# Faculty of Civil Engineering

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

The most essential service of the Faculty – education linked closely to research and engineering work – is reflected in the scientific activities of nearly 120 professors in 9 departments. They have contributed significantly to the scientific solution of diverse engineering problems. Out of the approximately 1800 students, who study at this Faculty, yearly 100 students from abroad participate in the English language program.

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

The Faculty offers three specializations in the field of structural engineering; Specialization in Numerical Modelling, Specialization in Structures, and Specialization in Geotechnics and Geology. Specialization in Numerical Modelling provides advanced knowledge of structural analysis using advanced computer techniques, including the theoretical background of the methods. Specialization in Structures provides knowledge in structural design and skills enabling own project coordination, executing special design, construction and development procedures. The main goal of Specialization in Geotechnics and Geology is providing enhanced knowledge and skills in the field of engineering geology, geotechnics modelling, underground structures and foundations. These specializations might be useful not only for those who are interested in research and consider continuing doctoral studies, but for leading engineers of the future: practicing engineers facing special structural problems.

## Departments

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

**Budapest University of Technology and Economics**
**Faculty of Civil Engineering**
Faculty Office:
Building R, ground floor, room 001.
Mailing Address: Műegyetem rkp. 7-9.
H-1111 Budapest, Hungary
Phone: (+36-1) 463-3898
Fax: (+36-1) 463-2550
Web: www.epito.bme.hu

*Dean: Dr. László Dunai*
*Course-director: Dr. Tamás Lovas*
*Program coordinator: Mrs Kinga Vass*

# Curriculum of BSc in Civil Engineering
# Core subjects (8 semesters)

| Subject | | | lecture/seminar/laboratory/exam | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Name | Code | Credits | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Preliminary requirement(s) |
| **Core subjects** | | | | | | | | | | |
| Compulsory English 1 | BMEGT63A3E1 | 4 | 4/0/4/M | | | | | | | |
| Surveying 1 | BMEEOAFAT41 | 3 | 3/1/2/M | | | | | | | |
| Chemistry of Construction Materials | BMEEOEMAT41 | 2 | 2/2/0/M | | | | | | | |
| Civil Engineering Representation and Drawing | BMEEOEMAT42 | 4 | 4/2/2/M | | | | | | | |
| CAD for Civil Engineers | BMEEOFTAT41 | 2 | 2/0/2/M | | | | | | | |
| Geology | BMEEOGMAT41 | 3 | 3/1/2/E | | | | | | | |
| Basis of Statics and Dynamics | BMEEOTMAT41 | 6 | 6/0/5/E | | | | | | | |
| Mathematics A1a - Calculus | BMETE90AX00 | 6 | 6/4/2/E | | | | | | | |
| Physics for Civil Engineers | BMETE11AX13 | 2 | 2/2/0/M | | | | | | | |
| Compulsory English 2 | BMEGT63A3E2 | 4 | 4/0/4/M | 4/0/4/M | | | | | | |
| Surveying 2 | BMEEOAFAT42 | 4 | | 4/2/2/E | | | | | | EOAFAT41 EOFTAT41 |
| Construction Materials 1 | BMEEOEMAT43 | 5 | | 5/2/0/2/E | | | | | | EOEMAT41 |
| Civil Engineering Informatics | BMEEOFTAT42 | 5 | | 5/2/2/M | | | | | | EOFTAT41 |
| Building Construction Study | BMEEOEMAT44 | 3 | | 3/1/2/M | | | | | | EOEMAT42 |
| Introduction to Strength of Materials | BMEEOTMAT42 | 6 | | 6/0/5/M | | | | | | EOTMAT41 TE90AX00~ |
| Hydraulics 1 | BMEEOVVAT42 | 3 | | 3/2/1/E | | | | | | |
| Mathematics A2a - Vector Functions | BMETE90AX02 | 6 | | 6/4/2/E | | | | | | TE90AX00 |
| Surveying Field Course | BMEEOAFAT43 | 3 | | 3/0/0/M | 9 days | | | | | EOAFAT42~ |
| Soil Mechanics | BMEEOGMAT42 | 4 | | | 4/2/2/M | | | | | EOGMAT41 EOTMAT42 |
| Geoinformatics | BMEEOFTAT43 | 3 | | | 3/2/1/M | | | | | EOAFAT42 |
| Basis of Design | BMEEOHSAT41 | 3 | | | 3/2/0/M | | | | | EOTMAT41~ |
| Structural Analysis 1 | BMEEOTMAT43 | 4 | | | 4/4/0/E | | | | | EOTMAT42 TE90AX00 |
| Railway Tracks | BMEEOUVAT41 | 3 | | | 3/3/0/E | | | | | EOAFAT41 |
| Basics of Environmental Engineering | BMEEOVKAT41 | 3 | | | 3/2/0/M | | | | | |
| Public Works 1 | BMEEOVKAT42 | 3 | | | 3/2/1/E | | | | | EOVVAT42 |
| Hydrology 1 | BMEEOVVAT41 | 3 | | | 3/2/1/M | | | | | |
| Mathematics A3 for Civil Engineers | BMETE90AX07 | 4 | | | 4/2/2/E | | | | | TE90AX02 |
| Earthworks | BMEEOGMAT43 | 3 | | | | 3/2/1/E | | | | EOGMAT42 |
| Steel Structures | BMEEOHSAT42 | 3 | | | | 3/3/0/M | | | | EOTMAT42 EOEMAT43~ EOHSAT41 |
| Reinforced Concrete Structures | BMEEOHSAT43 | 3 | | | | 3/3/0/M | | | | EOTMAT42 EOEMAT43~ EOHSAT41 |
| Roads | BMEEOUVAT42 | 2 | | | | 2/2/0/M | | | | EOUVAT41 |
| Hydraulic Engineering, Water Manag. | BMEEOVVAT43 | 3 | | | | 3/2/1/E | | | | EOVVAT41 EOVVAT42 |
| Construction Management | BMEEPEKAT41 | 3 | | | | 3/2/1/M | | | | EOEMAT44 EOGMAT42 |
| Business Law | BMEGT55A001 | 2 | | | | 2/2/0/M | | | | |
| Foundation Engineering | BMEEOGMAT45 | 4 | | | | | 4/3/0/E | | | EOGMAT43 |
| Management and Enterprise | BMEGT20A001 | 4 | | | | | 4/4/0/M | | | |
| Micro- and Macroeconomics | BMEGT30A001 | 4 | | | | | | 4/4/0/E | | |
| Communication Skills for Civil Engineers | BMEGT60A6EO | 2 | | | | | | 2/0/2/M | | |
| Urban and Regional Development | BMEEOUVAT43 | 3 | | | | | | | 3/2/0/M | |
| Elective subject | | 4 | | | | | | | 4/4/0/M | |

# Curriculum of BSc in Civil Engineering
# Specialization in Structural Engineering

| Subject | | | lecture/seminar/laboratory/exam | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Name | Code | Credits | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Preliminary requirement(s) |
| **Specialization in Structural Engineering** | | | | | | | | | | |
| Building Construction 1 | BMEEOEMAS42 | 3 | | | | 3/1/2/E | | | | EOEMAT44 |
| Timber Structures | BMEEOHSAS44 | 3 | | | | 3/2/0/M | | | | EOTMAT42 EOEMAT43 EOHSAT41 |
| Strength of Materials | BMEEOTMAS41 | 3 | | | | 3/2/0/E | | | | EOTMAT43 |
| Construction Materials 2 | BMEEOEMAS41 | 3 | | | | | 3/1/0/2/E | | | EOEMAT43 |
| Building Construction 2 | BMEEOEMAS43 | 3 | | | | | 3/1/2/E | | | EOEMAS42 EOHSAT41 |
| Steel and Composite Structures | BMEEOHSAS41 | 4 | | | | | 4/2/1/M | | | EOHSAT42 EOHSAT43 |
| RC and Masonry Structures | BMEEOHSAS42 | 4 | | | | | 4/2/1/M | | | EOHSAT43 EOEMAS42 EOTMAT43 |
| Bridges and Infrastructures | BMEEOHSAS43 | 3 | | | | | 3/2/0/E | | | EOHSAT42 EOHSAT43 |
| Laboratory Practice of Testing of Structures and Materials | BMEEOHSAS46 | 2 | | | | | 2/0/04/M | | | EOHSAT42 EOHSAT43 |
| Structural Analysis 2 | BMEEOTMAS42 | 4 | | | | | 4/3/1/M | | | EOTMAT43 EOTMAS41 TE90AX07 |
| Rock Mechanics | BMEEOGMAS41 | 3 | | | | | 3/1/1/M | 3/1/1/M | | EOGMAT41 EOGMAT42 |
| Underground Structures, Deep Found. | BMEEOGMAS42 | 3 | | | | | 3/2/1/M | 3/2/1/M | | EOGMAT45 |
| 3D Constructional Modelling of Structures | BMEEOHSAS45 | 3 | | | | | 3/0/2/M | 3/0/2/M | | EOHSAT42 EOHSAT43 EOFTAT42 |
| Design of Structures Projectwork | BMEEODHAS41 | 6 | | | | | 6/0/0/M | 6/0/0/M | | EOHSAS41 EOHSAS42 EOGMAT45 |
| Public Administration and Land Registry | BMEEOUVAT44 | 3 | | | | | 3/2/0/M | 3/2/0/M | 3/2/0/M | GT55A001 |
| Field Course of Structural Surveys | BMEEOAFAS42 | 1 | | | | | 1/0/0/2/M | 1/0/0/2/M | 1/0/02/M | EOAFAT43 EOHSAT42 EOHSAT43 |
| Dynamics of Structures | BMEEOTMAS43 | 3 | | | | | 3/2/0/M | 3/2/0/M | 3/2/0/M | EOTMAT43 TE90AX07 |
| Technical Internship | BMEEODHAS42 | 0 | | | | | 0/0/0/S | 0/0/0/S | 0/0/0/S | EOHSAS41 EOHSAS42 EOGMAT45 |
| Steel Buildings | BMEEOHSA-A1 | 5 | | | | | 5/3/1/E | 5/3/1/E | 5/3/1/E | EOHSAS41 |
| Reinforced Concrete Buildings | BMEEOHSA-A2 | 5 | | | | | 5/3/1/E | 5/3/1/E | 5/3/1/E | EOHSAS42 EOHSAS44 |
| Methodology of Building Construction Design | BMEEOEMA-A1 | 2 | | | | | 2/1/1/E | 2/1/1/E | 2/1/1/E | EOEMAS43 |
| Engineering Works | BMEEOHSA-B3 | 3 | | | | | 3/2/0/E | 3/2/0/E | 3/2/0/E | EOHSAT43 EOHSAS43 EOGMAS42 |
| Structural Design Projectwork | BMEEOHSA-PP | 6 | | | | | 6/0/0/M | 6/0/0/M | 6/0/0/M | EODHAS41 EOHSA-A1 EOHSA-A2 |
| Diploma Project | BMEEODHA-PD | 24 | | | | | | | | EOHSA-PP |

# Curriculum of BSc in Civil Engineering
# Specialization in Infrastructure Engineering

| Subject | | | lecture/seminar/laboratory/exam | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Name | Code | Credits | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Preliminary requirement(s) |
| **Specialization in Infrastructure Engineering** | | | | | | | | | | |
| Infrastructure CAD Course | BMEEOUVAI45 | 1 | | | | 1/0/0/2/M | | | | EOUVAT41 EOVKAT42 EOFTAT42 |
| Water Chemistry and Hydrobiology | BMEEOVKAI43 | 3 | | | | 3/2/0/1/E | | | | EOVKAT41 |
| Legal Aspects of Water and Environment | BMEEOVKAI45 | 2 | | | | 2/2/0/M | | | | |
| Hydraulics 2 | BMEEOVVAI42 | 3 | | | | 3/2/1/E | | | | EOVVAT42 |
| Highway and Railway Structures | BMEEOUVAI41 | 5 | | | | 5/4/0/E | 5/4/0/E | | | EOUVAT41 EOUVAT42 |
| Highway and Railway Design | BMEEOUVAI43 | 5 | | | | | 5/3/2/E | | | EOUVAT41 EOUVAT42 EOAFAT43 |
| Public Works 2 | BMEEOVKAI41 | 5 | | | | | 5/2/2/E | | | EOVKAT42 |
| Urban Environment | BMEEOVKAI42 | 3 | | | | | 3/2/0/M | | | EOVKAT41 |
| Water Quality Management | BMEEOVKAI44 | 3 | | | | | 3/2/1/M | | | EOVKAI43 EOVVAI42 |
| Hydrology 2 | BMEEOVVAI41 | 3 | | | | | 3/2/1/M | | | EOVVAT41 |
| Transportation Networks | BMEEOUVAI42 | 3 | | | | | 3/2/0/M | 3/2/0/M | | EOUVAT42 |
| Highway and Railway Laboratory Course | BMEEOUVAI44 | 1 | | | | | 1/0/0/3/M | 1/0/0/3/M | | EOUVAI41 |
| Water Resources Management | BMEEOVVAI43 | 3 | | | | | 3/2/0/E | 3/2/0/E | | EOVVAT43 |
| Hydraulic Engineering Field Course | BMEEOVVAI44 | 2 | | | | | 2/0/0/M | 2/0/0/M | | EOVVAI41 EOVVAI42 |
| Infrastructure Design Project | BMEEODHAI41 | 6 | | | | | 6/0/0/M | 6/0/0/M | | EOVVAT43 EOUVAI43 EOVKAI41 |
| Public Administration and Land Registry | BMEEOUVAT44 | 3 | | | | | | | 3/2/0/M | GT55A001 |
| Earthworks and Drainage of Transportation Infrastructures | BMEEOGMAI41 | 3 | | | | | | | 3/3/0/E | EOGMAT43 EOVVAT41 |
| Technical Internship | BMEEODHAI42 | 0 | | | | | | | 0/0/0/S | EOVVAT43 EOVVAI43 EOVVAI42 |
| Highway Planning and Design | BMEEOUVA-E1 | 3 | | | | | | | 3/0/2/E | EOUVAI43 |
| Water Damage Prevention and Water Use | BMEEOVVA-F1 | 5 | | | | | | 5/4/0/E | 5/4/0/E | EOVVAT43 EOVVAI41 EOVVAI42 |
| Drinking Water and Wastewater Treatment | BMEEOVKA-H1 | 4 | | | | | | 4/3/0/E | 4/3/0/E | EOVKAI41 |
| Railway Planning and Design | BMEEOUVA-E2 | 3 | | | | | | | 3/0/2/E | EOUVAI43 |
| River Basin Management | BMEEOVVA-F2 | 3 | | | | | | | 3/2/0/E | EOVVAI43 EOVKAI44 |
| Environmental Impact Assessment | BMEEOVKA-H3 | 3 | | | | | | | 3/3/0/E | EOVKAI42 EOVKAI44 EOVKAI45 |
| Transportation Facility Design Project | BMEEOUVA-QP | 6 | | | | | | | 6/0/0/M | EOHAI41 EOUVAI44 EOUVA-E2 |
| Hydraulic Engineering Design Project | BMEEOVVA-QP | 6 | | | | | | | 6/0/0/M | EODHAI41 EOVVA-F1 EOVVA-F2 |
| Urban Water Infrastructure Design Project | BMEEOVKA-QP | 6 | | | | | | | 6/0/0/M | EODHAI41 EOVKA-H1 EOVKA-H3 |
| Diploma Project | BMEEODHA-QD | 24 | | | | | | | | *EOUVA-QP *EOVVA-QP *EOVKA-QP |

# Curriculum of MSc in Civil Engineering
# Structural Engineering

| Subject | | | lectures/practical lectures/laboratory | | |
|---|---|---|---|---|---|
| Name | Code | Credits | 1 | 2 | 3 |
| **Core subjects** | | | | | |
| Advanced Mathematics | BMETE90MX33 | 3 | 2/1/0/E | | |
| Physics Laboratory | BMETE11MX22 | 1 | | 0/0/1/M | |
| Methods of Engineering Analysis | BMEEOHSMK51 | 3 | 1/1/0/M | | |
| Numerical Methods | BMEEOFTMK51 | 4 | 0/0/3/M | | |
| Geodynamics | BMEEOGMMS51 | 3 | | 2/0/0/M | |
| FEM for Civil Engineers | BMEEOTMMS51 | 5 | 2/2/0/E | | |
| Soil-structure interaction | BMEEOGMMS52 | 5 | 3/1/0/M | | |
| Structures 1 | BMEEOHSMS51 | 5 | 3/1/0/E | | |
| Numerical modeling project | BMEEOTMMS5P | 5 | | 0/0/0/2/M | |
| Decision Supporting Methods | BMEEPEKMST4 | 2 | | | 2/0/0/M |
| Accounting, Controlling, Taxation | BMEGT35M014 | 2 | | | 2/0/0/M |
| Corporate Finance | BMEGT35M411 | 2 | | | 2/0/0/M |
| Engineering Ethics | BMEGT41M004 | 2 | | | 2/0/0/M |
| **Specialization in Numerical Modelling** | | | | | |
| **Obligatory Subjects** | | | | | |
| Structural Dynamics | BMEEOTMMN-1 | 4 | | 2/1/0/M | |
| Stability of Structures | BMEEOHSMT-2 | 4 | | 2/1/0/E | |
| Nonlinear Mechanics | BMEEOTMMN-2 | 4 | 2/1/0/E | | |
| Diploma Project | BMEEODHMN-D | 20 | | | |
| **Recommended elective subjects** | | | | | |
| Plasticity | BMEEOTMMN61 | 3 | | 1/1/0/M | |
| Nonlinear FEM | BMEEOTMMN62 | 3 | | 2/0/0/M | |
| Analysis of Rods and Frames | BMEEOTMMN63 | 3 | | 1/1/0/M | |
| Discrete Element Method | BMEEOTMMN64 | 3 | | 1/1/0/M | |
| **Specialization in Structures** | | | | | |
| **Obligatory Subjects** | | | | | |
| Structures 2 | BMEEOHSMT-1 | 4 | | 2/1/0/E | |
| Stability of Structures | BMEEOHSMT-2 | 4 | | 2/1/0/E | |
| Seismic Design | BMEEOHSMT-3 | 4 | | 2/1/0/M | |
| Structural Dynamics | BMEEOTMMN-1 | 4 | | 2/1/0/M | |
| Diploma Project | BMEEODHMT-D | 20 | | | |
| **Recommended elective subjects** | | | | | |
| Applied Fracture Mechanics | BMEEOHSMT61 | 4 | | 2/1/0/M | |
| Prestressing Technologies | BMEEOHSMT62 | 3 | | 1/1/0/M | |
| Strengthening of Structures | BMEEOHSMT63 | 3 | | 1/1/0/M | |
| **Specialization in Geotechnics and Geology** | | | | | |
| Engineering Geology MSc | BMEEOGMMG-1 | 4 | | 2/1/0/E | |
| Environmental Geology | BMEEOGMMG-2 | 4 | 2/1/0/M | | |
| Geotechnical Design | BMEEOGMMG-3 | 4 | | 2/1/0/M | |
| Earthworks of Infrastructures | BMEEOGMMG-4 | 4 | | 2/1/0/M | |
| Diploma Project | BMEEODHMG-D | 20 | | | |
| **Recommended elective subjects** | | | | | |
| Tunneling | BMEEOGMMG61 | 3 | | 2/0/0/M | |
| Hydrogeology | BMEEOGMMG62 | 3 | | 2/0/0/M | |
| Numerical Methods in Geotechnics | BMEEOGMMG63 | 3 | 1/0/1/M | | |
| Engineering Geology of Hungary | BMEEOGMMG64 | 3 | | 2/0/0/M | |

# Description of BSc Courses
# Civil engineering BSc - Major in Structural Engineering

## Compulsory English 1.

**BMEGT63A3E1**

The course is designed to enable students to communicate fluently and effectively in study environment. Receptive, productive and interactive activities and strategies are included in the curricula. (4 credits)

## Surveying I.

**BMEEOAFAT41**

Surveying and Geodesy. Height systems. Optical levelling, the surveyors' level. Line levelling (procedure, field observations and processing). Systematic error sources of levelling, the two-peg-test. Line levelling, detail point levelling. Height observations for horizontal layouts.
Horizontal positioning observations. Angular observations and the theodolite. Calibration procedure of the theodolite. Measuring with the theodolites: set up, sighting, horizontal and vertical angular observations, systematic error sources. The computation of the mean direction and the zenith angle. Centring excentric observations. Trigonometric heighting.
Distance observations: corrections, reductions. Physical methods of distance measurements. Electrooptical Distance Meters. Processing distance observations.
Plane surveying. Computation of horizontal coordinates on the projection grid. Orientation of the horizontal circle. Intersections. (3 credits)

## Chemistry of Construction Materials

**BMEEOEMAT41**

The importance and necessity of chemistry in civil engineering. The structure of atoms, the electron shell structure, the structure of molecules and chemical bonding models. States of materials - explanation by intermolecular forces. Ideal and real laws of gases. Fluid systems properties. The structure of crystalline solids (ionic, atomic, molecular and metallic lattice crystal structure and properties). Difference between ideal and realistic structure, macroscopic properties of crystalline materials, lattice defects. Structure and properties of non-crystalline (amorphous or glassy) solids. Macromolecular substances and its chemical properties. Homogeneous and heterogeneous systems. Gibbs law. interfacial phenomena. The types of chemical reactions, speed of chemical reactions. Activation energy and reaction heat. Hess's law. Chemical equilibrium. Acids, bases and salts. The pH concept. Hydrolysis of salts. Electrochemistry. Redox processes, redox potentials. Production of metals, corrosion of metals. Binding materials and binding mechanism. Cement chemistry. Chemical and mineralogical composition of cements. Hydration products, CSH, CAH, CH, primary and secondary ettringite. Application of theoretical knowledge in engineering practice. (2 credits)

## Civil Engineering Representation and Drawing

**BMEEOEMAT42**

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. (4 credits)

## CAD for Civil Engineers

**BMEEOFTAT41**

Besides an overview on CAD systems and application fields, students will learn the 2D drawing commands that enable carrying out basic design tasks. Layer management, block definition and applying annotations and dimensions are discussed in detail. Learning printing options and parameters supports further design works in the BSc civil engineering program. The aim of the course is to let students understand the potential and capabilities of CAD systems and their applications. The course introduces the basic spatial drawing solutions providing bases for high level courses involving 3D constructions, BIM applications. (2 credits)

## Geology

**BMEEOGMAT41**

The geology provides the characterisation of geological formations and materials from a civil engineering point of view. It describes the processes and the interactions between the engineering works and the geological environment. The dynamics of the Earth, the description of raw materials and geo-materials used in engineering practice (minerals and rocks), the geological risks such as earthquakes, volcanism, landslides and their effect, characterisation of surface and subsurface waters and related geological problems. (3 credits)

## Basis of Statics and Dynamics

**BMEEOTMAT41**

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. (6 credits)

## Mathematics A1a - Calculus

**BMETE90AX00**

Algebra of vectors in plane and in space. Arithmetic of complex numbers. Infinite sequences. Limit of a function, some important limits. Continuity. Differentiation: rules, derivatives of elementary fuctions. Mean value theorems, l'Hospital's rule, Taylor theorem. Curve sketchig for a func-

tion, local and absolute extrema. Integration: properties of the Riemann integral, Newton-Leibniz theorem, antiderivatives, integration by parts, integration by substitution. Integration in special classes of functions. Improper integrals. Applications of the integral. (6 credits)

## Physics for Civil Engineers

**BMETE11AX13**

Electric charge, Coulomb's law, electric field, electric flux. Work and energy in electric fields. Electric potential. Capacitors, dielectrics. The piezoelectric effect and its applications. The contact potential, its application for temperature measurements. Electric current, Kirchhoff's laws, electric circuits. Magnetic field. The Biot-Savart law, Ampere's law. Forces in magnetic fields, practical applications. Magnetic flux, Faraday's law. Practical applications of Faraday's law in sensors. Self induction, mutual induction. Varying electromagnetic fields. Magnetic properties of matter, magnetic circuits. ACcircuits, impedance. Sensors in measurements. Measurement of basic electric quantities. Resistance, capacitance and magnetic induction based sensors. Magnetic, thermoelectric and piezoelectric sensors. Measurement of displacement, force, acceleration. Measurement of flow of gases and liquids. Measurement of liquid level. Measurement of humidity and temperature. Thermovision, thermograms. (2 credits)

## Compulsory English 2.

**BMEGT63A3E2**

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

## Surveying II.

**BMEEOAFAT42**

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. (4 credits)

## Construction Materials I.

**BMEEOEMAT43**

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. (5 credits)

## Civil Engineering Informatics

**BMEEOFTAT42**

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. (5 credits)

## Soil Mechanics

**BMEEOGMAT42**

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). (4 credits)

## Introduction to Strength of Materials

**BMEEOTMAT42**

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. (6 credits)

## Hydraulics I.

**BMEEOVVAT42**

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. (3 credits)

## Mathematics A2a - Vector Functions

**BMETE90AX02**

Solving systems of linear equations: elementary row operations, Gauss-Jordan- and Gaussian elimination. Homogeneous systems of linear equations. Arithmetic and rank of matrices. Determinant: geometric interpretation, expansion of determinants. Cramer's rule, interpolation, Vandermonde determinant. Linear space, subspace, generating system, basis, orthogonal and orthonormal basis. Linear maps, linear transformations and their matrices. Kernel, image, dimension theorem. Linear transformations and systems of linear equations. Eigenvalues, eigenvectors, similarity, diagonalizability. Infinite series: convergence, divergence, absolute convergence. 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. (6 credits)

## Surveying Field Course

**BMEEOAFAT43**

Using the theoretical background of the courses Surveying 1 & 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). (3 credits)

## Building Construction Study

**BMEEOEMAT44**

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. (3 credits)

## Geoinformatics

**BMEEOFTAT43**

The aim of Geoinformatics is to introduce the principles and potential application fields of geographic information systems (GIS) in the civil engineering practice. The course discusses the basic concepts and applications of GIS, the modelling process needed to create GIS, the reference systems of geometric data, the spatial data sources and data acquisition methods, the aspects of data quality, the resources, tools, databases of GIS, the basics of data analysis, visualization and implementation of GIS. Through the lectures and labs students learn the GIS workflow based on desktop and web-based solutions, and tools of spatial process modelling, data management and web integration. (3 credits)

## Basis of Design

**BMEEOHSAT41**

Modelling of structures, design process. Selection of structural form and material. Structural model. Thrust line. Probabilistic basics of structural design, partial (safety) factor method. Selection of critical load case, design load. Actions on structures. Material laws. Geometrically linear and nonlinear analysis, Elastic and plastic resistance. Superposition. Limit states. Load-carrying capacity and serviceability. Beams and columns. Design of structures for horizontal actions. Spatial structures. Classification of structures according to their form and static behaviour. (3 credits)

## Structural Analysis I.

**BMEEOTMAT43**

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. (4 credits)

## Railway Tracks

**BMEEOUVAT41**

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. (3 credits)

## Basics of Environmental Engineering

**BMEEOVKAT41**

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. (3 credits)

## Public Works I.

**BMEEOVKAT42**

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. (3 credits)

## Hydrology I.

**BMEEOVVAT41**

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. (3 credits)

## Mathematics A3 for Civil Engineers

**BMETE90AX07**

Differential geometry of curves and surfaces. Scalar and vector fields. Potential theory. Classification of differential equations. Linear differential equation of the second order. Nonlinear differential equations. Systems of linear differential equations. The concept of probability. Discrete random variables an their distributions. Random variables of continuous distribution. Two-dimensional distributions, correlation and regression. Basic notions of mathematical statistics. (4 credits)

## Earthworks

**BMEEOGMAT43**

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. (3 credits)

## Steel Structures

**BMEEOHSAT42**

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. (3 credits)

## Reinforced Concrete Structures

**BMEEOHSAT43**

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. (3 credits)

## Roads

**BMEEOUVAT42**

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. (2 credits)

## Hydraulic Engineering, Water Manag.

**BMEEOVVAT43**

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. (3 credits)

## Construction Management

**BMEEPEKAT41**

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. (3 credits)

### Business Law

**BMEGT55A001**

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

### Foundation Engineering

**BMEEOGMAT44**

Foundation Types.Design of rigid and flexibile shalow foundations (spread, pier, slab, box foundation). Determination the bearing capacity and settlements of soils under load. Factors effecting the value of differential settlements. Stability analysis. Types and design of different support systems of Excavations. Bearing capacity of pile foundations. Anchorages. Design of ground Anchors. Design and construction of cast in situ and prefabricated diaphragm walls. Dewatering. (4 credits)

### Management and Enterprise

**BMEGT20A001**

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

### Micro- and Macroeconomics

**BMEGT30A001**

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

### Communication Skills for Civil Engineers

**BMEGT60A6EO**

The Communication Skills course is designed to meet the language needs of civil engineering students in academic and professional fields. Special emphasis is on the language of meetings and discussions, oral presentation and summary writing. (2 credits)

### Urban and Regional Development

**BMEEOUVAT43**

Infrastructure and Regional Development. Historical construction processes of canals, railways, motorways. Aviation and the internet age. Livable, sustainable cities, regions. Computer aided teamwork. Construction projects, mobility measures; parking regulations. Improving traffic safety, Traffic management and intelligent investments. Basics of Land-Use Planning. Cities with road pricing, congestion pricing. Lessons learned in Oslo, London, Stockholm, Singapore. Calculations with demand curves.
The city as a system. [Area, core network]. The morphology of the city. Basics on the the Hungarian settlement system. Development of large cities. Concentration, suburbanization. Fundamentals of urban planning. Case studies: Paris, Budapest – Vienna – Prague.
The regional development strategy of the European Union. Steps and documents of the implementation in Hungary. Strategic Environmental Assessments. Monitoring of Environmental Effects. (3 credits)

## Branch of Structural Engineering

### Building Construction I.

**BMEEOEMAS42**

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. (3 credits)

### Timber Structures

**BMEEOHSAS44**

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. (3 credits)

### Strength of Materials

**BMEEOTMAS41**

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. (3 credits)

## Construction Materials II.

**BMEEOEMAS41**

Importance of selection construction materals. Ranges of applicability of construction materials. Influencing factors to the strength of concrete. Steam curing. Influencing factors to the water tightness and the freeze-thaw resistance of concrete. Fibre reinforced concrete. Light weight concrete. Metals. Aluminium. Production of iron and steel. Steel-carbon interaction diagram. Martenzite. Heat curing of steel. Steel corrosion. Normal potential. Roads. Road making materials. Aggreagates and possible binders to pavements. Properties of bitumen and asphalt. Concrete pavements. Properties of road marking. Concrete corrosion. Protection against concrete corrosion. Properties of polymers. Polymeric protection layers. Thermal and sound insulations. (3 credits)

## Building Construction II.

**BMEEOEMAS43**

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. (3 credits)

## Steel and Composite Structures

**BMEEOHSAS41**

Design specialities of plated steel girders: plate and web buckling phenomena and design according Eurocodes. Design of steel structural members subjected to bending and axial compression – interaction formulae according EC3. Simple joints in steel structures – structural behaviour and design. Structural behaviour of steel and concrete composite members; design of composite beams and columns according EC4. (4 credits)

## RC and Masonry Structures

**BMEEOHSAS42**

Design principles of reinforced concrete slab and frame structures, exact and approximate design methods, structural details. Bracing systems of reinforced concrete buildings, determination of the forces acting to the individual shear walls, checking of stability. Detailing of reinforced concrete structures (beam end, corbel, frame corner, curved bars, stairs, force transfer between members, expansion joints, etc.). Types and strength characteristics of masonry. Design principles of unreinforced masonry walls according to EC6. Reinforced masonry walls. (4 credits)

## Bridges and Infrastructures

**BMEEOHSAS43**

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. (3 credits)

## Laboratory Practice of Testing of Structures and Materials

**BMEEOHSAS46**

Experimental demonstration the behaviour of the loaded structural members and joints made from different materials (steel, reinforced or prestressed concrete, composite, glass...). Introduction into different experimental and measurement techniques and equipments. Up-to-date building materials and material testing methods. General and specific analytical and diagnostic methods for building materials and structures. (2 credits)

## Structural Analysis II.

**BMEEOTMAS42**

Problem statements for mechanical problems. Solution with approximative displacement functions, Ritz method. Fundamentals of the finite element method. Fundamentals of matrix analysis and application for computation of structures. Equations of the Euler-Bernoulli beam model. Equations of the Timoshenko beam model. Models of bar structures: equations of truss, grid, planar and spatial frame models. Differential equations of the classical plate theory. Differential equations of the Mindlin plate theory. Analytical solution methods for the equations of plate problems, application of the finite element method. Differential equations of discs in the states of plane stress and plane strain. Analytical solutions of discs problems, application of the finite element method. Derivation of shell models, shell elements of the finite element method. (4 credits)

## Rock Mechanics

**BMEEOGMAS41**

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. (3 credits)

## Underground Structures, Deep Found.

**BMEEOGMAS42**

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. (3 credits)

### 3D constructional modelling of structures

**BMEEOHSAS45**

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. (3 credits)

### Design of Structures Projectwork

**BMEEODHAS41**

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. (6 credits)

### Public Administration and Land Registry

**BMEEOUVAT44**

Preparation of major civil engineering projects. Governance of Civil Engineering activities. World-wide examples. Case studies for Public Transport and/or Water Management. Private and public projects. Investments by modern Public Private Partnerships. Lessons on Civil Engineering "Mega-Projects". [Major Canals, Bridges. Motorways. Channel Tunnel, Oresund Bridge.] Student studies and presentations on actual projects. Public participation. The Role of Civil Organisations. Chamber of Engineers, Institute of Civil Engineers. International Organisations. [PIARC, IRF, UIC, UITP, IABSE, IAHR]. The process of public procurements. Competition and transparency requirements.
Authorisitation processes. Participants and stake-holders. Legal and administrative requirements. Environmental Acts, Decrees and Guidelines. Land registry processes and tasks. Real estate valuation. Elementary Cost – Benefit – Analysis. Financing and banking requirements. (3 credits)

### Field Course of Structural Geodesy

**BMEEOAFAS42**

The main purpose of the subject is introduce the most modern techniques and methods for students in the field of state surveying and movement detection of civil engineering structures. The students apply the skills and knowledges learned in Surveying I, II and Field Course of Surveying to solve more complex structural engineering projects. Project are solved by students team. During the practices students survey some inner parts of a more levelled building, determine the geometry of axis of an about 30 m high brick chimney. Furthermore they determine the deflections of a slab and the distortions of floor. They determine the deflection of a cable bridge caused by traffic. They are introduced into the applications of photogrammetry, remote sensing and laserscanning in the area of construction engineering. (1 credit)

### Dynamics of Structures

**BMEEOTMAS43**

Computation of the equivalent mechanical model of structures with a single degree of freedom: stiffness, mass, damping, consideration of friction. Differential equation of motion. Vibration of mechanical systems with a single degree of freedom: free vibration, forced vibrations with harmonic excitation, general excitation, and excitation with support motion for undamped and damped systems. Modeling of systems with multiple degrees of freedom, meaning of the matrices of the system. Differential equation system of motion. Vibrations of mechanical systems with multiple degrees of freedom: free vibration, forced vibrations with harmonic excitation, general excitation, and excitation with support motion. Free vibrations of continua: differential equation of vibrating strings, axial and flexural vibration of beams. Fundamentals of earthquake analysis, response function of structures, meaning and usage of response spectrum. (3 credits)

### Industrial Practice

**BMEEODHAS42**

20 days of industrial practive at a civil engineering construction company. (0 credits)

## Major of Buildings

### Steel Buildings

**BMEEOHSA-A1**

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. (5 credits)

### Reinforced Concrete Buildings

**BMEEOHSA-A2**

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. (5 credits)

### Building Construction Methodology

**BMEEOEMA-A1**

During the semester methodology of planning, methods of design of building constructions are presented. Listing of requirements depend on function of building (building physical, acoustical point of views and fire protection). Designation of structural hierarchy based on the determined requirements. Building constructional relationship and design rules: i) skirtings - connections of load-bearing structures ii) structures of floors (floors on ground, floors of general slabs) - connections of load-bearing structures iii) facade - connections of load-bearing structures iv) thermal insulation and rainwater seepage, soil moisture and waterproofing - connections of load-bearing structures v) special

building constructions (windows, doors, gates), structures of fire protection (skylights, suspended walls against fume spreading). (2 credits)

### Engineering Works

**BMEEOHSA-B3**

The basis of the design and construction of engineering works is presented. The discussion holds on the waterproofing of reinforced concrete structures with waterthight concrete, on the thermal effects and on the description of time dependent strains of concrete structures. The use of cast-in-place and precast concrete in engineering works is presented. Some other modules: modelling the soil and structure interaction. Design aspects of pools, tanks and tower-like structures. Internal forces and reinforcements of typical structural elements of engineering works: rectangular, circular and ring plates, walls, wallbeams, box-like and shell structures. Dynamics of tower-line structures: wind effects and seismic action, dampers, wind turbines. (3 credits)

### Building Design Projectwork

**BMEEOHSA-AP**

Students need to accomplish a complex projectwork that is based on the major subjects. Students need to regularly attend consultations and get support from the supervisor(s). (6 credits)

### Diploma Project

**BMEEODHA-AD**

(24 credits)

Elective option:

### Reinforced Concrete bridges

**(BMEEOHSA-B2)**

Long-term behaviour of concrete. Typical cross-sectional forms of concrete superstructures. Reinforced concrete slabs. Grid type and box girder bridges. Precast concrete superstructures. Prestressing in bridges: idea and technologies. Modern construction methods: incremental launching, segmental and monolithic balanced cantilever methods. Cable-stayed bridges. Arch bridges. Maintenance and strengthening of concrete superstructures. Typical structural types of timber bridges: truss, frame, arch, plate, hippedplate and suspension bridges. Structural analysis of timber pedestrian bridges. Durability and fire timber bridges. Constructive timber preservation. (4 credits)

## Description of MSc Courses
## MSc in Structural Engineering

### Advanced Mathematics

**BMETE90MX33**

Heat equation on an interval. The wave equation on an interval The wave equation on the line. Convolution Fourier transform. The fundamental subspaces of a matrix. Orthogonal projection to a subspace. Power method. Singular value decomposition. Pseudoinverse. (3 credits)

### Physics Laboratory

**BMETE11MX22**

Measurement of the eigenmodes of a vibrating string by an oscilloscope. Study of the excited vibration of a mass on a spring with the help of a computer controlled ultrasonic distance detector. Basic measurements in optics (lenses, prism, polarization, diffraction). Measurement of submicron expansions (thermal expansion, magnetostriction) by Michelson interferometer. Measurement of specific heat and the heat of fusion in a stainless steel vacuum flask. Study of a solar collector model system. (1 credits)

### Methods of Engineering Analysis

**BMEEOHSMK51**

The objective of the course is that the student shall understand and be aware of the principles and basis of methods of engineering analysis and assessments, statistics, probability theory, reliability analysis, numerical methods, risk analysis, optimization and digital sign processing. It also serves as the basis of the subsequent MSc subjects on modelling, design and programming. (3 credits)

### Numerical Methods

**BMEEOFTMK51**

The aim of this course is that students learn and apply skill level at solving engineering problems numerically on computers, as well as to introduce the basics of Building Information Modelling (BIM). At the beginning of the semester BIM systems and their application opportunities are introduced, later the principles of the most relevant numerical techniques including their advantages, disadvantages and applicability are presented during laboratory practices. Students may learn and apply mathematical procedures suitable for solving and visualizing technical problems on computer practices. A further purpose of this course is to prepare the students for later independent research. (4 credits)

### Building Physics

**BMEEOEMMS51**

The aim of the subject is that the students get to know the basics of modern building physics, the theory of the heat conduction, convection, heat radiation, heat transport processes, the tech-nical alternatives of the heat loss reduction of buildings and building constructions, the role of outdoor and indoor environment-related boundary conditions in building physical calculations and the method of determining these parameters, the analytical calculations of the of heat transport, the theory and practical application of non-steady-state, transient, non-linear and multi-dimensional heat transport processes, as well as conjugated heat-moisture and air transport simulations, and basics of city-scale building-physics. (3 credits)

### Geodynamics

**BMEEOGMMS51**

The subject focuses on the understanding of dynamic effects that are transferred from the geological environment to the engineering structures. The students are getting familiar with geophysics, rock stress and its interpretation and graphic representation, local and world-scale (Word Stress Map). The deformations caused by seismic waves in igneous, metamorphic and sedimentary rocks also form part of the subject, as well as deformations caused by historic earthquakes. A main topic is the understanding of the Earth's

structural geology and seismicity with special emphasis on the Carpathian basin. The lectures will help in learning the detection methods of seismic waves and acquire the information content of the seismograms. By completing the course the students will able to determine the parameters that are necessary for appropriate seismic design. Engineering seismological approach will help the students to place the structures in the geological environment allowing the minimal risk and reducing the cost by proper seismic design. (3 credits)

## Materials' science for civil engineers

**BMEEOEMMS52**

Main objective of this subject is to learn a wide range of special material properties used for structural design. Within this subject special material properties and material processes are taught including: definition of performance based material properties, role of micro-structure of materials to their properties, related physical-chemical processes, possibilities in modelling, re-lationship of sustainability – durability – service life, possibilities of nanotechnology in civil en-gineering, possibilities in reuse and recycling in civil engineering. (3 credits)

## FEM for Civil Engineers

**BMEEOTMMS51**

The goal of the subject is to present the theoretical bases of the finite element method and its practical application to typical structural engineering problems. The classic approach to the finite element method will be followed in presenting the basic idea of the method, the element types, the applied interpolation functions, the various matrices and the basic steps of their construction, the resulting system of equation and the solution techniques of it. All these will be demonstrated and practiced through examples, showing how the various structure types (trusses, beams, frames, plates, shells, 3D solids) can be analysed. An introduction to nonlinearities from various sources will be given, with special focus on the effect and handling of geometric nonlinearity. Beside the static problems, the application of the finite element method to some heat transfer problems of the structural engineering practice will also be discussed. (5 credits)

## Soil-structure interaction

**BMEEOGMMS52**

The scope of the subject is to teach the students the fundamentals of geotechnics required for structural design, such as familiarity with and use of EC7. These include geotechnical categorization; types and contents of geotechnical documentations; geotechnical and structural design of piles for different loading types, design of soil-supported ground slabs along with the determination of the values of subgrade reaction modulus; design of pile-supported ground slabs and "rigid inclusion" slabs; structural design of excavation support structures, determination of soil reaction moduli along with their effect on deformations and internal forces; design of ground anchors; geotechnical questions of bridge abutments; and the basics of soil dynamics and geotechnical earthquake engineering. (5 credits)

## Structures 1

**BMEEOHSMS51**

The objective of the subject is the modelling of beams, membrans, plates and the simplest circular shell structures. The most important analytical solutions, the basics and assumptions of numerical solutions are introduced. It's presented that the different structural considerations can be implemented in the design codes and regulations. The fundamental membrane solutions, shear lag effect, effective width, shear deformation, second-order effects and large deformations, anisotropy and the vibration of floors are also analysed. The main focus of the subject is the analysis of plates and slabs. (5 credits)

## Numerical modeling project

**BMEEOTMMS5P**

The goal of the subject is that the students solve a civil engineering problem the complexity of which is in accordance with the level of the MSc course and with the credit and time-frame of the subject. The problem should be solved by high level application of some analytical or numerical method (e.g., finite element method). The problem is solved by the individual work of the student, helped by a tutor. (5 credits)

## Structures project

**BMEEOHSMS5P**

The objective of the course is that the student shall solve a structure-specific problem, by which his/her problem solving skills are improved, gains the skill of literature review, aims the comprehensive thinking. Aim is that the student becomes able to efficiently solve problems arising during design or research tasks. The subject of the study can be any structure-related problem discussed and agreed with the supervisor; not exclusively: modelling, analysis and/or design of part of or whole structural system, experimental analysis; research, research and development or expert design task; based on individual problem statement or joining to ongoing research program. (5 credits)

## Geotechnical and engineering geological project

**BMEEOGMMS5P**

The goal of the subject, that the students are getting familiar with the geotechnical and engineering geological design process. The students get to know through a project work the geotechnical, engineering geological data collection, modelling, design and calculation tasks. Furthermore, they get familiar with practical application of analytical and numerical design methods. (5 credits)

## Decision Supporting Methods

**BMEEPEKMST4**

The aim of the course is to familiarize students with some practically used or usable mathematical models in the field of construction management, scheduling and tendering process. The course covers a wide variety of topics dealing with least cost scheduling problems, multi attribute decision models, learning curves. There are two computational modeling tasks as homework assignments. Final grades will be based on the two assigned tasks 15-15% and test 70%. (2 credits)

## Accounting, Controlling, Taxation

**BMEGT35M014**

The main issues of 'window dressing' and their interpretation through financial ratio analysis and interpretation. The cost volume profit analysis and its relationship with costing and pricing decision-making. The operational and capital budgetary process in an international context and its advisory role through the process of variance analysis. The best international accounting practice both at the functional,

planning and strategic stages. The wider developmental strategic and ethical international issues concerned with managerial accounting. (2 credits)

## Engineering Ethics

**BMEGT41M004**

The purpose of this course is to help future engineers be prepared for confronting and resolving ethical issues that they might encounter during their professional careers. It gives an overview of the moral problems engineers face in their different social roles, and it provides conceptual tools and methods necessary for pursuing those issues. Topics include engineering professionalism; social roles of engineers; ethical theories; ethical decision making techniques; social impacts of engineering, professional organizations; code of ethics of engineering societies. Case studies are discussed in a practice oriented approach. The primary goal is to stimulate critical and responsible reflection on moral issues surrounding engineering practice. (2 credits)

## Structural Dynamics

**BMEEOTMMN-1**

The purpose of the course is that students become familiar with the dynamic tasks occurring in the structural engineering practice, and the mechanical-mathematical background of their solution methods. There will be emphasized: the differential equations used to describe the continuum of mechanical vibration and their analytical and numerical solution methods, free vibration of multiple degrees of freedom systems and its approximate solutions, computation methods of mass and stiffness matrix of the (finite element method) discretized structures, taking into account the damping, dynamic issues supporting effect of the soil, the mechanical background of earthquake analysis of structures and the efect of wind. (4 credits)

## Stability of Structures

**BMEEOHSMT-2**

The objective of the subject is the presentation of the most important problems in the stability analysis and stability design of steel structures. The student will learn the terminology of theory of engineering stability and theory of torsion of thin-walled members, as well as their practical importance and applicability. The most relevant modes of instabilities of engineering steel structures will be presented (flexural buckling, flexural-torsional buckling, lateral-torsional buckling, plate buckling). To each instability mode the student will learn the background and mathematical bases, as well as the Eurocode design procedures and their practical applications. (4 credits)

## Nonlinear Mechanics

**BMEEOTMMN-2**

The subject is the continuation of the Strength of Materials subjects taught in the Civil Engineering BSc programme on the expansion and the generalization of its linear models. Its two main goals are:
A./ the students will become acquainted with the approaches of nonlinear mechanics, its variables used in theoretical and numerical modeling, and the principal equations required for the formulation of nonlinear mechanical problems. The application of various nonlinear strain and stress tensors is analysed, furthermore the origination of the equations in the form of a general boundary and/or initial value problem or as a variational problem formthe most important types of engineering structures.
B./ The second important goal is to get to know the theoretical background required for the - primarly finite element - analysis of nonlinear problems, with an emphasis on the tehoretical and practical differences between the linear and nonlinear analysis. (4 credits)

## Plasticity

**BMEEOTMMN61**

The purpose of the subject is, that the students acquire the basic concepts and methods of plasticity. In the frame of this they will get to know the material models, yield and hardening conditions of plasticity. The torsion problem of prismatic bars, and planar problems of solids will be learnt through examples and applications. There will be an emphasis given to the plastic load bearing capacity of elasto-plastic frame structure, and their limit states. (3 credits)

## Nonlinear FEM

**BMEEOTMMN62**

The main goal in this subject is, that the students get to know the solution with the finite element method (FEM) of the nonlinear mechanical problems typical in engineering practice, alongside with the mathematical background of the solutions. The specialities of one- and multidimensional problems will be discussed. There will be interpreted the nonlinear behaviour of the most important stuctures (beams, frames, plates, shells) from the practical use, with a focus on the important questions about the effect of large displacements and plastic deformations. Beyond the general nonlinearity the students will learn the special techniques (finite strip method, finite volume method, boundary element method, meshfree methods, smooth and finite particle methods, etc.). As an organic part of the course, students will analyse case studies solved by computer simulation, in order to deeper understand the modeling techniques of various nonlinearities and connect theory and practice. (3 credits)

## Analysis of Rods and Frames

**BMEEOTMMN63**

The goal of the subject is to get students to know the modeling possibilities of rod structures appearing in the structural engineering practice, the theoretical background of the models. Based on the linear mechanical model of the generalized beam element students will be acquainted with the calculation of the stiffness matrix and load vector of frame structures and their generalizations e.g. trusses, grids, and infilled frames. Higher-order analysis of kinematically indeterminate structures with high importance in engineering practice will be learnt. (3 credits)

## Discrete Element Method

**BMEEOTMMN64**

The goal of the subject is to get students to know the basics of the concept and methodology of the discrete element methods (DEM) occurring in the structural engineering practice, and allow an insight to the operation of a discrete element software. Students will learn the most important variations DEM, th applied equations of motion, their numeric solution methods with the limits of applicability, advantages and disadvantages. Students will analyse the model of a simple engineering problem. (3 credits)