Entering Budapest University of Technology and Economics - Study in the European Union
BULLETIN

Budapest University of Technology and Economics
2016–2017

An ECTS Guide

Engineering Programs in English
http://www.kth.bme.hu/en/
admission@kth.bme.hu
Dear Student,

You are reading the Bulletin of the Budapest University of Technology and Economics. Its direct predecessor, the Institutum Geometricum, was established in 1782 by Emperor Joseph II, as part of the Faculty of Liberal Arts at the University of Buda. During the past 234 years the professors of the university have striven to provide an outstanding quality of education. This has earned the university an international reputation, attracting students and also professors from all over the world.

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

“Education is the most powerful weapon which you can use to change the world.”
This is the quotation from Nelson Mandela. It is unquestionably true and especially applicable for engineers who have the power to make a better world:
Sustainable energy, clean water, safe transport on roads and bridges producing less pollution, buildings for comfortable living and working, machines and robots for work and for amusement, fast and reliable communications, medical equipment that assure a good quality of life for the individual and can be financed by society, and healthy food for us all. All of these goals need engineering solutions to make the world a safer, better and more exciting place to be. This is also your responsibility. You can acquire the necessary knowledge and skills to make your own contribution. As a graduate you will certainly do your best for your colleagues, company and society.

Two components are decisive for a good diploma: good teachers and a good student. I can say our university provides you with excellent teachers – you must be good students! I am sure it is worth being so.
Besides, you will love it: the university years will be your best memory, the engineering profession will provide you the joy of creation.
Hungary is a member of the European Union. As a student in Budapest you will find general European as well as particular Hungarian cultural customs: food, fashion, folk art, music and dance.

Use this bulletin to help you consider our programs. Come to visit our campus. Better yet, come to study with us for one or two semesters or for an entire degree program. Should you decide to stay for only one semester, this bulletin will also help you choose from among the different semester programs.

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

Károly Veszprémi
vice-rector for education
<table>
<thead>
<tr>
<th>Course</th>
<th>For EU citizens</th>
<th>For non-EU citizens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparatory Course and General Course in Architecture</td>
<td>EUR 3,200 / semester</td>
<td>EUR 3,200 / semester</td>
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<tr>
<td>Undergraduate Tuition Fees, leading to B.Sc. degree</td>
<td>EUR 2,250 / semester</td>
<td>EUR 3,200 / semester</td>
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<tr>
<td>Undergraduate Tuition Fees, leading to B.Sc. degree in Civil Engineering</td>
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<td>Graduate Tuition Fees, leading to M.Sc. degree for graduates of external higher education institutions</td>
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<td>Tuition Fees for special students (courses leading to no degree)</td>
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<td>Tuition Fees for special students (courses leading to no degree) in Civil Engineering</td>
<td>EUR 2,000 / semester minimum</td>
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</table>
Agencies and representatives in the target countries

Azerbaijan

Anar Gurbanzade  
Study Abroad Coordinator  
CELT Colleges  
Mammad Afandiyev 6, Flat 12, AZ 1001, Baku, Azerbaijan  
+994 12 4926853; +994 55 6447280  
admissions@celt.az; www.celt.az

Aynur Mammadova  
Recruitment Manager  
AZ1117, Baku, Azerbaijan, Bilajari region, Yahya Huseynov street 15.  
+994 55 990 94 14  
E-mail: apply@bme-budapest.com  
Website: www.bme-budapest.com  
Facebook: https://www.facebook.com/macaristandatehsil

China

Grand Education Group  
Dawn Zhang  
Room 720 Qingdao, World Trade Center, Building B, No.6, Xianggangzhong Road  
Qingdao, PRC, 266071  
dawnzhang@grandeducationgroup.com,  
dawnyuhang@hotmail.com  
www.grandeducationgroup.com

Shenyang EU-SINO Education Information Consulting Co., Ltd.  
Mr. Chen Qlin Director  
Room 1407, Ouya Lianying Business Building, No.1 Jia, Nanjingnan St., Heping Dist., Shenyang City, Liaoning Province, China. 110001  
Tel: 8-6-24-23286616/400-006-7997  
Web: www.studyinhungary.org  
E-mail: eusinoedu@hotmail.com

Mohar Global Services (MGS)  
Abu Bakar Ejaz  
Managing Director  
Achter de Grote Kerk 15  
8911 GD Leeuwarden  
The Netherlands  
Fax: 0031 – 588 – 434 – 932  
www.letsgostudyabroad.com  
Email: abu.bakar.ejaz@letsgostudyabroad.com

Cyprus

L.S. Moussoulos Co Ltd. (Studies Dept.)  
Mr. Sofocles Moussoulos  
President  
1: P.O.Box 21454, Nicosia 1509, Cyprus  
2: Moussoulos Building, Corner of Ay. Pavlos and I. Kadmos str., Ayios Andreas, 1105 Nicosia, Cyprus  
Telephone: 02-781644  
Fax: 02-773111  
moussoulos@cytanet.com.cy

Egypt and Middle East

Professor Dr. Mr. Ashraf Elsayed Mohamed Mohamed  
Manufacturing Institute Group  
BRNO University of Technology  
SOUFF SHAMAA-TALON-ST#1-Or28  
ALEXANDRIA 21351 - EGYPT  
MOBILE/ 00201147602039  
EMAIL/ ashraf.mohamed@saudieng.org  
EMAIL/ ashrafelsayedm@gmail.com  
(Egypt, Oman, Qatar, Bahrain, Lybia, Arab Golf countries and Middle east)

Greece

Judith Chafta  
P.P. Germanou 12, Philothei Athens, Greece  
Fax: 3010-6800686  
Mobile: 309-74123209  
E-mail: jchafta@otenet.gr

India

Ganga D. Dandapani  
Vice President Marketing-Overseas Education  
Canam Consultants Ltd  
113, First Floor, ‘New Delhi House’, Barakhamba Road  
New Delhi-110001, India  
Telephone: +91 11 2433 0295  
Fax: +91 11 2433 0269  
+9312601937 (M)  
+91 11 3230 1937 (M)  
education@canamgroup.com

Jasdeep Kaur  
Director  
Worldwide Studies Private Limited  
S.C.O 80-82, 1st Floor, Near Passport Office, Sector 34A, Chandigarh -160022 (UT), India  
Telephone: 91-172-4676100, 4676101, 4676102  
Mobile: 9888555229  
worldwide_edu@rediffmail.com;  
worldwidechandigarh@gmail.com  
www.worldwidestudy.org

Iran

Dehlavi Educational Institute  
Mehdi Dara  
Managing Director  
Address: No.10, Apt. No. 5, Shekar Abi Alley, Shariati Ave.  
Upper Than Motahari St., Tehran, Iran  
Telephone: 0098 21 88427100 (10 line)  
Fax: 0098 21 88419954  
studysite@hotmail.com  
Pany Dara (in Hungary)  
pany.dara@yahoo.com

Dr. Alireza Habibi  
Director  
Daneshpooyan Aria Institute  
Unit 2, No.18, 2nd Alley,  
South Kaj St., Fatemi Ave.  
Tehran 14147-63413, Iran  
Tel: +98 21 8895 2288, 8895 4081, 8897 5337  
Fax:+98 21 8898 1392  
habibi@daneshpuyan.com

Agents and Representatives in the Target Countries
Open Iran Ltd
Anita Papp
International Director
Address: 25, Arikeh Iranian Complex, Farahzadi Bulvar, Shahrake Gharb, Tehran, Iran
Tel: +98 21 2235 1161, +98 21 2235 1171
Fax: +98 21 2209 4856
Mobile: +98 912 707 20 83
info@open-iran.com
www.open-iran.com

Avicenna College
Dr. Shahrokh Mirza Hosseini
President
1089 Budapest, Orczy út 3-5.
Telephone/Fax: 456-1020, 456-1024
president@avicenna.hu; klarik@avicenna.hu

Darya Afsoon
Fishing and Food Industries Co.
Ms. E. Hayatdavoudi
Managing Director
No. 6, 16th Gandi St. Unit 15
Tehran 15179-1711, Iran
Telephone: (9821) 886 6431, 886 6432, 886 63135
Mobile: (98) 912 105 6116
hayatdavoudie@yahoo.com

MATINIT Institute
Eng. Matin Hashem Manager
Address: Shemiran, Dezashib, Boooli, Abbasi, Mehmaz No. 2
Tehran 19349-35753, Iran
Phone: +9821 22201448
Fax: +9821 22211424
info@majarestan.com; www.majarestan.com

Hermes International College
Reza Shahbaziatabar President
1062 Budapest, Andrássy út 53.
Phone: +361-3217176
Fax: +361-7048038
Mobile: +3630-4647000
manager@hermescollege.com, info@hermescollege.com
www.hermescollege.com

Setareh Danesh Arman Institute (SDAI)
Omid Razeghi Director
Unit 5, No 1, 4th Street, Shah Nazari Ave.
Madar Sq. – Mirdamad Ave –Tehran, Iran
Postal code: 1547916616
Mobil: +98 9122526175
Phone: 98 21 22914766-8
info@sdarman.ir, www.sdarman.ir

PersiaPest
Ali Reza Torkamani
Viola str. 34-36 No. 34-36.
1094 Hungary, Budapest
Mobile: + 36 30 338 5910; + 36 70 275 56 81
www.persiapest.com

Iraq and Middle East
Pre-University Bagdad Co.
Dr. Altaii A. Jabrah
1118 Hungary, Budapest, Muskatöly u. 35.
Jabra_1313@yahoo.com

Israel
University International Studies
Mr. Roni Fried
Hazoran 1.
Enterance 10, Floor 2
Netanya, 42504 P.O. Box 8552, Israel
Fax: 972-9-8858287
Mobile: 972-57-4450445
info@uis.co.il; www.uis.co.il

Jordan
United Education Consultancy (PVT) LTD.
CEO: I.A. Bhatti
P.O. Box 77.176 Bucharest, 033290; Romania
Tel: +40 (0)720 377 333
uecromania@yahoo.com; www.uecromania.com

Kazakhstan
Republican Social Association of “Kazakh Tili Kogamy” named after Konir Mandoki
060100, Kulsarynskaya str. 33, Atyrau, Republic of Kazakhstan
Suleimenova Dana
Tel: +7 707 333 7007
Email: sedupost@gmail.com

Kenya
United Education Consultancy (PVT) LTD.
CEO: I.A. Bhatti
P.O. Box 77.176 Bucharest, 033290; Romania
Tel: +40 (0)720 377 333
uecromania@yahoo.com; www.uecromania.com

Kuwait
Raad H. Mohammed
Mona Trading Services
1054 Hungary, Budapest, Bajcsy Zsilinszky út 66.
Rahamo56@yahoo.com

Pervin Mirza
Kapico Travels and Tours
AI Chawali Complex
Sharq Kuwait
Tel.: +965 65777066
pervin.mirza@kapicotravels.com
AGENCIES AND REPRESENTATIVES IN THE TARGET COUNTRIES

Malaysia
MISSIB Management
Dr. Najieb Mokhtar Chief Executive
B3-03 Megan Ambassy 225 Jalan Ampang,
50450 Kuala Lumpur, Malaysia
Telephone: 603-21665218
ceo@missib.com.my

CT TWO SDN BHD
Alisha Chow Director
Suite 33-01 33rd Floor, Menara Keck Seng,
203 Jalan Bukit Bintang, 55100 Kuala Lumpur, Malaysia
info@admissionmalaysia.com.my

United Education Consultancy (PVT) LTD.
CEO: I.A. Bhatti
P.O. Box 77.176 Bucharest, 033290, Romania
Tel: +40 (0)720 377 333
uecromania@yahoo.com
www.uecromania.com

MGS Holland
Abu Bakar Ejaz Managing Director
De Fennen 322
8918CP Leeuwarden
The Netherlands
Tel: 0031-588-434-932
Mob: 0031-616-563-733
Skype ID: letsgostudyaabroad
E-mail: info@letsgostudyaabroad.com

Nigeria
ALMERC
Dr. A.B.E. Nnuji Chairman
11, Calcutta Crescent, Apapa, Lagos
5th Avenue, ‘G’ Close House 16, Festac Town Lagos, Nigeria
Telephone: 234-(0)-1-7741243, 4342421,
234-803-307381
aloynnuji@yahoo.com

CROWN STUDENT AGENCY
Engr. Chukwukadibia Amadi Director
20, Nguru Road Barnawa, Kaduna, Nigeria.
Tel.: 234-9035015608, 234-0996065025,
Email: crownstudentagency@yahoo.com

Atlantic Tourism Organization Ltd (ATOL)
Mr. Adedayo Egbeleke
Address: 20, Akinsoji, close Akobo,
Ibadan, OYO State Nigeria.
Phone No. 00-2348055257748, +36203535094
+3605462023
E-mail: dayo.egebeleke@atlantictourism.org
info@atlantictourism.org

DREAM EDUCATION.HU
Ms. Linda Abia-Okon Managing Director
Tel.: +234 817 999 9909; +36702011 999
Office: 61, Jose Marti Crescent, Asokoro, ABUJA, Nigeria
Email: linda.abia.okon@dreameducationhungary.com;
linda.abia.okon@gmail.com
www.dreameducationhungary.com

Pakistan
United Education Consultancy (PVT) LTD.
CEO: I.A. Bhatti
P.O.Box 77.176 Bucharest, 033290; Romania
Tel: +40 (0)720 377 333
uecromania@yahoo.com
www.uecromania.com

Asif Mahmood
Managing Director
(MSc. Computer Science, Dipl. DCS, DHE, DWA)
STUDYLINKER Student Consultancy (SSC)
(Foreign Student Admission & Advisory Services)
Tel No. 0345-4149210, 0310-4149210
Email: info_studylinker@yahoo.com
LinkedIn: pk.linkedin.com/pub/asif-mahmood/45/652/87b/
FB: Security Check Required

Russia
English-Hungarian Training Center
“Origins of Knowledge”, Budapest
Marina M. Sverchokne-Dumnova
Managing Director
Hungary Budapest, 1325 P.O.Box: 410
Tel/fax: +36-1-380-7716
Tel.mob: +36-30-456-4893
infojet62@gmail.com
www.oroszpiac.com

Ernest Diós
Senior Educational Manager
Mobile: +36-20-347-6746
collegeinter@yandex.ru
www.collegeinter.com

Saudi Arabia
Dr. M.H. Osman Taha Hungarian Business Consultant
P.O. Box 365812 Riyadh 11393 Saudi Arabia
Tel.: 00966 1 4654488 – 4643150
Fax. 00966 1 4658560
Mobile: 00966 50 3419791
droszman@gmail.com
www.tu.com.sa

Sri Lanka
Y2GO Ltd
Richard Morgan Managing Director
World of Achievers Limited
Y2Go Limited
Mob UK: +44 77 10 763 474
Mob: +234 7038 05 6665
Mob Ukraine: +38 0632 651 050
Skype: morgan.richard14
Email: morganrichard1164@yahoo.com.sg
richard@morganproperty.uk.com

Sudan
Blis Trading and Investment Co. Ltd.
Hassan El Tayeb Ali
P.O. Box 11662 Khartoum, Sudan
hassan_blais@yahoo.com
Sweden
Pre International College of Stockholm (PICS)
Omid Razaghi Director
Finlandsgatan 12 – kista – Stockholm Sweden
Postal Code: 16474
Mobil: +46723294111, Phone +46 87507075
director@preinternationalcollege.se
www.preinternationalcollege.se

Syria and Middle East
Eng. Ghassan Chanis
GCEE Director
e-mail: chanisg50@hotmail.com
Syria: Damascus-Abasia Sqr. 3
Hungary: Budapest, Kassák Lajos u 66.
Tel.: Damascus: +963114455786
Budapest: +36705483362

Taiwan
Dynasty Tours
1051 Budapest Dorottyua u. 9, 1. em
Telephone: 311-0158
Mobile: 36-30-627-5168
E-mail: rexway@enteret.hu

Turkey
EDUIDEAL International Education Counselling
Isa Taskin, General Manager
Aysin Gök, Coordinator
Address: Halitaga Cad. Emek Apt. No. 74/5.
34716 Kadiköy Istanbul Turkey
Telephone: +90216 3364964, +90216 3364749
Fax: +90216 3372294
eduideal@gmail.com
www.eduideal.com

MEDA
STUDY ABROAD COUNSELLING
Ayse Ayan - Counsellor
MACARISTAN ve YURTDISI EGBITIM DANISMANLIGI
Buyukdere Cad. No:182 D:16 Yeni Levent
Besiktas 34330 Istanbul - Turkey
Tlf: +90.212.270 64 19 (20) GSM: +90.532.690 33 39
Skype: ayse.ayan
ayse.ayan@medaegitim.com, www.medagitim.com

Mehmet M. Besirikli
General Manager
All4You s.r.o.
Obchodná 66/A
81106 Bratislava
Slovak Bratislava
Mobil: +421 917 881 617
E-mail: besirikli@all4you.sk

ELT International Education
& Student Exchange Services Inc.
Ismail Dansman
Barbaros bulvarı, 31/5
Besiktas/ Istanbul, 34353 TURKEY
Telephone: +90-212-236-0444
Fax: +90-212-236-0222
+90-312-418-8484
+90-232-422-0129
ismail@elt.com.tr
www.elt.com.tr

Ukraine
Y2GO Ltd
Richard Morgan Managing Director
World of Achievers Limited
Y2Go Limited
Mob UK: +44 77 10 763 474
Mob Nigeria: +234 7038 05 6665
Mob Ukraine: +38 0632 651 050
Skype: morgan.richard14
Email: morganrichard1164@yahoo.com.sg
richard@morganproperty.uk.com

United Arab Emirates
Blis Trading and Investment Co. Ltd.
Hassam El Tayeb Ali
P.O.Box 11662 Khartoum, Sudan
hassan_blais@yahoo.com

United Education Consultancy (PVT) LTD.
CEO: I.A. Bhatti
P.O.Box 77.176 Bucharest, 033290; Romania
Tel:+40 (0)720 377 333
uecromania@yahoo.com
www.uecromania.com

Vietnam
GIA LOC Education Company
Mrs. Do Thanh Thuy Director
01504, Building CT5/X2, Bac Linh Dam, Hoang Mai, Hoang Liet, HaNoi, Vietnam

Viet Nam Centre Point
Phuc Tien Director
Education & Media Services Center
8E Luong Huu Khanh – Dist. 1 – Ho Chi Minh City
Tel: (848) 39.252.602 – 39.253.183
Fax: (848) 39.252.830
counseling@vietnamhopdiem.edu.vn
vietnamcentrepoint.edu.vn
The Faculty of Architecture at the Budapest University of Technology and Economics focuses on training highly professional experts in architectural engineering who are aware of the social and cultural implications of their profession. Versatility is emphasised so that students will gain fundamental knowledge and abilities in every possible field of architecture and be able to find work in a highly competitive job market, and in any building- or design-related area of consulting, construction, and management. The 5-year program in English leads directly to an MSc degree in Architecture and Architectural Engineering (Dipl. Ing. Arch.), but it is also possible to graduate as a Bachelor of Science in Architecture.

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

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

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

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

**General course – Preparatory Course**

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

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

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

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

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

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

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

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

Graduation

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

Departments

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

<table>
<thead>
<tr>
<th>Subject</th>
<th>Code</th>
<th>Credits</th>
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a) can be taken parallelly in the same semester. For students of BME Faculty of Architecture only criteria subjects (no credit points)

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

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### Curriculum of BSc/MSc Subjects (contd.)

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* a) can be taken parallely in the same semester  
 s) signature only  
*: Obligatory for MSc / Elective for B. Sc. Degree

**: Obligatory for B. Sc. / Elective for M. Sc. Degree

Minimum number of credits for B. Sc. Degree: 240

Minimum number of credits for M. Sc. Degree: 300
Design skills 1.

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

Design skills 2.

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

Freehand Drawing 1-2.

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

Fundamentals of Architectural Design 4

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

Basic Tools of Building Constructions

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

Computer Literacy 1

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

Computer Literacy 2

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

Geometrical Constructions 1

Pál Ledneczki PhD I

Geometrical Constructions 2

Pál Ledneczki PhD II

Fundamentals of Structures

BMEEPSTA001
Dr András Draskóczy, Dr Gábor Domokos
Introduction: requirements of the built environment. 1st site visit: an existing, functioning building. Parts of buildings. Discussion of experiences of the 1st site visit: functions and requirements of parts of buildings. 2nd site visit: a construction site. Loadbearing parts of buildings. Discussion of experiences of the 2nd site visit: functions and requirements of loadbearing parts of buildings. The notion of safety. 3rd site visit: laboratory testing of structural members (brickwork column, reinforced concrete beam). Loads and responses when being loaded. Discussion of experiences of the 3rd site visit: structural members; ways of becoming unfit for use: rupture, loss of stability (overturning, sliding, buckling), excessive cracking and deformations. 4th site visit: laboratory testing of structural materials. Yield and rupture. Collection of strength measurement data. Discussion of experiences of the 4th site visit: statistical evaluation of measurement data. The notion of safety, safety factors of materials and loads. 5th site visit: a project bureau. Graphical presentations of buildings. Architecture and structure. Results of structural analysis. Discussion of experiences of the 5th site visit: Parts and kinds of documentations. Scales and graphical symbols. Modelling of structures, structural projects. 6th site visit: ready structure construction site. Discussion of experiences of the 5th site visit: modelling of structures. The static model.
Description of MSc Subjects

Mathematics 1
BMETE90AX24
Dr. Béla Barabás

Descriptive Geometry 1
BMEEPGA102

Introduction to Building construction
BMEEPESA101
This subject introduces all major building construction components (walls, foundations, floors, roofs, skeleton frames, stairs, ramps, doors and windows) and primary building engineering service systems. During lectures, the building is considered as a composition of spaces with different functions, separated by special surfaces. The course aims to introduce and explain the grammar of architectural design through practical tasks, such as the survey of one’s own flat. Concurrently, the basic dependant factors of the creative design process are described. Students are acquainted with technical terminology as well as the role and use of various construction solutions including their classifications. The above shall assist students with both starting independent design exercise work and the continuing of building construction studies in greater detail. (2 credits)

History of Architecture I. (The Beginnings)
BMEEPET101
The course gives an overview of the architecture in the first period of the evolution of human culture. The classes follow chronology – mainly in the first part of the course – with focusing on the development of building constructions and the development of settlements.
The practical lessons show details were delivered in the lecture before. The drawings drawn by students help them to understand the colourful world of common and rural architecture. (3 credits)

Introduction to Structural Design
BMEEPSTA101
The most important methods of analysis and design of engineering structures are presented, together with their modelling, and the applied approximations. It is shown how on high school statics (and math) can be applied to engineering structures. The understanding of the behaviour of structures is emphasized. (2 credits)

Drawing and Composition 1
BMEEPRAA101
The objective of this subject is to introduce students to the fundamentals of perspective spatial representation based on geometrical solids (e.g. cube, cylinder, quadratic and triangular prisms.) In the course of the semester, drawing tasks range from simple arrangements to complex spatial constructions, while representation techniques range from constructive line drawing to tinted drawing (showing light-shadows effects), applying lead pencil. (2 credits)

Introduction to Architecture
BMEEPUIA101
The subject intends to raise and maintain first-year students’ professional interest and give a common architectural language preparing for further special courses. This subject intends to make students’ attitude positive towards architecture; enlarge their intellectual capacities and get them understand the many-sided learning processes of architecture: lectures, texts, project analyses, films etc. (2 credits)

Space Composition
BMEEPKOA101
Space composition is the creative course of the first semester, during which the students study the basics of the composition of architectural space. The aim of the course on one hand is to develop one’s creativity, on the other hand getting a deeper knowledge about the nature of creating architectural space through space-composition exercises.
This knowledge will be the basis of the process of architectural design in the forthcoming semesters. (5 credits)

Mathematics 2
BMETE90AX34
Descriptive Geometry 2
BMEEPAGA202
Curved lines and surfaces; quadratic surfaces, surfaces of revolution; developable surfaces, screw surfaces, ruled surfaces. Representation in multi-view system, axonometry and perspective. Construction of tangent plane, contour and shadow. Intersection of surface and plane, intersection of a pair of surfaces. Topographic map, projection with elevation, sections, earth works platform, road, cuts and fills. (5 credits)

Building Constructions 1
BMEEPESA201
This subject presents the details of the main load-bearing constructions (walls, floors, stairs) and the joints between them. Wall supported / skeleton frame, or mixed construction. Walls: Effects on walls, and how to fulfill the requirements. Sorting the walls by function, position, material, by layer-order. Walls built from elements, the development of walling elements. Floors: Functions, effects on floors, how to fulfill the requirements. Elements of floor construction. Types: plain floors (in details), arches (overview). The materials, construction lines, building methods. About the future of floors joints between walls – floors, skeleton frames – floors. Methodology of the floor design. Stairs: Functions, effects on stairs, how to fulfill the requirements, principles of stressing and how to choose construction. Sorting the constructions by material, load bearing method, building method etc. Design possibilities. (4 credits)

Statics
BMEEPSTAA201
The basic laws and theorems of statics are presented and applied to engineering structures. Statically determinate trusses, beams, frames, and assembled structures are considered, the line of trust is presented. Internal forces are treated in 2D and 3D. (4 credits)

History of Architecture 2 (Antiquity)
BMEEPETA201

Drawing and Composition 2
BMEEPRAA201
This subject intends to inspire students to think creatively via free-hand drawing tasks. It is closely related to the material covered by preceding semester, however, spatial arrangements are complex, and students are expected to creatively supplement them and apply light-shadow effects. Classes present the basics of the theory of colours and its architectural application. After a creative model building task, students return to the representation of complex spatial forms practised in the previous semster (e. g. furniture, drapery, details of space, drawing studio etc.) to apply and practise a wide range of drawing techniques (e.g. pencil, crayon, ink, washed drawing). (4 credits)

Residential Building Design 1
BMEEPPLAA201
This class covers the theory and fundamentals of residential building design, which is the same as the fifth-year and BSc training. The time for enrolment is the second semester, and the prerequisite for admission is successful completion of the Introduction to Architecture course. The goal of the class is the mastery of basic knowledge concerning the formation of a dwelling environment, residential building design, and housing topics in general. The lecture series presents the historical and intellectual evolution in housing design – providing information on the historical precedents and intellectual roots for the formation of residential areas and apartment buildings, as well as a special perspective on last century’s trends, which determine design practice to this day. Also presented are expectations (operative or otherwise) for the formation of dwelling areas, apartment arrangement methods, types of residential buildings in use and the specific requirements that apply, lessons of techniques used in professional practice, problems of apartment buildings’ architectural formation and aesthetic appearance, as well as fundamental relationships in housing architecture. Planned lectures will only deal with the exact know-how as necessary, and this knowledge must be acquired through the class textbook (Residential Building Design by Dr. János Bitó). The class concludes with an oral exam, questions being derived in part from the lectures and in part from textbook material. (2 credits)

Basics of Architecture
BMEEPPLAA202
Architectural planning is a creative process, typified mainly by an end result that is either one-of-a-kind in its details or uncommon as a whole. Hence, the design path is unique in and of itself. In the case of design activity, instruction does not only impart basic knowledge of the profession (the mastery and practice of which is a requirement of the design process), but also develops creative skills. The Fundamentals of Architecture class consists of weekly practice; before receiving each assignment, however, there is a general lecture held for all that year’s students. Within the subject, architectural pupils encounter tasks that require architectural-based problem solving and creative trouble-shooting. Classes of 25-28 pupils are run by 3-4 main instructors. In the course of the semester, there are several small planning tasks to be solved, modelling, architectural drawing, and technical drawing with equipment. Design tasks are built around a unifying theme or motto. (6 credits)

Building Materials 1
BMEEOEMA301
Material properties and classification of building materials (densities, mechanical properties, hydrotechnical properties, thermal properties). Detailed introduction of timber, masonry, mortar, concrete (and constituent materials), metals, polymers, glass used in architecture. Fields of application. Types of commercial products. Material testing methods for building materials (tensile, compressive and bending testing). Observation of basic natural stones and applications. Students work individually or in small groups during the laboratory sessions and study the physical and mechanical properties of building materials. (3 credits)
Architectural Informatics 1

**BMEEPAGA301**

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

Building Physics

**BMEEPAGA301**


Introduction to Thermal Bridges, Definition of Self-Scale Temperature, two applications of SST, Definition of Apparent Thickness, Generalized model of wall corner, generalized model of wall corner temperature, Example: estimation of wall corner temperature.

Moisture transfer

Definition of Moist air, Dalton’s Law, Moisture content, Saturation vapour pressure, Relative humidity, dew point, dry and wet bulb temperatures, Specific Enthalpy, Moisture balance, Mechanism of vapour transfer, Scope of calculation, Vapour conductivity and resistance, Overall vapour resistance of mulliayer wall, Overall vapour transfer, Design consideration, example.

Introduction to Solar Architecture

Indirect Solar collecting walls. Mass walls: principles, surface, shading, energetic operation, delaying, losses, operation in summer, irradiated solar energy, examples, simplified thermal model. Example: calculation of thermal balance of a mass wall

Solar Design Strategies


Strength of Materials 1

**BMEEPSTA301**


History of Architecture 3 (Medieval)

**BMEEPETA301**


Drawing and Composition 3

**BMEEPRAA301**

This subject introduces students to professional specific applications of the drawing skills they acquired so far. Classes present drawing methods for the representation of reality irrespective of the given point of view, from any other one. Students learn to consciously apply perspective in drawing small-scale models as tall buildings, and develop various graphic skills by practising the architectural graphic representation of masonry, stone, wooden and glass surfaces and those of materials. A creative modeling task assigned to students is building an autonomous construction, which focuses on the relations of materials and volume, internal space and the phenomenon of transparency. During model building, problems of space, form and structural arrangement are investigated; while at graphic elaboration, great emphasis is laid on the representation of materials, fluency in perspective drawing and abstraction. (4 credits)
Public Building Design 1
BMEEEPKA301

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

Residential Building Design 2
BMEEEPLA301

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

Building Constructions 2
BMEEEPESA301

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

Sociology for Architects
BMEGET43A044

Dr. János Farkas, Dr. Adrienne Csizmady


Architectural Informatics 2
BMEEPAGA401

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

Building Constructions 3
BMEEEPESA401

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

Strength of Materials 2
BMEEPSTA401

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

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

History of Architecture 4
BMEEEPETA401


Drawing and Composition 4
BMEEEPRAA401

The main topic in the syllabus of the subject is the "analytic" representation of external spaces; students learn how to recognise the invisible geometrical-structural relations below the surface of buildings through preparing "X-ray drawings". Not only the views but also the sections of buildings are studied in order to understand and grasp the gist of the architectural structure behind the view, and to
prepare such 'X-ray drawings' that represent more complex architectural compositions than what the eyes can see. Students prepare drawings on external sites (such as the Museum of Fine Arts, the Great Market Hall, and the assembly halls of BUTE and Corvinus University) to investigate the options of perspective drawing and the versions of plane representation of large spaces. (2 credits)

Design Methodology

BMEEPKO4A02
Design Methodology deals with theoretical and practical methodology of architectural design flow. The point of theoretical Design Methodology is the design itself as a process that can be modeled. The process of architectural design thus can be compared to an informatics system, so for making the method more clear. Practical Design Methodology is closely connected to the Public Building Design 2 process itself, extending it with special design factors and details. Through analyzing existing buildings and fictional situations interesting practical problems and solutions can be discussed. With the help of invited practicing architects, special methods of new facilities and building reconstructions are presented, along with the design of technologically or structurally determined buildings. Because of its importance, sustainability, free access and ecological design will be touched along whole study. (2 credits)

Architecture of Workplaces 1

BMEEPIPA401
The history of industrial architecture, the history of Hungarian industrial architecture. Load-bearing structures of halls and of multi-storey buildings. Size standardization. Constructions of space separation, facades, subsystems of space separation constructions (foundations, roof structures, intermediate floors, external wall systems, finishes. Characteristic architectural requirements, social facilities. Logistics: transport, storage. From location to layout, enlargement of industrial plants. Design methodology, re-use, reconstruction. Administrative workplaces. (2 credits)

Public Building Design 2

BMEEPKO4A01
Target of the exercise, how to realize the general architectural design of a public building without loss of focus regarding the types collective characteristic. What does the studio hope to achieve? The architectural design of a smaller public building, with assistance from architect consultants. The student should learn the process from within regarding the architectural design process and the unusual stress placed upon development of space / manipulation of form whilst considering their approach to solving real environmental problems.

Communication of this architectural design is the key to making a successful presentation and your ideas should encompass dialogue with client (class tutors), relationship to the surrounding environment both built and natural, understanding of trends, financial awareness and understanding of intellectual property. It is expected that this work will involve a deeper research into project types and location - site visits, photographs, topographical mapping and land use mapping. (6 credits)

Architectural Informatics 3

BMEEPAGA501
Use of state-of-the-art CAAD software to develop professional architectural solutions. Extensive use of 3-D computer model development. Architectural documentation with computers. Computer animation and fly-through pictures for architectural space analysis. (3 credits)

Construction Management 1

BMEEEPERS501
The goal of the subject is to present basic information on the technologies and organization of construction work, with special respect on construction activities of sub and superstructures. Considering the character of the subject both theoretical and practical knowledge is essential, therefore besides the lectures the site visits play emphasized role as well.

Main topics: The construction process. Phases and participants of the construction process (roles, responsibilities, connections, etc.). Technical preparation and controlling of the construction. Handover – take-over of the building (reviewing the constructions – quality and quantity – and the plans) Introduction to construction technologies, conditions, requirements. Aspects of selecting the technology. Sequence of construction works (the follow-up of processes). Main equipment of construction (earthwork, foundation work, construction of loadbearing structures, etc.) Material supply on site – to the site. Informations about the construction site. Construction site planning. Time scheduling. Types, realations. List of operations, survey for quantities, labour schedule, plant schedule, material schedule. (2 credits)

Building Service Engineering 1

BMEEPEGAGA501
Water supply
Gas supply
Artificial lighting

Building Constructions 4

BMEEPESA501
Flat roofs. Classification, general design aspects, basic construction principles (inclination and geometry of the water collecting areas) according to the impacts on the roofs. Arrangement of roofing layers. Requirements concerning to the different constructions, layers, materials, building physics. Waterproofing (membranes, coatings), applied materials and their features. Technologies and details. Tracking type and terrace roofs, green roofs. Flooring. Effects and requirements. Layers, subsystems, acoustical evaluation. Substructures of floor coverings and their technical features. Classification according to the materials, specifications. Waterproofing against domestic and industrial wet effects. Drywalls, suspended ceilings, internal wall coverings. Labelling systems, design aspects, effects, requirements, basic structural principles. Internal separating structures of residential buildings satisfying acoustical requirements, connecting details of slabs, floorings and stairs. Principles of primary building engineering service systems and building constructions of sanitary block. (4 credits)

Design of Load-Bearing Structures

BMEEPSTA501
Basic conceptual and computational design methods of load-bearing structures are discussed for reinforced concrete-, steel-, timber and masonry buildings. The main goal is to gain knowledge about structural design problems and principles of structural design in order to understand how and why the load-bearing structure influences the work of an architect. (6 credits)

History of Architecture 5 (19th century)

BMEEEPETA501
The period of this History of Architecture subject is the “long nineteenth century” from the 1750s to the 1910s. In this era the architecture and the art turned to the past, to the previous styles using them in a new approach. The architects had discovered the history of art and artistic liberty at the same time. At the turn of the 20th century the art and also the architecture searched for new ways instead of using historical architectural elements or motifs. The changes led to the Modern Movement when buildings were being erected without decoration or ornaments in the first quarter of the 20th century. This period was divided into different eras, but these types of periodization were different in different countries and changed in the course of the 20th century. Beside the question of styles 19th century is important not only because of the appearing of new structures and materials in the architecture but because of the great development in the field of the functional planning. While following the timeline, the classes concentrate on the development of the styles in several areas of Europe (Great Britain, France, Germany, Russia) looking out to the United States of America too, because there the styles reflected the European ones. (3 credits)

Drawing and Composition 5

BMEEPRAA501
In this semester students apply their previously acquired skills in the most complex architectural representation: in drawing after imagination. After practising the representation of reality and preparing creative perspective drawings (with the help of the real view, which could not be drawn from real points of view), students in this course prepare fully detailed, external and internal perspective views of buildings of various size, based on plans (e.g. ground plans, sections, elevations), using their experience and creative imagination, applying conventional graphic techniques. Students have to accomplish a modelling task during the semester, which improves creative thinking. (2 credits)

Urban Design 1

BMEEPUIA501
The subject is the theoretical course of the fifth semester, with 2 hours lecture weekly. The task of the course is to introduce students to the theoretical background of Urban Planning and Design with specially focusing on the knowledge and skills necessary for the successful participation in the Design courses later on in the curriculum. The course deals with the historical background, fundamental theories, basic typologies, most wide spread forms and basic sustainability aspects of urban design and planning. (2 credits)

Architecture of Workplaces 2

BMEEPIPA501
In an advanced society the world of labour is synonymous with order and being well-arranged. The aim of this one-semester course is to acquaint students with this world that not only suggests but also requires a lot of organizing and planning. The complexity of the topic manifests itself in the buildings designed to house certain activities with the attached architectural content such as space, stucture, and fabric as well as in the questions regarding the architectural formation of the surroundings by this world. As Architecture of Workplaces 2 is the main designing course in the fifth semester, it has a significant position and task among the BSc courses. It gives a chance to summarize the acquired architectural-technical knowledge at the midpoint of the education in the form of a last challenge right before the Global Design exam. This complex challenge foreshadows the desire of a real and complicated architectural thinking since it aims to create an equilibrium between the aesthetic and technical constituents of planning of a building. This task of the semester is an organic part of the students’ studies and is designed to be a realistic challenge for them regarding their age and level of professional knowledge. The task involves real architectural programs that contain building sites that are based on actual spots, thus the plans are ought to be highly commensurable resulting in a fair and matter-of-fact grading. (6 credits)

Economics 1. (Microeconomics)

BMEGCT301004
Objectives and description of the course: The aim is to allow students to understand today’s economic environment. After having finished the course, students should understand the key concepts of microeconomics (e.g. opportunity cost, supply and demand, market equilibrium, prices, cost functions, profit, competition and monopoly), master a basic set of tools of economic analysis and demonstrate the ability to apply them to simple practical problems. This course is
Construction Management.2 * *(Building Project Management)

BMEEEPET601

The subject introduces the investment process from emerging the idea through tendering until the hand-over and use. It shows the role and tasks of an architect in different phases of a construction process. It gives an introduction of real estate investment, basics of project management. The relationship between costs, time and quality: scheduling, planning and estimating and the procurement methods are revealed. There are case studies in the field of construction projects, their preparation and performance, planning, organising leading and commanding of works.

Main topics: Building project management; Participants of the construction; Start-up of the construction project - architectural competition; Tendering and contracting; Scheduling, networks; Cost estimation; Post occupancy evaluation (2 credits)

Construction Management.2 ** *(Building Project Management)

BMEEEPET601

The subject introduces the investment process from emerging the idea through tendering until the hand-over and use. It shows the role and tasks of an architect in different phases of a construction process. It gives an introduction of real estate investment, basics of project management. The relationship between costs, time and quality: scheduling, planning and estimating and the procurement methods are revealed. There are case studies in the field of construction projects, their preparation and performance, planning, organising leading and commanding of works.

Main topics: Building project management; Participants of the construction; Start-up of the construction project - architectural competition; Tendering and contracting; Scheduling, networks; Cost estimation; Post occupancy evaluation (4 credits)

Building Service Engineering 2

BMEEEPETG601


Building Constructions 5

BMEEEPETG602

This subject introduces the students to the precast reinforced concrete, steel and the timber load bearing construction systems of the big span halls and their special additional structures by a system- and performance-based approach. Details both of heavy elevation and roof slab structures made of prefabricated r.c. sandwich panels and lightweight external constructions are presented. Specific flooring, big size doors and partitions of industrial and commercial halls are shown.

It is also an objective to present the special construction rules and the service system aspects of the buildings of lightweight system and their particularities in the terms of building physics and fire protection.

Additional information is presented about multilevel precast r.c. skeleton frames, its typical technical details and the structural solutions of mass produced blocked and panel load bearing systems in case of residential buildings.

The main object of the course is to explain the constructions of one storey high big span halls. Students practice knowledge transmitted during the presentations and workshops in their semester projects on basis of the whole complexity of previous studies. (4 credits)

Preservation of Historic Monuments *

BMEEEPETG1611

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

The third part is dealing with architectural and design-methodological questions of preservation. Especially the architectural problems of presentation of archaeological heritage, the reuse and functional problems of industrial and vernacular buildings for modern purposes. (2 credits)

History of Architecture 6 *

BMEEEPETG601

The course gives an overview on the architecture in the 20-21st centuries. The classes follow chronology with focusing on the works of some great architects: Modernism and Modern Movement. Architecture between the two world wars – De Stijl, Bauhaus, Russian Constructivism, Less is more – Architecture of Ludwig Mies van der Rohe, Toward a New Architecture – Architecture of Le Corbusier. The Nordic Classicist Tradition – Architecture of E. G. Asplund and S. Lewerentz. Alvar Aalto and the modern Finnish architecture. In the second part the course picks up some relevant architectural trends: New Empiricism, New Humanism, New Brutalism and the Team X, the way from large housing estates to architecture without architects. Unfolding estates to architecture without architects. Unfolding post-modern architecture, participation and the Las Vegas strip, Colin Rowe’s studio, Critical Regionalism. The third part concentrates on timely problems: new materials or the multi-sensorial experience of space and surface, Rem Koolhaas’s Dirty Realism, new technology and digital perception, architecture of seduction. (3 credits)
Drawing and Composition 6

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

Department's Design 1 *

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

Urban Design 2

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

Special Load-Bearing Structures *

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

History of Architecture Global* (basic)

The complex exam (BMEEPETO699) is mandatory for students following the new education system. The complex exam comprehends the architecture of classical antique, the medieval, the Early Modern (renaissance and baroque) and the 19th century periods. The main purpose of the exam is to summarise main tendencies in history of architecture that determined the forming of the architectural space in different historic periods. Exam topics are based on the History of Architecture 1 - 5 courses, a list is available in the department (credits)

Reinforced Concrete Structures I.**

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

Economics 2. (Macroeconomics)

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

Construction Management 3

(Planning of Construction Technology)

The goal of the subject is to present information on the planning of elementary construction technologies related to superstructures and finishing work. The subject introduces how to apply recent innovations of building technologies during design and realisation. It gives a basic knowledge to evaluate construction options and make appropriate decisions about technology. There are case studies of building technologies used in construction of loadbearing structures, finishing and cladding works. The practical part contains workshops on planning of construction technologies: connection of structures and technologies, volume calculation, resource estimation, scheduling and construction site planning. (6 credits)

Building Constructions 6

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

**History of Art 1 **

BMEEPETT721

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

**Drawing 7 **

BMEEPRAO702


**Department's Design 2 **

BMEEPRA701

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

**Department's design 3. **

BMEExxT711

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

**Soil Mechanics **

BMEEOGTK701

Dr. Géza Petrasovics, Dr. József Farkas

Fundamentals of soil mechanics, including information indispensable to architectural practice such as the interaction between subsoil and building, the importance of testing the subsoil, foundation costs, essential soil properties, soil exploration methods, the design of spread foundations, drainage (3 credits)

**Building and Architectural Economics**

BMEEEPEKAB01

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

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

**Facility Management **

BMEEPK0633

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

**History of Hungarian Architecture 1. **

BMEEPETO801

The subject History of Architecture in Hungary I. aims to present and analyze the architecture of historic Hungary in European and domestic context from the history of Pannonia to the end of Baroque. The principle of the presentation is the chronological interdependence, however, particular attention is given to the main trends within the different periods as the main stylistic tendencies or external and internal factors that determine the historical and architectural context. A great emphasis is given to the exploration of the connections between the European and Hungarian history of architecture.

Lecture topics include: The beginnings of architecture in the Carpathian Basin. Roman architecture in Hungary. Early medieval architecture in Hungary - Christian Architecture between West and East. The flourishing Romanesque and the beginnings of Gothic Architecture. The rise of Gothic Architecture - architecture in towns and Gothic architecture of the orders. The beginning and the first period of the renaissance till the middle of 16th century. The architecture of fortified palaces and fortifications. The renaissance architecture in Transylvania. The beginnings of the baroque in Western Hungary in the 17th century. The High Baroque in Hungary. (2 credits)

**Drawing 8 **

BMEEPRAO801

Department Design 3 for students is a one semester design course in English, organized by the Departments of Design in. The object of the course is to introduce a multilevel design method for students from general urban concept to the design of an architectural element. A comprehensive urban-architectural design based on the analysis of the urban tissue, cultural heritage, architectural details is going to give a common frame for individual architectural proposals. Teamwork and individual work will constantly implement and define each other. The semester will also give space to work on some contemporary questions in architecture, like the sustainability of an established urban environment, the relationship and social aspects of public and private spaces, the effects of landscape design and design of public spaces buildings. (2 credits)
Urbanism *
BMEEEPUI0805
The goal of the course is to get students acquainted with the multidisciplinary characteristics of Urban Design, Urban Planning and Urban Studies. The semester is divided into three 4 lecture long blocks dealing with: the issues of contemporary urbanity; related fields of science and planning tools in various field of the profession. In the series of lectures professors of the Department of Urban Planning and Design and some invited experts of various fields are presenting lectures on various topics. (2 credits)

Contemporary Architect Offices *
BMEEEPPO0893
The aim of the course is representing Hungarian architect studios and giving useful information about working method of practitioners, creative teams. Lectures are performed by different practitioners architects, displaying their works by presentations or by visiting building projects. There is also a possibility to make informal conversation with architects. The lectures are organized in auditoriums or at building sites. To obtain the final mark, each student has to write an own essay of a defined topic. (2 credits)

Residential Design and Contemporary Competitions*
BMEEPLA0897
Through the study of actual, current public commissions, this class provides a perspective on contemporary Hungarian residential building design praxis. Also, through past projects, it presents the main changes over recent years. The aim is to complement lectures in the Residential Building Design 1 course by acquainting students with as many concrete examples as possible – of contemporary Hungarian architectural creations and, primarily, of the bubbling, fertile, and often controversial world of public commissions. The highlighted standpoint and aim is for students to observe architectural praxis in today’s Hungary, even if that is through more or less successful answers to questions that are posed. Another goal is for students to develop a routine of following public commissions, as well as an understanding of the procurement system, where to find such opportunities, and the rules and methodology regarding tenders. The hidden aim, by engaging with the given public tenders within the course, is to develop an active discourse among pupils on the basis of the evaluation and ‘judgment’ that follows. (2 credits)

Complex Design 1 *
BMEEPxxTB11
Students must develop a plan to the level requested for permit or for a large-scale project, to the depth of an investment program plan. Part of the building must be developed to the construction plan level. Students must also prepare dossiers of structural calculation, work details, mechanical installations and the organisation of the construction site and consult with staff members of various departments for assistance. Students can select their project as well as their Studio Master. (10 credits)

Construction Management 4. **
(Controlling of Construction Technology)
BMEEEPXX801
Subject obligatory for BSc degree - The goal of the subject is to present information on the controlling process of the whole construction activity and the applied technologies involving the legal environment, the quality management, the quality survey, the work safety and the fire protection. Site and company visits are integrated in the theoretical lectures.
Main topics: Regulations concerning to the construction; Building permission/building consent; Quality in construction, Fire protection; Dry construction systems; The work of the quality surveyor; Health and safety during building construction; Controlling activities in Construction Projects (4 credits)

Building Constructions 7 **
BMEEEPKEK801
The goal of the subject to introduce the building methods and the presentation of their validation possibilities. Today, the social, environmental and energy crisis in Central Europe as well is forcing to take into account the requirements of sustainability. The task of the subject the description of the sustainable construction methods, of the technical means, "gentle techniques" and presentation of specific structural systems having preserve and utilize of the existing values, and environmentally conscious design and facility management of new buildings. The aim is to educate architects who are able to comprehensively, the ecological, social, value-defense, engineering, energy, economic, aesthetic considerations are also taken into account and finding and accepting reasonable compromise, adopting individual decisions. (4 credits)

Construction Law *
BMEEPEK0901*
The subject introduces the legal environment of construction projects: contracts, building permit, permission of use, etc. (2 credits)

Construction Law **
BMEEEPKEB801 **The subject introduces the legal environment of construction projects: contracts, building permit, permission of use, etc. (2 credits)

Design of Reinforced Concrete structures*
BMEEPST0655
The subject introduces students into the way of design of approximate dimensions, joints and structural solutions of reinforced concrete structures. Invited lecturers expose some of the most significant recent investments in reinforced concrete in Hungary. The aim of the course is to develop the ability of students - on the basis of EUROCODE 2 - to adopt architectural dimensions and to evaluate the effect of the chosen architectural layout onto the structural solution. (2 credits)

Drawing 9 *
BMEEPRT901
The course provides a wide selection of representation techniques from traditional pencil drawing to collage, and from architectural geometry to computer aided visual rendering. The offered courses cover variable areas of basic architect-
tural graphics, from which students have the opportunity to choose. (2 credits)

**Architectural Interiors***

**BMEEPKO0905**

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

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

**The Form in Architecture***

**BMEEPRA0404**

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

**History of Theory of Architecture 1.***

**BMEEPETO907**

The subject History of Theory of Architecture I. follows the structure of preliminary architectural history courses focusing on the determinant theories of architecture of different periods. The exploration of the most important tendencies and notions of theory of architecture is based on the preliminary history of architecture studies in an essentially chronological structure, evaluating them in critical analysis and searching their role in the history of ideas. Lecture topics include: Categories and concepts of theory in the history of architecture from antiquity to the raise of modernism in the beginning of the 20th century. Vitruvius and his interpretations. Architectural theory in the Middle Ages from early Christianity to late Gothic period. Humanism and the revival of antique architecture in the 15th. The column orders and commentaries on Vitruvius; the theory of the ideal city. Baroque in the reform of the catholic church. Academic movement in France and Classicism in Italy in the 17th. Theory of architecture in France in the 18th century. Enlight-
The education of chemical engineers and chemists has a long-standing tradition in Hungary. Hungary’s earliest chemistry department was established in 1763 at the Selmecbánya Mining School, the first school to offer practical instruction in the chemical laboratory. In 1769, a common department for chemistry and botany was founded at the University of Nagyszombat, which was resettled to Buda in 1777 and later to Pest. In 1846, the Department of General and Technical Chemistry was founded at Joseph II Industrial School, one of the Budapest University of Technology and Economics’s predecessor institutions. Education of chemical engineers, separate from that of mechanical and civil engineers, reaches back to the 1863/64 academic year.

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

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

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

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

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

**Departments**

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

**Budapest University of Technology and Economics**

**Faculty of Chemical Technology and Biotechnology**

Faculty Office:  
Building R, ground floor, room 1.  
Mailing Address: Műegyetem rkp. 7-9.  
H-1111 Budapest, Hungary  
Phone: (+36-1) 463-4618  
Fax: (+36-1) 463-2550

Dean of the Faculty: Dr. Ferenc Faigl  
Course Director: Dr. Zoltán Hell  
Program Coordinator: Mrs Kinga Vass
## Curriculum of BSc Subjects

### General Subjects

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| | Chemical Process Design and Control | BMEVEKFM101 | 4 | 2/0/2p | | | | |
| | Complex and Organometallic Chemistry | BMEVESAM101 | 2 | 2/0/0p | | | | |
| | Sample Preparation and Sampling | BMEVESAM204 | 3 | 2/0/0p | | | | |
| | Mathematics M1c - Differential Equations | BMETE90MX44 | 3 | 2/1/0e | | | | |
| | Intellectual Property Management | BMEVEFAM103 | 2 | 2/0/0e | | | | |
| | Project Work I | BMEVESAM100 | 3 | 0/0/4p | | | | |
| | Organic Chemistry | BMEVESZM101 | 4 | 3/0/0e | | | | |
| | Social and Visual Communication | BMET33MS07 | 2 | 2/0/0p | | | | |
| | Analytical Chemistry III | BMEVESAM201 | 5 | 1/0/4p | | | | |
| | Theory of Analytical Testing Methods in Material Science | BMEVESAM202 | 4 | 2/0/2p | | | | |
| | Physical Chemistry and Structural Chemistry | BMEVEFAM201 | 5 | 5/0/0e | | | | |
| | Modern Methods in Analytical Separation | BMEVESAM203 | 4 | 2/0/1p | | | | |
| | Design of Experiments 2 | BMEVEKFM209 | 3 | 2/0/0p | | | | |
| | Project Work II | BMEVESAM200 | 3 | 0/0/4p | | | | |
| | Bioanalytics and Metabolite Research | BMEVESAM304 | 3 | 2/0/0p | | | | |
| | Modern Physics for Chemical Engineers | BMETE14MX00 | 3 | 3/0/0e | | | | |
| | Biology, Biotechnology | BMEVEMBM301 | 3 | 2/0/0p | | | | |
| | Economic Analyses of Technology | BMET30MS07 | 2 | 2/0/0e | | | | |
| | Computational Chemistry | BMEVESAM301 | 3 | 2/0/1e | | | | |
| | Structure Elucidation of Organic Substances II | BMEVESAM303 | 5 | 3/1/0e | | | | |
| | Thesis Project I | BMEVExxM300 | 15 | 0/0/11p | | | | |
| | Summer Practice | BMEVExxMB88 | 0 | 4 | weeks/s | | | | |

**Notes:**
- **Subject hours/week:** 1, 2, 3, 4 represent the number of hours dedicated to each subject.
- **Remarks:** Notes on specific requirements or prerequisites.

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#### Polymer Technology Specialization

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**Description of BSc Courses**

**Mathematics A1a - Calculus**

**BMETE90AX00**


**General Chemistry**

**BMEVESAA101**


**General Chemistry Calculations**

**BMEVESAA104**


**General Chemistry Laboratory Practice**

**BMEVESA209**

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

**Computing**

**BMEVESAA103**

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

**Chemical Eng. Fundamentals**

**BMEGEVGA003**


**Chemical Engineering Practice**

**BMEGEVGA004**

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

**Macro- and Microeconomics**

**BMEGT30A001**

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

Mathematics A2c
BMETE90AX17

Mathematics A3 for Chemical Engineers and Bioengineers
BMETE90AX18
Outcomes, events, and probability, conditional probability and independence, discreet and continuous random variables, distribution function, density function, expected values and variance, binomial, geometric, poisson, uniform, exponential, normal distribution, joint distributions, and independence, covariance and correlation, the law of large numbers, central limit theorem, exploratory data analysis, graphical and numerical summaries, estimators, unbiased estimators, the linear regression model, confidence intervals, testing hypotheses. (4 credits)

Physics 1 - Mechanics
BMETE14AX15

Inorganic Chemistry
BMVESEAA208
General reactivity principles for the different elements and compounds. Reaction conditions with water, air, acids and bases. General principles in the synthesis of the different elements. Hydrogen, hydrides. The alkalies and their compounds. Alkaline earth metals. Group 13 elements. The carbon group and important compounds of the heavier elements. The nitrogen group and important compounds. The oxygen group, oxides, sulfides. The halogens, halides. Noble gases, D-elements and their compounds. Early d elements, the chromium group, Manganese group, Iron, cobalt and nickel. The noble metals. The copper group. The zinc group. Lanthanides. (3 credits)

Inorganic Chemistry Laboratory Practice
BMVESEAA301
Reactions and properties of elements and their major compounds. Qualitative inorganic analysis: detecting the most important cations and anions: alkaline metals (Li+, Na+, K+); alkaline earth metals (Mg2+, Ca2+, Sr2+, Ba2+); boron group (BO33–, Al3+); carbon group (CO32–, HCO3–, SiO32–, Sn4+, Sn2+, Pb2+); nitrogen group (NH4+, NO3–, NO2–, PO43–, As3+); oxygen group (OH–, SO32–, SO42–); halogens (F–, Cl–, Br–, I–); some transition metal ions (Cr3+, Mn2+, Fe2+, Fe3+, Ni2+, Cu2+, Zn2+, Ag+, Cd2+, Hg2+, Hg2+); Analytical system of Freisen and Bunsee, analysis of mixed cations, mixed anions, and polluted compound (3 credits)

Organic Chemistry I.
BMVESEZ301
Structures of molecules; Stereochemistry, configuration, conformation; Theory of reactions, theories of acid and bases, HSAB and FMO theories; Theory of redox and radical reactions, chemistry of peroxides. Reactivity of olefins and acetylenes, electrophilic addition, oxidation and polymerization; Reactivity of monomeric aromatic compounds, electrophilic substitution; The theory of substitution and elimination; The chemistry of halogen compounds, alcohols, phenols and ethers; The chemistry of nitro compounds and amines; Reduction and oxidation of alcohols, oxo compounds and carboxylic acid derivatives; Reactivity of oxo compounds, carboxylic acids and carboxylic acid derivatives; Oxo-enol tautomers; Chemistry of carboxylic acids; Chemistry of carboxylic acid derivatives; (5 credits)

Chemical Technology
BMVEKFA203
Technology, know-how, chemical technologies. Characteristics of chemical industry, chemical industry products. Inorganic chemical technologies; Chemical technology in metall production industries; Alkali electrolysis, chlorine, sodium-hydroxide and hydrogen production, Silicate industry; Microelectronic industry; Energy and energy production: resources and reserves. Water and its role in chemical technologies. The chemical technology of coal, Clean coal technologies. Fischer-Tropsch synthesis; Hydrocarbon chemistry and technologies, oil and gas. Fuels for transport vehicles; Crude oil refinery; Lubricating and cooling products from the oil industry. Laboratory practice: Water treatment ion exchange and membrane separation; Boiler efficiency, exhaust gas analysis; Hydrocarbon characteristics, viscosity and flash point determination; Engine exhaust gas analysis, catalytic conversion; Corrosion experiments; Catalytic reforming (dehydrogenization of cyclohexane); (3 credits)
Physics 1 Electrodynamics

**BMETE14AX04**


Physical Chemistry I

**BMEVEFKA304**


Polymers

**BMEVEFAA306**


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

Organic Synthesis Laboratory Practice

**BMEVESA402**

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

Analytical Chemistry Laboratory Practice

**BMEVESSA403**

Gravimetric and titrimetric (acid-base, argentometry, complexometry, redoxi) determinations of different inorganic ions and organic compounds. Determination of inorganic and organic compounds using various instrumental analytical (potentiometry, conductometry, liquid-, gas- and thin layer chromatography, flame photometry, atomic absorption spectrometry, fluorometry, mass spectrometry, immunoassay methods. (4 credits)
Physical Chemistry II
BMEVEFAA405

Medicines
BMEVESZA403
The subject gives a brief introduction to the medicinal chemistry and pharmacology. The fundamental pharmacological definitions and ideas as well as a historical outline of drug discovery and design are presented. Selected examples of drug action at some common target areas demonstrate the importance of the special receptor-drug interactions and the impropriety of chemical modifications of the leading molecules to produce highly selective medicines. Typical examples are also discussed for drug metabolism including several organic chemicals and solvents which are important for the organic chemists. (3 credits)

Colloid chemical approach to nanotechnology
BMEVEFAA409

Environmental Chemistry and Technology
BMEVEKFA403
Chemical properties, ways of formation, elimination ways, reaction kinetics, and control methods of environmental polluting materials (airborn pollutants: carbon dioxide, nitrogen oxides, sulfur oxides, hydrocarbons, and photochemical oxidants, particulates, dioxines, waterborn pollutants: organic materials, toxic organic materials, plant nutrients, mineral oil and fractions, detergents, pesticides, toxic metals). (4 credits)

Organic Chemical Technology
BMEVESTA411
The subject shows the typical fields, equipment and transformations of the organic chemical industry. The relevant fields discussed are: C₆H₆, C₂ and C₃ intermediates, as well as aromatic substrates; detergents, washing powders and environmental considerations; pesticides, such as insecticides, fungicides and herbicides, toxicity and environment; features of the pharmaceutical industry, typical syntheses and technologies illustrated by the examples of some drugs selected; principles of green chemistry, environmental-friend considerations; characteristics of the plastic and rubber industry, recycling of thermoplastics; the textile and dye industry, natural and synthetic dyes. (3 credits)

Organic Chemical Technology Practice
BMEVESZA412
In the framework of the laboratory practice, the students get acquainted with typical organic chemical transformations (eg. oxidations, hydrogenations, esterifications, Friedel-Crafts reactions, diazotation and coupling) carried out in suitable reactors, such as stirred tank reactor, tube reactor, autoclave, cascade reactor, ball- and tube mill and Mettler-Toledo intelligent reactor. Operation of the reactors should be optimized by studying the effect of the technological parameters, such as temperature, pressure and stirring. The reaction mixtures are analysed by up-to-date techniques. (3 credits)

Chemical Unit Operations I
BMEVEKFA410

Business Law
BMEGET55A001
The problems of the area will be treated in two major parts. Part One introduces students to the general topics, for example the concept of law, the functions of the law in the socioeconomic life. Some basic legal problems, like the conception, characteristics and functions of the modern state and, in a comparative view, the characteristics of the Anglo-Saxon and continental systems of business law and the development of the Hungarian business law will be also discussed. The emphasis of Part Two is on the questions of company law and competition law presented in a European context. The lectures of this part outline not only the regulations of the Hungarian Company Act and Company Registry Act but they cover EU directives and regulations on companies and competition as well. (2 credits)

Design of Experiments
BMEVEVMA606
Hydrocarbon processing

BMEVEKFA506

Introduction, types and characteristics of hydrocarbons, resources. Artificial hydrocarbon production, Fischer-Tropsch synthesis; Important crude oil treatment technologies: catalytic reforming, cracking of petrol, alklylation, polymerization, isomerization, thermal cracking, visbreaking, delayed coking, hydro-desulfurization and refining, hydrocracking, transport fuel production, its trends, components, environmental effects. Alternative fuel production, lubricating oils, paraffine and bitumen production and characteristics; Production and use of selected aromatic hydrocarbons, aromatic raw materials, their extraction, BTX production and use; Transformation of aromatic hydrocarbons, dealkylation, disproportioning, production and use of ethyl-benzene, styrene, cyclohexane and polymer-benzenes; Olefin production, pyrolysis technology and product separation, treatment and technologies of C5-fraction, production and use of linear-α-olefins (3 credits)

Biochemistry

BMEVEBEA301

Introduction: structure of procariotic and eucariotic cells; major classes of biomolecules; C, H, N, O cycle; Properties of enzymes; classification of enzymes; role of cofactors; Fatty acid degradation (β-oxidation); Glycolysis; Pentose phosphate cycle; Amino acid catabolism (deamination, decarboxylation); Urea cycle; Conversion of pyruvate to acetyl-CoA; Citric Acid Cycle; Citrate cycle; Glyoxylate cycle; Electron transport, Oxidative phosphorylation; Photosynthesis (light reaction, Calvin cycle, Photospiration); Fatty acid-, triacylglycerol-, phospholipid-, sphingolipid-, colesteryl biosynthesis; Nitrogen fixation, amino acid biosynthesis; Nucleic acid biosynthesis (DNA, RNA); Protein biosynthesis; Regulation (molecular, cell and body level) (4 credits)

Physical Chemistry Laboratory Practice

BMEVEFAA506


Chemical Process Control

BMEVEVMA504


Chemical Unit Operations II

BMEVEKFA512


Management and Business Economics

BMEGT20A001

This course introduces the essentials of management as they apply within the contemporary work environment and gives a conceptual understanding of the role of management in the decision making process. It particular attention is paid to management theories, corporate finance, leadership, teamwork, quality management, management of technology, economics calculation and operations management. For problem formulation both the managerial interpretation and the mathematical techniques are applied. (4 credits)

Safety Technology in the Chemical Industry

BMEVESZA101


Quality Management

BMEVEKFA615

Development stages of quality management, quality models quality systems (ISO 9000, QS9000, ISO 1400), TQM – customer in the centre, management of key processes, organization background, techniques for continuous improvement; 6 sigma methods, fundamentals of reliability, stability and capability, variables control charts (xbar-range, individual), attributes control charts (effective and defect), process capability, measurement system analysis, acceptance sampling (4 credits)
Chemical Unit Operations Laboratory Practice

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

Analytical and Structural Chemistry Specialization

Analytical and Structure Determination Laboratory

BMEVEAAA604

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

Elemental Analysis

BMEVEAAA701


Chemical and Biosensors

BMEVEAAA708

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

Chromatography

BMEVEAAA611

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

Elucidation of Organic Structures

BMEVEAAA512

Introduction into the theory of ultraviolet/visible, infrared, mass and nuclear magnetic resonance spectroscopy. Interpretation of ultraviolet/visible, infrared, El-mass as well as one-dimensional H1 and 13C NMR spectra. Presentation of their application for the solution of practical problems. Presentation of their joint application in the elucidation of the structure of simple unknown compounds. (3 credits)

Theory of Testing Methods in Material Sciences

BMEVEFAA708

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

Organic Chemistry III

BMEVESKA504

Chemical and Process Engineering Specialization

Hydrocarbon Technology and Catalysis
BMEVEKFA503
Catalytic reformation of naphtha, the starting material and product testing; Catalytic naphtha reformation, modeling calculation; Cracking of naphtha and diesel, production of olefins; Hydrogenation of toluene vapor on Ni catalyst; Alkylation of toluene with ethanol vapor on HZSM zeolite catalyst; X-ray measurements of Pd metal content on activated carbon catalysts; Oil and gas separation by molecule sieves (5 credits)

Process Engineering
BMEVEVMA605

Environmental Benign Chemical Processes
BMEVEVMA607
Green chemistry metrics: The concepts of green chemistry, green engineering and sustainability. The necessity of quantifying a green reaction/process/product/firm. E factor, EQ factor, CI. Atom selectivity, atom efficiency, stoechiometric factor, conversion, reaction mass efficiency, material recovery parameter. Metrics to be applied for a process/production: mass index; energy factors: life cycle, waste treatment, solvent recovery; intensity factors: solvent, waste, energy; Emission control – Example: Gas purification: Regulation aspects, Best available technology concept, Nitric acid production, environmental considerations in process development; Processes under vacuum: Sublimation, Freeze drying, lyophilization, Evaporation under vacuum, Short-path distillation, Molecular distillation; High-pressure processes: High-pressure distillation, Pressure-sensitive distillation (breaking azeotropes), High pressure processing of food; Supercritical fluid extraction and other processes: Supercritical fluids, properties, Solubility in supercritical fluids, Supercritical fluid extraction and fractionation, Chemical and biochemical reactions in supercritical fluids, Particle formation (crystallization) using supercritical fluids, Supercritical fluid chromatography; Biofuels (raw materials, by-products): Bioethanol, Biodiesel: trans-esterification; gasification; Fischer – Tropsch synthesis, Biogas: hydrolysis; fermentation/digestion; purification; Recovery of organics from water: Separation of ethanol: azeotropic distillation, extractive distillation, liquid-liquid extraction, adsorption, membrane separations; Separations in fine chemical – biochemical industry: Aqueous biphasic extraction, Chromatographic techniques (size exclusion, ion-exchange). Example: IgG purification from a fermentation broth. (4 credits)

Computer Process Control
BMEVEKFA709

Chemical Production Control
BMEVEKTA707
The management and economics that are typical for the chemical industry are presented in this course. The examples are taken from the petrochemical industry. Consumer and producer behaviours. Chemical production. Financial system. Profit and investment analysis. Emerging Economic and business environment. (3 credits)

Radiochemistry and Nuclear Energetics
BMEVEKFA502
Industrial Pharmaceutics Specialization

Elucidation of Organic Structures
BMEVESAA512
Introduction into the theory of ultraviolet/visible, infrared, mass and nuclear magnetic resonance spectroscopy. Interpretation of ultraviolet/visible, infrared, El-mass as well as one-dimensional $^1\text{H}$ and $^{13}\text{C}$ NMR spectra. Presentation of their application for the solution of practical problems. Presentation of their joint application in the elucidation of the structure of simple unknown compounds. (3 credits)

Organic Chemistry III
BMEVESKA504

Organic Chemistry Laboratory Practice II
BMEVESKA605
During laboratory practice students acquire the basics of synthetic organic chemistry, the ways of safe work, the simple and fast ways of the identification of the synthesized substances (TLC, IR, NMR and mass spectroscopy) and the use of the current organic chemical literature. They extend their organic chemical knowledge and acquire substantial practical experience in the field of organic chemical research (they join the research of their instructors and get acquainted with advanced preparative methods and chromatographic techniques). (5 credits)

Pharmaceutical Technology I.
BMEVESTA704
This subject gives an overview on the characteristic methods for the industrial synthesis of active pharmaceutical ingredients based on known technologies of Hungarian and other producers. The relevant fields discussed are: choice of the synthesis strategy, development and permanent updating of the industrial technology from different aspects such as the protection of the environment, the assurance of the quality, the safety, the thrift and the protection of the copyright. Choice criteria of the appropriate equipment, technologies for separation of active pharmaceutical ingredients and their intermediates from natural raw materials (plants, animals) are presented. Aspects of the diminution of the waste materials produced, waste treatment are also discussed. (2 credits)

Unit processes in Industrial Drug Synthesis Laboratory Practice
BMEVESTA705
In the framework of the practice typical industrial level synthetic technologies and processes are presented for the students. The theoretical background of the unit processes applied in the presented technologies has been discussed in the lectures of “Unit Processes in Drug Synthesis” and highlighted again during the practices. (4 credits)

Unit processes in Industrial Drug Synthesis
BMEVESTA606
The subject deals with the typical chemical transformations, isomer separation techniques and scale up processes of the pharmaceutical and fine chemical industry. Among the unit processes the special N-, O- and C-alkylations, C-C bond forming reactions (Claisen-, Dieckman-, Knoevenagel- és Darzens-condensation, Vilsmeier-formylation, synthesis and reactions of polar organometallics), and selective reductions with inorganic and organic hydrides are discussed. The theory and methods for separation and enrichment optical isomers, as well as the rules of application dry technologies are discussed and illustrated by industrial examples. (2 credits)

Technology of Pharmaceutical Materials
BMEVESTA607
The subject covers the theoretical background and practice of the technology of pharmaceuticals and biopharmacy including the formulation of medicines, characteristics of the pharmaceutical excipients and carriers, the relevant structural and mechanistic relationships, main dosage forms, relevant analytical methods and machinery. Emphasis is put on the comparison of the capability and limitations of traditional and advanced analytical and processing tools. (3 credits)

Unit Processes of Organic Chemistry
BMEVESTA508
The subject gives an overview on the most important chemical transformations relevant to the pharmaceutical-, pesticide- and fine chemical industry. The following basic processes are discussed systematically: alkylation and acylation including the Friedel-Crafts reactions, halogenations, sulfonations, nitrations, diazotation and azo-coupling, oxidations, hydrogenations, CO-reactions and others. The stress is laid on the substrates, reagents, catalysts and optimal conditions, as well as on industrial examples and environmental-friend solutions. (2 credits)
### Polymer Technology Specialization

#### Theory of Testing Methods in Material Sciences
**BMEVEFAA708**

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

#### Machines and Tools for Polymer Processing
**BMEVEFAA705**

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

### Polymer Processing
**BMEVEMGA608**

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

### Polymer Physics Laboratory Practice
**BMEVEMGA509**

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

#### Polymer Additives
**BMEVEMGA610**

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

### Polymer Physics
**BMEVEMGA511**

Textile Technology Specialization

Theory of Testing Methods in Material Sciences
BMEVEFAA708
Introduction (the models of molecules, crystals, liquids, amorphous materials; interaction of materials with electromagnetic radiation); infrared and Raman spectroscopy; Absorption UV-Vis spectroscopy; optical and electronic properties of solids; photoelectron spectroscopy (UPS, XPS, AES); NMR spectroscopy (molecular and solid state); X-ray diffraction (crystal, liquid, small angle); microscopy (SEM, TEM, AFM) (4 credits)

Fibre Forming Polymers
BMEVEMGA512
General properties of the fibre forming polymers, physical and chemical structure of natural and man-made fibres, properties of the fibres in general, relation of the structure and the properties (2 credits)

Chemistry of Dyes and Surfactants
BMEVESTA510
Colouristic knowledge will be presented based upon the correlation between the colour and structure of dyes. Systems, production, chemical and technological characteristics and application of dyes and surfactants on the field of macromolecular systems as specially of fibrous ones will be presented. Methods of fastness property investigations of dyed systems e.g. light fastness, rubbing fastness, wash fastness are included. Optimal water and energy consumption as well as the reduction of environmental pollution will also be discussed. (2 credits)

Colorimetry, Colormeasurement
BMEVEMGA515
Colorimetry, optics, Areas of application; Characterization and systematization of colours. Hue, lightness, saturation. Munsell system; Colour expression; Light-sources, characterization of illuminants, spectral distribution of energy, spectral distribution of the light; Quantifying Colour, CIE colour system; CIE 1931 and CIE 1994 systems; Uniform colour spaces; XYZ tristimulus values, colour coordinates; Colour difference values: explanation and calculation; Modern colorimeters; Colour-matching functions, Kubelka-Munk equation, relations of reflection and dye concentration; Application of colour measurement for quality assurance; Measurement of whiteness, whiteness indices. Fluorescent or optical brighteners; (2 credits)

Chemical Technology of Textiles I.
BMEVEFMAF617
Preparatory processes: desizing, scouring, bleaching, carbonizing; Mercerization and liquid ammonia treatment; Dyeing processes: fundamentals and methods; Textile printing; Laboratory practices: Identification of textile materials; Preparatory processes: desizing, scouring and bleaching; Dyeing of cellulose fibres; Dyeing of wool; Dyeing of synthetic-polymer fibres; Textile printing; (7 credits)

Chemical Technology of Textiles II.
BMEVEFAA718
Introduction; Specific functional finishes (Crease resistance, Dimensional stability, Flame retardancy, Antimicrobial finishes, Soil-release and repellent finishes); Laundering; Coatings; Environmental impact of textile wet processes; Quality insurance of textiles; (4 credits)

Mechanical Technologies of Textiles
BMEGEPTAKV1
Textile materials: Natural and synthetic textile fibres and their properties; Yarn production: Materials and equipment available for producing the various types of yarn; Spinning, opening, cleaning, carding, twist, drawing, blending, imparting order, reducing the unevenness of yarn mass, attenuation (draft), yarn formation, handling material; Ring spinning, post-spinning, open end spinning, different spinning techniques (ring spun yarns, rotor spun yarns, air-jet spun yarns, friction spun yarns, wrap spun yarns); Thread production: Thread construction; Characteristics of sewing threads; Thread-production methods’ types of thread package; Woven fabric production: Preparation; Winding; Warping; Slashing (warp sizing); Drawing-in and tying-in; The fundamental of fabric structure. Woven fabric design; Shuttleless weaving systems; Knitted fabric production: Weft knitting: yarn delivery systems on circular and flat knitting machines. Warp knitted fabric production; Non-woven fabric production: Formation of dry, wet, spun laid and other types of non-wovens; Clothing technologies: (2 credits)
The Faculty of Civil Engineering is the oldest Faculty of the Budapest University of Technology and Economics and can trace its history back to the University’s predecessor, the Institutum Geometricum, founded by Emperor Joseph II in 1782. In the past 233 years, thousands of engineers have graduated from this Faculty to work worldwide as educators, international researchers and engineering project managers.

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

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

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

Departments

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<tr>
<th>Geodesy and Surveying</th>
<th>Structural Mechanics</th>
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<tr>
<td>Construction Materials and Technologies</td>
<td>Highway and Railway Engineering</td>
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<td>Photogrammetry and Geoinformatics</td>
<td>Hydraulic and Water Resources Engineering</td>
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<tr>
<td>Engineering Geology and Geotechnics</td>
<td>Sanitary and Environmental Engineering</td>
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<td>Structural Engineering</td>
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Budapest University of Technology and Economics
Faculty of Civil Engineering
Faculty Office:
Building R, ground floor, room 001.
Mailing Address: Műegyetem rkp. 7-9,
H-1111 Budapest, Hungary
Phone: (+36-1) 463-3898
Fax: (+36-1) 463-2550
Web: www.epito.bme.hu

Dean: Dr. László Dunai
Vice-dean: Dr. Sándor Ádány
Course-director: Dr. Tamás Lovas
Program coordinator: Mrs Kinga Vass
# Curriculum of BSc in Civil Engineering (8 semesters), Branch of Structural Engineering, Major of Buildings

<table>
<thead>
<tr>
<th>Subject</th>
<th>Code</th>
<th>Credits</th>
<th>1</th>
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49
### Curriculum of BSc in Civil Engineering (8 semesters), Branch of Structural Engineering, Major of Buildings (contd.)

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Description of BSc Courses

Compulsory English 1.
BMET63A3E1
The course is designed to enable students to communicate fluently and effectively in study environment. Receptive, productive and interactive activities and strategies are included in the curricula. (4 credits)

Surveying I.
BMEEOFAT41

Chemistry of Construction Materials
BMEEOMAT41

Civil Engineering Representation and Drawing
BMEEOMAT42
3 main parts of the subject: 1. Descriptive geometry 2. Engineering drawing 3. Freehand drawing. 1. Basics of descriptive geometry course modules: Students gain knowledge and skills in regularities and techniques of descriptive geometry, developing spacial reasoning. Topics: basic constructions in planes of projections, transformations, tasks of intersections, intersections and penetrations of plane and curved solids, cast shadows, construction in scale, special revolution solids and skew surfaces. Additional representation systems: dimensioned representations, orthogonal axonometry, perspective projection. 2. Engineering drawing course modules: Students gain knowledge and skills in engineering drawing, specific notations, proportions and scale, magnification, minification, construction of ground plans and sections. 3. Engineering free-hand representation course modules: develop free-hand drawing in scale. (4 credits)

CAD for Civil Engineers
BMEEOFAT41
Besides an overview on CAD systems and application fields, students will learn the 2D drawing commands that enable carrying out basic design tasks. Layer management, block definition and applying annotations and dimensions are discussed in detail. Learning printing options and parameters supports further design works in the BSc civil engineering program. The aim of the course is to let students understand the potential and capabilities of CAD systems and their applications. The course introduces the basic spatial drawing solutions providing bases for high level courses involving 3D constructions, BIM applications. (2 credits)

Geology
BMEEOGMAT41
The geology provides the characterisation of geological formations and materials from a civil engineering point of view. It describes the processes and the interactions between the engineering works and the geological environment. The dynamics of the Earth, the description of raw materials and geo-materials used in engineering practice (minerals and rocks), the geological risks such as earthquakes, volcanism, landslides and their effect, characterisation of surface and subsurface waters and related geological problems. (3 credits)

Basis of Statics and Dynamics
BMEEOTMAT41

Mathematics A1a - Calculus
BMTE90AX00
Physics for Civil Engineers

**BMETE11AX13**


Compulsory English 2.

**BMEG63A3E2**

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

Surveying II.

**BMEEOAFAT42**

Properties of analogue and digital maps, the application of maps in engineering practice. Traversing, the types of traverse lines. Localizing blunder in traverse lines: the linear and angular error. Offset surveys. The determination of the horizontal and vertical positions of detail points: the tacheometry. Total stations and their application in surveying. Topographic surveys: 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. (4 credits)

Construction Materials I.

**BMEEOEMAT43**


Civil Engineering Informatics

**BMEEOFTAT42**

The course gives an overview on the major areas of informatics, on the components of information technology systems. Besides supporting the labs, some practical problems and particular tasks are also discussed on the lectures. On the labs, students use spreadsheet application to solve different tasks, then learn the basics of numerical and non-numerical methods in mathematical software environment. Students also learn the basics of programming: most of the tasks have to be solved by own scripts, routines, programs. Civil engineering informatics discusses 2D and 3D computer graphics and the basics of database management that supports high level courses involving spatial construction and database systems. (5 credits)

Soil Mechanics

**BMEEOGMAT42**

Origin of soils, soil exploration, soil samples. Components of soils (phase relationships, grain size distribution, consistency limits), soil classification, compaction. Stresses in the soil (under static conditions, conditions of steady vertical flow). Flow of water through soil due gravity (Darcy’s law, coefficient of permeability, flow nets). Compressibility of soil (reasons and types of compression). Shear strength of soil (Mohr-Coulomb failure criterion, determination of shearing strength). (4 credits)

Introduction to Strength of Materials

**BMEOOTMAT42**

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. (6 credits)

Hydraulics I.

**BMEEOVVAT42**


Mathematics A2a - Vector Functions

**BMETE90AX02**


Surveying Field Course
BMEEQAFAT43
Using the theoretical background of the courses Surveying 1 & 2 students are required to: assess the existing datasets used for mapping; define the necessary surveying activities; practice the surveying observations, planning, data processing and documentation; practice profile boarding, setting out of roads; learn to use modern surveying instruments (total stations, GPS/GNSS receivers, electronic levels, digital photography). (3 credits)

Building Construction Study
BMEEQMAT44

Geoinformatics
BMEEQFTAT43
The aim of Geoinformatics is to introduce the principles and potential application fields of geographic information systems (GIS) in the civil engineering practice. The course discusses the basic concepts and applications of GIS, the modelling process needed to create GIS, the reference systems of geometric data, the spatial data sources and data acquisition methods, the aspects of data quality, the resources, tools, databases of GIS, the basics of data analysis, visualization and implementation of GIS. Through the lectures and labs students learn the GIS workflow based on desktop and web-based solutions, and tools of spatial process modelling, data management and web integration. (3 credits)

Basis of Design
BMEEQHSTAT41

Structural Analysis I.
BMEEQTMAT43

Railway Tracks
BMEEOUVAT41
Basic concepts of the railway tracks and vehicles, most important technical parameters. Features of normal railways, suburban railways, urban railways, classification of different types of railways. Speed, acceleration, changing of acceleration. Horizontal and vertical alignment of the railway tracks, straight lines, circular curves and transition curves, superelevation, vertical curves. Elements of the substructure and superstructure. Rails, sleepers, rail fastenings, ballast, subgrade, strengthening of the subgrade. Setting out major and detail points of curves and transition curves. Structures and solutions of dewatering and drainage of railway tracks. Basic concepts of conventional and continuously welded rail tracks. Types of turnouts and simple track connections. Basic concepts of railway stations, platforms, passenger access. (3 credits)

Basics of Environmental Engineering
BMEEQVKAT41
The aim of the course is to provide basic scientific and engineering background for further studies in environmental engineering by giving introduction to the following subjects: basics of ecology, the natural cycle of ecologically important elements and substances, the environmental effects of human activities, the ecological footprint, energy consumption patterns and energy production technologies, renewable energy sources. Selected environmental problems associated with civil engineering activities (water, air and soil pollution), with focus on the urban environment. Tools and methods for conducting environmental impact assessment. (3 credits)

Public Works I.
BMEEQVKAT42
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. (3 credits)

Hydrology I.

**BMEEOVAT41**

Mathematics A3 for Civil Engineers

**BMET900AX07**

Earthworks

**BMEEOGMAT43**

Steel Structures

**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 centrally loaded tension members. Design of Centrally loaded compression members. Buckling problem – behaviour – design method. Design of beams: construction, behaviour under bending and shear interaction. Beam structural behaviour - design approaches for lateral torsional buckling. Design of bolted connections. Design of welded connections. Fatigue design and brittle fracture. Plate buckling phenomena, basics of the cross section classification. (3 credits)

Reinforced Concrete Structures

**BMEEOHSAT43**
Structural safety of reinforced concrete (RC) structures; loads and effects on RC 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. (3 credits)

Roads

**BMEEOUVAT42**

Hydraulic Engineering, Water Manag.

**BMEEOVAT43**
The tasks, methods and tools of water management. Hungarian and European specialities of water management. Types and tasks of hydraulic engineering structures with the following topics: Watershed management of lowland and hilly areas, regulation of lakes and rivers, reservoirs and storage, flood control and land drainage, inland navigation, water power development, water intake and pumping stations, small hydraulic engineering structures, characteristic environmental impacts of hydraulic engineering structures. During the practical lessons four design works will be elaborated. (3 credits)

Construction Management

**BMEEPEKAT41**
Curricula, themes, individual projects, tests, subjects of lectures and seminars of the Course are embracing managerial and organizational learnings useful and necessary for all civil engineers, such as: - jobs and organizational structure of Contracting Construction Trade; - jobs and relations of parties collaborating in executing construction projects; - time and resource needs of executing construction projects (basic methods and terms of time-, resource- and cost estimates); - basics of mechanizing Construction, construction equipments and auxiliary plants, typical applications; - organizing construction site (site layout designs). Individual project: Organizational plans (time estimates, resources calculations and site layout designs) of building a simple linear structure (reinforced concrete retaining wall) well known in practice of all civil engineers. (3 credits)

Business Law

**BMEGT555A001**
The problems of the area will be treated in two major parts. Part One introduces students to the general topics, for example the concept of law, the functions of the law in the socioeconomic life. Some basic legal problems, like the conception, characteristics and functions of the modern state and, in a comparative view, the characteristics of the
Anglo-Saxon and continental systems of business law and the development of the Hungarian business law will be also discussed. The emphasis of Part Two is on the questions of company law and competition law presented in a European context. The lectures of this part outline not only the regulations of the Hungarian Company Act and Company Registry Act but they cover EU directives and regulations on companies and competition as well. (2 credits)

**Foundation Engineering**

**BMEEOGMAT44**


**Management and Enterprise**

**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. (4 credits)

**Micro- and Macroeconomics**

**BMEGT30A001**


**Communication Skills for Civil Engineers**

**BMEGET60A6EO**

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

**Urban and Regional Development**

**BMEEOUVA43**


**Branch of Structural Engineering**

**Building Construction I.**

**BMEEOEMAS42**

Students gain knowledge and skills during the semester work in the following topics: Flat and deep foundations, relation to sub-soil insulation of buildings. Masonry works, prefabricated panel systems. Plasters and ETICS. Reinforced concrete, steel and wooden beam slab constructions. Stairs. High roofs. Passable and non-passable flat roofs, green roofs. Insulations against functional water. (3 credits)

**Timber Structures**

**BMEEOH2464**


**Strength of Materials**

**BMEEOETM41**

Differential equation of the elastic curve, computation of the deflected shape for various boundary conditions. Virtual displacement systems, virtual work. Theorem of virtual displacements. Computation of external and internal forces of statically determinate structures using the theorem of virtual displacements. Concept of potential energy, theorem of stationarity of potential energy, application of the theorem for the computation of displacements of structures. Concept of complementary potential, theorem of minimum complementary potential energy, using the theorem for the computation of reactions of structures. Revision of common work and energy theorems of mechanics. Characterization of equilibrium states, concept of critical load. Methods of stability analysis: statical, kinematical, and energy methods. Elastic Euler buckling. (3 credits)
Construction Materials II.

**BMEEOEMAS41**


Building Construction II.

**BMEEOEMAS43**


Steel and Composite Structures

**BMEEOHSA41**

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

RC and Masonry Structures

**BMEEOHSA42**

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

Bridges and Infrastructures

**BMEEOHSA43**


Laboratory Practice of Testing of Structures and Materials

**BMEEOHSA46**

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

Structural Analysis II.

**BMEEOTMA42**


Rock Mechanics

**BMEEOGMA41**

Petrophysical properties of solid rocks, the characterisation of rock blocks and rock masses, the jointing system in the rock environment. The deformation processes and rheological characters in rock mechanics, the influence of joint spacing. The durability and effect of rock environment on the engineering structures. The evaluation of geological conditions in rock environment at tunnels foundations and rocky slopes. The influence of material properties on the petrophysical properties of rocks. (3 credits)

Underground Structures, Deep Found.

**BMEEOGMA42**

Types and field of application of deep foundations (stone columns, diaphragm walls), Load transfer mechanism of deep foundations. Determination the bearing capacity and settlement by different methods (by theoretical formulas, load tests, sounding). Design and construction of Pedestrian subways, Underground garages. Analysis against uplift. Insulations. (3 credits)

3D construcional modelling of structures

**BMEEOHSA45**

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

**Design of Structures Projectwork**

**BMEEDOHAS41**

Students need to accomplish a complex design projectwork that is based on the knowledge gained through the branch courses. The project work is supervised by three lecturers from three areas of structural engineering. (6 credits)

**Public Administration and Land Registry**

**BMEEOUVAT44**


**Field Course of Structural Geodesy**

**BMEEOOAFAS42**

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. (1 credits)

**Dynamics of Structures**

**BMEEOOTMAS43**


**Industrial Practice**

**BMEEOOHSA-A1**

20 days of industrial practice at a civil engineering construction company. (0 credit)

**Major of Buildings**

**Steel Buildings**

**BMEEOHSA-A2**


**Reinforced Concrete Buildings**

**BMEOOHSA-A3**


**Building Construction Methodology**

**BMEEOEMA-A1**

During the semester methodology of planning, methods of design of building constructions are presented. Listing of requirements depend on function of building (building physical, acoustical point of views and fire protection). Designation of structural hierarchy based on the determined requirements. Building constructional relationship and design rules: i) skirtings - connections of load-bearing structures ii) structures of floors (floors on ground, floors of general slabs) - connections of load-bearing structures iii) facade - connections of load-bearing structures iv) thermal insulation and rainwater seepage, soil moisture and waterproofing - connections of load-bearing structures v) special building constructions (windows, doors, gates), structures of fire protection (skylights, suspended walls against fume spreading). (2 credits)

**Construction Technology**

**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. (3 credits)
Building Design Projectwork  
*BMEEOHSA-AP*

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

Elective option: Reinforced Concrete bridges  
*BMEEOHSA-B2*


Description of MSc Courses

Advanced mathematics

*BMETE90MX33*

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

Physics laboratory

*BMETE11MX22*


Numerical methods

*BMEEOFTMKT2*

The aim of this course is to introduce numerical techniques that can be used on computers employing Matlab system, as well as to provide understanding of how these methods work and aid in choosing the proper algorithm. The topics cover linear and non-linear equations, optimization, numerical integration and differentiation, interpolation, regression and ordinary differential equations resulted mainly from civil engineering problems. (3 credits)

Database systems

*BMEEOFTMKT3*

This course will present the base theory, management and analysis of Database Systems which play increasing role in the field of civil engineering practice, the science and the everyday life. It will cover the evaluation factors of database systems and the theoretical, logical, physical and non-structured models of database architectures. Introduce the planning, modeling, retrieving and analysis techniques of databases. Cover the national/international practice used in infrastructural, environmental, technical data bases, data warehouses. (2 credits)

Advanced mechanics

*BMEEOTMMST9*

Basic variables of non-linear continuum mechanics, equations of kinematics. Definition of strain, small and large strains, strain tensors. Definition of stress, stress tensors. Thermodynamic conditions of material models, stress and strain pairs, the most important material models for elastoplastic and time-dependent materials. Basic equations of continuum mechanics, strong and weak forms. Different work and energy theorems, applications. Basic solution methods of equations of continuum mechanics, displacement and force methods, stress functions. Basic mechanical equations of beams, plates and shells. (4 credits)

Finite element method I.

*BMEEOTMMST0*


FEM modelling of structures

*BMEEOHSMB01*

The aim of the course is to demonstrate the finite element modelling possibilities in the structural design. Finite element model development; static system and FEM model relationship. Demonstration of the advanced finite element analysis: possible finite elements and analysis methods. Modelling of structures with truss-, surface- or volume elements. Finite element model verification and model refinement possibilities (convergence study, adaptive mesh generation). (2 credits)

Management accounting and controlling

*BMEGT35M410*

The main issues of ‘window dressing’ and their interpretation through financial ratio analysis and interpretation. The cost volume profit analysis and its relationship with costing and pricing decision-making. The operational and capital...
budgetary process in an international context and its advisory role through the process of variance analysis. The best international accounting practice both at the functional, planning and strategic stages. The wider developmental strategic and ethical international issues concerned with managerial accounting. (4 credits)

**Engineering ethics**

**BMEEGT41M004**

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

**Decision supporting methods**

**BMEEPEKMS05**

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

**Material models and plasticity**

**BMEEOTMMB04**

The effect of microstructure of materials on macro-behaviour. Micro- and phenomenological models. Thermodynamic conditions in generation of material models, conditions of stability and definiteness. Models of elastic and irreversible behaviour: plastic and fracturing physical states, basic ideas of continuum damage mechanics. Description of complex material behaviour. Numerical and experimental aspects of material modelling. The main emphasis is placed on the fundamental relations and theorems of the incremental theory of plastic bodies and on the principles and methods of incremental and limit analysis, optimal design, and shakedown analysis of bar structures. In additions, however, the elastoplastic analysis of prismatic bars under torsions and thick-walled cylinders and subjects subjected to internal pressures, as well as the theory and application of plane strain and plane stress problems of plasticity are also discussed. (5 credits)

**Finite element method II.**

**BMEEOTMMB05**


**Structural reliability**

**BMEEOHSMST5**


**Structural dynamics**

**BMEEOTMMB02**


**Stability of structures**

**BMEEOTMMB03**


**Numerical methods for structures**

**BMEEOTMMB06**

Fundamentals of Discrete Element Modeling. Overview of the mathematical principles of DEM. Theoretical fundamentals of the most important modeling methods: UDEC, PFC, DDA, CD, mixed techniques. Interpretation of the results with the help of microstructural state variables. Fundamentals of the semi-analytical Finite Strip Method. FSM application to stability analysis of thin-walled prismatic columns and beams. Introduction to Spline Finite Strip Method. (3 credits)

**Structural analysis theory**

**BMEEOTMMB07**

Basics of Mathematics. Numerical analysis of trusses (state equation, static/kinematic characterization, force and displacement method). Frames: characteristics of a general bar element (of curved axis and variable cross section); basic relationships, stiffness matrix, reduced load vector, special (eccentric, elastic, partial) connections, solution with the displacement method. Special cases: planar frames, grillages, beams on elastic foundation, filled frames. Higher-order theories: suspension bridges, bar networks. (3 credits)
Seismic design

**BMEEOHSMC03**


FEM based structural design

**BMEEOHSMB09**


Geotechnical design

**BMEEOGTMCT1**


Numerical modelling in geotehnics

**BMEEOGTMCO5**


Extreme actions on structures

**BMEEOHSMB10**


Fracture mechanics and fatigue

**BMEEOHSMB11**

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

This Bulletin describes the curricula and the subjects being available for the 2016/2017 academic year, regarding the BSc, MSc and PhD programmes, respectively.

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

The **MSc programme** (4 semesters) advances the knowledge in the following fields: (1) Electrical Engineering, offering specializations in (i) embedded systems, (ii) multimedia systems and services, and (iii) electric power systems; and (2) Engineering Information Technology, offering specializations in (i) applied informatics, and (ii) internet architecture and services.

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

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

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

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

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

**Admission policy**

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

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

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

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

Practical guidelines for acceptance to the PhD programme

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

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

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

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

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

Departments

Automation and Applied Informatics
Electronics Technology
Electron Devices
Department of Networked Systems and Services
Control Engineering and Information Technology
Measurement and Information Systems

Computer Science and Information Theory
Broadband Infocommunications and Electromagnetic Theory
Telecommunications and Media Informatics
Electric Power Engineering

Budapest University of Technology and Economics
Faculty of Electrical Engineering and Informatics
Faculty Office:
Building R, ground floor, room No. 001
Mailing Address: Műegyetem rkp. 7-9,
H-1111 Budapest, Hungary
Phone: (+36-1) 463-4609
Fax: (+36-1) 463-2550
E-mail: nagy-margit@mail.bme.hu

Dean of the Faculty: Dr. László Vajta
Vice-Dean of the Faculty:
Prof. Dr. János Levendovszky
Course Director: Dr. Eszter Udvary
Programme Co-ordinator: Ms. Margit Nagy
## Curriculum of BSc Subjects in Electrical Engineering

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<tr>
<th>Subject</th>
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*Free electives (10 credits)
The one (corresponding to the specialization) of the specialization prerequisite courses (see below) must be finished to enter into the specialization starting in the 5th semester.

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

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

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

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Specializations

List of available specialization blocks depends on the number of students wanting to join. At least power engineering will be available. List of subjects are published on the website.
## Curriculum of BSc Subjects in Engineering Information Technology

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**Budapest University of Technology and Economics**

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

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

1 One of the restricted electives (see below) must be finished.
2 10 credits of free electives could be substituted by any subjects available
3 Internship is required and must be fulfilled to get the diploma. Internship possibilities are offered by Hungarian companies to international students with the help of BME
4 Students should note that due to the early scheduling of the thesis defense session for students applying to MSc studies, the period for examination could be rather limited in the 7th semester
**Curriculum of MSc Subjects in Engineering Information Technology**  
**Applied Informatics Main Specialization**

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**Notes:**

1. Subjects from Economic and Human Sciences: three subjects are selected by the Faculty from the following list before the actual semester.

   - Quality Management: BMEGT20M002
   - Argumentation, Negotiation, Persuasion: BMEGT41MS01
   - Investments: BMEGT35M004
   - Management Accounting: BMEGT35M005

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

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

**Notation:** working hours/week: x/y/z/r
- x = lecture hours
- y = practice hours
- z = laboratory hours
- r = requirement (e = exam, p = continuous work for a mark, s = signature)
## Curriculum of MSc Subjects in Engineering Information Technology
### Internet Architecture and Services Main Specialization

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### Notes:
1. **Subjects from Economic and Human Sciences**: three subjects are selected by the Faculty from the following list before the actual semester.
   - Quality Management | BMEGT20M002 | 2 | 2/0/0/p |
   - Argumentation, Negotiation, Persuasion | BMEGT41MS01 | 2 | 2/0/0/p |
   - Investments | BMEGT35M004 | 2 | 2/0/0/p |
   - Management Accounting | BMEGT35M005 | 2 | 2/0/0/p |
2. **Basic Compulsory Elective Subjects**: the three subjects will be determined before the actual semester.
3. **Freely Elective Subjects**: a list of these subjects is under construction.

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- \(y\) = practice hours
- \(z\) = laboratory hours
- \(r\) = requirement (\(e\) = exam, \(p\) = continuous work for a mark, \(s\) = signature)
# Curriculum of MSc Subjects in Electrical Engineering
## Embedded Systems Main Specialization

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**Notes:**

1. **Subjects from Economic and Human Sciences:** three subjects are selected by the Faculty from the following list before the actual semester.

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<tr>
<th>Subject</th>
<th>Name</th>
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<th>Credits 2</th>
<th>Credits 3</th>
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2. **Freely Elective Subjects:** a list of these subjects is under construction.

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

- x = Lecture hours
- y = Practice hours
- z = Laboratory hours
- r = Requirement (e = exam, p = continuous work for a mark, s = signature)
## Curriculum of MSc Subjects in Electrical Engineering

### Multimedia Systems and Services Main Specialization

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<th>Subject</th>
<th>Code</th>
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**Notes:**

1. Subjects from Economic and Human Sciences: three subjects are selected by the Faculty from the following list before the actual semester

   - Quality Management: BMETG20M002 2 2/0/0/p
   - Argumentation, Negotiation, Persuasion: BMETG41MS01 2 2/0/0/p
   - Investments: BMETG35M004 2 2/0/0/p
   - Management Accounting: BMETG35M005 2 2/0/0/p

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

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

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- y = practice hours
- z = laboratory hours
- r = requirement (e = exam, p = continuous work for a mark, s = signature)
## Curriculum of MSc Subjects in Electrical Engineering

### Electric Power Systems Main Specialization

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<tr>
<th>Subject</th>
<th>Name</th>
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<th>Credits</th>
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**Notes:**

1. Subjects from Economic and Human Sciences: three subjects are selected by the Faculty from the following list before the actual semester.
   - Quality Management
   - Argumentation, Negotiation, Persuasion
   - Investments
   - Management Accounting

2. Basic Compulsory Elective Subjects: the three subjects will be determined before the actual semester.
3. Freely Elective Subjects: a list of these subjects is under construction.

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

- x = lecture hours
- y = practice hours
- z = laboratory hours
- r = requirement (e = exam, p = continuous work for a mark, s = signature)
Description of BSc Courses in Electrical Engineering

Mathematics A1
BMETE90AX00

Mathematics A2
BMETE90AX26

Mathematics A3
BMETE90AX09

Mathematics A4
BMETE90AX51

Physics 1
BMETE11AX21

Physics 2
BMETE11AX22

**Foundation of computer science**

**BMEVISZAA02**

The objective of the subject is to provide the students with the required theoretical background in combinatorics, algorithms, elementary cryptography, and graph theory for further studies in electrical engineering. Within the subject the students learn about the basic concepts of combinatorics and of graph theory (trees, planar graphs, Euler circuits and Hamilton cycles, colorings of graphs, matchings and some basic algorithms like BFS, shortest path algorithms, maximal flow algorithm, DFS and the PERT method. We also discuss the basic concepts of complexity theory, NP completeness as well as fundamentals of number theory, leading to the concept of public key cryptography and RSA encoding. (4 credits)

**Informatics 1**

**BMEVIIIAB04**

This course (as a continuation of Digital Design 1 and 2) provides the students with comprehensive knowledge related to the architecture and functioning principles of modern computers and their operating systems. The basic principles and the evolution of most hardware and software concepts used in today’s computer systems are presented through case studies of existing systems and through quantitative example problems. Students successfully satisfying the course requirements will be able to understand the documentation and the functioning of modern computers and operating systems. They will also be able to easily learn the installation, configuration and maintenance tasks of such systems. (5 credits)

**Informatics 2**

**BMEVIAUAB01**


**Electronics technology and materials**

**BMEVIETAB00**

The primarily objective of the course is to provide the students with knowledge and practical skills related to circuit modules and systems. The course provides a comprehensive overview of microelectronic devices, components, mechatronic, optoelectronic and other modules and about the structure of electronic equipments including their manufacturing, maintenance and assembly technologies. (6 credits)

**Basics of programming 1**

**BMEVIHIAA01**

The main objective of the course is to provide students with appropriate skills in computerized problem-solving and basic use of tools that can be effectively applied during their further studies. A further goal of the course is to teach writing portable programs. Learning a high-level programming language the C language allows students to reach these goals in practice. The classroom practice follows the syllabus of lectures; helps better understand the topics of the lecture through detailed examination of the algorithms. (7 credits)

**Basics of programming 2**

**BMEVIAUAA00**

This course, as a basic BSc course based on the previous term, continues the exposition of methods and tools of computational problems. The main goal is an introduction of object-oriented programming. Based on the C programming language skills, the object-oriented techniques are introduced with the help of C++ programming language. The curriculum of computer laboratories continuously follows the lectures. (7 credits)

**Digital design 1**

**BMEVIIIAA01**

The course (together with the course entitled Digital Design 2) provides the students with all system level hardware knowledge required to the logical level design of digital equipment. The theoretical background is also widened through the solution of design problems during the classroom practices. Obtained skills and expertise: The knowledge acquired in the framework of the course (together with the course entitled Digital Design 2) allows students to solve any logical design problems they may encounter in electrical engineering. (5 credits)

**Digital design 2**

**BMEVIIIAA02**

The course (together with the course entitled Digital Design 1) provides the students with all system level hardware knowledge required to the logical level design of digital equipment. The theoretical background is also widened through the solution of design problems during the classroom practices. Obtained skills and expertise: The knowledge acquired in the framework of the course (together with the course entitled Digital Design 1) allows students to solve any logical design problems they may encounter in electrical engineering. (5 credits)

**Signals and systems 1**

**BMEVIHVAA00**

The objective of this class is to introduce the basic concepts of signal and system, and to provide computational methodologies applicable to continuous systems. It presents the time domain and the sinusoidal steady state analysis. The practical examples refer to continuous systems represented by Kirchoff type electric circuits. The principles to formulate the models and the methods to solve the resulting equations are discussed. The students fulfilling the requirements of this class will be able to apply the methodologies of system and network analysis in the time domain and in the frequency domain in case of sinusoidal excitation (6 credits)
Signals and systems 2

BMEVIIHVA001

The course is a follow-up of Signals and Systems I. It provides the foundations of analysis methods for continuous time systems in the frequency and complex frequency domains. Furthermore, it presents various system description methods and establishes the connections between these representations. It also deals with analysis methods of discrete time signals and systems both in time, frequency, and z domains. The link between continuous and discrete systems is presented by dealing with discrete approximation of continuous time systems, and the basics of signal sampling and reconstruction are shown. The last part introduces analysis techniques for continuous time nonlinear circuits and systems. (6 credits)

Electrotechnics

BMEVIVEAB00


Introduction to electromagnetic fields

BMEVIIHVAC03

The course teaches the fundamentals of classical electrodynamics in an engineering approach. Besides the main principles, the most important fields of engineering applications as well as some analysis methods are discussed. The lectures are complemented with classroom practices. Topics covered: Part I. Fundamental laws: measurable quantities, scalar and vector fields, Maxwell’s equations, fields in materials, interface conditions. Poynting’s theorem, forces, classification. Part II. Static fields; scalar electric potential, Laplace-Poisson-equation, electrodes, capacitance, electric dipole, method of images, finite difference method; current flow problems, grounding, step voltage; static magnetic fields, Biot-Savart law, self and mutual inductance, induction phenomena. Part III. Transmission lines: telegraph equations, Helmholtz-equation, specific loads, matching, standing wave ratio, two-port equivalent. Part IV. Wave phenomena: wave equation, plane waves, transmission line analogy, reflection and refraction, polarised waves, waves in dielectrics and conductors, skin effect, elementary electric dipole antenna, rectangular waveguides. (4 credits)

Electronics 1

BMEVIIHVA002

Virtually every electronic equipment used today is constructed on the basis of high complexity circuits. All electrical engineers must know the construction and functioning principles of such devices. In order to understand the behavior of complex systems, the elementary design principles and dimensioning procedures should be presented which is the objective of this course. Obtained skills and expertise: The students get acquainted with the definitions and management of the parameters of electrical components and will understand the calculations of the properties of electronic circuits built up of such components. The skills obtained in the framework of this course (together with the course entitled Electronics 2) empower students with the necessary expertise to understand the courses of the related study specialization blocks. (5 credits)

Electronics 2

BMEVIAUAC05

The goal of the course is to lay down the basis of the aspects of more complex electronic systems, including their functions, their operation and their structure. This formed basis can be built upon by later specialization courses. The course discusses two main areas of electronics: power electronics and signal level electronics.

During the discussion of power electronics, the design and usage of basic power semiconductors (PN junction, diode, BJT, Darlington, MOSFET, SCR, GTO, IGBT) are covered. Diodes and thyristors in rectifiers, grid commutation based converters and AC choppers are also covered. The material includes basic DC-DC converter topologies (buck, boost, buck-boost) and single phase inverters as well. The second part of the course provides a brief introduction into several topics of signal level electronics, including nonlinear circuits, phase locked loops (containing voltage controlled oscillators, phase detectors, analog PI controllers), passive and active filters, and analog modulation techniques. (5 credits)

Measurement technology

BMEVIMIAB001

The aim of the subject is to give insight into metrology, measurement theory, measurement technology and instrumentation. Besides the theoretical aspects, the course also prepares students for laboratory practices. Model building and problem solving skills of the students are developed. The subject focuses on the measurement of electrical quantities but also emphasizes the analogies with non-electrical problems. (5 credits)

Laboratory 1

BMEVIMIAC05

The primary aim of this laboratory course is to improve the skills of the students in the following areas: to get acquainted with the materials, components and instruments in the area of electrical engineering and to practice the designing of measurement setups, setting up the measurement, mea-
suring and using the infrastructure of the laboratory; furthermore, to practice the evaluation and documentation of the measurement results. By the end of the course, the students acquire practical competence and skills at the selected fields of electrical engineering, and become experienced with up-to-date measurement equipment. (5 credits)

**Laboratory 2**

**BMEVIMIAC07**

This subject is based on the “Laboratory 1” subject and enables the students to gain deeper knowledge and experience along to further improving their skills in the following areas: the materials, components and instruments in the area of electrical engineering; the designing of measurement setups, setting up the measurement, measuring and using the infrastructure of the laboratory; and to evaluate and document the measurement results. These practical competences and skills in the selected fields of electrical engineering are acquired by using up-to-date measurement equipment. (4 credits)

**Space Technology**

**BMEVIVHVC05**

This subject is an overview of engineering, design, construction, testing and operation of electronic systems for space. Nevertheless, this knowledge is well applicable also in design of high reliability terrestrial equipments that are operating under extreme environmental conditions. System concepts of big space structures like satellites and probes and the problems of smaller units are also discussed. The theory and practice of space communications, the design and parts selection for high reliability electronics, the effects of interplanetary space and radiation, the mechanical construction problems and space related analogue and digital electronics are also highlighted. The lectures are extended with practice to deepen the knowledge and resolve practical problems. (4 credits)

**Embedded and ambient systems**

**BMEVIMIAC06**

The aim of the subject is to develop the ability to select components of embedded systems, to design the system and to integrate the components. This includes selection of communication interfaces and protocols, design of information processing algorithms and software structure. The subject presents the principal building blocks of embedded systems, their main requirements and properties. These topics cover (but are not limited to) analog signal processing and signal conditioning, operation and features of processing units (DSP), digital signal processing, basic software architectures and their analyses, signal converters (AD/DA) and the popular communication systems used in embedded systems. (4 credits)

**Power engineering**

**BMEVIVEAB01**

The aim of the course is to lecture basic knowledge of power systems, which are necessary for all electrical engineers, and are also a foundation for students taking power system engineering major. Introduction of the structure and operation of power systems, organised along the operation principles of elements and subsystems of the network. Representation of power systems, basic methods of examination of symmetrical operation. Detailing of the most important questions of asymmetrical operation from the aspect of distribution and consumer networks. Requirements of power quality and security of supply. Health effects and EMC aspects of electric and magnetic fields of the power system. Overview on the paradigm shift of different fields of power system engineering (production, transmission, service, environmental effects), the smart grid concept and other actual trends. (5 credits)

**Electric power transmission**

**BMEVIVEAC00**

The course is intended to provide theoretical knowledge and practical skills in the following fields: structure of the power system, network transformations, process of power transmission and distribution, network elements used for transmission and distribution tasks, interpretation and determination of parameters of transmission network elements used for calculations, representation of the elements, power line and transformer operations, power and voltage conditions of steady state operation, power losses, application of symmetrical components, fundamental effects of short-circuits and switches, calculation, principles of star point earthing, related phenomena, Substation and busbar topologies. (4 credits)

**Electrical machines and applications**

**BMEVIVEAC01**


**Control of electric drives**

**BMEVIVEAC04**

Drive specific and task specific drive controls. Subordinated control structure. Transient equations and block schemes of DC machines. Line-commutated converter-fed DC drives: block schemes for continuous and discontinuous conduction, circulating current and non-circulating current control for quadrant and 2/4 quadrant operation. Adaptive cur-

Microelectronics

**BMEVIEAB00**

The basic goal of the course is to deepen the already acquired knowledge in the field of digital electronics through presenting the latest implementation techniques of digital integrated circuits. Further goals of the subject are to provide information on the basics of analogue integrated circuits, components of power electronics and solid-state lightning. Today's electronics and IT devices are all based on different special discrete semiconductors and complex integrated circuits. Solid knowledge regarding the structure, operation and manufacturing of these devices is among the necessary skills of today's electrical engineers including basics of IC design at least on the level which allows effective communication with IC design specialists. They have to know how system level design connects with the IC design as well. Special emphasis is put on the corresponding practical skills through simple case studies (calculation examples) as well as computer laboratory practices where the students get acquainted with the basic steps IC design. An important aspect of the course is to bridge the gap between the operation of abstract electronics components and the physical reality: the major components used in ICs (diodes, transistors, etc.) are discussed in detail. A detour is made towards the MEMS and MOEMS, where electrical operation is combined with mechanical and optical effects. (5 credits)

Microcontroller based systems

**BMEVIAUAC06**

The course describes the most widespread microcontroller architectures and gives guidance for their selection for the given application. The course provides competences to design and implement the hardware components of microcontroller based systems and to implement the associated low level software system. Design phases are demonstrated by case studies. (4 credits)

Embedded operating systems and client apps.

**BMEVIAUAC07**

The students will be able to understand and make use of the basic concepts of embedded operating systems. The objective of the course is to present platforms, techniques and tools which are required to create and run both application and system level software for embedded systems. After creating the hardware unit and embedded programs for it, the next natural step is the implementation of a desktop or web application that enables monitoring and parameterizing the hardware unit from a standard PC. Mobile applications are becoming more widely used as well. The course presents the programming of desktop and web based client applications, focusing on user interfaces, graphics drawing tools, multithreaded and network programming. Most modern development platforms follow object-oriented concepts. Consequently, the course provides introduction to object-oriented design, basic UML and a few architectural and design patterns. Students will be able to develop desktop and thin client applications to access hardware units from PCs, and to create user friendly user interfaces for different client types. Network programming also gets an important role. The topics covered are illustrated by case studies and demo applications. (4 credits)

Network Technologies and Applications

**BMEVITMAC05**

The goal of this course is on one hand to present the basic principles of the currently used and emerging wired access network technologies, focusing mostly on the data link layer. On the other hand it aims to present the principles of network layer communication both in wired and wireless environments, focusing on routing algorithms in fixed and ad hoc networks, IP multicast technologies as well as mobility handling over IP networks. Then, the course presents different architectures of networking applications, the client-server and the peer-to-peer communication model, and the principles of cloud communications. Finally, the course presents some application scenarios, and touches briefly emerging topics such as the Future Internet and the Internet of Things. (4 credits)

Control engineering

**BMEVIIIAB05**

The control of technological, economical, and environmental processes belongs to the electrical engineers' most important professional activities that require both abstract and applied knowledge and competences. Besides its contribution to form an engineering approach of problem solving, the course teaches the fundamentals of control engineering, the main principles of analysis and synthesis of control loops, and the use of the related computational tools. Students successfully satisfying the course requirements are prepared to analyze discrete and continuous time control loops, to design different types of compensators and to later engage courses in more advanced fields in control theory such as optimal control and identification of dynamical systems. Lectures are complemented with classroom and computer laboratory practices. (4 credits)
Description of BSc Courses in Engineering Information Technology

Calculus 1 for informaticians
BMETE90AX21
Real sequences. Special limits, number e. Operations on convergent sequences. Monotonic and bounded sequences. Continuity and differentiability of real functions of a single variable. Elementary functions and their inverses, properties of differentiable functions, mean value theorems, L'Hôpital rule, sketching graphs, parametric and polar curves. Integral of functions of a single variable. Methods of integration, the fundamental theorem of calculus (Newton-Leibnitz formula), applications, improper integrals. (6 credits)

Calculus 2 for informaticians
BMETE90AX22

Probability theory
BMEVISZAB00
The objective of the subject is to learn the basics of stochastic modeling. Within the subject the students learn about the basic concepts of probability and random variables. They get acquainted with various discrete and continuous distributions. Students also learn the notion of expected value and higher moments. The course concludes with theorems of large numbers, the notion of regression and correlation. (4 credits)

Introduction to the theory of computing 1
BMEVISZAA00
The objective of the subject is to acquire the fundamental mathematical knowledge (in the area of linear algebra and number theory) necessary for software engineering studies. Within the subject the students learn about coordinate geometry in the space, the vector space Rn and its various properties, solving systems of linear equations with the Gaussian elimination, determinants and basic properties of linear mappings as well as fundamentals of number theory, leading to the concept of public key cryptography and RSA encoding. (4-490) (4 credits)

Introduction to the theory of computing 2
BMEVISZAA01
The objective of the subject is to acquire the fundamental mathematical knowledge (in the area of graph theory) necessary for software engineering studies. Within the subject the students learn about the basic notions of graph theory, trees, planar graphs, Euler circuits and Hamilton cycles, vertex- and edge colorings of graphs, matchings and higher connectivity as well as some basic algorithms like BFS, shortest path algorithms, Kruskal's algorithm, maximal flow algorithms, DFS and the PERT method. (4 credits)

Coding technology
BMEVHIAB00
Clear understanding of the basic principles, notions, models, techniques in the field of data compression coding, error control coding, and cryptography security encoding, supported by solving a lot of numerical problems. Obtained skills and expertise: Ability to apply basic techniques in communication technologies and solve standard design problems. (4 credits)

Theory of algorithms
BMEVVISZAB01
The objective of the subject is to learn the basic methods and skills in the design and analysis of algorithms and to study the most important models of computations. Within the subject the students learn about the basic types of automata (finite, pushdown and Turing machine, all deterministic and non-deterministic) and their relationship to formal languages. They get acquainted with the basic complexity classes. Further algorithmic tools include linear and integer programming, dynamical programming, and sorting and searching techniques. (4 credits)

Physics 1i
BMETE11AX23
kinematics, work and energy, potential energy, linear momentum and collisions, rotation of a rigid object about a fixed axis, angular momentum, kepler's laws of planetary motion, static equilibrium, accelerating frames, oscillatory motion, waves, special relativity, kinematics, special relativity, dynamics, temperature, heat and the 1st law of thermodynamics, the kinetic theory of gases, heat engines, entropy and the 2nd law of thermodynamics. (4 credits)

Physics 2i
BMETE11AX24
electric fields, electric potential, capacitance and dielectrics, current and resistance, direct current circuits, magnetic fields, sources of the magnetic field, faraday's law, inductance, light and optics, interference of light waves, diffraction and polarization, lasers and holography, introduction to quantum physics, quantum mechanics. (4 credits)

System theory
BMEVHVAB00
The main objective of the class is to introduce the basic concepts of signal and system theory, mathematical methods. It will be introduced the linear, time invariant system analysis for time continuous and discrete cases. The analysis methods are introduced in time, frequency and complex frequency domain. Examples for signal processing, telecommunications and also for business processes are discussed. The students fulfilling the requirements of this class will be able to apply the methodologies of system analysis and the basic elements of process control. (4 credits)
Technology of IT devices

**BMEVIIEAC00**

The goal of the subject is to present the students the operation of the most important hardware elements of IT devices, the fundamentals of electronics and its manufacturing technology. It is presented what opportunities modern microelectronics assures to computation, what are the physical limits and the trends of development. At the laboratory practices the students experience themselves that hardware and software development occurs with the help of similar methods and tools. (4 credits)

Digital design

**BMEVIIMIAA01**

Digital technology is an important core subject in the curriculum of the Engineering Information Technology. The most important objective of the course is to present the process of engineering and system-oriented approach of problems, and to acquire basic practical skills to for good problem solving. The following topics are discussed: computing systems, the basic elements of the operation of logic circuits, the digital abstraction of the simple tasks and the direct hardware or low-level software implementations of them. The course starts with the introduction of the binary arithmetic, the operations done by basic digital functional units and controllers, and ends by the presentation of the general-purpose microcontroller architectures and its design and applications. Lectures are completed with classroom and laboratory exercises, where the focus is on the mastering of modern computer design methods and on the direct design/development experience. (7 credits)

System modelling

**BMEVIIMIA00**

The course overviews the design process of IT systems in a model based approach. The goal of this course is to provide solid understanding on the basic modeling tasks and tools, which are important prerequisite for other courses including application specific modeling. (e.g.) Additionally, the course provides opportunity to experiment with conceptually straightforward and easy to learn tools, which can be used for simple application logic development. The participants of the course will learn the basic concepts and modeling aspects of high level, graphical tool supported, process centric modeling, verification, performance analysis and service quality assurance. The course builds on learning experience at digital technology course and you can build competence in systematic system design process. Participants will also gain experience in the process of implementing IT system through the steps of modelling exercises. Finally, they get an overview of simulation based system analysis and visual data analysis of measurement results. The didactical goal of the course is to improve the abstraction skill of the participants and lay the foundations of the upcoming courses on conceptual and motivational level. (4 credits)

Computer architectures

**BMEVIHIAA00**

The course objective is to present the basic notions of computer architectures and the related application and design methods such that the student can formally solve fundamental software and hardware problems. Obtained skills and expertise: Understand and solve computer architecture related hardware and software problems. (5 credits)

Communication networks 1

**BMEVIHIAB01**

The course objective is to present the fundamental principles of the construction, architecture and protocols of computer network. Obtained skills and expertise: Understanding the operating principles, architecture and protocols in computer networks as a basis for later specialized studies. (4 credits)

Communication networks 2

**BMEVITMAB01**

The aim of this course is to provide both theoretical and practical knowledge about communication networks, and about telecommunication networks in particular. The course starts from the classical wireline telephony networks, including the speech digitalization, and the architecture of telephony exchanges. The next major part is wired IP access networks, including digital subscriber loops (especially ADSL and its variants), cable television-based Internet access, and optical access networks with the focus on GPON systems. Triple-play services, including IP television and Voice over IP (VoIP), are certainly part of this subject, including an introduction to speech codecs. A whole range of mobile cellphone networks are also covered from GSM to LTE. Introduction to backbone transport network technologies (including MPLS and its extensions, optical wavelength- and waveband switching) concludes the course. (4 credits)

Operating systems

**BMEVIIMAB00**

The subject introduces students to the functions, internal operation, and types of operating systems, and in addition, to the programming model of concurrent, distributed systems. It also demonstrates these concepts using examples, including the task of operating system selection. The lectures and the laboratories, which are inherent part of the subject, concentrate on the relationship of the hardware and the operating system, making it possible for students to use operating systems in practical applications. (5 credits)

Basics of programming 1

**BMEVIEEA00**

The main objective of this course is to provide students with appropriate skills in computer-based problem solving and basic use of program development tools. These skills are to be effectively applied during further studies. The C language is selected as working language to illustrate how portable programs can be developed and to allow students to gain practice in actual coding. The classroom practice follows the syllabus of lectures; helps better understand the topics of the lecture through detailed examination of the algorithms. The classes are completed with a long-term individual homework assignment to help improve the students’ skills. (7 credits)

Basics of programming 2

**BMEVIIIAA00**

This semester focuses on leading the students to a deeper understanding of C language, and a special emphasis is also put on the steps of solving very complex programming tasks using an object-oriented approach. The latter is achieved via learning the C++ language, assuming a reliable knowledge of C. The practice classes follow the topics of the lectures and discuss further details of the object-oriented concept and the language elements. First the students learn
how the C++ language derives from C. Inline macros, prototypes, default arguments and function overloading are explained. Dynamic memory allocation process of C++, reference type, visibility and scope of data are discussed. Next the object-oriented concept is introduced via the C++ language. The principles and concepts behind the object oriented programming paradigm are shown with the corresponding C++ syntax. Topics include classes, encapsulation, protection; member functions, constructor/destructor, friend mechanism; operator overloading; inheritance, virtual functions; generic classes. Last the students are introduced to essential operating system functions and to development and documenting tools. (7 credits)

**Basics of programming 3**

**BMEVIIIAB00**

The course, as a continuation of Basics of Programming 1 and 2, aims at further enhancing skills in object-oriented techniques and algorithmic solutions. The course introduces Java syntax and the basic Java class libraries, like IO, utilities, generics, collections. Special topics, like thread handling with synchronization and signaling, GUI concepts and implementation using Swing, unit testing with JUnit, XML handling in SAX and JDOM, and logging via log4j are also covered. The connections between UML and OO implementations, especially in C++ and Java are introduced. The course relies on skills and knowledge of C and C++, that are mandatory for successfully finishing the semester. (5 credits)

**Databases**

**BMEVIITMAB00**


**Databases laboratory**

**BMEVIITMAB02**

The course provides practical and technological knowledge related to some selected topics of database usage and database application development. Oracle system: logical and physical data structures, operation of Oracle instance, locking levels, SQL Developer, configuration of physical storage parameters. SQL language: definition, creation and deletion of tables, insert-delete-modification of data, queries, indices, granting different rights, modification of data structures, transaction management, controlling of concurrent data access. Application development in Java language using client-server architecture: JDBC API, managing database connections, running SQL commands in Java, exception handling, transaction management. XML based application development: structures of XML documents, elements and labels, namespaces, creation of XML documents by XSQL, XSL transformation, Xpath expressions, assignment of XSL stylesheets to XML documents. Creation of dynamic web pages using PHP: operation of PHP, scripts, types, variables, operators, arrays, controlling structures, defining functions, predefined variables, most important Oracle functions. (2 credits)

**Software engineering**

**BMEVIIIAB01**

The aim of the course is to examine the overall process of software development, including the analysis and design of information systems and the project management issues. On completion of this course students will be able to understand the economic and managerial implications of software projects, have a global view and understanding of the software development, describe the static and dynamic aspects of a real-world system using appropriate modeling techniques, advise on the selection of an appropriate software architecture for a problem, describe the concepts underlying object orientation, use and create UML models, demonstrate the quality of software products created at different stages of the lifecycle. (4 credits)

**Software techniques**

**BMEVIUAUAB00**

The objective of the course is to present up-to-date techniques used in object oriented and event-based software development. The concepts, the structures and the programming of GUI (graphical user interface) and RAD (Rapid Application Development) are presented together with the most important features of modern supervised execution environments and class libraries (reflection techniques, data binding, displaying figures and text, parallel computing basics with related synchronization techniques, etc.). The widely used architectural and design patterns for software development are also covered. Students satisfying the course requirements will be able to develop software on the most widely used platforms with up-to-date tools and technology, having design patterns incorporated. (5 credits)

**Software project laboratory**

**BMEVIIIAB02**

The aim of the course is gaining first-hand experience of working in software projects. The goal is to create an object oriented application with full UML (Unified Modeling Language) description, Java implementation, according to RUP (Rational Unified Process) concepts. The students are working on the project in groups of 3 or 4 that are formed by the supervisor. The students are preparing the documentation and program of the game according to the predefined schedule specified at first week. Documentations must be submitted in a predefined format, usually printed. Good understanding of Java and UML are required for successfully finishing the course. (2 credits)

**Web and mobile software**

**BMEVIUAUC00**

During the course, students get an overview of the latest model platforms and its capabilities. The course teaches the student to be able to choose the most suitable tool and platform for solving a given problem and give the knowledge to estimate the complexity of a project. Furthermore, the method of developing small application for Java Me platform is presented, as well as the basics of Android platform and usage of the Android emulator. The course also presents the method of quick prototype-development method
in Python environment. The following techniques will be described: application structure, basic UI, development compiling and installing. Besides the mobile platform, modern client based web technologies are also presented with the method of developing web applications for devices with small screen and using development tools for multiplatform. (5 credits)

**Computer graphics**

**BMEVIIIAB03**


**Artificial intelligence**

**BMEVIMIAC00**

The aim of the subject is a short, yet substantial presentation of the field of artificial intelligence. The principal presented topics are expressing intelligent behavior with computational models, analysis and application of the formal and heuristic methods of artificial intelligence, and methods and problems of practical implementations. The subject is intended to develop the abilities and skills of the students of informatics in the area of studying novel applications of the computing, developing effective methods to solve computational problems, understanding the technological and conceptual limits of the computer science, and intellectual understanding of the central role of the algorithm in information systems. (4 credits)

**IT security**

**BMEVIIIAC01**

This course gives an overview of the different areas of IT security with the aim of increasing the security awareness of computer science students and shaping their attitude towards designing and using computing systems. The course prepares BSc students for security challenges that they may encounter during their professional carrier, and at the same time, it provides a basis for those student who want to continue their studies at MSc level. We put special emphasis on software security and the practical aspects of developing secure programs. (3 credits)

**Management of information systems**

**BMEVITMAC02**

The course introduces the students to the tasks of the IT System Administrators. The objective of the course is to teach the maintenance and system administration tasks of computers and networked information systems. The course provides a system level overview about the information systems and about the tasks of system administrators in a broad sense. Among many others, the students will learn basis of the Network and Desktop Management Systems, the data management (data networks, back-up and restore), the virtualization and cloud computing, the service management, the Telecommunications Management Network (TMN), the IT management-related standards, and the security issues. (4 credits)

**Integration & verification techniques**

**BMEVIMIAC04**

The subject aims to provide an overview of a variety of information integration systems, and introduces the development and verification techniques of such systems. We discuss the most common integration approaches of distributed data, documents and other type of resources available on the Web. The subject deals with the semantic heterogeneity and structural problems, and unveils the necessary technologies. We analyze in this framework the approaches and technologies of the Semantic Web concept. The subject continues with the discussion of the verification processes and the checking possibilities in the typical development phases. Among the several verification tasks, we focus on the static analysis of the specifications and plans for dealing with static controls, the dynamic verification of the components, and with the tests of integration. The subject ends with the overview of the system testing methods. (4 credits)

**Industrial control**

**BMEVIIIAC03**

Industrial control systems are present in fields including packaging, water management, petrochemical processes, manufacturing lines or food and beverage processing. Although seem different, all of these applications share the requirements of accurate measurements and executing appropriate actions based on the state of the process. The first part of the course focuses on sensor technology: methods for temperature, force, pressure, flow, displacement, proximity and level sensing are presented along with transmitters and interfacing signals with control systems. Second part of the course gives a deep overview on PLCs, devices most commonly used in industrial automation systems. Besides the software architecture and programming languages, industrial field bus systems are also presented in details. (4 credits)
Description of MSc Courses

Engineering Management

BMEVITMM803


Engineering Information Technology

System Optimization

BMEVISZMA02

The subject introduces some areas of operations research and combinatorial optimization. Besides covering the most relevant algorithms and methods and their limits, it also aims at giving a glimpse into some of their engineering applications. Thus the subject also covers some general algorithmic approaches like linear and integer programming and matroid theory. Furthermore, the course aims at extending and deepening the knowledge formerly provided by the Introduction to the Theory of Computing 1 and 2 and the Theory of Algorithms subjects of the BSc degree program in Software Engineering. (4 credits)

Formal Methods

BMEVIMIMA07

As the complexity of information systems and the costs of potential failures are increasing, it becomes more and more important to prove that the design of the critical system components is correct. One of the typical solutions for the challenge of provably correct design is the application of formal methods. Mathematically precise formal models allow the precise and unambiguous specification of requirements and construction of designs; formal verification allows the checking of design decisions and proof of design properties; while the verified models allow automated software synthesis. The subject provides an overview of the formal background needed for the elaboration and analysis of the formal models of IT components and systems: the modelling paradigms, the widely used formal modelling languages, and the related verification and validation techniques. The subject demonstrates the application of formal methods in the field of requirement specification, system and software design, model based verification and source code synthesis. (4 credits)

Information theory

BMEVISMA03

This course offers an introduction to the quantitative theory of information and its applications to reliable, efficient communication systems. Topics include mathematical definition and properties of information, source coding theorem, theoretical bounds for lossless data compression, optimal data compression methods for both known and unknown distribution of the source, the fundamentals of lossy source coding principles, channel encoding and the main types of multiple access channels. The course lays the foundation for doctoral research in the subject of mobile telecommunications. (4 credits)
 languages and automata

During the course of the semester we review the basic types of automata and examine their capabilities. Examination of automata is closely related to the examination of formal languages. The objective is the description of the relations between the classic automata and formal languages. Students will learn the theoretical principles to that can be used for the preparation of a compiler. In connection with Turing machines we examine the algorithmic decidability of some theoretical and practical problems and languages. (4 credits)

Software Development Methods and Paradigms

The goal of this course is to teach the software development methodologies, their application possibilities and conditions, practices and tools required and preferred for the design and development of methods. Students become practiced in treating issues of common software architectures and software systems, furthermore, they will have a good knowledge related to software development methods. The course discusses the software development methodologies, the methods and techniques supporting methodologies and development processes, furthermore, practices, architectural requirements and solutions related to software systems. (4 credits)

Distributed Systems and Domain-Specific Modeling

The goal of this course is to teach component-based technologies, the usage of middleware services, distributed systems, asynchronous communication, reliability, security, scalability, distributed state handling and monitoring. Furthermore, the goal is to teach domain-specific languages and modeling techniques, model processing and using these techniques in creating software. (4 credits)

Service Oriented System Integration

Service-Oriented Architecture (SOA) defines the principles of connecting distributed heterogeneous software components. Web services provide the technology for implementing these principles. Web services are built on open standards. They are based on XML, therefore, they are suitable for connecting different platforms with each other (e.g., .NET and Java). Most platforms provide simple APIs for creating web services. For example, .NET has the library called Windows Communication Foundation (WCF), while Java offers the Java API for XML-based Web Services (JAX-WS) specification. Using these APIs it is very easy to communicate between applications created in different platforms. Enterprise Service Bus (ESB) is a framework for hosting web services, and publishing legacy applications also as web services providing a unified platform for interaction between applications. Business entities can also benefit from SOA, since business processes can also be described as web services through the Business Process Execution Language (BPEL). Business processes can also be defined at a higher level using the Business Process Modeling Notation (BPMN). The goal of this subject is to explain the principles behind SOA and to give a deep understanding in the corresponding standards, APIs and technologies. (4 credits)

Business Intelligence

The goal of the subject is to give a current knowledge to the students about modern data warehouse building, business intelligence system design, data transformation, reporting, charts, dashboards, data visualization, location based data processing, KPI discovery and churn and fraud detection. (4 credits)

Software and Systems Verification

The objective of the course is to present the different verification techniques that can be used throughout the full software and systems development lifecycle. Nowadays such techniques are used not only in critical systems (where their usage are usually mandated by standards), but quality is a requirement for every system. After completing the course, students will have a general understanding of the whole verification process and will know which techniques are recommended for the different phases. They will be able to identify the various static verification techniques, and will be able to review specifications and designs, and to apply static analysis tools on source code. They will be able to list the different levels and methods of software testing, and to use specification and structure based test design techniques. They will know the techniques for verifying extra-functional properties (e.g., modeling and analyzing dependability) and will be able to describe the techniques for runtime verification. (4 credits)

Distributed Systems Laboratory

The goal of this course is to give a practical knowledge to the materials learned during Distributed Systems and Domain-Specific Modeling and Software Development Methods and Paradigms. (4 credits)

Engineering Information Technology

Internet Architecture and Services

Agile Network Service Development

The course introduces the students to the Agile development method, which is widely used in software development since it can easily react to the frequent changes. The students will be introduced to Extreme Programming (XP), different Agile methods (Scrum, Kanban). They will learn the Continuous Integration (CI) and the typical environments supporting it. The course also gives an overview about testing methodologies, Test Driven Development (TDD), Behaviour Driven Development (BDD) and Model Based Testing (MBT). During the practical classes, the students form Agile teams that develop a software product in the field of Telecommunications. (4 credits)
Cloud Networking

A cloud platform is a complex system, its architecture consists of many different technological building blocks, where the cloud networking has an important and emerging role. The lectures present the types of cloud computing platforms, the different service models, the applied technologies and management methods focusing mainly on the networking aspects. The networking background of cloud architectures, including network virtualization, tunneling techniques, data center network topologies and the application of Software Defined Networking in clouds are presented. The special requirements of clouds that can provide telecommunication services in the form of Network Function Virtualization are also discussed. (4 credits)

Modeling Seminar for Engineers

In this course the students face the main engineering challenges and design goals of infocommunication networks from local computer networks to the global Internet. We show through practical examples that how easy to use the algorithmic knowledge they already have for communication network modeling. In specific the course includes examples from the routing and control mechanisms of the Internet, topology design, traffic and bandwidth characterization of networks, some problems from software defined and virtual networks, and shows how the theoretical tools the students already have can be applied for these practical engineering problems. (4 credits)

Internet Services and Applications

The course will give a thorough overview of application-specific, content-centric and collaborative services, the challenges of the Internet as a service and application development platform, and its service models. The technology foundations necessary for service implementation are also covered, including service quality issues as well. Use cases from different application areas are discussed to show the process of service planning and implementations well as the method to build successful business models. An Internet architect will be able to develop efficient network services satisfying the required service quality. During the course project homework the students will gain experience in practice as well. (4 credits)

Sensor networks and applications

The "intelligence" of the so-called smart environments (smart city, smart office, smart home) is largely depends on the sensors integrated into physical objects (walls, surface of roads, etc.) or carried by the users (e.g., intelligent user devices, wearable devices). Sensors monitor the surrounding physical environment continuously, gather raw measurement data that is communicated towards the application. To do this, an efficient sensor networking environment has to be set up. The course will give a thorough overview of wireless sensor networking, from the physical devices up to the networking and application layers. Application areas that are connected to smart cities and intelligent transport systems are emphasized. (4 credits)

Intelligent traffic systems

The aim of the course is to present the technologies used and current trends in the field of intelligent transport systems. The students will learn the principles of vehicular systems, the technologies deployed in vehicles and the supporting infrastructure. They will understand how these technologies support the Smart Cities. During practical courses the students will have to understand a selected technology and the application built on it, and implement their own services using the publicly available interfaces. (4 credits)

Human-machine interface

The aim of the subject is to introduce visual and speech interface technologies to students in Human Computer Interaction. The course will introduce in detail the elements of the user interface, the basic principles of software ergonomics, the evaluation methods of software from an ergonomic point of view. Parallel to introduction to the principles of theory, practical classes are also held. Students will demonstrate the comprehension of the material by solving practical problems. By the end of the course students will learn the basic principles necessary for the design, testing and evaluation of user interfaces. They could employ that knowledge during their future work career. (4 credits)

Cloud Computing

The basic objective of the course is introducing the basics of the modern computing cloud systems and cloud based applications. The students learn about the virtualization techniques and software solutions, protocols, standards and interfaces, which advanced the development of cloud-based services can be used in practice. They learn about the cloud-based IT systems design, development, operation, and quality control methods and tools. The students receive comprehensive information on the most commonly used approaches, models, standards related to software quality. Students learn about the characteristics of the software product and the product manufacturing process and should be interpreted taking into account the characteristics of the cloud-based systems can. They understand the similarities and differences between ISO 9001, CMMI, SPICE and auditing structure, will be able to more software quality model is applied in an integrated manner. (4 credits)

High Performance Parallel Computing

The basic objective of the course is introducing the very intensive and high-performance computing solutions which are needed of engineering and research tasks. The students will learn about the supercomputing architecture classes, the supercomputer software components and programming languages. The students get acquainted with the subject of networking solutions that use the most powerful machines (TOP500) as well. They learn about the various co-processors and storage systems. The purpose of the object is important to give a comprehensive picture of the use, programming, control and operation of these systems as well. (4 credits)
nullspace, rank, basis and dimension, the four fundamental subspaces. Matrix operations, inverse of matrices, LU-decomposition. Linear transformations, matrices of linear transformations, change of basis. Determinant as a multi-linear function, as a sum of products, by cofactor expansion. Inner product, orthogonalization, QR-decomposition, least squares and data fitting. Eigenvalues, diagonalization, orthogonal diagonalization, spectral decomposition. Complex and real matrices, symmetric matrices, positive definite matrices, quadratic forms. Singular Value Decomposition and other matrix decompositions. Jordan canonical form. Applications in mathematics (derivative as a linear transformation, solving differential equations...) Applications in engineering (graphs and networks, Markov matrices, Fast Fourier Transform, data mining...) (3 credits)

Combinatorial optimization (Advanced Mathematics for Electrical Engineers)  
BMEVISZMA06  
The subject introduces some areas of operations research and combinatorial optimization. Besides covering the most relevant algorithms and methods and their limits, it also aims at giving a glimpse into some of their engineering applications. Thus the subject also covers some general algorithmic approaches like linear and integer programming and matroid theory. Furthermore, the course aims at extending and deepening the knowledge formerly provided by the Foundations of Computer Science subject of the BSc degree program in Electrical Engineering. (3 credits)

Communication Theory  
BMEVIHMMA07  
Widespread concepts of and tasks to be solved by telecommunications can be described by a more or less unified theory, that are the objectives of the Communication Theory. Aim of this subject is to present basics of and applied approaches in this theory. Main topics dealt with are information theory, decision- and estimation theory as well as theory of digital communications including source coding, channel coding, modulations, and performance of noisy channels. In this framework students get acquainted with important concepts, methods and procedures. Application of these concepts is presented via a detailed discussion of practical examples taken from the techniques of wireless and optical communication. Lectures, exercises as well as tests are put together so to prepare students for being able to understand and apply these concepts. Thus understanding of new or novel systems is relatively easy for them; also they get the basis for following more specialized subjects in later semesters as well as in solving novel tasks during their career. (4 credits)

Electrical Engineering  

Smart city laboratory  
BMEVITIMMB04  
Smart City Laboratory is a part of the Smart City specialization of the Electrical Engineering MSc. course. The goal of this laboratory subject is to present some interesting and noteworthy elements from the huge set of software and hardware building blocks which support the concept of smart city. Students can learn the programming sensors and sensor networks as well as the usage of microcontrollers to control these sensors and to process data collected by them. Moreover the subject has two exercises about the construction of applications in an Augmented Reality environment and the usage of a gesture control device, respectively. (2 credits)

Physics 3  
BMEET11MX33  
The course covers introduction to two disciplines: Quantum Mechanics and Solid State Physics. After the semester students should be able to understand the basic principles behind these two disciplines and solve some simple problems. This will contribute to the understanding of the workings of modern electronics and nanotechnology. (4 credits)

Measurement theory  
BMEVIMIMA17  
The subject discusses the theoretical background as well as the qualitative and quantitative characterization of the engineering methods used for studying the physical world around. It gives an overview of the basic methods of signal and system theory, estimation and decision theory, as well as of the most important data- and signal processing algorithms. The main goal of the subject is to show how different tasks such as complex measurement problems, modelling and information processing problems, etc. can be solved using this theoretical background. The knowledge discussed in the subject gives a general basis for solving research and development problems too. (4 credits)

Linear algebra (Advanced Mathematics for Electrical Engineers)  
BMET90MX54  

Electrical Engineering  

High performance controllers  
BMEVIAUMA07  
Wide inside is given of the computer system architectures, high performance microcontroller architectures and their building blocks. Conventional architectures are analyzed then special architectures (ARM, DSP, network and graphic processors, GPGPU) are dealt with and compared with the SoC devices with soft and hard processors. Methods increasing the performance, security and reliability, decreasing power consumption are treated. Mechanical, electrical and
logical aspects of bus systems connecting parts of control systems are treated in detail. Diagnostic methods of WEB, mobile, etc. based control systems are also introduced. (4 credits)

**SW technology for embedded systems**

**BMEVIMIMA09**

The subject introduces the students to the modern technologies used in developing embedded software for better software quality. The introduction is both theoretical and practical. The subject shows why modern embedded software systems are complex, it lists the consequences of complexity and details how we handle complexity in this context, and how we define and increase software quality. The subject then iterate through the modern solutions available to keep control over the software development process, and how we can increase software quality. These modern solutions are introduced, and its properties are investigated using both a theoretical and a practical approach by programming examples. (4 credits)

**Computer vision systems**

**BMEVIIIMA07**

Aim of this course is to transfer knowledge about most important techniques of computer vision. This includes simple methods for daily use and more complex ones as well. Theory and Practice are kept in balance. The areas and methods covered by this course are not complete. Our aim is to help the students to be able to understand the alternatives of the discussed methods to the extent necessary for choosing among them in the perspective of theory and praxis. The topics of the course have been separated into three parts as follows: two- and three-dimensional vision and real time image processing covering the right choice of paradigms and image processing hardware components. (4 credits)

**Development of SW applications**

**BMEVIAUMA09**

The goal of the course is to introduce those software development tools and practices which are essential for larger scale development projects. This includes the higher level class libraries, automatic testing and continuous integration tools, version control and documentation tools. Special configuration options of the compiler and deployment profile selection and cloud services for server side applications. Beside these, the course emphasizes the use of these techniques in embedded system development and its special requirements. (4 credits)

**Design & integration of embedded systems**

**BMEVIMIMA11**

The aim of the subject is the presentation of the basic methods that are needed for the systematic development of embedded systems. First, the following topics are discussed: development life cycle models (e.g., V-model, iterative models), quality assurance, project planning, requirements traceability, version control and configuration control methods. Among system development methods, the subject presents the hardware-software co-design and component integration techniques, based on the previously studied technologies and building blocks, emphasizing also the model-based design approaches. The subject also covers the specific design methods for safety-critical embedded systems in which the malfunctions may lead to hazards, or in case of given environmental conditions even to accidents or damages. Such safety-critical systems are used for example in transportation, vehicles, medical equipment or process control systems. The students will be familiar with the architectural concepts (that are often referred in related standards), the techniques of safety and dependability analysis (that are needed to assess the design decisions), as well as the techniques of systematic verification. The exercises present concrete tools and techniques to support the typical tasks in requirement management, configuration control, source code analysis, unit testing, integration testing, system testing, hazard analysis and model based design. (4 credits)

**Embedded systems laboratory 1**

**BMEVIMIMA12**

The laboratory exercises present the modern, up to date technologies which are used for the design of embedded systems. The student thus get acquainted with FPGA based system design, efficient software development on dedicated digital signal processors and with high level, model-based virtual instrumentation using LabVIEW. The laboratory exercises also consist of setting up and solving real tasks by utilizing the before mentioned techniques. (4 credits)

**Electrical Engineering**

**Multimedia Systems and Services**

**Mobile and wireless networks**

**BMEVIIIMA07**

The objective of this course is to introduce today’s modern wireless and mobile systems to our students. This contains basic knowledge needed to operate and maintain such networks. Further goal of this subject is to show the possibilities and operations of advanced radio and wireless solutions, through practical examples. (4 credits)

**Broadband Wireless Telecommunication and Broadcasting Systems**

**BMEVIHVMA01**

The objective of the subject is to develop design, modeling and analysis skills related to the physical layer of wideband fixed, mobile communications and broadcasting systems of the future. Four major topics are discussed. The first one covers some special aspects of digital communication: spectraly efficient coding methods (high order QAM modulations, CPM, OFDM and FBMC), coded modulation systems and spread spectrum systems, as well as multiple access methods (CDMA, FDMA, TDMA, SDMA). The second part of the subject explains the properties of terrestrial and satellite microwave bands, fixed and broadcasting radio channels (WSSUS model), including also (multi)point-to-(multi)point transmissions (e.g. MIMO). The third part of the subject introduces specific terrestrial, cable and satellite broadcasting systems (mainly DAB, DVB and DRM variants), along with BFWA networks. Convergence between cellular and broadcasting networks is also considered (including SDR, LTE, 5G, DVB IP, DVB RCT/RCC/RCS). The fourth part gives in-depth knowledge about the test and measurement techniques of state-of-the-art digital broadcasting and communication systems, covering frequency domain and time domain measurements, modulation analysis and bit error / packet error related tests. The baseband representation of these systems is also discussed along with modeling and simulation methods, extending also to the generation of real and complex signals featuring specific stochastic characteristics. (4 credits)
## Foundations of multimedia technologies

**BMEVIHIMA08**

The course gives an overview of modern media communication system architectures, coding and modulation techniques, media service customer behavior and user devices. This course allows students to get acquainted with the capabilities of different media capture, storage, delivery and display solutions. (4 credits)

## Laboratory on Multimedia Systems and Services 1

**BMEVIHIMA10**

The aim of this laboratory course is to extend the knowledge learnt in Foundations of multimedia technologies lecture and improve practical skills. Technical methods and solutions for mobile and media communication systems are studied in this course. (4 credits)

## Electrical Engineering

### Electric Power Systems

#### Power system operation and control

**BMEVIEEMA01**

The course is intended to provide theoretical knowledge and practical skills in the following fields: system approach of power system design, operation and control, understanding of related physical phenomena and processes and devices capable of influencing these processes, application of the theoretical knowledge in computer aided design, control and safe operation. (4 credits)

#### Electrical systems of sustainable energetic

**BMEVIEEMA02**

The purpose of the subject is to give information for the students about the problems of ageing in the power system. Basics of asset management, monitoring and diagnostic methods, line management (including the economic questions) is also presented. Electric and magnetic field acting on the workers and the protection against their harmful effects are also in the focus. Further topics are also involved in the subject, like special energy converters of renewable energy systems, like duoble-fed asynchronous generator, motor. Special energy converters of large scale energy storing are also the part of the subject as well as the integration of renewables into the renewable energy system. (4 credits)

#### Power system transients

**BMEVIEEMA03**

The aim of the course is to provide theoretical knowledge and practical skills for computer based modelling of power system transients including understanding physics of electromagnetic wave propagation on multiphase power lines, being familiar with the origin of transients and their consequences, understanding transients appearing at abnormal system conditions, like switching on or off, during short-circuit or fault clearing. Students will be familiar with design practices and protection principles against overvoltages in order to be skilled about advanced solution methods to reduce the risk of failures. They will have an opportunity to learn how to operate modern power system transient simulation software tools and how to create digital models and evaluate the results obtained by computer simulation. (4 credits)

## Protection systems and measurement technology

**BMEVIVEMA04**

The aim of the course is to provide theoretical knowledge and practical skills for understanding principles and settings of protections used for parry of failure in power systems, power plants, industrial and communal systems, being familiar with measurement technology, digital signal processing, as well as intelligent protections and introducing functions and constructions of operational and malfunction automatics which provide reliable operation of the power system. (4 credits)

## Electric energy market

**BMEVIVEMA05**

Aim of the course is to lecture the students the basic principles, stakeholders and their connections, market designs, the technical, legal and commerce rules of the electricity markets that have already been deeply integrated with the operation and control of the electricity power systems, along with the economic principles, price trends of the commodities and services and the investment promoting techniques of the power markets. After successfully completing the course the students the possibility to have the required competences to join the workforce of an energy trading, a market oriented services, distribution or system operator corporation. (4 credits)

## Fundamentals of smart systems

**BMEVIEEMA04**

The course aims to develop a detailed knowledge and critical understanding of Smart Systems technologies and the physics of MEMS devices. A significant range of principal and specialist skills will be developed in the fields of Smart Systems manufacturing technology, and its applications in MEMS and bio-MEMS devices. During the laboratory work the students are getting familiar with the numerical modeling and analysis by the use of a cutting edge simulation tools. (4 credits)

## System level design

**BMEVIEEMA05**

The subject presents the design, implementation and verification of digital hardware. Various concepts and tools are presented, including alternatives of digital system relazitation, automation, silicon compilers, simulation methods, system level modelling. The languages hardware modellign languages SystemC, CatapultC, VHDL, Verilog, and Verilog-AMS are introduced. The actual trends are also discussed, e.g. hardware-software co-design, IC and MES co-design, MEMS integration. The subject also includes computer-based design demonstrations and practices. (4 credits)

## Circuit environment

**BMEVIEEMA06**

The scope of the subject is to get the students acquainted with the development of the packaged intelligent devices operating environment, the design software, the modern simulation tools. Deals with the design, testing, simulation steps and gives practical knowledge on their industrial applications. The whole process development flow is described, including basics steps of the developments, test methods, reliability investigations, and the effects of the ambient to
the operation of the circuit. The subject also introduces to signal integrity, e.g., plane capacitance, losses, delays, skin effect and proximity effect, wave impedance and passive devices in real parasitic elements. (4 credits)

**Smart systems design laboratory**

BMEVIEEMB00

The laboratory practice covers the complete design flow of IC and MEMS co-design. A workgroup of students are designing a Smart System solution including MEMS sensors and actuators and the relevant CMOS circuitry. The laboratory practice is built on the lecture course of System Level Design. Up to date industry standard software CAD tools are utilized thanks to the EU and international support. (2 credits)
Introduction

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

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

The undergraduate BSc program of the Faculty of Mechanical Engineering is designed to continue a tradition of excellence by:
- providing well-grounded and broad knowledge that graduates of this Faculty can apply immediately in their work and also use as the basis for further studies; and
- graduating competent engineers who are not only masters of their profession, but also possess an ethical philosophy of engineering based on accuracy, punctuality and reliability as well as a respect for the human element.

The goals of our MSc and PhD programs are as follows:
- to train creative, inventive mechanical engineers who can apply the engineering skills and the knowledge they have gained from the natural sciences on a state-of-the-art level; and
- to foster the development of leaders in engineering research and development.

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

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

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

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

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

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

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

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

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

Budapest University of Technology and Economics
Faculty of Mechanical Engineering
Faculty Office:
Building R, ground floor, room 001.
Mailing Address: Műegyetem rkp. 7-9.
H-1111 Budapest

Dean: Prof. Dr. Tibor Czigány
Vice-Dean (scientific and international affairs):
Dr. Ádám Kovács
Course Director:
Mr. Axel Groniewsky, BSc Course Director
## Curriculum of BSc Subjects
### Process Engineering Specialization

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The Faculty of Mechanical Engineering offers additional and optional courses (30 credits - upgrade to 240) on BSc level to its students - who completed 210 credits - to take.

### Optional Subjects

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Total credits: 31

The Faculty of Mechanical Engineering offers additional and optional courses (30 credits - upgrade to 240) on BSc level to its students - who completed 210 credits - to take.

**Optional subjects**

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XX in the Final Project code varies from department to department  e - exam, p - practical mark, ge - global exam
# Curriculum of MSc Subjects

**Mechanical Engineering Modeling - Fluid Mechanics module**

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

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### Curriculum of MSc Subjects

#### Mechanical Engineering Modeling - Solid Mechanics module

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### Basic knowledge in natural sciences

- **Differential Equations and Numerical Methods**
  - Code: BMETE90MX46
  - Credit: 4/2/0/e/8

- **Advanced Fluid Mechanics**
  - Code: BMEGEATMWM01
  - Credit: 3/0/0/e/4

- **Advanced Thermodynamics**
  - Code: BMEGEENMWAT
  - Credit: 2/1/0/e/4

- **Analytical Mechanics**
  - Code: BMEGEMMW01
  - Credit: 2/1/0/e/4

- **Laser Physics**
  - Code: BMETE12MX00
  - Credit: 3/1/0/e/4

- **Electronics**
  - Code: BMETEIAUM001
  - Credit: 2/0/1/e/4

- **Advanced Control and Informatics**
  - Code: BMEGEMMW01
  - Credit: 2/1/0/e/4

### Primary subjects

- **Machine Design and Production Technology**
  - Code: BMEGEWEMW01
  - Credit: 2/1/0/e/4

- **Finite Element Analysis**
  - Code: BMEGEMMW02
  - Credit: 2/2/0/p/5

- **Continuum Mechanics**
  - Code: BMEGEMMW03
  - Credit: 2/1/0/p/5

- **Teamwork Project**
  - Code: BMEGEMMW01
  - Credit: 0/0/3/p/3

### Diploma

- **Final Project A**
  - Code: BMEGEMMWDA
  - Credit: 0/13/0/p/15

- **Final Project B**
  - Code: BMEGEMMWDB
  - Credit: 0/13/0/p/15

### Economics and human subjects

- **Management**
  - Code: BMETW20MW02
  - Credit: 3/0/0/p/5

- **Marketing**
  - Code: BMETW20MW01
  - Credit: 3/0/0/p/5

### Differentiated professional subjects

- **Minor Compulsory Subject I.**
  - Code: BMETW20MW01
  - Credit: 2/1/1/p/5

- **Minor Compulsory Subject II.**
  - Code: BMETW20MW02
  - Credit: 2/1/1/p/5

- **Minor Elective Subject I.**
  - Code: BMETW20MW03
  - Credit: 2/0/1/e/3

- **Minor Elective Subject II.**
  - Code: BMETW20MW04
  - Credit: 2/0/1/e/3

- **Major Elective Subject I.**
  - Code: BMETW20MW05
  - Credit: 1/1/0/e/3

- **Major Elective Subject II.**
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  - Credit: 2/1/0/e/3

- **Major Elective Subject III.**
  - Code: BMETW20MW07
  - Credit: 2/0/1/p/3

### Elective subjects

- **Further Elective Subject 1.**
  - Code: BMETW20MW08
  - Credit: 2/0/0/p/3

- **Further Elective Subject 2.**
  - Code: BMETW20MW09
  - Credit: 2/0/0/p/3

### Major Elective Subjects & Further Elective Subjects

- **Biologically Inspired Systems**
  - Code: BMEGEMMW01
  - Credit: 2/0/0/p/3

- **Elasticity and Plasticity**
  - Code: BMEGEMMW05
  - Credit: 1/1/0/p/3

- **Nonlinear Vibrations**
  - Code: BMEGEMMW06
  - Credit: 1/1/0/e/3

- **Coupled Problems in Mechanics**
  - Code: BMEGEMMW07
  - Credit: 1/0/1/p/3

- **Mechanisms**
  - Code: BMEGEMMW08
  - Credit: 1/0/1/p/3

- **Beam Structures**
  - Code: BMEGEMMW09
  - Credit: 1/0/1/e/3

- **Experimental Methods in Solid Mechanics**
  - Code: BMEGEMMW10
  - Credit: 1/0/1/p/3

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

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## Curriculum of MSc Subjects
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* e - exam, p - practical, ge - global exam
### Curriculum of MSc Subjects

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<td>Major Elective Subject III.</td>
<td>2/0/1/p/3</td>
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<td><strong>Elective subjects</strong></td>
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<td>Further Elective Subject 1.</td>
<td>2/0/0/p/3</td>
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<td></td>
<td>Further Elective Subject 2.</td>
<td>2/0/0/p/3</td>
<td>2/0/0/p/3</td>
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</tbody>
</table>

**Major Elective Subjects & Further Elective Subjects**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Name</th>
<th>Block</th>
<th>Subject group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Biologically Inspired Systems</td>
<td>BMGEMIMGBI</td>
<td>2/0/0/p/3</td>
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<tr>
<td></td>
<td>CAD Technology</td>
<td>BMGEGEMW04</td>
<td>1/0/2/e/4 spring</td>
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<tr>
<td></td>
<td>Materials Science</td>
<td>BMGEGTMW01</td>
<td>2/0/0/e/3 spring</td>
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<td>Structural Analysis</td>
<td>BMGEGEMW05</td>
<td>1/0/2/p/4 spring</td>
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<tr>
<td></td>
<td>Process Planning</td>
<td>BMGEGTMW02</td>
<td>1/1/0/p/3 fall</td>
</tr>
<tr>
<td></td>
<td>NC Machine Tools</td>
<td>BMGEGTMW03</td>
<td>1/1/0/p/3 fall</td>
</tr>
<tr>
<td></td>
<td>Fatigue and Fracture</td>
<td>BMGEGTMW02</td>
<td>2/0/0/e/3 fall</td>
</tr>
</tbody>
</table>

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

### Subjects Block Subject group

- **Product Modeling**: BMGEGEMW02
  - Major Compulsory: Major Compulsory Subject I. (5cr)

- **Advanced Manufacturing**: BMGEGTMW01
  - Major Compulsory: Major Compulsory Subject II. (5cr)

Select one subject from table of major elective & further elective subjects

- Major Elective: Major Elective Subject I. (3cr)
- Major Elective: Major Elective Subject II. (3cr)
Description of BSc Subjects

Compulsory English I and II.

The courses are designed to enable students to communic- fect competition and pure monopoly. Market structure and te efficiently and effectively in study environment. Recep- tions. Introducing supply decisions. Costs and supply. Per- demand and supply. Consumer choice and demand deci- nomic analysis. Demand, supply and the market. Elasticities of demand and supply. Consumer choice and demand deci- Macro- and Microeconomics


Mathematics A1a - Calculus


Technical Chemistry


Statics


Materials Science and Testing


Fundamentals of CAD


Physics A2

Properties of electric charges. Insulators and conductors. Coulomb's law. The electric field. Superposition. Electric field lines of forces. The electric flux. Gauss's law. Exam- ples: the electric field of some specific charge distribu-

**Fundamentals of Machine Design**

**BM&E**


**Mathematics A2a - Vector Functions**

**BM&E**


**Software Engineering**

**BM&E**


**Strength of Materials**

**BM&E**


**Dynamics**

**BM&E**


**Materials Engineering**

**BM&E**


**Physics A3**

**BM&E**


**Machine Elements 1**

**BM&E**

of shafts and rotors for static combined loads. Fatigue and life of members. Dimensioning on strength at harmonically varying loads. 4 hours/5 credits.

**Environmental Management Systems**

**BMEGT42A003**

The course covers the topics relevant to the protection of environmental compartments, environmental pressures and pollution in a global context. Introduces the concepts, indicators and tools of environmental protection (air, water, noise and soil protection and waste management). Environmental management systems (EMS) at enterprises and other organizations. EMS topics include the assessment of environmental aspects and impacts, environmental audit, reporting, environmental performance evaluation, life cycle assessment and related international standards. 3 hours/3 credits.

**Mathematics A3 for Mechanical Engineers**

**BMETE90AX10**


**Analysis of Technical and Economical Data**

**BMEGEVGAG14**


**Measurement Technology**

**BMEGEMIAMG1**

The measurement of geometric quantities of mechanical engineering. Statistical analysis and data acquisition of the measured values. Systematization of errors, according to their origin, character and form. Measurement methods. Electronic measurement of typical time-dependent non-electric quantities of mechanical engineering and of mechatronics. Structure of the measurement chain, sensor and transducer types, the role of intermediate quantities. Dynamical errors, frequency transfer characteristics. Classification and Fourier analysis of signals. Digital measurement systems for length and angle. Basics of digital measurement of signals, digitization methods and sampling theorem. 3 hours/3 credits.

**Basics of Electrical Engineering**

**BMENVIAUA007**

Basics of stationary and time-varying electric and magnetic fields and their engineering applications. DC and single-phase AC circuit with lumped parameters. Complex quantities, and phasor diagram, Active, reactive and apparent powers. Modeling electromechanical systems. Basic electrical instruments and measurements. 3 hours/3 credits.

**Machine Elements 2**

**BMEGEGEAGG2**


**Manufacturing**

**BMEGEGTAG01**

The basic model of the machining system (WFMTC system), introduction to the part modeling, to the fixtureing the parts, to the machine tools and robotics, to the cutting tools and to the controlling of the machine tools. Mechanics of cutting; geometry of the cutting edge, chip breaking, stability of cutting. Tool wear and tool life. Tool materials and cutting fluids. Fundamentals of the measuring techniques and quality control. The main measuring devices. Fundamentals of metal cutting machine tools kinematics. Manually operated, cam controlled and computer controlled machine tools. Basic types of machine tools. Flexible manufacturing cells and systems. Manufacturing process planning. Computer-Aided Manufacturing. 5 hours/5 credits.

**Fluid Mechanics**

**BMEGEÁTAG11**


**Engineering Thermodynamics**

**BMEGEEAETD**

Polymer Materials Science and Engineering

BMEGEPTAG0P


Vibrations

BMEGEMMAGM4


Electromechanics

BMEVIUAU008


Control Engineering

BMEGEMIAE01


Heat Transfer

BMEGEENAEHK


Diffusion Processes

BMEGEVEAG02


Measurement at Energy and Environmental Protection

BMEGEENAG51

The role of measurements in maintaining and controlling the energy conversion processes. Hardware and software tools of the control and measurement systems. Laboratory tests of different engines and equipments. Simultaneous determination of system variables (flow rates, pressures, temperatures, etc.). Methods of determination of performance, efficiency, exhaust gas composition. 3 hours/3 credits.

Measurement Technique of Processes

BMEVEVAG03


Fundamentals of FEM

BMEGEMMA54

Management and Business Economics

BMEGT20A001

This course introduces the essentials of management as they apply within the contemporary work environment and gives a conceptual understanding of the role of management in the decision-making process. Particular attention is paid to management theories, corporate finance, leadership, teamwork, quality management, management of technology, economics calculation and operations management. For problem formulation both the managerial interpretation and the mathematical techniques are applied. 4 hours/4 credits.

Business Law

BMEGT55A001

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

Marketing

BMEGT201A002


Communication Skills - English

BMEGT63A061

It is designed to meet the language needs of students in academic and professional fields. Special emphasis is on the language of meetings and discussions, oral presentation and summary writing. 2 hours/2 credits.

Technical Acoustics and Noise Control

BMEGEATAG15


Fluid Machinery

BMEGEVGAG02

Euler equation, specific work, head, performance characteristics of axial and centrifugal machines. Losses, efficiencies. Non-dimensional parameters, scaling laws, specific speed. Cavitation, NPSH. Operation (parallel, serial) and control of turbomachines. Thrust loads (axial, radial). Axial fan, axial compressor stage. 4 hours/4 credits.

Heat Engines

BMEGEENAEGK


Numerical Simulation of Fluid Flows

BMEGEATAG06


Processes and Equipment of Chemical Industry

BMEGEVÉAG03


Air Pollution, Wastewater and Solid Wastes Management

BMEGEÁTAG04

Gaseous and particulate air pollutants. Source control of emissions. Waste gas treatment techniques for volatile organic compounds and inorganic compounds, for gaseous pollutants in combustion exhaust gases and for particulate matter. Wastewater characteristics, pre-treatment. Primary
separation or clarification wastewater treatment techniques. Physical, chemical, and water treatment techniques. Biological treatment techniques for biodegradable waste water. Wastewater sludge treatment techniques, sludge disposal. Types, sources, properties, quantities, and qualities of solid wastes. On-site handling, storage and processing of solid wastes. Collection, transfer and transport of solid wastes. Solid wastes processing techniques. Biological, chemical and energetic resource recovery processes. Ultimate disposal. 3 hours/3 credits.

Independent Study 1

**BMEGEVGAG06**

One-semester long individual project work. 4 hours/4 credits.

### Heating

**BMEGEÉPAG61**


### Manager Communication

**BMEGT63A081**

It is designed to establish and update basic language skills, and competences required by acting in management fields. 2 hours/2 credits

### Crosscultural Communication

**BMEGT63A091**

It is designed to make students aware of cultural differences, develop their intercultural competencies. Special emphasis is on verbal and non-verbal communication, language diversity, and socio-cultural factors. 2 hours/2 credits.

### Fluid Flow Systems

**BMEGEVGAG07**

Operation of pumps and fans in systems. Selection of the proper turbomachine considering safety, cavitation free operation and efficiency of controlling the turbomachine. Stability of operation of fans and compressors in systems containing large air volumes - an investigation based on a simple linear theory of stability. Computation of the flow rate and pressure distribution in looped pipe networks. Flow in open channels. Optimisation of the operation of water distribution systems containing pumps and reservoirs for minimum electricity cost. Basics of hydraulic transients. 3 hours/3 credits.

### Energy Processes and Equipments

**BMEGEENAG71**


### Volumetric Pumps and Compressors

**BMEGEVGAG04**


### Measurement for Chemical and Environmental Processes

**BMEGEVÉAG04**

Introduction to instrumentation and measurement systems. Process instrumentation, measurement methods, instruments and techniques of various physical quantities. On-line measurement with modular multi-parameter measuring system. Laboratory exercises for monitoring of waste water and air pollutants. Receive practical hands on experience in the laboratory using dryer, filter and heater equipment. 3 hours/3 credits.

### Final Project

**BMEGEXX4A45D**

One-semester long individual project work. 10 hours/15 credits. * XX in the code varies from department to department.

### Air-Conditioning

**BMEGEÉPAG62**

Basis for ventilation, thermal comfort and indoor air quality. Heating and cooling load calculations. Calculation of supply airflow rate for ventilated rooms, pollution and energy balance. Layout of air conditioning systems. Air movement in rooms, air distribution systems. Elements and processes of air handling systems. Filtration of air, filters. Treatments of air, equipment of heating, cooling, heat recovery and humidification. Hydraulic sizing of air duct system. Psychrometric charts. Process and flow diagrams of several air-conditioning systems. 4 hours/4 credits

Additional and optional courses on BSc level Pre-requisites: BSc final exam (diploma)

### Optional Subjects (upgrade to ECTS 240)

### Modeling of Processes and Equipment

**BMEGEÉEAG01**

Generalized two- and three-phase state model. Types of equations describing the operation of equipment. Number of degrees of freedom. Design and modeling algorithms. Vapor-liquid and liquid-liquid equilibrium calculations. Simulation of countercurrent separation processes (distillation, absorption, stripping, extraction, extractive distillation) with a professional flow sheet simulator. 2 hours/3 credits.

### Laboratory

**BMEGEÉEAG00**

Heat and material balance in spray drier. Overall heat transfer coefficient in tubular heat exchangers. Adsorption of gases (Breakthrough curve). Absorption in packed columns (Mass transfer coefficient, number of transfer units). Air vol-
ume flow rate measurement in an air technology system. The measurement of pressure relations of a ventilator on a Bernoulli bench. Thermal comfort related laboratory measurements. Measurement of combustion parameters and efficiency of gas boilers. 4 hours/5 credits.

**Independent Study 2**

**BMEGEVGAIP2**  
One-semester long individual project work. 8 hours/8 credits

**Heating**  
**BMEGEÉPEG61**  

**Manager Communication**  
**BMEGT63A081**  
It is designed to establish and update basic language skills, and competences required by acting in management fields. 2 hours/2 credits

**Crosscultural Communication**  
**BMEGT63A091**  
It is designed to make students aware of cultural differences, develop their intercultural competencies. Special emphasis is on verbal and non-verbal communication, language diversity, and socio-cultural factors. 2 hours/2 credits.

**English for Engineers**  
**BMEGT63A051**  
It is designed to meet the language needs of students in academic and professional fields. Special emphasis is on understanding complex technical texts, as well as producing clear paragraphs and essays on certain technical topics. 2 hours/2 credits.

**Analytical Mechanics**  
**BMEGEMMMMW01**  

**Advanced Fluid Mechanics**  
**BMEGEATMW01**  

**Advanced Thermodynamics**  
**BMEGEENMMWAT**  

**Motion Control**  
**BMEVIAUA016**  

**Power Electronics**  
**BMEVIAUA017**  
Semiconductor devices, the basic power electronics (PE) circuits and their application to such an extent that makes the students capable of understanding the principle of operation of PE equipment, carry out their laboratory tests, diagnosing faults and solving the task of selection as well as operation. Topics: 1. Introduction, Definition of PE; 2. Applications of Power Electronics; 3. DC/DC Converters; 4. Characteristics of Semiconductor Switching Devices; 5. Diodes, Thyristors, Application of Thyristors; 6. Controllable Semiconductor Switches: BJT, MOSFET, IGBT, GTO, Emerging Devices; 7. Converters: Classification, Configurations, Properties; 8. Output Voltage Regulation Methods, Overview of PWM; 9. AC Voltage Controllers: On-Off Control, Phase Control, Applications; 10. DC motor types, DC motor drives, Fields of Application; 11. Characteristics of the DC...

**Engineering Design and Technology Specialization**

The below courses make exclusive part of the Engineering Design and Technology Specialization.

**Metal Forming**

BMEGEMTAGE1

To present different processes in the field of cold, hot and sheet metal forming using the base-knowledge about material structure, mechanics and tribology taking into account the deformability of the material and other process parameters. Process design is based on the modeling of plastic deformation. Tools and equipments for the forming also are presented.


Base technologies and raw materials of cold forming processes: upsetting, heading, forward, backward and radial extrusion. Workability of materials. Die and process design of technology.


Laboratory: Flow curve and friction factor determination, testing of cold forming processes, design of die and forming technology, modeling of plastic forming. (4 credits)

**Non-Destructive Testing of Materials**

BMEGEMTAGE2

The subject gives an experience-oriented overview to the up-to-date non-destructive testing and evaluation (NDT and NDE) methods and technologies applied in mechanical-, electrical- and electronic industries. The subject deals with the basic and special non-destructive material testing methods, equipment and techniques of material defect analysis.

Lectures: Classification of NDT and NDE methods. Visualization, liquid penetration investigation of cracks. Ultrason-


**Novel Engineering Materials**

BMEGEMTAGE3

The structure, properties of novel structural and functional materials used in mechanical and electrical engineering applications and their testing methods are discussed. The technological processes and their practical aspects are discussed. Fundamental concepts of material structures and the principles of material properties and their relations. Special attention is paid to materials used in the electronics industries including their production and technological usability.

Basics of crystallography, crystal defects, dimensional effects, nano-, micro-, and macrostructures, multi-component systems. Thermal behavior, diffusion mechanisms. Phase transformations, heat treatments, recrystallization. Mechanical properties and their measurements.

Types and properties of novel structural and stainless steels. Fundamental new concepts in steel development. High entropy alloys.

Alloys used in biomedical engineering applications.

Materials deterioration processes such as corrosion, fracture, fatigue (mechanical, thermal, etc.), creep, migration. Microscopy, electron microscopy, X-ray diffraction. Conduction properties, conductive, superconductive, resistive, and insulator materials. Semiconductor materials. Effects of material properties on semiconductor materials used in microelectronics and in integrated optoelectronics. Insulator, dielectric and ferro-electric materials. Production of semiconductor single crystals and the related measurement techniques (Hall, CV). Non-metallic materials in electronics. Magnetic properties and the types of magnetic materials used in industrial applications. Intelligent materials. Shape memory and super elastic alloys. (3 credits)
Machine Design  
BMEGEGEAGMD


CAD Systems  
BMEGEGEAGCS

The course prepares the students to resolve complex task in the mechanical engineering with the tools of the computer aided design. Lecture topics: Introduction, using of the intelliFiles. Theory of the TOP-DOWN design. Integrated CAD systems. Virtual product development. Parametric design. Design of the mechanisms. Topics of the labs: Introduction, overview on the 3D part modeling. TOP-DOWN design in static constructions. Issuing homework No.1. Overview on 3D assembly modeling. Design of the cast parts. 3D model based technical drafting. SW test (45 min). (3 credits)

Project Work  
BMEGEGEAGPW

The course is to introduce the behavior analysis of machine construction and the optimal design using the tools of geometrical modeling and analysis. During the semester a machine design project should be worked out in small groups according to the following schedule. The task involves the conceptual and detailed designing of a machine structure, building a 3D-geometrical model in a CAD-System and, furthermore, the solving of several analysis problems. The main steps and milestones of the project: Fixing the aim of the project. Project scheduling. Collecting information. Requirements. Developing and evaluating of design concepts. Simplified modeling and analytical calculation of the construction. Building the structural model (simplified geometry, load cases, boundary conditions and material properties). Presentation 1 (in team, max. 10 points). Working out the 3D-solid model of the evaluated design concept. Numerical modeling of the problem (static, dynamic, thermal, kinematic analysis). Evaluating and critic of the first model. Presentation 2 (in team or individually, min. 10, max. 20 points). Finalizing the construction. Preparing the project documentation and the assembly drawing. Presentation 3 (in team and individually, 20 minutes, max. 20 points). Submitting the project documentation and drawings (individually max. 50 points). (3 credits)

Manufacturing Processes  
BMEGEGTAG91


Machine Tools and Manufacturing Systems  
BMEGEGTAG92

The subject introduces structural elements, structural layout, and various types of the metal-cutting machine tools, their technological and operation characteristics, the basic concepts and layouts of manufacturing systems, and the most important material supply equipment needed to build up manufacturing systems. The lectures include the following topics. Fundamentals of the kinematics of machine tools and the NC technology. Classification of metal-cutting machine tools. Selection criteria of machine tools. Structural building blocks: friction, rolling and hydrostatic guideways; ball screws; linear motors; rack and pinion mechanisms; hydrostatic screws; indexing and NC rotary tables; rotary actuators; gears, warm wheel, torque motor. Spindles: belt drive, gear drive, direct drive, integrated spindle; rolling, hydrostatic, aerostatic bearings; tool holders and tool clamping; lathe and milling spindles. Lathes and turning centres. Milling machines and machining centres. Automatic tool and workpiece changing peripherals. Multi-functional machine tools. Parallel and hybrid kinematics machine tools. Methods and tools for design and simulation of machine tools. Types and various layouts of manufacturing systems. Material supply principles. Material supply equipment: conveyors, forklifts, AGVs, robots. Flexible manufacturing systems. Methods and tools for planning, design and simulation of manufacturing systems. (3 credits)
**CAD/CAM Applications**

**BMEGEPTAG93**

The aim of the subject is to introduce students to computer aided design and manufacturing systems via industry proven tasks, application examples. Out through laboratory works they can learn the main principles of computer aided manufacturing programming techniques, the characteristics, advantages and limits of recent CAD and CAM systems and up to date developments. The focus of the subject is to teach manufacturing oriented computer modeling (preprocessing), applications and programming (post-processing).

Detailed thematic description of the subject: Product and production life cycle: Product, product workflow (lifecycle), production and manufacture, product design and production planning, modeling (models). Computer aided automation of process planning (engineering): manufacturing process planning and engineering models (CAD/CAM models); object and process oriented, integrated planning methods (CIM); manufacturing and manufacturability planning, CAD or/and CAM systems: principles of CAD and CAM system application, design for manufacture and assembly, feature based design and manufacturing process planning, manufacturing process oriented (generated) surface models and modeling; technology and quality controlled design and planning. CAM items and basic workflows: modeling of parts, assembly, environment (machine, device, tool, control, etc.) and technological process; CAD/CAM systems and elements (modules); CAM work- and data flows (interfaces, documents); manufacturing dimension; material, tool and technological databases; manufacturing strategies (roughing and finishing, path generation and combination, etc.); manufacturing levels and boundaries; 2.5-3D tasks, cycles, options. >3D manufacturing via CAM systems: manufacturing planning on lathes, mills and wire EDMs, spatial motion strategies, manufacturing sculptured and composed (combined) surfaces, applications of combined strategies, high speed machining (HSM) and special techniques. CAM-CNC interfaces, postprocessors: adaptation and transportation interface drivers (engine, processor), surfaces (HW/SW) and languages (formats), intermediate surfaces, languages, ISO CLDATA, ISO standard and advanced NC program languages, post processing (postprocessors and postprocessor generator), DME connections (DMIS) and NC auxiliary functions (in process measure, adaptive feed and/or path optimization, etc.). Surveying knowledge: lecture’s and supplementary labor’s test.

Thematic of laboratories: Subject requirements and thematic, 2.5D multiple hollow part modeling, NASA CAD test laboratory, Test1 (CAD labor work), surface and solid modeling of complex surfaces and combined, assembled block, NASA CAM test milling, 2.5D milling of hollow part in EdgeCAM, 3D-s CAM modeling and manufacturing programming, Test2 (CAM labor work), Homework consulting, check and submission. (3 credits)

**Injection Molding**

**BMEGEPTAG2**


**Polymer Processing**

**BMEGEPTAG3**

Description of MSc Subjects

Mechanical Engineering Modeling

Basic Subjects for each module

Differential Equations and Numerical Methods


Laser Physics


Analytical Mechanics


Advanced Fluid Mechanics


Advanced Thermodynamics


Electronics


Advanced Control and Informatics

Fluid Mechanics module

Primary Subjects

Machine Design and Production Technology

BMEGEÁTMW01
The goal of the course is to give a theoretical overview on the fields of machine design and production technology, according to the detailed topics below. Some elements of the methodology is covered on the seminars throughout a semester project.


Computational Fluid Dynamics

BMEGÉÁTMW02

Flow Measurements

BMEGÉÁTMW03

Teamwork Project

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

Final Project A

BMEGÉÁTMWDA
The aim of the course is to develop and enhance the capability for complex problem solving of the students under advisory management of the so-called Evaluation Team. The student's supervisor and two advisors form the Evaluation Team (ET).

Detailed thematic description of the subject: various experimental and/or numerical (CFD) project proposals are announced by the supervisors well before the registration week. The project proposals are defined as being complex problems both for the 3rd and further on the 4th semester, since they are to be continued in course of the Final Project B (BMEGÉÁTMWDB) in the 4th semester. The findings of the complex, two-semester long project will be summarised in the final Master (MSc) Thesis.

In course of the Final Project A and further on the Final Project B the student will work on one selected challenging problem of fluid mechanics.

1st ET meeting - 4th week:
1st project presentation by the student
2nd ET meeting - 8th week:
2nd project presentation by the student
3rd ET meeting - 14th week:
3rd project presentation by the student
15th week: submission of the major Project Report in printed and electronic format.

Evaluation Team members assess the students work, presentations & report.
Note, that for students taking the major in Fluid Mechanics of Mechanical Engineering Modeling MSc, various Final Project A proposals are announced also by the Department of Hydrodynamic Systems (under their own subject code BMEGEVMWDA).
Final Project B

**BMEGÉATMWDB**

The aim of the course is to develop and enhance the capability for complex problem solving of the students under advisory management of their project supervisor and two advisors. Each student’s project is guided by the project supervisor and depending on the problem—if applicable—by two advisors. They form the so-called Evaluation Team (ET). ET meetings are organized 3 times per semester.

Detailed thematic description of the subject: Several experimental and/or numerical (CFD) final project proposals will be announced by the project leaders well before the registration week. The final project proposals are defined as being complex problems of mainly fluid mechanics, usually they must be the continuation of the major projects’ proposals. The students will work on complex problems proposed in the 3rd semester in course of the Final Project A (BMEGÉATMWA). The Final Projects A and B together serve as a two-semester project that results in the Master (MSc) Thesis of the student. In course of the Final Project B one single student will work on the selected challenging problem of fluid mechanics.

1. ET meeting - 4th week:
   - 1st project presentation by the student

2. ET meeting - 8th week:
   - 2nd project presentation by the student

3. ET meeting - 14th week:
   - 3rd final project presentation by the student

15th week: submission of the Final Project Report (ie, the Master Thesis) in printed and electronic format. Evaluation team members assess the students work, presentations & report.

Note, that for students taking the Final Project A that was announced by the Department of Hydrodynamic Systems (under subject code BMEGEVMWDA) must continue their project in course of the Final Project B announced also by the Department of Hydrodynamic Systems (under code BMEGEVMWDB).

Subjects in Economics and Human Sciences

**Marketing**

**BMEGT20MWO1**


**Management**

**BMEGT20MWO2**

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

Major Elective and Further Elective Subjects

**Biologically Inspired Systems**

**BMEGEMIMGBI**

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

**Large-Eddy Simulation in Mechanical Engineering**

**BMEGÉATMW05**

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

**Multiphase and Reactive Flow Modeling**

**BMEGÉATMW17**

Building Aerodynamics

BMGEÁTMW08


Aerodynamics and Its Application for Vehicles

BMGEÁTMW19

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

Advanced Technical Acoustics and Measurement Techniques

BMGEÁTMW10

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

Open Source Computational Fluid Dynamics

BMGEÁTMW11

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

Unsteady Flows in Pipe Networks

BMGEVGMW02


Hemodynamics

BMGEVGMW06


**Flow Stability**


**Theoretical Acoustics**

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

**Solid Mechanics module**

**Primary Subjects**

**Machine Design and Production Technology**

The goal of the course is to give a theoretical overview on the fields of machine design and production technology, according to the detailed topics below. Some elements of the methodology is covered on the seminars throughout a semester project.


**Finite Element Analysis**

Continuum Mechanics

**BMEGEMMMW03**


Teamwork Project

**BMEGEMMWP1**

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

Final Project A

**BMEGEMMMWDA**

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

Final Project B

**BMEGEMMMWDB**

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

Subjects in Economics and Human Sciences

Marketing

**BMEGT20MW01**


Management

**BMEGT20MW02**

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

Major Elective and Further Elective Subjects

Biologically Inspired Systems

**BMEGEMMMGB1**

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

Elasticity and Plasticity

**BMEGEMMMW05**

Nonlinear Vibrations

BMEGEMMMW06


Experimental Methods in Solid Mechanics

BMEGEMMMW10

Thermal Engineering module

Primary Subjects

Machine Design and Production Technology

*BMEGEENGW01*

The goal of the course is to give a theoretical overview on the fields of machine design and production technology, according to the detailed topics below. Some elements of the methodology is covered on the seminars throughout a semester project.


Combustion Technology

*BMEGEENMWCT*

Course is started with introduction of fuel properties and fuel supply systems. It is followed by calculation of mass and energy balance of combustion, stoichiometry and CO2 and pollutant emission, flue gas loss calculation, condensation of flue gas components. Heat transfer in combustion chamber has important role on energy balance and retention time formation. After that combustion process of different fuels, parameters of combustion will be presented as homogenous / heterogeneous reactions, flow type and concentration effects on chemical reactions. Nowadays application of catalysts in combustion process and flue gas cleaning has become important part of this technology. Anaerobe biogas generation, gas cleaning and features and gasification technology overview, features of generated gas, gas cleaning technologies, tar filtering and/or condensation, torrefaction and pyrolysis will be discussed as well. Carbon capture and storage (CCS) technologies will be also presented. In the 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, and for solid fuels, and waste material incineration.

Energy Conversion Processes and Its Equipement

*BMEGEENMWEP*


Teamwork Project

*BMEGEENMWPR*

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

Final Project A

*BMEGEENMWDA*

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

Final Project B

*BMEGEENMWDB*

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

Subjects in Economics and Human Sciences

Marketing

*BMEGT20MW01*


Management

*BMEGT20MW02*

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

Biologically Inspired Systems

**BMGEEMIMGBI**

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

Simulation of Energy Engineering Systems

**BMGEENMWSE**


Thermal Physics

**BMGEENMWTP**


Thermo-Mechanics

**BMGEEMMMWTM**


Steam and Gas Turbines

**BMGEENMWTU**

Preliminary, property of Parsons and Laval steam turbines, property of modern steam turbines. Properties of impulse stage. Curtis stage, negative reaction number evoluation, sonic speed, velocity bended, efficiency curve, properties of reaction stage, long blade bended criteria, equistress design, determination of steam turbine’s main geometry, wet steam turbines, calculate pressure variation with Stodola constants. 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 gas turbine, wing shape theory and compressor stage.

Measurements in Thermal Engineering

**BMGEENMWMT2**

Design and Technology module

Primary Subjects

Machine Design and Production Technology

BMEGEGEMW01
The goal of the course is to give a theoretical overview on the fields of machine design and production technology, according to the detailed topics below. Some elements of the methodology is covered on the seminars throughout a semester project.


Product Modeling

BMEGEGEMW02

Advanced Manufacturing

BMEGEGTMW01

Teamwork Project

BMEGEGTMWP1
The complex task covers a semester project in the diverse topics of manufacturing.

Final Project A

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

Final Project B

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

Subjects in Economics and Human Sciences

Marketing

BMEGT20MW01

Management

BMEGT20MW02
The objectives of the course are that the students know the duties of management and the attributes of the manager job with the current formed perception in different ages. Over the set targets the students will understand the characteristic of human behavior, the behavior of managers and their employee, the team properties in the labor-environment and the corporations how develop their functional rules. The applicable (for previous) management methods and their expected effects on the members of corporation and their capacities are presented in the course of the discussed themes.

Major Elective and Further Elective Subjects

Biologically Inspired Systems

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

**CAD Technology**

**BMEGEGEMW04**


**Material Science**

**BMEGEMTMW01**


**Structural Analysis**

**BMEGEGEMW05**


**Process Planning**

**BMEGEGTMW02**

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

**NC Machine Tools**

**BMEGEGTMW03**

The lectures include the following topics: Fundamentals of the kinematics of machine tools and the NC technology. Classification of metal-cutting machine tools. Selection criteria of machine tools. Structural building blocks: friction, rolling and hydrostatic guideways; ball screws; linear motors; rack and pinion mechanisms; hydrostatic screws; indexing and NC rotary tables; rotary actuators: gears, warm wheel, torque motor. Spindles: belt drive, gear drive, direct drive, integrated spindle; rolling, hydrostatic, aeroelastic bearings; tool holders and tool clamping; lathe and milling spindles. Lathes and turning centres. Milling machines and machining centers. Automatic tool and workpiece changing peripheries. Multi-functional machine tools. Parallel kinematics machine tools. The seminars support the design assignment and help the student in selecting the motion unit components (i.e. ball screw, rolling guideway, servo motor) and designing the main structural element i.e. frames, moving slides, tool changers) of machine tools.

**Fatigue and Fracture**

**BMEGEMTMW02**

PhD Degree

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

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

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

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

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

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

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

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

Upon completing all necessary work for the PhD thesis, this dissertation must be prepared according to the formal requirements in the Doctoral Code of the Budapest University of Technology and Economics. According to the procedural code of our university, every PhD candidate individually must apply to the Doctoral Board of the faculty concerned. However, the recommendation of the supervising professor and department, including the attachment of the protocol of the departmental public presentation of the thesis (with the comments and recommendations of several departmental and/or internal referees, and other professional experts of the field) is a strong expectation.

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

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

NOTE:
Individual research topics and their overall conditions are formulated in negotiations between candidates and supervisors at BME.
BME GPK guidelines for acceptance to the PhD programme

1. The primary condition of admission to post-graduate studies is that the applicant must hold an MSc-degree in Mechanical Engineering, or in some closely related fields. Minimum requirement is at least “good” (min. 3.51 out of 5.00 or equivalent) qualification of the diploma.

2. Applicants are expected to have a definite scope of research in the following fields:
   - mechanical engineering (materials science and technology, solid or fluid mechanics, thermal engineering, combustion, process engineering, building services, manufacturing, engineering design, polymer science and technology),
   - mechatronics (robotics, system and control technology, optics, measurement, instrumentation technologies, biomechatronics),
   - energy engineering (heat and power generation, energy systems)
where they would like to advance their knowledge. They are requested to present a proposal, specifying a domain of interest with some research objectives, milestones and deliverables during the postgraduate studies. The suggested topic should have sufficient preliminaries in their university studies.

3. Applicants with experience and initial results are asked to submit a short summary of preliminary research activities together with relevant reports, published papers, which give help in the admission process.

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

5. It is highly preferable when applicants have already agreed with the future supervisor prior to the application.

6. Each admission is valid only for the forthcoming academic year (starting right after the letter of acceptance).

7. Application procedure is as follows:

   **Application deadline:** 1st July for Fall semester, 15th October for Spring semester.

   **Application fee, processing, postage:** EUR 100 (non-refundable). The application will be considered and communication is assured when application fee has been transferred to the bank account of BME, and submitted all the required documents.

**Documents to submit:**
   - application form (online) completely filled (be careful that your personal data appear correctly as are in your passport because they will be the form to appear in your transcripts and degree certificate)
   - copy of your passport
   - one of the following documents of internationally recognized English language proficiency:
     a) TOEFL iBT test score of 90, or PBT score 550,
     b) Cambridge First Certificate "B",
     c) IELTS score of 5.0
   - official transcripts, degrees/diplomas of any higher education already completed. Notarized English translation
   - 4 recent photographs
   - curriculum vitae (autobiography/résumé)
   - two letters of recommendation
   - Study Plan (agreed with the supervisor)

**NOTE:** Notarization is necessary for every school leaving document even if the original is in English. Notification of your acceptance/rejection will be sent to you after your complete application has been reviewed. All necessary further information will be attached to the letter of acceptance.
The Faculty of Natural Sciences, one of the newest faculties at the Budapest University of Technology and Economics, was established in 1998 and now employs 190 full and part time faculty members. The Faculty provides classes in Physics, Mathematics and Cognitive Science and is designed to meet the needs of its own and other faculties.

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

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

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

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

The **BSc in Mathematics Program**, a traditional curriculum, leads to a BSc degree in 6 semesters (currently available only in Hungarian). In the fifth semester students are offered two options: specialization “Theoretical Mathematics” is recommended to those who are interested in a deeper understanding of some branches of mathematics and in doing theoretical research and are probably going to continue their studies in a Mathematics MSc Program. Specialization “Applied Mathematics” is recommended to students who are eager to apply their knowledge in industry or finance. Therefore, we have prepared four modules
of courses, namely “Data Science”, “Engineering Mathematics”, “Operation Research” or “Stochastics”. Graduated students from either specialization are allowed to continue their studies in one of our Mathematics Master programs.

In another 4 semesters an **MSc in Mathematics** or **MSc in Applied Mathematics** degree can be earned. A large variety of subjects are offered in the **MSc in Mathematics Program**, covering the topics algebra and number theory, analysis, geometry, probability theory and statistics, discrete mathematics, operations research. There is a large flexibility in choosing subjects according to the personal interests of the student. From the available subjects we also offer two specializations called “Analysis” and “Optimization”.

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

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

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

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

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

**Institutes**

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

**Institute of Nuclear Techniques**
- Department of Nuclear Techniques
- Department of Nuclear Energy

**Institute of Physics**
- Department of Atomic Physics
- Department of Physics
- Department of Theoretical Physics

**Department of Cognitive Science**

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**Budapest University of Technology and Economics**

**Faculty of Natural Sciences**

Faculty Office:
Building K, 1st floor 18.
Mailing address:
H-1111 Budapest, Műegyetem rkp. 3.
Phone: (+36-1) 463-3561
Fax: (+36-1) 463-3560

Dean of the Faculty: Dr. János Pípek
Vice-dean (finance): Dr. Imre Varga
Vice-dean (Scientific and International):
Dr. György Károlyi
Vice-dean (education): Dr. István Prok
## Curriculum of MSc in Physics

<table>
<thead>
<tr>
<th>Subject</th>
<th>Name</th>
<th>Code</th>
<th>Type</th>
<th>Lecture / Practice / Laboratory / Exam type / Credit</th>
<th>Requisities</th>
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<tbody>
<tr>
<td><strong>Basic Courses</strong></td>
<td>6 credits</td>
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<tr>
<td>Computer Solution of Technical and Physical Problems</td>
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<td>Professional Training</td>
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<td>Physical Materials Science</td>
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Exam type: v = exam, f = midterm exam, a = signature, s = comprehensive exam  
Subject type: K = obligatory, KV = elective, V = optional, KR = criterium
## Curriculum of MSc in Mathematics

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

Subject type:  K = obligatory,  KV = elective,  V = optional
Curriculum of MSc in Applied Mathematics
Specialization in Applied Analysis

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Subject type: K = obligatory, KV = elective, V = optional
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### Specialization in Operation Research

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Exam type:  v = exam,  f = midterm exam,  a = signature
Subject type:  K = obligatory,  KV = elective ,  V = optional
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### Specialization in Financial Mathematics

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*Subject type: K = obligatory, KV = elective, V = optional*
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*Exam type: v = exam, f = midterm exam, a = signature*
*Subject type: K = obligatory, KV = elective, V = optional*
## Curriculum of MSc in Cognitive Science

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**Subject type:** K = obligatory, KV = elective, V = optional
Description of MSc Subjects in Physics

COMMON COURSES

Atomic and Molecular Physics
BMETE15MF03 – 2/0/0/f/3
Dr. István László
This course describes the quantum mechanical study of atoms and molecules building on quantum mechanical knowledge gained while earning a BSc degree in Physics. The following topics are discussed: Schrödinger equation of many particle systems, the Born-Oppenheimer approximation, variational principles, The Hartree-Fock method, the Kohn-Sham equations, the choice of basis functions, electronic structure of atoms, the group theory and the symmetry of the wave function, the density matrix, the virial theorem, the Hellmann-Feynman theorem, electronic structure of molecules, the density functional method. (3 credits)

Computer Simulation in Statistical Physics
BMETE15MF03 – 2/0/0/v/3
Dr. János Kertész
This course builds on the knowledge acquired during the BSc studies in statistical physics and programming. It presents the basic simulation techniques and gives insight to the newer developments. Important topics are: Monte Carlo method (generation of random numbers, importance sampling, Metropolis algorithm, boundary conditions, ensembles, averages, characteristic times). Phase transitions (finite size scaling, critical slowing down, accelerating techniques). Algorithmic aspects of discrete models (percolation, magnetic models, lattice gases, cellular automata, growth models). Molecular dynamics (interactions, solvers, ensembles, event driven MD, instabilities). (3 credits)

Computer Solution of Technical and Physical Problems
BMETE11MF01 – 0/0/2/f/2
Dr. Gábor Varga
In the frame of this course several areas of technical and physical problems (e.g.: one and many particle problems, Poisson equation, fluid flow, sheet deformation, heat transport, wave equation, Schrödinger equation) are investigated applying the knowledge of BSC degree in Physics. Investigated problems can be described by ordinary or partial differential equations. For every problem computer program is written. During the computer implementation not only the physical models but the needed numerical methods are analysed. MATLAB program language is applied as a programming tool. The course is complemented at beginning of the semester with optional MATLAB training. (2 credits)

Investments
BMETG35M004 – 2/0/0/f/2
Dr. Mihály Ormos
Markowitz’s portfolio theory: maximization of expected utility, risk-aversion and rationality, diversification, diversifiable and non-diversifiable risk, efficient frontiers, CAPM by Sharpe: risk-free opportunity, homogeneous expectations, market portfolio and the capital market line, beta and the security market line. Market efficiency: efficient capital market, efficient market hypothesis (EMH), levels of market efficiency (weak form, semi-strong form, strong form). Market microstructure: theory and empirics. Behavioral fi-

Nuclear Physics
BMETE80MF00 – 3/0/0/v/4
Dr. Dániel Péter Kis
This course describes the main chapters of the low-energy nuclear physics building on the experimental nuclear physics knowledge gained while earning a BSc degree in Physics. The following topics are discussed: measurement and systematics of the most important parameters of nuclei in ground state, nuclear models, nuclear forces, nuclear reactions, theoretical description of nuclear decay modes, nuclear fission, nuclear fusion and its use for energy production, nuclear cosmology, nuclear astrophysics. (4 credits)

Particle Physics
BMETE13MF00 – 4/0/0/v/4
Dr. Gábor Takács
The goal of this course is to provide a basic but comprehensive knowledge on modern particle physics, based on the lectures of the BSc training in Physics (electrodynamics and quantum mechanics). The topics covered are including: discovery, properties and classifications of particles; particle detectors, accelerators; gauge theory of quantum electrodynamics; Fermi theory and gauge theory of weak interaction, parity violation; description of strong interaction, QCD, properties; basics of quantum field theory; scattering theory; perturbation theory in scalar, Dirac-spinor and gauge theories. (4 credits)

Physical Materials Science
BMETE12MF02 – 2/0/0/f/3
Dr. Ferenc Réti
The course aims to give a modern knowledge in the materials science based on the fundamentals learned in physics (B.Sc.). The topics covered are: the process of solidification, defects in crystals, the diffusion, mechanical properties of the solids, phase diagrams, polymers, alloys, ceramics, composites, the corrosion process, electric and magnetic properties of the materials. (3 credits)

Problem Solving in Mathematics
BMETE95MF00 – 0/2/0/f/2
Dr. Márton Balázs
GROUPS AND STABILITY PHENOMENA

Advanced Quantum Mechanics

BMETE13MF01 – 2/0/0/v/3
Dr. Péter Kálmán
This is an advanced course of quantum mechanics (QM) based on electrodynamical and quantum mechanical studies required to the BSC degree. The following topics are discussed: the Dirac-formalism of QM, canonical quantization, the momentum operator and its matrix elements, the coherent state and its characteristics, the time evolution operator, Schrödinger-, Heisenberg- and interaction picture, the life-time, time dependent perturbation calculation, ionization by x-ray absorption, gauge invariance in QM and the gauge independent transition probability, spin, the density operator and the basics of QM statistical physics, the semiclassical self-interaction of radiation, the elements of relativistic QM. (3 credits)

Charge- and Spin-Density Waves

BMETE11MF17 – 2/0/0/v/3
Dr. György Mihály
Quasi-one dimensional materials: instability of the 1d electron-gas (Linhard function, Kohn-anomaly, Peierls-distortion, spin-density waves). Low-dimensional fluctuations, phase transition in case of coupled chains (diffuse X-ray, NMR). Incommensurate density waves: slidind, deforma-
tion, pinning (Fukuyama-Lee-Rice model, narrow band noise). Collective excitations: phason and amplitude, effective mass, optical properties. Nonlinear and frequency dependent phenomena: two-fluid model (I-V characteristics, dielectric relaxation, Hall-constant, Onsager relations). (3 credits)

Dynamical Systems

BMETE14MF02 – 2/0/0/v/2
Dr. Kristóf Kály-Kullay
This course studies the qualitative behavior of determinis-
tic models applied in various fields of natural sciences like physics, chemistry or biology. Within this topic the course deals with systems which can be described by ordinary differential equations and maps. The following subjects are discussed: the Lotka-Volterra and the Brusselator model, conservative and limit cycle oscillations, attractors and bi-
furcations of dissipative systems, local and global stability, the logistic map, Lyapunov exponent, chaos. (2 credits)

Evolutionary Games

BMETE15MF11 – 2/0/0/v/3
Dr. László Szunyogh
This course gives an introduction to the multi-agent evo-
olutionary games building on statistical physics knowledge gained while earning a BSC degree in Physics. The fol-
lowing topics are discussed: Concepts of traditional game theory (strategy, payoff, matrix game, Nash equilibrium, etc.); Evolutionary games with population dynamics; Evo-
olutionary games on lattices and graphs; Generalization of dynamical pair approximation. Many interesting phenom-
ena are described by considering the repeated multiagent Prisoner’s Dilemma and Rock-Scissors-Paper games for dif-
ferent connectivity structures. (3 credits)

Group Theory in Solid State Research

BMETE11MF12 – 2/0/0/v/3
Dr. István Kézmári
Introduction: point groups, fundamental theorems on finite groups, representations, character tables. Optical spectros-
copy: selection rules, direct product representations, factor group. Electronic transitions: crystal field theory, SO(3) and SU(2) groups, correlation diagrams, crystal double groups. Symmetry of crystals: space groups, International Tables of Crystallography. Electronic states in solids: representations of space groups, compatibility rules. (3 credits)

Foundations of Density Functional Theory

BMETE15MF15 – 2/0/0/v/3
Dr. János Pipek
Many-body Fock space and density operator. Reduced den-
sity operators. Exact equations and the independent particle approximation for the interacting electron gas in the density operator picture. N-representability. The Fermi hole and lo-

Electronic Structure of Solid Matter 1

BMETE15MF18 – 2/0/0/v/3
Dr. László Szunyogh
Building on the quantum mechanics and solid state physics studies of the Physics BSC education, this course aims to discuss modern theories and methods for the electronic structure of solid matter. The following topics will be out-
lined: Foundations of the static density functional theory. Variational and pseudopotential methods. The multiple scat-
tering theory (Green function method). Ab initio methods for correlated systems (LDA+U, self-interaction correction, DMFT). Alloy theory, the coherent potential approximation. Metallic (itinerant) magnetism, method of the disordered local moments. Time-dependent density functional calcula-
tions. (3 credits)

Electronic Structure of Solid Matter 2

BMETE15MF19 – 2/0/0/v/3
Dr. László Szunyogh
Continuation of the Electronic structure of solid matter I. course by discussing specific methods and phenomena. Topics: Relativistic electronic structure calculations, magnetic anisotropy in solid matter. Systems in reduced dimension: surfaces, interfaces, one-dimensional chains, finite clusters. Interactions in solid matter: asymptotic analysis, RKKY interaction, Dzaloshinskii-Moriya interaction, pair- and cluster interactions in alloys, phase diagrams. Ab ini-
tio calculations of electronic and optical transport properties: Caroli-, Landauer, and Kubo-Greenwood formalism. (3 credits)

Introduction to Superconductivity

BMETE11MF11 – 2/0/0/v/3
Dr. Balázs Dóra
Phenomenology of superconductors, Meissner effect, London equations, electrodynamic of superconductors. Bardeen-Cooper-Schrieffer theory: ground state, thermody-
amic and transport properties. Ginzburg-Landau theory:
free energy, GL equations and their solution, Abrikosov vortices, magnetic properties of Type II superconductors, Josephson effect and its applications. High-temperature superconductors. Prerequisites: Modern Solid State Physics. (3 credits)

**Magnetic Resonance**

**BMETE13MF04 – 2/0/0/v/3**

*Dr. Titusz Fehér*

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

**Many-Body Physics 1**

**BMETE15MF07 – 2/0/0/v/3**

*Dr. Gergely Zaránd*

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

**Many-Body Physics 2**

**BMETE15MF08 – 2/0/0/v/3**

*Dr. Gergely Zaránd*

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

**Mesoscopic Systems**

**BMETE15MF16 – 2/0/0/v/3**

*Dr. Gergely Zaránd*

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

**Modern Solid State Physics**

**BMETE11MF15 – 2/2/0/v/5**

*Dr. Attila Virosztek*

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

**Molecular Physics 2**

**BMETE15MF06 – 2/0/0/v/3**

*Dr. László Udvardi*

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

**Nanomagnetism**

**BMETE15MF17 – 2/0/0/v/3**

*Dr. László Szunyogh*

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

**New Experiments in Nanophysics**

**BMETE11MF18 – 2/0/0/v/3**

*Dr. András Halbritter*

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

Dr. János Kertész

Optical Spectroscopy

Dr. István Kézmári

Phase Transitions

Dr. János Kertész

Quantum Computer Physics 1

Dr. Barnabás Apagyi
Tárgytelefős / Responsible lecturer: Apagyi Barnabás

Quantum Computer Physics 2

Dr. Barnabás Apagyi

Random Matrix Theory and Physical Applications

Dr. Imre Varga
Random matrix theory provides an insight of how one can achieve information relatively simply about systems having very complex behavior. The subject based on the knowledge acquired in quantum mechanics and statistical physics together with some knowledge of probability theory provides an overview of random matrix theory. The Dyson ensembles are defined with their numerous characteristics, e.g. the spacing distribution, the two-level correlation function and other quantities derived thereof. Then the thermodynamic model of levels is obtained together with several models of transition problems using level dynamics. Among the physical applications the universality classes are identified in relation to classically integrable and chaotic systems. The problem of decoherence is studied as well. Then the universal conductance fluctuations in quasi-one-dimensional disordered conductors are investigated. Other models are investigated: the disorder driven Anderson transition and the random interaction model of quantum dot conductance in the Coulomb-blockade regime. We use random matrix models to investigate chirality in two-dimensional and Dirac systems and the normal-superconductor interface. The remaining time we cover problems that do not belong to strictly physical systems: EEG signal analysis, covariance in the stock share prize fluctuations, mass transport fluctuations, etc. (3 credits)
Scaling and Criticality
BMETE15MF14 – 2/0/0/v/3
Dr. Gergely Zaránd
Understanding critical phenomena and their connection to renormalization group belongs to the basic knowledge of modern solid state physicists. The course ‘Scaling and criticality’ builds upon the BSC level statistical physics and quantum mechanics courses and introduces the notions of scale invariance and renormalization group while avoiding the usual heavy field theoretical formalism. The course is organized along the following topics: critical phenomena (simple systems, universality, mean field theory), the renormalization group (The one-dimensional Ising model, Wilson’s renormalization group transformation, fixed points, critical dimensions, correlation functions), phase diagrams and scaling (cross-over phenomena, finite size scaling, dimensional cross-overs, quantum criticality), the perturbative scaling approach (fixed point Hamiltonian, operator product expansion, epsilon-expansion, anisotropy), low-dimensional systems (lower critical dimension, the XY model, Kosterlitz-Thouless phase transition, the O(n) model in 2+ε dimension). (3 credits)

Solitons and Inverse Problems
BMETE15MF09 – 2/0/0/v/3
Dr. Barnabás Apagyi
Inverse scattering theory, application to solution of nonlinear evolution equations. Formation of solitons (stable waves preserving shape and velocity for a long time), KdV equation. Physical application of solitons: nonlinear Schrödinger equation. Optical solitons. BEC solitons. (3 credits)

The Path Integral Method in Physics
BMETE13MF02 – 2/0/0/v/3
Dr. Antal Jakovác
A basic theoretical tool of physics is the path integral introduced by Feynman. Starting with simple stochastic models we arrive at the path integral formalism as it is used in quantum mechanics, statistical physics and field theory. Topics: Simple models of diffusion, generating function, Wiener measure. Diffusion with absorption, Schwinger-Dyson equations, harmonic approximation. Canonical partition with path integral. Feynman-Hibbs path integral. Path integral in the field theory, S-matrix, Feynman graphs. Lattice field theory. (3 credits)

The Physics of One-Dimensional Systems
BMETE15MF05 – 2/0/0/v/3
Dr. Gergely Zaránd
This course gives a basic introduction to the physics and theoretical description of interacting one-dimensional electron and spin systems. One-dimensional systems display basic phenomena such as charge- and spin density wave formation, antiferromagnetism and exotic superconductivity, and are fundamental test-gards for solid state physicists, since powerful field theoretical approaches can be used for them. Moreover, they are often realized in physical systems such as carbon nanotubes, quasi one-dimensional systems, or edge states. The course assumes the knowledge of basic Green’s function methods (Many body physics I), and is organized along the following topics: one-dimensional systems in nature (the Hubbard model, instabilities within the random phase approximation, spin and charge density waves, mapping to the Heisenberg model), basic properties of spin chains (Haldene’s conjecture, spin coherent states, spin liquids, the basics of Bethe Ansatz), the continuum limit (renormalization group and the Tomonaga-Luttinger model), bosonization (spin-charge separation, the Luttinger liquid phase), effects of disorder. (3 credits)

Theory of Magnetism 1
BMETE11MF13 – 2/0/0/v/3
Dr. Attila Virosztek
Magnetic phenomena are considered as electron correlation effects. The Hubbard model is used to interpret the Mott metal-insulator transition. A variational theory is given which allows the understanding of heavy fermion behavior. The antiferromagnetic Heisenberg model is introduced as the effective Hamiltonian of the large-U Hubbard model at half filling. Other kinetic exchange processes, including ring exchange with application to the magnetism of solid He3, are discussed. A detailed treatment of the two-site Coulomb processes allows the introduction of direct exchange. The survey of various mean field theories of magnetic order begins with the Stoner theory. Weak itinerant ferromagnets like ZrZn2 and MnSi are discussed in some detail. (3 credits)

Theory of Magnetism 2
BMETE11MF14 – 2/0/0/v/3
Dr. Attila Virosztek
The basic concepts and results from the first part of the course are assumed to be familiar. The variety of magnetic ordering phenomena is surveyed, the conditions of ordering, and the nature of the excited states over ordered ground states are discussed in various theoretical frameworks. The concept of the quantum critical point is used for rare earth systems with non-fermi-liquid behavior. Localized-spin order and spin wave theory is described both for ferromagnets and antiferromagnets. A detailed discussion of quantum fluctuations in the ground state is given, including recent results on the possibility of spin liquid ground states. A particular kind of magnetic cooperative behavior is shown to give rise to the integer and the fractional quantum Hall effect. (3 credits)

Transport Processes
BMETE14MF02 – 2/0/0/v/2
Dr. Ferenc Márkus
During physical and chemical processes various quantities are transported and the understanding of these processes is important for the practice. The following topics are covered: balance equations, equations of state, constitutive equations, conservation laws, mass and component balances, balance of the internal energy, Fourier’s law, equation of heat conduction and its analytical solutions, Green-function, diffusion, membranes, thermo-diffusion, multi-component diffusion, chemical reactions. (2 credits)

Variational Principles in Physics
BMETE13MF03 – 2/0/0/v/3
Dr. Gábor Takács
This theoretical physics course gives a review over variational principles formulating basic laws in mechanics, relativity, electrodynamics and quantum mechanics. Its aim is to present a mathematical basis for use in disperse areas of physics as well as to demonstrate the utility of physics in the way of theory making. Topics: The principle of virtual work (statics), D’Alembert, Gauss, Lagrange and Hamilton principles, action (dynamics), Maupertuis principle, geodetic motion, Einstein-Hilbert action (relativity), electric and magnetic field energy conditioned by the Gauss and Biot-Savart laws, electric – magnetic duality, waves and gauge
symmetry as reflected in the variational principle (electrodynamics), the Schrödinger equation as the minimal break with the classical Hamilton-Jakobi equation (quantum mechanics). (3 credits)

Wavelets, Coherent States and Multiresolution Analysis

Dr. János Pipek

COURSES OF SPECIALIZATION

APPLIED PHYSICS

Basic Physics of Optical Communication

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

Crystalline and Amorphous Materials

Dr. Sándor Kugler

Electrical and Optical Properties of Solids

Dr. Ádám Gali
This course prescribes the knowledge of fundamental solid state physics and quantum mechanics from BSc education in Physics. In this course it is schematically explained how the structure is formed in different type of solids due to the different type of forces that bind them. The electronic structure of typical metals and semiconductors is reviewed and explained how that can be measured or calculated.

The semiconductors are defined from technological point of view. Typical carriers in semiconductors are defined and explained how they can be measured or calculated. The dynamics of Bloch-electrons is reviewed within semi-classical treatment, and the basic definitions needed for understanding the function of semiconductor devices are explained (Fermi-level, n and p-type conduction, excitonic states). It is shown how the point defects influence the electronic band structure of the semiconductors: definition of doping, thermal point defects. The electronic structure and the density of states of low-dimensional systems as well as the amorphous solids are examined. Finally, the interaction of the electromagnetic radiation with the matter is explained for metals, semiconductors and insulators. (3 credits)

Electron- and Ion Optics

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

Experimental Methods in Material Science 1, 2

Dr. Péter Richter
This course is an introduction for MSc students, who have not taken Optics during their BSc studies. It is based upon the BSc level Electrodynamics. Main topics discussed in- clude: models of light, transmission and reflection, geometrical/paraxial optics, interference, thin films, diffraction, optical grating, polarization, propagation in anisotropic media, waveguides, light and matter interaction, absorp-
tion, emission, operation of lasers, coherence, electro- and acousto-optics. (3 credits)

**Laser Physics**

**BMETE12MF17 – 2/0/0/v/3**

Dr. Pál Maák

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

**Light Sources**

**BMETE12MF14 – 2/0/0/v/3**

Dr. László Kocsányi

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

**Optical Design**

**BMETE12MF39 – 2/2/0/v/4**

Dr. Gábor Erdéi

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

**Optical Information Processing and Data Storage**

**BMETE12MF19 – 2/0/0/v/3**

Dr. Pál Maák

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

**Optical Metrology**

**BMETE11MF21 – 2/0/0/v/3**

Dr. János Kornis

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

**Optical materials and technologies 1, 2**

**BMETE12MF33, 34 – 2/0/0/v/3**

Dr. László Kocsányi

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

**Optoelectronic Devices**

**BMETE12MF21 – 2/0/0/v/3**

Dr. Attila Barócsi

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

**Problemsolving in Physics**

**BMETE12MF01 – 2/2/0/v/4**

Dr. Péter Richter

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

**Quantumelectronics**

**BMETE12MF16 – 3/0/0/v/4**

Dr. Attila Barócsi

The course based on the course of quantummechanics and classical electrodynamics. Topics: Susceptibility of atomic gas (semiclassical treatment), quantization of free electromagnetic field, vacuum fluctuation Lamb shift, photoeffect
Semiconductor Physics 1, 2

Dr. Szabolcs Csonka

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

Spectroscopy and Structure of Matter

Dr. Péter Richter

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

Surface Physics and Thin Layers 1, 2

Dr. Olga Homokiné Kraiczk

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

Trends in Materials Science

Dr. Gábor Kiss

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

Vacuum Physics and Technology

Dr. György Hárs

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

COURSES OF SPECIALIZATION
NUCLEAR TECHNOLOGY

Calculations in Thermohydraulics

Dr. Attila Aszódi

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

Chemistry in Nuclear Power Plants

Dr. Imre Szalóki

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

Introduction to Fusion Plasma Physics

Dr. Gergő Pokol

Introduction, basics of fusion, classification, Debye length, plasma frequency. Motion of particle in magnetic field, one and two fluid model; Atom physics in plasma, energy levels Electromagnetic waves in plasma, dispersion MHD waves, instability transport effects, kinetic theory to plasma distri-
In the lectures and exercises of the course we introduce simple radiation shielding problems the solution of which can be performed using approximate methods. Here the spatial power density distribution and related thermal and operational limits, parameter changes during a cycle, special operational aspects at the end-of-cycle. We present the on-line core monitoring methods and the in-core and ex-core detectors applied. Furthermore, the core analysis codes, the methods of data acquisition, the basics of data processing and on-line fuel condition monitoring are discussed in detail. The course is closed with the introduction to reactor pressure vessel problems and monitoring, and the operation of reactor control instrumentation. (3 credits)

Dr. Szabolcs Czifrus

Physical Principles of Radiological Methods

Dr. Szabolcs Czifrus

In the frame of the course students study the physical principles of radiological imaging techniques applied in medicine. The main subjects are the following: Principal characteristics of radiation sources used for medical imaging, properties of radiation-matter interaction, physics and modelling of radiation detection, physical modelling of the imaging process, characterization of the image, imaging techniques, projection radiology, and physical principles of tomography techniques. The physics of CT, SPECT and PET, furthermore, the worldwide trends of radiology techniques, such as multimodality techniques are described. The last topic of the course is the basic principles of image processing algorithms. (4 credits)
Radiation Protection 2
BMETE80MF30 – 2/0/2/v/4
Dr. Péter Zagyvai
This course describes the determination of external and internal dose due to natural and – occasionally – artificial sources of generally low radioactivity based on nuclear physics and radiation protection knowledge gained while attending a BSC course in Physics. Topics discussed: detailed analysis of dose concepts, special problems (KERMA versus absorbed dose, equivalent and effective dose for assessing stochastic radiation effects), health physics control and regulation based on dose/risk dependence, principles and practice of dose and dose rate measurement, calculation of internal exposure, nuclear analysis for determining internal dose, compound radiation measurements: radon analysis, nuclear environmental monitoring. (4 credits)

Radioanalytics
BMETE80MF24 – 2/0/3/v/5
Dr. Imre Szalóki
The course describes the fundamentals of radioanalytics based on the knowledge about radiochemistry gained while earning a BSC degree in Physics. The major topics to be discussed are the following: analysis of radionuclides by means of radiochemical procedures and nuclear measuring techniques, application of nuclear methods for the analysis of the elemental composition and material structure. During the laboratory exercises difficult-to-determine\textsuperscript{*} nuclides e.g. uranium and transuranium isotopes, strontium-90 will be analysed. (5 credits)

Reactor Control and Instrumentation
BMETE80MF35 – 2/1/0/v/3
Dr. Gábor Pór
From details of temperature, pressure, vibration sensors and nuclear detectors applied in contemporary nuclear power plants via problems of building and maintaining measuring chains to data collection and data processing, to data evaluation. Safety consideration including principles of two from three, and independence of signals, international standards including recommendations of IAEA and nuclear authorities, man-machine interface including nuclear power plants control room and operator support systems. Detailed studies in high-tech nuclear measuring methods and systems like VERONA, C-PORCA, PDA, core diagnostics, loose parts monitoring, vibration monitoring, leakage monitoring, acoustic monitoring ageing monitoring systems built in NPP. Short survey of future trends like wireless measuring systems, testing of digital software for I&C, artificial intelligence for operator support systems. (3 credits)

Reactor Physics
BMETE80MF26 – 2/0/0/v/2
Dr. Mihály Makai

Safety of Radioactive Wastes
BMETE80MF31 – 3/0/1/v/4
Dr. Péter Zagyvai
This course describes regulation and control pertaining to radioactive wastes and key issues of safe waste management based on radiation protection knowledge gained while attending a BSC course in Physics. Topics discussed: international and national regulations – theory and practice, detailed studies on safe processing, immobilization and disposal of radioactive wastes, reprocessing of certain waste types, waste analysis. (4 credits)

Simulation Techniques
BMETE80MF27 – 2/0/1/f/4
Dr. Sándor Fehér
In the course the knowledge required to the development of real-time, interactive simulators used for the education and training in the field of nuclear energy is discussed according to the following topics: simulation principles; design and development of real-time interactive simulators; simulation techniques for systems modeled with ordinary differential equations; numerical methods for real-time integration; simulator interface design; software and operational system issues; types of nuclear power plant simulators; simulation of nuclear reactor kinetics; simulation of thermohydraulic processes taking place in the primary circuit of PWR type power plants; simulation of the operation of the main components of a nuclear power plant. (4 credits)

Sustainable Development and Nuclear Energy
BMETE80MF21 – 2/0/0/v/3
Dr. Attila Aszódi
Definition of sustainable development, international agreements, development of electricity production methods, their role in the sustainable development, energy source supply, fossil energy sources and their mining, security of energy supply, relation of energy supply and economic independence, global warming, Kyoto protocol, climate protection, role of renewable sources and nuclear energy in a healthy energy-mix, structure and types of nuclear reactors, comparison of different energy production methods, nuclear energy systems, radioactive wastes, safety of nuclear power plants and environmental effects, Tsernobyl. (3 credits)
Advanced Linear Algebra

**BMETE91MM05 – 2/0/0/v/3**

Dr. Erzsébet Horváth


Algebraic and Arithmetical Algorithms

**BMETE91MM08 – 3/1/0/f/5**

Dr. Attila Nagy


Algebraic Number Theory

**BMETE91MM07 – 2/0/0/v/3**

Dr. Ferenc Wettl

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

Algorithms and their Complexity

**BMEVISZM031 – 3/1/0/f/5**

Dr. Katalin Friedl


Analysis of Economic Time Series

**BMEGT30M400 – 2/0/0/f/2**

Dr. Dietmar Meyer

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

Analytic Number Theory

**BMETE95MM13 – 2/0/0/f/2**

Dr. Csaba Sándor

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

Biomathematics

**BMETE93MM11 – 2/0/0/f/2**

Dr. Krisztina Kiss


Combinatorial and Discrete Geometry

**BMETE94MM02 – 3/1/0/f/5**

Dr. Zsolt Lángi


Combinatorial Optimization

**BMEVISZM029 – 3/1/0/v/5**

Dr. Dávid Szeszlér

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

**BMETE91MM01 – 3/1/0/v/5**

*Dr. Alex Küronya*

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

**Control Systems**

**BMETE93MM07 – 2/0/0/v/3**

*Dr. Éva Gyurkovics*


**Differential Geometry and Topology**

**BMETE94MM00 – 3/1/0/v/5**

*Dr. Szilárd Szabó*

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

**Dynamic Programming in Financial Mathematics**

**BMETE93MM14 – 2/0/0/v/3**

*Dr. József Fritz*


**Dynamical Systems**

**BMETE93MM02 – 3/1/0/v/5**

*Dr. Károly Simon*


**Econometrics**

**BMETE93MM10 – 0/0/2/f/2**

*Dr. Zsanett Orlovits*


**Ergodic Theory and Dynamical Systems**

**BMETE95AM22 – 2/0/0/v/2**

*Dr. Domokos Szász*


**Extreme Value Theory**

**BMETE95MM16 – 2/0/0/v/3**

*Dr. Béla Barabás*

Financial Processes

BMETE95MM14 – 2/0/0/f/3
Dr. József Fritz

Fourier Analysis and Function Series

BMETE92MM00 – 3/1/0/v/5
Dr. Miklós Horváth

Fractals and Geometric Measure Theory

BMETE95MM06 – 2/0/0/f/3
Dr. Károly Simon

Game Theory

BMETE93MM09 – 2/0/0/f/3
Dr. Tibor Illés
Introduction into Game theory, especially into its non-cooperative variant. Game theory models such economic, political, military etc. situations where more than one actor optimizes his utility function, whose value also depends on the others’ decisions. By now game theory has become the fundament of economics, which helps modelling monopolly, the design of auctions and other problems. The structure of the lectures is as follows: Non-cooperative game theory (Nash-equilibrium, Bayesian equilibrium). Cooperative game theory: Shapley value. Introduction into economet-
Group Theory

Dr. Erzsébet Horváth

Homological Algebra

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

Individual Projects 1, 2

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

Insurance Mathematics 2

Dr. Béla Barabás

Introduction to Economic Dynamics

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

Inverse Scattering Problems

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

Limit- and Large Deviation Theorems of Probability Theory

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

Linear Programming
BMETE93MM01 – 3/1/0/v/5
Dr. Tibor Illés

Markov Processes and Martingales
BMETE95MM07 – 3/1/0/v/5
Dr. Márton Balázs

Mathematical Chemistry
BMETE92MM09 – 2/0/2/v/5
Dr. János Tóth

Mathematical Modelling Seminar 1, 2
BMETE95MM01, 02 – 2/0/0/f/1
Dr. Domokos Szász
The aim of the seminar to present case studies on results, methods and problems from applied mathematics for promoting the spreading of knowledge and culture of applied mathematics; the development of the connections and cooperation of students and professors of the Mathematical Institute, on the one hand, and of personal, researchers of other departments of the university or of other firms, interested in the applications of mathematics. The speakers talk about problems arising in their work. They are either applied mathematicians or non-mathematicians, during whose work the mathematical problems arise. An additional aim of this course to make it possible for interested students to get involved in the works presented for also promoting their long-range carrier by building contacts that can lead for finding appropriate jobs after finishing the university. (1 credit)

Mathematical Methods of Classical Mechanics
BMETE93MM12 – 2/0/0/l/2
Dr. Gábor Etesi

Matrix Analysis
BMETE92MM03 – 2/0/0/v/3
Dr. Dénes Pézsit
Vector spaces and linear operators, Hilbert spaces, orthonormal basis, the matrix of a linear operator, matrix norms, self-adjoint and unitary matrices, localization of eigenval-
ues and singular values, positive definite matrices, tensor product and Hadamard product, Schur theorem and applications, functional calculus, derivation, the exponential function, Lie-Trotter formula, matrix monotone functions, means of positive matrices, block-matrices, applications to differential equations, matrices with positive entries. (3 credits)

**Multivariate Statistics**

**BMETE95MM15 – 3/0/1/v/5**  
*Dr. Marianna Bolla*  

**Multivariate Statistics with Applications in Economy**

**BMETE95MM18 – 2/0/0/v/2**  
*Dr. Marianna Bolla*  

**Nonparametric Statistics**

**BMETE95MM20 – 2/0/0/v/3**  
*Dr. László Györfi*  

**Nonlinear Programming**

**BMETE93MM04 – 3/1/0/v/5**  
*Dr. Tibor Illés*  

**Nonlinear Hyperbolic Equations**

**BMETE93MM13 – 2/0/0/v/3**  
*Dr. Katalin Nagy*  

**Numerical Methods 2 – Partial Differential Equations**

**BMETE92MM07 – 2/0/2/v/5**  
*Dr. Róbert Horváth*  
Operations Research Softwares

BMETE93MM06 – 0/0/2/f/5
Dr. Boglárka Gazdag-Tóth
The aim of this course is twofold. On the one hand it aims to advance the student’s routine in programming by coding the basic algorithms of operations research. On the other hand its goal is to give perfection in the use of operations research software. The standard description of linear programming problems, the MPS data structure, and the most important algebraic modelling languages (GAMS, AMPL, AIMMS). Introduction and usage of the most important software packages in linear, integer, non-linear, and stochastic programming (CPLEX, MINOS, SNOPT, LOQO, LGO). (2 credits)

Partial Differential Equations 2

BMETE93MM03 – 3/1/0/f/5
Dr. Márton Kiss

Potential Theory

BMETE92MM04 – 2/0/0/f/3
Dr. Ágota G. Horváth

Projective Geometry

BMETE94MM01 – 2/2/0/f/3
Dr. Ákos G. Horváth
Perspectivity in the practice, harmonic division, cross-ratios, the projective scale. The addition and multiplication of points on the base of the Desargues’s theorem. The field defined by the above operations. Structures based on incidences. Projective and affine planes. The Galois-type geometries. The n-dimensional spherical space, projective space and affine space. The classifications of collineations and polarities by the normal form of Jordan. The projective geometrical base of the visualization by computer. The central projection of figures of dimension 3 and 4 and its visualization on the monitor. (5 credits)

Representations of Groups and Algebras

BMETE91MM04 – 3/1/0/f/5
Dr. Erzsébet Lukács

Representation Theory

BMETE91MM02 – 3/1/0/f/5
Dr. Alex Kőrnyea

Statistical Program Packages 2

BMETE95MM09 – 0/0/2/f/2
Dr. Csaba Sándor
The goal of the course is to provide an overview of contemporary computer-based methods of statistics with a review of the necessary theoretical background. 1. How to use the SPSS (Statistical Package for Social Sciences) in program mode. Writing user’s macros. Interpretation of the output data and setting the parameter values accordingly. Definition and English nomenclature of the displayed statistics. 2. Introduction to the S+ and R Program Packages and surveying the novel algorithmic models not available in the SPSS (bootstrap, jackknife, ACE). 3. Practical application. Detailed analysis of a concrete data set in S+. (2 credits)

Statistics and Information Theory

BMETE95MM05 – 3/1/0/f/5
Dr. Marianna Bolla
Stochastic Analysis and Applications

**BMETE95MM04 – 3/1/0/v/5**

**Dr. Károly Simon**


Stochastic Differential Equations

**BMETE95MM08 – 3/1/0/v/5**

**Dr. Bálint Tóth**


Stochastic Models

**BMETE95MM11 – 2/0/0/f/2**

**Dr. Márton Balázs**


Theoretical Computer Science

**BMETE91MM00 – 3/1/0/f/5**

**Dr. Miklós Ferenčzi**

## Theory of Operators

**BMETE92MM05 – 3/1/0/v/5**  
**Dr. Béla Nagy**


## Wavelet Analysis

**BMETE92MM06 – 2/0/0/f/2**  
**Dr. Ky Nguyen Xuan**

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

## Description of MSc Subjects in Cognitive Science

### Brain in Trouble

**BMETE47MC34 – 2/0/0/f/2**  
**Dr. Mátra Zimmer**


### Cognition and Emotion

**BMETE47MC26 – 2/0/0/f/3**  
**Dr. Gyula Demeter**

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

### Cognitive Neuropsychiatry

**BMETE47MC30 – 2/0/0/v/3**  
**Dr. Szabolcs Kéri**


Cognitive Psychology Laboratory

**BMETE47MC20 – 0/0/8/v/9**

Dr. Ferenc Kemény

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

Evolutionary Psychology

**BMETE47MC07 – 2/0/0/f/3**

Dr. Péter Simor


Informatics

**BMETE92MC19 – 0/2/0/f/3**

Dr. János Tóth

The aim is to provide and extremely powerful tool to solve calculation, simulations, drawing, presentation, etc. problems connected with the studies of the student, which will also come useful later in research. The tool Mathematica, Version 7, at the time of writing this syllabus, is also useful to show the latest developments in different fields of applied computer science, such as programming paradigms (with emphasis on functional programming). Parts of mathematics will also be presented or repeated in this course. – Topics: Mathematical program packages. An intelligent calculator: application in elementary mathematics. Kernel, front end, packages, demonstrations. Numbers, solving equations. Plotting, graphics. Animation, manipulation, sound. The language of Mathematica. Lists and generalized lists. Functional programming. Rule based programming. Rewrite rules. Pattern matching. Procedural programming. Applications in mathematics: discrete, continuous, stochastic. Applications in linguistics. Elements of image processing. (3 credits)

Introduction to Cognitive Science

**BMETE47MC01 – 2/0/0/f/3**

Dr. Gyula Demeter


Introduction to Experimental Psychology

**BMETE47MC25 – 2/0/0/v/3**

Dr. Gyula Demeter

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

BMETE92MC15 – 2/2/0/v/5
Dr. János Tóth

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

Memory and the Psychology of Learning

BMETE47MC29 – 0/3/0/f/3
Dr. Mihály Racsmány

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

Neurobiology 1 – Foundations and Neurobiology of Perception

BMETE47MC22 – 2/0/2/v/5
Dr. Gyula Kovács


Neurobiology 2 – Sensory and Motor Processes

BMETE47MC23 – 2/0/0/v/3
Dr. Gyula Kovács

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

Neurobiology 3 – Higher Cognitive Functions

BMETE47MC24 – 2/0/0/v/3
Dr. Szabolcs Kéri

Neuropsychology

BMETE47MC06 – 2/0/2/v/5

Dr. Gyula Demeter

In this course students will study the neural foundations of higher cognitive functions such as concept formation, language, planning of action, problem solving, emotions and consciousness, with a focus on recent findings and methodological development. Not only do recent findings and methodological achievements shape scientific theory, they also tend to affect therapy as well. We review these new findings while looking for links between normal and pathological functioning. (3 credits)

Psycholinguistics

BMETE47MC36 – 2/0/0/v/3

Dr. Ágnes Lukács

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

Reading Seminar in Psycholinguistics 1, 2, 3

BMETE47MC31, 32, 33 – 2/0/0/v/3

Dr. Anna Babarzcy


Social Cognition

BMETE47MC28 – 2/0/0/v/3

Dr. Szabolcs Kéri


Statistics and Methodology

BMETE92MC20 – 2/0/2/v/5

Dr. Márta Lángné Lázi

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

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

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

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

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

Currently more than 50 PhD students are participating in different individual research programs in different areas of economic and social sciences.

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

Educational and Research Activities

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

Languages, International Studies

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

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

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

Physical Education

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

Farkas Heller Foundation

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

Harvard Business Review

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

Institute of Applied Pedagogy and Psychology
Department of Ergonomics and Psychology
Department of Technical Education

Institute of Economic Sciences
Department of Economics
Department of Environmental Economics

Institute of Social Studies
Department of Philosophy and History of Science
Department of Sociology and Communication

Institute of Business
Department of Management and Corporate Economics
Department of Finance
Department of Business Law

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

Center of Physical Education

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Budapest University of Technology and Economics
Faculty of Economic and Social Sciences
Faculty Office:
Building “Q” wing A, Mezzanine-floor, Room 5.
Mailing Address: Magyar tudósok krt. 2.
H-1111 Budapest, Hungary
Phone: (+36-1) 463-3591
Fax: (+36-1) 463-3590

Dean of the Faculty: Dr. György Andor
Vice-Deans of the Faculty:
Dr. Edit Németh (education)
Dr. Benedek Láng (scientific and international)
Dr. Gábor Bóta (finance)
Dr. Zsuzsanna Eszter Tóth (quality management)
Forms of Training (in Hungarian)

**BSc/BA training in the two-cycle system**

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

Full-time Bachelor programs
- Business Administration and Management
- International Business Economics
- Finance and Accounting
- Communication and Media Science
- Engineering Management

Part-time Bachelor program
- Vocational Technical Instruction

**MSc/MA Programs**

Full-time Master programs
- Finance
- Management and Leadership
- Regional and Environmental Economic Studies
- Psychology
- Communication and Media Science
- Engineering Management

Part-time Master programs
- Marketing
- Accountancy
- Master of Business Administration (MBA)
- Teacher of Economics
- Teacher of Engineering

**Postgraduate programs**

- Environmental Management Specialist
- School Management
- Master of Business Administration (MBA) (in Hungarian and also in French)
- Management
- Work and Organizational Psychology
- Translator and Interpreter

Accredited doctorate (Ph.D.) schools
- Business and Management
- History and Philosophy of Science

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

Every year more than 50 courses are offered in English for students from other BME faculties’ full-time programmes and for our part-time international mobility program students (Erasmus, CEEPUS and “Science without Borders”).
Management and Business Economics

BMEGT20A001

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

Quality Management

BMEGT20M002

Spring semester only!

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

Management

BMEGT20MW02

Autumn semester only!

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

Marketing

BMEGT20A048

Autumn semester only!

Learning outcomes: After the course the students will be able to understand the role of marketing in an organization. Students will become familiar with marketing tasks, tools and strategies. Through practical work students will be able to elaborate certain marketing topics using the knowledge acquired during lectures.


Micro- and Macroeconomics

BMEGT30A001


History of Economic Thought

BMEGT30N001

Spring semester only!

The subject’s main goal is to give an introduction into the evolution of economic thinking. Beginning with the ideas of ancient Greek philosophers about economic and social life and following on from Thomas Aquinas’ scholasticism, the course turns to the theories and practice of mercantilism. The study of pre-classical Scottish philosophers will be the basis for understanding liberal economics and the classical supply-side economics in the 18th century. It will be shown that the development of technology had implied that the demand side became the bottle-neck and thus the foundation of modern micro- and macroeconomics. (2 credits)

Accounting

BMEGT35A002

Autumn semester only!

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

Finance

BMEGT35A001
Spring semester only!

Economic Policy

BMEGT35A003
Autumn semester only!
The objective of the course is to introduce the students to the fundamentals of business-government relations in the environment of modern market economy. Basic theories, schools and ideologies of economic policy as well as their main institutions and institutional participants are discussed. The theory and practice of economic intervention of the government are illustrated by means of cross-sectional analysis for various states and with respect to the specific issues for the stabilization of their economic policies. Special attention is devoted to the economic policy processes of Eastern European countries and to the investigation of dilemmas related to Hungarian economic policy. (2 credits)

Investments

BMEGT35M004
Autumn semester only!
The main topic of this course is fixed income valuation, with a special emphasis on US mortgage backed securities. First, we briefly review the fundamentals of modern portfolio theory, starting from Markowitz’s original model to the foundations of modern multi-factor models. We analyze the Capital Asset Pricing Model, define risk, introduce risk measures and talk about the risk free rate and risk premium. Later, we turn our attention to fixed income instruments. We classify the instruments, and review the most frequent cash-flow structures, then discuss valuation. We define duration and convexity, and the basics of building an index replicating bond portfolio. We go into more details in US agency (prime) mortgage backed pass-through and structured securities. Using MS Excel to model prepayment behaviour, we simulate future interest rates, generate cash-flows of complex structured products and finally use Monte Carlo simulation to calculate modelled price. We define and calculate option adjusted spreads. The second part of the course is quite technical. While not a prerequisite, some background in probability theory, Monte Carlo simulation, interest rate models, and general mathematics is considered an advantage. (2 credits)

Research Methodology

BMEGT41A002
Autumn semester only!
The undergraduate course offers a basic introduction to long-standing issues concerning scientific knowledge and methodology. It examines case studies taken from realistic scenarios and surveys a variety of topics from the standard philosophy of science. The course discusses issues from the point of view of empirical research in various fields as well as from the point of view of epistemology and philosophy. The topics covered give an introduction to core concepts and connect recent contributions that explore contemporary approaches (e.g. recent advances in the philosophy of measurement and modelling). Apart from familiarizing the student with the established theories and key concepts in philosophy of science and methodology, the course also examines the mechanisms that underlie scientific creativity and discusses the ethical responsibilities of scientists and engineers. (2 credits)

Art of Negotiations and Basics of Presentation Techniques

BMEGT41A010-ER
Spring semester only!
The presentation techniques part of the course is designed to give the students some insights into useful presentation techniques that can be used throughout their academic and non-academic career. In the art of negotiations segment of the curriculum we help students to become self-aware and successful negotiators. The basic theoretical foundations of the art of negotiations are also covered (BATNA, competitive arousal etc.). (2 credits)

Logic and Argumentation

BMEGT41A027-ER
The undergraduate course offers a basic introduction to the everyday issues and scientific use of arguments with an introduction to formal and informal methods of analysing arguments. It examines case studies taken from realistic scenarios and surveys a variety of topics from standard logic, argumentation and critical thinking. The course discusses issues from the point of view of argumentation and formal analysis in various fields as well as from the point of view of rhetoric and critical thinking. The topics covered give an introduction to core concepts and connect recent contributions that explore contemporary approaches to analysing everyday discourses and theoretical works. Apart from familiarizing the student with the established theories and key concepts in logic and argumentation theory, the course also provides practical training that enables students to analyse complex arguments with the help of various tools. (2 credits)

EU Environmental and Regional Policy

BMEGT42MN06
Spring semester only!
This course unit aims to introduce the evolution of environmental and regional policies, their strategic elements and changing tools, and their contemporary practices and key policy areas in the European Union. The course will introduce the basics of regional policy; its goals and interrelations with environmental policy, and the practical implica-
The subject aims to present the most important principles of environmental economics, environmental policy and sustainability as well as to show some practical applications. The topics included are: systems and relations of economy, the society and the environment, a historical overview of environmental economics, the concept, levels and different interpretations of sustainable development. Environmental policy from an economic perspective is also discussed: its definition and types, economic and regulatory instruments in environmental protection, their advantages and limitations. Theoretical approaches include the theory of externalities, internalisation of externalities, Pigovian taxation, the Coase theorem, environmental economics in a macroeconomic context, alternative, “green” macro-indicators (NEW, ISEW, GPI), monetary environmental valuation, the concept of total economic value and environmental valuation methods (cost-based methods, hedonic pricing, travel cost method, contingent valuation, benefit transfer). Environmental Policy in Hungary, Introduction to environmental economics. Nature conservation and natural parks. Energy policy: providing a safe and sustainable development strategy, European and Hungarian Sustainable Development Strategy. Sustainable consumption, Corporate Social Responsibility. (4 credits)

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

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

The aim of the subject is to introduce and expand the scope of sustainable energy and resource management both on a domestic, EU and global scale, primarily from the corporate and policy aspects. The course will give an overview of the energetic status and trends in the EU and the world. It will give an introduction to Energetic Life Cycle Analysis. Business model of energetics and energy enterprises. EU energy policy, environmental and sustainability strategies. Energy strategies and energy-saving programmes. A Sustainability analysis of the environmental effects of the different kinds of sources of energy. Energetic interrelations in climate protection. Pollutions from energetic sources in Hungary and the EU. State institutions of energy and environmental protection policy. Summary and future perspectives. (2 credits)

The course covers the topics relevant to the protection of environmental compartments, environmental pressures and pollution in a global context. The course introduces the concepts, indicators and tools of environmental protection, and the environmental management systems (EMS) at enterprises and other organizations. EMS topics include the assessment of environmental aspects and impacts, environmental audits, reporting, environmental performance evaluation, life cycle assessment. (3 credits)

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

**BMEGT42MN03**

*Spring semester only!*

The course unit aims to give an overview of the sectoral aspects and particularities of the transition to sustainable development. Students are introduced to the concept of sustainable development and the basics of environmental evaluations. They are then introduced to the horizontal strategies and policies of sustainable development. To conclude, students will learn about the sustainability strategies in various economic sectors. (5 credits)

Sectoral Sustainability Studies

**BMEGT42N004**

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

Sociology

**BMEGT43A002**

This course will give students an introduction into sociology by discussing a subject that concerns all of us: the global financial crisis and the ensuing Great Recession (or Slump). The course offers fundamentals for students interested in the social changes brought about in contemporary societies, and provides expertise on the social conditions and consequences of scientific and economic activities that may be taken advantage of in the fields of economics and engineering. (2 credits)

Philosophy of Art

**BMEGT43A186**

The course will introduce students into some major issues and problems in aesthetics and the philosophy of art. We will study a number of philosophical questions about the nature, the production, the interpretation and the appreciation of works of art. After studying the basic philosophical categories concerning art and artworks we will concentrate on specific aspects of the creation and appreciation of paintings, drawings, photographs, moving images, digital images, fictions, music etc. For instance, we will consider questions and arguments about “realism” with respect to pictorial works of art, about literature and fictional works, and about the understanding and appreciation of music. Although most of the course will be devoted to the analytic philosophy art, we will also examine issues concerning design practices and products. (5 credits)

Interdisciplinary Research in Communication Studies

**BMEGT43M100**

*Autumn semester only!*

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

Introduction to critical cultural studies

**BMEGT43M410**

*Autumn semester only!*

Cultural research developed at the intersection of a number of different disciplines and theoretical traditions through history. The objective of the course is to introduce these theoretical, conceptual roots and some of the current approaches through the discussion of current cultural phenomena. Following the schedule of the class, first we will discuss the notion of culture and its place in the academic discourse. After the introduction we will look into some of the most prevalent and important contemporary cultural issues, interpreting them with the help of research articles and other readings. (3 credits)

European politics

**BMEGT43MN20**

*Spring semester only!*

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

Comparative country studies

**BMEGT43A141**

*Autumn semester only!*

The main focus of the course is culture, what kind of effect it has on civilizations, societies and economies of past and present. There will be three major topics, such as “food & traditions; water, energy & scarcity of resources; people, environment & cities”, which represent the most challenging areas of development in the 21st century. Under these umbrella topics, we attempt to explore and compare the culture and life of many continents and regions of the world. (5 credits)
Sociology for Architects

BMEGT43A044

Spring semester only! Important note: for Architects and Civil Engineers only

The course will be presented for foreign students of the Faculty of Architecture. The aim of the course is to analyse the social context of urban development and the social implications of spatial problems. We will treat the main problems of urban sociology: e.g. architecture of cities, traffic, congestion, experience of urban life, the behaviour of inhabitants, housing, planning of cities, etc. Urban sociology examines the social aspects of urban life: planning improvement of life in cities, urban forms and structures, histories of urban growth, biological or ecological basis of urban behaviour, quality of the urban experience, etc. We will analyse the anonymity, unpredictability and uncertainty of events, senses of possibility and danger induced by cities. Some of the main questions are: How is urban life affected by the features of local social structure? How do informal social bonds develop? How can the history of urbanisation be explained? What are the basic features of the spatial structure of cities? During this semester we will analyse how the interacting mechanisms of capitalism and modernity constitute differential urban experiences. We provide a brief history of urban sociology, mostly focusing on the results of the Chicago Schools, while also exploring other economic and sociological theories of urban development and declination.

Pedagogy-Digital Pedagogy

BMEGT51A001


History of Education and Technologies of Communication

BMEGT51A017


(Lifelong) Learning and Working Life

BMEGT51A020

Emphasizing the development of independent problem-identifying and problem-solving skills by analyzing Hungarian and European labour market challenges. In the framework of optional exercises and self-controlled learning processes and by acquiring the steps of program planning concentrating on the field of technology, training orientation possibilities are granted to participants in their fields of interest. During the training period we will present the practical applicability and large scale practice orientation through theoretical knowledge, wide-range technological examples, case-studies and the analysis of changes. The participants of the course will gain the necessary knowl-
Ergonomics

**BMEGT52A001**

*Autumn semester only!*

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

**Psychology**

**BMEGT52A002**

*Spring semester only!*


**Fashion, advertising & psychology**

**BMEGT52V100**

*Autumn semester only!*

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

**Business Law**

**BMEGT55A001**

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

**Hungarian Culture**

**BMEGT658361**

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

**Beginners’ Hungarian Course**

**BMEGT658151**

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

BMEGT658152

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

English and other language subjects offered for Erasmus students

(Language) for Engineers

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

The course is designed to meet the language needs of students in academic and professional fields. Special emphasis is on understanding complex technical texts, as well as producing clear paragraphs and essays on certain technical topics.

Communication Skills – ..... (language)

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

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

Manager Communication – .... (language)

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

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

Crosscultural Communication – ... (language)

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

This course is designed at an awareness of cultural differences, develop their intercultural competencies. Special emphasis is on verbal and non-verbal communication, language diversity, and socio-cultural factors.

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

BMEGT6*EU

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

Language for Specific Purposes (LSP) – ...

Engineering in (foreign language)

BMEGT6*M*S**

(*characters depend on the language of instruction and ** on the specific field of engineering)

This course is designed to prepare students to be successful in the academic and work environment. It enables students to take part in professional discussions fluently and effectively; to clearly express his/her point of view reasoning logically for or against. Special emphasis is on language functions and specific vocabulary of the students’ specialization.
The Faculty of Transportation Engineering and Vehicle Engineering (KJK) has been training engineers in the fields of transportation and vehicle engineering and logistics since 1951.

The mission of the Faculty of Transportation Engineering is to be the scientific centre for all the technical, logistical, organizational and economic areas related to the transport process and vehicles which are an integral part of the system. All these areas are the basis for research activities based on engineering training and education up to Doctorate level. Within this framework the Faculty can ensure the practical utilization of the knowledge necessary for the development of society.

In order to provide high level education the Faculty provides 3 basic specifications (BSc):
- BSc in Transportation Engineering,
- BSc in Vehicle Engineering,
- BSc in Logistics Engineering,

With adequate BSc qualification certified engineering qualification can be obtained in the master training specialties (MSc). All the fundamental and complementary educations continued at the Faculty are carried out in accordance with the rules of the ECTS (European Credit Transfer System). The second stage of the training courses contains also 3 specialties in master training (MSc):
- vehicle engineering master specialty,
- transportation engineering master specialty,
- logistics engineering master specialty.

Departments:

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

BSc in Transportation Engineering
Length of study: 7 semesters

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


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

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

BSc in Logistics Engineering
Length of study: 7 semesters

Program objectives: The education of logistics engineers, who are able to analyse, organise and manage the logistics processes and systems related to the material and information flow (transportation, material handling, storage, commission, loading, acquisition, distribution, recycling) inside and outside of enterprises, and further, to solve the basic tasks of engineering; concerning their design, development, manufacturing and repair. They can perform special missions with emphasized regard to transport safety, environment protection and energy planning. Possessing the obtained knowledge, the BSc graduated vehicle and mobile-machinery engineers will be able to continue the studies in the second cycle of engineering education (leading to an MSc degree).

Specialisations: Logistic processes, Technical logistics, Shipping logistics

Competencies and skills: Possessing the basic certificate, the logistics engineers - taking into consideration also the prospective specialisations - become able:
• to define the equipment necessary to realize logistics systems and processes,
• to organize, arrange, control logistics systems in a safe and environmentally-friendly way,
• to perform the basic engineering tasks related to the design, manufacture and repair, as well as the organization of material handling machines,
• to provide and organize the official work related to the installation and operation of logistics machinery.

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

### Description of MSc training

#### MSc in Transportation Engineering

**Length of study:** 4 semesters

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

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

- to recognise connections between systems and processes of transportation, to evaluate and to handle them in the framework of system theory, as well as to apply the related principles and methods,
- connected with the specialization selected, to carry out state assessments, to develop, design, organise and control complex transportation systems.

Basic specialization accepted to the input without any conditions:

- basic specialization of transportation engineering

Basic specializations accepted to the input under given conditions:

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

#### MSc in Vehicle Engineering

**Length of study:** 4 semesters

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

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

- to integrate a system oriented and process analysing way of thinking directed on vehicles and mobile-machinery, having a role in transportation processes,
connected with the specialization selected, to carry out assessments, to develop, design, organise and control complex systems of vehicle technology.

Basic specialization accepted to the input without any conditions:
- basic specialization of transportation engineering

Basic specialization accepted to the input under given conditions:
- mechanical engineering;
- mechatronics engineering;
- military staff, and safety technology engineering;
- agricultural and food industrial engineering;
- engineering informatics.

**MSc in Logistics Engineering**

**Length of study:** 4 semesters

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

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

Basic specialization accepted to the input without any conditions:
- basic specialization of transportation engineering

Basic specialization accepted to the input under given conditions:
- mechanical engineering;
- mechatronics engineering;
- military staff, and safety technology engineering;
- agricultural and food industrial engineering;
- engineering informatics;
- light industry engineering.

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

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**Description of the Doctoral training**

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

The name of the predecessor Doctoral Program was “Vehicles and Mobile Machines”, the head of the predecessor program was Prof. Pál Michelberger, full member of the Hungarian Academy of Sciences (HAS), from 1994 until 2001. From 2014 Prof. József Bokor, Doctor of the HAS is the head of the Doctoral School.
Description of M.Sc. Subjects
Master Section in Logistics Engineering

Engineering mathematics

BMEKOVM101
Dr. József Rohács

Control theory

BMEKOKAM102
Dr. Péter Gáspár
The course introduces the results of modern control theory and their application, on a level, which can be used in design problems during engineering practice. Besides introduction of theory it also improves the skills of students in the use of CAD tools. Both theory and its applications are introduced using examples from intelligent traffic control systems and vehicle control. This well satisfies the needs of both transportation and mechanical engineers.

Electronics - electronic measurement systems

BMEKOKAM103
Dr. István Hrivnák
It provides engineer’s view of basic knowledge of the rudiments, quantities and possibilities of electronics and electronic measuring systems and their application in the traffic systems. It makes the students acquainted with the essential elements, functional principles, view of devising and adoption of electronics and measuring techniques. It sums up the measuring methods of different electric and mechanical quantities and possibilities of processing their results. It illustrates the employment by different examples of branches in transport.

I+C technologies

BMEKOKAM104
Balázs Sághy
The principle of up-to-date computers, their general and especially at traffic applied functions. Functional description of microcomputers. Integrated circuit technology. Generally and especially at transport used communication and data transfer methods.

System technique - system modelling

BMEKOVM108
Dr. István Zobory

Advanced materials and technologies

BMEKOJM107
Dr. Krisztián Bán
Gives intense knowledge to the MSc students from the field of material structures, production and analysis techniques, and enables the students to understand and work on research and development tasks.

Decision making methods

BMEKOKGM110
Dr. Zoltán Békefi
Demonstration of methods and techniques in identifying, modelling and solving problems of making decisions for an MSc graduated engineer in practical adaptation. Elaborating practical examples to illustrate their application in transport sector.

Project management

BMEKOKGM111
Zoltán Nagy
Exposition of preparing, design, constructing and monitoring infrastructure and toolkit investment and development projects in the transport sector. Demonstrating methodology of public procurement proceedings and rules, condition for calls, preparation and evaluation of application and basis of quality management.

Informatics in logistics

BMEKOKUM301
Dr. Jenő Tokody
Introduce the students in Course of Logistics Processes of Logistics Engineering to the up to date processes of logistics information technologies in the fields of identification and navigation systems, e-business, geographic information systems (GIS), enterprise resource planning systems (ERP) and simulation technologies.

Decision making methods

BMEKOKGM110
Dr. Zoltán Békefi
Demonstration of methods and techniques in identifying, modelling and solving problems of making decisions for an MSc graduated engineer in practical adaptation. Elaborating practical examples to illustrate their application in transport sector.

Planning of material handling and warehouse systems I.

BMEKOKUM302
András Bakos
Introduce the students of Logistics Engineering to the processes of method for planning and modelling of material handling systems inside the enterprises.

Planning of material handling and warehouse systems II.

BMEKOKUM303
Dr. Kristófi Bóna
Introduce the students of Logistics Engineering to a process of method for planning of warehousing and material handling systems.
Logistics machine, equipment, robotics
BMEKOEAM304
Dr. Gábor Bohács
Dimensioning questions of automated cranes: modeling, positioning, drive system structuring, sensors, localizing load swings for long and short rope lengths. Load transfer to fixed and moving positions (container handling etc.). Dimensioning questions for automated roller conveyors, overhead conveyors and monorail systems. Use of automated technologies, speed regulation. Dimensioning of automated warehousing equipment (loading and unloading, order picking); modeling, position determination for various drive systems. Localizing mast swings for reach stackers. Robots in the automated logistic system, mobile robots.

Control and automation of logistic systems
BMEKOEAM305
Dániel Gáspár

Database systems in logistics
BMEKOAM306
Dr. Jenő Tokody

Planning of logistic processes
BMEKOKUM307
Dr. Krisztián Bóna
Introduce the students in Course of Logistics Processes of Logistics Engineering to the general planning and analysis of logistics processes, partly global optimization of plant, layout inside the enterprises and computer aided transport optimization.

Enterprise logistics
BMEKOKUM308
Dr. Krisztián Bóna
Introduce the students in Course of Logistics Processes of Logistics Engineering to the enterprise logistics processes and methods for planning, organization and analysis of supply chain and set models, moreover software solutions implemented for planning and control of production logistics.

Production logistics - production planning
BMEKOEAM309
Dr. Krisztián Bóna
Basic problem statements of production planning systems. Demand oriented product planning and it’s various models.

Strategic questions of production planning. Infrastructure planning. Elements of operative production and production program planning. MRP I and MRP II systems. Planning of materials handling and warehousing systems. Features of push and pull type production planning systems.

Operation of Logistics Systems
BMEKOKGM310
Dr. Zoltán Bokor
Elaboration and application of operative and strategic controlling based decision support models for planning and monitoring technology and management processes in the field of logistics and freight transport.

Data communication systems
BMEKOEAM311
Dániel Gáspár
General principles of network control systems. ISO OSI reference model’s layer services. Multilevel control architectures, protocols. Problems of network connection of PLC’s at the low control level, hardware and setting. Communication protocols in production systems (PROFIBUS, CAN-Bus). Possibilities for network programming with the PLC’s programming software in Master-Slave connection, using the RS-232/RS-485 ports and ADAM Interfaces. Automatic protocol, settings and memory addresses of OMRON PLCs type CQM1, C200HS, CJ1M. Host-Link protocol of OMRON control units. Protocol’s structure, control of writing and reading of data. Host-link protocol among an OMRON CQM1 (master) and two OMRON CQM1 (slave) PLCs. Structure of protocols for multi-PLC networks. Control of data writing and reading. Creating a common network of PC’s and PLC’s, settings and software. Visualization, operation of visualizing software. Communication to barcode subsystems, TCP/IP communication modes. Connection of network database systems and PLC’s.

Materials handling in flexible manufacturing systems
BMEKOEAM312
Dr. Gábor Bohács

Machine intelligence
BMEKOEAM313
Dr. Gábor Bohács
Robots and applications
BMEKOAM314
Zsolt Győrváry

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

Engineering mathematics
BMEKOVM101
Dr. József Rohács

Control theory
BMEKOKAM102
Dr. Péter Gáspár
The course introduces the results of modern control theory and their application, on a level, which can be used in design problems during engineering practice. Besides introduction of theory it also improves the skills of students in the use of CAD tools. Both theory and its applications are introduced using examples from intelligent traffic control systems and vehicle control. This well satisfies the needs of both transportation and mechanical engineers.

Electronics - electronic measurement systems
BMEKOKAM103
Dr. István Hrivnák
It provides engineer’s view of basic knowledge of the rudiments, quantities and possibilities of electronics and electronic measuring systems and their application in the traffic systems. It makes the students acquainted with the essential elements, functional principles, view of devising and adoption of electronics and measuring techniques. It sums up the measuring methods of different electric and mechanical quantities and possibilities of processing their results. It illustrates the employment by different examples of branches in transport.

System technique and analysis
BMEKOKAM109
Dr. Vilmos Zoller

Mechanics I
BMEKOJKM106
Dr. Dezső Szöke
Theory of mechanical procedures used in FEM and MBS systems. Practical applications.

Advanced materials and technologies
BMEKOJMJ107
Dr. Krisztián Bán
Gives intense knowledge to the MSc students from the field of material structures, production and analysis techniques, and enables the students to understand and work on research and development tasks.

Decision making methods
BMEKOKGM110
Dr. Zoltán Békefi
Demonstration of methods and techniques in identifying, modelling and solving problems of making decisions for an MSc graduated engineer in practical adaptation. Elaborating practical examples to illustrate their application in transport sector.
Integrated quality management systems  
*BMEKOGJM112*

Dr. Zsolt Stukovszky

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

Computer aided conception, dimensioning and manufacturing  
*BMEKOJHM401*

Dr. János Máraligeti

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

Vehicle operation, reliability and diagnostics  
*BMEKOVJM402*

Dr. Teofil Benedek

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

Materials flow and technical logistics  
*BMEKEOAM403*

Dr. Gábor Bohács


Mechatronics, robotics and microcomputers  
*BMEKOKAM404*

Zsolt Győrváry

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

Vehicle body structures  
*BMEKOJKM405*

Dezső Szőke

Analysis methods of vehicle body structures.

Vehicle engines and transmission systems  
*BMEKORHM406*

Dr. Árpád Veress

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

Design and testing of railway vehicle systems  
*BMEKOVJM407*

Dr. András Szabó


Railway vehicle system dynamics  
*BMEKOVJM408*

Dr. Zoltán Zabó


Operation of railway vehicles  
*BMEKOVJM409*

Dr. Albert Győrik

Diesel and electric traction

**BMEKOVJM410**

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

Engine design

**BMEKOGJM411**

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

Transmission system design and vehicle mechanics

**BMEKOGJM412**

Dr. Gergely Bóka
Introducing the mechanics of vehicle motion along with modern procedures of geometric design, stress analysis, fluid and thermo-dynamical calculation of components of vehicle transmission systems.

Suspension design and vehicle dynamics

**BMEKOGJM413**

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

Vehicle construction and design, road safety

**BMEKOGJM414**

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

Design and testing of ships

**BMEKORHM415**

Dr. Győző Simongáti

Theory and propulsion of ships III.

**BMEKORHM416**

Dr. Győző Simongáti

Manufacturing and operation of ships

**BMEKORHM417**

László Csaba Hargitai

Construction of ships

**BMEKORHM418**

László Csaba Hargitai

Design and testing of aircrafts

**BMEKORHM419**

Dr. Balázs Gáti

Flight theory

**BMEKORHM420**

István Róbert Jankovics

Theory of aircraft engines

**BMEKORHM421**

Károly Tamás Beneda
Dynamics of logistical machines

Dr. István Keisz


Mobile hydrostatic system

Dr. Antal Balpataki


Design of concrete technology’s machinery

Dr. Kornélia Rácz

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

Construction processes

Dr. Péter Mészáros

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

Theory of material handling machine design

Boglárka Odonics


Network control systems of material handling

Dániel Gáspár

General principles of network control systems. ISO OSI reference model’s layer services. Multilevel control architectures, protocols. Problems of network connection of PLC-s at the low control level, hardware and setting. Communication protocols in production systems (PROFIBUS, CAN-Bus). Possibilities for network programming with the PLC’s programming software in Master-Slave connection, using the RS-232/RS-485 ports and ADAM Interfaces. Automatic protocol, settings and memory addresses of OMRON PLCs type CQM1,C200HS,CJ1M. Host-link protocol of OMRON control units. Protocol’s structure, control of writing and reading of data. Host-link protocol among an OMRON CQM1 (master) and two OMRON CQM1 (slave) PLCs. Structure of protocols for multi-PLC networks. Control of data writing and reading. Creating a common network of PC’s and PLCs, settings and software. Visualization, operation of visualizing software. Communication to barcode subsystems. TCP/IP communication modes. Connection of network database systems and PLC’s.

Mechatronics

Zsolt Győrváry


Automated materials handling systems

Dr. Gábor Bohács

Measuring system in the vehicle manufacturing

**BMEKOJM431**

Dr. Tamás Markovits

Gives modern approach in the field of coordinate measuring technique and dynamic process analysis.

Vehicle manufacturing systems

**BMEKOJM432**

Dr. János Takács

This subject enables the students to develop and design vehicles and components production systems.

Surface engineering

**BMEKOJM433**

Dr. János Takács

This subject gives developer's level skills in the field of state of the art surface technologies and surface analysis.

Typical vehicle-production technologies

**BMEKOJM434**

Zoltán József Pál

This subject deals with the production and assembly technologies of the most relevant vehicle components.

Measurement techniques and signal processing in vehicles

**BMEKOKAM435**

Dr. Alexandros Soumelidis

This course intends to give basic knowledge in measurement and analysis techniques that are used in acquiring knowledge of the operation of vehicles; gives introduction into the principles, methods, and typical realizations of sensing, measurements, data and signal processing processes, as well as in the detection, cognition, feature extraction, decision and control techniques based upon them, crucial in the control field concerning both individual vehicles, vehicle groups, and the transport flow.

Vehicle system dynamics and control

**BMEKOVM436**

Dr. Péter Gáspár

Dynamical models apt for the analysis of the fundamental motion of vehicles, interconnected strings of vehicles and traffic flows. Non-linear dynamical model of the force transfer through rolling contacts taking into consideration also the presence of tribological stochasticities. Generation of the motion equations of lumped parameter vehicle systems models capable for vibrations. Excitation sources. The set of ordinary stochastic differential equations of the lumped parameter system. Generation of the set of motion equations of distributed parameter vehicle system models. The set of partial differential equations describing the motion processes evolving in the distributed parameter vehicle dynamical system. The vehicle dynamical system as a controlled object. Formulation of characteristic tasks of vehicle control, explanation of the control signals applied. Analysis and synthesis problems in the application fields of vehicle dynamics and control. Formulation of model based vehicle control systems. Methods for designing vehicle control systems. Fault detection in vehicle control systems. Designing of failure-tolerant and re-configurable vehicle control systems. Designing of integrated control- and inspection control systems. Case studies on controlled vehicle dynamical systems.

Vehicle system informatics

**BMEKOVM437**

Dr. Ferenc Kolonits

Deepening of the knowledge of the students in computing and data representation. Structure of the relation type and document-based data-bases, which contain the characteristics of the vehicle structures and operation properties in a comprehensive way. Systems of document treatment. Methods of generating complicated data-bases for the structure identification and description of vehicles and mobile machines. Computer based gathering and registration of sequential operational events (e.g. failures, repair, change of components, etc.). Elaboration computer algorithms and programs necessary for the vehicle reliability evaluations and the control of reliability centred maintenance.

Vehicle simulation and optimisation

**BMEKOVM438**

Dr. Vilmos Zoller


Road safety, accident reconstruction

**BMEKOJM439**

Dr. Gábor Melegh

The basic and general aim of this science specific subject is to grant students graduating in transportation or mechanical engineering a deeper insight into vehicle utilization, operation, maintenance, repair in order to apply it in case of traffic accidents or different litigations. Because of the feature and the number of lectures of the subject the theoretic and practical parts are not strictly isolated. Theoretical procedures are also introduced in practical lectures and on the contrary, calculations are also likely take place in lectures.

Vehicle evaluation, traffic environment, human factors

**BMEKOJM440**

Dr. Gábor Melegh

The basic and general aim of vehicle evaluation is to grant the students graduated in transportation or mechanical engineering a deeper insight into vehicle evaluation, loss assessment and evaluation of reparation. Influence and effects of human factors.
Dynamics of vehicle
BMEKOGJM441
Dr. László Palkovics
The subject introduces the motion circumstances of a whole vehicle, the stability criteria and dynamical conditions along with typical parameters of each vehicle system (transmission, running gear, braking, steering) deriving from requirements of traffic safety.

Motor vehicle measurements
BMEKOGJM442
Dr. Gábor Melegh
Acquiring modern theoretical and practical methods of instrumental vehicle measurements. Introduction and application of modern gauging instruments, analyzing devices and measurement methods.

Design of alternative vehicle drive systems
BMEKOGJM443
Dr. Zsolt Stukovszky
The subject gives an insight into the design and measurement of non-traditional operating internal combustion engines and other applicable energy converters (e.g. fuel cell) in vehicles.

Control of hybrid vehicle systems
BMEKOGJM444
Dr. László Palkovics
The subject introduces the complex control strategy of hybrid vehicle driving systems, focusing on the optimum of energy utilization and vehicle drivability.

Dynamics of electro-hybrid vehicles
BMEKOGJM445
Dr. László Palkovics
The subject deals with the principles of vehicle dynamics and their application in special vehicle driving systems.

Design of mechatronic components for alternative drive systems
BMEKOGJM446
Dr. Zsolt Szalay
The subject deals with the design and analysis questions of alternative driving, mainly the components of hybrid electrical driving, and makes the students capable of specifying them.

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

Engineering mathematics
BMEKOVJM101
Dr. József Rohács

Control theory
BMEKOKAM102
Dr. Péter Gáspár
The course introduces the results of modern control theory and their application, on a level, which can be used in design problems during engineering practice. Besides introduction of theory it also improves the skills of students in the use of CAD tools. Both theory and its applications are introduced using examples from intelligent traffic control systems and vehicle control. This well satisfies the needs of both transportation and mechanical engineers.

Electronics - electronic measurement systems
BMEKOKAM103
Dr. István Hrivnák
It provides engineer’s view of basic knowledge of the rudiments, quantities and possibilities of electronics and electronic measuring systems and their application in the traffic systems. It makes the students acquainted with the essential elements, functional principles, view of devising and adoption of electronics and measuring techniques. It sums up the measuring methods of different electric and mechanical quantities and possibilities of processing their results. It illustrates the employment by different examples of branches in transport.

I+C technologies
BMEKOKAM104
Dr. Balázs Sághy
The principle of up-to-date computers, their general and especially at traffic applied functions. Functional description of microcomputers. Integrated circuit technology. Generally and especially at transport used communication and data transfer methods.

Mechanics K
BMEKOJKM105
Péter Béda
Mechanical relations of vehicles and vehicle systems.

Advanced materials and technologies
BMEKOJJM107
Dr. Krisztián Bán
Gives intense knowledge to the MSc students from the field of material structures, production and analysis techniques, and enables the students to understand and work on research and development tasks.

Decision making methods
BMEKOKGM110
Dr. Zoltán Békéfi
Demonstration of methods and techniques in identifying, modelling and solving problems of making decisions for an MSc graduated engineer in practical adaptation. Elaborating practical examples to illustrate their application in transport sector.
Project management

**BMEKOKG111**

Zoltán Nagy

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

Transport Economics

**BMEKOKG201**

Dr. Ferenc Mészáros

Demonstration of theoretical relations and techniques for economically efficient, environment friendly and social cohesion sensible statutory in operation of a transport system to support integration of the European Union - focusing on specialities of transport modes and transport of goods and passengers. Review of opportunities for development with concluding (analysing) practical experiences in frame of seminar study.

Transport automation

**BMEKOKA202**

Dr. Balázs Sághy

The aim of the subject is to get acquainted generally with safety critical automatic traffic control systems with regard to their philosophy, to the methods of definition of safety requirements and that of the justification of safety.

Transport informatics

**BMEKOKU203**

Dr. Csaba Csiszár

The subject is built on the approach and knowledge gained at subjects Transport Informatic Systems I. and II. of the Transportation Engineering B.Sc. education. Its object is the modelling of notions and rules connected to information and information systems. The students adopt these models in the different fields of transportation. The theme of the subject is, how to arrange the information-set according to transport’s basic processes and the transport’s management into a special, working system. The subject’s lectures analyse the common and special features of informatic systems used for railway, road, waterway, and air transportation. The method of analyses is the definition of static and dynamic sections of transport informatics systems, and how to create an optimum working system of managed and managing elements of transportation, using the suitable up-to-date technical solutions.

Traffic Flow

**BMEKOKU204**

Tamás Dévid Soltész

Analysing, modelling and planning of traffic flow on road transportation network, in consideration of passenger and goods transport. Intelligent Transport Systems

BMEKOKU205 Dr. János Tóth

Familiarization with types of Intelligent Transport Systems and their components. Introduction with the fields of application of the Geographical Information Systems. The students acquire the knowledge of planning, choosing and operating of ITS and GIS systems.

Transport operation

**BMEKOKU206**

Dr. Péter Mándoki

Knowledge acquisition about planning, organizing and optimal developing of Transport operation process.

Logistics

**BMEKOKU207**

Dr. Gábor Kovács

Introduce the students in Course of Transport Systems of Transportation Engineering to the processes of enterprise purchasing and distribution system’s purposes, to the enterprise material handling and warehousing processes, to the set models, moreover to the material handling between the factories, and to the computer aided transport organisation.

Passenger transport

**BMEKOKU208**

Dr. Csaba Csiszár


Transport modelling

**BMEKOKU209**

Dr. János Tóth

Familiarization with practical usage of methods of transport network planning. Introduction of theoretical background of international software (VISUM, EMME/2), and the practical usage of software.

Environmental effects of transport

**BMEKOKU210**

Dr. János Juhász

Survey of development and operation opportunities of transport systems, due to sustainability concepts.

Signal processing in transport

**BMEKOKA211**

Dr. Károly Gyenes

The structure, the planning and programming of microcontroller families, used at the transport. Interfacing of the input-output signals to the analog signals of difference vehicles. The most popular methods of signal coding.

Information connection of the vehicle and the track

**BMEKOKA212**

Géza Szabó

The subject gives an overview on the information transmission methods used between the track side elements and the vehicles in different transportation areas. It summarizes the technologies and traffic control methods using the above mentioned transmissions.

Modelling and control of vehicles and traffic systems

**BMEKOKA213**

Dr. Balázs Sághy

The knowledge included by the subject should give high standard theoretical designing and practical knowledge to the engineers wishing to find employment in this area. It examines model-classes for controlling road, railway and
air transport systems. It deals with macro-simulating programs for modeling transport networks. It makes student acquainted with the possibilities and methods of up-to-date traffic control, with the technical instruments make all this possible, together with the designing process and the guiding principles.

**Engineering of transport automation systems**

**BMEKOKAM214**

Dr. Tamás Tettamanti

The purpose of the subject is to transfer deep and detailed knowledge to develop traffic control systems of different transportation modes. The subject is based on previous studies and aims to widen deepen and acquire engineering skills.

**Controlling systems in transportation**

**BMEKOKGM215**

Ferenc Mészáros

Exposition and promoting national adaptation of technical, legal, economic, fiscal, social and institutional policy for controlling improvement and operation of transport systems in the European Union.

**Financing techniques in transportation**

**BMEKOKGM216**

Dr. Zoltán Bákefi

Financing methods concerning transport system developments and operations. In form of computer practices presenting the theoretical knowledge and apply them by using an own developed software, and analyzing real case studies.

**Management of transport and logistic services**

**BMEKOKGM217**

Zoltán Nagy

Economic, operational and regulatory measures concerning the planning and developing processes of transport and logistic service providers. Theoretical and practical knowledge.

**Human Resource Management in Transportation**

**BMEKOKGM218**

Dr. Botond Kővári

Theory, practice and leading technics of human resource management specialized in transportation on the following levels: individual (micro), company (mezo), economy (macro).
PRE-ENGINEERING COURSE
Pre-Engineering Course

The Budapest University of Technology and Economics (BME) is one of the leading universities in Europe and a member of CESAER (Conference of European Schools for Advanced Engineering Education and Research), with a high admission standard.

The Hungarian secondary schools have very high level final exam in mathematics and physics, one of the highest in the world, as it has been proved through international competitions. Very often, there is a gap between the Hungarian and foreign students’ secondary school’s education program as far as the preparation for engineering studies are concerned. Many students are not trained enough to solve complex problems.

Therefore the Pre-Engineering Course is designed to help students develop the basic skills necessary to successfully pursue engineering studies at the Budapest University of Technology and Economics or any other engineering or science-oriented university with high academic standards.

The program lasts one academic year and offers intensive instruction in mathematics, physics, and English language. In addition, students are introduced to conceptual approaches in engineering.

New students at the Budapest University of Technology and Economics take a required Placement Test on the week before the academic year starts (see the Academic Calendar). Based on the results of this test, students will either be accepted into the first semester of the undergraduate program (BSc), or will be instructed to the Pre-Engineering Course prior to the undergraduate program.

Students who think they would benefit from the profound preparation of the Pre-Engineering Course may simply register for the Pre-Engineering Course (without taking the Placement Test).

Exams are given at the end of each semester of the Pre-Engineering Course. Students who achieve at least good results at the end of the second semester can begin their first year engineering studies at the Budapest University of Technology and Economics without taking the Placement Test.

Students who will not continue their studies at the Budapest University of Technology and Economics can take any of the individual subjects on a credit basis. Acceptance of the credits depends on the student’s home institution.
Description of Subjects

Description of 1st Semester Subjects
(Fall)

Introductory Physics I

Mechanics


Electricity


Introductory Mathematics I

Algebra


Geometry

Elements of geometry: circumference and area of geometric figures, surface area and volume of geometrical solids. Right triangle trigonometry. Law of cosines and sines. To solve a triangle. Trigonometric identities, equations. 4 hours/week. Compulsory English for Pre-Eng. Students I.

(0 credit)

Description of 2nd Semester Subjects
(Spring)

Introductory Physics II

Vibration, Waves, and Thermodynamics


Optics and Atomic Physics

Optics: fundamental concepts of optics; reflexion, refraction, dispersion of light; coherence of light; light as electromagnetic wave; interference, diffraction, polarization; holograms. Atomic physics: photoelectric effect; wave particle duality; hydrogen atom model. 2 hours of lectures with demonstrational experiments and problem solving practice 4 hours/week.

Introductory Mathematics II

Algebra


Geometry

Coordinate system. Distance and midpoint formula. To sketch a graph. Equations of a line. The circle. Quadratic functions and parabolas. Ellipse and Hyperbola. Trigonometric functions. Complex numbers. Complex algebra. 4 hours/week.

Computer Algebra

Compulsory English for Pre-Eng. Students

(0 credit)

Elective subjects (2nd Semester)

Computing

General informations about computers and peripheral devices. Algorithms and programs. PASCAL Programming Language. 2 hours/week.

Engineering Drawing

Rules and conventions of engineering drawing. Descriptive geometry. 2 hours/week.

Advanced Algebra

Workshop
Excursions - Hortobágy
Excursions - Sopron
Graduation Speech

“Do not go where the path may lead, go instead where there is no path and leave a trail”

I am most honored to be called amongst many to give this speech on this special occasion. I stand here today to reinforce character and vision.

I started by grace and have finished by grace, and I thank God, my parents, my lecturers, my fellow graduating students, and of course you sited here as well as my friends, for this rare opportunity to stand before you. Have you ever sat in your mums chair at her office, and in her absence you had to sign the collection of a letter (your admission letter) which was delivered to her, and yet you did not know it was your admission letter to school abroad, I guess not, but that was me signing the collection of that letter more than four years ago.

Leaving your mother land to a foreign land to be educated should not be done without vision/dream. Four and half years ago I could have fallen prey to the lack of vision, stepping my feet into Hungary and listening to those who at the time had no vision telling me to be comfortable with the poorest of academic grades, and I thought to myself if the reason for being educated in this institution is to fall short of my expectations then I could have as well been home schooled, I decided not to speak with poor minds on serious issues for I had vision.

This group of graduates has been strong, tough and thriving, having clearer vision by the day, walking with any of them would leave a lesson of hard work and the ability to bend due to tough academic work and yet not be bent. Budapest University of Technology and Economics in my short experience is not a place for poor minds so I urge you to be visionaries if you must take the world by storm.

We are here today to celebrate the end of a very significant phase in life and the beginning of the next most important phase of a new life outside school. The world has been waiting for us and we are now ready for them. I believe that the lessons learnt here at BME, from the accomplishments/successes, failures and studies, means we now posses the skills to learn, aptitude to succeed, ability and creativity to make a difference, to work to meet world needs and to assist in solving the problems facing the society at large. Knowledge as we know is power and it is gotten from education, although it might seem expensive but it, for ignorance is more expensive. This school has taught us the elements of character and vision, on this note I want to encourage all students to show character, have vision and pursue it, and if an opportunity of success has not knocked on your door build a door and keep in mind that neither success nor failure is final keep succeeding.

To accomplish great things today and in the future, we must not only dream, but also act, and not just act but plan and believe in our dreams and vision, for “the future belongs to those who believe in the beauty of their dream”, and “I hope your dreams take you to the corners of your smile, to the highest of your hopes, to the windows of your opportunities and to the most special places your heart has ever known”.

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Courses and Doctorate schools at BME

We offer undergraduate & PhD courses in:

- Architecture
- Architectural Engineering
- Civil Engineering
- Chemical Technology
- Electrical Engineering
- Information Technology
- Mechanical Engineering
- Mathematics
- Physics
- Cognitive Science

Doctorate Schools

- Géza Pattantyús-Ábrahám PhD School in Mechanical Engineering
- PhD School in Computer Science and Information Technology
- PhD School in Electrical Engineering
- Kálmán Kandó PhD School in Mechanical Engineering
## 2016/2017 ACADEMIC CALENDAR

### Fall Semester: All accepted Preparatory Beginners

<table>
<thead>
<tr>
<th>Event</th>
<th>Dates</th>
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</thead>
<tbody>
<tr>
<td>Registration in Students' Office, Bldg. R 1.</td>
<td>29 Aug – 9 Sept 2016</td>
</tr>
<tr>
<td>(after payment of tuition fees)</td>
<td></td>
</tr>
<tr>
<td>Appointments for Obligatory Medical Check-up (Necessary for Health Insurance).</td>
<td>29 Aug – 9 Sept 2016</td>
</tr>
<tr>
<td>Preparatory Classes (Math, Physics) for Placement Test</td>
<td>24 – 26 Aug</td>
</tr>
<tr>
<td>Placement Tests: Math (29.08.), Physics (30.08.) and English Language (31.08.)</td>
<td>29 – 31 Aug</td>
</tr>
<tr>
<td>Orientation Program</td>
<td>5 – 9 Sept</td>
</tr>
<tr>
<td>Newly enrolled regular and Exchange Students</td>
<td></td>
</tr>
<tr>
<td>Placement Test Results Posted Outside Student's Office</td>
<td>2 Sept at 12 am</td>
</tr>
<tr>
<td>Presentation of Schedules for Freshmen in Bldg. R 1. Student’s Office</td>
<td>2 Sept at 12 am – 1 pm</td>
</tr>
<tr>
<td>First day of classes</td>
<td>12 Sept at 8:15 am (Monday)</td>
</tr>
<tr>
<td>Opening ceremony</td>
<td>29 Sept (Thursday)</td>
</tr>
<tr>
<td>Last Day of Classes</td>
<td>9 Dec (Friday)</td>
</tr>
<tr>
<td>Examinations in fall semester 2016/2017</td>
<td>19 Dec 2016 – 23 Jan 2017</td>
</tr>
<tr>
<td>Winter Holidays</td>
<td>23 Dec 2016 – 1 Jan 2017</td>
</tr>
</tbody>
</table>

### Fall Semester: BSc/MSc Students

<table>
<thead>
<tr>
<th>Event</th>
<th>Dates</th>
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<tbody>
<tr>
<td>Registration in Student’s Office</td>
<td>22 Aug – 2 Sept 2016</td>
</tr>
<tr>
<td>First Day of Classes</td>
<td>5 Sept 2016</td>
</tr>
<tr>
<td>Last Day of Classes</td>
<td>9 Dec 2016</td>
</tr>
<tr>
<td>Delayed submission</td>
<td>12 Dec 2016 – 16 Dec 2016</td>
</tr>
<tr>
<td>Examination Period (Check with your Faculty!)</td>
<td>19 Dec 2016 – 23 Jan 2017</td>
</tr>
<tr>
<td>Winter Holidays for All Students</td>
<td>23 Dec 2016 – 1 Jan 2017</td>
</tr>
</tbody>
</table>

### Spring Semester: All Students

<table>
<thead>
<tr>
<th>Event</th>
<th>Dates</th>
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</thead>
<tbody>
<tr>
<td>Registration in Students’ Office, Bldg. R 1.</td>
<td>30 Jan - 3 Feb 2017</td>
</tr>
<tr>
<td>Orientation program</td>
<td>Newly enrolled regular and Exchange Students</td>
</tr>
<tr>
<td>First Day of Classes</td>
<td>6 Feb 2017 (Monday)</td>
</tr>
<tr>
<td>Last Day of Classes</td>
<td>12 May 2017 (Friday)</td>
</tr>
<tr>
<td>Delayed submission</td>
<td>15 May – 19 May 2017</td>
</tr>
<tr>
<td>Examination Period (Check with your Faculty!)</td>
<td>22 May – 19 June 2017</td>
</tr>
<tr>
<td>Last Day of Final Exams</td>
<td>30 June 2017</td>
</tr>
</tbody>
</table>

### Days off for All Students

<table>
<thead>
<tr>
<th>Event</th>
<th>Dates</th>
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<tbody>
<tr>
<td>Sports day</td>
<td>14 Sept 2016 (Wednesday)</td>
</tr>
<tr>
<td>Students’ Sci. Con.</td>
<td>17 Nov 2016 (Thursday)</td>
</tr>
<tr>
<td>Open Day</td>
<td>25 Nov 2015 (Friday)</td>
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Entering Budapest University of Technology and Economics - Study in the European Union

Administration Block A
Fluid Mechanics Building Ae
Chemistry Building Ch
Mechanical Engineering Building D
Building Construction Laboratory El
Physics Building F
Production Engineering Building G
Informatics Buildings I, Q
Vehicle Engineering Building J
Central Building K
Central Library Kö
Hydraulic Machinery Laboratory L
Mechanics Building Mm/Mg
Mechanical Technology Building Mt
Classrooms R, T, H, E
Electrical Engineering and Informatics Buildings St, V1, V2
Nuclear Training Reactor TR
Office of International Education, Central Academic Office: R

Budapest

Infopark