Faculty of Architecture

IMPORTANT NOTES

If for one subject you can find several different types (lecture, practice, laboratory) of courses then please choose one and only one course from each type in order to be able to perform the subject's requirements successfully.Civil Engineering courses are on the website seperately. Courses chosen from the offer of Faculty of Civil Engineering will be checked and arranged individually by the departmental coordinator.

Subject code	Subject name	Requirement	ECTS credit
BMEEPAG0236	CAAD and Architects Informatics F	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	EN1-ER	English	WED:18:15-20:00(K217)

This course aims to expand the existing CAD knowledge of students to be able to create and modify complex CAD models easily. During the course, we use Archicad, so a basic knowledge of the program is expected.

Subject code	Subject name	Requirement	ECTS credit
BMEEPAG0246	Constructive CAAD F	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	EN1-ER	English	THU:18:15-20:00(K217)

Design and documentation with Revit Architecure - Introductory course.Design and basic CAD knowledge is recommended. (Architectural informatics 2)

Subject code	Subject name	Requirement	ECTS credit
BMEEPAG0249	Constructive CAAD CE	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	EN1-ER	English	THU:12:15-14:00(K216)

Advanced CAD modelling course for students who are familiar with AutoCAD. The course deals with modeling concepts and techniques, texture, lighting and rendering. In the second part of the semester students work more or less autonomously (with occasional one-on-one consultations) on a model of their choice. See: http://www.epab.bme.hu/en/?ccce/

Subject code	Subject name	Requirement	ECTS credit
BMEEPAGA401	Architectural Informatics 2 - Digital Representation	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	EN1-ER	English	TUE:13:15-15:00(K217,K216)
Lecture	EN0-ER	English	TUE:12:15-13:00(K216)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEEPEG0995	Architectural Research for Exchange Students - EG	Mid-semester mark	6

Course type	Course code	Course language	Timetable information
Practice	EN1-ER	English	

Architectural Research for Exchange Students on the topics of the Department's competency. The aim of the subject is to carry out a research on a special topic. The research contains specifying and processing the related international literature, summing up the findings in a study and finally a presentation. The language of the research depends on the consultant - the available topics are listed on the department's homepage.

Subject code	Subject name	Requirement	ECTS credit
BMEEPEGA601	Building Service Engineering 2	Exam	2

Course type	Course code	Course language	Timetable information
Lecture	EN0-ER	English	MON:14:15-16:00(K285)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEEPEK0626	Real-Estate Development	Exam	2

Course type	Course code	Course language	Timetable information
Lecture	EN1-ER	English	TUE:15:15-17:00(K350)

Basics of RE development: The RE Cycle. Contributors and actors in the process. Real estate Market. Descriptive figures of market segments. RE Market, presentation of different markets. Market Valuation, Definition of the Market Value. Other valuation bases: RICS, TEGOVA. Valuation methodology. Development Process : the process and the Developer. Main international development companies. Feasibility Study, legal, technical and economic analysis. Sensitivity analysis. Development Parameters: GBA, GLA, lot coverage ratio, green area. Functional mix. Potential rental and other revenues. Development Cost, elements of the building costs, structure of the operation costs, yearly CF calculation. RE Marketing: Sales methodology, traditional and new marketing tools. RE Agencies and their activities. Contracting, contract types, contracting process. RE Financing.

Subject code	Subject name	Requirement	ECTS credit
BMEEPEK0995	Architectural Research for Exchange Students - EK	Mid-semester mark	6

Course type	Course code	Course language	Timetable information
Practice	EN1-ER	English	

Architectural Research for Exchange Students on the topics of construction technology and management. The aim of the subject is to carry out a research on a special topic. The research contains specifying and processing the related international literature, summing up the findings in a study and finally a presentation. The language of the research depends on the consultant - the available topics are listed on the department's homepage.

Subject code	Subject name	Requirement	ECTS credit
BMEEPEKA701	CM3 - Planning of Construction Technology	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EN0-ER	English	WED:10:15-12:00(K221)
Practice	EN1-ER	English	WED:12:15-14:00(K213)

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 and construction site planning.

Subject code	Subject name	Requirement	ECTS credit
BMEEPEKA801	Building and Architectural Economics	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EN0-ER	English	WED:10:15-12:00(K275)

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 mid-semester test as indicated, minimum pass grade required. Following main topics are discussed: construction cost, estimates, time value of money, building life cycle cost , measuring the worth of real estate investments.

Subject code	Subject name	Requirement	ECTS credit
BMEEPEKAT41	Construction Management	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	TUE:12:15-14:00(KF88); TUE:12:15-14:00(KF88)
Practice	EN1	English	WED:10:15-12:00(KF10)

Curricula, themes, individual projects, tests, subjects of lectures and seminars of the Course are embracing managerial and organizational learnings useful and necessary for all civil engineers, such as: - jobs and organizational structure of Contracting Construction Trade; - jobs and relations of parties collaborating in executing construction projects;- time and resource needs of executing construction projects (basic methods and terms of time -, resource- and cost estimates);- basics of mechanizing Construction, construction equipments and auxiliary plants, typical applications;- organizing construction site (site layout designs).Individual project: Organizational plans (time estimates, resources calculations and site layout designs) of building a simple linear structure (reinforced concrete retaining wall) well known in practice of all civil engineers.

Subject code	Subject name	Requirement	ECTS credit
BMEEPESA201	Building Constructions 1.	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EN0-ER	English	MON:08:15-10:00(K221)
Practice	EN1-ER	English	FRI:08:15-10:00(K344)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEEPESA401	Building Constructions 3	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EN0-ER	English	TUE:08:15-10:00(K342)
Practice	EN1-ER	English	THU:08:15-10:00(K342)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEEPESQ602	Building System Methodology (Building Constructions 5.)	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	EN0-ER	English	FRI:08:15-10:00(K351)
Practice	EN1-ER	English	MON:16:15-18:00(K343)

Subject code	Subject name	Requirement	ECTS credit
BMEEPET0408	History of Theory of Architecture 2	Exam	2

Course type	Course code	Course language	Timetable information
Lecture	EN1-ER	English	THU:13:15-15:00(K397)

HISTORY OF THEORY OF ARCHITECTURE 2. BMEEPET0408 The course presents, exposes and explains the most important constituent facts, selected from the innumerable different intellectual reflections of the twentieth century and the second millennium, as a rich and simultaneous interplay of parallel stories, either promoting, or opposing each other. It doesnrsquo;t interpret history as a homogeneously evolving story, emerging from the past, but at the same time, it doesnrsquo;t deny the importance and operative function of creating histories. Instead of a simple, successive presentation of well-known historical facts, or a collection of fashionable notions, topics and themes, it rather concentrates on exploring their synchronic functional relationships and finding creative and relevant conclusions. 1. Introduction, theory and history in the 20th century. 2. Dominant modern reflections: Riegl, Loos Corbusier 3. Science, technology, art, future, constituent parts of the modern identity Submission and discussion of first paper. 4. Great histories of modern architecture. History, or theory? 5. The destructions of modern technologies. Totalitarian regimes, and the war. Post war time, neo-technicism and total utopias of the sixties, Banham, Archigram. 6. Rediscovery of the operative function of history. Kahn, Venturi. Vulgar modernism and vulgar historicism. Submission and discussion of second paper. 7. The global, the regional, the rural, the archaic. Structuralism, accidentism. 8. Positive and negative side of modern urbanism. 9. Beyond modern histories. Critical theories anthologies. Presence and representation. Deconstruction, phenomenology, hermeneutics. Submission and discussion of third paper.

Subject code	Subject name	Requirement	ECTS credit
BMEEPET0995	Architectural Research for Exchange Students - ET	Mid-semester mark	6

Course type	Course code	Course language	Timetable information
Practice	EN1-ER	English	

Similarly to the international practice, the course aims research activity in architecture and its documentation primarily. The research topics' possible horizon is determined by the course lists of the departments and the students' interest. Besides the architectural topics, the course will appreciate interdisciplinary and special fields in the

international environment. The project work will demonstrate generic and specific skills and understanding of the research's open and synthetic character. The objective of this course is to hone the skills of analysis and abstraction in order to develop a framework for research. The student should be able to draw from precedent in the art, architecture, and engineering in the development of this framework, which will act as scaffolding for the theoretical, experimental, and creative decisions. This course will consist of a series of consultations with the teachers, but the essay should write by the student. The available topics are given by the Departments of the Faculty. The student can also propose a special topic for research during the course, but the teacher must be agreeing with the proposal. The available topics are listed on the department's homepage: http://www.eptort.bme.hu/

Subject code	Subject name	Requirement	ECTS credit
BMEEPETA201	History of Architecture 2. (Antiquity)	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0-ER	English	WED:13:15-15:00(K221)
Practice	EN1-ER	English	WED:15:15-16:00(K221)

The intended task of the subject is to investigate the evaluation and formation of the European architecture of the four main cultures as Mesopotamia, Egypt, Greece and Rome. Before introducing to the evaluation of architecture we are speaking the used building materials and the structures involved. The presentation of architecture follows chronological order, analysing the functional expectation of the building types used. In Mesopotamia we discuss the space demands of the sacral, the dwelling and the palace architecture. The analysis makes possible to prove the early use of space systems in architecture. The accented topic in Egypt is the evaluation of monumental architecture in stone. It is important to understand, that the later funerary buildings are not unique architectural constructions, but part of a composition. The Hellenic and the Roman civilisation is basically an urbanistic culture. That is the reason, that both cultures are discussed through their developments in settlements. The analysis of Hellenic temple construction gives opportunity to discuss the evaluation of the Greek and Roman orders.

Subject code	Subject name	Requirement	ECTS credit
BMEEPETA401	History of Architecture 4	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	EN0-ER	English	MON:12:15-14:00(K391)
Practice	EN1-ER	English	MON:14:15-15:00(K391)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEEPETO601	History of Architecture 6	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0-ER	English	MON:09:15-12:00(K285)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEEPETO801	History of Architecture in Hungary 1	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EN0-ER	English	TUE:10:15-12:00(K285)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEEPETT611	Preservation of Historic Monuments	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EN0-ER	English	FRI:12:15-14:00(K350)

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 Ruskinrsquo;s work, over Boitorsquo;s ldquo;Prima carta del restaurordquo; (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 ndash; 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.

Subject code	Subject name	Requirement	ECTS credit
BMEEPIP0893	Contemporary Architect Offices	Exam	2

Course type	Course code	Course language	Timetable information
Lecture	EN1-ER	English	FRI:14:15-16:00(K250)

This subject is about contemporary Hungarian architecture. The course is set up of weekly lectures or a site visits by a famous/talented Hungarian architects. The lectures are Hungarian language, for the international students it will be translated by an interpreter. For execution of the subject an essay is to be written about one of the lectures. The topics will be personalized for everyone during the last lecture.

Subject code	Subject name	Requirement	ECTS credit
BMEEPIPA401	Architecture of Workplaces 1	Exam	2

Course type	Course code	Course language	Timetable information
Lecture	EN0-ER	English	THU:10:15-12:00(K285)

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. Offices.

Subject code	Subject name	Requirement	ECTS credit
BMEEPKO0995	Architectural Research for Exchange Students - KO	Mid-semester mark	6

Course type	Course code	Course language	Timetable information
Practice	EN1-ER	English	

Similar to the international practice aims the course primary research activity on architecture and its documentation. The possible horizon of the research topics is determined by the course lists of the departments and the personal interest of the students. Beside the architectural topics will give the course an appreciation of interdisciplinary and special fields in international environment too. The project work demonstrating generic and specific skills and understanding of the open and synthetic character of the research. The objective of this course is to hone the skills of analysis and abstraction in order to develop a framework for research. The student should be able to draw from precedent in both art, architecture and engineering in the development of this framework, which will act as scaffolding for the theoretical, experimental and creative decisions. This course will consist of a series of consultations to the teachers, but the essay should written by the student. The available topics are given by the Departments of the Faculty. The student can propose also a special topic for research during the course, but the teacher has to be agree with the proposal.

Subject code	Subject name	Requirement	ECTS credit
BMEEPRAA401	Drawing and Composition 4	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Practice	EN1-ER	English	WED:14:15-16:00(K3R8)

The main topic in the syllabus of the subject is the rsquo;analyticrsquo;representation of external spaces: students learn how to recognise the invisible geometrical-structural relations beloww the surface of buildings through

preparing rsquo;X-ray drawingsrsquo;. 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 rsquo;X-ray drawingsrsquo;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.

Subject code	Subject name	Requirement	ECTS credit
BMEEPRAA601	Drawing and Composition 6	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Practice	EN1-ER	English	TUE:14:15-16:00(K3R4)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEEPST0995	Architectural Research for Exchange Students - ST	Mid-semester mark	6

Course type	Course code	Course language	Timetable information
Practice	EN1-ER	English	

Architectural Research for Exchange Students on the topics of the Department's competency. The aim of the subject is to carry out a research on a special topic. The research contains specifying and processing the related international literature, summing up the findings in a study and finally a presentation. The language of the research depends on the consultant - the available topics are listed on the department's homepage.

Subject code	Subject name	Requirement	ECTS credit
BMEEPSTA201	Statics	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	TUE:10:15-12:00(K221)
Practice	EN1	English	WED:10:15-12:00(K364)

The basic laws and theorems of statics are presented and applied to engineering structures. We learn to determine reactions and internalforces (stress resultants) of 2D and 3D line structures including statically determinate trusses, beams, frames, cables, vaults and assembled structures.

Subject code	Subject name	Requirement	ECTS credit
BMEEPSTA401	Strenght of Materials 2	Mid-semester mark	6

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	MON:10:15-12:00(K392); WED:10:15-12:00(K392)
Practice	EN1	English	FRI:10:15-12:00(K393,K392)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEEPSTG201	Fundamentals of Structures	Mid-semester mark	0

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	TUE:12:15-14:00(K221); THU:15:15-17:00(K221)

The aim of the subject is to get aquainted students with the profession of an archtectural engineer with emphasis on structures. After visits to a functioning building (the central building of the BME), to a material testing laboratory (that of the Department), to a construction site and an architectural design bureau, the experiences are treated in detail and discussed on the next lesson: what kind of requirements are to be considered by design, how to evaluate material strength test results, the collaboration of what kind of participants is necessary to design and construct a building.

Subject code	Subject name	Requirement	ECTS credit
BMEEPSTM101	Special Load-Bearing Structures	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	MON:12:15-14:00(K285)

Practice	EN1	English	MON:14:15-16:00(K345)

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

Subject code	Subject name	Requirement	ECTS credit
BMEEPTCEP02	Interdisciplinary, Project based Design S	Mid-semester mark	16

Course type	Course code	Course language	Timetable information
Practice	EN2-ER	English	TUE:09:15-17:00(K222); THU:09:15-17:00(K222)
Practice	EN1-ER	English	MON:09:15-17:00(K222); WED:09:15-17:00(K222)

The subject is based on the cooperation of the departments of the Faculty of Architecture. Students work in studios in groups with individual tasks as well instructed by teachers of the departments involved. There are two design tasks to be solved during the semester, that can be chosen freely from the offered opportunities. Each task is to solve in seven weeks. Some of the tasks are: sport hall for Olympic Games in Budapest, Dwelling Underground, Suspension in Architecture, The Green in the Metropolitan Area (green walls, green roofs) etc.

Subject code	Subject name	Requirement	ECTS credit
BMEEPUI0801	Contemporary Urban Design	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EN1	English	FRI:12:15-15:00(K210)

The course gives a stable theoretical background not only for understanding contemporary urban design theory but also to practice urban design. The semester divided into three main parts: the first focuses on contemporary housing neighborhood developments, new constructions and regenerations projects from Europe; the second is an introduction to the background of the notion of public space and how this notion requalified the use of the contemporary city; the third is about the re-use of historic urban cores in Europe, focusing Berlin, Amsterdam and Zurich.

Subject code	Subject name	Requirement	ECTS credit
BMEEPUI0805	Urbanism	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EN1-ER	English	WED:16:15-18:00(K350)

The goal of the course is to get students acquainted with the multidisciplinary characteristics of Urban Studies. The semester is divided into two blocks dealing with: urbanisation processes in the world, in Hungary and Budapest; 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. On the end of the semester, you have to present a specific urban topic of your home city.

Subject code	Subject name	Requirement	ECTS credit
BMEEPUI0904	Landscape Architecture	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Practice	EN1	English	FRI:12:15-15:00(K210)

The lecture series analyzes the transformation of green spaces along the three sides of ldquo;positions, visions, conceptsCloseCurlyDoubleQuote; that can be understood as a model of landscape theory, through which the viewpoints of the different disciplines (landscape architect, garden designer, urban designer, architect, etc.) can be used to examine the urbanized landscape and the green spaces appearing in the urban environment. Contemporary gardening and landscape architecture projects are presented during short on-site study trips with special regard to the practical experience in creative work.The motto of the subject assumes the active participation of the students also, and in connection with the lectures topics, a presentation of a case study based on a personal experience has to be done once during the semester. Each occasion ends with a common debate, discussing the different points of view on the topics.

Subject code	Subject name	Requirement	ECTS credit
BMEEPUI0906	Participation, simulation, activism: new methods in urban design	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Practice	EN1-ER	English	WED:16:15-18:00(K390)
Practice	EN1	English	WED:16:15-18:00(K390)

The elective course aims to teach students the practice of participatory design, focusing on urban public space design involving local communities. Students ndash; after analyzing the European best practices ndash; will get experience in involving different social groups and interest-groups into the design process of a public space. Students will get an extensive knowledge on the international practice of participatory design, reading much of

itCloseCurlyQuote;s English literature, analyzing completed European public spaces designed with this method. During the practical classes the students will make a design proposal or activity process simulation for a selected public space in Budapest, either in a dense urban context or on the spaces of a housing estate, or in a suburban situation.

Subject code	Subject name	Requirement	ECTS credit
BMEEPUI0995	Architectural Research for Exchange Students - UI	Mid-semester mark	6

Course type	Course code	Course language	Timetable information
Practice	EN1-ER	English	
Practice	EN2-ER	English	

Architectural research for exchange and international students: with the professional leadership of the tutors of the Department of Urban Planning and Design students work on individual research topics (eg.. Urban History, Urban Tipologies, Urban Morphologies, Housing estates etc.). The course is based on individual work, with a final output of an essay.

Subject code	Subject name	Requirement	ECTS credit
BMEEPUIQ601	Department's Design 1.	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Practice	EN1-ER	English	THU:13:15-16:00(K344)

A special urban design course 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 where students get acquainted with special issues and problems of public space definition, basic notions and tools of public realm and public space design. In the design assignment students deal with a smaller spatial entity, where they start from the analysis of the urban problem and provide a possible solution for the publicly attainable zones in between buildings.

Faculty of Chemical Technology and Biotechnology

IMPORTANT NOTES

If for one subject you can find several different types (lecture, practice, laboratory) of courses then please choose one and only one course from each type in order to be able to perform the subject's requirements successfully.Civil Engineering courses are on the website seperately. Courses chosen from the offer of Faculty of Civil Engineering will be checked and arranged individually by the departmental coordinator.

Subject code	Subject name	Requirement	ECTS credit
BMEVEFAA409	Colloid Chemical Approach to Nanotechnology	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	A0-ER	English	TUE:14:15-17:00(F11Schay)

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

Subject code	Subject name	Requirement	ECTS credit
BMEVEFAM110	Materials science: traditional structural materials and polymers	Exam	4

Course type	Course code	Course language	Timetable information
Laboratory	16A_lab	English	MON:14:15-18:00(HF4)
Lecture	16A	English	TUE:12:15-14:00(HF2)

Materials science explores the relationship between the processing technology, structure and properties of materials in order to meet the requirements of specific applications. The goal of the course is to offer information about the structure, properties and behavior of the frequently used structural and functional solid materials. The subject demonstrates the importance of the design, production and shaping of materials and products through real-lie examples. The course discusses in detail the structure-property correlations of plastics, metals and ceramics, as well as solid structural and functional materials based on renewable resources. This course highlights also the similarities and important differences between the studied structural materials.
https://www.ch.bme.hu/oktatas/targyak/BMEVEFAM110/en

Subject code	Subject name	Requirement	ECTS credit
BMEVEFKA304	Physical Chemistry I	Exam	5

Course type	Course code	Course language	Timetable information
Lecture	A0-ER	English	MON:10:15-12:00(CH307); WED:10:15-12:00(CH302)
Practice	A1-ER	English	MON:10:15-12:00(CH307); WED:10:15-12:00(CH302)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEVEFKA603	Physical Chemistry of Surfaces	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	A06-ER	English	WED:08:15-10:00(F1MFK)

Fundamentals of solid/fluid interfaces. The qualitative description of the surface layer, the concept of surface excess. Thermodynamics of the interfaces, surface tension and interaction potential. Interactions at solid/gas and solid/liquid interfaces. Adsorption isotherms, their interpretation (Langmuir, BET, Dubinin-Radushkevich and DFT models). Experimental methods, including calorimetry. Particle size analysis. Applied surface science: the role of interfaces in material science, environmental and industrial processes. Heterogenous catalysis, Pressure/Temperature Swing Adsorption

Subject code	Subject name	Requirement	ECTS credit
BMEVEKFA203	Chemical Technology	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	ENGLISH-ER	English	MON:12:15-14:00(CH307)

Definition, role, characteristics of chemical technologies, industrial branches using chemical technologies, characteristics of the chemical industry, classification of chemical products, inorganic chemical technologies, basic

concepts of energy production, energy sources, coal, crude oil, natural gas, nuclear energy, renewable energy sources. Burning technology. Water treatment technologies. Hydrocarbon production and technology. Fuels and raw materials for the chemical industry. Laboratory practice 28 hours, 7 lessons, 4 hours each: water treatment, ion exchange, membrane filtering, measurement of boiler efficiency, analysis of exhaust gases, hydrocarbon tests, flammability, viscosity, engine exhaust gas analysis, corrosion test, catalytic reformation.

Subject code	Subject name	Requirement	ECTS credit
BMEVEKFA403	Environmental Chemistry and Technology	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	english-ER	English	THU:14:15-17:00(F211)

Elements of the environment, dangerous factors. The process of pollution: emission, transmission, imission. The aim and the instruments of environmental protection. Technical solutions. Economical instruments, fees, fines, supports. Air polluting materials (carbonmonoxide, nitrogen oxides, sulfur oxides, ozone, hydrocarbons, photochemical oxidants, particulates, dioxins, water polluting materials (materials with high oxygen demand, detergents, mineral oils, organic compounds, inorganic compounds, chemistry of their formation, parameters influencing their rate of formation, their chemical and physical interaction with the atmosphere, hydrosphere, litosphere and biosphere. Biologycal degradation of polymers. Heat pollution. Techniques of air and water pollution control. Classification of wastes, dangerous wastes, treatment and disposal technologies.

Subject code	Subject name	Requirement	ECTS credit
BMEVEKFM104	Modern Separation Technologies	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	eng_pract_ER	English	THU:14:15-17:00(F211)
Lecture	theory+prac_ER	English	THU:14:15-17:00(F211)

The subject gives an overview of environmentally friendly processes and unit operations of the chemical, biochemical and food industries. It deals with widely applied and currently researched technologies as well. During the course we will focus on how the development, selection and optimisation of a novel technology are influenced by environmental aspects besides selectivity and improved yield. By new separation technologies, adding different modifiers, solvents, etc. are not favoured and toxic adducts are one by one substituted to less harmful analogues. Modelling and design aspects will be also considered and explained through detailed description and evaluation of main application examples.

Subject code	Subject name	Requirement	ECTS credit
BMEVEKFM105	Chemical Process Design and Control	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	eng_ER	English	TUE:10:15-12:00(F211)

Chemical process synthesis and analysis, levels of chemical process design, batch vs. continous systems, input-output structure, reactor system, recycling system, separation systems, heat exhanger network, pinch technology, flowsheeting and flowsheeting softwares, advanced process control system, control structure design, selective control, examples for design and controls, individual computer aided process design.

Subject code	Subject name	Requirement	ECTS credit
BMEVEKFM501	Environmentally Benign Chemical Processes	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	eng_ER	English	WED:11:15-14:00(CH307)

The course gives an overview of possibilities to evaluate, understand and take into account the environmental impact of various technologies. Furthermore, through case studies the best available technique concept is demonstrated and discussed in details. Concepts and typical applications of separation methods from high vacuum to high pressure techniques are explained.

Subject code	Subject name	Requirement	ECTS credit
BMEVEMBM301	Biology, biotechnology	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	A9	English	WED:14:15-16:00(CH305)

1. Introduction, special features of biotech: de novo fermentations and biotransformations. 2. Cell biology summary: cell structure and function 3. Microbiology and physiology survey: kinds of industrial microorganisms, their biochemistry: aerobes eacute;s anaerobes, basic microbial metabolic paths. 4. Introduction to enzyme engineering. 5. Techniques and unit operations applied in bioindustries: cultivation methods of microorganisms, culture media, sterilization, bioreactors: mass transfer. 6. Special methods of product isolation and purification: cell homogenization, affin (biocpecific) methods. 7. Some examples in white and green biotechnology: ethanol, citric acid, lactic acid fermentations, etc., biotransformations (semisynthetic antibiotics, enzymatic resolution methods) 8. Biotechnological waste water treatments:removal of organic materials, removal of phosphorus and nitrogen.

Subject code	Subject name	Requirement	ECTS credit
BMEVESAA208	Inorganic Chemistry	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	A12-ER	English	WED:13:15-16:00(CHFSEKÖ)

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 (Mg2+, Ca2+, Sr2+, Ba2+); boron group (BO33ndash;, Al3+); carbon group (CO32-, HCO3ndash;, SiO32ndash;, Sn2+, Sn4+, Pb2+); nitrogen group (NH4+, NO2ndash;, NO3ndash;, PO43ndash;, As3+, As5+); oxygen group (OHndash;, S2ndash;, SO32ndash;, SO42ndash;); halogens (Fndash;, Clndash;, Brndash;, Indash;); some transition metal ions (Cr3+, Mn2+, Fe2+, Fe3+, Ni2+, Cu2+, Zn2+, Ag+, Cd2+, Hg2+, Hg22+); Analytical system of Fresenius and Bunsen, analysis of mixed cations, mixed anions, mixed compounds, and polluted compound

Subject code	Subject name	Requirement	ECTS credit
BMEVESAA403	Analytical Chemistry Laboratory Practice	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Laboratory	A15L	English	WED:14:15-18:00(CHFLAB)
Lecture	A15	English	WED:14:15-18:00(CHFLAB)

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.Gravimetric and titrimetric (acid-base, argentometry, complexometry, redoxi) determinations of difinorganic 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. Literature: Skog D.A., West D. M., Holler F. J.: Fundamentals of Analytical Chemistry.5th Edition, Sounders College Publishing, New York, USA, 1988. Willard H. H., Merritt L. L., Dean J. A., Settle F. A.: Instrumental Methods of Analysis. 7th. Edition, Wadsworth Publ. Comp., Belmont, California, USA, 1988. Lecture material in electronic form ravand 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. Gravimetric and titrimetric (acid-base, argentometry, complexometry, redoxi) determinations of difinorganic 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.

Subject code	Subject name	Requirement	ECTS credit
BMEVESAM101	Complex and Inorganic Chemistry	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	A14-ER	English	TUE:14:15-16:00(CH306)

The subject provides an overview about organometallic chemistry and application of organometallic compounds. It discusses the special properties of orgamometallic compounds (different from those of classical inorganic and organic compounds) and their role in applications as chemical reagents and catalysts. It discusses the basics of homogen catalysis and the mechanism of industrial homogen catalytic processes.The organometallic chemistry of the following elements is discussed in detail: Li, Mg, Al, Sn, Ti, Cr, Fe, Co, Ni, Cu, Zn, Rh, and Pd. Discussion involves stability, structure, synthesis, physical and chemical properties, characteristic reactions, and application (industrial and laboratory). Short syllabus of the subject: History of organometallic chemistry. Definitions. Grouping of organometallic compounds. General properties of organometallic compounds. Synthesis of organometallic compounds. Characteristic reactions. Homogen catalysis. Synthesis, structure and characteristic reactions of Li- and Mg-organic compounds (substitution and addition reactions, metalation and transmetalation, catalytic reactions). Synthesis, structure and characteristic reactions of Al-organic compounds (polymer catalyst, Ziegler-Natta catalyst, synthesis of alpha;-olefins and alpha;-alcohols, olefin dimerization, preparation of organometallic compounds, preparation of high purity inorganic materials). Sn-organic compounds: synthesis, structure, and characteristic reactions (hydrostannation, hydrostannolysis, radical reactions, organostannylenes, redistribution reactions). Application as polymer catalyst, stabilizer, curing agent, and pharmaceutical. Ti-organic compounds: synthesis and characteristic reactions (substitution and insertion reactions of alkines, reactions of aldehydes and ketones, reductiv coupling and elimination with Ti-organic compounds, polymer catalysts). Cr-organic compounds: synthesis, characteristic reactions, substitution reactions, reactions on the organic ligand, rections of carben complexes. Fe-organic compounds: synthesis, characteristic reactions, Friedel-Crafts acylation, Mannich reaction, metalation, cyclization, polymerization. Co-organic compounds: synthesis, characteristic reactions, cyclization of acetylenes and olefins, Pauson-Khand reaction, carbonylations. Rh-organic compounds: synthesis, characteristic reactions, hydrogenations, hydrometalations, decarbonylations, carbonylations, hydroformylations, cyclizations. Ni-organic compounds: sysnthesis, characteristic reactions, substitution reactions, carbonylation, oligomerization of unsaturated

hydrocarbons, catalytic reactions, coupling reactions with organic halides. Pd-organic compounds: synthesis, characteristic reactions, insertions, cyclic dimerizations, oxidative reactions with Pd(II),catalysts, Wacker process, reactions with Pd(0) catalysts, coupling reactions, Heck arylation, cyclization and carbonylation, cascade reactions. Cu- and Zn-organic compounds: sysnthesis, characteristic reactions (substitution, addition and transmetalation).

Subject code	Subject name	Requirement	ECTS credit
BMEVESAM301	Computational Chemistry	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	A-10-ER	English	MON:09:15-12:00(CHFGEP)

Aim of the subject: The subject gives an overview about the principles used to describe the structure of molecules and bulk phases. The modeling of physico-chemical parameters, chemical processes will be presented together with the usual techniques. Solution of practical problems by computer modeling. Short syllabus of the subject: 1./ Basic principles of quantum mechanics: The axioms, the hydrogen atom, the Born-Oppenheimer approximation, the independent particle model, and the MO theory. Hyerarchy of the theoretical models: Molecular mechanics, semiempirical, Hartree-Fock and post HF methods. Oniom and QM-MM methods. Density functional methods. The concept of the electron density. 2./ Application possibilities. Energy and electronic structure of atoms and molecules. Computation of measures related to physico-chemical or chemical concepts. Molecular geometry, conformation, conformational space. Modeling chemical reactions, thermodynamics and transition structures. Large systems, solutions and crystal structures. Molecular dynamics.

Subject code	Subject name	Requirement	ECTS credit
BMEVESKA504	Organic Chemistry III	Exam	2

Course type	Course code	Course language	Timetable information
Lecture	A8-ER	English	WED:08:15-10:00(CH204)

Based on the knowledge of subjects Organic Chemistry I and II, this subject puts major emphasis on all aspects of chemical problems associated with chiral compounds. By systematic classification of all major stereochemical terms and stereoselective syntheses, this subject adds solid knowledge to the existing understanding of organic chemistry for the future chemical engineers of pharmaceutical and fine chemicals industry. Short syllabus of the subject: 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.

Subject code	Subject name	Requirement	ECTS credit
BMEVESTA411	Organic Chemical Technology	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	30a	English	MON:10:15-12:00(F2M012)

The subject shows the typical fields, equipment and transformations of the organic chemical industry. The relevant fields discussed are: C1-, C2- and C3- 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.

Subject code	Subject name	Requirement	ECTS credit
BMEVESZA401	Organic Chemistry II.	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	A11-ER	English	TUE:10:15-13:00(CH204)

Derivatives of carbonic acid; Diazomethane, diazonium salts; Sulfur and phosphor-containing compounds; Unsaturated carboxylic acids, lipids; Substituted acids; alpha;-, beta;-, gamma;-, and delta;-halogen, hydroxy, and oxo acids and derivatives. Stereochemistry; Amino acids and proteins; Carbohydrates; Nucleic acids; Polycyclic aromatic compounds; Heterocycles;

Subject code	Subject name	Requirement	ECTS credit
BMEVESZA403	Medicines	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	9a	English	TUE:08:15-10:00(F2M012)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEVESZM101	Organic Chemistry	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	A12-ER	English	THU:10:15-13:00(CH304)

In the frame of this subject the teaching of basic knowledge in modern organic chemistry is carried out at an advanced level. The aim of the subject is to make acquainted the M.Sc students with the theory, the molecular structures, the stereochemistry, the kinetics and the synthetic strategies applicable in organic chemical reactions taking place in idustrial sytheses, in plastic industry, in biochemical processes and in the environment. Short syllabus of the subject: The theory and application of the most important types of reactions: nucleophilic and electrophilic substitutions, addition to multiple carbon-carbon bonds, polymerization, elimination, nucleophilic addition and addition-elimination at carbonyl groups, nucleophilic addition and addition-elimination at conjugated systems, polycondensation, ring closing and ring opening reactions, processes accompanied by rearrangements. Simple reactions and polimerizations taking place by radical mechanism. Static stereochemistry and dynamic stereochemistry. Basics of planning synthesis; kinetical, molecule structural and stereochemical aspects in planning synthesis. Planning of synthesis: retrosynthetic analysis. Synthetic strategies: linear and convergent syntheses, synthons, inverse synthons, synthetic equivalents, stereochemical questions. Using of heterocycles and natural products (sugars, amino acids, alkaloids and their synthetic analogues) in organic syntheses. Bio- and chemo-catalysis: regio- and stereoselectivity. Applying of enantioselective synthetic methods in building up of complex natural products containing more than one stereocenters. Special synthetic technics. Chemical syntheses using solid supports. The basics of combinatorial chemistry. The theory of molecular recognition and its use in analytical and separation technics

Subject code	Subject name	Requirement	ECTS credit
BMEVEVMA504	Chemical Process Control	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Laboratory	lab.prac_ER	English	THU:12:15-14:00(DFcsarnok)
Lecture	theor_ER	English	TUE:14:15-16:00(F211)
Practice	prac_ER	English	THU:12:15-14:00(DFcsarnok)

Aims of the chemical process control. Areas and methods of process control, feed forward control, feed back control. Mathematical basics, dynamic behaviours. Transfer function, frequency function. Model and modelling 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.

Subject code	Subject name	Requirement	ECTS credit
BMEVEVMA607	Environmental Benign Chemical Process	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	english_ER	English	WED:11:15-14:00(CH307)

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 ndash;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 ndash; 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 ndash; biochemical industry: Aqueous biphasic extraction, Chromatographic techniques (size exclusion, ion-exchange), Example: IgG purification from a fermentation broth.

Faculty of Civil Engineering

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Subject code	Subject name	Requirement	ECTS credit
BMEEOAFAT42	Surveying II.	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	THU:10:15-12:00(KF99); THU:10:15-12:00(KF99)
Practice	EN4	English	THU:14:15-16:00(KF27b); THU:14:15-16:00(KF27b)
Practice	EN2	English	WED:08:15-10:00(KF27b); WED:08:15-10:00(KF27b)
Practice	EN1	English	TUE:14:15-16:00(KF27b); TUE:14:15-16:00(KF27b)
Practice	EN3	English	THU:14:15-16:00(KF27k); THU:14:15-16:00(KF27k)
Practice	EN6	English	FRI:10:15-12:00(KF27k); FRI:10:15-12:00(KF27k)
Practice	EN5	English	FRI:08:15-10:00(KF27k); FRI:08:15-10:00(KF27k)

Properties of analogue and digital maps, the application of maps in engineering practice.Traversing, the types of traverse lines. Localizing blunder in traverse lines: the linear and angular error.Offset surveys. The determination of the horizontal and vertical positions of detail points: the tacheometry. Total stations and their application in surveying. Topographic surveys: reconnesaince, sketch, detail survey and mapping. Free stationing. The principles of computational adjustments, the law of error propagation. Construction tolerances and the fundamental of geometrical quality control. Horizontal and vertical deformation monitoring. Setting out straight lines, curves, transition curves and points in a given elevation.The global navigation satellite systems (GPS, GLONASS, Galileo, …) and their application in surveying.Building surveys. The localization of underground public utilities. Mapping public utilities and the public utility register.

Subject code	Subject name	Requirement	ECTS credit
BMEEOAFAT43	Surveying Field Course	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Practice	EN2	English	
Practice	EN3	English	
Practice	EN1	English	

Using the theoretical background of the courses Surveying 1 amp; 2 students are required to: assess the existing datasets used for mapping; define the necessary surveying activities; practice the surveying observations, planning, data processing and documentation; practice profile boarding, setting out of roads; learn to use modern surveying instruments (total stations, GPS/GNSS receivers, electronic levels, digital photography).

Subject code	Subject name	Requirement	ECTS credit
BMEEOAFMF-1	Theory and Application of GNSS	Exam	5

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	
Practice	EN1	English	

Subject code	Subject name	Requirement	ECTS credit
BMEEOAFMF-2	Automated Survey Systems	Exam	5

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	
Practice	EN1	English	

Subject code	Subject name			Requirement	ECTS credit
BMEEOAFMF62	European Geodetic Networks and Special Projections			Exam	3
Course type	**Course code**	**Course language**	**Timetable information**		
Lecture	EN0	English			

Subject code	Subject name			Requirement	ECTS credit
BMEEODHA-PS	Bachelor Thesis Project			Mid-semester mark	15
Course type	**Course code**	**Course language**	**Timetable information**		
Practice	ENA	English			

Subject code	Subject name			Requirement	ECTS credit
BMEEODHA-PT	Preparatory Course for Bachelor Thesis Project			Mid-semester mark	9
Course type	**Course code**	**Course language**	**Timetable information**		
Practice	ENA	English			

Subject code	Subject name			Requirement	ECTS credit
BMEEODHAS41	Design of Structures Projectwork			Mid-semester mark	6
Course type	**Course code**	**Course language**	**Timetable information**		
Practice	EN1	English	TUE:10:15-12:00(EL111); TUE:10:15-12:00(EL111)		
Students need to accomplish a complex design projectwork that is based on the knowledge gained through the branch courses. The project work is supervised by three lecturers from three areas of structural engineering.					

Subject code	Subject name			Requirement	ECTS credit
BMEEODHMG-D	Diploma Project Structural Engineering MSc Program			Mid-semester mark	20
Course type	**Course code**	**Course language**	**Timetable information**		
Practice	ENG	English			

Subject code	Subject name			Requirement	ECTS credit
BMEEODHMN-D	Diploma Project Structural Engineering MSc Program			Mid-semester mark	20
Course type	**Course code**	**Course language**	**Timetable information**		
Practice	ENN	English			

Subject code	Subject name			Requirement	ECTS credit
BMEEODHMT-D	Diploma Project Structural Engineering MSc Program			Mid-semester mark	20
Course type	**Course code**	**Course language**	**Timetable information**		
Practice	ENT	English			

Subject code	Subject name			Requirement	ECTS credit
BMEEOEMAS42	Building Construction I.			Exam	3
Course type	**Course code**	**Course language**	**Timetable information**		
Lecture	EN0	English	TUE:10:15-12:00(K373)		
Practice	EN1	English	MON:08:15-10:00(K371); MON:08:15-10:00(K371)		
Students gain knowledge and skills during the semester work in the following topics: Flat and deep foundations, relation to sub-soil insulation of buildings. Masonry works, prefabricated panel systems. Plasters and ETICS. Reinforced concrete, steel and wooden beam slab constructions. Stairs. High roofs. Passable and non-passable flat roofs, green roofs. Insulations against functional water.					

Subject code	Subject name			Requirement	ECTS credit
BMEEOEMAS43	Building Construction II.			Exam	3
Course type	**Course code**	**Course language**	**Timetable information**		
Lecture	EN0	English	TUE:10:15-12:00(K373)		
Practice	EN1	English	MON:12:15-14:00(K144); MON:12:15-14:00(K144)		
Floor structures, finishes, orders of layers: floors on ground, floors of intermediate slabs, floors of attics, terraces,					

prefabricated concrete and stone pavings. Tile and plate roof claddings, metal sheet seamed strip claddings: orders of layers, materials, rules of technique, details, rainwater gutter systems. Structures of built-in-roofs: structures and roofing of pitched roofs, orders of layers, foils of vapour-/air-/waterproofing. Facade claddings: plastered, thermal insulated, assembled light and heavy claddings. Posterior thermal insulation of facades. Curtain walls, glass roofs. Structures and materials of dry technologies: assembled walls, ceilings, floors. Building physics: thermal and vapour protection. Acoustics, protection against noise. Building construction solutions of building reconstruction, tasks of refurbishment.

Subject code	Subject name	Requirement	ECTS credit
BMEEOEMAT42	Civil Engineering Representation and Drawing	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	TUE:12:15-14:00(EL111); TUE:12:15-14:00(EL111)
Practice	EN1	English	TUE:16:15-18:00(KM30); TUE:16:15-18:00(KM30)

3 main parts of the subject: 1. Descriptive geometry 2. Engineering drawing 3. Freehand drawing. 1. Basics of descriptive geometry course modules: Students gain knowledge and skills in regularities and techniques of descriptive geometry, developing spacial reasoning. Topics: basic constructions in planes of projections, transformations, tasks of intersections, intersections and interpenetrations of plane and curved solids, cast shadows, construction in scale, special revolution solids and skew surfaces. Additional representation systems: dimensioned representations, orthogonal axonometry, perspective projection. 2. Engineering drawing course modules: Students gain knowledge and skills in engineering drawing, specific notations, proportions and scale, magnification, minification, construction of ground plans and sections. 3. Engineering free-hand representation course modules: develop free-hand drawing in scale.

Subject code	Subject name	Requirement	ECTS credit
BMEEOEMAT43	Construction Materials I.	Exam	5

Course type	Course code	Course language	Timetable information
Laboratory	EN1	English	THU:08:15-10:00(MMFL2); THU:08:15-10:00(MMFL2)
Laboratory	EN3	English	THU:08:15-10:00(MMFL4); THU:08:15-10:00(MMFL4)
Laboratory	EN4	English	
Laboratory	EN2	English	THU:08:15-10:00(MMFL3); THU:08:15-10:00(MMFL3)
Lecture	EN0	English	WED:10:15-12:00(KF88); WED:10:15-12:00(KF88)

Basic physical and hydrotechnical characteristics of the most important structural materials: stress, strength, deformation, fatigue, creep, shrinkage, toughness, relaxation, brittleness, hardness. Binding materials: Lime, gypsum, production of cements, the klinker minerals, hydration and properties. Mortar. Concrete: Aggregates, admixtures. Fresh concrete: consistency, mix design. Hardened concrete: Interpretation of strength, and its evaluation. Metals: iron, steel yield strength, ultimate tensile strength, ultimate strain, influence of temperature, weldability. Timber. Mechanical properties, shrinkage, swelling. Bricks and masonry . Main constituents and porperties of glass. Types of polymers.

Subject code	Subject name	Requirement	ECTS credit
BMEEOEMAT44	Building Construction Study	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	FRI:10:15-12:00(K389)
Practice	EN2	English	MON:10:15-12:00(K144); MON:10:15-12:00(K144)
Practice	EN1	English	WED:14:15-16:00(K183); WED:14:15-16:00(K183)

Subject of architectural engineering, fundamental terms and base definitions. elations of buildings and building constructions. Effects on buildings, requirements of building constructions. Building blocks and specific brick connections. Load-bearing wall systems and lintel beams in wall structures. Groups of foundation modes and characteristics. Water insulation of under grade parts of buildings. Slabs and ring beams. Balconies. Basics of mechanical installations of residential buildings. Frame system buildings, construction systems and materials. Structures of stairs, systematization. Railings, main coverings. Types of traditional roof trusses, specialties, rainwater gutters and roof claddings. Order of layers of flat roofs, rainwater drainage, gullies, waterproofing materials. Types and materials of typical external and internal doors and windows. Classic contact facade finishes. Basics of building physics.

Subject code	Subject name	Requirement	ECTS credit
BMEEOEMK601	Building Materials 2.	Exam	3

Course type	Course code	Course language	Timetable information
Laboratory	EN1	English	
Lecture	EN0	English	

Subject code	Subject name	Requirement	ECTS credit
BMEEOFTAT42	Civil Engineering Informatics	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Laboratory	EN4	English	FRI:12:15-14:00(K142b); FRI:12:15-14:00(K142b)
Laboratory	EN2	English	FRI:08:15-10:00(K142a); FRI:08:15-10:00(K142a)
Laboratory	EN1	English	MON:14:15-16:00(K142a); MON:14:15-16:00(K142a)
Laboratory	EN3	English	FRI:12:15-14:00(K142a); FRI:12:15-14:00(K142a)
Lecture	EN0	English	THU:12:15-14:00(KF88); THU:12:15-14:00(KF88)

The course gives an overview on the major areas of informatics, on the components of information technology systems. Besides supporting the labs, some practical problems and particular tasks are also discussed on the lectures. On the labs, students use spreadsheet application to solve different tasks, then learn the basics of numerical and non-numerical methods in mathematical software environment. Students also learn the basics of programming; most of the tasks have to be solved by own scripts, routines, programs. Civil engineering informatics discusses 2D and 3D computer graphics and the basics of database management that supports high level courses involving spatial construction and database systems.

Subject code	Subject name	Requirement	ECTS credit
BMEEOFTMF-3	Mapping technologies	Exam	5

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	
Practice	EN1	English	

Subject code	Subject name	Requirement	ECTS credit
BMEEOFTMF61	Intelligent Transport Systems	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	
Practice	EN1	English	

Subject code	Subject name	Requirement	ECTS credit
BMEEOFTMI51	Database systems	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	
Practice	EN3	English	
Practice	EN2	English	
Practice	EN1	English	

Subject code	Subject name	Requirement	ECTS credit
BMEEOFTMK51	Numerical Methods	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Practice	EN2	English	WED:10:15-12:00(KF27c); WED:10:15-12:00(KF27c); FRI:12:15-14:00(KF27c)
Practice	EN1	English	THU:08:15-10:00(K142a); THU:08:15-10:00(K142a); FRI:10:15-12:00(K142b)

Subject code	Subject name	Requirement	ECTS credit
BMEEOGMAS41	Rock Mechanics	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	EN2	English	THU:14:15-16:00(K136)
Laboratory	EN1	English	TUE:14:15-16:00(K389)
Laboratory	EN3	English	TUE:14:15-16:00(K129)
Lecture	EN0	English	TUE:14:15-16:00(K389)

Petrophysical properties of solid rocks, the characterisation of rock blocks and rock masses, the jointing system in the rock environment. The deformation processes and rheological characters in rock mechanics, the influence of joint spacing. The durability and effect of rock environment on the engineering structures. The evaluation of geological conditions in rock environment at tunnels foundations and rocky slopes. The influence of material

properties on the petrophysical properties of rocks.

Subject code	Subject name	Requirement	ECTS credit
BMEEOGMAS42	Underground Structures, Deep Found.	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	FRI:08:15-10:00(KM21); FRI:08:15-10:00(KM21)
Practice	EN1	English	FRI:10:15-12:00(KM21)

Types and field of application of deep foundations (stone columns, diaphragm walls). Load transfer mechanizm of deep foundations. Determination the bearing capacity and settlement by different methods (by theoretical formulas,load tests,sounding).Design and construction of Pedestrian subways,Underground garages. Analysis against uplift. Insulations.

Subject code	Subject name	Requirement	ECTS credit
BMEEOGMAT42	Soil Mechanics	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	WED:12:15-14:00(K372); WED:12:15-14:00(K372)
Practice	EN1	English	FRI:12:15-14:00(KM21); FRI:12:15-14:00(KM21)

Origin of soils, soil exploration, soil samples. Components of soils (phase relationships, grain size distribution, consistency limits), soil classification, compaction. Stresses in the soil (under static conditions, conditions of steady vertical flow). Flow of water through soil due gravity (Darcy's law, coefficient of permeability, flow nets). Compressibility of soil (reasons and types of compression). Shear strength of soil (Mohr-Coulomb failure criterion, determination of shearing strength).

Subject code	Subject name	Requirement	ECTS credit
BMEEOGMAT43	Earthworks	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	WED:12:15-14:00(KM21); WED:12:15-14:00(KM21)
Practice	EN2	English	WED:14:15-16:00(KM30)
Practice	EN1	English	TUE:10:15-12:00(K374)

Scope of earth works. Plastic limit states, Rankine earth pressures. Earth pressure and passive resistance of „real" walls. Soilstatical design of retaining structures. Stability of earth works. Construction of earth works. The designal, executional and monitoring questions of construction. Dewatering of earth works. Geosynthetics.

Subject code	Subject name	Requirement	ECTS credit
BMEEOGMMG-1	Engineering Geology MSc	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	MON:08:15-10:00(K136); MON:08:15-10:00(K136)
Practice	EN1	English	MON:10:15-11:00(K136); MON:10:15-11:00(K136)

Subject code	Subject name	Requirement	ECTS credit
BMEEOGMMG-3	Geotechnical design	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	THU:14:15-16:00(KM21); THU:14:15-16:00(KM21)
Practice	EN1	English	THU:16:15-17:00(KM21); THU:16:15-17:00(KM21)

Subject code	Subject name	Requirement	ECTS credit
BMEEOGMMG-4	Earthworks of Infrastructures	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	MON:11:15-13:00(EL111); MON:11:15-13:00(EL111)
Practice	EN1	English	MON:13:15-14:00(EL111); MON:13:15-14:00(EL111)

Subject code	Subject name	Requirement	ECTS credit
BMEEOGMMG61	Tunneling	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	MON:14:15-16:00(KM78); MON:14:15-16:00(KM78)

Subject code	Subject name		Requirement	ECTS credit
BMEEOGMMG62	Hidrogeology		Mid-semester mark	3
Course type	**Course code**	**Course language**	**Timetable information**	
Lecture	EN0	English	WED:08:15-10:00(K136); WED:08:15-10:00(K136)	

Subject code	Subject name		Requirement	ECTS credit
BMEEOGMMG64	Engineering Geology of Hungary		Mid-semester mark	3
Course type	**Course code**	**Course language**	**Timetable information**	
Lecture	EN0	English	TUE:12:15-14:00(K136); TUE:12:15-14:00(K136)	

Subject code	Subject name		Requirement	ECTS credit
BMEEOGMMS51	Geodynamics		Mid-semester mark	3
Course type	**Course code**	**Course language**	**Timetable information**	
Lecture	EN0	English	WED:12:15-14:00(K389); WED:12:15-14:00(K389)	

Subject code	Subject name		Requirement	ECTS credit
BMEEOGMMS5P	Engineering geological and geotechnical project		Mid-semester mark	5
Course type	**Course code**	**Course language**	**Timetable information**	
Practice	EN1	English	THU:12:15-14:00(KM21); THU:12:15-14:00(KM21)	

Subject code	Subject name		Requirement	ECTS credit
BMEEOHSA-A1	Steel Buildings		Exam	5
Course type	**Course code**	**Course language**	**Timetable information**	
Lecture	EN0	English	WED:12:15-14:00(EL111); WED:12:15-14:00(EL111); THU:10:15-12:00(EL111)	
Practice	EN1	English	THU:10:15-12:00(EL111)	

Low rise industrial halls. Lattice girders. Crane girders. Design of secondary members (purlins, sheeting). Analysis and design: Principles, analysis and modelling methods, global analysis of frames.Stability analysis and design of steel structures. Floor systems, design of composite floor systems. Joints and connections in steel and composite building structures. Bracing of steel and composite structures. Seismic design of structures. Fire design. Highrise and tall buildings.

Subject code	Subject name		Requirement	ECTS credit
BMEEOHSA-A2	Reinforced Concrete Buildings		Exam	5
Course type	**Course code**	**Course language**	**Timetable information**	
Lecture	EN0	English	TUE:08:15-10:00(EL111); TUE:08:15-10:00(EL111); THU:08:15-10:00(EL111)	
Practice	EN1	English	THU:08:15-10:00(EL111)	

Formation of reinforced concrete buildings, loads and effects, basics of earthquake design. Plastic behaviour of flat slabs, prestressing. Structural systems of highrise buildings. structural elements of the stiffening systems: shear walls, flat-slabs, cores, frames with masonry infill. Formation of timber halls, sizing of prefabricated prestressed and glued laminated timber structural elements. Masonry structures.

Subject code	Subject name		Requirement	ECTS credit
BMEEOHSA-B3	Engineering Works		Exam	3
Course type	**Course code**	**Course language**	**Timetable information**	
Lecture	EN0	English	WED:14:15-16:00(K375); WED:14:15-16:00(K375)	

Subject code	Subject name		Requirement	ECTS credit
BMEEOHSA-PP	Structural Design Projectwork		Mid-semester mark	6
Course type	**Course code**	**Course language**	**Timetable information**	
Practice	EN1	English	MON:08:15-10:00(KF12); MON:08:15-10:00(KF12)	

Subject code	Subject name	Requirement	ECTS credit
BMEEOHSAS43	Bridges and Infrastructures	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	MON:10:15-12:00(KF12); MON:10:15-12:00(KF12)

Historical development of bridges. Basic terms of bridges. Classification of bridges. Superstructure systems. Typical superstructures of steel, steel and concrete composite as well as concrete bridges. Composite action between main girders. Basis of bridge design. Traffic load models and their application rules for highway and railway bridges. Testing of bridges. Substructures of bridges: abutments and piers. Bridge equipment. Conceptual design of bridges. Fitting of bridges into environment, bridge aesthetics. Supervision of bridges. Reconstruction and strengthening of bridges. Civil engineering work in traffic infrastructure, systems and hydraulic engineering.

Subject code	Subject name	Requirement	ECTS credit
BMEEOHSAS44	Timber Structures	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	THU:12:15-14:00(KF10); THU:12:15-14:00(KF10)

Introduction and comparative analysis of existing timber structures. Material characteristics and strength grades of timber material. Design of timber structural members for ULS according to EC5 (compression, tension, bending, shear, torsion, combined actions, stability analysis). Design of timber structural members for SLS according to EC5 (deformations, durability). Basis of the fire design of timber structures. Design of single and multiple shear plane connections with metal dowel-type fasteners (nailed and bolted connections). Design of connections with punched metal plate fasteners, split ring connectors and toothed plate connectors. Bonded connections, design of glued-laminated timber structures. Analysis of stress concentration sites in timber structures. Constructive protection methods and typical construction details of timber structures.

Subject code	Subject name	Requirement	ECTS credit
BMEEOHSAS45	3D Constructional Modelling of Structures	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	EN1	English	WED:10:15-12:00(EL111); WED:10:15-12:00(EL111)

The aim of the course is to introduce the 3 dimensional detailing of steel-, reinforce concrete- and timber structures to the students. The course intends to develop basic practical skills by real 3D modelling of structures where the model is able to provide drawings and lists automatically for fabrication and construction processes. The course provides insight into the integration of the 3D constructional model of structures with other branches like architectural, mechanical, electrical and plumbing models into a BIM (Building Information Modelling) model. The students will learn the necessary knowledge and also obtain experience for the later project home works and diploma works by the help of presentations, small examples and a modelling home work.

Subject code	Subject name	Requirement	ECTS credit
BMEEOHSAS47	Steel and Composite Structures	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	MON:12:15-14:00(KF12); MON:12:15-14:00(KF12); MON:14:15-16:00(KF12)

Subject code	Subject name	Requirement	ECTS credit
BMEEOHSAT42	Steel Structures	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	MON:12:15-14:00(KM30); THU:10:15-12:00(KF88); THU:10:15-12:00(KF88)

Lectures of Steel Structures have the general aim to study the basics of the design of steel stuctures, which consists of the design of simple structural members, simple joints and the investigation of the basic failure phenomenon, which can occure in steel structures. The program consists of the following topics: Steel grades, mechanical properties of the steel material. Calculation of cross sectional properties. Design of centrically loaded tension members. Design of Centrically loaded compression members. Buckling problem – behaviour – design method. Design of beams: construction, behaviour under bending and shear interaction. Beam structural behaviour - design approaches for lateral torsional buckling.Design of bolted connections. Design of welded connections. Fatigue design and brittle fracture. Plate buckling phenomena, basics of the cross section classification.

Subject code	Subject name	Requirement	ECTS credit
BMEEOHSAT43	Reinforced Concrete Structures	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	TUE:08:15-10:00(KF12); WED:08:15-10:00(KF12); WED:08:15-10:00(KF12)

Structural safety of reinforced concrete (RC) structures; loads and effects on RC strucrures, material properties of concrete and reinforcing steel; moment- curvature relation of RC cross sections; Uncracked and cracked cross section; flexural strength theory, strength and ductility; design of RC cross section; eccentric compression; shear failure in beams without and with shear reinforcement; strength in bending and torsion; anchorage and stress development, bar curtailment; deflection and crack width.

Subject code	Subject name	Requirement	ECTS credit
BMEEOHSMI51	Bridges and Infrastructures	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	

Subject code	Subject name	Requirement	ECTS credit
BMEEOHSMK51	Methods of Engineering Analysis	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	FRI:08:15-09:00(KF12); FRI:08:15-09:00(KF12)
Practice	EN1	English	FRI:09:15-10:00(KF12); FRI:09:15-10:00(KF12)

Subject code	Subject name	Requirement	ECTS credit
BMEEOHSMS5P	Structures project	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Practice	EN1	English	WED:10:15-12:00(KF99); WED:10:15-12:00(KF99)

Subject code	Subject name	Requirement	ECTS credit
BMEEOHSMT-1	Structures 2	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	THU:12:15-14:00(KM30); THU:12:15-14:00(KM30)
Practice	EN1	English	THU:14:15-16:00(KM30); THU:14:15-16:00(KM30)

Subject code	Subject name	Requirement	ECTS credit
BMEEOHSMT-2	Stability of Structures	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	MON:08:15-10:00(K389); MON:08:15-10:00(K389)
Practice	EN1	English	MON:10:15-11:00(K389); MON:10:15-11:00(K389)

Subject code	Subject name	Requirement	ECTS credit
BMEEOHSMT-3	Seismic Design	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	TUE:08:15-10:00(K389); TUE:08:15-10:00(K389)
Practice	EN1	English	TUE:10:15-11:00(K389); TUE:10:15-11:00(K389)

Subject code	Subject name	Requirement	ECTS credit
BMEEOHSMT61	Applied Fracture Mechanics	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	MON:14:15-16:00(K144); MON:14:15-16:00(K144)
Practice	EN1	English	MON:16:15-17:00(K144); MON:16:15-17:00(K144)

Subject code	Subject name	Requirement	ECTS credit
BMEEOHSMT62	Prestressing Technologies	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	FRI:10:15-11:00(KF12); FRI:10:15-11:00(KF12)
Practice	EN1	English	FRI:11:15-12:00(KF12); FRI:11:15-12:00(KF12)

Subject code	Subject name	Requirement	ECTS credit
BMEEOHSMT63	Strengthening of Structures	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	WED:08:15-09:00(EL111); WED:08:15-09:00(EL111)
Practice	EN1	English	WED:09:15-10:00(EL111); WED:09:15-10:00(EL111)

Subject code	Subject name	Requirement	ECTS credit
BMEEOTMAS41	Strength of Materials	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	WED:16:15-18:00(KM26Olt); WED:16:15-18:00(KM26Olt)

Differential equation of the elastic curve, computation of the deflected shape for various boundary conditions. Virtual displacement systems, virtual work. Theorem of virtual displacements. Computation of external and internal forces of statically determinate structures using the theorem of virtual displacements. Concept of potential energy, theorem of stationarity of potential energy, application of the theorem for the computation of displacements of structures. Concept of complementary potential, theorem of minimum complementary potential energy, using the theorem for the computation of reactions of structures. Revision of common work and energy theorems of mechanics. Characterization of equilibrium states, concept of critical load. Methods of stability analysis: statical, kinematical, and energy methods. Elastic Euler buckling.

Subject code	Subject name	Requirement	ECTS credit
BMEEOTMAT41	Basics of Statics and Dynamics	Exam	6

Course type	Course code	Course language	Timetable information
Practice	EN1	English	MON:10:15-12:00(KM30); MON:10:15-12:00(KM30); TUE:12:15-14:00(KM21); TUE:12:15-14:00(KM21); FRI:12:15-14:00...

Classification of mechanics, basic vector operations. Kinematics of particles, description of motion in Cartesian coordinate system. Newton's laws of motion. Concurrent and general force systems in the plane, distributed forces: reduction, resultant, centroid, equilibration. Mechanical work. Planar motion of rigid bodies. Centroid and moment of inertia of rigid bodies. Kinetics of rigid bodies moving in the plane. Linear momentum, angular momentum, theorems of change of kinetic energy for particles and rigid bodies. Constraints. External and internal forces of planar structures and trusses. Statical determinacy. Spatial force systems: reduction, resultant, equilibration. Spatial structures. Internal force diagrams of statically determinate planar bar structures, relationships between internal force diagrams. Sliding friction and rolling resistance.

Subject code	Subject name	Requirement	ECTS credit
BMEEOTMAT42	Introduction to Strength of Materials	Mid-semester mark	6

Course type	Course code	Course language	Timetable information
Practice	EN1	English	MON:12:15-14:00(K373); MON:12:15-14:00(K373); WED:12:15-14:00(KM78); FRI:14:15-16:00(K373); FRI:14:15-16:...
Practice	EN2	English	MON:12:15-14:00(KM78); MON:12:15-14:00(KM78); WED:12:15-14:00(K373); FRI:14:15-16:00(KM78); FRI:14:15-16:...

Internal forces and internal force diagrams of planar and spatial structures (revision, generalization). Moments of inertia and principal directions of planar figures. Strength properties of materials. Concept of stresses and deformations. Material models: linearly elastic material and linerly elastic and perfectly plastic material. Beam element, beam model composed of elastically connected cross-sections. Computation of normal stresses in beams for centric tension/compression, simple bending, skew bending, and tension/compression combined with bending. Computation of shear stresses in beams for pure shearing, torsion, and shearing combined with bending. Eccentric compression of cross-sections of no tension matrials. Shear centre of thin-walled cross-sections. Displacements of bent beams with straight axis. Principal stresses and principal directions.

Subject code	Subject name	Requirement	ECTS credit
BMEEOTMAT43	Structural Analysis I.	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	TUE:14:15-16:00(KM78); TUE:14:15-16:00(KM78); FRI:10:15-12:00(KM78); FRI:10:15-12:00(KM78)

Principle of small displacements: displacements of rigid body chains using small displacements. Computation of displacements of statically determinate simple and compound structures using displacement equivalency statements. Virtual force systems, concept of virtual complementary work, theorem of virtual forces. Computation of displacements of statically determinate simple and compound structures using the theorem of virtual forces. Influence lines of internal forces and displacements of statically determinate structures. Maximal internal forces. Concept of envelope curves. Computation of statically indeterminate planar structures under fix loads using the force method. Computation of statically indeterminate planar structures under moving load using the force method: influence lines. Computation of statically indeterminate planar structures under fix loads using the displacement

method.

Subject code	Subject name	Requirement	ECTS credit
BMEEOTMMN-1	Structural Dynamics	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	MON:11:15-13:00(K389); MON:11:15-13:00(K389)
Practice	EN1	English	MON:13:15-14:00(K389); MON:13:15-14:00(K389)

Subject code	Subject name	Requirement	ECTS credit
BMEEOTMMN61	Plasticity	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	THU:10:15-11:00(KM78); THU:10:15-11:00(KM78)
Practice	EN1	English	THU:11:15-12:00(KM78); THU:11:15-12:00(KM78)

Subject code	Subject name	Requirement	ECTS credit
BMEEOTMMN62	Nonlinear FEM	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	TUE:11:15-13:00(K144); TUE:11:15-13:00(K144)

Subject code	Subject name	Requirement	ECTS credit
BMEEOTMMN63	Analysis of Rods and Frames	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	THU:15:15-16:00(KM78); THU:15:15-16:00(KM78)
Practice	EN1	English	THU:16:15-17:00(KM78); THU:16:15-17:00(KM78)

Subject code	Subject name	Requirement	ECTS credit
BMEEOTMMN64	Discrete Element Method	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	THU:17:15-18:00(KM78); THU:17:15-18:00(KM78)
Practice	EN1	English	THU:18:15-19:00(KM78); THU:18:15-19:00(KM78)

Subject code	Subject name	Requirement	ECTS credit
BMEEOTMMS5P	Numerical modeling project	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Practice	EN1	English	THU:08:15-10:00(KM78); THU:08:15-10:00(KM78)

Subject code	Subject name	Requirement	ECTS credit
BMEEOUVAI45	Infrastructural CAD Course	Mid-semester mark	1

Course type	Course code	Course language	Timetable information
Laboratory	EN3	English	
Laboratory	EN2	English	
Laboratory	EN1	English	

Subject code	Subject name	Requirement	ECTS credit
BMEEOUVAT41	Railway Tracks	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	MON:14:15-17:00(K373); MON:14:15-17:00(K373)

Basic concepts of the railway tracks and vehicles, most important technical parameters. Features of normal railways, suburban railways, urban railways, classification of different types of railways. Speed, acceleration, changing of acceleration. Horizontal and vertical alignment of the railway tracks, straights, circular curves and transition curves, superelevation, vertical curves. Elements of the substructure and superstructure. Rails, sleepers, rail fastenings, ballast, subgrade, strengthening of the subgrade. Setting out major and detail points of curves and transition curves. Structures and solutions of dewatering and drainage of railway tracks. Basic concepts of conventional and

continuously welded rail tracks. Types of turnouts and simple track connections. Basic concepts of railway stations, platforms, passenger access.

Subject code	Subject name	Requirement	ECTS credit
BMEEOUVAT42	Roads	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	MON:14:15-16:00(KF88); MON:14:15-16:00(KF88)

History of transportation. Sustainable transportation and transportation policy. The system of tracks, vehicles and drivers/passengers. Design and behavioural patterns and self-explaining roads. Transport facilities. Elements of the alignment in cross sections, horizontal and vertical alignment. Basic rules and disciplines of planning and design. Transition of superelevation. Planning process: planning, design project, construction, operation. Traffic operation basics: measures of traffic, traffic operation and management. Intersections and junctions. Urban transportation planning, the concept of accessibility. Characteristics, production and installation of asphalt pavements. Types of tracks, layers, materials. Design of new pavement structures. Construction, management and operation of road networks. Project 1: Authorization plan of a curved section of a secondary main road with transition curves: site plan on a contour line map with long section and cross sections. Drainage, earthwork, road marking. Project 2: Feasibility study of a main road between two point on a contour line map.

Subject code	Subject name	Requirement	ECTS credit
BMEEOUVMU-2	Design of Railway Stations	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	
Practice	EN1	English	

Subject code	Subject name	Requirement	ECTS credit
BMEEOUVMU65	Economics of Civil Engineering Projects	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	

Subject code	Subject name	Requirement	ECTS credit
BMEEOVKAI43	Water Chemistry and Hydrobiology	Exam	3

Course type	Course code	Course language	Timetable information
Laboratory	EN1	English	
Lecture	EN0	English	

Subject code	Subject name	Requirement	ECTS credit
BMEEOVKAI45	Legal Aspects of Water and Environment	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	

Subject code	Subject name	Requirement	ECTS credit
BMEEOVKAT41	Basics of Environmental Engineering	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	THU:14:15-16:00(KM31); THU:14:15-16:00(KM31)

The aim of the course is to provide basic scientific and engineering background for further studies in environmental engineering by giving introduction to the following subjects: basics of ecology, the natural cycle of ecologically important elements and substances, the environmental effects of human activities, the ecological footprint, energy consumption patterns and energy production technologies, renewable energy sources. Selected environmental problems associated with civil engineering activities (water, air and soil pollution), with focus on the urban environment. Tools and methods for conducting environmental impact assessment.

Subject code	Subject name	Requirement	ECTS credit
BMEEOVKAT42	Public Works I.	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	FRI:08:15-10:00(KM31); FRI:08:15-10:00(KM31)
Practice	EN1	English	WED:14:15-16:00(KF10)

The main goal of the subject is to provide information about the most important features of the public works. The

subject is also including the connections between the different public works and other establishments. Further aim is to provide knowledge for the future general designers and technical managers to make the right decisions on the underground infrastructure of settlements. Main scopes are: system knowledge and design of different publc work types like water acquisiton, drinking water supply, waste water networks, storm water networks and public works asset management.

Subject code	Subject name	Requirement	ECTS credit
BMEEOVKMI53	Drainage of engieering constructions	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	

Subject code	Subject name	Requirement	ECTS credit
BMEEOVKMV61	Drinking water and wastewater treatment plants	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	
Practice	EN1	English	

Subject code	Subject name	Requirement	ECTS credit
BMEEOVVAI42	Hydraulics 2	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	
Practice	EN1	English	

Subject code	Subject name	Requirement	ECTS credit
BMEEOVVAT41	Hydrology I.	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	MON:10:15-12:00(KF10); MON:10:15-12:00(KF10)
Practice	EN1	English	WED:14:15-16:00(KF10)

The global water cycle. The water balance. Basic elements of hydrometeorology. Evaporation and its main features. The origin of the precipitation, quantitative characteristics, principles of precipitation. Weather, weather conditions, climate. The concept and principles of runoff. Infiltration. runoff estimation on small and large catchments. Elements of hydrography. Exploration of natural streams. Characterisation of subsurface waters and their principles. Characterisation of groundwater regime.

Subject code	Subject name	Requirement	ECTS credit
BMEEOVVAT42	Hydraulics I.	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	TUE:10:15-12:00(KF88); TUE:10:15-12:00(KF88)
Practice	EN2	English	WED:12:15-14:00(KF10)
Practice	EN1	English	WED:12:15-14:00(KF10)

Physical properties of water. Hydrostatics: pressure distribution, absolute and relative equilibrium. Equilibrium of submerged and floating bodies. The flow of fluids: velocity, discharge, continuity, specific energy head, other properties. Laminar and turbulent motion. Behaviour of ideal and real fluids. Outflow, through-flow. Channel flow. Hydraulic jump, energy breaker. Weirs, sluice-gates. Steady-state flow in pipes. Seepage in porous media. Wells. Turbo-machines.

Subject code	Subject name	Requirement	ECTS credit
BMEEOVVAT43	Hydraulic Engineering, Water Management	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	THU:08:15-10:00(KF88); THU:08:15-10:00(KF88)
Practice	EN2	English	THU:16:15-18:00(KF10)
Practice	EN1	English	WED:10:15-12:00(KF10)

The tasks, methods and tools of water management. Hungarian and European specialities of water management. Types and tasks of hydraulic engineering structures with the following topics: Watershed management of lowland and hilly areas, regulation of lakes and rivers, reservoirs and storage, flood control and land drainage, inland navigation, water power development, water intake and pumping stations, small hydraulic engineering structures, caracteristic environmental impacts of hydraulic engineering structures. During the practical lessons four design works will be elaborated.

Subject code	Subject name	Requirement	ECTS credit
BMEEOVVMV-2	Hydromophology	Exam	4

Course type	Course code	Course language	Timetable information
Laboratory	EN1	English	
Laboratory	EN2	English	
Lecture	EN0	English	

Subject code	Subject name	Requirement	ECTS credit
BMEEOVVMV61	Design of Water Use Structures	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	
Practice	EN1	English	

Subject code	Subject name	Requirement	ECTS credit
BMEEOVVMV64	Hydrography and Hydroinformatics	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	
Practice	EN1	English	

Faculty of Economic and Social Sciences

IMPORTANT NOTES

If for one subject you can find several different types (lecture, practice, laboratory) of courses then please choose one and only one course from each type in order to be able to perform the subject's requirements successfully.Civil Engineering courses are on the website seperately. Courses chosen from the offer of Faculty of Civil Engineering will be checked and arranged individually by the departmental coordinator.

Subject code	Subject name	Requirement	ECTS credit
BMEGT20A001	Management and Business Economics	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	EEN04BM	English	TUE:08:15-10:00; THU:08:15-10:00

https://edu.gtk.bme.hu/ The 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: principles of management, marketing management, quality management, production and project management. For problem formulation, both the managerial interpretation and the mathematical techniques are applied. Budapest University of Technology and Economics Faculty of Economic and Social Sciences Course Syllabus and Requirements Management and Business Economics 2. Course code Semester Hours per week (Theory/Practice) ECTS credits Language of Instruction Level (BSc/BA/MSc/MA) BMEGT20A001 fall/spring 4/0 4 Hungarian BSc/BA 3. Course supervisor (name, title, department): János Kövesi, dr. Habil, Professor, Department of Management and Business Economics 4. Lecturers: Name: Position: Department/Institute/availability(Room, e-mail address): Szilvia Bíró-Szigeti, PhD Associate Professor Dept. of Management and Business Economics, QB305, szigetisz@mvt.bme.hu János Kövesi Professor Dept.of Management and Business Economics, QA315, kovesi@mvt.bme.hu Noémi Kalló, PhD Associate Professor Dept.of Management and Business Economics, QA308, kallo@mvt.bme.hu Tibor Szabó, PhD Assistant Professor Dept.of Management and Business Economics, QA317, tiborszabo@mvt.bme.hu 5. Preliminary knowledge required: Basic concept of companies and their operation. 6. Academic prerequisites: - 7. Objectives and description of the course: The 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: principles of management, marketing management, quality management, production and project management. For problem formulation, both the managerial interpretation and the mathematical techniques are applied. 8. Teaching methods: Lectures. 9. Requirements and assessment: 4 midterm exams have to be taken during the semester. The grade will be determined by the sum of the midterm exams (4x25=100 %), there are no minimum requirements for the individual exams. 10. Exams, make-up duties and make-up exams: Maximum 3 of the 4 midterm exams can be repeated or make up at the end of the semester. There are no final make-up exams in this course. 11. Office hours: By making appointment with the lecturers. 12. Course material, compulsory and recommended readings: Materials provided by the lecturers: www.mvt.bme.hu/segedanyagok 13. Workload and detailed class schedule: Topics to be discussed, readings required for the class, other assignments Week 1 Marketing management: Creating Customer Value and Engagement Week 2 Consumer behaviour, Analyzing the Marketing Environment Week 3 Market research, Product and brand management Week 4 Service management, Promotion management Week 5 Communication management, Online marketing Week 6 Quality management: Principles of quality management, the brief history of quality management systems Week 7 Overview of quality assurance systems based on ISO 9001:2000 Quality Management System. Week 8 Overview of quality assurance systems based on Total Quality Management System. Week 9 Production-economics: production systems, manufacturing models, product-process matrix. Week 10 Inventories, inventory control systems, costs of carrying stocks Week 11 Principles of management: Resources of a firm, firm as an organization. Week 12 Functions of managerial processes Week 13 Corporates strategies, Team work, communication in an organization. Week 14 Repeat of midterms

Subject code	Subject name	Requirement	ECTS credit
BMEGT301004	Economics I.	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EEN35BM	English	THU:10:15-12:00(K392)

Objectives and description of the course: The aim is to allow students to understand todayrsquo;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 bachelorrsquo;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.

Subject code	Subject name	Requirement	ECTS credit
BMEGT30A001	Micro- and Macroeconomics	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EEN34BM	English	WED:08:15-10:00; THU:12:15-14:00

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 ldquo;choicerdquo; 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.

Subject code	Subject name	Requirement	ECTS credit
BMEGT30M400	Analysis of Economic Time Series	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EEN05TT	English	

Subject code	Subject name	Requirement	ECTS credit
BMEGT30MS07	Economic Analysis of Technology	Exam	2

Course type	Course code	Course language	Timetable information
Lecture	EEN18VE	English	TUE:08:15-10:00(Q épület Tanszék)

Objectives and description of the course: Recently the education in different fields of engineering does not contain only the traditional topics of technology, but also elements from economic sciences. Thus engineers will be engaged to understand economic consequences of their decisions. The aim of the present subject is to give an introduction into this field based on empirical investigations as well as on theoretical approaches. After a short introduction it will be shown how basic categories could be used to describe the situation being under consideration. It follows the detailed investigation of the special relationship between technology and costs, again based on empirics and on traditional models. The next block contains questions dealing with the economic consequences of technological decisions, e. g. exhausting of natural resources, transport problem, environmental decisions, choosing production places, etc. Finally, problems of market structure (free competition, monopoly, monopolistic competition, oligopoly, etc.) caused by technology will be analyzed.

Subject code	Subject name	Requirement	ECTS credit
BMEGT30N002	Industrial Organization	Exam	6

Course type	Course code	Course language	Timetable information
Lecture	EEN17BM	English	

This course is about different theoretical approaches to the organization and institutions of a market economy. The of the course is to get students acquainted with the most recent theories of different market structures and to their potential applications to practical problems related to market strategy and market regulation. After having finished the course, students should understand the key concepts of monopolistic and oligopolistic markets, the ways companies play their strategic games under different market conditions and the role a government can and should play in correcting market failures. /* Style Definitions */ table.MsoNormalTable {mso-style-name:"Normál táblázat"; mso-tstyle-rowband-size:0; mso-tstyle-colband-size:0; mso-style-noshow:yes; mso-style-priority:99; mso-style-parent:""; mso-padding-alt:0cm 5.4pt 0cm 5.4pt; mso-para-margin:0cm; mso-para-margin-bottom:.0001pt; mso-pagination:widow-orphan; font-size:10.0pt; font-family:"Times New Roman",serif;}

Subject code	Subject name	Requirement	ECTS credit
BMEGT42A003	Environmental Management Systems	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EEN33BM	English	WED:08:15-12:00; WED:10:15-12:00

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.

Subject code	Subject name	Requirement	ECTS credit
BMEGT42A011	Environmental Economics	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	EEN31GT	English	THU:12:15-14:00(QA240)

Subject code	Subject name	Requirement	ECTS credit
BMEGT42A022	Environmental Evaluation and Risk Management	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	EEN28BM	English	TUE:10:15-12:00(QA240)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEGT42M104	Sustainable Environmental and Natural Resource Management	Exam	5

Course type	Course code	Course language	Timetable information
Lecture	EEN14GT	English	TUE:12:15-16:00(QA240)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEGT42M105	Environmental and Regional Politics of the EU	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Lecture	EEN08GT	English	MON:12:15-16:00(QA240)

Subject code	Subject name	Requirement	ECTS credit
BMEGT42M111	Sectorial Sustainability Studies	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Lecture	EEN07GT	English	MON:10:15-14:00(QB104)

Subject code	Subject name	Requirement	ECTS credit
BMEGT42V101	BME International Climate Change Role-Play	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EEN04BM	English	TUE:16:15-19:00

Subject code	Subject name	Requirement	ECTS credit
BMEGT431143	Sociology of Culture	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EEN01ER	English	WED:16:15-18:00(E303)

SOCIOLOGY OF CULTURE 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 todayrsquo;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.

Subject code	Subject name	Requirement	ECTS credit
BMEGT43A002	Sociology	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EEN01ER	English	TUE:12:15-14:00(E302)

This course will give students an introduction to sociology by discussing a subject that concerns all of us: the global financial crisis and the ensuing Great Recession (or Slump) whose dire consequences continue to affect the world economy to this day. The objective is to equip students with the tools required to make sense of this crisis in its complexity. A further consideration, specific to engineering and economics students is that a sociological study of the Great Recession provides valuable insights into the social determinants of innovations, most prominently technological and financial. Learning about these issues will also help them develop a basic understanding of late capitalism. They will find that the major subjects in sociology like power, cultural values, violence, symbolic goods, anomy, collective action, etc. touch upon things that profoundly impact our lives without us being aware of their implications. The craft of sociology is to depart from conventional notions by asking hard questions about these things using the methods of rational inquiry.

Subject code	Subject name	Requirement	ECTS credit
BMEGT43A044	Sociology for Architects	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EEN01ER	English	WED:12:15-14:00(E205)

The course aims at giving an insight for the students into the nature of major social phenomena by demonstrating their main characteristics and their key interpretations in social sciences through the standard as well as the most up -to-date frameworks, methods and results with a clear and distinct focus on urbanisation and urban affairs. Major themes discussed during the course are Modernisation, Society and People, The Social Perspective, The Foundation and Construction of the Society, Social Stratification, Economy and Society, Community and identity, Social Institutions, Transformations of the Society, Globalisation, Urbanisation and Society, Metropolis and urban changes, Urban space and place.

Subject code	Subject name	Requirement	ECTS credit
BMEGT43A186	Philosophy of Art	Exam	5

Course type	Course code	Course language	Timetable information
Lecture	EEN01ER	English	WED:16:15-20:00(E302)

The course will introduce students to some major issues and problems in aesthetics and the philosophy of art. We will study a number of philosophical questions about the nature, the production, the interpretation and the appreciation of works of art. After studying the basic philosophical categories concerning art and artworks we will concentrate on specific aspects of the creation and appreciation of paintings, drawings, photographs, moving images, digital images, fictions, music etc. For instance, we will consider questions and arguments about bdquo;realismrdquo; with respect to pictorial works of art, about literature and fictional works, and about the understanding and appreciation of music. Although most of the course will be devoted to the analytic philosophy art, we will also examine issues concerning design practices and products.

Subject code	Subject name	Requirement	ECTS credit
BMEGT43M302	Local Development and Social Policy	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EEN01ER	English	TUE:08:15-10:00(E501)

Subject code	Subject name	Requirement	ECTS credit
BMEGT43MS07	Social and Visual Commucation	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EEN01ER	English	WED:10:15-12:00(E302)

Subject code	Subject name	Requirement	ECTS credit
BMEGT43V104	Popular Music	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EEN01ER	English	WED:14:15-16:00(E205)

Subject code	Subject name	Requirement	ECTS credit
BMEGT52A001	Ergonomics	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EEN01BM	English	

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.

Subject code	Subject name	Requirement	ECTS credit
BMEGT52A002	Psychology	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EEN01BM	English	

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.

Subject code	Subject name	Requirement	ECTS credit
BMEGT52V100	Fashion and the Psychology of Advertising	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EEN01BM	English	

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 knowledge 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. /* Style Definitions */ table.MsoNormalTable {mso-style-name:"Normál táblázat"; mso-tstyle-rowband-size:0; mso-tstyle-colband-size:0; mso-style-noshow:yes; mso-style-priority:99; mso-style-parent:""; mso-padding-alt:0cm 5.4pt 0cm 5.4pt; mso-para-margin:0cm; mso-para-margin-bottom:.0001pt; mso-pagination:widow-orphan; font-size:10.0pt; font-family:"Times New Roman",serif;}

Subject code	Subject name	Requirement	ECTS credit
BMEGT55A001	Business Law	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	EEN08ER	English	

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.

Faculty of Electrical Engineering and Informatics

IMPORTANT NOTES

If for one subject you can find several different types (lecture, practice, laboratory) of courses then please choose one and only one course from each type in order to be able to perform the subject's requirements successfully.Civil Engineering courses are on the website seperately. Courses chosen from the offer of Faculty of Civil Engineering will be checked and arranged individually by the departmental coordinator.

Subject code	Subject name	Requirement	ECTS credit
BMEVIAUAB00	Software Techniques	Exam	5

Course type	Course code	Course language	Timetable information
Laboratory	AL	English	THU:10:15-12:00
Laboratory	ALE	English	THU:10:15-12:00
Lecture	AE	English	WED:10:15-12:00

https://portal.vik.bme.hu/kepzes/targyak/VIAUAB00/en/

Subject code	Subject name	Requirement	ECTS credit
BMEVIEEAB00	Microelectronics	Exam	5

Course type	Course code	Course language	Timetable information
Laboratory	al2	English	TUE:10:15-12:00
Laboratory	al1	English	WED:10:15-12:00
Lecture	ae	English	MON:14:15-16:00

https://portal.vik.bme.hu/kepzes/targyak/VIEEAB00/en/ The basic goal of the course is to deepen the already acquired knowledge in the field of digital electronics through presenting the latest implementation techniques of digital integrated circuits. Further goals of the subject are to provide information on the basics of analogue integrated circuits, components of power electronics and solid-state lightning. Today’s electronics and IT devices are all based on different special discrete semiconductors and complex integrated circuits. Solid knowledge regarding the structure, operation and manufacturing of these devices is among the necessary skills of today’s electrical engineers including basics of IC design at least on the level which allows effective communication with IC design specialists. They have to know how system level design connects with the IC design as well. Special emphasis is put on the corresponding practical skills through simple case studies (calculation examples) as well as computer laboratory practices where the students get acquainted with the basic steps IC design. An important aspect of the course is to bridge the gap between the operation of abstract electronics components and the physical reality: the major components used in ICs (diodes, transistors, etc.) are discussed in detail. A detour is made towards the MEMS and MOEMS, where electrical operation is combined with mechanical and optical effects.

Subject code	Subject name	Requirement	ECTS credit
BMEVIEEAV99	Solar Cells and Renewable Energy Sources	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	a1	English	TUE:12:15-14:00; THU:12:15-14:00

This course gives a short description of the well-known and generally used renewable energy sources, During the classes the students can get acquainted with socio-economic impacts, basic environment protection principles related to renewable energy sources and are provided with basics of device physics, device construction and manufacturing processes, especially that of solar cells. Besides other renewable energy source the course is focusing on usage of solar energy especially through photo-voltaic devices and the semiconductor aspects of these devices.

Subject code	Subject name	Requirement	ECTS credit
BMEVIHIAA02	Computer Architectures	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EA	English	WED:10:15-12:00
Practice	GA	English	WED:14:15-16:00

https://portal.vik.bme.hu/kepzes/targyak/VIHIAA02/en/

Subject code	Subject name	Requirement	ECTS credit
BMEVIHIAV34	Security and Privacy: an Economic Approach	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	E	English	WED:12:15-14:00

Subject code	Subject name	Requirement	ECTS credit
BMEVIHIAV37	V2X Communication Technologies of Autonomous Vehicles	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EA	English	
Practice	GA	English	

Subject code	Subject name	Requirement	ECTS credit
BMEVIHIAV39	Administrating Computer Networks in Practice I.	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Laboratory	LA2	English	WED:16:15-18:00(IL107)

https://portal.vik.bme.hu/kepzes/targyak/VIHIAV39/en/ The basic objective of "Administrating Computer Networks I." is to introduce the practical administration of computer networks - including network design, installation, and configuration of network devices. This subject gives the basics of "Administration Computer Networks in Practice II." (VIHIAV42) subject, thus providing adequate theoretical and practical knowledge and the way of its direct application. The students who successfully complete also the subject "Administrating Computer Networks II" acquire the knowledge and skills required for the Cisco CCNA (Cisco Certified Network Associate) certification. The certification can be obtained in authorized examination centers, independently from the University education.

Subject code	Subject name	Requirement	ECTS credit
BMEVIHIMA07	Mobile and Wireless Networks	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EA	English	WED:10:15-12:00
Practice	GA	English	THU:10:15-12:00

https://portal.vik.bme.hu/kepzes/targyak/VIHIMA07/en/ The objective of this course is to introduce today’s modern wireless and mobile systems to our students. This contains basic knowledge needed to operate and maintain such networks. Further goal of this course is to show the possibilities and operations of advanced radio and wireless solutions, through practical examples.amp;lt;!-- --amp;gt; amp;lt;!-- /* Font Definitions */ @font-face {font-family:"MS Mincho"; panose-1:2 2 6 9 4 2 5 8 3 4; mso-font-alt:"MS ??"; mso-font-charset:128; mso-generic-font-family:modern; mso-font-pitch:fixed; mso-font-signature:-536870145 1791491579 18 0 131231 0;} @font-face {font-family:"MS Mincho"; panose-1:2 2 6 9 4 2 5 8 3 4; mso-font-alt:"MS ??"; mso-font-charset:128; mso-generic-font-family:modern; mso-font-pitch:fixed; mso-font-signature:-536870145 1791491579 18 0 131231 0;} @font-face {font-family:Cambria; panose-1:2 4 5 3 5 4 6 3 2 4; mso-font-charset:0; mso-generic-font-family:roman; mso-font-pitch:variable; mso-font-signature:-536870145 1073743103 0 0 415 0;} @font-face {font-family:"\@MS Mincho"; panose-1:2 2 6 9 4 2 5 8 3 4; mso-font-charset:128; mso-generic-font-family:modern; mso-font-pitch:fixed; mso-font-signature:-536870145 1791491579 18 0 131231 0;} /* Style Definitions */ p.MsoNormal, li.MsoNormal, div.MsoNormal {mso-style-unhide:no; mso-style-qformat:yes; mso-style-parent:""; margin:0cm; margin-bottom:.0001pt; mso-pagination:widow-orphan; font-size:12.0pt; font-family:"Cambria","serif"; mso-ascii-font-family:Cambria; mso-ascii-theme-font:minor-latin; mso-fareast-font-family:"MS Mincho"; mso-fareast-theme-font:minor-fareast; mso-hansi-font-family:Cambria; mso-hansi-theme-font:minor-latin; mso-bidi-font-family:"Times New Roman"; mso-bidi-theme-font:minor-bidi; mso-ansi-language:EN-US; mso-fareast-language:EN-US;} p.MsoCommentText, li.MsoCommentText, div.MsoCommentText {mso-style-noshow:yes; mso-style-priority:99; mso-style-link:"Jegyzetszöveg Char"; margin:0cm; margin-bottom:.0001pt; mso-pagination:widow-orphan; font-size:12.0pt; font-family:"Cambria","serif"; mso-ascii-font-family:Cambria; mso-ascii-theme-font:minor-latin; mso-fareast-font-family:"MS Mincho"; mso-fareast-theme-font:minor-fareast; mso-hansi-font-family:Cambria; mso-hansi-theme-font:minor-latin; mso-bidi-font-family:"Times New Roman"; mso-bidi-theme-font:minor-bidi; mso-ansi-language:EN-US; mso-fareast-language:EN-US;} span.MsoCommentReference {mso-style-noshow:yes; mso-style-priority:99; mso-ansi-font-size:9.0pt; mso-bidi-font-size:9.0pt;} span.JegyzetszvegChar {mso-style-name:"Jegyzetszöveg Char"; mso-style-noshow:yes; mso-style-priority:99; mso-style-unhide:no; mso-style-locked:yes; mso-style-link:Jegyzetszöveg;} .MsoChpDefault {mso-style-type:export-only; mso-default-props:yes; font-size:12.0pt; mso-ansi-font-size:12.0pt; mso-bidi-font-size:12.0pt; font-family:"Cambria","serif"; mso-ascii-font-family:Cambria; mso-ascii-theme-font:minor-latin; mso-fareast-font-family:"MS Mincho"; mso-fareast-theme-font:minor-fareast; mso-hansi-font-

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Subject code	Subject name	Requirement	ECTS credit
BMEVIHVAA00	Signals and Systems 1	Exam	6

Course type	Course code	Course language	Timetable information
Lecture	EA	English	MON:14:15-16:00; MON:14:15-16:00; TUE:10:15-12:00
Practice	GA	English	FRI:10:15-12:00

https://portal.vik.bme.hu/kepzes/targyak/VIHVAA00/en/ The objective of the two semester Signals and Systems classes is to introduce the basic concepts of signal and system, and to provide computational methodologies to continuous and discrete time systems. The first semester (Signals and Systems I) presents the time domain and the sinusoidal steady state analysis. The examples refer to continuous systems represented by Kirchoff type electric circuits. The principles to formulate the models and the methods to solve the resulting equations are discussed. The students fulfilling the requirements of this class will be able to apply the methodologies of system and network analysis in the time domain and in the frequency domain in case of sinusoidal excitation. Synopsis: 1-2. classes (1. week) Basic concepts: signals, systems and circuits. System properties: linearity, causality and time – invariance. Input – output relationship. Systems represented with electric circuits. Two poles. Kirchhoff type systems. 3-4. classes (2. week) The full set of circuit equations. Series resistors and voltage division. Parallel resistors and current division. The principle of superposition. Node voltage analysis. Mesh current analysis. Source transformations. Maximum power transfer. 5-6. classes (3. week) Coupled two poles: ideal transformer, controlled sources, ideal operational amplifier and gyrator. 7-8. classes (4. week) Two-Port Resistive Networks. Equations of the Two-Port Networks. Reciprocity, symmetry and passivity of the Two-Ports. Equivalent circuits of reciprocal and nonreciprocal Two-Ports. Two-Ports terminated with Two- Poles. Calculation of the input and transfer characteristics. 9-10. classes (5. week) Dynamic circuits. Capacitors, inductors, coupled capacitors and coupled inductors. Circuit equations. Regularity. Initial conditions. State variables. The normal form of the continuous time state equations. Generation of the continuous time state equations from the full set of circuit equations. 11-13. classes (6-7. week) Solution of the continuous time state equations. The natural response and the forced response. First-order circuits. The time constant of first-order circuits. Sequential switching. Second and higher order dynamic systems and circuits. Higher order dynamic circuits with complex or equal eigenvalues. The concept of stability. 14-16. classes (7-8. week) Step function and Dirac delta function. Generalized derivatives. The Step response and Impulse response of dynamic systems. Calculation of linear time invariant dynamic systems response to arbitrary input with convolution. The concept of bounded-input, bounded-output (BIBO) stability. 17-20. classes (9-10. week) Sinusoidal steady state analysis. Phasor notation. The concept of impedances. The methods of circuit analysis with phasors (node voltage and mesh current analysis, source transformations). Resonant circuits, quality factor, Wheatstone-bridge. Coupled inductors (the model of a transformer). Phasor diagrams. AC Steady state power analysis: averaged power, reactive power, complex power, apparent power, power factor. Maximum power transfer. 21-22. classes (11. week) The concept of the Network Function. Logarithmic units and quantities. The Bode- and the Nyquist- diagram. Two-Port Network equations in frequency domain. The scattering parameters of Two-Ports. Interconnection of Two-Ports and equivalent equations. 23-26. classes (12-13. week) Periodic steady state analysis. Fourier series of periodic signals. The trigonometric, the engineering and the complex Fourier series. Calculation of systems response to periodic excitation. Properties of periodic waveforms: definitions and relations to Fourier series. Periodic steady state power analysis. Averaged power calculations based on Fourier series. 27-28. classes (14. week) Summary, auxiliary.

Subject code	Subject name	Requirement	ECTS credit
BMEVIHVAC04	High Frequency System Techniques	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EA	English	THU:10:15-12:00
Practice	GA	English	TUE:14:15-16:00

https://portal.vik.bme.hu/kepzes/targyak/VIHVAC04/en/ The objective of the subject is to give an overview of the fundamental design considerations applied in high frequency systems (extending up to 3 GHz), along with the properties of common analog and digital modulations schemes, including also OFDM.the following major topics are covered: General radio technology: -noise figure, -linearity, compression of amplifiers, intermodulation, passive intermodulation, linear and nonlinear distortions -mixers, superheterodyne principle, (test) receivers and spectrum analyzers Modulations: -AM, FM, PM (waveforms and spectra), analog QAM -single carrier digital modulations (I/Q-signals, xFSK, xQAM, xPSK) -multi carrier (OFDM) systems: orthogonality, guard interval, transmisison cells /* Font Definitions */ @font-face {font-family:Calibri; panose-1:2 15 5 2 2 2 4 3 2 4; mso-font-charset:238; mso-generic-font-family:swiss; mso-font-pitch:variable; mso-font-signature:-

536870145 1073786111 1 0 415 0;} /* Style Definitions */ p.MsoNormal, li.MsoNormal, div.MsoNormal {mso-style-unhide:no; mso-style-qformat:yes; mso-style-parent:""; margin:0cm; margin-bottom:.0001pt; mso-pagination:widow-orphan; font-size:11.0pt; font-family:"Calibri","sans-serif"; mso-ascii-font-family:Calibri; mso-ascii-theme-font:minor-latin; mso-fareast-font-family:Calibri; mso-fareast-theme-font:minor-latin; mso-hansi-font-family:Calibri; mso-hansi-theme-font:minor-latin; mso-bidi-font-family:"Times New Roman"; mso-bidi-theme-font:minor-bidi; mso-fareast-language:EN-US;} p.MsoPlainText, li.MsoPlainText, div.MsoPlainText {mso-style-noshow:yes; mso-style-priority:99; mso-style-link:"Csak szöveg Char"; margin:0cm; margin-bottom:.0001pt; mso-pagination:widow-orphan; font-size:11.0pt; mso-bidi-font-size:10.5pt; font-family:"Calibri","sans-serif"; mso-fareast-font-family:Calibri; mso-fareast-theme-font:minor-latin; mso-bidi-font-family:"Times New Roman"; mso-bidi-theme-font:minor-bidi; mso-fareast-language:EN-US;} span.CsakszvegChar {mso-style-name:"Csak szöveg Char"; mso-style-noshow:yes; mso-style-priority:99; mso-style-unhide:no; mso-style-locked:yes; mso-style-link:"Csak szöveg"; mso-bidi-font-size:10.5pt; font-family:"Calibri","sans-serif"; mso-ascii-font-family:Calibri; mso-hansi-font-family:Calibri;} .MsoChpDefault {mso-style-type:export-only; mso-default-props:yes; font-family:"Calibri","sans-serif"; mso-ascii-font-family:Calibri; mso-ascii-theme-font:minor-latin; mso-fareast-font-family:Calibri; mso-fareast-theme-font:minor-latin; mso-hansi-font-family:Calibri; mso-hansi-theme-font:minor-latin; mso-bidi-font-family:"Times New Roman"; mso-bidi-theme-font:minor-bidi; mso-fareast-language:EN-US;} @page WordSection1 {size:612.0pt 792.0pt; margin:70.85pt 70.85pt 70.85pt 70.85pt; mso-header-margin:35.4pt; mso-footer-margin:35.4pt; mso-paper-source:0;} div.WordSection1 {page:WordSection1;} --> /* Style Definitions */ table.MsoNormalTable {mso-style-name:"Normál táblázat"; mso-tstyle-rowband-size:0; mso-tstyle-colband-size:0; mso-style-noshow:yes; mso-style-priority:99; mso-style-parent:""; mso-padding-alt:0cm 5.4pt 0cm 5.4pt; mso-para-margin:0cm; mso-para-margin-bottom:.0001pt; mso-pagination:widow-orphan; font-size:11.0pt; font-family:"Calibri","sans-serif"; mso-ascii-font-family:Calibri; mso-ascii-

Subject code	Subject name	Requirement	ECTS credit
BMEVIHVAC06	Radio Systems and Applications Laboratory	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Laboratory	LA	English	WED:14:15-18:00

https://portal.vik.bme.hu/kepzes/targyak/VIHVAC06/en/ The objective of the laboratory is to perform practical experiments related to the topics presented in the subject "High Frequency System Techniques". Besides basic exercises, the measurements focus on demonstrating the theoretical notions on the examples of live practical systems. The following topics are covered: -analog FM systems (mono and stereo broadcasting systems, including RDS as well) -analog TV (optional) - DAB/DAB+, DVB-T/T2/C2, DVB-S/S2/C systems (stream generation, transmission and reception techniques) -digital measurement technology (MER/EVM, CCDF, constellation anlysis, channel analysis, CIR, MER/EVM spectra) /* Font Definitions */ @font-face {font-family:Calibri; panose-1:2 15 5 2 2 2 4 3 2 4; mso-font-charset:238; mso-generic-font-family:swiss; mso-font-pitch:variable; mso-font-signature:-536870145 1073786111 1 0 415 0;} /* Style Definitions */ p.MsoNormal, li.MsoNormal, div.MsoNormal {mso-style-unhide:no; mso-style-qformat:yes; mso-style-parent:""; margin:0cm; margin-bottom:.0001pt; mso-pagination:widow-orphan; font-size:11.0pt; font-family:"Calibri","sans-serif"; mso-ascii-font-family:Calibri; mso-ascii-theme-font:minor-latin; mso-fareast-font-family:Calibri; mso-fareast-theme-font:minor-latin; mso-hansi-font-family:Calibri; mso-hansi-theme-font:minor-latin; mso-bidi-font-family:"Times New Roman"; mso-bidi-theme-font:minor-bidi; mso-fareast-language:EN-US;} p.MsoPlainText, li.MsoPlainText, div.MsoPlainText {mso-style-noshow:yes; mso-style-priority:99; mso-style-link:"Csak szöveg Char"; margin:0cm; margin-bottom:.0001pt; mso-pagination:widow-orphan; font-size:11.0pt; mso-bidi-font-size:10.5pt; font-family:"Calibri","sans-serif"; mso-fareast-font-family:Calibri; mso-fareast-theme-font:minor-latin; mso-bidi-font-family:"Times New Roman"; mso-bidi-theme-font:minor-bidi; mso-fareast-language:EN-US;} span.CsakszvegChar {mso-style-name:"Csak szöveg Char"; mso-style-noshow:yes; mso-style-priority:99; mso-style-unhide:no; mso-style-locked:yes; mso-style-link:"Csak szöveg"; mso-bidi-font-size:10.5pt; font-family:"Calibri","sans-serif"; mso-ascii-font-family:Calibri; mso-hansi-font-family:Calibri;} .MsoChpDefault {mso-style-type:export-only; mso-default-props:yes; font-family:"Calibri","sans-serif"; mso-ascii-font-family:Calibri; mso-ascii-theme-font:minor-latin; mso-fareast-font-family:Calibri; mso-fareast-theme-font:minor-latin; mso-hansi-font-family:Calibri; mso-hansi-theme-font:minor-latin; mso-bidi-font-family:"Times New Roman"; mso-bidi-theme-font:minor-bidi; mso-fareast-language:EN-US;} @page WordSection1 {size:612.0pt 792.0pt; margin:70.85pt 70.85pt 70.85pt 70.85pt; mso-header-margin:35.4pt; mso-footer-margin:35.4pt; mso-paper-source:0;} div.WordSection1 {page:WordSection1;} --> /* Style Definitions */ table.MsoNormalTable {mso-style-name:"Normál táblázat"; mso-tstyle-rowband-size:0; mso-tstyle-colband-size:0; mso-style-noshow:yes; mso-style-priority:99; mso-style-parent:""; mso-padding-alt:0cm 5.4pt 0cm 5.4pt; mso-para-margin:0cm; mso-para-margin-bottom:.0001pt; mso-pagination:widow-orphan; font-size:11.0pt; font-family:"Calibri","sans-serif"; mso-ascii-font-family:Calibri; mso-ascii-theme-font:minor-latin; mso-hansi-font-family:Calibri; mso-hansi-theme-font:minor-latin; mso-

Subject code	Subject name	Requirement	ECTS credit
BMEVIHVAV09	Windows Native Programming	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Laboratory	LA	English	THU:12:15-14:00

Microsoft Windows is one of the best known operating systems for PCs. Writing applications for this system requires special programming knowledge, supported by different programming languages and platforms. This subject introduces to native mode programming for Microsoft Windows using the Win32 API (Application Programming Interface) and offers to extend the theoretical and practical knowledge of the students in visualizing, data processing, data communications, etc. The subject provides also the basics of WinRT (Windows Runtime Library) that is supported with Windows 8, and the later UWP (Universal Windows Platform) that has several new functionalities similar to Win32 API but using C++ language. An overview is also gives basic skills in driver development the earlier DDK (Windows Driver Development Kit) and the actual WDK (Windows Driver Kit) /* Style Definitions */ table.MsoNormalTable {mso-style-name:"Normál táblázat"; mso-tstyle-rowband-size:0; mso-tstyle-colband-size:0; mso-style-noshow:yes; mso-style-priority:99; mso-style-parent:""; mso-padding-alt:0cm 5.4pt 0cm 5.4pt; mso-para-margin:0cm; mso-para-margin-bottom:.0001pt; mso-pagination:widow-orphan; font-size:10.0pt; font-family:"Times New Roman","serif";}

Subject code	Subject name	Requirement	ECTS credit
BMEVIHVMA01	Broadband Wireless Telecommunication and Broadcasting Systems	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EA	English	MON:14:15-16:00
Practice	GA	English	WED:08:15-10:00

https://portal.vik.bme.hu/kepzes/targyak/VIHVMA01/en/

Subject code	Subject name	Requirement	ECTS credit
BMEVIHVMA05	Optical Networks Elements	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EA	English	MON:10:15-12:00
Practice	GA	English	THU:10:15-12:00

https://portal.vik.bme.hu/kepzes/targyak/VIHVMA05/en/

Subject code	Subject name	Requirement	ECTS credit
BMEVIHVMA07	Communication Theory	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	EA	English	WED:14:15-17:00

https://portal.vik.bme.hu/kepzes/targyak/VIHVMA07/en/

Subject code	Subject name	Requirement	ECTS credit
BMEVIMIAB01	Measurement Technology	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Lecture	EA	English	THU:14:15-17:00
Practice	GA	English	FRI:14:15-16:00

https://portal.vik.bme.hu/kepzes/targyak/VIMIAB01/en/ The aim of the subject is to give insight into metrology, measurement theory, measurement technology and instrumentation. Besides the theoretical aspects, the course also prepares students for laboratory practices. Model building and problem solving skills of the students are developed. The subject focuses on the measurement of electrical quantities but emphasizes the analogies with non-electrical problems.

Subject code	Subject name	Requirement	ECTS credit
BMEVIMIMA07	Formal Methods	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	EA	English	MON:14:15-17:00

https://portal.vik.bme.hu/kepzes/targyak/VIMIMA07/en/ As the complexity of information systems and the costs of their potential failures are increasing, it becomes more and more important to prove that the design of the critical system components is correct. One of the typical solutions for the challenge of provably correct design is the application of formal methods. Mathematically precise formal models allow the unambiguous specification of requirements and construction of designs; formal verification allows the checking of design decisions and proof of design properties; while the verified models allow automated software synthesis. The subject provides an overview of the formal background needed for the elaboration and analysis of the formal models of IT components and systems: the modelling paradigms, the widely used formal modelling languages, and the related verification and validation techniques. The subject demonstrates the application of formal methods in the field of requirement

specification, system and software design, model based verification and source code synthesis.

Subject code	Subject name	Requirement	ECTS credit
BMEVIMIMA09	Software Technology for Embedded Systems	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EA	English	MON:16:15-18:00
Practice	GA	English	THU:14:15-16:00

https://portal.vik.bme.hu/kepzes/targyak/VIMIMA09/en/ The subject introduces the students to the modern technologies used in developing embedded software for better software quality. The introduction is both theoretical and practical. The subject shows why modern embedded software systems are complex, it lists the consequences of complexity, and details how we handle complexity in this context, and how we define and increase software quality.The subject then iterate through the modern solutions available to keep control over the software development process, and how we can increase software quality. These modern solutions are introduced, and its properties are investigate using both a theoretical and a practical approach by programming examples.

Subject code	Subject name	Requirement	ECTS credit
BMEVIMIMA17	Measurement Theory	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	EA	English	TUE:14:15-17:00

https://portal.vik.bme.hu/kepzes/targyak/VIMIMA17/en/ The subject discusses the theoretical background as well as the qualitative and quantitative characterization of the engineering methods used for studying the physical world around. It gives an overview of the basic methods of signal and system theory, estimation and decision theory, as well as of the most important data- and signal processing algorithms. The main goal of the subject is to show how different tasks such as complex measurement problems, modelling and information processing problems, etc. can be solved using this theoretical background. From the students absolving this subject it can be expected that they are familiar with the: (1) role of modelling and measurements in different learning processes; (2) concepts of signal and systems theory, and that of the decision and estimation theory;(3) basic methods of identification, adaptation and optimization, with special emphasis on recursive techniques; (4) basics of information processing in supervisory systems; (5) requirements of intelligent measurement and information processing systems.

Subject code	Subject name	Requirement	ECTS credit
BMEVITMAB01	Communication Networks II.	Exam	4

Course type	Course code	Course language	Timetable information
Laboratory	ALER	English	MON:14:15-18:00
Lecture	AER	English	MON:12:15-14:00

https://portal.vik.bme.hu/kepzes/targyak/VITMAB01/en/To provide both theoretical and practical knowledge about communication networks, especially about telecommunication networks. Starting from the classical telephony networks, through mobile (cell) phone systems and IP access networks, to high speed backbones, the students of this course will get acquainted with the architecture of these networks, along with their main building blocks as well as the communication protocols they apply. This course, in accordance with Communication Networks 1, aims to provide strong foundation for the relevant specialization courses. Synopsis: Introduction to the course Basics Overview of telephony networks Analog and digital speech transfer Architecture of telephony switches Wired IP access networks Digital subscriber loops (xDSL) Cable television Internet access Optical access networks Voice over IP (VoIP) speech codecs, SIP and H.323 protocols 3play services: Video on Demand, IPTV, etc. Mobile telephony networks overview, GSM, UMTS, HSPA, LTE, satellite telephony systems Signaling Backbone network technologies MPLS and its extensions, optical wavelength- and waveband switching Outlook: Peer-to-peer, AdHoc networks, Machine to machine communication – Internet of Things The lectures are accompanied by laboratory measurements: 3 measurements, each 4x45 minutes, allowing the students to exercise with some of the technologies discussed above (e.g. VoIP, DSL, telephony switches).

Subject code	Subject name	Requirement	ECTS credit
BMEVITMAC02	Information Systems Management	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Laboratory	AL1	English	WED:14:15-18:00
Lecture	AE1	English	MON:10:15-12:00

https://portal.vik.bme.hu/kepzes/targyak/VITMAC02/en/

Subject code	Subject name	Requirement	ECTS credit
BMEVITMAK47	Engineering Management Methods	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	AE1	English	THU:14:15-16:00(IE220)

Engineer as a leader (situations and solution): role of informaticians and electrical engineers in the information based society. General trends, business models and the development of value chains. Leader roles, leader tasks

and situations. Management of IT based, communication related and business functions in a company. Complex engineering methods in the information transmission and processing, technological and economical optimization of the related processes. Management problems of resource and time allocation, task distribution and scheduling, and workforce placement. Decision preparation techniques: statistical and heuristics based methodologies.Innovation management: tools of innovation management, institutions of innovation management, funding models and typical calls for applications. Organizations of scientific research and technology development, business models of spin-off companies. Conception of technological visions about the future, ways to identify technological breakthroughs, management of generation changes. The process of standardization, its organization and its consequences on technological markets. Intellectual property rights during the innovation process: protection of technical creations, neighboring rights, protection of databases. New trends in IP rights: free software licensing models. Processes of product development and product introduction to the market, market study and marketing methodology. The role of IT technologies in the product and business development, their contribution to the value creation.
https://portal.vik.bme.hu/kepzes/targyak/VITMAK47/en/

Subject code	Subject name	Requirement	ECTS credit
BMEVITMMA01	Agile Network Service Development	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	AE1	English	TUE:10:15-12:00
Practice	AG1	English	THU:08:15-10:00

https://portal.vik.bme.hu/kepzes/targyak/VITMMA01/en/

Subject code	Subject name	Requirement	ECTS credit
BMEVITMMA09	Sensor Networks and Applications	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	AER	English	MON:10:15-12:00
Practice	AGER	English	THU:10:15-12:00

https://portal.vik.bme.hu/kepzes/targyak/VITMMA09/en/

Subject code	Subject name	Requirement	ECTS credit
BMEVITMMB03	Engineering Management	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	AE1	English	FRI:08:15-12:00

Engineering management (EM) in the knowledge-based society. Definition, role and areas of the EM. The evolution of the EM discipline. Peculiarities, generic trends and EM of the information, communication and electronic media technologies (ICT). Managerial elements of the engineering activity. Components and principles of the managerial activity. Managerial situations, methods and tools. Strategic management. Strategy types and parts. Business strategic planning methods. Classes of competitive strategies. Implementation of strategy: success factors, progress tracing. Methods of the strategic direction and control. Complex engineering decision problems, customer-oriented and systemic approaches, solutions, procedures. Planning and allocation of resources, multi-project management. Management of organizations. Organization types in the ICT sector. Lifecycle, decision culture of organizations, change management. Managing cooperation of organizations, complex working groups. Knowledge management. Knowledge process: accumulation, internalization, adaptation, externalization. Competence. Knowledge sharing and transfer. Knowledge based systems. Types of the intellectual property, principles of intellectual property rights. Open access software. Exploitation of the intellectual properties. Intellectual public utilities. ICT specific EM. Technology management. Technological planning, forecast, transfer, launching, change. Making technology vision, analyzing driving forces, scenarios. Technology-driven business strategies. Corporate ICT functions. Application of the ICT in shaping new business strategies, global work-flows, efficient organization structures. Innovation management. Goals of research, development and innovation. Innovation models and metrics. Management of the innovation process, quality and risks. Innovation chain: university-industry partnership, role of the government. Multi-tier organization and operation of the research-development-innovation management. Innovation financing. National and EU sources, grants, funds, tenders. Development projects. Technological incubators, innovation centers, start-up companies, technological consortia in the ICT sector. Product management. Goals and process of the product development. Markets of the ICT products and services. Market players, competitive environment. Market segmentation. Life-cycle of the product, and its management. Product pricing, price-sensitivity of the customers. Market-research, sale and sale-support methods. Business process management. Analyzing, planning, regulating, improving and transforming corporate business process. Criteria of the process-based management systems. Methods for developing processes. IT in the corporate value creation. Customer relationship management (CRM), operation support systems, supply chain management, business continuity management. Special business functions (e.g. billing), industry-specific systems, IT system architecture of telecommunication service providers. Regulatory environment. Sector regulation. Goals and principles of the regulation in general and in the networked and public service sectors. Competition regulation, consumer protection. Regulatory institutions and procedures, ex-ante and ex-post regulation, self-regulation, public hearing, standards. Regulation of the information and communication technologies and markets. Technology and marker regulatory models in the ICT sector. Regulatory tasks for deploying the convergence of the telecommunications, information and media technology sectors. Community and national

regulation of the electronic communications network and services. Framework and specific directives. Rules for the cooperation of the network operators and service providers. Regulation for managing scarce resources, frequency, number and address management. Concept for regulating information security, data protection and content.https://portal.vik.bme.hu/kepzes/targyak/VITMMB03/en/

Faculty of Mechanical Engineering

IMPORTANT NOTES

If for one subject you can find several different types (lecture, practice, laboratory) of courses then please choose one and only one course from each type in order to be able to perform the subject's requirements successfully.Civil Engineering courses are on the website seperately. Courses chosen from the offer of Faculty of Civil Engineering will be checked and arranged individually by the departmental coordinator.

Subject code	Subject name	Requirement	ECTS credit
BMEGEENBGHK	Heat Transfer G	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	22-2-DEU-E	German	
Practice	22-2-DEU-G	German	

Subject code	Subject name	Requirement	ECTS credit
BMEGEENBGKG	Heat Engines G	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	22-2-ENG-E	English	WED:12:15-14:00(KF81)
Practice	22-2-ENG-G1	English	WED:14:15-16:00(D318)

The course aims to give a general overview about operation of equipmentsbased on thermodynamical cycles and shows how real processes arerunning inside these equipments. Basics of combustion technology will be introduced also, because in most of the cases heat is gained from combustion. A lot of everyday life energy utilization procedure or system operation is made understandable e.g. principals of firing from camp-fires or domestic heaters to power station boilers, operation principals of air-conditioning, heat pump, steam- and gas-turbine internal combustion engine. Environmental effects and pollution if any will be introduced as well..Knowledge competence s: The students will... Understand basic principals of combustion technology. Identify pollutants and reduction possibilities generated during combustion processes. Be aware of processes running in domestic and industrial boilers. Informed about design and energy flow principals of impulse stage turbines. Familiar with design and energy flow principals of reaction stage turbines. Has knowledge about design principals of compressors, turbines and combustion chambers of industrial gas turbines. Familiar with main features and design principals of aviation gas turbines. Describe energy transformation procedures in gas turbines. Has basic knowledge about design and process principals of spark and compression ignition engines. Familiar with operation principals of vapor compression cooling. Skill competence, The students will be able to… Identify combustion processes flowing in real fired equipments. Describe real systems with abstract thermodynamical models. Calculate with mathematical models process values of thermodynamical systems. Identify thermodynamical processes in thermodynamical charts. Handle complex thermodynamical procedures of real equipment. Analyze theoretical and practical backgrounds of real energy transformation processes. Apply learnt procedures to be able to follow real processes. Evaluate operational parameters of real energy related equipments. Can compute complex procedures by means of knowledge in informatics. Is able to interpret own ideas both in oral and written form. Attitude competences: The students…. Initiate cooperation with the teacher and other students. Broaden the knowledge with continues collection of informations. Open for utilisation of possibilities provided by information technology. Improve engineering tool sets applicable for problem solving related to heat engines. Follow accurate and errorless solving of process related problems. Broaden energy efficiency measures in connection with heat engines. Support environmental protection measures in connection with heat engines and energy related processes.Autonomy and responsibility competences: The students... Individually committed process follow and problem solving of thermodynamical problems by given methods. Accept reviews and critical comments related to his/her work. Cooperative with his/her team mates during solving processes. Implement systematization in his/her mind and in problem solving. Takes reponsibility for own performance by both individual and team work.

Subject code	Subject name	Requirement	ECTS credit
BMEGEENBGTD	Engineering Thermodynamics G	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	22-2-ENG-E	English	
Practice	22-2-ENG-G2	English	
Practice	22-2-ENG-G1	English	

Subject code	Subject name	Requirement	ECTS credit
BMEGEENMLCA	LCA of Power Generation Systems	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Laboratory	22-2-ENG-LAB	English	
Lecture	22-2-ENG-E	English	

Subject code	Subject name	Requirement	ECTS credit
BMEGEENMWDA	Final project A	Mid-semester mark	15

Course type	Course code	Course language	Timetable information
Practice	22-2-ENG-G	English	

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.

Subject code	Subject name	Requirement	ECTS credit
BMEGEENMWDB	Final project B	Mid-semester mark	15

Course type	Course code	Course language	Timetable information
Practice	22-2-ENG-G	English	

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.

Subject code	Subject name	Requirement	ECTS credit
BMEGEENMWPR	Teamwork project	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	22-2-ENG-LAB	English	

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEENNWAT	Advanced Thermodynamics	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	22-2-ENG-E	English	TUE:10:15-12:00(KF87)
Practice	22-2-ENG-G2	English	THU:08:15-10:00(D224)
Practice	22-2-ENG-G1	English	THU:08:15-10:00(D224)

Subject code	Subject name	Requirement	ECTS credit
BMEGEENNWCO	Combustion	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Lecture	22-2-ENG-E	English	MON:10:15-12:00(D318)
Practice	22-2-ENG-G	English	TUE:12:15-14:00(KF84)

Important note: According to the rules, any MSc student can be enrolled. However, this subject strongly builds on your existing Fluid dynamics, Thermodynamics, and Heat transfer knowledge. Completion of Heat engines is recommended. CONTENTS This subject is discussing combustion from both fundamental (first half of the semester) and practical point of views (second half of the semester). 1. Introduction, administration. State-of-the-art devices and technologies. Gross reactions. 2. Flame stabilization, fluid dynamics, and non-dimensional numbers. 3. Reaction pathways and pollutant formation. 4. Fuel properties in general. 5. Gaseous, liquid, and solid fuels. 6. Fuel evaporation. 7. Midterm exam 1. 8. Combustion modes and turbulence. 9. Combustion safety and control. 10. Free jet and gas burners. 11. Atomization and liquid fuel burners. 12. Solid fuel burners. 13. Modern combustion chambers. 14. Midterm exam II. REQUIREMENTS 2 midterm exams 1 project/homework

Subject code	Subject name	Requirement	ECTS credit
BMEGEENNWTP	Thermal Physics	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	22-2-ENG-LAB	English	THU:17:15-18:00(D216)
Lecture	22-2-ENG-E	English	THU:16:15-17:00(D216)

Subject code	Subject name	Requirement	ECTS credit
BMEGEGIBGG2	Machine elements 2.	Exam	6

Course type	Course code	Course language	Timetable information
Laboratory	AL2	English	MON:15:15-16:00(R112)
Laboratory	AL1	English	MON:15:15-16:00(R111)
Laboratory	AL3	English	
Lecture	A_EA	English	THU:11:15-14:00(R113)
Practice	AG2	English	MON:14:15-15:00(R112)
Practice	AG3	English	
Practice	AG1	English	MON:14:15-15:00(R111)

Subject code	Subject name	Requirement	ECTS credit
BMEGEGIBXCA	Introduction to cad	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Laboratory	AL2	English	WED:12:15-14:00(D303)
Laboratory	AL3	English	
Laboratory	AL1	English	WED:12:15-14:00(R110,R109)
Lecture	A_EA	English	MON:08:15-10:00

Subject code	Subject name	Requirement	ECTS credit
BMEGEGTAG92	Machine tools and manufacturing systems	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	1	English	FRI:10:15-12:00(T47)

Subject code	Subject name	Requirement	ECTS credit
BMEGEGTBG01	Manufacturing	Exam	5

Course type	Course code	Course language	Timetable information
Laboratory	A2	English	THU:16:15-18:00
Lecture	A0	English	THU:14:15-16:00(G113)
Practice	A1	English	THU:14:15-16:00(G113)

Subject code	Subject name	Requirement	ECTS credit
BMEGEGTNWAM	Advanced Manufacturing	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Laboratory	A2	English	FRI:09:15-12:00(G116)
Lecture	A1	English	FRI:08:15-09:00(G116)

Subject code	Subject name	Requirement	ECTS credit
BMEGEPTAGE1	Composites technology	Exam	4

Course type	Course code	Course language	Timetable information
Laboratory	L_ERASMUS	English	MON:14:15-16:00(MT_PTLAB)
Lecture	E_ERASMUS	English	MON:10:15-12:00(T200)

Main objective is 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. 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.

Subject code	Subject name	Requirement	ECTS credit
BMEGEPTBG01	Polymer Materials Science and Engineering	Exam	6

Course type	Course code	Course language	Timetable information
Laboratory	L_ERASMUS	English	FRI:08:15-10:00(MT_PTLAB)
Lecture	E_ERASMUS	English	WED:08:15-10:00(KF82); THU:08:15-10:00(KF82); THU:08:15-10:00(KF82)

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGA4SD	BSc Final Project	Mid-semester mark	15

Course type	Course code	Course language	Timetable information
Practice	AnGy_a	English	

http://www.hds.bme.hu/oktatas.php?sm=1amp;lang=EN One-semester long individual project work. 10 hours/15 credits. * VG in the code stand for the supervising Department of Hydrodynamic Systems.

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGBG06	Individual project 1.	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Laboratory	AnL-EGR	English	
Laboratory	AnL-HDR	English	
Laboratory	AnL-ARA	English	

http://www.hds.bme.hu/oktatas.php?sm=1amp;lang=EN Independent Study 1 BMEGEVGAG06 One-semester long individual project work. 4 hours/4 credits.

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGBKSD	Final project	Mid-semester mark	15

Course type	Course code	Course language	Timetable information
Practice	AnGy	English	

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGBKSZ	Summer Internship	Signature	0

Course type	Course code	Course language	Timetable information
Practice	AnGy	English	

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGBV08	Individual project 2.	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	AnL	English	

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGBX01	Fluid Machinery	Exam	4

Course type	Course code	Course language	Timetable information
Laboratory	AnLpar	English	FRI:08:15-10:00(L-HIDROLAB)
Laboratory	AnLlan	English	FRI:08:15-10:00(L-HIDROLAB)
Lecture	AnE	English	WED:08:15-10:00(KF84)
Practice	AnGylan	English	FRI:08:15-10:00(KF85)

Practice	AnGypar	English	FRI:08:15-10:00(KF85)
http://www.hds.bme.hu/oktatas.php?sm=1amp;lang=EN			

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGBX14	Analysis of technical and economical data	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	AnL2	English	TUE:12:15-14:00
Laboratory	AnL1	English	TUE:12:15-14:00
Lecture	AnE	English	TUE:10:15-12:00(KF82)

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGNKDA	Master Thesis Project A	Mid-semester mark	15

Course type	Course code	Course language	Timetable information
Practice	AnGy	English	

http://www.hds.bme.hu/oktatas.php?sm=1amp;lang=EN

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGNKDB	Master Thesis Project B	Mid-semester mark	15

Course type	Course code	Course language	Timetable information
Practice	AnGy	English	

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGNW21	Unsteady Flow in Pipe Networks	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	AnE	English	TUE:10:15-11:00(D327)
Practice	AnGy	English	TUE:11:15-12:00(D327)

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGNWPR	Teamwork Project	Mid-semester mark	6

Course type	Course code	Course language	Timetable information
Laboratory	AnL	English	

Faculty of Natural Sciences

IMPORTANT NOTES

If for one subject you can find several different types (lecture, practice, laboratory) of courses then please choose one and only one course from each type in order to be able to perform the subject's requirements successfully.Civil Engineering courses are on the website seperately. Courses chosen from the offer of Faculty of Civil Engineering will be checked and arranged individually by the departmental coordinator.

Subject code	Subject name	Requirement	ECTS credit
BMETE119779	MATLAB Programming	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	E1	English	TUE:12:15-14:00(F3213)

MATLAB programming course (2020 / spring) Educator: Gabor Varga PhD, Associate Professor, Department of Physics, BUTE E-mail: vargag@phy.bme.hu Course frequency: 2-hour/week LAB work near the computer using MATLAB Semester duration: 14 weeks Semester requirement and mark: 90 minutes test at the end of semester: writing a MATLAB code for a given algorithm (100 point) and semester project (100 points) Marks: 0-79 failed (1), 80-109 poor (2), 110-139 average (3), 140-169 good (4), 170-200 excellent (5) Thematics: 1. MATLAB environment and programming: matrix operations, basics of linear algebra, rendering of one-, two- and three-dimensional functions, printing, file operation, control commands, graphical user interface (GUI). Basics of object-oriented programming. 2. MATLAB data types and operations: matrices, arrays, structure, cell, character, string, logical 3. Get skill in MATLAB programming by writing numerical algorithms of derivation, integral and ordinary differential equations. Debugging of MATLAB programs. 4. Program design and writing within the semester project: core of numerical solver, handling of file input/output, character and graphical based user interface. 5. Program testing. Validation of MATLAB code and simulation. Optimization of speed and memory. 6. Scientific style program documentation. Inserting help and demo in MATLAB code of semester project. 7. Short presentation of semester project.

Subject code	Subject name	Requirement	ECTS credit
BMETE11AX14	Nobel Prize Physics in Everyday Application	Exam	2

Course type	Course code	Course language	Timetable information
Lecture	T0	English	TUE:14:15-16:00

Scope: The amazing and explosive development of technology is our everyday experience in various fields of life from informatics and medicine. It is less well known how this development is supported by scientific research. As an example a notebook computer applies numerous Nobel Prize awarded ideas, like the integrated circuits (2000), semiconducting laser (2000), liquid crystal display (1991), CCD camera (2009), GMR sensor of the hard disk (2007) and several further achievements from earlier days of quantum mechanics and solid state physics. The course is intended to give insight to a range of amazing everyday applications that are related to various Nobel Prizes with a special focus on recent achievements. The topics below are reviewed at a simplified level building on high school knowledge of physics. Syllabus:- Textbook applications from the early days of Nobel prizes: wireless broadcasting, X-rays, radioactivity, etc.- Optics in everyday application: lasers, CCD cameras, optical fibers, liquid crystal displays, holography- Quantum physics: from atom models to quantum communication- Measurements with utmost precision: application of Einstein's theory of relativity in GPS systems, atomic clocks, Michelson interferometry, etc.- Nuclear technology from power plants to medical and archeological applications- Advanced physics in medicine: magnetic resonance imaging, computer tomography and positron emission tomography- Semiconductors from the first transistor to mobile communication- Fundamental tools of nanotechnology (scanning probe microscopes, electron beam lithography, etc)- Spintronics from the discovery of electron spin to everyday application in data storage devices- Exotic states of solids in everyday application: superconducting magnets and levitated trains- Towards quot;all carbon electronicsquot;: envisioned and already realized applications of graphene

Subject code	Subject name	Requirement	ECTS credit
BMETE11AX22	Physics 2	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	VN0	German	
Lecture	VE0	English	TUE:12:15-14:00
Practice	VN1	German	
Practice	VE1	English	TUE:14:15-16:00

Elektrodynamics: Faradayrsquo;s law. Self induction, mutual induction. Magnetic properties of materials. Magnetic data storage. Maxwell equations. Generation, propagation and reflection of electromagnetic waves. Basics of geometrical optics. Wave optics, interference, diffraction. Polarized light. Basics of atomic Physics: Natural and coherent light sources. Physical foundations of optical communication. Matter waves of de Broglie. The

Schrouml;dinger equation. The electron structure of atoms. Electron spin. Free-electron theory of metals. Band structure of solids. Superconduction. Quantum-mechanical phenomena in modern electronics. Basics of nuclear physics. Nuclear reactors. Elementary particles. Curiosities in cosmology. Fundamentals of the physics of the atomic kernel, elementary particles, selected topics in cosmology.

Subject code	Subject name	Requirement	ECTS credit
BMETE11AX24	Physics 2i	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	IN0	German	
Lecture	IT0	English	TUE:12:15-14:00
Lecture	IE0	English	TUE:12:15-14:00
Practice	IT1	English	TUE:14:15-16:00
Practice	IE1	English	TUE:14:15-16:00
Practice	IN1	German	

ELECTRIC FIELDS: Electric charges. Coulomb's law. Coulomb's constant and the dielectric constant. Electric field. Electric field of a point charge, a dipole, a group of charges, continuous charge distributions. Electric field lines. GAUSS' LAW: Electric flux. Gauss' law. Applications for charge distributions having a large degree of symmetry. Conductors in electrostatic equilibrium. ELECTRIC POTENTIAL: Potential energy associated with the electrostatic force. Electric potential difference (voltage) and electric potential. Equipotential surfaces. The electric potential of a point charge, a group of charges, a continuous charge distribution. Mathematical relationship between the electric field vector and the electric potential. Charged conductors in electrostatic equilibrium. CAPACITANCE AND DIELECTRICS: Capacitance. Parallel plate capacitor, cylindrical capacitor, spherical capacitor. Parallel and series combination of capacitors. Energy stored in a charged capacitor. The electric dipole in an external electric field: torque, potential energy. Dielectrics. Atomic dipole moments and the polarization vector. Electric susceptibility, relative dielectric constant. The electric displacement vector. Boundary conditions for the electric field vector and the displacement vector. Energy density of the electric field. CURRENT AND RESISTANCE, DIRECT CURRENT CIRCUITS: Electric current. Current density. Ohm's law. resistivity, conductivity, resistance. Power supplied by a battery. Power dissipated in a resistor. Parallel and series combination of resistors. Kirchhoff's rules. RC circuits: charging and discharging a capacitor. MAGNETIC FIELDS. SOURCES OF THE MAGNETIC FIELD: Magnetism. Magnetic field. Magnetic force on a moving charge. Applications: cyclotron, velocity selector. Magnetic force on a current-carrying conductor. Torque on a current loop. The magnetic dipole. The magnetic field strength. The permeability of free space. Analogy between electricity and magnetism (electricity: acts on charges, is created by charges; magnetism: acts on moving charges, is created by moving charges). The Biot-Savart law and some of its applications. Magnetic force between two parallel conductors. The paradoxical nature of the force acting on a moving charge (resolution of the paradox using special relativity). Ampere's law. Applications for a long straight wire and a solenoid. The magnetic flux. Gauss' law in magnetism. The displacement current and the general form of Ampere's law. Magnetism in matter. The magnetization vector. Ferromagnetism, paramagnetism, diamagnetism. Boundary conditions for the magnetic field and the magnetic field strength. FARADAY'S LAW: Faraday's law of induction. Motional emf: a straight conductor moving through a perpendicular magnetic field; emf induced in a rotating bar. Lenz's law. Induced emf and the associated nonconservative electric field. Eddy currents. Maxwell's four equations in integral and differential form. Electromagnetic waves. INDUCTANCE: Self-induction. Self-inductance. RL circuits. Energy stored in an inductor. The energy density of the magnetic field. Mutual inductance. Oscillations in an LC circuit. The RLC series circuit. LIGHT AND OPTICS: Measurements of the speed of light (Roemer, Fizeau). Geometric optics, ray approximation. Reflection. Refraction and Snell's law. Total internal reflection. Huygens' principle. Fermat's principle. Dispersion. INTERFERENCE OF LIGHT WAVES: Spatial and temporal coherence. Young's double slit experiment, the intensity distribution on the screen. Phasor addition of waves. Generalization for N slits. Interference in thin films. Newton's rings. The Michelson interferometer. DIFFRACTION AND POLARIZATION: Fraunhofer diffraction on a single slit, the intensity distribution on the screen. Resolution of a single slit and a circular aperture. Rayleigh's criterion. Diffraction grating. The spectral resolving power of a grating. X-ray diffraction in crystals, the Laue condition. Fresnel zones. Zone plates and phase Fresnel lenses. Polarization of light waves: elliptical, linear, circular polarization. Polarization by selective absorption, reflection (Brewster's law), birefringence, scattering. Optical activity. LASERS AND HOLOGRAPHY: Interaction between light and matter: spontaneous emission, stimulated emission, absorption. Light amplification by population inversion. Resonators. 3-level and 4-level optical pumping. Electrical pumping. Laser types (solid-state, gas, liquid, semiconductor). Properties of laser beams. The basic idea of holography and its difference from conventional photography. Applications of holography. INTRODUCTION TO QUANTUM PHYSICS: Blackbody radiation and Planck's hypothesis. The photoelectric effect. The Compton scattering. Atomic spectra of low pressure gases. Bohr's quantum model of the hydrogen atom. QUANTUM MECHANICS: Wave properties of particles, de Broglie's hypothesis. The double slit experiment with massive particles. The wave function. The uncertainty principle. Particle in a 1D box. The Schrouml;dinger equation. Particle in a well of finite height. Tunneling and its applications. The simple harmonic oscillator.

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF04	Seminar RP2	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Practice	T1	English	

In this seminar course, each student will process, and give a presentation about, a selected topic in modern physics. Knowledge of classical physics (mechanics, electromagnetism, thermodynamics, statistical physics) as well as basics of modern physics (quantum mechanics, quantum solid-state physics, special relativity) is essential.

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF06	Seminar RP4	Signature	0

Course type	Course code	Course language	Timetable information
Practice	T1	English	

In this seminar course, each student will process, and give a presentation about, a selected topic in modern physics. Knowledge of classical physics (mechanics, electromagnetism, thermodynamics, statistical physics) as well as basics of modern physics (quantum mechanics, quantum solid-state physics, special relativity) is essential.

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF07	Independent Laboratory RP1	Mid-semester mark	7

Course type	Course code	Course language	Timetable information
Laboratory	E1	English	

The student must have chosen a diploma work topic before registering to this course. The student performs research tasks related to the diploma work topic during the semester, under the guidance of the thesis advisor.

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF12	Group Theory in Solid State Research	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	T0	English	THU:14:15-16:00

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.

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF25	Seminar on Nanophysics 1	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Practice	T1	English	MON:14:15-16:00

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF32	Independent Laboratory RP2	Mid-semester mark	13

Course type	Course code	Course language	Timetable information
Laboratory	E1	English	

The student must have chosen a diploma work topic before registering to this course. The student performs research tasks related to the diploma work topic during the semester, under the guidance of the thesis advisor.

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF33	Diploma Work RP	Mid-semester mark	30

Course type	Course code	Course language	Timetable information
Laboratory	E1	English	

The prerequisit to registering this course is successful completion of the course Independent laboratory RP2. The student performs research tasks related to the diploma work topic during the semester, under the guidance of the thesis advisor.

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF40	Trends in Nanotechnology	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	T0	English	THU:09:15-11:00

The courses provides insight to the most up-to-date results and the state of the art measurement and fabrication techniques in the field of nanotechnology. The selected topic (like micro-and nanomechanical systems, scanning

probe techniques, nanobiosensors, semiconductor nanostructures, nanoinformatics, etc.) are present.

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF42	Quantum Information Processing	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	T0	English	WED:12:15-14:00

Quantum bit, quantum computing, quantum algorithms. Spin-based quantum bits in solids: quantum dots, interactions, energy scales. Realization of single- and two-qubit quantum-logical operations. Mechanisms of information loss: relaxation, dephasing, decoherence. Experiments.

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF48	Seminar NA2	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Practice	T1	English	

The students process a leading field of modern physics, and present their part to the others as a scientific talk.

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF50	Seminar NA4	Signature	0

Course type	Course code	Course language	Timetable information
Practice	T1	English	

The students process a leading field of modern physics, and present their part to the others as a scientific talk.

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF53	Fundamentals of Nanophysics	Exam	5

Course type	Course code	Course language	Timetable information
Lecture	T0	English	WED:09:15-12:00

The building blocks of nowadays electronic devices have already reached a few tens on nanometers sizes, and further miniaturization requires the introduction of novel technologies. At such small length-scales the coherent behavior and the interaction of electrons, together with the atomic granularity of matter induce several striking phenomena, that are not observed at the macroscopic scale. The course gives an introduction to a broad set of nanoscale phenomena covering the following topics: characteristic length-scales; basic concepts of quantum transport, conductance quantization; coherent and incoherent transport, interference phenomena in nanostructures; mesoscopic phenomena in atomic and molecular nanojunctions; quantized Hall effect; noise phenomena in nanostructures; graphene nanostructures, 2D heterostructures; quantum dots.

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF54	Optical Spectroscopy in Materials Science	Exam	5

Course type	Course code	Course language	Timetable information
Lecture	T0	English	FRI:09:15-11:00

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.

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF56	Magnetic Resonance	Exam	5

Course type	Course code	Course language	Timetable information
Lecture	T0	English	
Practice	T1	English	

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. The fundamentals of magnetic resonance imaging (MRI)

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF57	Theory of Magnetism	Exam	5

Course type	Course code	Course language	Timetable information
Lecture	T0	English	THU:11:15-13:00(F3M01)

Practice	T1	English	THU:13:15-14:00(F3M01)

Magnetic phenomena are considered as electron correlation effects. This course builds heavily on knowledge gained by successful completion of the course “Modern solid state physics”. The following topics are discussed: Landau levels in magnetic field, magnetism of extended electron states, magnetism of atoms and ions, magnetite, direct exchange, kinetic exchange, Mott transition, Mott insulators, mean field theory of magnetic ordering, the ferromagnetic Heisenberg model, the antiferromegnetic Heisenberg model.

Subject code	Subject name	Requirement	ECTS credit
BMETE11MX22	Physics Laboratory for Civil Engineers	Mid-semester mark	1

Course type	Course code	Course language	Timetable information
Laboratory	EA2	English	TUE:14:15-18:00(F32L1); TUE:14:15-18:00(F32L1)
Laboratory	EA1	English	WED:14:15-18:00(F32L1); WED:14:15-18:00(F32L1)

In the semester three measurements are to be performed: studying of standing waves on a stretched string; measuring specific heat, latent heat; measurements with thin lenses, prism, polarizers, and interferometer. The purpose is to get to know basic measurement techniques and simple equipment. The course is based on BSc physics knowledge.

Subject code	Subject name	Requirement	ECTS credit
BMETE11MX33	MSc Physics	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	VE0	English	MON:12:15-14:00; MON:12:15-14:00; THU:10:15-12:00
Practice	VE1	English	THU:10:15-12:00

The course covers introduction to two disciplines: Quantum Mechanics and Solid State Physics. After the semester students should be able to understand the basic principles behind these two disciplines and solve some simple problems. This will contribute to the understanding of the workings of modern electronics and nanotechnology. Quantum mechanics: Experimental antecedents.The Wave function.Time dependent and time independent Schrouml;dinger's equation.Simple problems. Tunneling. Angular momentum. The hidrogen atom. Perturbations. Formal quantum mechanics. Operator calculus. Commutators, canonical conjugates and uncertainity relations. Harmonic oscillator. Selection rules and spectrum of H. The He atom, the independent particle approximation. The exclusion principle. Periodic system of elements. Molecules. molecular orbitals, chemical bonding, H-H bond. Molecules of many atoms. Orbital hybridisation. Conjugated molecules, cyclic conjugated molecules. Rotation and vibration of molecules. Franck-Condon principle, Rayleigh amp; Raman scattering. Classical and quantum statistics. Solid State Physics: The solid state. Short and long range order. Crystallography. Bonds in crystals. Real and point lattices. Symmetries and unit cells. The reciprocal lattice. Bravais lattices. X- ray diffraction methods. Electrical conductivity. Drudel model. Sommerfeld model. Band theory of solids.Work function. Contact potential. The adiabatic principle. Electrons in periodic lattices. Charge carrier characteristics. Crystal momentum. Effective mass. Band theory. The tight binding model. Intrinsic and doped semiconductors. Semiconductor structures. Superconductivity. Thermal properties. The transport equation. Onsager relations. Quantum theory of lattice vibrations. Optical properties. Magnetic and dielectric properties of solids.

Subject code	Subject name	Requirement	ECTS credit
BMETE14AX15	Physics 1 - Mechanics	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	C0A	English	
Practice	C1A	English	

Subject code	Subject name	Requirement	ECTS credit
BMETE14MX00	Modern Physics for Chemical Engineers	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	E0	English	

Topics: The course covers introductions to two disciplines: Quantum Mechanics and Solid State Physics. After the semester students should be able to understand the basic principles behind these two disciplines and solve some simple quantum mechanical and solid state physics problems. This will contribute to the understanding of the workings of modern electronics and nanotechnology. To follow the course no higher mathematics than algebra and the basics of the differential and integral calculus is required. Detailed thematics: Quantum Mechanics. Blackbody radiation, photoelectric effect, Compton effect, stability and line spectra of atoms, Frank-Hertz experiment, Time dependent and independent Schrödinger's equation, stationary states, wave function, "wave - particle duality", electron diffraction, two-slit experiment, uncertainty relations, electron wavefunction probability distribution in an atom, solving the Schrödinger equation, tunneling, the ammonia molecule, electron emission from metals, perturbation calculus, selection rules, operator calculus, eigenstate problems, measurement, quantum mechanics of the hydrogen atom, quantum numbers, H spectrum and selection rules, electron spin, Zeeman-effect, Stern-Gerlach experiment, spin-orbit coupling, atoms with more than one electron, the exclusion principle, indistinguishable

particles, periodic table of elements, buildup of shells, Hund's rule, valence and core electrons, molecules, molecular orbitals, chemical bonding, H-H bond, H2+ molecule ion, bonding and anti-bonding states, orbital hybridisation, heteronuclear molecules, sp3 hybridization, rotation and vibration of molecules, Franck-Condon principle, Rayleigh and Raman scattering, Stokes and anti-Stokes scattering, Statistical physics. Classical and quantum statistics. Distribution functions, distinguishable and indistinguishable particles, photon gas, Einstein model, laser principle. Solid State Physics. Short and long range ordering, amorphous and crystalline solids, crystal structures, lattices (point lattice and basis), symmetries and unit cells, primitive, conventional and Wigner-Seitz cells, primitive vectors, Miller indexes, Bravais lattices, close packing structures, reciprocal lattice, k-space, X-ray diffraction, Laue formulae, classical physical models for crystals: lattice vibrations, monatomic and diatomic linear chain model, boundary conditions, form of the solution, dispersion relation, generalization for 3 dim., QM handling of lattice vibrations, phonons, momentum and energy of phonons, relative to the momentum and energy of Bloch electrons, specific heat of solids, equipartition principle and the Debye model, specific heat from electrons, conductors and insulators, band theory of solids, formation of bands, insulators, conductors, real band structures, conduction models, Drude model, collision time, mean free path, Wiedmann-Franz law, Sommerfeld model of metals, Fermi energy, electrons and holes, equivalence of electron and hole conductivity in a completely filled band, metals with hole conduction, work function, thermionic emission, contact potential, crystal potential, double layer at the surface, Bloch functions, Hartree-Fock method, dispersion relation, Brillouin zone, reduced zone picture, kinematics of electrons and holes, Bloch oscillations, effective mass, tight binding model, semiconductors, intrinsic conductivity, density of states in the conduction and valence bands, position of the Fermi level, donors and acceptors, charge carrier concentrations, extrinsic conductivity, Fermi level in doped semiconductors, p-n junction, application of p-n junctions, diode, (MOS) FET, bipolar transistors, Schottky and ohmic structures, characteristics.

Subject code	Subject name	Requirement	ECTS credit
BMETE15AF32	Mechanics 2	Exam	2

Course type	Course code	Course language	Timetable information
Lecture	T0	English	MON:10:15-12:00(F3M01)

Relativistic mechanics: Lorentz-transformations, four-vectors and Minkowski space, relativistic collisions, relativistic action and equations of motion. Relativistic particle in an electromagnetic field. Lagrange-theory of continuum mechanics: Lagrange density of a string, Euler-Lagrange equations, energy density. Application to quantum mechanics and to harmonic media, Klein-Gordon equations. Hamiltonian formulation of continuum mechanics. Symmetries: Noether's theorem, symplectic formulation of Hamiltonian mechanics. Poisson's brackets, integrability. Canonical transformations, Hamilton-Jacobi equations, action-angle variables. Nonlinearity, second harmonic generation, parametric resonance. Basics of dynamical systems and chaos. – H. Goldstein: Classical Mechanics (Addison-Wesley)– J.R. Taylor, Classical Mechanics (University Science Books)

Subject code	Subject name	Requirement	ECTS credit
BMETE15AF44	Practical Course in Mechanics 2	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Practice	T1	English	TUE:12:15-14:00

Problem solving class accompanying Mechanics 2. – H. Goldstein: Classical Mechanics (Addison-Wesley)– J.R. Taylor, Classical Mechanics (University Science Books)

Subject code	Subject name	Requirement	ECTS credit
BMETE15AF46	Theory of Relativity	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	T0	English	WED:10:15-12:00

Minkowski spacetime, four-vectors. Lorentz and Poincaré group. Time dilation, length#160; contraction, relativity of simultaneity. Velocity-addition formula, rapidity. Causality, Zeeman theorem. Proper time, four-velocity, four-acceleration. Hyperbolic motion Relativistic dynamics. Equivalence principle. Equality of inertial and gravitational mass. Principle of covariance. Geodesic hypothesis, local inertial frames of reference. Riemannian and Pseudo-Riemannian geometry, Christoffel symbols, geodesics. Covariant derivative, parallel transport. Newtonian limit, relationship of the metric tensor and the gravitational potential. Derivation of the geodesic equation from the variational principle. Riemann curvature tensor and its properties. Riemann tensor and parallel transport along a closed curve. The geodesic deviation equation. Ricci tensor, scalar curvature, Bianchi identity, Einstein tensor. Stress -energy tensor, continuity equation, conservation laws. Einstein equations, Einstein-Hilbert action. Cosmological term. Schwarzschild solution. Perihelion precession of Mercury.#160;

Subject code	Subject name	Requirement	ECTS credit
BMETE15AF48	Electrodynamics 2	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Lecture	T0	English	MON:12:15-14:00(F3M01)
Practice	T1	English	

Electrostatics: Solving Laplace's equation in spherical and cylindrical coordinates. Grounded sphere in external field, electric field near a sharp cone. Multipole expansion in spherical harmonics. – Magnetic and quasistatic fields:

magnetic scalar potential, solution methods in nonlinear materials. – Electromagnetic waves in vacuum and matter. Microscopic model for polarizability. Dispersion, plasma frequency, Kramers-Kroing relations. – Wave guides, resonant cavity. Losses, quality factor. – Radiation field of oscillating charges. Electric dipole and quadrupole, magnetic dipole radiations. – Scattering of electromagnetic waves, cross section. Scattering on solids and gases. – Lienard-Wiechert potential of moving charge, field strength, radiated power, angular distribution, spectrum. Synchrotron radiation. Cherenkov and transitional radiations. – Elements of relativistic electrodynamics. – David J. Griffiths: Introduction to Electrodynamics (Pearson)– John D. Jackson: Classical Electrodynamics (Wiley)

Subject code	Subject name	Requirement	ECTS credit
BMETE15MF10	Random Matrix Theory and Its Physical Applications	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	T0	English	TUE:08:15-10:00

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.

Subject code	Subject name	Requirement	ECTS credit
BMETE15MF11	Evolutionary Game Theory	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	T0	English	FRI:10:15-12:00

The main goal of this course is to demonstrate the ways how the game theory and evolutionary game theory describe real-life situations affecting human behavior, economics, and biological systems. After a brief survey of the basic concept of the traditional game theory (e.g., games, strategies, Nash equilibrium, etc.) we will study evolutionary games that combine the concepts of game theory with the spirit of Darwinism. We will discuss the decomposition of games and also the potential games related to physical systems. Using simple multi-agent mathematical models we will investigate the effects supporting the maintenance of cooperative behavior in the situations of different social dilemmas (e.g., prisoner's dilemma or public goods game) when the individual interests prefer defection to cooperation. The predictions of the mathematical models will be contrasted with human and animal experiments. Finally we study systems where the evolution is controlled by the competition between different spatial strategy associations.

Subject code	Subject name	Requirement	ECTS credit
BMETE15MF21	Crystalline and Amorphous Material	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	T0	English	

1. Introduction 1.1. Historical overview: Science and applications 1.2. Definitions Crystalline, non-crystalline, amorphous, glassy materials, 2. Preparation techniques 2.1. Growth of thin-film forms 2.2. Melt-quenched glasses 2.3. Other techniques 2.4. Phillips constraints theory 3. Structure 3.1. Differences between amorphous and crystalline semiconductors 3.2. Projection from three dimensional structures to one dimensional functions Diffraction measurements 3.2. Three dimensional structure derivation from one dimensional function 3.3. Atomic interactions. Computer simulation methods, Models 3.4. Phase change materials and its application 4. Electronic structure 4.1. Chemical bonds, 4.2. Electronic density of states, 4.3. Defects 4.4. Optical and electronic properties 5. Photo induced phenomena 5.1. Photoinduced volume changes (PVE), photodarkening, photobleaching (PD), 5.2. Photoinduced defect creation (PDC): the Staebler-Wronsky effect, 5.3. In-situ simultaneous measurements of PVE, PD, and PDC 5.4. Photoinduced amorphization or crystallization, 5.5. Some applications of photo-induced effects (solar cells, XEROX, sensors, DVD, etc.)

Subject code	Subject name	Requirement	ECTS credit
BMETE15MF64	Statistical Field Theory	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	T0	English	
Practice	T1	English	

Second order phase transitions. Field theoretic description of the Ising model in d dimensions.Renormalisation group, fixed points, classification of couplings. Landau-Ginsburg description. WilsonCloseCurlyQuote;s RG in field

theory, beta function. Idea of epsilon expansion.Conformal field theory in d dimensions. Conformal symmetry, energy -momentum tensor, scaling fields. Conformal Ward identities. 2 and 3 point functions.Conformal symmetry in 2 dimensions. Primary and quasi-primary fields, Ward identity. Energy-momentum tensor, Ward identity and its relation to the free energy.Virasoro algebra. Operator-state correspondence. Correlators of descendent fields from Ward identities.Highest weight representations. Verma modules. Singular vectors. Minimal models. Operator product expansion in minimal models.Modular invariance and partition functions. Operator product coefficients and conformal bootstrap.Vicinity of critical point. C-theorem. Perturbative RG flows. G. Mussardo: Statistical Field Theory (Oxford University Press)C. Itzykson and J-M. Drouffe: Statistical Field Theory (Cambridge University Press)P. Ginsparg: Applied Conformal Field Theory (arXiv:hep-th/9108028)

Subject code	Subject name	Requirement	ECTS credit
BMETE15MF68	Many-Body Theory 1	Exam	6

Course type	Course code	Course language	Timetable information
Lecture	T0	English	TUE:09:15-12:00
Practice	T1	English	TUE:12:15-13:00

The course introduces the Green's function technique to investigate interacting electronic systems, mostly within the context of solid state physics. The course relies on the knowledge of basic quantum mechanics and statistical physics and is practically essential for other courses such as Many-body theory 2, Physics of one dimensional systems, Disordered systems etc. During the semester, the following topics are discussed:- Second quantization, definition of Green's functions and their relations to physical quantities- Heisenberg, Schrödinger and interaction pictures- Perturbation theory, diagrammatics (Wick's theorem, Feynman diagrams), resummations (self energy, vertex function, skeleton diagrams), equation of motion method- Having acquainted with the technique, we use it to evaluate- The ground state energy of dense, interacting electron gas- Friedel oscillations around a charged impurity- Anderson's orthogonality catastrophe and Fermi edge singularity- RKKY interaction between localized magnetic moments- Mean-field theory of two dimensional antiferromagnets etc.The corresponding practical course offers a variety of related problems to be solved.G.D. Mahan: Many-Particle Physics (Plenum Press, New York and London, 1981)A.A. Abrikosov, L.P. Gorkov and I. Dzialoshinskii: Methods of Quantum Field Theory in Statistical Mechanics (1963)

Subject code	Subject name	Requirement	ECTS credit
BMETE15MF74	Computer Simulation in Physics	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Lecture	T0	English	THU:16:15-18:00(F3213)
Practice	T1	English	THU:18:15-19:00(F3213)

Subject code	Subject name	Requirement	ECTS credit
BMETE15MF76	Complex Networks	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	E0	English	FRI:14:15-16:00
Practice	E1	English	

Basic graph theory, adjacency matrix, distance, path, connectedness, clustering. Random (Erdős-Rényi) networks, degree distribution, clustering, Watts-Strogratz network. Preferential attachment, scale free networks, configuration model. Temporal networks, burstiness. Growth models and cascades. Diffusion, spreading. Local measures, link prediction. Mesoscopic description: communities (stochastic blok model, inference, modularity, node/link hierarchical clustering, clique percolation), hierarchical, core-periphery structures. Sampling of networks. Navigation, search on networks.

Subject code	Subject name	Requirement	ECTS credit
BMETE90AX02	Mathematics A2a - Vector Functions	Exam	6

Course type	Course code	Course language	Timetable information
Lecture	EN0-EMK	English	MON:16:15-18:00(K389); MON:16:15-18:00(K389); THU:16:15-18:00(K389); THU:16:15-18:00(K389)
Practice	EN1-EMK	English	WED:16:15-18:00(KF88); WED:16:15-18:00(KF88)

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. Sewuences and series of functions, convergence criteria, power series, Taylor series. Fourier series: axpansion, 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 integrals.

Subject code	Subject name	Requirement	ECTS credit
BMETE90AX17	Mathematics A2c	Exam	6

Course type	Course code	Course language	Timetable information
Lecture	EN0-CA0	English	
Practice	EN0-CA1	English	

Differential calculus of functions of several variables: partial derivatives, differentiability, tangent plane. Derivatives of composite functions. Local and global maxima / minima. Inverse function, implicit function. Double and triple integrals. (5 weeks) Numerical series, power series, Taylor series. (2 weeks) Laplace and Fourier transform. (1 week) Linear algebra. Vectors, applications in geometry. Systems of linear equations. (3 weeks). Differential equations (separable differential equations, first order linear differential equations, second order linear differential equations with constant coefficients). (3 weeks)

Subject code	Subject name	Requirement	ECTS credit
BMETE90AX22	Calculus 2 for Informaticians	Mid-semester mark	6

Course type	Course code	Course language	Timetable information
Lecture	EN0-EB0	English	MON:10:15-12:00; TUE:10:15-12:00
Practice	EN1-EB1	English	THU:14:15-16:00

Differential equations: Separable d.e., first order linear d.e., higher order linear d.e. of constant coefficients. Series: Tests for convergence of numerical series, power series, Taylor series. Functions of several variables: Limits, continuity. Differentiability, directional derivatives, chain rule. Higher partial derivatives and higher differentials. Extreme value problems. Calculation of double and triple integrals. Transformations of integrals, Jacobi matrix. Analysis of complex functions: Continuity, regularity, Cauchy - Riemann partial differential equations. Elementary functions of complex variable, computation of their values. Complex contour integral. Cauchy - Goursat basic theorem of integrals and its consequences. Integral representation of regular functions and their higher derivatives (Cauchy integral formulae).

Subject code	Subject name	Requirement	ECTS credit
BMETE90AX26	Mathematics A2f - Vector Functions	Mid-semester mark	6

Course type	Course code	Course language	Timetable information
Lecture	EN0-VIK	English	MON:10:15-12:00; WED:08:15-10:00
Practice	EN1-VIK	English	WED:10:15-12:00

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. Sewuences and series of functions, convergence criteria, power series, Taylor series. Fourier series: axpansion, 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 integrals.

Subject code	Subject name	Requirement	ECTS credit
BMETE90AX34	Mathematics EP2	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Practice	EN1	English	WED:08:15-10:00(K221)

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.

Subject code	Subject name	Requirement	ECTS credit
BMETE90MX54	Advanced Mathematics for Electrical Engineers - Linear Algebra	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	MON:08:15-10:00
Practice	EN1	English	THU:08:15-10:00

System of linear of equations, Gaussian elimination, vectors, vector spaces, subspaces, basis, matrices, special matrices, LU and PLU decomposition of a matrix, determinants, linear transformations and its properties,

computation of the eigenvalues and eigenvectors, euclidean space, orthogonality, diagonalization of a matrix, Jordan canonical form of a matrix, Jordan basis, orthogonal diagonalization, norm of vectors and matrices, singular value decomposition of a matrix, nonnegative matrices, matrix functions, Perron-Frobenius theory. J. Hefferon: Linear Algebra, 3rd ed.C.D. Meyer: Matrix Analysis and Applied Linear Algebra

Subject code	Subject name	Requirement	ECTS credit
BMETE93BG02	Mathematics G2	Exam	6

Course type	Course code	Course language	Timetable information
Lecture	EN0-GPK	English	MON:16:15-19:00(K150); TUE:16:15-17:00(K150)
Practice	EN1-GPK	English	TUE:17:15-19:00(K150)

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: axpansion, 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 integrals.