Description of Civil Engineering BSc courses

General courses

Compulsory English 1. (4 credits) **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.

Surveying I. (3 credits) **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 eccentric 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.

Chemistry of Construction Materials (2 credits) **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.

Civil Engineering Representation and Drawing (4 credits) **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 spatial 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.

CAD for Civil Engineers (2 credits) **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.

Geology (3 credits) **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.

Basis of Statics and Dynamics (6 credits) **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.

Mathematics A1a - Calculus (6 credits) **BMETE90AX00**

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

Physics for Civil Engineers (2 credits) **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. AC circuits, 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.

Compulsory English 2. (4 credits) **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

Surveying II. (4 credits) **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: reconnaissance, 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.

Construction Materials I. (5 credits) **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 properties of glass. Types of polymers.

Civil Engineering Informatics (5 credits) **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.

Soil Mechanics (4 credits) **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).

Introduction to Strength of Materials (6 credits) **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 linearly 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 materials. Shear centre of thin-walled cross-sections. Displacements of bent beams with straight axis. Principal stresses and principal directions.

Hydraulics I. (3 credits) **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.

Mathematics A2a - Vector Functions (6 credits) **BMETE90AX02**

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

Surveying Field Course (3 credits) **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).

Building Construction Study (3 credits) **BMEEOEMAT44**

Subject of architectural engineering, fundamental terms and base definitions. Relations 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.

Geoinformatics (3 credits) **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.

Basis of Design (3 credits) **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.

Structural Analysis I. (4 credits) **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.

Railway Tracks (3 credits) **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.

Basics of Environmental Engineering (3 credits) **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.

Public Works I. (3 credits) **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 public work types like water acquisition, drinking water supply, waste water networks, storm water networks and public works asset management.

Hydrology I. (3 credits) **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.

Mathematics A3 for Civil Engineers (4 credits) **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 and their distributions. Random variables of continuous distribution. Two-dimensional distributions, correlation and regression. Basic notions of mathematical statistics.

Earthworks (3 credits) **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 design, executional and monitoring questions of construction. Dewatering of earth works. Geosynthetics.

Steel Structures (3 credits) **BMEEOHSAT42**

Lectures of Steel Structures have the general aim to study the basics of the design of steel structures, which consists of the design of simple structural members, simple joints and the investigation of the basic failure phenomenon, which can occur 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.

Reinforced Concrete Structures (3 credits) **BMEEOHSAT43**

Structural safety of reinforced concrete (RC) structures; loads and effects on RC structures, 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.

Roads (2 credits) **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 points on a contour line map.

Hydraulic Engineering, Water Management (3 credits) **BMEEOVVAT43**

The tasks, methods and tools of water management. Hungarian and European specialties 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, characteristic environmental impacts of hydraulic engineering structures. During the practical lessons four design works will be elaborated.

Construction Management (3 credits) **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 equipment 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.

Business Law (2 credits) **BMEGT55A001**

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

Foundation Engineering (4 credits) **BMEEOGMAT44**

Foundation Types. Design of rigid and flexible shallow 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.

Management and Enterprise (4 credits) **BMEGT20A001**

Intended for engineering students who would like a better conceptual understanding of the role of management in the 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.

Micro- and Macroeconomics (4 credits) **BMEGT30A001**

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

Communication Skills for Civil Engineers (2 credits) **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.

Urban and Regional Development (3 credits) **BMEEOUVAT43**

Infrastructure and Regional Development. Historical construction processes of canals, railways, motorways. Aviation and the internet age. Liveable, 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.

Branch of Structural Engineering

Building Construction I. (3 credits) **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.

Timber Structures (3 credits) **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.

Strength of Materials (3 credits) **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 stationary 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.

Construction Materials II. (3 credits) **BMEEOEMAS41**

Importance of selection construction materials. 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. Aggregates 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.

Building Construction II. (3 credits) **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.

Steel and Composite Structures (4 credits) **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.

Reinforced Concrete and Masonry Structures (4 credits) **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.

Bridges and Infrastructures (3 credits) **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.

Laboratory Practice of Testing of Structures and Materials (2 credits) **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 equipment. Up-to-date building materials and material testing methods. General and specific analytical and diagnostic methods for building materials and structures.

Structural Analysis II. (4 credits) **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.

Rock Mechanics (3 credits) **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.

Underground Structures, Deep Foundation (3 credits) **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.

3D constructional modelling of structures (3 credits) **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.

Design of Structures Projectwork (6 credits) **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.

Public Administration and Land Registry (3 credits) **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.

Authorisation 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.

Field Course of Structural Geodesy (1 credit) **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 knowledge 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.

Dynamics of Structures (3 credits) **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. Modelling 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.

Industrial Practice (0 credits) **BMEEODHAS42**

30 days of industrial practice at a civil engineering construction company.

Major of Buildings

Steel Buildings (5 credits) **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. High-rise and tall buildings.

Reinforced Concrete Buildings (5 credits) **BMEEOHSA-A2**

Formation of reinforced concrete buildings, loads and effects, basics of earthquake design. Plastic behaviour of flat slabs, prestressing. Structural systems of high-rise 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.

Building Construction Methodology (2 credits) **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).

Construction Technology (3 credits) **BMEEOHSA-K1**

Fabrication and erection of steel and reinforced concrete structures. Technology aspects on steel structures: welding technology and practice, brittle fracture and choosing of material subgrade. Special processes of concrete building technology.

Building Design Projectwork (6 credits) **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).

Elective option: Reinforced Concrete bridges (4 credits) **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, hipped-plate and suspension bridges. Structural analysis of timber pedestrian bridges. Durability and fire timber bridges. Constructive timber preservation.

Preparatory Course for Bachelor Thesis Project (9 credits) **BMEEODHA-PT**

The cursus aims to give a background for the student to successfully complete the requirement of the Bachelor Thesis project by obtaining the basic knowledge on the subject of the Bachelor Thesis project to prepare studies and preliminary design plans. The topic of the Preparatory Course for Bachelor Thesis project is given by the Diplomawork assignment covering the topics of both the Preparatory Course for Bachelor Thesis project and the Bachelor Thesis project. The topic is from within the domain of structural engineering in accordance with the outcome requirements, it has to be assigned by giving the possibility to continue it in the Bachelor Thesis project course..

Bachelor Thesis Project (15 credits) **BMEEODHA-PS**

The student should prove that he/she has acquired the knowledge and fulfilled the general requirements required by the BSc programme. The Bachelor Thesis project course establishes the frame to the special workflow for structural engineering. The subject of the Bachelor Thesis project is from within the domain of structural engineering in accordance with the outcome requirements.