. The DSM and ROoC. Continuum hypotheses, fuzzy clusters, and latent categories. Fundamental neuronal systems in psychopathology: PFC and subregions, amygdala, hippocampus, basal ganglia and their large-scale networks (default mode, executive, mirroring). Neuronal connections, synaptic transmission and key neurotransmitters. Psychotropic drugs: mechanism of action. Neurodevelopmental processes, neurodegeneration, plasticity, neuroinflammation. Orientation to time, space, and person. Quantitative and qualitative disorders of consciousness. Delirium. Perception, aperception, gnosia: representations at the sensory, perceptual, and conceptual level and psychopathology. Classification and mechanisms of hallucinations: efferent copy, parasite foci. Neuroimaging results. Perceptual distortions, deja vu, jamais vu. Capgras and Fregoli syndrome. Mechanism of dissociation: disconnections, role of PFC/anterior cingulate/amygdala circuits. Cognitive distortions, schemas, and heuristics. Overvalued belief and false belief (delusion). Classification and mechanism of delusions: perception

of social signals, early jump to conclusions, selective attribution, and mentalization. Role of early traumas, reinforcement, neurodevelopmental features, and social context. Alienation, disturbances of self-representation. Semantic networks and conceptual disorganization. Role of left inferior PFC and perisilvyan areas, relationship with executive functions. Classification and mechanism of obsessions: the anterior cingulate/OFC/striatal loops. Phobias: processing of social signals and the amygdala. Reinforcement and extinction. (3 credits)

Cognitive Psychology Laboratory

BMETE47MC20 – 0/0/8/v/9

Dr. Ferenc Kemény

The aim of the course is to keep students up-to-date on the most popular paradigms of human psychological research. To introduce the major methodologies and related softwares. The course covers three major issues: Psycholinguistics, Memory and Sleep research. Students learn computer programming (E-prime), with thich they will be able to plan and run experiments. Neuroscience methods like EEG and eye-tracking will also be demonstrated. Psycholinguistics: students design and conduct a traditional psycholinguistic experiment, and disseminate results in the format of a course paper. Memory: students plan and conduct an experiment on memory using either behavioural or eye-tracking methodology. Sleep research: students learn the basics of the discipline, with special focus on the overlap of sleep research and cognitive neuroscience, its research streams and most important methodologies. Along with the major research paradigms (e.g. sleep deprivation, biorhythms, the neurobiological background of sleep disorders, sleep and memory consolidation, sleep-related information processing) students learn how to register and analyse sleep-related EEG. (9 credits)

Evolutionary Psychology

BMETE47MC07 – 2/0/0/f/3

Dr. Péter Simor

Evolutionary sciences and their hierarchy. The origin and fate of the Darwinian heritage in psychology. The notion of adaptation. Modular and single factor based theories of evolutionary psychology. Hominid evolution and cognitive architectures. Sexual and natural selection. Cultural multiplicity and evolution. – Main topics: Units and mechanisms of evolution: groups, individuals, genes, memes. Sexual selection. Mate choice and human mating strategies. Innateness and development. Social development; kin relationships and conflict. Reciprocity, group behavior, cooperation, competition. Game theory and evolution. Thought, cognition, and mental representation. The evolution of language and communication. The evolution of emotion, and evolutionary psychopathology. Culture and evolution. (3 credits)

Informatics

BMETE92MC19 – 0/2/0/f/3

Dr. János Tóth

The aim is to provide and extremely powerful tool to solve calculation, simulations, drawing, presentation, etc. problems connected with the studies of the student, which will also come useful later in research. The tool Mathematica, Version7, at the time of writing this syllabus, is also useful to show the latest developments in different fields of applied computer science, such as programming paradigms (with emphasis on functional programming). Parts of mathematics will also be presented or repeated in this course. – Topics: Mathematical program packages. An intelligent calculator: application in elementary mathematics. Kernel, front end, packages, demonstrations. Numbers, solving equations. Plotting, graphics. Animation, manipulation, sound. The language of Mathematica. Lists and generalized lists. Functional programming. Rule based programming. Rewrite rules. Pattern matching. Procedural programming. Applications in mathematics: discrete, continuous, stochastic. Applications in linguistics. Elements of image processing. (3 credits)

Introduction to Cognitive Science

BMETE47MC01 – 2/0/0/f/3

Dr. Gyula Demeter

Fundamental concepts of cognitive science: mental representation, computers, and information processing. Brain and cognition; the role of neuroscience. Cognitive architectures: modularity and domain-general systems. Propositional and schematic representation; schemas, mental images, and skill acquisition. Connectionism: artificial neural networks as models of the mind. Knowledge representation in artificial intelligence. Language and cognition; knowledge of language; the problem of meaning. The role of philosophy: the nature of mind, knowledge and consciousness. Interpreted Cognitive Science: neurobiology, evolution and social interpretation. Adaptation and knowledge. Skill, competences, and emotions in knowledge. Applied cognitive science: artificial intelligence; human information processing in human-machine interaction. (3 credits)

Introduction to Experimental Psychology

BMETE47MC25 – 2/0/0/v/3

Dr. Gyula Demeter

Introduction. Understanding psychology as a science. Experimental psycholgy and the scientific method. Research techniques : observation and correlation, experiments. Ethics in psychological research. Attention and reaction time. 1st Written examination paper. Conditioning and learning. Memory and forgetting. Individual differences and development. 2nd Written examination paper. Presentation of research plans. Presentation of research plans. (3 credits)

Mathematics

BMETE92MC15 – 2/2/0/v/5

Dr. János Tóth

The aim of the course is to give a nontechnical introduction into higher mathematics via lectures and via reading texts containing the use of mathematics in the different parts of cognitive science. Instead of calculation methods logical and philosophical connections will be emphasized. Technical and geometrical aspects will not receive emphasis, however, we try to analyse the meaning of notions within and, if possible, outside mathematics. Instead of proofs examples will be shown together with applications and with historical remarks. A shortened introduction to the classical material of calculus will be followed by introductions to areas which cannot be absolutely neglected by someone interested in cognitive science: dynamical systems, graphs and networks, algorithms and the use of computers in mathematics. – Topics: Fundamental notions of set theory and logics. A review of the notion of numbers. Relations and functions. The connection between operations and relations and between functions. Operations on functions. Series and infinite sums. Convergence, limit. Limit and continuity of real variable real valued functions. Differentiability of real variable real valued functions. Tangent. Rules of derivation. Applications of calculus: analysis of functions. Monotonicity, maxima and minima. Integration: antiderivative, definite integral. The fundamental theorem of calculus. Solving simple differential equations. On discrete dynamical systems. Simple models with chaotic behavior. On graphs and networks. Their rules of modelling. Algorithms. Applying mathematical program packages. (5 credits)

Memory and the Psychology of Learning

BMETE47MC29 – 0/3/0/f/3

Dr. Mihály Racsmány

The topics covered in the course are the currently topical areas of memory research. The most controversial results and new theories of the various topics are discussed based on one or two studies. – Sleep and memory. Consolidation and reconsolidation. Amnesia. Prospective memory. Autobiographica memory. Memory decay. Consultation with students on research proposal. Recall. Inhibition and interference. Learning and transfer. Working memory. Consultation with students on second research proposal. (3 credits)

Neurobiology 1 – Foundations and Neurobiology of Perception

BMETE47MC22 – 2/0/2/v/5

Dr. Gyula Kovács

Basic neural processes, the cell membrane, the action potential. The synapse. Autonomous nervous system, hypothalamus. Perception – intorduction – methods. Integration of sensory and motor functions. From nerve cells to cognition. Somatosensory system: periphery, cortical processing, the perception of pain and temperature. Vision: early vision, higher vision. Hearing. Chemical senses – smell and taste. Practice: a HHSIM simulatory program, summary paper. (5 credits)

Neurobiology 2 – Sensory and Motor Processes

BMETE47MC23 – 2/0/0/v/3

Dr. Gyula Kovács

Multisensory integration. The human eye – anatomy, eye-movements, the retina. Subcortical mechanisms, thalamic nuclei and the superior colliculus. The V1. Visual cortical processes – after the V1. Dorsal and ventral visual pathways. Hearing. The motor system: from the muscle fibre to the spinal chord, brainstem, cortex, the basal ganglia and the cerebellum. (3 credits)

Neurobiology 3 – Higher Cognitive Functions

BMETE47MC24 –2/0/0/v/3

Dr. Szabolcs Kéri

The concept of mental functions. Structure of the association neocortex: Brodmann's areas, columnas, local neuronal circuits. The Mesulam-Fuster model, functional maps, cognits, temporal integration (oscillations, synchronization) Connections between neocortex and limbic system: Broca, the concept of the extended limbic system, Papez circuit + amygdala/OFC/cingulate system. Connections between neocortex and basal ganglia, subregions of the frontal lobe, maps of striatal loops, the Gruber-MacDonald model (S-R-C-O). Cellular bases of cognitive processes (selectivity, associativity, sustained activity, reward prediction, mirroring). The connectome", large-scale neuronal networks. The Bayes model, Friston's free energy principle. Posner's concept of attention: alerting, orienting, executive. The frontoparietal system, thalamus, colliculus. Ventral bottom-up, dorsal top-down and cingulo-opercular systems. Neglect. The biased competition model (Desimone). Frontal eye field [FEF] and intraparietal sulcus, search versus detection. Attention and temporal integration, alpha-gamma interactions. Cellular bases of the biased competition model, interaction of preferred and non-preferred stimuli in the receptive field, attentional weighting. FEF microstimulation, role of dopamine in attention and decision making. Subfields of intraparietal sulcus, attention and body-reference, affordances, interactions with premotor cortex canonic cells. Attention and Gestalt-organization, feature integration (Treisman) pop-out, object file", spatial filters and their attentional modulation. Ultra rapid attentional modulation. The MTL (medial temporal lobe) and its connections with the prefrontal cortex: fornix, thalamus, prefrontal subfields. Gamma-on-theta temporal integration. (3 credits)

Neuropsychology

BMETE47MC06 – 2/0/2/v/5

Dr. Gyula Demeter

In this course students will study the neural foundations of higher cognitive functions such as concept formation, language, planning of action, problem solving, emotions and consciousness, with a focus on recent findings and methodological development. Not only do recent findings and methodological achievements shape scientific theory, they also tend to affect therapy as well. We review these new findings while looking for links between normal and pathological functioning. (5 credits)

Psycholinguistics

BMETE47MC36 – 2/0/0/v/3

Dr. Ágnes Lukács

The course is based on the relationship between problems in linguistics and psychology and the history of the overlap between the two fields of research. In analysing the processes of language comprehension, beside presenting experimental methods in psycholinguistics, the main organizing principle is the contradiction of decompositional and interactive theories in explaining linguistic behavior, together with the problem of the psychological reality of linguistic levels. For speech production, the goal is to present stage models of planning and realization, as well as to demonstrate how production is embedded in conversation. The course also relates models of lexical organization to analyses of conceptual organization. The part on child language mainly focuses on constructivist and innatist explanations of language development, and connects them to our current biological knowledge. (3 credits)

Reading Seminar in Psycholinguistics 1, 2, 3

BMETE47MC31, 32, 33 – 2/0/0/v/3

Dr. Anna Babarczy

The course discusses current issues in psycholinguistics and experimental linguistics through the analyisis of current theoretical and empirical papers in the Hungarian and international literature. Each semester, the most topical issue will be chosen. Topics to choose from include: Theoretical debates in language acquisition. Language learning and implicit learning. Language Specific Impairment. Language and executive functions. The development of pragmatic competence. Scalar implicatures. Empirical findings in Metaphor theory. Clinical pragmatics. Models of language processing. Ambiguity. Corpus analysis of child language. Computer models of language acquisition. Computer models of pragmatic competence. Speech production. Language evolution. (3 credits)

Social Cognition

BMETE47MC28 – 2/0/0/v/3

Dr. Szabolcs Kéri

Infant understanding of others' behavior: intentions, goals, agency and early theory of mind. The foundations of cultural learning: ostensive signals, referencial communication and imitation. The roots of understanding the social world: cooperation, competition, altruism and the moral baby". Intentional stance, processing of social signals, group processes. Haggard's model of intentional actions, whether-what-when" decisions. Internal models and efferent copy. Neuronal mechanisms of intentional, self-generated and reflexive-stimulus-driven actions. Hypoactivity, alienation, delusions of reference, and hallucinations. Pre-SMA and alien hand syndrome. Processing of social signals. Self-representation and the somatosensory/insular cortex. Medial PFC and the default mode network": introspective cognition, mentalisation, mental time travel. Anticorrelative network with the executive system. Evolution of the anterior PFC, von Economo neurons, canonic cells, mirror cells and their network. Higher-level person perception: mentalisation, attribution, early conclusions, self-monitoring. Neuronal correlates of empathy. Neuronal representation of the self (Damasio and Frith): proto-, core- and autobiographic self. Nuclei of the brainstem, colliculi, somatosensory cortex, and the cingulum. The motor self: reconstruction in time. Basic processes in group interactions: competition, cooperation, cultural synchronization, distribution of resources, opportunism, heuristics, fragmentation. Neuronal relevance of the Nash-equilibrium: ultimatum game, dictator game, trust game, and prisoner's dilemma. Neuronal correlates of moral emotions and decisions. Hyperscanning, correlations of brain activity during cooperation, role of oxytocin in trust and attachment. Evolutionary cycles of cooperation and deception, cultural evolution, religion and political Machiavellianism. (3 credits)

Statistics and Methodology

BMETE92MC20 – 2/0/2/v/5

Dr. Márta Lángné Lázi

All the major areas of statistics (such as estimation, hypothesis testing, regression) will be treated with special reference to the assumptions usually assumed in introductory courses (such as normality, linearity, stationarity and scalar valuedness), which, however, are never fulfilled in real applications. How to test these assumptions and what to do if they are violated - these questions will act as guides in the course. – Topics: Random variables. Distributions. Generating random numbers. Sampling. Methods of estimation. Confidence intervals. Testing hypotheses. Independence, normality. Regression and interpolation. Getting and importing data. Cluster analysis. Experimental designs. Applications. Writing a report. Depending on the circumstances the calculations will either be done using Mathematica, or EXCEL, or SPSS. (5 credits)

Faculty of Economic and Social Sciences

General Information

Based on the long tradition of providing education in the fields of economics, management and social sciences, in 1998 the Budapest University of Technology and Economics established a new faculty, the 'Faculty of Economic and Social Sciences' employing 300 instructors and researchers.

Parallel to the traditional five-year university training, according to the Bologna model the two-cycle system (for BSc and MSc degrees) was introduced in 2006.

The accredited full time degree programs in Economics, Engineering Management, Communication and Media Studies, Teachers Training in Vocational Fields are carried out according to the latest European standards. Besides its own training programs the Faculty co-operates closely with all the engineering faculties of the University providing courses in management, economics, social sciences, languages and physical education.

Additionally the Faculty offers different kinds of post-graduate programs and short-term courses of various types.

Currently more than 75 PhD students are participating in different individual research programs in different areas of economic and social sciences.

The Faculty of Economic and Social Sciences pays special attention to the integration of theoretical and practical knowledge in its curricula and Faculty has established strong professional relationships with the participants of various economic fields (profit and non profit oriented institutions, banks etc).

Educational and Research Activities

The total number of participants of different graduate-, postgraduate and distance learning forms of training launched by the faculty is about 6000. The number of full-time students of basic training of the faculty itself has been increasing. Research is conducted in 2 doctorate (PhD) schools.

Languages, International Studies

Dutch, English, French, German, Italian, Spanish, Russian and Hungarian as a foreign language are taught at levels from A1 to C1 by 80 lecturers and language instructors at BME Centre of Modern Languages. Language instruction for Specific Purposes (LSP) as well as translator and interpreter training are also offered by the Centre.

Students can sit for nationally and internationally accredited general and specific (LSP for Economics or Engineering) language exams at 3 different levels (B1, B2 and C1) at the BME Language Examination Centre.

The teaching staff of the Centre is actively involved in the Hungarian and Central European Studies programme (for detailed description see the section of Hungarian and Central European Studies).

Physical Education

The University offers a wide range of curricular and extra-curricular forms of physical education. The Department of Physical Education co-operates with the University Sports Club and other student sports organisations.

Farkas Heller Foundation

Farkas Heller was a world famous professor of economics and former rector of the University. The foundation established in 1999 in his honour provides for the development of training and research at the Faculty. The foundation operates as an organization of common benefit. The foundation receives donations from different organizations for different general and specified tasks that would promote the establishment of further forms of cooperation with companies, research centres and other organizations.

Harvard Business Review

It was a great honour for us that professors of our faculty formed the editorial board of the Hungarian edition of the outstanding international business journal Harvard Business Review. The Hungarian edition was published from 1999 until 2011.

Institutes and Departments

Institute of Applied Pedagogy and Psychology
Department of Ergonomics and Psychology
Department of Technical Education
Centre for Continuing Engineering Education
Centre for Learning Innovation and Adult Learning
Institute of Economic Sciences
Department of Environmental Economics
Department of Economics
Institute of Social Studies
Department of Philosophy and History of Science
Department of Sociology and Communication
Institute of Business Sciences
Department of Management and Corporate Economics
Department of Finance and Accounting
Department of Business Law

Center of Modern Languages
BME Language Examination Centre
English Department
German Department
Department of Romance Languages
Section of Hungarian Language
Section of Slavic Languages

Center of Physical Education

Budapest University of Technology and Economics
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Dean of the Faculty: Dr. János Kövesi
Vice-Deans of the Faculty:
Dr. Edit Németh (education)
Dr. Benedek Láng (scientific and international)
Dr. Gábor Bóta (finance)

Forms of Training (in Hungarian)

Traditional five-year university training

Full-time degree courses and programs
- MSc program in Engineering Management
- MSc program in Business Management
- MSc program in Technical Education

Supplementary training for university degree
- MSc program in Business Management
- Teachers Training program for Engineers
- Training of Translators and Interpreters

Postgraduate programs
- Informatics for Banking
- Business law
- Environmental Management Specialist
- School Management
- Master of Business Administration (MBA) (in Hungarian and also in French)
- Management
- Work and Organizational Psychology
- Translator and Interpreter

Accredited post-secondary vocational training
- Engineering manager-assistant (specialization: logistics)

Accredited doctorate (Ph.D.) schools
- Business and management
- Psychology (Cognitive Science)
- History and Philosophy of Science

BSc/BA training in the two-cycle system

Full-time degree courses and programs
- BSc in Engineering Management
- BA in Business and Management
- BA in Applied Economics
- BA in Communication and Media Studies
- BA in International Business
- BA in Vocational Technical Training

MSc Programs
- Marketing
- Master of Business Administration (MBA)
- Finance
- Accounting
- Management and Organization
- Economic Analysis
- International Business and Management
- Regional and Environmental Management
- Cognitive Studies

The language for the training is Hungarian, but most of the departments offer courses in English as well, with which the faculty is represented in the programs of all engineering faculties.

Every year more than 50 courses are offered in English for students from other BME faculties' full-time programmes and for our part-time international mobility program students (Erasmus, CEEPUS and "Science without Borders"). Apart from these course modules, the Faculty is soon to launch its first full-time English language degree programme. In a spirit of fruitful collaboration between faculties and departments of BME, the Faculty of Economic and Social Sciences and the Faculty of Architecture are jointly launching a new 2 year long, 120 ECTS, full time, Central and Eastern European problem-orientated, multidisciplinary English-language Master's degree programme in Sustainable Urban Development. The programme was approved by a decision of the Hungarian Accreditation Committee in May 2014, and following the ministerial level legal accreditation phase it is expected that the first programme can begin in the 2015/16 academic year. Detailed description can be found at the programme's website: http://susud.bme.hu

Counseling, consultancy

Services of counseling, consultancy are provided for companies in the following fields:

- Human resource development
- Professional training in foreign languages,
- communication skills development in the-mother tongue
- Strategies of information technology development
- Innovation management
- Environmental impact assessment
- Logistics
- Quality management
- Ergonomic design of workplaces
- Information technology solutions in banking
- Finance, accounting, tax system and regulations
- Project management
- Sport and other health protection activities
- Organization development
- Support in decision making for organizations and management
- Organizational behavior
- Software ergonomics
- Technology assessment
- Product development
- Production management
- Environmental management systems of companies (ISO 14000)

On-the-job professional and foreign language training is also organized on companies' request.

English language course offer for Erasmus+ mobility program

Management and Business Economics

BMEGT20A001

The course is designed for engineering students who would like to have a better conceptual understanding of the role of management in the decision making process. The course introduces the essentials of management as they are applied within the contemporary work environment. Particular attention is paid to management theories, corporate finance, motivation, leadership, teamwork, change management, quality management, management of technology, economic calculation and operations management. For problem formulation both managerial interpretation and mathematical techniques are applied. (4 credits)

Quality Management

BMEGT20M002

Spring semester only!
The primary goal is to get the students acquainted with the current issues and methods of quality improvement. Students are given an overall picture of quality philosophies applied in both productive and non-productive industries, the basics of quality management related standards and total quality management including self-assessment models and of the various soft and hard methods of quality management. (2 credits)

Management

BMEGT20MW02

Autumn semester only!
The course introduces the field of the life in workplaces. It covers a wide range of theories and applications dealing with such topics as motivation, team dynamics, leadership, organizational culture, and different HRM activities, like recruitment and selection, performance appraisal and training. The goal of this course is to help students develop a conceptual understanding of theories in organizational life (Organizational Behaviour) and to provide special set of skills to manage human resources (Human Resource Management), not only for those who are in managerial positions, but for future engineers and other professionals. (5 credits)

Marketing

BMEGT20A048

Autumn semester only!
Learning outcomes: After the course the students understand the role of marketing in an organization. Students get familiar with the marketing tasks, tools and strategies. Through the practical work the student is able to elaborate certain marketing topic using the knowledge acquired on lectures.
Content: Introduction to marketing. The marketing environment. Strategic marketing planning. Marketing information and marketing research. Market segmentation and targeting. Positioning. Consumer buyer behaviour. Business-to-business marketing. Product strategy. New product development. Marketing services. Pricing strategies. Marketing channels. Advertising, sales promotion and PR. Direct marketing and personal selling. (5 credits)

Micro- and Macroeconomics

BMEGT30A001

Selected topics and analytical techniques in micro- and macroeconomics tailored for engineering students. Introduction to microeconomics. Some basic economic concepts and analytical tools. Scarcity: source of eternal struggle or the foundation of all economic systems? How does "choice" determine everyday life, and what role does it play in the operation of businesses? Opportunity cost, sunk cost, normal profit. How does the product market work? Consumer choice: what are the options on the demand side, what are the goals of the consumer and how they are achieved? The forms and aims of businesses. Basics of accounting and finance. Cost and profit analysis. Competition and market systems. Introduction to macroeconomics. How does government policy interact with the decisions, profitability and life cycle of businesses? The main issues of macroeconomic study: gross domestic product, changes in the price level, unemployment ratio. Governmental policies: tools and effects. Fiscal policy: direct intervention to the life of the households and firms. Monetary policy: changes in the regulations, workings and major indicators of the financial market, and their effect on the households and firms. Economic growth and productivity. Issues of international trade: exchange rate and exchange rate policy. (4 credits)

History of Economic Thought

BMEGT30N001

Spring semester only!
The subject's main goal is to introduce into the evolution of economic thought. Beginning with the ideas of ancient Greek philosophers about economic and social life and following with Thomas Aquinas' scholasticism, the course turns to theories and practice in the sense of mercantilism. The study of pre-classical Scotch philosophers will be the basis for understanding liberalism and the classical supply side economics in the 18th century. Development of technology had implied that the demand-side became the bottle-neck and thus the foundation of modern micro- and macroeconomics. The process of time-development of theories will be combined with the analysis of the concrete conditions for production, distribution and consumption in different periods. (2 credits)

Accounting

BMEGT35A002

Autumn semester only!
Students of the course receive managerial and other practice oriented knowledge concerning the financial and profitability status of companies, learn about the methodology, procedure and settlement of financial transactions. The purpose is to provide the students with a confidential knowledge in the field, to guide them in the language of business, to present a financial concept and to supply the students with an asset necessary for international communication based on accounting cognition. (2 credits)

Finance

BMEGT35A001

Spring semester only!
Introduction: financial decisions. An overview of the financial management system. The role of financial markets. The structure of financial markets. Money and capital markets. Accounting and cash flow conception. The financial statement and analysis. Time value of money. Present value, future value, annuity, perpetuity. Determining discount rates. Risk concepts. Understanding and measuring risk. Risk and required rate of return. Valuation and financial management. Market values, risk and return relationship. Concepts in valuation. Types of securities. Stock valuation. Dividend discount model. Bond valuation. Government securities. Understanding managed funds. Investment into real assets. Investment analysis, determination of stock price. Securities and the stock exchange. Fundamental and technical analysis. Information system for investment analysis. (2 credits)

Economic Policy

BMEGT35A003

Autumn semester only!
The objective of the course is to introduce the students to fundamentals of business–government relations in the environment of modern market economy. Basic theories, schools and ideologies of economic policy as well as their main institutions and institutional participants are discussed. The theory and practice of economic intervention of the government are illustrated by means of cross-sectional analysis for various states and with respect to the specific issues for stabilization their economic policies. Special attention is devoted to economic policy processes of Eastern European countries and to the investigation of dilemmas related to Hungarian economic policy. (2 credits)

Investments

BMEGT35M004

Autumn semester only!
The main topic of this course is fixed income valuation, with a special emphasis on US mortgage backed securities. First, we briefly review the fundamentals of modern portfolio theory, starting from Markowitz's original model to the foundations of modern multi-factor models. We analyze the Capital Asset Pricing Model, define risk, introduce risk measures and talk about the risk free rate and risk premium. Later, we turn our attention to fixed income instruments. We classify the instruments, and review the most frequent cash-flow structures, then talk about valuation. We define duration and convexity, and the basics of building an index replicating bond portfolio. We go into more details in US agency (prime) mortgage backed pass-through and structured securities. Using MS Excel to model prepayment behaviour, we simulate future interest rates, generate cash-flows of complex structured products and finally use Monte Carlo simulation to calculate modelled price. We define and calculate option adjusted spreads. The second part of the course is quite technical. While not a prereq, some background in probability theory, Monte Carlo simulation, interest rate models, and general mathematics is definitely an advantage. (2 credits)

Research Methodology

BMEGT41A002

Autumn semester only!
The course aims at helping the students to create a conscious attitude towards the methodological tools and abstract notions of their own subject. We are going to examine the chief characteristics of scientific activity as well as the primary methodological norms of research. We will study the basic notions of scientific knowledge (what do we understand by knowledge, causal relationship, law of nature, what basic understandings of space and time can be identified), and we will also observe the different phases of scientific cognition (experience, making hypotheses and theories). We are going to examine the role mathematics plays in the sciences. Among the scientific methods we will treat separately the followings: experimenting, measuring, quantification, verification and falsification. We will examine when a theory can be seen as verified, confirmed and falsified, and which results confirm a given theory. During the course, we are gong to illustrate with historical and contemporary examples how the above discussed methodological rules have been put into practice. (2 credits)

Theory and Practice of Environmental Economics

BMEGT42N000

The subject is to present the most important principles of environmental economics, environmental policy and sustainability as well as to show some practical applications. The topics included: systems and relations of economy, the society and the environment, a historical overview of environmental economics, the concept, levels and different interpretations of sustainable development. Environmental policy from an economic perspective is also discussed: its definition and types, economic and regulatory instruments in environmental protection, their advantages and limitations. Theoretical approaches include the theory of externalities, internalisation of externalities, Pigovian taxation, the Coase theorem, environmental economics in a macroeconomic context, alternative, "green" macro-indicators (NEW, ISEW,GPI), monetary environmental valuation, the

concept of total economic value and environmental valuation methods (cost-based methods, hedonic pricing, travel cost method, contingent valuation, benefit transfer).
Environmental Policy in Hungary. Introduction to environmental economics. Nature conservation and natural parks. Energy policy: providing a safe and sustainable development strategy. European and Hungarian Sustainable Development Strategy. Sustainable consumption. Corporate Social Responsibility. (4 credits)

Hungarian and EU Environmental Strategies

BMEGT42N001

Autumn semester only!
The course is aimed at providing an insight into the interrelationships between government and natural resources, and the theoretical and practical opportunities for executing strategies of sustainable development. The course will introduce the development of the concept of sustainable development, from its earliest days to the global factors of contemporary days. The course will explore the possible paths of transitioning to sustainability, firstly through the aspect of resource management, and secondly from an aspect of corporate management, through Corporate Social Responsibility. The local and micro-regional levels of sustainability will be addressed. Students will get an insight into sustainable consumption, and closing the open links in the economic chain, including "Retain – Reduce – Re-Use – Recycle", and the principles of Life Cycle Analysis. Students will get an overview of regulating recycling and other policy measures. Finally, the course will focus on the technological foresight in conjunction with sustainable development, and the outlines of the key trajectories. To wrap up the course, an overview of European sustainable development policy will be given. (4 credits)

Regional Economics

BMEGT42N002

The aim of the subject is to introduce basic, actual regional economics and spatial planning theory as well as the EU and Hungarian practice. The topics of the subject include the roots of spatial planning in economic theory, including the theories of Thünen, Weber and Lösch, the theory of central places, growth poles and growth centres and territorial division of labour (Ricardo, Ohlin). The structural funds of the EU are introduced in detail. Further topics include the types and history of regions in Western, Central and Eastern Europe, regionalisation, decentralisation and regionalism, rural development, the effect of agricultural policy on rural development and rural development in Hungary, urban development, historical overview, differences between Western and Eastern Europe. The main characteristics of infrastructure development are also introduced, as well as the types of borders, the significance of borders in regional development and cross-border regional co-operations. Finally, the financial instruments of regional development, advantages and disadvantages of various instruments, Hungarian practice, distribution of resources among regions, institutional background and the system, management and financing of Hungarian municipalities are presented. (2 credits)

Environmental Management of Energy

BMEGT42N003

The aim of the subject is to introduce and expand the scope of sustainable energy and resource management both on a domestic, EU and global scale, primarily from the corporate and policy aspects. The course will give an overview of the energetic status and trends in the EU and the world. It will give an introduction to Energetic Life Cycle Analysis. Business model of energetics and energy enterprises. EU energy policy, environmental and sustainability strategies. Energy strategies and energy-saving programmes. A Sustainability analysis of the environmental effects of the different kinds of sources of energy. Energetic interrelations in climate protection. Pollutions from energetic sources in Hungary and the EU. State institutions of energy and environmental protection policy. Summary and future perspectives. (2 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. The course introduces the concepts, indicators and tools of environmental protection, and the environmental management systems (EMS) at enterprises and other organizations. EMS topics include the assessment of environmental aspects and impacts, environmental audits, reporting, environmental performance evaluation, life cycle assessment. (3 credits)

Environmental Evaluation and Risk Management

BMEGT42A022

Autumn semester only!
Monetary valuation of natural capital and the concept of sustainable development (weak and strong sustainability). The necessity to valuate natural resources: the problem of public goods and free goods, discounting (social discount rate) and externalities. The areas of application and methodological basics of environmental valuation. The concept and elements of Total Economic Value. A detailed overview of the methods of environmental valuation: cost-based methods, productivity approach, revealed preference methods (hedonic pricing and travel cost method), stated preference or hypothetical methods and benefit transfer. An introduction to risk management: definition and approaches of risk, corporate risk management techniques, corporate social responsibility. Cost-benefit and cost-effectiveness analysis, case studies. (3 credits)

Sustainable Environmental and Natural Resource Economics

BMEGT42MN03

Spring semester only!
The course unit aims to achieve two main goals. Firstly, to teach students the economic theory governing the efficient allocation of environmental and natural resources, based on their scarcity and renewability. Secondly, to offer an insight into the practical use-related questions of the various types of environmental and natural resources, with an overview of best practices currently available. (6 credits)

Sectoral Sustainability Studies

BMEGT42A025

Spring semester only!
The course unit aims to give an overview of the sectoral aspects and particularities of the transition to sustainable development. Students will be given an insight into the current trends and practices in the various sectors of the economy. Students are introduced to the concept sustainable development and the basics of environmental evaluations. They are then introduced to the horizontal strategies and policies of sustainable development. To conclude, students will learn

about the sustainability strategies in various economic sectors. (5 credits)

Sociology

BMEGT43A002

The aim of the course is to provide an insight into the processes and operations of modern societies and to assist in the comprehension of the crucial problems of contemporary Hungarian society. The course offers fundamentals for students interested in the social changes brought about in contemporary societies, and provides expertise on the social conditions and consequences of scientific and economic activities that may be taken advantage of in the fields of economics and engineering. (2 credits)

Philosophy of Art

BMEGT43A186

The aim of the course is to introduce students to the most important questions and problems in the philosophy of art. We will also study the various methods and tools that enable us to understand and answer philosophical questions and questions in communication theory concerning works of art. We will first look at some attempts to capture and identify the essence of art and art genres, and then we will critically examine the nature of works of art, along with questions about their creation and reception. Having covered the basic concepts, categories and theories of art, we will concentrate on the specific aspects of the creation and reception of graphic, photographic, moving and digital images. Among other issues we will discuss widely contested questions concerning realism" and realistic depiction". Although the course focuses on the fundamental issues in the philosophy of art, we will also examine various issues of design. (5 credits)

Interdisciplinary Research in Communication Studies

BMEGT43M100

Autumn semester only!
The history of research in communication studies has been strongly intertwined with questions concerning research methodologies. The reason for this is that methods for studying communicative phenomena as communicative phenomena have been developed over the course of rethinking and reformulating traditional disciplinary frameworks according to new perspectives, new conceptual systems and new scientific methodologies. The aim of the course is to provide students with an overview of these developments and to introduce them to current research methodologies in communication studies. Theoretical issues will be examined in an interdisciplinary framework, allowing students to study the results and methods of related disciplinary fields (e.g., sociology, anthropology, cultural studies, cognitive, evolutionary and environmental psychology). Small groups of students will conduct specific research projects of their choice during the course of the semester. Topics for discussion will be formulated in relation to these research projects. (5 credits)

Introduction to critical cultural studies

BMEGT43M410

Autumn semester only!
Cultural studies developed at the intersection of a number of different disciplines and theoretical standpoints. The objective of the course is to introduce these theoretical roots and the current approaches, which have developed within the framework of cultural studies. One of the most important elements of the development of approaches within cultural studies is the critical reassessment of the positivist epistemological tradition according to which reality can be experienced and understood in a relatively unproblematic fashion. Another defining element of a large portion of work within cultural studies is its conceptualisation of culture as always political. According to this approach all texts are inherently political as they inevitably bear the marks of structures of power and are at the centre of struggles over meaning and signification. The problematization of knowledge structures and meaning has contributed to opening up the analysis of reading and consumption towards a sensitivity for the possible independent readings and interpretations created by readers, viewers and consumers based on their own social experience, acknowledging the fact that these readers, viewers and consumers are capable of resisting the dominant readings of different texts and can even construct counter-interpretations opposing the dominant ideology from within the very texts aimed at supporting those dominant positions. (3 credits)

European politics

BMEGT43MN20

Spring semester only!
The aim of the course is to introduce students into the theoretical background and development of the European politics and the EU, then a more detailed examination of the particular EU policies. In the first part of the course, we clarify the most important theoretical terms, like politics, nation state, democracy, power, international economic order, globalization and regionalization, international governmental and non-governmental organizations, etc., necessary for the understanding of the complex system of international political and economic order developed after WWII, in which the EU is embedded. Then we deal quite detailed with the historical background, foundation, development of the integration process and institutional set-up of the EU with a special attention to the recent changes, problems and challenges. In the last section students will have the opportunity to examine the most essential EU policy areas, like the finance and budget, agriculture &food, regional and local development, international economic relations, environment and energy, social policy & employment, culture and education. (3 credits)

Comparative country studies

BMEGT43A141

Autumn semester only!
The main focus of the course is culture, what kind of effect it has on civilizations, societies and economies of past and present. There will be three major topics, such as FOOD&TRADITIONS, WATER, ENERGY & PEOPLE, ENVIRONMENT&TOURISM" which represent the most challenging areas of development in the 21st century. Under this umbrella topics, we try to explore and compare the culture and life of many continents and regions of the world. (5 credits)

Recorded Music

BMEGT43A066

Technology for recording, processing, storing and distributing information does not only influence access to cultural products (price, circulation, distribution channels). It also fundamentally impacts upon the formation on cultural can-

ons and, on an individual level, the reception, interpretation and social use of cultural products. The theoretical perspective of the course draws on Cultural Studies, Media Theory, the Sociology of cultural production and consumption, as well as Popular Music Studies. Besides the technological history of sound recording, we will also look at the history and logic of the music industry, primary areas of sound archiving and collecting, and further cultural use relating to recorded music. We pay particular attention to avant-garde/experimental music that makes use of recorded music; digital pop music and DJ culture; as well as copyright debates relating to sampling and remixing. (2 credits)

Sociology of Culture

BMEGT431143

The course introduces basic theories of the Sociology of Culture relating to identity, subcultures, cultural differences and ethnicity, as well as presenting and discussing their practical relevance. Throughout the term, we will critically examine the concepts of high, mass and subculture, as well as those of nation, tradition, and community. The aim of this critical inquiry is not the relativisation of the mentioned concepts, but the introduction of those processes of social construction that lead to the emergence, consolidation and at times (re)negotiation of these categories and the related values and emotions. Through such inquiry, we are aiming towards a more nuanced understanding of the social-cultural conflicts of today's globalised society by the end of the term. Beyond presenting relevant theories and literature, the goal is to discuss the practical relevance and applicability of the observations through examples taken from across the globe. (2 credits)

Pedagogy-Digital Pedagogy

BMEGT51A001

Pedagogical terms. The structure of teaching and learning processes. Self-regulated learning and learning motivation. New possibilities for teaching and learning in the information technology age. The educational application of networks in vocational education and training. Efficient methods of learning. The possibilities of study management. Concepts of learning from ancient times to our days. Prevailing trends in pedagogy. Alternative possibilities. New developments in educational technology, modern media as a technological support of effective presentation. The tendencies of formal and non-formal education The relationship of public education, vocational education and training, and the world of work. (2 credits)

History of Education and Technologies of Communication

BMEGT51A017

Pre-history: the language of gestures; cave paintings; the culture of primary orality. The Greek origins of Western education: alphabetic literacy and the philosophy of Plato. Medieval culture: the decline and rebirth of literacy; religious orders; universities in the Middle Ages. A social history of timekeeping: from natural time to the mechanical clock. Image and word: woodcuts, etchings, photography. Pictorial meaning and word-meaning. The printing press; early-modern school systems; the new concept of childhood; modern science and modern libraries. Telegraphy, telephony, radio broadcasting: the beginnings of secondary orality. Comics: a new integration of image and word. John Dewey's philosophy of education and communication. The epistemology and pedagogy of film; new iconic culture. The end of the Gutenberg Galaxy: from Hajnal to McLuhan. The internet. Secondary literacy: e-mail and web-based communication. Education and learning in the Information Society: networked knowledge, e-learning. The Mobile Information Society. M-learning. New meanings of space and time. (2 credits)

(Lifelong) Learning and Working Life

BMEGT51A020

Emphasizing the development of independent problem-identifying and problem-solving skills by analyzing Hungarian and European labour market challenges. In the framework of optional exercises and self-controlled learning processes and by acquiring the steps of program planning concentrating on the field of technology, training orientation possibilities are granted to participants on their fields of interest. During the training period we try to present the practical applicability and large scale practice orientation through theoretical knowledge, wide-range technological examples, case-studies and the analysis of changes. The participants of this course will gain the necessary knowledge and competences for understanding the importance of sustaining the lifelong competitive knowledge by making individual job and scope of activities analysis based on their own learning competences and methods. They will understand the problems of learning skills as life skills, a new type of human capital, networking, teamwork and working methods in the context of lifelong learning. What does it mean not only surviving but being successful in the dynamically changing professional and global environment today? The development of modern, modular and competence-based methods and curriculum, elaboration of methods, curriculum and programs that allow individual and open learning ways. The thorough modernization of the system of trainers' training for allowing educators to learn the skills, competences, methodological and practical knowledge which enables them the successful transmission of knowledge. (2 credits)

Ergonomics

BMEGT52A001

Autumn semester only!
Concept of Ergonomics: Man-machine systems, levels of compatibility, characteristics of the human and the technical subsystems, significance and quality of user interface. Workplace design: Basic ergonomic principles and design guidelines for different working environments: workshops in mechanical industry, traditional and open room offices as well as other working places with VDUs, control rooms in the process industry, client service workplaces (governmental organizations, banks and ICT companies). Human factors of safety. Human-computer interaction: Analytical (cognitive walkthrough, guideline review and heuristic) and empirical methods of assessing usability of software and other smart products. Website quality, web-mining. Industrial case studies with the INTERFACE research and assessment workstation. (2 credits)

Psychology

BMEGT52A002

Spring semester only!
Human cognition: Sensation: sensory systems, vision, hearing, the chemical senses, somatic senses and the vestibular system. Perception: organising the perceptual world, theories and illusions. Attention, focussed and divided attention. Memory: three stages of memory: sensory, short-term and long-term. Some phenomena of memory: mnemonics, peg word system, interferences. Thinking: human information

processing system. Decision making and problem solving. Mental abilities, intelligence and creativity, cognitive styles. Learning, classical and instrumental theory of conditioning. Cognitive processes in learning: insight, latent learning and cognitive maps. Social learning. Motivation: Basic concepts of motivation. Work and motivation: achievement, satisfaction and procrastination. Emotion, emotional intelligence (Goleman). Stress and coping system, some stress-coping programmes. Type A behaviour. Personality: Studying personality (tests), psychodynamic (Freud, Jung), behavioural, and phenomenological (Rogers, Maslow) approaches. The individual in the social world: Some basic sources of social influence, social perception, first impressions, group stereotypes and prejudice, attribution theory. Attitudes and persuasion. Group influences and interpersonal behaviour. Communication: assertiveness, social skills in communication. (2 credits)

Fashion, advertising & psychology

BMEGT52V100

Autumn semester only!
The course aims to have a look behind the scenes of the colorful and glamorous world of fashion and advertising. What we see at first glance is a huge industry where millions of professionals are pushing the maschinery to play upon our instincts. We shall study the methods, reviewing the role of public relations, sales promotion, the role of the brands, and the templates and stereotypes used in the different media. The vast amount of knowlegde piled up by behavioral sciences will help us answer the question why our basic instincts to imitate can be used and abused. Why is it that we are ready to spend billions on shampoo, new clothes, junk food, gadgets ... etc. hoping to buy identity. We will also reveal that the very nature of the social animal - the group - plays an even more decisive role in our preferences and purchases – introducing a variety of approaches from the basic theories of fashion (trickle down, cascade, herd behavior) to network theories. (2 credits)

Business Law

BMEGT55A001

The aim of the course: Characteristics of the Anglo-Saxon and continental systems of business law. The development of the system of the Hungarian business law. Basic legal institutions of the state to manage the economics. Organisations and enterprises as the subjects of law: conceptional questions. International models of company law. The development of the Hungarian company law. General rules of the Hungarian Company Act. Internal organisation of companies. The law of company registration, the registration proceedings and the company registry. Companies with a partnership profile. Companies limited by shares. Concept and types of securities. Competition law. EU directives and regulations on companies and competition: their execution in the Hungarian law. (2 credits)

Hungarian Culture

BMEGT658361

This interdisciplinary course covers a variety of interconnected fields to present a comprehensive survey of Hungarian culture and history. The course is thematically organised and focuses on Hungarian culture as it is expressed through the arts (fine arts, literature, music). Special emphasis is given to the history of Hungarian thought from early to recent times. The concepts of Hungarian poets, writers, composers, and scientists are considered in their historical and social context. (2 credits)

Beginners' Hungarian Course

BMEGT658151

The course focuses on the basic elements of Hungarian grammar: the sound-system and spelling; some elements of morphology; most important syntactic structures. The students acquire a basic vocabulary and a number of idiomatic phrases of everyday Hungarian, and develop skills to enable them to communicate in simple routine tasks. (4 credits)

Intermediate Hungarian Course

BMEGT658152

Spring semester only!
The course is designed for students who have already studied Beginners' Hungarian (BMEGT658151) and acquired the bases of the language. The teaching material includes the more complex syntactic structures and the inflectional system, the use of tenses, and the most important elements of composing texts in Hungarian. Topics: Visiting friends and family; Family relations; Food and drink, shopping for food, cooking and baking; Restaurants – eating out; Free time activities: travelling around, getting to know famous Hungarian cities; Going to the cinema and theatre; Public transport in Budapest; Driving in Hungary. (4 credits)

English and other language subjects offered for Erasmus students

(Language) for Engineers

English BMEGT63A051
German BMEGT61A061
French BMEGT62AF51
Italian BMEGT62AI51
Spanish BMEGT62AS51
Russian BMEGT64A051

The course 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.

Communication Skills – ..... (language)

English BMEGT63A061
German BMEGT61A061
French BMEGT62AF61
Italian BMEGT62AI61
Spanish BMEGT62AS61
Russian BMEGT64A061

The Communication Skills course 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.

Manager Communication – .... (language)

English BMEGT63A081
German BMEGT61A081
French BMEGT62AF81
Italian BMEGT62AI81
Spanish BMEGT62AS81
Russian BMEGT64A081

This course is designed to prepare students to be successful in exchange programmes and in business environment. Special emphasis is on job-related activities and topics like public relations, job descriptions, CV-writing, job interviews, managing conflicts and changes.

Crosscultural Communication – ... (language)

English BMEGT63A091
German BMEGT61A091
French BMEGT62AF91
Italian BMEGT62AI91
Spanish BMEGT62AS91
Russian BMEGT64A091

This course 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.

Specific Language Features in the European Union - in (foreign language)

BMEGT6*M*EU

*(*characters depend on the language of the instruction)*
The course is designed to make students aware of the EU institutions and their functions. It also aims to enable students to take an active part in discussions about the European Union, its activities and current issues. Students will be prepared to explain their viewpoint clearly and effectively.

Language for Specific Purposes (LSP) – ... Engineering in (foreign language)

BMEGT6*M*S**

*(*characters depend on the language of instruction and ** on the specific field of engineering)*
This course is designed to prepare students to be successful in academic and work environment. It enables students to take part in professional discussions fluently and effectively; to clearly express his/her point of view reasoning logically for or against. Special emphasis is on language functions and specific vocabulary of the students' specialization.

Faculty of Transportation Engineering and Vehicle Engineering

The Faculty of Transportation Engineering and Vehicle Engineering (founded in 1951) has been training engineers in the fields of transportation, vehicle engineering and logistics. Actually, conforming to the linear, there are three basic specifications:

- BSc in Transportation Engineering,
- BSc in Vehicle Engineering,
- BSc in Logistics Engineering,

As the second stage of the linear training courses (BSc), there are three master training courses (MSc) in the same fields, i.e:

- Transportation Engineering master specialty,
- Vehicle Engineering master specialty,
- Logistics Engineering master specialty.

With adequate BSc qualification certified engineering qualification (MSc) can be obtained in 2 years at these master training specialties. All the fundamental and complementary educations continued at the Faculty are carried out in accordance with the rules of the ECTS (European Credit Transfer System). The quantity of students' labour necessary for attaining the knowledge material of an arbitrary subject is measured through credit-points. One credit-point means on average 30 hours of student's labour, one study semester contains a study material with the quantity of 30 credit-points.

Departments:

Department of Material Handling and Logistics Systems
Department of Automobiles and Vehicle Manufacturing
Department of Vehicle Elements and Vehicle-Structure-Analysis
Department of Control for Transportation and Vehicle Systems
Department of Transport Technology and Economics
Department of Aeronautics, Naval Architecture and Railway Vehicles

Budapest University of Technology and Economics
Faculty of Transportation Engineering and
Vehicle Engineering
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H-1111 Budapest, Hungary
Phone: (+36-1) 463-3898
Fax: (+36-1) 463-2550

Dean of the Faculty: Dr. István Varga
Vice-Dean of the Faculty: Dr. Gábor Bohács
Program Co-ordinator: Ms. Eszter Rövid

Description of BSc training

BSc in Transportation Engineering
Length of study: 7 semesters

Program objectives: The education of transportation engineers, who are able to design, arrange, operate and control transportation and transport-logistics processes, to fulfil the related official and management tasks, as well as the works related to the selection, operation and maintenance of equipments realising processes, including the elements of infrastructure, informatics and control systems, as well. Possessing the obtained knowledge, the BSc graduated transportation engineers will be able to continue their studies in the second cycle of engineering education (leading to an MSc degree).

Specialisations: Road transport processes, Railway transport processes, Air transport processes, Processes of ship transport, Transportation processes, Haulage Management

Competencies and skills: The transportation engineers received a basic certificate (BSc) - taking into consideration also the specialisations - become able:

- to recognise the demands for transportation and transportation-logistics, to determine the relationships to be applied,
- to exert active detailed cognition of transportation-and transportation logistics processes, to manage the processes mentioned together with their technical realisation,
- to design processes in accordance with the function of transportation and transportation-logistics systems, to select the technical components and to manage the operation of the system,
- to keep in operation vehicles and mobile machines serving the transportation process, to make the control systems operated, to take into consideration the environmental factors,
- to perform designing, organising and keeping in operation duties,
- to carry out public service and marketing activities.

BSc in Vehicle Engineering
Length of study: 7 semesters

Program objectives: The education of vehicle engineers, who are able to keep in operation road vehicles, railway vehicles, aircraft and ships, as well as building machines and materials-handling machines in a system oriented way, taking into consideration the characteristics of the transportation and transport-logistics processes, furthermore to solve the basic tasks of engineering, concerning their design, development, manufacturing and repair. They can perform special missions with emphasized regard to transport safety, environment protection and energy planning. Possessing the obtained knowledge, the BSc graduated vehicle and mobile-machinery engineers will be able to continue the studies in the second cycle of engineering education (leading to an MSc degree).

Specialisations: Railway vehicles, Road vehicles, Aircraft, Ships, Buildings machines, Automated materials-handling equipments and robotics, Vehicle manufacturing, Vehicle mechatronics, Vehicle superstructures.

Competencies and skills: Possessing the basic certificate, the vehicle engineers - taking into consideration also the prospective specialisations - become able:

- to determine the necessary equipment for the realisation of transportation and logistic processes,
- to organize, arrange, control the safe, the powerful and environmental-protective operation of vehicles, vehicle systems, mobile machines, materials-handling machines and machine systems,
- to perform the basic engineering tasks related to the designing, manufacturing, repair, as well as organisation of vehicles and mobile-machinery,
- to provide and organize the official work related to installation and operation of vehicles and mobile-machinery.

BSc in Logistics Engineering
Length of study: 7 semesters

Program objectives: The education of logistics engineers, who are able to analyse, organise and manage the logistics processes and systems related to the material and information flow (transportation, material handling, storage, commission, loading, acquisition, distribution, recycling) inside and outside of enterprises, and further, to solve the basic tasks of engineering; concerning their design, development, manufacture and repair. Possessing the obtained knowledge, the BSc graduated logistics engineers will be able to continue their studies in the second cycle of engineering education (leading to an MSc degree).

Specialisations: Logistic processes, Technical logistics, Shipping logistics

Competences and skills: Possessing the basic certificate, the logistics engineers - taking into consideration also the prospective specialisations - become able:

- to define the equipment necessary to realize logistics systems and processes,
- to organize, arrange, control logistics systems in a safe and environmentally-friendly way,
- to perform the basic engineering tasks related to the design, manufacture and repair, as well as the organization of material handling machines,
- to provide and organize the official work related to the installation and operation of logistics machinery.

Actually, due to changes in basic training (BSc) our Faculty can ensure training in English with tuition fee for the time being only part-time (attending term at other faculties, training exchange students). The list of optional subjects in the given term is on website: http://english.www.bme.hu/studies/

Description of MSc training

MSc in Transportation Engineering

Length of study: 4 semesters

Program objectives: The MSc level education of transportation engineers, who are prepared to analyse, to design, to organise and to control transportation processes and systems taking into consideration the principles of economics and system orientation. They are prepared to carry out management and official tasks, as well as to select and keep vehicles and equipment in operation as elements of transportation systems, including the elements of infrastructure and informatics systems, too.

Competencies and skills: Possessing the MSc degree, transportation engineers are able:

to recognise connections between systems and processes of transportation, to evaluate and to handle them in the framework of system theory, as well as to apply the related principles and methods,

connected with the specialization selected, to carry out state assessments, to develop, design, organise and control complex transportation systems.

Basic specialization accepted to the input without any conditions:

- basic specialization of transportation engineering

Basic specializations accepted to the input under given conditions:

- mechanical engineering;
- mechatronics engineering;
- military staff and safety technology engineering;
- civil engineering;
- engineering informatics;
- light industry engineering.

MSc in Vehicle Engineering

Length of study: 4 semesters

Program objectives: The MSc level education of vehicle engineers, who are prepared to develop, design, manufacture and research operation processes, as well as to keep in operation, maintain railway vehicles, road vehicles, agricultural vehicles, ships, aircraft, building machines and materials-handling machines taking into consideration the requirements of safety, environment protection and energy management.

Competencies and skills: Possessing the MSc degree, vehicle engineers are able:

- to integrate a system oriented and process analysing way of thinking directed on vehicles and mobile-machinery, having a role in transportation processes,

- connected with the specialization selected, to carry out assessments, to develop, design, organise and control complex systems of vehicle technology.

Basic specialization accepted to the input without any conditions:

- basic specialization of transportation engineering

Basic specialization accepted to the input under given conditions:

- mechanical engineering;
- mechatronics engineering;
- military staff, and safety technology engineering;
- agricultural and food industrial engineering;
- engineering informatics.

MSc in Logistics Engineering

Length of study: 4 semesters

Program objectives: The MSc level education of logistics engineers, who are prepared to analyse, design, organise and control logistic processes and systems with regard to the management of material-flows and connected information-flows realised between the companies concerned. They are prepared to design, develop and take part in manufacturing and quality control, as well as to control the operation of logistic machinery, tools and equipments of elements of logistic systems.

Competencies and skills: Possessing the MSc degree, logistic engineers are able to interconnect the component-processes of logistic systems and the component-units performing the physical realisation of the former relationships.

Basic specialization accepted to the input without any conditions:

- basic specialization of transportation engineering

Basic specialization accepted to the input under given conditions:

- mechanical engineering;
- mechatronics engineering;
- military staff, and safety technology engineering;
- agricultural and food industrial engineering;
- engineering informatics;
- light industry engineering.

Admittance to master courses (MSc) ensured by the announced training, partly in English language, is possible in case of meeting the input conditions, passing entrance examination and in case of at least 5 students' participation.

Description of the Doctoral training

The mission of the "Doctoral School of Mechanical Engineering Sciences "Kálmán Kandó" is to prepare students for doctoral procedures in an organized form in the field of transport sciences, logistics and vehicles and vehicle systems, as well. The Doctoral School ensures high level training in system-modelling, process analysis, designing, automation and measurement procedures, as well as in evaluation of system-reliability, in safety maximisation and in optimum material selecting, furthermore in vehicle and mobile machine maintenance and repair technology development.

The name of the predecessor Doctoral Program was "Vehicles and Mobile Machines", the head of the predecessor program was Prof. Pál Michelberger, full member of the Hungarian Academy of Sciences (HAS), from 1994 until 2001. From 2014 Prof. József Bokor, Doctor of the HAS is the head of the Doctoral School.

Description of M.Sc. Subjects
Master Section in Logistics Engineering

Engineering mathematics

BMEKOVJM101

Dr. József Rohács

Mathematical characterisation of engineering systems by using system operators. Input and output sequence-spaces and function-spaces. Applications of the latters in dynamical and control-theoretical analyses of engineering systems. Vector- and tensor quantities in the analysis of vehicle and machine systems. Mathematical models of hydrodynamical and electrodynamical systems. Process description of engineering systems. by using function series. Application of orthogonal series for description transfer-systems. Stationary stochastic processes in vehicle dynamics and control theory.

Control theory

BMEKOKAM102

Dr. Péter Gáspár

The course introduces the results of modern control theory and their application, on a level, which can be used in design problems during engineering practice. Besides introduction of theory it also improves the skills of students in the use of CAD tools. Both theory and its applications are introduced using examples from intelligent traffic control systems and vehicle control. This well satisfies the needs of both transportation and mechanical engineers.

Electronics - electronic measurement systems

BMEKOKAM103

Dr. István Hrivnák

It provides engineer's view of basic knowledge of the rudiments, quantities and possibilities of electronics and electronic measuring systems and their application in the traffic systems. It makes the students acquainted with the essential elements, functional principles, view of devising and adoption of electronics and measuring techniques. It sums up the measuring methods of different electric and mechanical quantities and possibilities of processing their results. It illustrates the employment by different examples of branches in transport.

I+C technologies

BMEKOKAM104

Balázs Sághy

The principle of up-to-date computers, their general and especially at traffic applied functions. Functional description of microcomputers. Integrated circuit technology. Generally and especially at transport used communication and data transfer methods.

System technique - system modelling

BMEKOVJM108

Dr. István Zobory

System-view oriented mobile machine analysis. Hierarchy in structures: components, group of components, sub-systems, machines and machine systems. Flow chart, structuregraph and signal-flow-graph of complex systems. Possibilities of describing system connections. Signal transfer properties, system-operators. Linear and non-linear systems. Generating system equations by using synthetic and analytic method. Fundamental principles and methods of the 3D-view dynamical simulation and parameter optimisation. Controlled vehicle dynamical systems. Sphere of problems of optimum control. Analysis of operation loading conditions of mobile machines. Fundamental problems of operation reliability of vehicles. Mechanical relations of vehicles and vehicle systems.

Advanced materials and technologies

BMEKOJJM107

Dr. Krisztián Bán

Gives intense knowledge to the MSc students from the field of material structures, production and analysis techniques, and enables the students to understand and work on research and development tasks.

Decision making methods

BMEKOKGM110

Dr. Zoltán Békefi

Demonstration of methods and techniques in identifying, modelling and solving problems of making decisions for an MSc graduated engineer in practical adaptation. Elaborating practical examples to illustrate their application in transport sector.

Project management

BMEKOKGM111

Zoltán Nagy

Exposition of preparing, design, constructing and monitoring infrastructure and toolkit investment and development projects in the transport sector. Demonstrating methodology of public procurement proceedings and rules, condition for calls, preparation and evaluation of application and basis of quality management.

Informatics in logistics

BMEKOKUM301

Dr. Jenő Tokody

Introduce the students in Course of Logistics Processes of Logistics Engineering to the up to date processes of logistics information technologies in the fields of identification and navigation systems, e-business, geographic information systems (GIS), enterprise resource planning systems (ERP) and simulation technologies.

Planning of material handling and warehouse systems I.

BMEKOKUM302

András Bakos

Introduce the students of Logistics Engineering to the processes of method for planning and modelling of material handling systems inside the enterprises.

Planning of material handling and warehouse systems II.

BMEKOKUM303

Dr. Krisztián Bóna

Introduce the students of Logistics Engineering to a process of method for planning of warehousing and material handling systems.

Logistics machine, equipment, robotics

BMEKOEAM304

Dr. Gábor Bohács

Dimensioning questions of automated cranes: modeling, positioning, drive system structuring, sensors, localizing load swings for long and short rope lengths. Load transfer to fixedand moving positions (container handling etc. Dimensioning questions for automated roller conveyor, overhead conveyor and monorail systems. Use of automated technologies, speed regulation. Dimensioning of automated warehousing equipment (loading and unloading, order picking); modeling, position determination for various drive systems. Localizing mast swings for reach stackers. Robots in the automated logistic system, mobile robots.

Control and automation of logistic systems

BMEKOEAM305

Dániel Gáspár

Information carriers for object identification; barcodes, electronic identification. Barcodes' coding theory aspects, barcode norms. Barcode reading. Data structure of electronic data carriers. Communication of the above systems with a PLC through RS-232. NT terminals. Communication between NT terminals and PLC's. Smart Platform; Componet, Devicenet, Mechatronet, Ethernet. CX-One programming language. Smart platform realization, handling of sensors and actuators.

Database systems in logistics

BMEKOEAM306

Dr. Jenő Tokody

Levels and structures of logistic systems. Prediction and processes initiated by customer demands. Logistic processes of an international firm. Electronic data management (EDM). Content and structure of databases. Database processing systems. Modeling possibilities of databases. Development steps of a database processing system. Elements and norms of open database systems. Operations of relational algebra. Structure of queries. Data definitions. Relation and object-based databases. Operations on objects. Tables, queries, forms, reports, SQL language.

Planning of logistic processes

BMEKOKUM307

Dr. Krisztián Bóna

Introduce the students in Course of Logistics Processes of Logistics Engineering to the general planning and analysis of logistics processes, partly global optimization of plant, layout inside the enterprises and computer aided transport optimization.

Enterprise logistics

BMEKOKUM308

Dr. Krisztián Bóna

Introduce the students in Course of Logistics Processes of Logistics Engineering to the enterprise logistics processes and methods for planning, organization and analysis of supply chain and set models, moreover software solutions implemented for planning and control of production logistics.

Production logistics - production planning

BMEKOEAM309

Dr. Krisztián Bóna

Basic problem statements of production planning systems. Demand oriented product planning and it's various models. Strategic questions of production planning. Infrastructure planning. Elements of operative production and production program planning. MRP I and MRP II systems. Planning of materials handling and warehousing systems. Features of push and pull type production planning systems.

Operation of Logistics Systems

BMEKOKGM310

Dr. Zoltán Bokor

Elaboration and application of operative and strategic controlling based decision support models for planning and monitoring technology and management processes in the field of logistics and freight transport.

Data communication systems

BMEKOEAM311

Dániel Gáspár

General principles of network control systems. ISO OSI reference model's layer services. Multilevel control architectures, protocols. Problems of network connection of PLC-s at the low control level, hardware and setting. Communication protocols in production systems (PROFIBUS, CAN-Bus). Possibilities for network programming with the PLC's programming software in Master-Slave connection, using the RS- 232/RS-485 ports and ADAM Interfaces. Automatic protocol, settings and memory addresses of OMRON PLCs type CQM1,C2OOHS,CJ1M. Host-lnk protocol of OMRON control units. Protocol's structure, control of writing and reading of data. Host-link protocol among an OMRON CQM1 (master) and two OMRON CQM1 (slave) PLCs. Structure of protocols for multi-PLC networks. Control of data writing and reading. Creating a common network of PC's and PLC's, settings and software. Visualization, operation of visualizing software. Communication to barcode subsystems. TCP/IP communication modes. Connection of network database systems and PLC's.

Materials handling in flexible manufacturing systems

BMEKOEAM312

Dr. Gábor Bohács

Concept of FMS systems. System structures of flexible manufacturing systems. Modeling of materials handling processes. Relation analysis, time series analysis, determination of paths. Connection between system structure and technology. Logistic functions of FMS systems. Concept and materials handling processes of flexible mounting systems. Modeling processes, relation, capacity, time process analysis. Structure and automation of flexible mounting systems used in the car industry. Automation and visualization of materials handling system of flexible manufacturing- and mounting systems.

Machine intelligence

BMEKOEAM313

Dr. Gábor Bohács

History of machine intelligence. Classic AI systems and their features. Artificial neural networks. Learning and typical applications of artificial neural networks. Fuzzy logic, fuzzy reasoning. Examples for fuzzy systems. Combined neurofuzzy systems. Basics of image processing, typical applications and methods. Mobile robotics and it's application. Special features of mobile robot software. Sensors and navigation of mobile robots.

Robots and applications

BMEKOEAM314

Zsolt Győrváry

Robot actuators and sensors. Displacement and rotational sensors. Robot's architecture, coordinate systems (frames). Inner data processing, path generation, linear circle- and spline interpolation. Torques at the joints. Creating drive- and control systems using the torque values of the joints. Innerand outer sensors, jignal transformation. Force and torque measuring sensors. Visual sensors and image processing for robot systems. Robots' motion equations, robot motions. Inverted kinetics of robots. Data communication in robot control systems. Structure and navigation of mobile robots. Examination of robots. Stopping, path following and repeating accuracy. Work areas' examination of robots using simple methods and teodolits. Robots' acoustic examination. Experimental model analysis. Robots' application and it's requirements. Materials handling applications, synchronizing tasks. Typical applications in car manufacturing and logistic. Integration of robots into FMS systems.

Description of M.Sc. Subjects
Master Section in Vehicle Engineering

Engineering mathematics

BMEKOVJM101

Dr. József Rohács

Mathematical characterisation of engineering systems by using system operators. Input and output sequence-spaces and function-spaces. Applications of the latters in dynamical and control-theoretical analyses of engineering systems. Vector- and tensor quantities in the analysis of vehicle and machine systems. Mathematical models of hydrodynamical and electrodynamical systems. Process description of engineering systems, by using function series. Application of orthogonal series for description transfer-systems. Stationary stochastic processes in vehicle dynamics and control theory.

Control theory

BMEKOKAM102

Dr. Péter Gáspár

The course introduces the results of modern control theory and their application, on a level, which can be used in design problems during engineering practice. Besides introduction of theory it also improves the skills of students in the use of CAD tools. Both theory and its applications are introduced using examples from intelligent traffic control systems and vehicle control. This well satisfies the needs of both transportation and mechanical engineers.

Electronics - electronic measurement systems

BMEKOKAM103

Dr. István Hrivnák

It provides engineer's view of basic knowledge of the rudiments, quantities and possibilities of electronics and electronic measuring systems and their application in the traffic systems. It makes the students acquainted with the essential elements, functional principles, view of devising and adoption of electronics and measuring techniques. It sums up the measuring methods of different electric and mechanical quantities and possibilities of processing their results. It illustrates the employment by different examples of branches in transport.

System technique and analysis

BMEKOVJM109

Dr. Vilmos Zoller

System-view oriented vehicle-and machine analysis. Hierarchy in structures: components, group of components, sub-systems, machines and machine systems. Flow chart, structure-graph and signal-flow-graph of complex systems. Possibilities of describing system connections. Signal transfer properties, system-operators. Linear and non-linear systems. Generating system equations by using synthetic and analytic methods. Fundamental principles and methods of the dynamical simulation and parameter optimisation. Controlled vehicle dynamical systems. Sphere of problems of optimum control. Analysis of operation loading conditions of vehicles and machines. Fundamental problems of operation reliability of vehicles.

Mechanics I

BMEKOJKM106

Dr. Dezső Szőke

Theory of mechanical procedures used in FEM and MBS systems. Practical applications.

Advanced materials and technologies

BMEKOJJM107

Dr. Krisztián Bán

Gives intense knowledge to the MSc students from the field of material structures, production and analysis techniques, and enables the students to understand and work on research and development tasks.

Decision making methods

BMEKOKGM110

Dr. Zoltán Békefi

Demonstration of methods and techniques in identifying, modelling and solving problems of making decisions for an MSc graduated engineer in practical adaptation. Elaborating practical examples to illustrate their application in transport sector.

Integrated quality management systems

BMEKOGJM112

Dr. Zsolt Stukovszky
The subject deals with the integrated and integrable quality control systems applied in industry and transport, covering the condition of their introduction, application and improvement. A further task is to ensure that the students are capable of managing, operating and adequately measuring quality control systems with the tools of industrial project management acquiring the related skills. They are familiarized with the practical application of quality techniques and become able to prevent and avoid potential failures to ensure an equal good standard.

Computer aided conception, dimensioning and manufacturing

BMEKOJHM401

Dr. János Márialigeti
Attain the integrated application of up-to-date design methods in all phases of advanced design processes, starting from the conceptual design up to the manufacturing, including the connections between computer aided design and manufacturing. So, the basic knowledge in the field of vehicle structures, design calculations, computer modelling, etc. acquired during the BSc courses, will be treated in the frame of the general design process structure.

Vehicle operation, reliability and diagnostics

BMEKOVJM402

Dr. Teofil Benedek
Time scheduling of the vehicle operation. Strategies for maintenance. Ensuring the optimum energy and material supply, as well as information technology environment for the operation. Rudiments of the vehicle reliability theory. The modern RCM systems. Practical methods of analysing vehicle reliability for the solution of various design- and operationproblems. The information technology system, which the vehicle reliability analyses can be based on. Basic vehicle system diagnostics, monitoring, measurement, automated diagnostic evaluation, and decision-making concerning the permission for further operation of the vehicles examined. Application of a system dynamical simulation based data-set in accordance with the traffic safety criterions, for giving permission regarding the operation of the examined vehicles of appropriate technical state. Trouble shooting and weak-spot recovering by means of diagnostical examinations.

Materials flow and technical logistics

BMEKOEAM403

Dr. Gábor Bohács
Material flow of the production. Mechanization and automation of the material flow, logistic of automated production. Time- and cost-optimal design of inter-production stores and transport paths. Product identification systems, automatic signal-reading. Computerized manufacturing and logistic systems.

Mechatronics, robotics and microcomputers

BMEKOKAM404

Zsolt Győrváry
The principle and working of the computers and robotic automates. The internal and intercomputer communication methods. Principle of robotic used at the transport and storage technique.

Vehicle body structures

BMEKOJKM405

Dezső Szőke
Analisys methods of vehicle body structures.

Vehicle engines and transmission systems

BMEKORHM406

Dr. Árpád Veress
Design aspects based on the process analysis and synthesis of the vehicle transmission systems and internal combustion engines. Analysis and multipurpose optimization of the fluid mechanical and thermodynamic systems based on the environment protection and energy-retrenchment.

Design and testing of railway vehicle systems

BMEKOVJM407

Dr. András Szabó
Design of railway vehicle structures and the mechanical setups. System engineering oriented analysis of railway vehicles. Optimisation of the combined operation of the subsystems built into the vehicle. On board state monitoring and data lodger systems. Design systems of prescribed reliability. Analysis of longitudinal dynamical processes in trains. Energetics of the train operation. Computer aided vehicle analyses. Dynamical simulation for the prediction of the operation loading conditions. Computerised evaluation of measurement results. Optimising of vehicle parameters by means of numerical methods. Real time simulation methods. Railway vehicle design project.

Railway vehicle system dynamics

BMEKOVJM408

Dr. Zoltán Zábory
The railway vehicle as a dynamical system. Fundamental and parasitic motions. Vibration theory of railway vehicles. Elements of springing and damping. Force transfer in the wheel/rail rolling contact surface. Eigenfrequencies and stability reserves, limit cycles, chaotic motions. Non-linear models. Combined wheel/rail wear process. Dynamics of the vehicle/track system. Definition of the track irregularities. Track irregularity measurements. Spectral densities of the track irregularity processes. Parameter sensitivity of the vehicle/ track dynamical system. Optimising of vehicle parameters under given track conditions. Measurement procedures for evaluating the vehicle/track interaction.

Operation of railway vehicles

BMEKOVJM409

Dr. Albert Győrik
Mass service processes in the operation of railway vehicles. Arrival of vehicles, time demand of the service and passing out of vehicles described by stochastic processes. Storage and stockpiling-problems in the operation of railway vehicles, theory of the cost minimum storage contents replacement. Statistical theory of the technical state dependent operation of railway vehicles. Investigations into the operational reliability of railway vehicles. Reliability based maintenance (RCM) system of railway vehicles. Diagnostics of railway vehicles, stationary and on board diagnostic systems, diagnostic stations. Systems for vehicle and operation process identification. Operation problems with braked trains. Brake system anomalies, dynamical a thermal processes.

Diesel and electric traction

BMEKOVJM410

Dr. András Szabó

Design features of railway Diesel engines, dynamical processes in the fuel injection system. Turbo charger systems used with Diesel engines. Power and speed control systems. Design features of Diesel-hydraulic and Diesel-electric power transmission systems, optimising of the matching points of the co-acting machines, analysis of steady and non-steady operation processes. Drive system dynamics of electric traction units: electro-mechanical systems, drive control systems. Analysis and optimisation of the energy consumption of Diesel and electric traction units under train motion conditions. Analysis of braking characteristics with hydrodynamic and electro-dynamic brake system operation.

Engine design

BMEKOGJM411

Dr. Huba Németh

Design of vehicle engines. Demonstration of effects of each parameter. The subject has two main sections: theoretical questions of engine design and laboratory measurements.

Transmission system design and vehicle mechanics

BMEKOGJM412

Dr. Gergely Bóka

Introducing the mechanics of vehicle motion along with modern procedures of geometric design, stress analysis, fluidand thermo-dynamical calculation of components of vehicle transmission systems.

Suspension design and vehicle dynamics

BMEKOGJM413

Lehel Kádár

The subject introduces the vehicle dynamic requirements of running gear design and also covers the applied procedures of geometric design, stress analysis and calculations of thermo- and fluid-dynamics.

Vehicle construction and design, road safety

BMEKOGJM414

Dr. Gábor Melegh

Dynamics of motion, stability and control of road vehicles, electronic systems, traffic safety and design of whole vehicles.

Design and testing of ships

BMEKORHM415

Dr. Győző Simongáti

Aerodynamic, structural and statistical fundamentals of aircraft design. Airworthiness requirements. Theoretical basics of aircraft analysis. Up-to-date methods. Fundamentals of aircraft engine design. Design aspects, methods and resources. Mathematical models in aircraft operation and design.

Theory and propulsion of ships III.

BMEKORHM416

Dr. Győző Simongáti

3D ship motion equations and its calculation theory. Ship dynamics. Motion of ship by turning. Torsional vibration calculation. Common operation of engine hull and propulsion. Propeller design. Performance calculation of marine propulsion systems. Basics of computer based design.

Manufacturing and operation of ships

BMEKORHM417

László Csaba Hargitai

Organization of shipyards and ship production process. Shipbuilding technology. Building technologies of small watercraft. Ship repair and maintenance. Offshore technology. Equipment and outfits of ships. Operation of ships. Basics of ship operation economy. Dock and sea trials.

Construction of ships

BMEKORHM418

László Csaba Hargitai

Principals of ship construction. Main structural items of ships. Strength calculation (longitudinal, transversal, torsional strength). Scantlings and different structural solutions. Drafting methods. Design rules and regulations. Quality insurance. Design project: steel structural drawing.

Design and testing of aircrafts

BMEKORHM419

Dr. Balázs Gáti

Aerodynamic, structural and statistical fundamentals of aircraft design. Airworthiness requirements. Theoretical basics of aircraft analysis. Up-to-date methods. Fundamentals of aircraft engine design. Design aspects, methods and resources. Mathematical models in aircraft operation and design.

Flight theory

BMEKORHM420

István Róbert Jankovics

Fundamentals of aircraft and rotorcraft flight mechanics. Forces and moments in typical flight configurations. Steady and unsteady aerodynamic models, vortex panel methods, CFD applications. Equations of aircraft motions, flight dynamics, stability and control. Flight qualities, aero elasticity.

Theory of aircraft engines

BMEKORHM421

Károly Tamás Beneda

Basic types of gas turbine engines. Operation, analysis and calculations of thermogasdynamic parameters of aircraft engines: turbojet. turbofan. turboprop, turboshaft, propfan, ramjet, scramjet engines. Speed-altitude characteristics. Twin and three spool engines. Aircraft engines with variable cycles. Off-design operation of the engines. Transient behaviour of gas turbine engines. Operation analysis and calculation of processes in components: Inlet diffusers (subsonic, supersonic), compressors (centrifugal, axial), combustion chambers, turbines, nozzles, afterburners. Characteristics. Control of aircraft gas turbine engines. Role of FADEC. Effect of engine installation on the thrust. Basic viewpoints of Airplane-frame and engine fitting. Reciprocating internal combustion engines for aircraft. Characteristics. Turbocharging and supercharging of engines. Cooling and lubricating systems. Balancing of mass.

Dynamics of logistical machines

BMEKOEAM423

Dr. István Keisz

Specialty of dynamics for lifting machines. Methods for the reduction of the flexible system parts. Generalized coordinates and forces. Formation of motion equations using the D'Alembert-principle and the Lagrange-equation. Natural frequencies of the undamped system. Characteristic matrix equation. Numerical methods for the solution of motion-equation system. Basics of the simulation programming. Generating characteristics of machine parts. Modeling of load lifting and motion of bridge type cranes. Modeling of lift trucks and industrial robots.

Mobile hydrostatic system

BMEKOEAM424

Dr. Antal Balpataki

Structure of hydraulic systems in mobile machines. System solution of drive tasks. Application of electro hydraulic drives, proportional- and servo elements. Features of primary- and secondary controls. Requirements on hydraulics of special vehicles. Energy saving methods in the hydraulics. Design methods and dynamics of hydraulic systems. Interface of the bord electronic and the hydraulic systems. Diagnostic methods and board systems. Application examples, operational instructions, comparison of the different solutions.

Design of concrete technology's machinery

BMEKOEA425

Dr. Kornélia Rácz

Computer aided design of breakers for optimization of the mechanism. Motion equation for vibrating screens, effect of loss of balance for the vibration. Design of mixers, analysis of the connection between the path of the mixing elements and the mixing. Design of concrete pumps, dynamics of the valve altering mechanism. Swing and energetic dimensioning of concrete vibrators. Specific features of reinforcing steel processing machines' control.

Construction processes

BMEKOKUM426

Dr. Péter Mészáros

Planning, design, development and control of mechanised construction processes, and technologies as projects.

Theory of material handling machine design

BMEKOEAM427

Boglárka Odonics

General principles of materials handling machines' dynamic modeling (continuous and discrete modeling). Generating load spectrums for dynamic models. Dynamical modeling and solutions for lifting mechanisms of cranes. Dynamical modeling and solutions for travel mechanisms of cranes. Dynamical models of cranes' steel structures. Dynamical analysis, using finite element software. Discussion of the analysis's design. Observation of materials handling machines' states using measurements. Creating loading spectrums using measurement results. Predicting service life and damage for structural elements of materials handling machines using the results of dimensioning for operational loads and modal analysis.

Network control systems of material handling

BMEKOEAM428

Dániel Gáspár

General principles of network control systems. ISO OSI reference model's layer services. Multilevel control architectures, protocols. Problems of network connection of PLC-s at the low control level, hardware and setting. Communication protocols in production systems (PROFIBUS, CAN-Bus). Possibilities for network programming with the PLC's programming software in Master-Slave connection, using the RS- 232/RS-485 ports and ADAM Interfaces. Automatic protocol, settings and memory addresses of OMRON PLCs type CQM1,C2OOHS,CJ1M. Host-link protocol of OMRON control units. Protocol's structure, control of writing and reading of data. Host-link protocol among an OMRON CQM1 (master) and two OMRON CQM1 (slave) PLCs. Structure of protocols for multi-PLC networks. Control of data writing and reading. Creating a common network of PC's and PLC's, settings and software. Visualization, operation of visualizing software. Communication to barcode subsystems. TCP/IP communication modes. Connection of network database systems and PLC's.

Mechatronics

BMEKOEAM429

Zsolt Győrváry

Definition and main areas of mechatronics. Parameters of mechatronic systems. Measurements of dynamic and kinematical parameters. Sensors' application and grouping. Analogous and digital sensors. Rotational, displacement, force and torque measuring sensors. MEMS (Micro- Electro-Mechanical Systems) sensors. Signal properties, methods of signal processing. Features of A/D converters. Actuators and their grouping. General features and control of working elements. Principles for projection of motion information. Relative motions and their generation. Elements of a kinematical chain. Motion implementing mechanisms. Dynamical and control features. Controlled electric-, pneumatic- and hydraulic drives. System solution of drive tasks. Dynamics of mechatronic systems. Methods of model building, Kinematical a dynamical tasks of multi-body systems. Simulation of mechatronic systems. Control of mechatronic systems. Test methods. Design of control systems, parameter optimization.

Automated materials handling systems

BMEKOEAM430

Dr. Gábor Bohács

History of automated materials handling systems. Application, automation and board electronics of forklift trucks. Sensors and actuators of intermittent operating materials handling machines. Operation of wire- and laser guided forklifts. Automation of reach stackers. Main types and operation of automated warehouses. Continuous operating materials handling machines - main types and automation. Survey of applicable sensors and actuators. Application of overhead conveyors and monorails in car manufacturing for surface handling, painting and mounting technologies. Auxiliary equipment for overhead conveyors and monorails. Automation of overhead conveyor systems.

Measuring system in the vehicle manufacturing

BMEKOJJM431

Dr. Tamás Markovits
Gives modern approach in the field of coordinate measuring technique and dynamic process analysis.

Vehicle manufacturing systems

BMEKOJJM432

Dr. János Takács
This subject enables the students to develop and design vehicles and components production systems.

Surface engineering

BMEKOJJM433

Dr. János Takács
This subject gives developer's level skills in the field of state of the art surface technologies and surface analysis.

Typical vehicle-production technologies

BMEKOJJM434

Zoltán József Pál
This subject deals with the production and assembly technologies of the most relevant vehicle components.

Measurement techniques and signal processing in vehicles

BMEKOKAM435

Dr. Alexandros Soumelidis
This course intends to give basic knowledge in measurement and analysis techniques that are used in acquiring knowledge of the operation of vehicles; gives introduction into the principles, methods, and typical realizations of sensing, measurements, data and signal processing processes, as well as in the detection, cognition, feature extraction, decision and control techniques based upon them, crucial in the control field concerning both individual vehicles, vehicle groups, and the transport flow.

Vehicle system dynamics and control

BMEKOVJM436

Dr. Péter Gáspár
Dynamical models apt for the analysis of the fundamental motion of vehicles, interconnected strings of vehicles and traffic flows. Non-linear dynamical model of the force transfer through rolling contacts taking into consideration also the presence of tribological stochasticities. Generation of the motion equations of lumped parameter vehicle systems models capable for vibrations. Excitation sources. The set of ordinary stochastic differential equations of the lumped parameter system. Generation of the set of motion equations of distributed parameter vehicle system models. The set of partial differential equations describing the motion processes evolving in the distributed parameter vehicle dynamical system. The vehicle dynamical system as a controlled object. Formulation of characteristic tasks of vehicle control, explanation of the control signals applied. Analysis and synthesis problems in the application fields of vehicle dynamics and control. Formulation of model based vehicle control systems. Methods for designing vehicle control systems. Fault detection in vehicle control systems. Designing of failure-tolerant and re-configurable vehicle control systems. Designing of integrated control- and inspection control systems. Case studies on controlled vehicle dynamical systems.

Vehicle system informatics

BMEKOVJM437

Dr. Ferenc Kolonits
Deepening of the knowledge of the students in computing and data representation. Structure of the relation type and document-based data-bases, which contain the characteristics of the vehicle structures and operation properties in a comprehensive way. Systems of document treatment. Methods of generating complicated data-bases for the structure identification and description of vehicles and mobile machines. Computer based gathering and registration of sequential operational events (e.g. failures, repair, change of components, etc.).Elaboration computer algorithms and programs necessary for the vehicle reliability evaluations and the control of reliability centred maintenance.

Vehicle simulation and optimisation

BMEKOVJM438

Dr. Vilmos Zoller
The real vehicle system and its investigation model. Lumped and distributed parameter models, hybrid models. Construction of the vehicle model, which the simulation procedure can be based on. Characteristic techniques, linearisation. Taking into consideration the essential nonlinearities. Parameter space, state space, excitation space and response space. Gradual simulation technoque. Possibilities for the solution of the system equations: time-domain and frequency domain analyses. Numerical solution by means of digital simulation. Special methods and subroutines for solving ordinary differential equation systems. Real-time simulations. Prediction of the operation motion and loading conditions of the vehicle. Stochastic simulations. Statistical evaluation of the simulation results. The problem of system optimization. Selection of tye objective function, the action-parameters and the constraint conditions of the optimization procedure. Analitical and numerical optimization techniques. Problems leding to a task of linear programming. Algorithm and subroutine of the generalised gradient method. Optimzation procedure in case of a random variable-valued objective function (i.e. stochastic field).

Road safety, accident reconstruction

BMEKOGJM439

Dr. Gábor Melegh
The basic and general aim of this science specific subject is to grant students graduating in transportation or mechanical engineering a deeper insight into vehicle utilization, operation, maintenance, repair in order to apply it in case of traffic accidents or different litigations. Because of the feature and the number of lectures of the subject the theoretic and practical parts are not strictly isolated. Theoretic procedures are also introduced in practical lectures and on the contrary, calculations are also likely take place in lectures.

Vehicle evaluation, traffic environment, human factors

BMEKOGJM440

Dr. Gábor Melegh
The basic and general aim of vehicle evaluation is to grant the students graduated in transportation or mechanical engineering a deeper insight into vehicle evaluation, loss assessment and evaluation of reparation. Influence and effects of human factors.

Dynamics of vehicle

BMEKOGJM441

Dr. László Palkovics
The subject introduces the motion circumstances of a whole vehicle, the stability criteria and dynamical conditions along with typical parameters of each vehicle system (transmission, running gear, braking, steering) deriving from requirements of traffic safety.

Motor vehicle measurements

BMEKOGJM442

Dr. Gábor Melegh
Acquiring modern theoretical and practical methods of instrumental vehicle measurements. Introduction and application of modern gauging instruments, analyzing devices and measurement methods.

Design of alternative vehicle drive systems

BMEKOGJM443

Dr. Zsolt Stukovszky
The subject gives an insight into the design and measurement of non-traditional operating internal combustion engines and other applicable energy converters (e.g. fuel cell) in vehicles.

Control of hybrid vehicle systems

BMEKOGJM444

Dr. László Palkovics
The subject introduces the complex control strategy of hybrid vehicle driving systems, focusing on the optimum of energy utilization and vehicle drivability.

Dynamics of electro-hybrid vehicles

BMEKOGJM445

Dr. László Palkovics
The subject deals with the principles of vehicle dynamics and their application in special vehicle driving systems.

Design of mechatronic components for alternative drive systems

BMEKOGJM446

Dr. Zsolt Szalay
The subject deals with the design and analysis questions of alternative driving, mainly the components of hybrid electrical driving, and makes the students capable of specifying them.

Description of M.Sc. Subjects
Master Section in Transportation Engineering

Engineering mathematics

BMEKOVJM101

Dr. József Rohács
Mathematical characterisation of engineering systems by using system operators. Input and output sequence-spaces and function-spaces. Applications of the latters in dynamical and control-theoretical analyses of engineering systems. Vector- and tensor quantities in the analysis of vehicle and machine systems. Mathematical models of hydrodynamical and electrodynamical systems. Process description of engineering systems. by using function series. Application of orthogonal series for description transfer-systems. Stationary stochastic processes in vehicle dynamics and control theory.

Control theory

BMEKOKAM102

Dr. Péter Gáspár
The course introduces the results of modern control theory and their application, on a level, which can be used in design problems during engineering practice. Besides introduction of theory it also improves the skills of students in the use of CAD tools. Both theory and its applications are introduced using examples from intelligent traffic control systems and vehicle control. This well satisfies the needs of both transportation and mechanical engineers.

Electronics - electronic measurement systems

BMEKOKAM103

Dr. István Hrivnák
It provides engineer's view of basic knowledge of the rudiments, quantities and possibilities of electronics and electronic measuring systems and their application in the traffic systems. It makes the students acquainted with the essential elements, functional principles, view of devising and adoption of electronics and measuring techniques. It sums up the measuring methods of different electric and mechanical quantities and possibilities of processing their results. It illustrates the employment by different examples of branches in transport.

I+C technologies

BMEKOKAM104

Dr. Balázs Sághy
The principle of up-to-date computers, their general and especially at traffic applied functions. Functional description of microcomputers. Integrated circuit technology. Generally and especially at transport used communication and data transfer methods.

Mechanics K

BMEKOJKM105

Péter Béda
Mechanical relations of vehicles and vehicle systems.

Advanced materials and technologies

BMEKOJJM107

Dr. Krisztián Bán
Gives intense knowledge to the MSc students from the field of material structures, production and analysis techniques, and enables the students to understand and work on research and development tasks.

Decision making methods

BMEKOKGM110

Dr. Zoltán Békefi
Demonstration of methods and techniques in identifying, modelling and solving problems of making decisions for an MSc graduated engineer in practical adaptation. Elaborating practical examples to illustrate their application in transport sector.

Project management

BMEKOKGM111

Zoltán Nagy
Exposition of preparing, design, constructing and monitoring infrastructure and toolkit investment and development projects in the transport sector. Demonstrating methodology of public procurement proceedings and rules, condition for calls, preparation and evaluation of application and basis of quality management.

Transport Economics

BMEKOKGM201

Dr. Ferenc Mészáros
Demonstration of theoretical relations and techniques for economically efficient, environment friendly and social cohesion sensible statutory in operation of a transport system to support integration of the European Union - focusing on specialities of transport modes and transport of goods and passengers. Review of opportunities for development with concluding (analysing) practical experiences in frame of seminar study.

Transport automation

BMEKOKAM202

Dr. Balázs Sághy
The aim of the subject is to get acquainted generally with safety critical automatic traffic control systems with regard to their philosophy, to the methods of definition of safety requirements and that of the justification of safety.

Transport informatics

BMEKOKUM203

Dr. Csaba Csiszár
The subject is built on the approach and knowledge gained at subjects Transport Informatic Systems I. and II. of the Transportation Engineering B.Sc. education. Its object is the modelling of notions and rules connected to information and information systems. The students adopt these models in the different fields of transportation. The theme of the subject is, how to arrange the information-set according to transport's basic processes and the transport's management into a special, working system. The subject's lectures analyse the common and special features of informatic systems used for railway, road, waterway, and air transportation. The method of analyses is the definition of static and dynamic sections of transport informatics systems, and how to create an optimum working system of managed and managing elements of transportation, using the suitable up-to-date technical solutions.

Traffic Flow

BMEKOKUM204

Tamás Dávid Soltész
Analysing, modelling and planning of traffic flow on road transportation network, in consideration of passenger and goods transport. Intelligent Transport systems
BMEKOKUM205 Dr. János Tóth Familiarization with types of Intelligent Transport Systems and their components. Introduction with the fields of application of the Geographical Information Systems. The students acquire the knowledge of planning, choosing and operating of ITS and GIS systems.

Transport operation

BMEKOKUM206

Dr. Péter Mándoki
Knowledge acquirement about planning, organizing and optimal developing of Transport operation process.

Logistics

BMEKOKUM207

Dr. Gábor Kovács
Introduce the students in Course of Transport Systems of Transportation Engineering to the processes of enterprise purchasing and distribution system's purposes, to the enterprise material handling and warehousing processes, to the set models, moreover to the material handling between the factories, and to the computer aided transport organisation.

Passenger transport

BMEKOKUM208

Dr. Csaba Csiszár
Methods of organization, planning, development of passenger transport systems recognition. Computer planning procedures learning skill.

Transport modelling

BMEKOKUM209

Dr. János Tóth
Familiarization with practical usage of methods of transport network planning. Introduction of theoretical background of international software (VISUM, EMME/2), and the practical usage of software.

Environmental effects of transport

BMEKOKUM210

Dr. János Juhász
Survey of development and operation opportunities of transport systems, due to sustainability concepts.

Signal processing in transport

BMEKOKAM211

Dr. Károly Gyenes
The structure, the planning and programming of microcontroller families, used at the transport. Interfacing of the input-output signals to the analog signals of difference vehicles. The most popular methods of signal coding.

Information connection of the vehicle and the track

BMEKOKAM212

Géza Szabó
The subject gives an overview on the information transmission methods used between the track side elements and the vehicles in different transportation areas. It summarizes the technologies and traffic control methods using the above mentioned transmissions.

Modelling and control of vehicles and traffic systems

BMEKOKAM213

Dr. Balázs Sághy
The knowledge included by the subject should give high standard theoretical designing and practical knowledge to the engineers wishing to find employment in this area. It examines model-classes for controlling road, railway and

air transport systems. It deals with macro-simulating programs for modeling transport networks. It makes student acquainted with the possibilities and methods of up-to-date traffic control, with the technical instruments make all this possible, together with the designing process and the guiding principles.

Engineering of transport automation systems

BMEKOKAM214

Dr. Tamás Tettamanti
The purpose of the subject is to transfer deep and detailed knowledge to develop traffic control systems of different transportation modes. The subject is based on previous studies and aims to widen deepen and acquire engineering skills.

Controlling systems in transportation

BMEKOKGM215

Ferenc Mészáros
Exposition and promoting national adaptation of technical, legal, economic, fiscal, social and institutional policy for controlling improvement and operation of transport systems in the European Union.

Financing techniques in transportation

BMEKOKGM216

Dr. Zoltán Békefi
Financing methods concerning transport system developments and operations. In form of computer practices presenting the theoretical knowledge and apply them by using an own developed software, and analyzing real case studies.

Management of transport and logistic services

BMEKOKGM217

Zoltán Nagy
Economic, operational and regulatory measures concerning the planning and developing processes of transport and logistic service providers. Theoretical and practical knowledge.

Human Resource Management in Transportation

BMEKOKGM218

Dr. Botond Kővári
Theory, practice and leading technics of human resource management specialized in transportation on the following levels: individual (micro), company (mezo), economy (macro).


KIR JÓZSEF

Pre-Engineering Course

Pre-Engineering Course

The Budapest University of Technology and Economics (BME) is one of the leading universities in Europe and a member of CESAER (Conference of European Schools for Advanced Engineering Education and Research), with a high admission standard.

The Hungarian secondary schools have very high level final exam in mathematics and physics, one of the highest in the world, as it has been proved through international competitions. Very often, there is a gap between the Hungarian and foreign students' secondary school's education program as far as the preparation for engineering studies are concerned. Many students are not trained enough to solve complex problems.

Therefore the Pre-Engineering Course is designed to help students develop the basic skills necessary to successfully pursue engineering studies at the Budapest University of Technology and Economics or any other engineering or science-oriented university with high academic standards.

The program lasts one academic year and offers intensive instruction in mathematics, physics, and English language. In addition, students are introduced to conceptual approaches in engineering.

New students at the Budapest University of Technology and Economics take a required Placement Test on the week before the academic year starts (see the Academic Calendar). Based on the results of this test, students will either be accepted into the first semester of the undergraduate program (BSc), or will be instructed to the Pre-Engineering Course prior to the undergraduate program.

Students who think they would benefit from the profound preparation of the Pre-Engineering Course may simply register for the Pre-Engineering Course (without taking the Placement Test).

Exams are given at the end of each semester of the Pre-Engineering Course. Students who achieve at least good results at the end of the second semester can begin their first year engineering studies at the Budapest University of Technology and Economics without taking the Placement Test.

Students who will not continue their studies at the Budapest University of Technology and Economics can take any of the individual subjects on a credit basis. Acceptance of the credits depends on the student's home institution.

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Course Director: Dr. Zsolt Papp
Office: Building F. room 10, tel.: +36-1-463-4609
Program Co-ordinator: Ms. Margit Nagy

Description of Subjects

Description of 1st Semester Subjects (Fall)

Introductory Physics I

Mechanics

Principles and concepts of classical physics. Vector and scalar quantities. Motion in one and two dimensions. Projectiles. Newton's laws. Conservative and dissipative forces. Equilibrium of rigid bodies. Levers, pulleys. Torque, circular motion, angular acceleration, moment of inertia. Linear and angular momentum. Work and energy. Energy of rotational motion, work of spring. Laws of conservation. 2 hours of lectures with demonstrational experiments and problem solving practice 4 hours/week.

Electricity

Fundamental phenomena of electrostatics. Electric charge, field strength. Electric potential and voltage. Electric polarization. Capacitors. Energy of the electric field. Electric current. Electric power. Electric circuits. Magnetic field produced by current. Electromagnetic induction. Self induction. Transformers. Alternating current. Electrical oscillations. Electromagnetic waves. 2 hours of lectures with demonstrational experiments and problem solving practice 4 hours /week.

Introductory Mathematics I

Algebra

Real numbers and algebraic expressions. Fundamental laws, identities. Equations in one variable: linear and quadratic equations. Applications to word problems. Quadratic formula, relationship between roots and coefficients, the discriminant. Radical equations, extraneous roots. System of equations in two or more variables. Word problems. Exponents, integer and fractional. Laws of exponents. 4 hours /week.

Geometry

Elements of geometry: circumference and area of geometric figures, surface area and volume of geometrical solids. Right triangle trigonometry. Law of cosines and sines. To solve a triangle. Trigonometric identities, equations. 4 hours/week. Compulsory English for Pre-Eng. Students I.

(0 credit)

Description of 2nd Semester Subjects (Spring)

Introductory Physics II

Vibration, Waves, and Thermodynamics

Elastic properties of materials, vibrational motion. Simple and physical pendulum. Wave motion. Transverse and longitudional waves. Interference. Standing waves. Polarization of transverse waves. Sound waves. Thermodynamics: temperature and the behavior of gases, the ideal gas law, specific and molar heat capacity, first and second laws of thermodynamics, entropy, Carnot theorem and conservation of energy, refrigerators and heat pumps. 2 hours of lectures with demonstrational experiments and problem solving practice 4 hours /week.

Optics and Atomic Physics

Optics: fundamental concepts of optics; reflexion, refraction, dispersion of light; coherence of light; light as electromagnetic wave; interference, diffraction, polarization; holograms. Atomic physics: photoelectric effect; wave particle dualism; hydrogen atom model. 2 hours of lectures with demonstrational experiments and problem solving practice 4 hours/week.

Introductory Mathematics II

Algebra

Factoring. Sets: definition, notations, subset. Operations with sets. Wenn diagrams. The set of real numbers, intervals. Linear and quadratic inequalities. Functions: definition, domain and range of a function. Properties of functions. Inverse of a function. Exponential and logarithmic functions and equations. Absolute value, equations and inequalities involving absolute values. Sequences. Arithmetic and geometric progressions. Geometric progression with an infinite number of terms. 4 hours/week.

Geometry

Coordinate system. Distance and midpoint formula. To sketch a graph. Equations of a line. The circle. Quadratic functions and parabolas. Ellipse and Hyperbola. Trigonometric functions. Complex numbers. Complex algebra. 4 hours/week.

Computer Algebra

Introduction. What is Maple? The Command window. The Maple Syntax. Mathematical functions. The Maple Packages. Data types and operations. Expression sequences, arrays, sets. Plot structures. Basic plotting. Solving equations exactly and approximately. Preparing report with Graphs, comments. Applications. 2 hours/ week.

Compulsory English for Pre-Eng. Students

(0 credit)

Elective subjects (2nd Semester)

Computing

General informations about computers and peripheral devices. Algorithms and programs. PASCAL Programming Language. 2 hours/week.

Engineering Drawing

Rules and conventions of engineering drawing. Descriptive geometry. 2 hours/week.

Advanced Algebra

Functions (definition, domain, range, graph, zeros). Operations on functions. Power functions, polynomials. Graph of polynomials and rational functions using zeros and asymptotic behaviour at infinity. Limit of functions. Calculating limits. Convergent, divergent sequences. Calculating limits of sequences. Monotonic, bounded sequences. 2 hours/week.

Excursions - Solt

Excursions - Hortobágy

Excursions - Sopron

Graduation Speech

"Do not go where the path may lead, go instead where there is no path and leave a trail"

I am most honored to be called amongst many to give this speech on this special occasion. I stand here today to reinforce character and vision.

I started by grace and have finished by grace, and I thank God, my parents, my lecturers, my fellow graduating students, and of course you sited here as well as my friends, for this rare opportunity to stand before you. Have you ever sat in your mums chair at her office, and in her absence you had to sign the collection of a letter (your admission letter) which was delivered to her, and yet you did not know it was your admission letter to school abroad, I guess not, but that was me signing the collection of that letter more than four years ago.

Leaving your mother land to a foreign land to be educated should not be done without vision/dream. Four and half years ago I could have fallen prey to the lack of vision, stepping my feet into Hungary and listening to those who at the time had no vision telling me to be comfortable with the poorest of academic grades, and I thought to myself if the reason for being educated in this institution is to fall short of my expectations then I could have as well been home schooled, I decided not to speak with poor minds on serious issues for I had vision.

This group of graduates has been strong, tough and thriving, having clearer vision by the day, walking with any of them would leave a lesson of hard work and the ability to bend due to tough academic work and yet not be bent. Budapest University of Technology and Economics in my short experience is not a place for poor minds so I urge you to be visionaries if you must take the world by storm.

We are here today to celebrate the end of a very significant phase in life and the beginning of the next most important phase of a new life outside school. The world has been waiting for us and we are now ready for them. I believe that the lessons learnt here at BME, from the accomplishments/successes, failures and studies, means we now posses the skills to learn, aptitude to succeed, ability and creativity to make a difference, to work to meet world needs and to assist in solving the problems facing the society at large. Knowledge as we know is power and it is gotten from education, although it might seem expensive buy it, for ignorance is more expensive. This school has taught us the elements of character and vision, on this note I want to encourage all students to show character, have vision and pursue it, and if an opportunity of success has not knocked on your door build a door and keep in mind that neither success nor failure is final keep succeeding.

To accomplish great things today and in the future, we must not only dream, but also act, and not just act but plan and believe in our dreams and vision, for "the future belongs to those who believe in the beauty of their dream", and "I hope your dreams take you to the corners of your smile, to the highest of your hopes, to the windows of your opportunities and to the most special places your heart has ever known".

Courses and Doctorate schools at BME

We offer undergraduate & PhD courses in:

- Architecture
- Architectural Engineering
- Civil Engineering
- Chemical Technology
- Electrical Engineering
- Information Technology
- Mechanical Engineering
- Mathematics
- Physics
- Cognitive Science

Doctorate Schools

- Géza Pattantyús-Ábrahám PhD School in Mechanical Engineering
- PhD School in Computer Science and Information Technology
- PhD School in Electrical Engineering
- Kálmán Kandó PhD School in Mechanical Engineering

2015/2016 ACADEMIC CALENDAR

Fall Semester: All accepted new Students

Registration in Students' Office, Bldg. R 1. (**after payment** of tuition fees)	**24 Aug – 4 Sept 2015**
Appointments for Obligatory Medical Check-up (Necessary for Health Insurance).	24 Aug – 4 Sept
Preparatory Classes (Math, Physics) **for Placement Test**	**25 – 28 Aug**
Placement Tests: Math (31.08.), Physics (01.09.) and English Language (02.09.)	**31 Aug – 2 Sept**
Orientation Program Newly enrolled regular and Exchange Students	**31 Aug – 4 Sept**
Placement Test Results Posted Outside Student's Office	**4 Sept at 12 am**
Presentation of Schedules for Freshmen in Bldg. R 1. **Student's Office**	4 Sept at 12 am – 1 pm
First day of classes	**7 Sept** at **8:15 am** (Monday)
Pre-Engineering Classes begin	**7 Sept** at **8:15 am** (Monday)
Opening ceremony	**2 Oct (Friday)**
Last Day of Classes for Freshmen, Exchange Students, Pre-Engineering Students	**11 Dec (Friday)**
Classes and Examinations in fall semester of 2015/2016 for Pre-Engineering Students	21 Dec 2015 – 27 Jan 2016
Winter Holidays for Pre-Engineering Students	**14 Dec 2015 – 3 Jan 2016**
Examination Period for1st Year Students (Check with your Faculty!)	**22 Dec 2015 – 27 Jan 2016**
Winter Holidays for 1st Year Students	**24 Dec 2015 – 3 Jan 2016**

Fall Semester: 2nd and Higher Year Students

Registration in Student's Office	**31 Aug – 4 Sept 2015**
First Day of Classes	7 Sept 2015
Last Day of Classes	11 Dec 2015
Delayed submission	14 Dec 2015 – 18 Dec 2015
Examination Period (Check with your Faculty!)	**21 Dec 2015 – 27 Jan 2016**
Winter Holidays for All Students	**24 Dec 2015 – 3 Jan 2016**

Spring Semester: All Students

Registration in Students' Office, Bldg. R 1.	**8 - 12 Feb 2016**
Orientation for Exchange and Transfer Students	1 - 5 Feb 2016
First Day of Classes	**15 Feb 2016 (Monday)**
Last Day of Classes	**1 July 2016**
Delayed submission	24 May – 27 May 2016
Examination Period (Check with your Faculty!)	**30 May – 24 June 2016**
Last Day of Final Exams	**1 July 2016**

Days off for All Students

Sports day	16 Sept 2015 (Wednesday)	National Day	15 Mar 2016 (Friday)
National Day	23 Oct 2015 (Friday)	Easter Monday	28 Mar 2016 (Monday)
Students' Sci. Con.	17 Nov 2015 (Tuesday)	Whit Monday	16 May 2016 (Monday)
Open Day	27 Nov 2015 (Friday)		