Mechanical Engineering Modelling

Responsible: Prof. Dr. Gábor Stépán

BULLETIN
2nd semester of the 2013/2014. academic year
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1. FOREWORD

The Budapest University of Technology and Economics Faculty of Mechanical Engineering has educated engineers since 1871.

In 2005, according to the objectives of the European Higher Education Area, the Faculty of Mechanical Engineering introduced four Bachelor of Science (B.Sc.) programs. These four programs are the following: mechanical engineering, energetics engineering, mechatronics engineering and industrial design engineering. These programs are seven semesters long.

The Master of Science (M.Sc.) programs offered at The Budapest University of Technology and Economics (BME) are not restricted to those who received their B.Sc. diplomas in engineering at BME. These programs are open to all students who receive diplomas in mechanical engineering, mechatronics engineering or transportation engineering at any of the Hungarian or foreign institutions of higher education. The entrance requirements of the programs have been defined in a way which also allows someone having a B.Sc. in another engineering area, physics, mathematics or computer science to join the M.Sc. programs while fulfilling a few additional requirements.

I hope and believe that by partaking in these programs you will become engineers who are able to fully live up to the expectations of the late BME professor Géza Á. Pattantyús, who stated:

“In order to responsibly practice as a professional engineer, you not only need to have specialized knowledge, but also need to be well rounded, have strength of character, have ethical values and be responsible.”

I wish you all good health and the willpower to succeed in your studies.

Dr. Tibor Czigány
Dean
2. THE MECHANICAL ENGINEERING MODELLING PROGRAM AND THE MECHANICAL ENGINEERING PROFESSION

For years the Hungarian machine industry and machine manufacturing industry have grown at rates many times greater than Hungary’s own economic growth. The boost of the export market has played a key factor in this growth, as the machine industry makes up a dominant part of Hungary’s export market.

The classical 5 year mechanical engineering programs offered at BME always offered specialization opportunities geared toward research and development, putting emphasis on applying the newest theoretical, experimental and computational techniques in those areas of mechanical engineering which required a deep understanding of mathematics, solid and fluid mechanics, thermodynamics, computer science or electronics.

In the 1990-s, while the structure and ownership of the Hungarian industries were changing, a reduction in the percentage of mechanical engineers working in design, development and research was detected, while an increase in the percentage working in operations, servicing, sales and software development accompanied this change. At the same time, there were signs of certain western European companies establishing design and development divisions in Hungary, as well as hiring young Hungarian engineers temporarily, who would then return to Hungary in order to set up small divisions and institutions. These groups have expressed a need for engineers specializing in mechanical engineering modelling, who are able to use complex software packages used in development work and who understand the theoretical backgrounds on which these software packages are based, while also requiring that they be able to communicate, research the available literature and complete their everyday tasks in English.

According to a survey conducted by the Hungarian Institute for Economic and Enterprise Research in 2008, the Faculty of Mechanical Engineering of the Budapest University of Technology and Economics is the most prestigious engineering institution of higher education in Hungary today [www.gvi.hu]. A good measure of the international acknowledgement of a mechanical engineering diploma from BME is the number of alumni who now work internationally and the increase in the number of western European and American students choosing to study abroad at BME or even completing an entire program of study here. There is a continuous stream of students arriving from all corners of the world. It can therefore be said that, due to its interdisciplinary character and English courses, this program offers an ideal opportunity to distinguished guest lecturers and foreign students.
3. THE TWO CYCLE EDUCATIONAL SYSTEM

Today, we hear more and more about the formation of a “European Higher Education Area”. The plan is to accomplish this according to the necessary procedures and changes written down in the “Bologna Declaration”, which is referred to as the Bologna Process. One of the goals which are laid down in this declaration is the introduction of a multi cycle educational system, which will be used in order to compare and accept diplomas from different institutions of higher education.

Hungary has joined this process. Most of the higher education institutions of technology introduced the two cycle educational system in 2005, and many aspects formerly associated with the structure of higher education in Hungary have changed. Until now, students finishing secondary school needed to decide whether they wanted to continue their higher education in a vocational university, which offered a more practical training, or a university, which offered a deeper theoretical background.

In the new educational system, after seven semesters (acquiring 210 credit points), students finishing the first cycle (B.Sc. degree), have received enough practical training to work in the industry, also receiving the necessary certificates to do so. On the other hand, those who would rather specialize in a certain area are equipped with sufficient theoretical knowledge to continue on. At the end of this second cycle, after four semesters (acquiring 120 credit points), they can acquire the M.Sc. diploma. The top students then have the opportunity to continue on towards a PhD, which consists of an additional six semesters (acquiring 180 credit points, taking the final exams and defending their PhD thesis) of study.

While in theory a B.Sc. diploma from any institution has the same value, it is not trivial which institution a student chooses if he or she wishes to continue on after the first cycle. In Hungary, just as in any part of the world, the quality of the education provided changes from institution to institution. For this reason, students receiving their B.Sc. degrees from a university will be provided with specialized knowledge which will most definitely help them in successfully completing the second cycle. It is only natural though – based on the nature of the first cycle –, that they will also be provided with the practical skills which are necessary for someone not wishing to continue their education to successfully find work in the industry.

In developing the B.Sc. curriculum, the Faculty of Mechanical Engineering at BME aspired to provide students with a high level of education, as has always been the tradition at BME, which is up-to-date and competitive from a European point of view.

The Faculty of Mechanical Engineering changed to the two cycle educational system in 2005. In the first cycle, according to the curriculum, students study for seven semesters, receiving a B.Sc. diploma upon acquiring 210 credit points, completing a final project and passing the final exams, if they have a C-type intermediate language exam.

After finishing the first cycle – those students who have finished with adequate results – can continue on to the second cycle with a chance to possibly receive state funding to
cover the tuition.
In order to successfully finish the new two cycle educational program, it is required that students take a different approach. After finishing one or two semesters the students need to make a career plan based on their results, experiences and interests, and make decisions based on these. Deciding which area to specialize in, whether to continue on after the first cycle or instead to work in the industry are a few of these decisions which need to be made.

3.1. Measure of the educational work load
In working toward the M.Sc. diploma, the students need to complete four semesters, during which they need to acquire 120 credit points. This averages out to be about 30 credit points per semester.
In order to receive the credit points, one needs to fulfill the requirements of the given subject.

3.2. Measure of the academic achievements
Beside the grades received for each subject, the weighted grade point average serves as a measure of the academic achievements:

$$K = \frac{\sum (\text{grade} \times \text{credit points})}{\sum \text{credit points}}.$$  

The stipend index shows how a student performed in a given semester both in quantity and quality as compared to an expected optimum level:

$$\text{stipend index} = \frac{\sum (\text{acquired credit points} \times \text{grade})}{30}.$$  

It can be seen from the equation that the results are divided by the 30 credit points which are prescribed in the curriculum. Therefore a student taking more subjects in a semester will have a better stipend index, while a student taking less than the prescribed 30 credit points worth of classes will not be able to receive a 5.0 in the given semester. Only those classes are taken into consideration in the calculation for which the requirements were fulfilled.
The grade point average is calculated the same way as the weighted grade point average, the only difference being that all the completed semesters are taken into account and not only the present ones.
3.3. *Rules regarding the credit system*

The prerequisite for entering the M.Sc. program – other than a successful admission – is that the student needs to have completed certain subject matter. Since students applying for the Mechanical Engineering Modelling M.Sc. program can come from many different undergraduate programs, there might be some who do not meet these “prerequisites”. The completion of some “supplemental” subjects will be required of them. Due to the flexibility associated with the credit system, these subjects can be taken together with the M.Sc. subjects, or in a separate semester. The “supplemental” subject requirements must be fulfilled within two semesters of beginning the program.

During the M.Sc. program a total of 120 credit points must be attained from the M.Sc. level courses prescribed in the curriculum. The credit system gives students the opportunity to do this at their own pace and along one of many paths toward the M.Sc. degree.

Enrollment in subjects is very flexible due to the credit system. The M.Sc. program does propose certain prerequisite classes which help in making the subject easier to accomplish and are therefore highly advised.

In the M.Sc. curriculum there are 33 credit points which are dedicated to the final project. This can be completed in two semesters (Major Project and Final Project). It is a prerequisite that at least 54 credit points as well as any “supplemental” subjects be completed prior to beginning the Major Project. In order to begin the Final Project, it is required that the student finish – excluding the elective subjects – 79 credit points worth of the M.Sc. subjects found in the curriculum.

Students partaking in the M.Sc. program can take the final exams after finishing all the subjects required by the curriculum as well as acquiring the right to sit for the final exams, a certificate which has its own criteria. Diplomas are only received after the final exams have been successfully passed and the language exam requirements have been met.

The language exam requirements are regulated by ordinance 15/2006.IV.3 OM, which states that the M.Sc. degree can only be received if the student has a B2 (formerly known as intermediate “C”) language exam or an equivalent high school diploma in any modern foreign language for which literature is available in the given area of study.

Students who have not fulfilled the internship requirements of the given program of study in advance need to do so during the M.Sc. program. The internship needs to be at least six weeks long, as regulated in the curriculum of the given institution of higher education. Each student must take the subject “Industrial Practice” at the MSc level. Internship fulfilled in the course of the BSc formation is automatically acknowledged and the signature will be registered in Neptun before the examination period.

Any subject which is offered at the M.Sc. level can be taken as an elective subject.
All detailed rules regarding matters of study can be found in the Code of Studies and Exams of BME (BME TVSZ). All matters regarding fees and allowances can be found in the Code of Fees and Allowances (BME TJSZ).
4. FACULTIES AND DEPARTMENTS PARTAKING IN THE EDUCATIONAL PROGRAM

An educational unit is any establishment, usually in the form of a department or, yet more seldom, an institution, established in order to study and teach a certain area of science. The following departments partake in the educational program:

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<tr>
<th>Faculty</th>
<th>Code</th>
<th>Department</th>
<th>Address</th>
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<tbody>
<tr>
<td>GE</td>
<td>EN</td>
<td>Department of Energy Engineering</td>
<td>D bldg. 3rd floor</td>
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<tr>
<td>GE</td>
<td>FO</td>
<td>Department of Mechatronics, Optics and Mechanical Engineering Informatics (Additional old department codes: MI)</td>
<td>E bldg. 3rd floor, D bldg. 4th floor</td>
</tr>
<tr>
<td>GE</td>
<td>GT</td>
<td>Department of Manufacturing Science and Engineering</td>
<td>E bldg. 2nd floor</td>
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<tr>
<td>GE</td>
<td>GE</td>
<td>Department of Machine and Product Design</td>
<td>Mg bldg. 1st floor</td>
</tr>
<tr>
<td>GE</td>
<td>VG</td>
<td>Department of Hydrodynamic Systems</td>
<td>D bldg. 3rd floor</td>
</tr>
<tr>
<td>GE</td>
<td>MM</td>
<td>Department of Applied Mechanics</td>
<td>MM bldg. 1st floor</td>
</tr>
<tr>
<td>GE</td>
<td>MT</td>
<td>Department of Materials Science and Engineering</td>
<td>MT bldg. ground floor</td>
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<tr>
<td>GE</td>
<td>ÁT</td>
<td>Department of Fluid Mechanics</td>
<td>Ae bldg.</td>
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<tr>
<td>GT</td>
<td>20</td>
<td>Institute of Business Sciences</td>
<td>T bldg. 4th floor</td>
</tr>
<tr>
<td>TE</td>
<td></td>
<td>Faculty of Natural Sciences</td>
<td></td>
</tr>
<tr>
<td>TE</td>
<td>90</td>
<td>Department of Differential Equations</td>
<td>H bldg. 4th floor</td>
</tr>
<tr>
<td>TE</td>
<td>12</td>
<td>Department of Atomic Physics</td>
<td>F bldg. 3rd stairwell mezzanine-floor</td>
</tr>
<tr>
<td>VI</td>
<td>AU</td>
<td>Department of Automation and Applied Informatics</td>
<td>V2 bldg. 4th floor</td>
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5. THE CODE SYSTEM OF THE SUBJECTS

The following sections of the bulletin will present the subjects in the following manner. As an example let us look at the following subject:

______________________________
COUPLED PROBLEMS IN MECHANICS - BMEGEMMMW07
Contact hours: 1+0+1 Credits: 3 Requirement: practical mark
Responsible: Dr. Kovács Ádám, associate prof.
Topics:
Recommended literature:

Every subject has an identification code, in this case it is:

BME GE MM MW 07
university faculty department M - M.Sc. program, 2 digit code
The first part of the code contains BME, the code of the Faculty of Mechanical Engineering and that of the department. The names, addresses and codes of the different departments are given in a table found in chapter 4. The next two characters depict the M.Sc. program (M) and the Mechanical Engineering Modelling M.Sc. program (W). The last two characters are used to differentiate between a department’s different subjects. Additional information can be found in the 2nd and 3rd rows:

- **Contact hours**, followed by their distribution: the first being the lecture, the second the seminar, and the third the laboratory practice;
- **Credits**, these are received upon completion of the subject requirements (in the example there are „3” credit points);
- **Requirement**, can be either examination or practical mark (based on work done during the semester);
- **Responsible**. Notice: this is not necessarily the lecturer of the subject.
- This is followed by a concise summary of the subject matter and a list of recommended literature.
6. CURRICULUM OF THE MECHANICAL ENGINEERING MODELLING M.SC. PROGRAM

List of abbreviations appearing in the curriculum:

- lect – lecture
- sem - seminar (classroom practice)
- lab - laboratory practice
- cr – credits
- p/e/s - practical mark/exam/signature

<table>
<thead>
<tr>
<th>Beginning of the term: spring</th>
<th>Mechanical Engineering Modelling</th>
<th>Beginning of the term: fall</th>
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</thead>
<tbody>
<tr>
<td>1. Semester (spring)</td>
<td>Subjects</td>
<td>1. Semester (fall)</td>
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<td>2. Semester (fall)</td>
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<td>2. Semester (spring)</td>
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<tr>
<td>3. Semester (spring)</td>
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<td>3. Semester (fall)</td>
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<tr>
<td>4. Semester (fall)</td>
<td></td>
<td>4. Semester (spring)</td>
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<tr>
<td>lect / sem / lab / cr / p/e/s</td>
<td></td>
<td>lect / sem / lab / cr / p/e/s</td>
</tr>
</tbody>
</table>

**Basic Subjects**

- 4/2/0/8/e Differential Equations and Numerical Methods
- 3/1/0/4/e Laser Physics
- 3/0/0/4/e Analytical Mechanics
- 3/0/0/4/e Advanced Fluid Mechanics
- 2/1/0/4/e Advanced Thermodynamics
- 2/0/1/4/e Electronics
- 2/1/0/4/e Advanced Control and Informatics

**Special Compulsory Subjects**

- 2/1/0/4/e Machine Design and Production Technology
- 3/0/1/5/p Major Compulsory Subject I
- 2/1/0/5/p Major Compulsory Subject II
- 0/0/3/3/p Teamwork project
- 0/13/0/15/p Final Project A

**Special Subjects**

- 1/0/2/3/e Major Elective Subject I
- 1/0/1/3/e Major Elective Subject II
- 1/1/0/3/p Major Elective Subject III
- 3/0/1/5/p Minor Compulsory Subject I
- 2/1/0/5/p Minor Compulsory Subject II
- 1/0/1/3/e Minor Elective Subject I
- 2/0/0/3/p Minor Elective Subject II
- 0/13/0/15/p Final Project B

**Subjects in Economics**

- 3/0/0/5/p Management
- 3/0/0/5/p Marketing

**Elective Subjects**

- 1/0/1/3/p Further Elective Subject
- 1/1/0/3/p Further Elective Subject

**Criterion**

- Industrial Practice

**Total**

- 30 29 32 29
- 14/4/1/22 14/4/5/23 8/14/3/25 6/14/2/22
- 14/4/5/23 17/4/1/22 6/14/2/22 8/14/3/25
- 4 4 2 1

**Number of Exams**

- 4 4 1 2

**Total credit points**

- 29 30 29 32

**Total contact hours**

- 17/4/1/22 14/4/5/23 8/14/3/25 6/14/2/22

**11**
6.1. Modules available in the Mechanical Engineering Modelling M.Sc. program

Two specialization modules (major and minor) need to be picked from the five which are available in the BME Mechanical Engineering Modelling M.Sc. program. Though there are four modules available, it is not guaranteed that all of them will be started every year. It is not possible to start a module with less than 6 applicants. Therefore it is important that all students decide which modules they would like to study at the beginning of the program. Therefore, the students decide which modules will be started. Those students who choose modules which end up not having enough applicants can choose to either change over to a different module which is being started, or to wait until the desired module is started in a future semester. The students should make a decision about the major module before the application. However, the major and minor modules can be reversed before the students choose the major/final project topics. The module in which the students perform the major and final projects becomes the “major” one, the other remains the “minor” one.

6.1.1. Fluid Mechanics Module

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<th>Beginning of the term: fall</th>
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<td>1. Semester (spring)</td>
<td>2. Semester (fall)</td>
<td>3. Semester (spring)</td>
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<tr>
<td>Basic Subjects</td>
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<td>lect / sem / lab / cr / p/e/s</td>
<td>Subjects</td>
<td>lect / sem / lab / cr / p/e/s</td>
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<tr>
<td>3/0/0/4/e</td>
<td>Advanced Fluid Mechanics</td>
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<tr>
<td>2/2/0/5/p</td>
<td>Computational Fluid Dynamics</td>
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<tr>
<td>2/1/1/5/p</td>
<td>Flow Measurements</td>
<td>2/1/1/5/p</td>
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<tr>
<td>0/0/3/3/p</td>
<td>Teamwork Project</td>
<td>0/0/3/3/p</td>
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<tr>
<td>0/13/0/15/p</td>
<td>Final Project A</td>
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<td>Special subjects / Major or Minor Elective Subjects</td>
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<td>2/0/0/3/p</td>
<td>Large-Eddy Simulation in Mechanical Engineering</td>
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<td>1/1/0/3/p</td>
<td>Open Source Computational Fluid Dynamics</td>
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<td>Multiphase and Reactive Flow Modelling</td>
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<td>2/0/0/3/p</td>
<td>Unsteady Flows in Pipe Networks</td>
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<td>2/0/1/3/p</td>
<td>Building Aerodynamics</td>
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<td>2/0/0/3/p</td>
<td>Aerodynamics and its Application for Vehicles</td>
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<td>2/0/0/3/p</td>
<td>Advanced Technical Acoustics and Measurement Techniques</td>
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<td>Hemodynamics</td>
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### 6.1.2. SOLID MECHANICS MODULE

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<td><strong>Solid Mechanics</strong></td>
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<td>Elasticity and Plasticity</td>
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<td>Coupled Problems in Mechanics</td>
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<td>Beam Structures</td>
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<td>1/0/1/3/p</td>
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<td>Experimental Methods in Solid Mechanics</td>
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<td>1/0/1/3/p</td>
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<tr>
<td>0/13/0/15/p</td>
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<td>Final Project B</td>
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</table>

### 6.1.3. THERMAL ENGINEERING MODULE

<table>
<thead>
<tr>
<th>1. Semester (spring)</th>
<th>2. Semester (fall)</th>
<th>3. Semester (spring)</th>
<th>4. Semester (spring)</th>
<th>Subjects</th>
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<tr>
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<td><strong>Thermal Engineering</strong></td>
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<td><strong>Basic Subjects</strong></td>
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<td>Advanced Thermodynamics</td>
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<td>2/1/0/4/e</td>
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<td>2/1/1/5/p</td>
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<td>Combustion Technology</td>
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<td>1/0/3/5/p</td>
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<td></td>
<td>Measurements in Thermal Engineering</td>
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<td>0/0/3/3/p</td>
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<td>Teamwork Project</td>
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<td>Final Project A</td>
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<td><strong>Special subjects / Major or Minor Compulsory Subjects</strong></td>
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<td></td>
<td>Energy Conversion Processes and its Equipment</td>
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<td></td>
<td></td>
<td>2/1/0/3/e</td>
</tr>
<tr>
<td>1/0/2/3/p</td>
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<td>Simulation of Energy Engineering Systems</td>
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<td>2/0/1/3/p</td>
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<td>Thermophysical Processes</td>
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<td>Thermo-Mechanics</td>
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<td>2/0/1/3/p</td>
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<td>2/1/0/3/p</td>
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<td>Steam and Gas Turbines</td>
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<td>0/13/0/15/p</td>
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### 6.1.4. **Design and Technology Module**

<table>
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<th>Design and Technology</th>
<th>Beginning of the term: spring</th>
<th>Beginning of the term: fall</th>
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<tbody>
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<td>2. Semester (fall)</td>
<td>3. Semester (spring)</td>
</tr>
<tr>
<td>4. Semester (fall)</td>
<td>Subjects</td>
<td></td>
</tr>
<tr>
<td>1. Semester (fall)</td>
<td>2. Semester (spring)</td>
<td>3. Semester (fall)</td>
</tr>
<tr>
<td>4. Semester (spring)</td>
<td>Subjects</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Subjects</th>
<th>lect / sem / lab / cr / p/e/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine Design and Production Technology</td>
<td>2/1/0/4/e</td>
</tr>
<tr>
<td>Product Modelling</td>
<td>2/0/1/5/p</td>
</tr>
<tr>
<td>Advanced Manufacturing</td>
<td>1/0/3/5/p</td>
</tr>
<tr>
<td>Teamwork Project</td>
<td>0/0/3/5/p</td>
</tr>
<tr>
<td>Final Project A</td>
<td>0/13/0/15/p</td>
</tr>
</tbody>
</table>

**Special subjects / Major or Minor Compulsory Subjects**

1/0/2/4/e | CAD Technology
2/0/0/3/e | Materials Science
1/0/2/4/p | Structural Analysis
1/1/0/3/p | Process Planning
1/1/0/3/p | NC Machine Tools
2/0/0/3/e | Fatigue and Fracture
0/13/0/15/p | Final Project A

**Special subjects / Major or Minor Elective Subjects**

1/0/2/4/e | 1/0/2/4/e
2/0/0/3/e | 2/0/0/3/e
1/0/2/4/p | 1/0/2/4/p
1/1/0/3/p | 1/1/0/3/p
1/1/0/3/p | 1/1/0/3/p
2/0/0/3/e | 2/0/0/3/e
0/13/0/15/p | 0/13/0/15/p

### 6.2. Subjects of the final exam

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

- Major Compulsory Subject I, 5 cr
- Major Compulsory Subject II, 5 cr
- Major Elective Subject, 3 cr
- Major Elective Subject, 3 cr
7. INTRODUCTION OF THE MECHANICAL ENGINEERING MODELLING M.SC. SUBJECTS

7.1. Basic Subjects

**MATHEMATICS MI - DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS - BMETE90MX46**

<table>
<thead>
<tr>
<th>Contact hours: 4+2+0</th>
<th>Credits: 8</th>
<th>Requirement: examination</th>
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</thead>
<tbody>
<tr>
<td><strong>Responsible:</strong> Dr. Péter Moson, Dr. György Paál, associate profs.</td>
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</tbody>
</table>


**Recommended literature:**


**LASER PHYSICS - BMETE12MX00**

<table>
<thead>
<tr>
<th>Contact hours: 3+1+0</th>
<th>Credits: 4</th>
<th>Requirement: examination</th>
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</thead>
<tbody>
<tr>
<td><strong>Responsible:</strong> Dr. Emőke Lőrincz, associate prof.</td>
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</tbody>
</table>


**Recommended literature:**

ANALYTICAL MECHANICS - BMEGEMMMW01

Contact hours: 3+0+0  
Credits: 4  
Requirement: examination  
Responsible: Dr. Gábor Stépán, professor


Recommended literature:

ADVANCED FLUID MECHANICS - BMEGEÁTMW01

Contact hours: 3+0+0  
Credits: 4  
Requirement: examination  
Responsible: Dr. Gergely Kristóf, associate prof.


Recommended literature:
1. Lecture handouts: www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATMW01

ADVANCED THERMODYNAMICS - BMEGEENMWAT

Contact hours: 2+1+0  
Credits: 4  
Requirement: examination  
Responsible: Dr. Balázs Czél, assistant prof.

Recommended literature:


ELECTRONICS - BMEVIAUM001

Contact hours: 2+0+1 Credits: 4 Requirement: examination
Responsible: Dr. Balázs Rakos, assistant prof.

Electronic components: Diode, Zener diode, Transistors (bipolar and field effect transistors), Common-emitter characteristics.
Integrated circuits: Operational amplifier, Mathematical operations, Wave shape generation, Function generation, Filters, Power supply.

Recommended literature:

2. Animated Lecture notes in electronics form: http://elektro.get.bme.hu/

ADVANCED CONTROL AND INFORMATICS - BMEGEMIMW01

Contact hours: 2+1+0 Credits: 4 Requirement: examination
Responsible: Dr. Péter Korondi, professor


Recommended literature:

1. Peter Korondi “Selected chapters of Advanced Control” digital textbook
2. “DC Servo Motor Control via Internet”, Student exercise manual, Version 1.2
3. “Motion Control and Telemanipulation, Robotics” animated teaching material http://dind.mogi.bme.hu/animation/

MACHINE DESIGN AND PRODUCTION TECHNOLOGY - BMEGEGEMW01

(Special Compulsory Subject)
Contact hours: 2+1+0 Credits: 4 Requirement: examination
Responsible: Dr. Gábor Körtélyesi, assistant prof.
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.

**Machine design:** Design principles and methods. Requirements. Modern design techniques. Structural behavior and modeling. Design of frame structures. Polymer and composite components. Load transfer between engineering components. Structural optimization (object function, design variables, constrains, shape and size optimization).

**Production:** Machine-tools and equipment, devices and fixtures, kinematics, machining principles, production procedures and processes, production volume, batches and series. Manufacturability and tooling criteria, preliminary conditions and production analysis, methods of sequencing operations, production planning and scheduling. Production management (TQC and JIT), automated production; cellular manufacturing, machining centres and robots. Product data and technical document management (PDM, TDM), engineering changes and production workflow management (CE, ECM).

**Recommended literature:**

### 7.2. Subjects of the Fluid Mechanics module

#### 7.2.1. Special subjects / Major or Minor Compulsory Subjects

**COMPUTATIONAL FLUID DYNAMICS - BMEGEÁTMW02**

**Contact hours:** 2+2+0  
**Credits:** 5  
**Requirement:** practical mark

**Responsible:** Dr. Gergely Kristóf, associate prof.


**Recommended literature:**
1. Lecture handouts: www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATMW02

Recommended literature:
2. Lecture handouts: www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATMW03

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 also can be continued partly by a single student in course of the Final Project A or B (BMEGEÁTMWDAt or BMEGEÁTMWDB) 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. Recommended literature:
1. Preliminary literature survey is essential part of the project start, but reference literature will be provided by the project leader / advisors, too.
2. Further information: www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATMWTP

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 (BMEGEÁTMWDB) 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 on the 4th week: 1st project presentation by the student
2nd ET meeting on the 8th week: 2nd project presentation by the student
3rd ET meeting on the 14th week: 3rd project presentation by the student
On the 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 Modelling MSc
various Final Project A proposals are announced also by the Dept. Hydrodynamic Systems (under their
own subject code BMEGEVGMWDA).
Recommended literature:
1. Preliminary literature survey is essential part of the project s tart, but reference literature will be
   provided by the project leader / advisors, too.
2. Further information: www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATMWDA

7.2.2. SPECIAL SUBJECTS / MAJOR OR MINOR ELECTIVE SUBJECTS

LARGE-EDDY SIMULATION IN MECHANICAL ENGINEERING - BMEGEÁTMW05
Contact hours: 1+1+0               Credits: 3   Requirement: practical mark
Responsible: Dr. Gergely Kristóf, associate prof.

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 modelling 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.
Recommended literature:
1. Lesieur, M.; Métais, O. & Comte, P. Large-Eddy Simulations of Turbulence Cambridge University
   Press, 2005
5. Lecture handouts: www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATMW05

OPEN SOURCE COMPUTATIONAL FLUID DYNAMICS – BMEGEÁTMW11
Contact hours: 1+1+0               Credits: 3   Requirement: practical mark
**Responsible:** Dr. Gergely Kristóf, associate prof.

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).

**Recommended literature:**


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**MULTIPHASE AND REACTIVE FLOW MODELLING – BMEGEÁTMW17**

**Contact hours:** 1+1+0  
**Credits:** 3  
**Requirement:** practical mark

**Responsible:** Dr. Jenő Miklós Suda, assistant prof.


**Recommended literature:**

1. Lecture handouts: [www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATMW07](http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATMW07)
UNSTEADY FLOWS IN PIPE NETWORKS - BMEGEVGMW02

Contact hours: 2+0+0  Credits: 3  Requirement: practical mark
Responsible: Dr. Csaba Hős, assistant prof.


Recommended literature:

BUILDING AERODYNAMICS - BMEGEÁTMW08

Contact hours: 2+0+1  Credits: 3  Requirement: practical mark
Responsible: Dr. Jenő Miklós Suda, assistant prof.


Recommended literature:
4. Lecture handouts: www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATMW08

AERODYNAMICS AND ITS APPLICATION FOR VEHICLES - BMEGEÁTMW09

Contact hours: 2+0+0  Credits: 3  Requirement: practical mark
Responsible: Dr. Jenő Miklós Suda, assistant prof.

Measurement of car models evaluation of car bodies from aerodynamic and design point of view (in cooperation with MOME: Moholy-Nagy University of Arts and Design Budapest).

Individual project: passenger car modelling. 2-4 students form one group. Every group will receive two modelling 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 woods 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.

Recommended literature:
4. Web page: www.aerodyn.org

ADVANCED TECHNICAL ACOUSTICS AND MEASUREMENT TECHNIQUES - BMEGEÁTMW10

Contact hours: 2+0+0 Credits: 3 Requirement: practical mark
Responsible: Dr. János Vad, associate prof.

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.

Recommended literature:
3. Lecture handouts: www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATMW10
HEMODYNAMICS - BMEGEVGMW06

**Contact hours:** 2+0+0  
**Credits:** 3  
**Requirement:** practical mark  
**Responsible:** Dr. György Paál, associate professor


*Recommended literature:*

FLOW STABILITY - BMEGEVGMW07

**Contact hours:** 2+0+0  
**Credits:** 3  
**Requirement:** practical mark  
**Responsible:** Dr. György Paál, associate professor


*Recommended literature:*

THEORETICAL ACOUSTICS - BMEGEVGMW08

**Contact hours:** 2+0+0  
**Credits:** 3  
**Requirement:** practical mark  
**Responsible:** Dr. György Paál, associate professor

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.

*Recommended literature:*

FINAL PROJECT B - BMEGEÁTMWDB

**Contact hours:** 0+0+15  
**Credits:** 19  
**Requirement:** signature
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 (BMEGEÁTMWDA). The Final Projects A and B together serves as a two-semester project that results in the Master (MSc) Thesis of the student. In course of the Final Project B one single student will work on the selected challenging problem of fluid mechanics.

1st ET meeting: on the 4th week: 1st project presentation by the student
2nd ET meeting: on the 8th week: 2nd project presentation by the student
3rd ET meeting: on the 14th week: 3rd final project presentation by the student

On the 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 Dept. Hydrodynamic Systems (under subject code BMEGEVGMWDA) must continue their project in course of the Final Project B announced also by the Dept. Hydrodynamic Systems (under code BMEGEVGMWDB).

Recommended literature:
1. Preliminary literature survey is essential part of the project start, but reference literature will be provided by the project leader / advisors, too.
2. Further informations: www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATMWDB

7.3. Subjects of the Solid Mechanics module

7.3.1. Special subjects / Major or Minor Compulsory Subjects

**FINITE ELEMENT ANALYSIS - BMEGEMMMW02**

<table>
<thead>
<tr>
<th>Contact hours: 2+0+2</th>
<th>Credits: 5</th>
<th>Requirement: practical mark</th>
</tr>
</thead>
</table>

**Responsible:** Dr. András Szekrényes, associate prof.


**Recommended literature:**
CONTINUUM MECHANICS - BMEGEMMMW03
Contact hours: 2+1+0  
Credits: 5  
Requirement: practical mark  
Responsible: Dr. Attila Kossa, assistant professor


Recommended literature:

TEAMWORK PROJECT - BMEGEMMMWPA
Contact hours: 0+0+3  
Credits: 3  
Requirement: practical mark  
Responsible: Dr. András Szekrényes, associate prof.

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

Recommended literature: It depends on the topic of the project.

FINAL PROJECT A - BMEGEMMMWDA
Contact hours: 0+13+0  
Credits: 15  
Requirement: practical mark  
Responsible: Dr. András Szekrényes, associate prof.

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 they 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.

*Recommended literature:* It depends on the topic of the project.

### 7.3.2. Special Subjects / Major or Minor Elective Subjects

#### Elasticity and Plasticity - BMEGEMMWM05

- **Contact hours:** 1+1+0
- **Credits:** 3
- **Requirement:** practical mark
- **Responsible:** Dr. Attila Kossa, assistant professor


*Recommended literature:*

#### Nonlinear Vibrations - BMEGEMMWM06

- **Contact hours:** 1+1+0
- **Credits:** 3
- **Requirement:** examination
- **Responsible:** Dr. Gábor Stépán, professor


*Recommended literature:*
1. Ludvig Gy., Gépek dinamikája (Dynamics of Machines), Műszaki Könykiadó, Budapest, 1989.

#### Coupled Problems in Mechanics - BMEGEMMWM07

- **Contact hours:** 1+0+1
- **Credits:** 3
- **Requirement:** practical mark
- **Responsible:** Dr. Ádám Kovács, associate prof.

Recommended literature:

MECHANISMS - BMEGEMMMW08

Contact hours: 1+1+0  Credits: 3  Requirement: practical mark
Responsible: Dr. László Kovács, senior research associate


Recommended literature:

BEAM STRUCTURES - BMEGEMMMW09

Contact hours: 1+1+0  Credits: 3  Requirement: examination
Responsible: Dr. András Szekrényes, associate prof.

Recommended literature:

2. Ponomarjov, SZ. D., Szilárdsági számítások a gépészetben (Strength Calculations in Engineering), Műszaki Könykiadó, Budapest, 1964.

EXPERIMENTAL METHODS IN SOLID MECHANICS - BMEGEMMMW10

Contact hours: 1+0+1  
Credits: 3  
Requirement: practical mark

Responsible: Dr. András Szekrényes, associate prof.


Recommended literature:


FINAL PROJECT B - BMEGEMMMWDB

Contact hours: 0+13+0  
Credits: 15  
Requirement: signature

Responsible: Dr. András Szekrényes, associate prof.

The Final Project B subject is dedicated to prepare the second half of the MSc thesis. As the continuation of the Final Project Project A, 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.

Recommended literature: It depends on the topic of the project.
7.4. Subjects of the Thermal Engineering module

7.4.1. Special subjects / Major or Minor compulsory subjects

<table>
<thead>
<tr>
<th>COMBUSTION TECHNOLOGY - BMEGEENMWCT</th>
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</thead>
<tbody>
<tr>
<td>Contact hours: 2+1+1</td>
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<tr>
<td>Responsible: Dr. Ferenc Lezsovits, associate professor</td>
</tr>
</tbody>
</table>

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/or solid fuels, and waste material incineration.

Recommended literature:

<table>
<thead>
<tr>
<th>MEASUREMENTS IN THERMAL ENGINEERING - BMEGEENMWM1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact hours: 1+0+3</td>
</tr>
<tr>
<td>Responsible: Dr. Ákos Bereczky, associate prof.</td>
</tr>
</tbody>
</table>


Recommended literature:

<table>
<thead>
<tr>
<th>TEAMWORK PROJECT - BMEGEENMWPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact hours: 0+0+3</td>
</tr>
<tr>
<td>Responsible: Dr. Tamás Laza, assistant prof.</td>
</tr>
</tbody>
</table>
The complex task covers a semester project in the diverse topics of energetics. 

*Recommended literature:* It depends on the topic of the project.

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**FINAL PROJECT A - BMEGEENMWDA**

**Contact hours:** 0+13+0  
**Credits:** 15  
**Requirement:** practical mark  
**Responsible:** Dr. Ákos Bereczky, associate prof.

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

*Recommended literature:* It depends on the topic of the project.

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**7.4.2. SPECIAL SUBJECTS / MAJOR OR MINOR ELECTIVE SUBJECTS**

**ENERGY CONVERSION PROCESSES AND ITS EQUIPMENT - BMEGEENMWEE**

**Contact hours:** 2+1+0  
**Credits:** 3  
**Requirement:** examination  
**Responsible:** Dr. Ákos Bereczky, associate professor


*Recommended literature:*

**SIMULATION OF ENERGY ENGINEERING SYSTEMS - BMEGEENMWSE**

**Contact hours:** 1+0+2  
**Credits:** 3  
**Requirement:** practical mark  
**Responsible:** Dr. Pál Szentannai, associate prof.


*Recommended literature:*
**THERMAL PHYSICS - BMEGEENMWTP**

**Contact hours:** 2+0+1  
**Credits:** 3  
**Requirement:** practical mark

**Responsible:** Dr. Balázs Czél, assistant prof.


**Recommended literature:**

2. Ozisik: Inverse Heat Transfer (Fundamentals and applications), Taylor&Francis, 2000

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**THERMO-MECHANICS - BMEGEMMMWTM**

**Contact hours:** 2+0+1  
**Credits:** 3  
**Requirement:** practical mark

**Responsible:** Dr. Ádám Kovács, associate prof.


**Recommended literature:**


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**STEAM AND GAS TURBINES - BMEGEENMWTU**

**Contact hours:** 2+1+0  
**Credits:** 3  
**Requirement:** practical mark

**Responsible:** Dr. Krisztián Sztankó, assistant professor

Preliminary, property of Parsons and Laval steam turbines, property of modern steam turbines. Properties of impulse stage. Curtis stage, negative reaction number evolution, 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 gasturbine, wing shape theory and compressor stage.

**Recommended literature:**

3. Kostyuk, Frolov: Steam and gas turbine, MIR, Moscow
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.

Recommended literature: It depends on the topic of the project.

### 7.5. Subjects of the Design and Technology module

#### 7.5.1. Special subjects / Major or minor compulsory subjects

**PRODUCT MODELLING - BMEGEGEMW02**

- **Contact hours:** 2+0+1
- **Credits:** 5
- **Requirement:** practical mark
- **Responsible:** Dr. Károly Váradi, professor


Recommended literature:

**ADVANCED MANUFACTURING - BMEGEGTMW01**

- **Contact hours:** 1+0+3
- **Credits:** 5
- **Requirement:** practical mark
- **Responsible:** Dr. Márton Takács, associate prof.


Recommended literature:
TEAMWORK PROJECT – BMEGEGEMWP1

Contact hours: 0+0+3 Credits: 15 Requirement: practical mark
Responsible: Dr. Tibor Szalay, associate prof.

The complex task covers a semester project in the diverse topics of manufacturing.
Recommended literature: It depends on the topic of the project.

FINAL PROJECT A - BMEGEGEMWDA

Contact hours: 0+0+11 Credits: 14 Requirement: practical mark
Responsible: Dr. Tibor Szalay, associate prof.

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

7.5.2. SPECIAL SUBJECTS / MAJOR OR MINOR ELECTIVE SUBJECTS

CAD TECHNOLOGY - BMEGEGEMW04

Contact hours: 1+0+2 Credits: 4 Requirement: examination
Responsible: Dr. Attila Piros, assistant prof.

Recommended literature:

MATERIALS SCIENCE - BMEGEMTMW01

Contact hours: 2+0+0 Credits: 3 Requirement: examination
Responsible: Dr. István Mészáros, associate prof.

Recommended literature:


STRUCTURAL ANALYSIS - BMEGEGEMW05

Contact hours: 1+0+2 Credits: 4 Requirement: practical mark
Responsible: Dr. Tibor Goda, associate prof.


Recommended literature:


PROCESS PLANNING - BMEGEGTMW02

Contact hours: 1+1+0 Credits: 3 Requirement: practical mark
Responsible: Dr. Gyula Mátyási, associate prof.

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..

Recommended literature:


NC MACHINE TOOLS - BMEGEGTMW03

Contact hours: 1+1+0 Credits: 3 Requirement: practical mark
Responsible: Dr. István Németh, associate professor

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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 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.

Recommended literature:

FATIGUE AND FRACTURE - BMEGEMTMW02
Contact hours: 2+0+0  Credits: 3  Requirement: examination
Responsible: Dr. Jenő Lovas, assistant professor


Recommended literature:

FINAL PROJECT B - BMEGE2GWMDB
Contact hours: 0+13+0  Credits: 15  Requirement: signature
Responsible: Dr. Tibor Szalay, associate prof.

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.
7.6. Subjects in Economics

**MANAGEMENT - BMEGT20MW02**

<table>
<thead>
<tr>
<th>Contact hours: 3+0+0</th>
<th>Credits: 5</th>
<th>Requirement: practical mark</th>
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<tbody>
<tr>
<td><strong>Responsible:</strong> Dr. Irén Gyökér, associate prof.</td>
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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 behaviour, the behaviour of managers and their employee, the team properties in the labour-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.

**Recommended literature:**


**MARKETING - BMEGT20MW01**

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<tr>
<th>Contact hours: 3+0+0</th>
<th>Credits: 5</th>
<th>Requirement: practical mark</th>
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<tbody>
<tr>
<td><strong>Responsible:</strong> Dr. Zsuzsanna Szalkai, associate prof.</td>
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**Recommended literature:**


7.7. Further Elective Subject

**BIOLOGICALLY INSPIRED SYSTEMS - BMEGEMIMGBI**

<table>
<thead>
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<th>Contact hours: 2+0+0</th>
<th>Credits: 3</th>
<th>Requirement: practical mark</th>
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<tr>
<td><strong>Responsible:</strong> Dr. Péter Korondi, professor</td>
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</table>

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.

Recommended literature:

7.8. Criterion

INDUSTRIAL PRACTICE - BMEGEMMMWSZ

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<th>Requirement:</th>
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<td>signature</td>
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</table>

Responsible: Dr. András Szekrényes, associate prof.

One of the requirements to obtain the M.Sc. diploma is to carry out the internship in a company that performs some activities in the field of mechanical engineering. The industrial practice fulfilled in the BSc level is accepted automatically if the student accomplished the internship through the organization of the Department of Applied Mechanics. If the accomplishment took place through the organization of another department, then a certification needs to be provided to the department’s responsible (Dr. András Szekrényes). If the student does not possess a valid industrial practice, then it has to be accomplished in the course of the MSc qualification. The required duration of the industrial practice is 4 weeks. It is possible to request the organization of the industrial practice from the department's responsible. To obtain the signature in Neptun it is required to apply the Industrial practice subject before the acquisition of the M.Sc. diploma.