Faculty of Mechanical Engineering

IMPORTANT NOTES

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEÁTA4SD	BSc Final Project	Mid-semester mark	15

Course type	Course code	Course language	Timetable information
Practice	A-2017o-G	English	

SUBJECT DATA SHEET AND REQUIREMENTS last modified: 31th January 2014 BSc FINAL PROJECT SZAKDOLGOZAT KEacute;SZIacute;TEacute;S 1 Code Semester Nr. or fall/spring Contact hours/week (lect.+semin.+lab.) Requirements p / e / s Credit Language BMEGEAacute;TA4SD (7.) fall 0+10+0 p 15 English 2. Subjectrsquo;s responsible: Name: Title: Affiliation (Department): Dr. Jenő Mikloacute;s SUDA assistant professor Dept. of Fluid Mechanics 3. Lecturer: Name: Title: Affiliation (Department): - - Dept. of Fluid Mechanics 4. Thematic background of the subject: Knowledge of the subjects of the BSc in Mechanical Engineering and spec. in Process Engineering. 5. Compulsory / suggested prerequisites: Compulsory: Pre-requisite is 175 credits. 6. Main aims and objectives, learning outcomes of the subject: The aim of the course is to develop and enhance the capability for complex problem solving of the students under advisory management of their project leader (supervisor) and advisor. Each studentrsquo;s individual project is guided by the supervisor and depending on the problem -if applicable- by advisor(s). 7. Method of education: lecture 0h/w, seminar 10h/w, laboratory 0h/w Individual project work. Helped by regular consultations with the supervisor (and advisor). Several experimental and/or numerical (CFD) final project proposals are announced by the supervisors before the registration week on the subjectrsquo;s website (see ch.12.). In course of the BSc Final Project one individual student will work on one selected challenging (theoretical and/or experimental and/or numerical) problem of mainly fluid mechanics. 8. Detailed thematic description of the subject: - 9. Requirements and grading a) in term-period: BSc Final Project (=BSc Thesis): Submission deadline: see on the Project Assignments (4PM on the last working day (Friday) of the semester: 14th week) in printed AND also in electronic (CD/DVD) format. It is obligatory to use a common template for format: see detailed template on the subjectrsquo;s website. Document length: approx. 50 (min. 35 ndash; max. 70) pages. (Body text from the Introduction through the main Chapters up to the Conclusion, including Figures, Tables, etc.). The Report must contain the one and original signed Project Assignment document and all data that is used in course of the project. b) in examination period: - c) The students are subject to disciplinary measures against the application of unauthorized means at mid-terms, and the application of the 1/2013. (I.30.) Deanrsquo;s Order must be followed. 10. Retake and repeat: Due to the Code of Studies and Exams of BME. 11. Consulting opportunities: Consultation hours: by email appointments and as it is indicated on the departmentrsquo;s website. Weekly consulting hours will be provided. The consultation time can be enquired at the department administration after the registration week of the active semester. 12. Reference literature (compulsory, recommended): middot; http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATAA4SD 13. Home study required to pass the subject: Contact hours 140 h/semester Home study for the courses 310 h/semester Home study for the mid-semester checks - h/check Preparation of mid-semester homework - h/homework Home study of the allotted written notes - h/semester Home study for the exam - h/semester Totally: 450 h/semester 14. The data sheet and the requirements are prepared by: Dr. Jenő Mikloacute;s SUDA assistant professor Dept. of Fluid Mechanics

Subject code	Subject name	Requirement	ECTS credit
BMEGEÁTAG11	Fluid Mechanics	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Laboratory	A-2017o-L1a-prs	English	TUE:16:15-18:00(AE_NAGYLAB);
Lecture	A-2017o-E	English	TUE:10:15-12:00(KF83);
Practice	A-2017o-G1	English	WED:16:15-18:00(KF83);

ENGLISH course: Main aims and objectives, learning outcomes of the subject: Students will acquire the knowledge necessary to understand and describe the flow of gaseous and liquid fluids, which is important from a technical point of view. Building on this knowledge, the laboratory sessions and seminars will show the students how to solve technical problems related to the flow of a medium. An emphasis will be placed on knowledge related to flow measurements, measurement techniques applied in evaluating flow phenomena occurring in fluid machinery, equipment, and ducts. The students will be evaluated on their ability to learn the theory and apply it to practical problems. These evaluations will be in the form of mid-term exams, tests, and laboratory measurements. This subject prepares the students for their engineering careers by teaching them to recognize fluid mechanics related problems, provides them with the knowledge necessary to solve common problems, and gives them a solid foundation on which they can build in taking on complex assignments. Detailed thematic description of the subject: LECTURES: 1.Properties of Fluids, Newton’s law of viscosity. Cavitation, description of fluid flow, force fields. 2.Characterisation and visualisation of flows, free (irrotational) vortex, continuity theorem, hydrostatics3.Fluid acceleration, Euler-equation, Bernoulli-equation, total, static, and dynamic pressure4.Basic examples for the Bernoulli-equation: flow rate measurement using a Venturi-tube, measurement of pressure, velocity, and volume flow rate5.Syphon, rotating pipe pump, unsteady discharge from a vessel6.Euler equation in the streamline coordinate system, vortex theorem, floating bodies7.Momentum theorem and its applications, jet contraction, Borda-Carnot expansion, Pelton turbine8.Kutta-Joukowsky theorem, Allievi theorem, Euler turbine equation, propeller, wind turbine9.Non-newtonian fluids, momentum equation, Navier-Stokes equation, laminar flow in a pipe, laminar / turbulent flow10.Hydraulics, dimension analysis, Bernoulli-equation with losses, friction factor, losses in pipe components11.Bernoulli equation for compressible fluids, similarity of flows, boundary layer, mixing length model of turbulence, flat plate boundary layer12.Energy equation, speed of sound, wave propagation in gases13.Discharge from a vessel, use of a Laval nozzle and its simplified calculation14.Force acting on solid bodiesCLASSROOM SEMINARS: Problem solving according to the topics covered during the lecture, mid term exams.LABORATORY:1st-3rd weeks: preparatory classes: introduction of measurement techniques and instruments4th-7th : laboratory measurements, lab report submission + presentations

Subject code	Subject name	Requirement	ECTS credit
BMEGEÁTMW02	Computational Fluid Dynamics	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Lecture	A-2017o-E	English	WED:10:15-12:00(KF87);
Practice	A-2017o-G3	English	THU:12:15-14:00(AE_CFDLAB);
Practice	A-2017o-G2	English	THU:10:15-12:00(AE_CFDLAB);
Practice	A-2017o-G1	English	THU:08:15-10:00(AE_CFDLAB);

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEÁTMW08	Building Aerodynamics	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	A-2017o-L	English	WED:10:15-12:00(AE_NAGYLAB);
Lecture	A-2017o-E	English	WED:08:15-10:00(AE_MERLEG-T);

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEÁTMW17	Multiphase and reactive flow modelling	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	A-2017o-E	English	TUE:12:15-14:00(AE_MERLEG-T);

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEÁTMW19	Aerodynamics and its Application for Vehicles	Mid-semester mark	3

Course type	**Course code**	**Course language**	**Timetable information**
Laboratory	A-2017o-L	English	WED:14:15-16:00(AE_NAGYLAB);
Lecture	A-2017o-E	English	WED:14:15-16:00(AE_MERLEG-T);

This subject is available from 2014. This is the same but quot;re-designedquot; subject amp; course with a new code instead of the previous(BMEGEAacute;TMW09) subject. Please, register to the courses of this NEW code: BMEGEAacute;TMW19! Streamlined body aerodynamics: theory of airfoils, streamlined bodies of revolution, streamlined bodies of finite extension. Compressibility effects, flows with variable air density. Impact of aerodynamics on aircrafts at sub-sonic and supersonic speeds. Bluff body aerodynamics: boundary layer separation, characteristics of separated flows, vortices, their effects on the flow and their detection techniques, description of complex 3-dimensional flow fields. Principles of aerody-namic design and optimization of passenger car bodies, trucks and buses. Basics of flow control: control techniques without flow separation (turbulators, boundary layer blow down and suction), and with flow separation (high lift devices, vortex generators, winglets). STOL aircraft, delta wing aircraft, Formula 1 race car aerodynamics.

Subject code	Subject name	Requirement	ECTS credit
BMEGEÁTMW22	Aero-Elasticity	Mid-semester mark	3

Course type	**Course code**	**Course language**	**Timetable information**
Lecture	A-2017o-E	English	TUE:14:15-16:00(AE_MERLEG-T);

Subject code	Subject name	Requirement	ECTS credit
BMEGEÁTMWDA	Final Project A	Mid-semester mark	15

Course type	**Course code**	**Course language**	**Timetable information**
Practice	A-2017o-G	English	

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEÁTMWDB	Final Project B	Mid-semester mark	15

Course type	**Course code**	**Course language**	**Timetable information**
Practice	A-2017o-G	English	

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEÁTMWTP	Teamwork Project	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	A-2017o-L	English	

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEENAEHK	Heat Transfer	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	18-1-ENG-E	English	MON:16:15-18:00(D224);
Practice	18-1-ENG-G1	English	TUE:08:15-10:00(D218);
Practice	18-1-ENG-G2	English	TUE:08:15-10:00;

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEENAG51	Measurement at Energy and Environment Protection	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	18-1-ENG-LAB	English	WED:10:15-12:00(D224);
Practice	18-1-ENG-G	English	WED:08:15-10:00(D224);

Measurement at Energy and Environment Protection Aims and objectives and description of the course: middot; Fundamentals of measurement theory and basic metrological concepts. middot; Measurement procedures and data processing techniques. middot; The measuring system components and characteristics. middot; Basics of emissions, temperature, energetic and heat engines measurements. Learning outcomes: The main outcomes are the general overview of measurements of energetic systems, different temperature and emission measuring systems. The students has practice to use this elements. Course descriptiption: The role of measurements in maintaining and controlling the energy conversation processes. Hardware and software tools of the control and measurement systems. Laboratory tests of different engines and equipments. Simultaneous determination of system variables (flow rates, pressures, temperatures, etc.). Methods of determination of performance, efficiency, exhaust gas composition. Methodology to be used: Three hour lectures and laboratory test per week. The presentations are oral presentations, with computer projection, and notes on the blackboard. Presentation of the theoretical background and lab tests. URL: ftp://ftp.energia.bme.hu/pub/TAD/SDS_BMEGEENAG51_Measurement_at_Energ_and_Environment_Protection.pdf

Subject code	Subject name	Requirement	ECTS credit
BMEGEENAG71	Energy Processes and Equipments	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Laboratory	18-1-ENG-LAB	English	FRI:11:15-13:00(D218);
Lecture	18-1-ENG-E	English	FRI:08:15-11:00(D218);

Energy Processes and Equipment Aims and objectives and description of the course: The course gives a general overview of energy production and energy generation systems functioning and operation, importance of energy management. Opportunities and challenges are also discussed. Learning outcomes: General overview of energy production and energy generation systems function and operation. Course description: The Detailed topics are: basic processes of energy conversion fossil, and renewable energy sources. Steam and gas turbine, IC engines, fuel-cells, solar collectors, power stations: gas, steam, nuclear, and combined heat and power generation. Energy saves consumer equipments. Methodology to be used: Three hour lectures and two laboratory test per week. The presentations are oral presentations, with computer projection, and notes on the blackboard. URL: ftp://ftp.energia.bme.hu/pub/TAD/SDS_BMEGEENAG71_Energy_Processes_and_Equipments.pdf

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

Course type	**Course code**	**Course language**	**Timetable information**
Laboratory	18-1-ENG-LAB	English	WED:08:15-10:00(D318);
Lecture	18-1-ENG-E	English	MON:08:15-10:00(D218);
Practice	18-1-ENG-G	English	WED:08:15-10:00(D318);

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

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

Course type	**Course code**	**Course language**	**Timetable information**
Practice	18-1-ENG-G	English	

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

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

Course type	**Course code**	**Course language**	**Timetable information**
Practice	18-1-ENG-G	English	

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEENMWTU	Steam and Gas Turbines	Mid-semester mark	3

Course type	**Course code**	**Course language**	**Timetable information**
Lecture	18-1-ENG-E	English	TUE:12:15-14:00(D224);
Practice	18-1-ENG-G	English	TUE:14:15-16:00(D224);

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEEÉPAG62	Air-Conditioning	Exam	4

Course type	**Course code**	**Course language**	**Timetable information**
Lecture	A10	English	WED:08:15-10:00(KF86);
Practice	A11	English	WED:10:15-12:00(KF86);

Air-Conditioning BMEGEEacute;PAG62 Main aims and objectives, learning outcomes of the subject: The objective is the introduction to the fundamentals of air-conditioning systems in buildings providing a comprehensive knowledge on the theory and practice of system design and dimensioning with particular attention to the most recent technologies. By the end of this course you will: - Have knowledge about the aims of air-conditioning: providing comfort - both thermal and good indoor air quality, reduce energy consumption, increase energy performance, etc. - Be able to apply appropriate mathematical and computer-based methods for the calculation of buildingsrsquo; heat loads and cooling loads, sizing of air-conditioning elements. - Be able to apply knowledge of techniques, codes and standards of practice to the design of cooling components and systems. Method of education: The theoretical background will be interpreted via lectures, the calculations and tools will be presented during the seminars. Calculation problems/examples will require active participation. Detailed thematic description of the subject (by topic, min. 800 character): Date of class Topics to be discussed, readings required for the class Week 1 Introduction, AC systems, types Heat transfer Week 2 Thermal comfort Heat load calculation Week 3 Thermal comfort, examples Indoor Air Quality Week 4 Cooling load calculation h-x diagram, psychrometric chart Week 5 Elements, heat exchangers, hum. Volume flow rate calculation Week 6 Elements, heat exch. cooling, hum Injection Week 7 Test 1, HW out Injection Week 8 Pressure diagram Air Inlets, SCHAKO Week 9 Elements, heat recovery Week 10 Elements, filters Week 11 Air handling processes Duct network, sizing Week 12 Air handling processes Week 13 Air handling unit, calc. example Week 14 Test 2 HW in Requirements and grading a) in term-period Knowledge, understanding and skills are assessed through a combination of written tests and homework throughout the semester. Homework will be distributed during the semester and will have to be turned in by the end of the course, before the exam period. Later submission is allowed but a fee has to be paid and homework will have to be turned in by the 3rd week of the exam period. Homework will not be graded but is compulsory in order to receive a grade. b) in examination period The course ends with an exam in the exam period. Student will be allowed to take the exam if both mid-term and end-term tests are passed. c) Disciplinary Measures Against the Application of Unauthorized Means at Mid-Terms, Term-End Exams and Homework URL: http://epget.bme.hu/hu/14-oktatas/bsc/158-air-conditioning

Subject code	Subject name	Requirement	ECTS credit
BMEGEMMA4SD	BSc Final Project	Mid-semester mark	15

Course type	Course code	Course language	Timetable information
Practice	A	English	

One-semester long individual project work. 10 hours/15 credits. MM in the code specifically applied to the Department of Applied Mechanics.

Subject code	Subject name	Requirement	ECTS credit
BMEGEMMAGM1	Statics	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	AE	English	MON:10:15-11:00(D316A);
Lecture	FE	French	
Practice	FG	French	
Practice	AG	English	MON:11:15-12:00(D316A);

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEMMAGM3	Dynamics	Exam	5

Course type	Course code	Course language	Timetable information
Lecture	AE	English	WED:10:15-12:00(D316A);
Practice	AG	English	WED:16:15-18:00(D316A);

Dynamics Topics : Kinematics and kinetics of a particle. Constrained motion. Dynamics of a set of particles. Plane kinematics of rigid bodies. Relative kinematics. Plane kinetics of rigid bodies. Mass moments of inertia. Work and power theorems. Kinetic energy. Central and eccentric impact. General plane motion. Rotation about a fixed axis. Static and dynamic balancing.

Subject code	Subject name	Requirement	ECTS credit
BMEGEMMAGMV	Fundamentals of FEM	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	AL4	English	THU:15:15-16:00(MM_F15);
Laboratory	AL1	English	THU:12:15-13:00(MM_F15);
Laboratory	AL3	English	THU:14:15-15:00(MM_F15);
Laboratory	AL2	English	THU:13:15-14:00(MM_F15);
Lecture	AE	English	MON:12:15-14:00(KF87);

Subject code	Subject name	Requirement	ECTS credit
BMEGEMMMW03	Continuum Mechanics	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Lecture	E	English	THU:14:15-16:00(KF83);
Practice	G1	English	THU:16:15-17:00(KF83);

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEMMMW08	Mechanisms	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	E	English	THU:14:15-15:00(D316B);
Practice	G	English	THU:15:15-16:00(D316B);

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEMMMW09	Beam Structures	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	E	English	THU:08:15-09:00(KF84);
Practice	G	English	THU:09:15-10:00(KF84);

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEMMMW10	Experimental Methods in Solid Mechanics	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	L	English	TUE:10:15-12:00(MM_I29);
Lecture	E	English	TUE:10:15-12:00(MM_I29);

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEMMMWDA	Final Project A	Mid-semester mark	15

Course type	Course code	Course language	Timetable information
Practice	AD1	English	

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEMMMWDB	Final Project B	Mid-semester mark	15

Course type	Course code	Course language	Timetable information
Practice	AD2	English	

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEMMMWP1	Teamwork Project	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	P	English	MON:10:15-12:00(MM_I29);

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

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

Course type	Course code	Course language	Timetable information
Practice	ASZ	English	

Subject code	Subject name	Requirement	ECTS credit
BMEGEMMMWTM	Thermo-Mechanics	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	L	English	WED:12:15-14:00(MM_F15);
Lecture	E	English	WED:12:15-14:00(MM_I29);

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEPTAGE2	Injection molding	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	L	English	WED:08:15-10:00(MT_PTLAB);
Lecture	E	English	WED:08:15-10:00(MT_PTEA);

Objectives: theoretical and practical understanding of the injection molding technology. Knowledge of production engineering and design aspects of modern plastic products. Understanding of the most advanced design and simulation procedures. Topics: detailed description of the injection molding technology. Analysis of the process cycle diagram. Construction and operation of injection molding machines. Design for injection molding. Materials for injection molding, and fiber reinforced materials. Methods for the identification and elimination of molding defects. Injection mold design and injection molding simulation. /* Style Definitions */ table.MsoNormalTable {mso-style-name:"Normál táblázat"; mso-tstyle-rowband-size:0; mso-tstyle-colband-size:0; mso-style-noshow:yes; mso-style-priority:99; mso-style-parent:""; mso-padding-alt:0cm 5.4pt 0cm 5.4pt; mso-para-margin-top:0cm; mso-para-margin-right:0cm; mso-para-margin-bottom:8.0pt; mso-para-margin-left:0cm; line-height:107%; mso-pagination:widow-orphan; font-size:11.0pt; font-family:"Calibri",sans-serif; mso-ascii-font-family:Calibri; mso-ascii-theme-font:minor-latin; mso-hansi-font-family:Calibri; mso-hansi-theme-font:minor-latin; mso-fareast-language:EN-US;}

Subject code	Subject name	Requirement	ECTS credit
BMEGEPTAGE3	Polymer processing	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	L	English	WED:10:15-12:00(MT_PTLAB);
Lecture	E	English	WED:10:15-12:00(T111);

The aims of this subject is at familiarizing the students with the polymer processing technologies in details: preliminary techniques, extrusion, blow molding, thermoforming, rotational molding, polymeric foams and elastomers technology. Topics: classification of polymer processing technologies. Basic rheological aspects of polymers. Preliminary techniques of polymer processing (material conveying, drying, mixing, dosing etc.). Calendering. Extrusion. Extruder constructions, single and twin screw extruders. Compounding wit extruder. Extrusion dies (film blowing, flat film-, pipe, sheet, profile extrusion; extrusion blow molding; extrusion coating). Thermoforming: vacuum and pressure forming. Rotational molding. Foams technology: thermoplastic and thermoset foams. Elastomer technologies. Finishing and decoration. Joining technologies: welding and adhesive bonding. /* Style Definitions */ table.MsoNormalTable {mso-style-name:"Normál táblázat"; mso-tstyle-rowband-size:0; mso-tstyle-colband-size:0; mso-style-noshow:yes; mso-style-priority:99; mso-style-parent:""; mso-padding-alt:0cm 5.4pt 0cm 5.4pt; mso-para-margin-top:0cm; mso-para-margin-right:0cm; mso-para-margin-bottom:8.0pt; mso-para-margin-left:0cm; line-height:107%; mso-pagination:widow-orphan; font-size:11.0pt; font-family:"Calibri",sans-serif; mso-ascii-font-family:Calibri; mso-ascii-theme-font:minor-latin; mso-hansi-font-family:Calibri; mso-hansi-theme-font:minor-latin; mso-fareast-language:EN-US;}

Subject code	Subject name	Requirement	ECTS credit
BMEGEVÉAG02	Diffusion Processes	Exam	2

Course type	Course code	Course language	Timetable information
Lecture	A28	English	THU:08:15-09:00(D316A);
Practice	A29	English	THU:09:15-10:00(D316A);

Diffusion Processes Aim of the subject: To teach to the students the theory of the mass transfer operations and the methods and equipment of one of the most important diffusion process (distillation). Topics of the subject: 1st week: Applications of mass transfer, more important diffusion processes. Batch and continuous operation. Continuous and stagewise contact. Equilibrium stage. Phase rule of Gibbs. Vapour-liquid equilibrium of a binary mixture. 2nd week: Steady state and transient diffusion. Theory of diffusion, Fickrsquo;s 1-st law. Analogy with momentum and heat transfer. 3rd week: Relation between the diffusivities DA,B and DB,A. Equimolar counter diffusion. One way (unimolar) diffusion. 4th week: Prediction of diffusivities for gases, influence of pressure and temperature. Diffusion in small pores (Knudsen diffusion, in pores of intermediate size). Diffusion in liquids. Dilute aqueous solutions. 5th week: Schmidt number. Turbulent diffusion. Transient diffusion. Mass transfer coefficients. 6th week: Theory of film. Two film theory. The rate of mass transfer. Relation between the overall (Ky) and film transfer coefficients (kx, ky). 7th week: Determination of mass transfer coefficients. Measurements: wetted wall column. Correlations, Sherwood-number. 8th week: Vapour-liquid equilibrium conditions. Basic notions and laws. Vapour-liquid equilibrium of ideal mixtures. Temperature-composition (T-x,y) and y-x equilibrium diagrams of ideal and azeotropic (minimum and maximum boiling point) mixtures. Optimal feed plate location. 9th week: Distillation methods. Flashing and its calculation. 10th week: Rectification. Determination of the number of theoretical plates. Heat condition of feed (q). Intersection of the operating lines (q-line). 11th week: Heat balance of the column. Total reflux, minimum number of plates. Minimum reflux ratio. Optimal reflux ratio. 12th week: Rectification calculations. 13th week: Differential distillation, calculations. Batch rectification under constant reflux ratio and constant distillate composition. 14th week: Plate efficiencies. Different types of plates. URL: http://www.epget.bme.hu/hu/14-oktatas/bsc/159-diffusion-processes

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

Course type	Course code	Course language	Timetable information
Laboratory	AnL	English	

One-semester long individual project work. 10 hours/15 credits. * VG in the code stand for the supervising Department of Hydrodynamic Systems.

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGAG01	Introduction to Mechanical Engineering	Exam	4

Course type	Course code	Course language	Timetable information
Laboratory	AnL	English	WED:10:15-12:00(L-HIDROLAB);
Lecture	AnE	English	TUE:16:15-18:00(KF83);
Practice	AnGy	English	WED:10:15-12:00(D327);

Main aims and objectives, learning outcomes of the subject: Upon finishing the course, the students will be familiar with the basic concepts of physics and engineering needed for latter engineering studies such as linear and angular velocity and acceleration, force, torque, power, energy, efficiency, dimensional conversion, pressure, fluid velocity etc. They will have experience on how to solve and handle engineering problems. Method of education: lecture: 2h/w seminar: 2h/2 weeks laboratory: 2h/2 weeks homework: measurement report submission Detailed thematic description of the subject (by topic, min. 800 character): Some definitions for machines. Basic and derived quantities. Transmission of mechanical work. Losses and efficiency. Uniformly accelerated motion of machines. Motion graphs. Absolute and gauge pressure. Bernoullirsquo;s equation. Venturi meter. Linear and rotational analogues. Thermal energy. The specific heat capacity and latent heat. Introduction into error estimation. Balance machines. Orifice and volume meter tank. Measuring pressure, fluid velocity.

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGAG03	Measurement Technique of Processes	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Laboratory	AnL	English	FRI:12:15-14:00(L-HIDROLAB);
Lecture	AnE	English	FRI:12:15-14:00(D327);

Main objectives of the subject: The aim of this subject is to present the fundamental devices and methods of measurement techniques of processes. The course presents the mathematical methods of the measuring techniques and the signal processing; shows the practical usage of them; and points out the achievable results. Detailed thematic description of the subject: Lectures: 7*2h Reviewing the basic concepts of probability theory and mathematical statistics; Error Estimation for indirect measurements; estimating systematic errors Estimating systematic (accuracy class) and random errors ensemble for indirect measurement results; Calibration The fundamentals of measuring time variant signals: Sampling and Quantization Theorems; Theoremrsquo;s analysis; Consequences in measuring techniques Fourier series and transformation, and their role in signal processing; The Spectrum and itrsquo;s applications; Recognizing periodic and noise processes Application of spectrum and cepstrum analysis for investigation operating machines The real measurement result; Noise, as the characterization of stochastic processes; Amplitude density function; Autocorrelation and Cross correlation functions Application of Autocorrelation and Cross correlation technique for analyzing periodic and transient signals Laboratory practices: 4*3,5h Pressure transducerrsquo;s response to step function Pressure transducerrsquo;s response to harmonic excitation Measuring transmission characteristics of an impulse line Investigating the effects of sampling parameters

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGAG04	Volumetric Pumps and Compressors	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	AnE	English	WED:14:15-15:00(D327);
Practice	AnGy	English	WED:15:15-16:00(D327);

Main aims and objectives, learning outcomes of the subject: Upon finishing the course, the students will be familiar with the operating principles and basic types of positive displacement pumps and compressors. They will be able to perform simple sizing tasks and design basic hydraulic circuits. Method of education: lecture: 1h/w seminar: 1h/w laboratory: 0h/w homework: two design problems Detailed thematic description of the subject: Positive displacement pumps. Pump characteristic and performance. Reciprocating and rotary types. Gear pumps. Performance of a gear pump. Characteristics. Pressure balancing. Bearing forces. Screw pumps. Screw pumps for delivery of higher viscosities fluid. Roots blower. Delivery, isentropic and adiabatic power. Reciprocating compressors. Compression efficiency. Valves. Regulation. Pressure-volume diagrams for different methods of regulating and governing compressors. Sliding vanes pump. Characteristic performance. Capacity and efficiency. Effect of viscosity.

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGAG06	Independent Study 1.	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Laboratory	AnL	English	

Independent Study 1 BMEGEVGAG06 One-semester long individual project work. 4 hours/4 credits.

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGAG07	Fluid Flow Systems	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	AnE	English	THU:14:15-16:00(KF82);
Practice	AnGy	English	THU:16:15-17:00(KF82);

Main aims and objectives, learning outcomes of the subject: The main aim of the subject is to familiarize the students with the computational concepts of large water/gas distribution systems containing simple pipes, valves, throttles, reservoirs and pumps. Upon finishing the course, the students will be able to select pumps for a given system, perform stationary computations and reservoir sizing tasks. Detailed thematic description of the subject: Lectures: 7*3h Basic principles of the conservation laws (mass, momentum and energy). Pressure and head losses in different type of devices. Characteristic curves of a pipelines and pumps. Parallel and series connections of pipelines and pumps. General solution technique for large pipe network systems. Defining the unknown quantities and collecting the required number of equations. Newtonrsquo;s method for solving large scale algebraic systems. Case study of pump selection for a given water distribution system with given daily consumption schedule. Reservoir sizing and characteristic curve of the system. Generalization of solution concept for compressible flows. Case study of a long natural gas pipeline. Derivation of the first order ordinary differential equation describing the stationary open channel flows. Definition of the specific depths (normal, critical) and the wave celerity. Discussion of the solution properties as a function of the relative position of the normal and critical depts. Numerical solution technique for first order ordinary differential equations. Simple explicit Euler method. Selection of proper initial conditions.

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGAG14	Analysis of Technical and Economical Data	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	AnE	English	THU:10:15-12:00(D316A);
Practice	AnGy	English	THU:16:15-18:00;

6. Main aims and objectives, learning outcomes of the subject: Processing and analysis of technical data is often part of engineering tasks. The data can originate from measurements of economical processes and results or from some technological tests but the main methods of the analysis are basically independent from the data source. Utilizing these methods the valuable information can be extracted from complex data sets through measurements of possible correlations, hypothesis testing and quality assurance tests. 7. Method of education: Lectures: 2hrs/week Seminar: 1hr/week To be able to practice the course material usage of computers is necessary. 8. Detailed thematic description of the subject (by topic, min. 800 character): 1. Probability theory basic review: relative frequency, probability, probability density and distribution, expected value, standard deviation. 2. Basic definition in statistics: average, empirical variance, empirical ddensity and distribution functions. Application: quality control, histogram, Pareto-Lorenz diagram. 3. Data acquisition with sampling: sampling techniques. Sampling in quality control. Application: calculation of the required dataset sizes for analysis. 4 Operation characteristics curve: product acceptance using statistical sampling. Application: calculation of economically justifiable fallout rate. 5. Quality and reliability. Upper- and lower control bounds. Control capability index. Application: Machine settings verification. 6. Data acquisition with measurement: measurement principles (comparability, equality, disparity). Direct and indirect measurements. Propagation of measurement errors. Application: evaluation of acceptance measurements, error bounds. 7. Point and interval estimation: poperties of the estimations. Confidence interval for expected value and variance. Application: Analysis of technical and economic data with the help of confidence interval. 8. Correlation coefficient, empirical correlation coefficient. Main properties. Application: correlation diagram, use of correlation in quality control. 9. Regression analysis based on generalization of Gauss-Markov theorem. Application: linear and polynomial regression between the variables of the data of technical processes. 10. Regression models: Estimation of degree-index. Coefficient of determination. Forecasting economic trends with moving average and exponential smoothing. Application: prognosis of capacities, production and utilization. 11. Statistical tests: parametric and non-parametric test. Detailed discussion of the U-test. Critical domain. First and second type errors. Application: verification of change in consumption trends. 12. Parametric tests: T-test, F-test, etc. Application: Quality and production control with parametric tests. 13. Non-parametric tests: c2 and Wilcoxon tests. Application: verification of fittings in production and quality control. 14. Introduction to variance analysis: hypothesis testing with F-test, ANOVA test. Application: analysis of production quality.

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGAV03	Chemical Engineering Fundamentals	Exam	2

Course type	Course code	Course language	Timetable information
Lecture	AnE-V	English	TUE:16:15-18:00(D515);

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGAV04	Chemical Engineering Practice	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	AnL-Vegy	English	
Practice	AnGy-Vegy	English	

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGMW06	Hemodynamics	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	E	English	TUE:10:15-12:00(D327);

Introduction to physiology. Circulation system, arterial and venous system. Blood flow measurement methods, invasive techniques. Non-invasive blood flow measurements, Transmission properties of cuff-systems, estimation of eigenfrequency. Introduction to the method of characteristics (MOC). MOC and Solution for rapid change, Alievi (Joukowsky)-wave. MOC and study of the transmission properties of invasive blood pressure measurement technique (arterial catheter). Models and methods for the de scription of blood flow in blood vessels, material properties, Streeter-Wiley Model 1 and Model 2. Characteristic physiological quantities and their influence in hemodynamics.Flow in aneurysms.

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGMW07	Flow Stability	Mid-semester mark	3

Course type	**Course code**	**Course language**	**Timetable information**
Lecture	E	English	THU:10:15-12:00(D327);

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

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGMWD1	Major Project	Mid-semester mark	14

Course type	**Course code**	**Course language**	**Timetable information**
Laboratory	L	English	

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGMWD2	Final Project	Signature	19

Course type	**Course code**	**Course language**	**Timetable information**
Laboratory	L	English	

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGMWDA	Final Project A	Mid-semester mark	15

Course type	**Course code**	**Course language**	**Timetable information**
Practice	Gy	English	

Subject code	Subject name	Requirement	ECTS credit
BMEGEVGMWDB	Final Project B	Mid-semester mark	15

Course type	**Course code**	**Course language**	**Timetable information**
Practice	Gy	English	