Bulletin

Master of Mechatronical Engineering
(MSc program)

University of Debrecen Faculty of Engineering
Department of Electrical Engineering and Mechatronics

2016
CONTENTS

MECHATRONICAL ENGINEERING, MSC PROGRAM ......................................................... 3
Program Educational Objectives .................................................................................. 3
Subject modules .......................................................................................................... 3
The state examination .................................................................................................. 4
The classification of the degree ..................................................................................... 4
The thesis ..................................................................................................................... 4
FACULTY BACKGROUND, AND HISTORICAL FACTS ............................................... 5
FACILITIES AND INFRASTRUCTURE OF THE TRAINING ...................................... 7
Basic Science Subjects .............................................................................................. 12
Economics and Humanities Subjects ......................................................................... 15
LABORATORIES .......................................................................................................... 22
CONTACT INFORMATION .......................................................................................... 41
MECHATRONICAL ENGINEERING, MSC PROGRAM

The aim of the teaching is to train mechatronics engineers who are comfortable and competent with cutting edge technologies in both Mechanical and Electrical and Electronic Engineering. They may design, construct and maintain intelligent machines, micro-machines, smart structures, intelligent systems, control systems and consumer products such as cameras, washing machines or fully automated robotic assembly lines, or they may be involved with defense technology and systems.

Program Outcomes
In possession of an MSc degree mechatronics engineers will be capable to understand principles, to use their studies and problem solving techniques in practice. They have such professional practice at the area of mechatronics that they can elaborate any new phenomenon easily during their work. They will be able to design and solve tasks at high professional level at technical area.

Program Educational Objectives
The aim of the teaching is to train mechatronical engineers who are going to be developed in competence or acquire knowledge in the following areas:

- mechanics,
- electronics,
- design,
- signal analysis and processing,
- computer systems,
- computer science,
- sensor and actuator technology,
- automatic control,
- electrical system design,
- robotics and microprocessor technology.

Subject modules
The curriculum contains the following subject modules:

Basic of natural sciences: 26 credits

Economics and humanities subjects: 12 credits
Management, Investment decisions and applied economics for engineers.
Specific compulsory subjects: 28 credits
Engineering Technological Elements, Advanced Quality Management, Risk and Reliability, Integrated Informatics Systems Control
Field-specific vocational subjects: Building Mechatronics Specialization: 18 credits
Design of Building Mechatronics Systems, Industrial applications of mechatronics systems, vehicles, building automation and robotics I,II.

Optional subjects: 6 credits
Thesis: 30 credits
Duration of studies: 4 semesters, contact hours: 1.560

ECTS credits: 120, internship: 4 weeks
The state examination
The conditions for taking the final examination

- Defending the Diploma Work (oral presentation and discussion)
- Exam from two subjects chosen by the student
  1. Written and oral exam on the topics of Industrial applications of mechatronics systems: vehicles, building automation and robotics
  2. Defending the Diploma Work (oral presentation and discussion)

Parts of the state examination

- Introducing the results of the diploma work in an 8-10 minute presentation
- Defending the thesis (oral presentation and discussion by answering the questions of the Final Examination Committee)
- Exam on two subjects chosen by the student

The result of the state exam

The arithmetic mean of the mark given by the State Examination Committee for

- the defending of the diploma work and
- the two marks of the professional oral exams

The classification of the degree

The result of the final examination expressed by lettering

- EXCELLENT
- GOOD
- SATISFACTORY
- SUFFICIENT

The thesis

The thesis is a written task which the students should solve relying on previous studies and specialized national and international literature under the guidance of a tutor in one semester. The diploma work must prove that the author can apply the acquired theoretical knowledge. A student at Mechatronical Engineering MSc can choose any topic for the diploma work suggested by the faculty or in occasional cases individual topics acknowledged by the head of the department. The topics of the diploma work should be given in completely uniform manner and based on the system of requirements set up by the head of the institute and the head of the department responsible for the training. The diploma works are written with the close collaboration of the candidate and the tutor.

Making and justifying the thesis the students of Mechatronical Engineering MSc proves that they are able to use the learnt knowledge in practice, to summarize the fulfilled task and its results, to solve creatively the tasks in their topics and to do professional work.

The formal requirements of the diploma work are detailed in the “Thesis formal requirements” which is handed out to every candidate when they decide upon their topic. The diploma works must be handed in to the department responsible minimum ten days before the beginning of the state exam period. The thesis paper is evaluated by an external graduate professional who gives a grade as well as a short written comment on it. The head of the department makes a proposal for the final evaluation of the diploma work based on the comments. The diploma work receives a grade from the state exam committee.
FACULTY BACKGROUND, AND HISTORICAL FACTS

The history of the Faculty of Engineering dates back to 1965, when the Technical College was established. In 1972 it was named Ybl Miklós Polytechnic and in 1995 it became part of Kossuth Lajos University. In 2000 the Faculty of Engineering became part of the integrated University of Debrecen.
In 2005 the Bologna System was introduced, which aids the compatibility of the qualifications received at the University of Debrecen with universities all over Europe.
The Faculty of Engineering is at the forefront of education and training of engineers in the North Great Plain Region and in the whole of Hungary. It is a dynamically developing Faculty with over 3,000 students and a highly-qualified and enthusiastic teaching staff of about 80 members. The teaching staff is involved in numerous domestic and international research and design projects. The Faculty of Engineering is practice oriented and develops skills required for the current conditions of the national and international labor market. The recently opened new building wing with its ultra-modern design hosts several lecture halls, seminar rooms and laboratories equipped with the latest technology. Our students are provided with practical knowledge, training and field practice with the help of the numerous prestigious domestic and multi-national industry partners. The internship periods are excellent opportunities for students to experience theory put into practice at the most renowned industry representatives and to become more successful in the labor market in this highly competitive sector. Students learn to operate in the working environment of multi-national companies and adapt to challenges easily. After graduation they will be able to operate at a strategic decision-making level, placing priority on efficiency and engineering ethics.
The Faculty of Engineering offers a great variety of BSc, MSc courses and post-graduate training courses tailored to suit the rapidly changing world of engineering and focusing on European and international trends. In order to optimize the quality of training, the Faculty continuously strives to expand the number of industrial and educational partners at home and abroad.
The Faculty of Engineering launched the engineering trainings in English in 2011.
The Faculty of Engineering has been a pioneer in the introduction of the Quality Management System at faculty level to measure and evaluate the efficiency of its education and teaching staff in order to improve the quality of education and training from the feedback received. The Faculty was awarded by the Ministry of Education the Quality Prize in 2011 as a recognition of its efforts in this field.
The Faculty of Engineering has a vivid student life. There is a film club waiting for movie buffs and the door of the Faculty library is always open. The library is not only the host of the most recent technical books, exhibitions and tea afternoons with invited speakers, but students can also purchase theatre and concert tickets here from the staff. The Borsos József dormitory is also a hub of activities for students.
The increasing number of foreign students brings cultural and ethnic diversity to the faculty. Our aim is to aid students to become efficient members of the labor market and enrich the world of engineering in Hungary and abroad with their knowledge and expertise.

Total number of students

Number of students at the Faculty of Engineering: 2,860
According to time of study:
  full-time students: 2,210
  part-time students:  650
  undergraduate students: 1,990
  postgraduate students:  220
  international students:  45
  full time teachers:  98
  full college/university professor:  15
Dates of establishing the training programs (in Hungarian)

1972 Architect
    Mechanical engineering building industrial specialization
1984 Civil engineering
1987 Mechanical engineering building service engineering specialization
1991 Urbanism
1994 Technical management
2001 Environmental engineering
2005-2006 Date of switching to the Bologna (BSc/MSc) system

BSc programs (in Hungarian)

- **Architecture BSc**  number of students: 315
- **Civil Engineering BSc**  number of students: 605
  Specializations:
  - Urban Settings
  - Building Construction
- **Mechanical Engineering BSc**  number of students: 868
  Specializations:
  - Building Services
  - Automotive Engineering
  - Operational and Maintenance
- **Environmental Engineering BSc**  number of students: 115
  Specializations:
  - Environmental Technology
  - Environmental Management
- **Technical Manager BSc**  number of students: 423
  Specializations:
  - Industrial
  - Building Constructional
- **Mechatronics Engineering BSc**  number of students: 210
  Specialization:
  - Building Mechatronics
- **Vocational Technical Instruction BSc**  number of students: -

MSc programs (in Hungarian)

- **Architecture MSc**  number of students: 31
- **Building Engineering MSc**  number of students: 59
  Specializations:
  - Building operational
  - Building Services
  - Building Energetics
- **Engineering Manager MSc**  number of students: 41
  Specializations:
  - Industrial
- **Environmental Engineering MSc**  number of students: 63
Specializations:

Built Environment
Environmental technology, planning and construction

- **Infrastructural Engineering MSc**  number of students: -
- **Mechatronics Engineering MSc**  number of students: 6
- **Structural Engineering MSc**  number of students: -
- **Teacher of Engineering MSc**  number of students: -
  Teacher of Architectural Engineering
  Teacher of Environmental Engineering
- **Urban Systems Engineering MSc**  number of students: 42

Trainings in English  number of students: 69

- **Civil Engineering (BSc)**
- **Environmental Engineering (BSc)**
  Specializations:
  Environmental Technology
- **Mechanical Engineering (BSc)**
  Specializations:
  Operation and Maintenance
- **Mechatronics Engineering (MSc)**
- **Mechatronics Engineering (BSc)**
- **Technical Management (BSc)**

**FACILITIES AND INFRASTRUCTURE OF THE TRAINING**

*Classrooms, auditoriums, laboratories and their instrumentation, workshops.*

![Classrooms, auditoriums, laboratories and their instrumentation, workshops.](image)

The available capacity of the lecture halls:
- 24 classrooms and drawing-rooms for training purposes (each with 16-70 seats, altogether 1,258 seats, measures 1.670 m²)
- 18 auditoriums (each with 78-256 seats, altogether 1,281 seats, measures 1.396 m²)
- The total capacity of full-time students: 3,250. Current number of students: approximately 2,860.

**IT, Teaching technology and library supply etc.**

- **3 IT laboratories** for teaching graphics and CAD, seating 30 people each.

![3 IT laboratories for teaching graphics and CAD, seating 30 people each.](image)

The *Faculty library* is a unit of the University and
National Library of Debrecen University. The Library lays special emphasis on the extension of its electronic services. Most units of the Library worked with the integrated library system of Corvina (former Voyager) since 1992. The Library attaches great importance to collecting modern information carriers beside the traditional printed documents. Either by being a member of national consortia or by local subscription the library ensures that the citizens of the University be able to search in the bibliographic and full-text databases of the most important scientific periodicals of each discipline (EBSCO, WEB of Science, Elsevier periodicals, Biological Abstract, PsycINFO, Jstor etc.) It collects processes and services the specialized literature of the taught and researched fields of the sciences. It stores about 40,000 specialized books, textbooks and notes, 140 Hungarian and 25 foreign specialized journals, thousands of standards, extra materials for teaching and planning, product catalogues and brochures.

**Language learning materials**

The library provides students with language books, CDs and cassettes which help students fulfill the foreign language requirements necessary to finish the major. It pertains to the Hungarian teaching materials too in the case of training foreign students.

**Different services and benefits which help students graduate**

- Learning tools (course books and notes, technical books in Hungarian and in English)
- Textbook store where students can use their financial aid allocated for notes/textbooks
- Free wireless internet access in the Faculty buildings, including the dormitory

**Administration unit**

There is a Registry at the faculty, administration of courses is fully electronic with the NEPTUN system, the retrieval is helped by a register system.
<table>
<thead>
<tr>
<th>Subjects</th>
<th>Spring</th>
<th>Fall</th>
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9
### Specific compulsory subjects

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### Field-specific vocational subjects

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### Basic Science Subjects

#### Application of the Theory of Differential Equations

- **Code:** MF MAT51C04-EN
- **ECTS Credit Points:** 4
- **Evaluation:** ESE (exam)
- **Year, Semester:** 1\textsuperscript{st} year 2\textsuperscript{nd} semester
- **Number of teaching hours/week:**
  - Lecture: 2
  - Practice: 2


**Literature:**


#### Theory of Optimal Control

- **Code:** MF MAT52C04-EN
- **ECTS Credit Points:** 4
- **Year, Semester:** 1\textsuperscript{st} year/1\textsuperscript{st} semester
- **Number of teaching hours/week:**
  - Lecture: 2
  - Practice: 1

**Topics:**

Formulation of control models. General properties of linear systems: reachability, controllability, stabilizability, observability, detectability, reconstrucibility. State variables, dynamic feedback, realization.


**Literature:**

Selected Chapters from Electronics

Code: MFVFE51C03-EN
ECTS Credit Points: 3
Year, Semester: 1st year/1st semester
Number of teaching hours/week:
Lecture: 2
Practice: 1

Prerequisites:

Topics:
The course focuses on the theory and application of the following:
Laboratory and computer exercises help to promote understanding and mastery of the curriculum.

Literature:
Required literature:

Advanced systems

Code: MFHAT51L03-EN
ECTS Credit Points: 4
Evaluation: exam
Year, Semester: fall
Number of teaching hours/week:
Lecture: 2
Practice: 3

Prerequisites:

Topics:

Literature:
Péter Korondi: Systems and control BME
Laboratoryhandbook ISBN 978-963-473-509-0 Debreceni Egyetem
Clarence W. De Silva: Mechatronics: An Integrated Approach
**Dynamics of mechanical systems**

**Code:** MFMRD51C04-EN  
**Credit:** 4  
**evaluation:** ESE  
**Year, Semester:** 1st year/1st semester  
**Number of teaching hours/week:**  
**Lecture:** 4  
**Practice:** 0  
**Prerequisites:** -

**Topics:**  
Kinematics, dynamics and kinematics and motioncurves, equations of motionmechanisms.  

**Literature:**  
1. Béda: Lengéstan, Műegyetemi Kiadó, 45 043  

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**Material Science**

**Code:** MFMT51C04-EN  
**ECTS Credit Points:** 3  
**Year, Semester:** 3rd year/1st semester  
**Number of teaching hours/week:**  
**Lecture:** 2  
**Practice:** 1  
**Prerequisites:** -

**Topics:**  

**Literature:**  

Computing Systems
Code: MFHAT51L03-EN
ECTS Credit Points: 3
Evaluation: ESE
Year, Semester: 1 st year/1 st semester
Number of teaching hours/week:
Lecture: 2
Practice: 1
Prerequisites: N/A
Topics:
This series of lectures covers the topics related to embedded computer systems for controlling, measurement and intelligent analysis oriented to mechatronics systems.
Literature:

Economics and Humanities Subjects

Basics of Management
Code: MFMEN51X07-EN
ECTS Credit Points: 7
Year, Semester: 1 st year/1 st semester
Number of teaching hours/week:
Lecture: 4
Practice: 2
Prerequisites: -
Topics:
The aim of this course is describing organizational changes and the management of organizational development processes, tools and models through processing case studies.
Literature:

Investment decisions and applied economics for engineers
Code: MFGMJJ51X05-EN
ECTS Credit Points: 5
Year, Semester: 1 st year/2 nd semester
Number of teaching hours/week:
Lecture: 2
Practice: 4
Prerequisites: -
Topics:
This course is intended to introduce students to the main concepts and theories about economics, investment analyses and business/corporate performance measurement so that students are able to make comparative analyses. By the end of the course, students should be able to use basic tools and models of investment analyses, and apply them in solving problems.
The course focuses on the theory and application of the following:


**Literature:**

Required literature:

Recommended literature:


### Specific Compulsory Subjects

**Digital Servo Drives**

**Code:** MFDSH51C04-EN  
**ECTS Credit Points:** 4  
**Evaluation:** ESE  
**Year, Semester:** 1<sup>st</sup> year/1<sup>st</sup> semester  
**Number of teaching hours/week:**  
- Lecture: 2  
- Practice: 1  
**Prerequisites:** N/A  
**Topics:**  
This series of lectures covers the topics related to servo drive systems: design, theory of operation, motors, electronics drive circuits and control devices.

**Literature:**

**Measurement and Modelling**

**Code:** MF MMO51C05-EN  
**ECTS Credit Points:** 5  
**Evaluation:** ESE  
**Year, Semester:** 1<sup>st</sup> year/2<sup>nd</sup> semester  
**Number of teaching hours/week:**  
- Lecture: 2  
- Practice: 2  
**Prerequisites:** N/A  
**Topics:**  
This series of lectures covers the topics related to measurement, data acquisition, signal analysis, dynamical and event driven system modelling.

**Literature:**

**Real-time Embedded Programming**
**Image Processing**

**Code:** MFKEP51C03-EN  
**ECTS Credit Points:** 3  
**Evaluation:** ESE  
**Year, Semester:** 2nd year/1st semester  
**Number of teaching hours/week:**  
Lecture: 2  
Practice: 1  
**Prerequisites:** N/A  
**Topics:**  
This series of lectures covers the topics related to image processing and computer vision for industrial applications.  
**Literature:**  

**Electronics Technology**

**Code:** MFETN51C04-EN  
**ECTS Credit Points:** 4  
**Evaluation:** ESE  
**Year, Semester:** 1st year/2nd semester  
**Number of teaching hours/week:**  
Lecture: 2  
Practice: 1  
**Prerequisites:** -  
**Topics:**  
This series of lectures is based on the topics of electronics technology. The aim of the course is to introduce students to basic theoretical and practical knowledge of electronic circuits, modules and systems implementation developing their skills. Acquiring knowledge, respectively and the realization of electronic products is important for materials, components, manufacturing equipment and devices for certification. Students will acquire basic module circuits and methods of manufacture and assembly of equipment. They learn the tools of electronic technology and manufacturing and inspection equipment. Technological practiced methods of implementation. Students learn about module circuits documentation too.  
**Literature:**

**Computer simulation**

**Code:** Computer simulation MFSIM51C02-EN

**ECTS Credit Points:** 4

**Evaluation:** mid-semester grade

**Year, Semester:** spring

**Number of teaching hours/week:**

Lecture: 0
Practice: 2

**Prerequisites:**

**Topics:**

Tasks of simulation, overview, sample examples. Digital simulation of constant systems; Instructing-oriented and block oriented construction of systems. Description of constant and sampling systems; Block oriented types of general computational blocks of simulation systems; Realization of integration formulae, bindings, data flow programming (computation order); simulation of big time constant difference (stiff systems); Types and tasks of simulation of discreet events. Basic elements of generalized simulation: source, buffer, time delaying element, swallower type element; steps of a discreet event for simulating model's construction; Definition of a discreet event of simulating model's running time and style. Optimization of the parameters of technical systems; searching for the parameters of technical systems in a structure (identification). Hardware-in-the-loop (HIL) simulation.

**Literature:**

Dr. Schnell László (főszerk.): Jelek és rendszerek méréstechnikája. Műszaki Könyvkiadó, Budapest, 1985. Dr. Schnell László (főszerk.): Jelek és rendszerek méréstechnikája I. és III. kötet (51435, 514352, régen J5-1435, J5-1435/b)

**Field-specific vocational subjects**

**Design of mechatronics systems**

**Code:**

**ECTS Credit Points:** 4

**Evaluation:** mid-term grade

**Year, Semester:** spring

**Number of teaching hours/week:**

Lecture: 2
Practice: 1

**Prerequisites:**

**Topics:**

This course deals with the integration of the mechanical and electrical engineering disciplines within a unified framework. The topics are: Mechatronic systems classification, A mechatronic system in architecture, Modelling and simulations of mechatronic systems, actuators of a Mechatronic system. Electrical machines for mechatronic applications. Power electronic converters design and development for mechatronic systems. Current source and voltage source PWM converters design. Sensors interfacing to mechatronic systems. Data acquisition systems design and implementation for mechatronic systems. Mechatronics systems programming. Driver and interface programs development for mechatronic systems. Dynamic performances evaluation of mechatronic systems. Mechatronic
systems industrial applications. Significant laboratory-based design experiences. Topics covered in the course include:
Low-level interfacing of software with hardware; use of high-level graphical programming tools to implement real-time computation tasks; digital logic; analog interfacing and power amplifiers; measurement and sensing; electromagnetic and optical transducers; control of mechatronic systems.

Literature:

Industrial applications of mechatronics systems: vehicles, building automation and robotics I.
Code: MFEFBS1C04-EN
ECTS Credit Points: 4
Year, Semester: 1st year/2nd semester
Number of teaching hours/week:
Lecture: 2
Practice: 6
Prerequisites: -
Topics:
Mechatronics in industrial and consumer products.
Overview of application areas: vehicles, buildings and robotics.
Vehicles as a mobile machine with intelligence.
Vehicle dynamics and control. Cars, trucks, boats and aircrafts.
Intelligent functions and behaviors: sensors, decision making and actuation.
Telemetry of vehicles: internal combustion engine, electric driven. Data clustering, analysis and visualisation.
Literature:

Industrial applications of mechatronics systems: vehicles, building automation and robotics II.
Code: MFEFBS2C04-EN
ECTS Credit Points: 4
Year, Semester: 2nd year/1st semester
Number of teaching hours/week:
Lecture: 1
Practice: 3
Prerequisites: -
Topics:
Introduction, Building automation and information management
Application areas and use cases of building automation
Sensors, actuators, field controllers and field networks
Electrical power distribution for building automation, cables, networks and protection circuits
Security (alarm and access control) systems: technology, application and networks
Fire safety systems: sensors, cabling and centers
Communication: field networks, LAN, WAN. Wired and wireless solutions.
Building Energy Management
Literature:
Students majoring in the Mechatronical Engineering MSc have to carry out a 4 weeks internship involved in the model curriculum. The internship course must be signed up for previously via the NEPTUN study registration system in the spring semester (4th semester). Its execution is the criteria requirement of getting the leaving certificate (absolutorium).

**Objective of the internship, competences**

- Students get acquainted with quantitative methods, econometrics, leadership competences, managerial accounting, production and service management, project management and engineering technology in conformity with their major at the company or institution and join in the daily working process.
- During the internship common and professional competences may be acquired. Common competences: precise working on schedule either individually or in team, talking in groups about correct managing terms. Professional competences: applying the professional skill gained during the training and acquiring new knowledge.

**Places suitable for internship**

All the organizations, institutions and companies, which provide students with the opportunity to acquire proficiency in the field of management may be a suitable place.

**Documents necessary for commencing and completing the internship**

<table>
<thead>
<tr>
<th>document</th>
<th>copy</th>
<th>signer(s)</th>
<th>submission deadline</th>
<th>receiver</th>
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</thead>
<tbody>
<tr>
<td>Invitation Letter</td>
<td>1</td>
<td>company</td>
<td>29th May 2016</td>
<td>secretariat (Mrs. Anton Sándorné)</td>
</tr>
<tr>
<td>Internship Cooperation</td>
<td>2</td>
<td>company, faculty</td>
<td>29th May 2016</td>
<td>secretariat (Mrs. Anton Sándorné)</td>
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<td><strong>or</strong></td>
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<tr>
<td>“Megállapodás”</td>
<td>4</td>
<td>company, supervisor</td>
<td>29th May 2016</td>
<td>secretariat (Mrs. Magdolna Anton Sándorné)</td>
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<tr>
<td>(Company in Hungary)</td>
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<td>faculty, major</td>
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<tr>
<td>Evaluation Sheet and</td>
<td>1</td>
<td>company</td>
<td>11th September 2016</td>
<td>Ms. Andrea Matkó</td>
</tr>
<tr>
<td>Certificate</td>
<td></td>
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</tbody>
</table>

Initiative of the internship at the company and providing for the documents from the company is the student’s duty. If the student doesn’t specify the receiving company or doesn’t provide for the Invitation Letter or the initiative of the Agreement (or its signature) in time, the major responsible will refuse the Internship Certificate.

**Requirements**

**A, for a signature:**

1. Duration of the internship is 4 weeks and participation in it is compulsory. A Student must complete the work hours altogether at the company. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the supervisor may evaluate their participation as an absence due to the lack of active participation in internship.
2. Besides completing the internship, a student has to compile a 15-20 pages essay about the work done. The topic of the essay must be negotiated with the supervisor and attached to the activity actually done by the student.

3. The execution of the internship must be certified by the Evaluation Sheet and Certificate form can be downloaded from the website of the Department of Mechanical Engineering.

**The deadline of submitting the Essay and the “Evaluation Sheet and Certificate”:**

11th September 2016.

**Exemption**

A partial exemption may be required by a student who has completed an internship in secondary school and it is certified by the secondary school certificate. The request for partial exemption can be submitted till 31st May 2016. After this deadline requests are denied. A copy of the secondary school certificate and a written request addressed to Dr. Zsolt Tiba the major responsible must be submitted to Ms. Nóra Tóth.

In case of any problems arising from the internship please contact Ms Andrea Matkó instructor (office 120, husigeza@eng.unideb.hu or Ms. Nóra Tóth secretary (office 120, tothnora@eng.unideb.hu).
LABORATORIES

Laboratory and tutorial workshop background of the Mechanical Engineering and Mechatronics Engineering fields

- **Biomechanical materials testing lab**: for testing prosthesis’, plastics’ and light metals’ joints. Applied equipment: INSTRON 8874 universal biaxial materials testing machine.
- **LabView teaching room**: The basic teaching of LabView is carried out by 8 colleges trained by National Instruments (NI), in the teaching room supplied with 40 PCs. This lab is equipped with the latest technology of NI.
- **LEGO MINDSTORM teaching room**: Thanks to LEGO Hungary, 8 pieces of LEGO MINDSTORM robots are available for teaching the basics of the robot actuation and sensing technologies.
- **Machine elements lab**: oscilloscope, photo elastic bench, Spider 8 amplifier, DMC 9012 amplifier, CATMAN evaluating software, force transducer, torque transducer, inductive displacement transmitter, test pads.
- **Machining shop**: 5 machine lathes, 2 milling machines, gear-cutting machines, generating milling cutters, centre grinder, web-framed cross-cut saw, EMCO PC Mill type CNC drilling machine, CKE 6136i type CNC turning machine.
- **Material testing lab**: OLYMPUS GX41, NEOPHOT-2 and EPIGNOST-2 type metal microscopes.
- **Machine repairing lab**: hand tools, turning lathe, Castolin ROTOTEC type flame spraying pistol, EUTALLOY Super Jet type flame spraying pistol, column-type drilling machine.
- **Measuring lab**: calliper gauge, micrometer calliper gauge, base tangent length micrometer, optical dividing head.
- **Mechanical technology lab**: tensile-testing machine, ZD 20 type hardness tester, impact-tester, Brinell microscope, fatigue-testing machine.
- **Metallographic lab**: NEOPHOT type 2 and EPIGNOST type 2 microscopes, grinding- and polishing machines, power supply and auxiliary tools for electrolytic etching.
- **SKF and diagnostics lab**: manual OILCHECK equipment, CMVP type 10 vibrometer pen, CMVP type 30 SEE pen, shock impulse analyzer with PRO32-2 and PRO46-2 software, Testo 816 type acoustimeter, infrared distance thermometer, UNIBALANCE 4 type balancing equipment, informatics background.
- **X-Ray lab**: MXR type equipment, Liliput type radiation source, VA-J-15 type radiations-measuring assembly, densitometer, processing gauge, radiographic materials testing, magnetic crack detection, ultrasonic testing, liquid-penetrant testing.
- **Welding workshop**: 8 gas welder workstations, 6 manual arc welding workstations, 3 consumable-electrode welding workstations, 3 argon-shielded tungsten-arc welding workstations.
- **ZF Lenksysteme Hungary Automotive Laboratory**: the laboratory is equipped with ZF Lenksysteme Hungary’s products, mountable steering systems and steering columns.

Laboratories of the Building Mechatronics Research Center

- **Building mechatronics research laboratory**: The purpose of the laboratory is the elaboration of methods to carry out intelligent evaluation of measurements, intervention and planning. The competence of the laboratory includes the integrated parts of building
automation, building supervision and security techniques, including the operation of necessary sensors, regulators and interveners, which is defined as building mechatronics.

- **Hydraulics laboratory**: Presentation of most modern hydraulic systems and research in the field of hydraulics, teaching of hydraulic subject-matters on the basis of the programs elaborated by FESTO Ltd. Didactic, resp. BOSCH-Rexroth. The laboratory has been set up and is sponsored by BOSCH-Rexroth Ltd. and FESTO Didactic Ltd.

- **Laboratory of electronic engineering and electronics (Rohde & Schwarz reference lab)**: The main competence of the laboratory is the measuring of electric quantities in the field of mechatronics, mechanical engineering and chemical mechanical engineering by means of digital and analogue circuits. There are 10 measuring stations in the laboratory, which means that 20 students can carry out measurements at the same time.

- **Laboratory of re-configurable mechatronics controllers**: The purpose of the laboratory is the research and further development of intelligent controllers by using freely configurable digital electronic tools.

- **Measurement and Control Engineering Laboratory**: The following tools are of cardinal importance in the laboratory for the support of teaching and research activities:
  - storing oscilloscope
  - power-supply unit
  - digital manual instruments
  - plotter
  - function generator
  - data collection and signal conditioning unit

- **MPS manufacturing line laboratory**: Teaching of pneumatics on the basis of the program elaborated by FESTO Ltd. Didactic in the field of pneumatics, electro-pneumatics, hydraulics, electro-hydraulics, PLC technique, driving technique, mechatronics and sensor technique.

- **MPS PA laboratory**: Presentation and research processes based on the flow of industrial liquids. Study and research of the control of closed and opened systems. Festo Didactic’s Learning System for process automation and technology is orientated towards different training and educational requirements.

- **NI Elvis (Educational Laboratory Virtual Instrumentation Suite) Lab**: The NI Educational Laboratory Virtual Instrumentation Suite (NI ELVIS) features an integrated suite of 12 of the most commonly used instruments in the lab - including the oscilloscope, digital multimeter, function generator, variable power supply, and Bode analyzer - in a compact form factor for the lab or classroom demonstrations. Based on NI LabVIEW graphical system design software, NI ELVIS, with USB plug-and-play capabilities, offers the flexibility of virtual instrumentation and allows for quick and easy measurement acquisition and display.

- **Pneumatics laboratory (FESTO FACT - Festo Authorized and Certified Training Center)**: Teaching of pneumatics on the basis of didactic programs of FESTO Ltd. In the field of pneumatics, electro-pneumatics, hydraulics, electro-hydraulics, PLC technique, driving technique, mechatronics and sensor technique.

- **Robotics laboratory**: The lab contains 16 workstations of robot technology, allowing 32 students to work simultaneously. There are altogether 16 PLC controlled robots at the 16 workstations.
- **Schneider Electric knowledge center:** all teaching, research, expert and advisory activities concerning the products of Schneider Electric and the examination of the possibility of their non-conventional use. The laboratory is suitable for the following activities:
  - Teaching of industrial controls by means of small and medium PLCs and realization of real industrial processes on twido demonstration tables built with PLCs of type M340.
  - Regulation of driving technical models by programming frequency changers (ATV11, ATV31 and ATV71).
  - Complex engineering tasks by connecting operating models into the network.

**IT laboratories and software**
- AutoCAD® Map 3D
- AutoCAD® 2010
- Solid Edge
- FEMAP v9.3
- Autodesk® Inventor®
- AutoCAD® Electrical
- Autodesk® Robot™
- ECOTECT
- LabVIEW
- RobotStudio
- Fanuc Oi MATE TC Control

**Air and Noise Protection Laboratory**

**Purpose of the laboratory**
The Air and Noise Protection Laboratory provides the practical background for different courses such as Noise and Vibration Protection, Air Quality Protection, and Unit Operations. Numerous different specific software are introduced to students in the lab, which is also the place for result processing of field measurements.

**Competence of the laboratory**
The laboratory is suitable for carrying out and post-processing acoustic and vibration diagnostic tests. In addition, modeling noise and air pollution propagation and noise mapping are also important tasks of the lab, just like mathematical modeling of dynamical systems in the field of chemical and environmental methods. Numerous software are used for the determination of optimal operation of chemical and environmental systems.

**Our partners**
DKV Debrecen Transportation Services Ltd., Plánum 97 Ltd., TIKTVF (Green Authority)

**Equipment in the laboratory**
The laboratory boasts 20 personal computer with software for modeling noise and vibration measurements (IMMI, SAMURAI) and environmental processes (MATLAB, Control System Toolbox, Simulink Toolbox). The laboratory is also equipped with measurement systems and
devices for in situ tests, such as a Soundbook universal multi-channel acoustic measuring system, four channel analyzers with Samurai software for vibration and noise measurements, a PDV 100 portable digital vibrometer, SINUS 3D seismometer and a Larson Davis 831 sound level meter. Additionally, other sound level meters are available for student measurements.

Cutting and CNC Workshop

Purpose of the laboratory
The laboratory is based on the common and latest production technologies, thanks to which students have the opportunity to see the material removal processes on the production machine in real time. The machinery and equipment used in the lab provide the scientific and technical background to education. The available technologies are identical with the latest technologies used in industry.

Competence of the laboratory
Students learn about the basic manufacturing procedures (lathe machining, milling, planning, sawing, grinding gear-tooth forming), the main parts of the equipment and their operation by working on the machines in small groups. They also have the opportunity to study the cutting edge geometry of the different tools.

Our partners
Optimum Hungary Ltd

Equipment in the laboratory
The workshop is equipped with five universal lathe machines, a universal milling machine with two planer machines each, a Fellow Gear machine, two saw machines, two grinding machines used to sharpen tools.
A type of OPTI M2 CNC milling machine, a CNC lathe L28 Opti and Opti D280x700 a type universal lathe.
CNC programming and simulation software are available for ten students.
**Diagnostics Lab**

**Purpose of the laboratory**
The purpose of the lab is to provide the technical background to different diagnostic tests and measurements applied in general mechanical engineering. Studying the application of measuring systems and special diagnostic devices is also emphasized in the lab. Students can practise how to set up and carry out measurements and draw the conclusion about technical problems.

**Competence of the laboratory**
Acquiring the basics of measurement techniques of machine fault diagnostics applied in machine repairing and maintenance engineering fields. With the up-to-date equipment and measuring systems students carry out different testing and structural analysis of structures and machine elements as research and scientific activities. Our lab also provides the scientific and technical background for PhD students.

**Our partners**
SKF Group, FAG Schaeffler Technologies AG & Co. KG · Deutschland, GRIMAS Hungary Ltd., SPM Instrument Budapest Ltd., KE-TECH Ltd.

**Equipment in the laboratory**
The following measurement devices are available:
- Oilcheck oil tester
- CMVP 10 vibration tester
- CMVP 30 SEE tester
- SPM analysator with PRO32-2 and PRO46-2 software’s
- VIB 10 vibrometer
- Testo 816 noise meter
- Center 320 noise meter
- Infrared thermal meter
- SPM Leonova Infinity universal vibration tester
- SPM Vibchecker
- SPM Bearingchecker
- Flir (ThermaCAM E45)
- Labview software
- Audacity acoustic software
Building mechatronics research laboratory

Purpose of the laboratory
The goal of the laboratory is the elaboration of methods for carrying out intelligent evaluation of measurements, intervention and planning. The international research carried out in the laboratory promotes the activity of practicing planners, operators and builders so that they can use more efficient building engineering and building supervision systems from an energetic aspect and for buildings to meet the comfort feeling of residents, especially their special requirements in case environmental conditions differ from normal circumstances.

Competence of the laboratory
The competence of the laboratory includes the integrated parts of building automation, building supervision and security techniques, including the operation of necessary sensors, regulators and interveners, which is defined as building mechatronics. Our researchers have a wide-ranging theoretical and practical experience in automation of building engineering systems of intelligent grounds, elaboration of their support by means of building information technology as well as elaboration of objectives relating to the cost-saving intelligent automation of systems.

Our partners
The laboratory was established thanks to the EU-funded project “HURO/0802/155_AFA „Hungarian-Rumanian Research and Development Platform for supporting the building of Intelligent Buildings” and with the co-operation of the European Regional Development Fund. Apparatus utilizing renewable energy were built with the co-operation of ENERGOTEST Ltd, while the measuring and automations objectives have been realized by means of instruments and software of National Instruments.

Equipment in the laboratory
The construction and embodiment of the apparatus manufactured individually and installed into the laboratory promotes the access for teaching, research, presentation and measurement.

- Hot water supply system
- Vacuum-tube solar collector (1000W).
- Flat solar collectors:
- Buffer stores

...
6 pcs solar cells (PV) to be used for research.
Rotating stand

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**Biomechanics Laboratory**

**Purpose of the laboratory**
The main purpose of the lab is the determination of mechanical properties of polymer structural materials and biomaterials in contrast with stress. The Laboratory of Biomechanics participates in material testing, particularly in tests of human bones. The Laboratory supports the following courses: Biomechanics, Material Testing Methods of Plastics and CAD-CAM, Rapid Prototyping. It is also used for various research activities.

**Competence of the laboratory**
The Biomechanical Material Testing Laboratory was founded in 2005 for accredited material testing activities with its quality management system. The main activity of the Material Testing Laboratory is research: various biomechanical nature experiments, measurements and tests. In accordance with the accredited activity orders from external companies are executed as well.

**Our partner**
DEKK (University of Debrecen, Clinical Center)

**Equipment in the laboratory**
The most important devices of the laboratory:
- Instron 8874 biaxial material testing machine,
- Instron AVE advanced video extensometer,
- Instron 51 portable digital durometer,
- Mitutoyo measuring devices,
- Torque meters,
- Connex three dimensional printer
- Zprinter 310 three dimensional printer,
- Cobra Fastscan three dimensional scanner.
Heat Treatment Lab

Purpose of the laboratory
Heat treating is a group of industrial and metalworking processes used to alter the physical, and sometimes chemical, properties of a material. The following basic heat treatment techniques take place in the laboratory: annealing, case hardening, precipitation strengthening, tempering and quenching processes for small groups (8-10 students).

Competence of the laboratory
The lab supports the teaching of the Materials Sciences and Manufacturing Engineering practice course, and presents the main heat treatment processes for small groups (8-10 people). With the up-to-date equipment and heat treatment techniques different heat treatment methods of different materials can be carried out as research and scientific activities.

Equipment in the laboratory
- Heat treatment furnaces: RE-60, KO-14, ET-2
- Quenching vessels: water, oil, salt
- Hardness testers
- Temperature measurement & management equipment
- Personal protection & safety equipment

Machine Elements Lab

Purpose of the laboratory
The machine elements lab practice is part of the Machine Elements course, which introduces machine elements and machine constructions built up of them to students, familiarizing them with the material taught at lectures. Machines and equipment in the lab are designed in the framework of the four designing tasks: Welded Machinery Base; Hydraulic Cylinder; External Double-Shoe Thruster Released Drum Brake; Counter drive, which may be dismantled and assembled with the guidance of the instructor.

Competence of the laboratory
Students have the opportunity to gain hands-on experience with machine elements and parts and to study their construction and operation methods. The lab provides the background for the technical knowledge and hands-on skills required by the educational and outcome requirements of the training program. Students have the opportunity to design the four designing tasks, operate and maintain mechanical systems. The lab is equipped with test-benches instrumented with an up-to-date measuring system comprising an amplifier and evaluating software, which is suitable for the fast, electrical measurement of mechanical parameters changing with time.

**Our partner**
Hottinger Baldwin Messtechnic Ltd. (HBM)

**Equipment in the laboratory**
Test benches for testing drive train vibration, bolted joints, spring operation, endurance limit of composite materials and friction phenomenon between surfaces, and so on. The lab is instrumented with Spider 8 amplifier and CATMAN Easy software from HBM for acquisition and evaluation of the measurement signals provided by transducers for the measurement of force, pressure, acceleration, torque, and displacement. The Catman software package running under MS-Windows is applied for experimental stress analysis with strain gauges and an on-line measurement system.

The applied transducers and gauges:
- force transducers: measure static and dynamic tensile and compressive loads,
- torque transducers: in rotating and non-rotating version,
- pressure transducers: for absolute and differential pressure measurements,
- displacement transducers,
- strain gauges for determining the strain on the surface of components,
- piezoelectric accelerometer.

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**Hydraulics laboratory**

**Purpose of the laboratory**
Presentation of most modern hydraulic systems and research in the field of hydraulics.

**Competence of the laboratory**
Teaching of hydraulic systems of different courses by means of software developed by FESTO Didactic Ltd, resp. BOSCH-Rexroth.

**Our partners**
The laboratory is sponsored by BOSCH-Rexroth Ltd and FESTO Didactic Ltd.
Equipment in the laboratory
- Two-side stand system with hydraulic power-supply unit, slave cylinder, hose storage, oil tray, hydro-battery, cog-wheel motor, pressure limiter, stuffing-one-way valves, electronically controlled root changers, manometers,
- error locating system: electro-hydraulic elements operating defectively, manually controlled valves operating defectively,
- a set of mobile hydraulic elements, including the control block necessary for mobile hydraulic research,
- axial-piston hydro-motor, pre-controlling apparatus and loading simulator.

Laboratory of electronic engineering and electronics

Purpose of the laboratory
In the laboratory students obtain experience in the field of electronics and electronic engineering in the framework of the following courses: electrical engineering and electronics, technique and electronics and chemical science of mechanics.

Competence of the laboratory
Students measure electric quantities by means of digital and analogue circuits composed by the students themselves, which enables them to extend their experience. The examination of passive and active elements for understanding the operation of digital and analogue circuits is also possible, just as well as practising the search of electric errors. The laboratory takes part in the development of electric cars through activities such as the energy supply of vehicles, charging batteries, planning and building dashboard panels.

Equipment in the laboratory
There are 10 measuring stations in the laboratory, where 20 students can carry out measurements at the same time. The equipment of the stations includes 2-channel and 35-MHz oscilloscopes, 2-MHz function, direct-current double power-supply units, 3.5-digit multimeters, and measuring bags.
Mechanical Lab

Purpose of the laboratory
The laboratory is based on common testing methods of raw materials, technological materials and structures like welded joints. The devices in the lab follow the order of an ordinary material testing method. There are several devices for test sample preparation (cutting, grinding). Comprehensive analysis of materials is rendered possible by the tensile test machine and the Charpy impact testers.

Competence of the laboratory
Transferring the basic knowledge of lectures of material testing, technology of structural materials, fracture mechanics courses, representing the testing processes by specialized test machines. Our lab is a scientific and technical background for PhD students providing the facilities to carry out experimental tests for research and scientific activities.

Equipment in the laboratory
- Tensile test machine (with computer managed closed loop data storage & handling)
- Charpy impact tester machines (computer controlled from 0 to 450J impact range)
- Hardness tester (computer managed)
- Furnace up to 1300°C (computer managed heating & cooling curve)
- Personal protection & safety equipment

MPS PA laboratory

Purpose of the laboratory
- Presentation and research processes based on the flow of industrial liquids,
- study and research of the control of closed and open systems,
- FESTO Didactic’s Learning System for process automation and technology is orientated towards different training and educational requirements.

Competence of the laboratory
Teaching of pneumatics on the basis of didactic programs by FESTO Ltd. in the fields of pneumatics, electro-pneumatics, hydraulics, electro-hydraulics, PLC technique, driving technique, mechatronics and sensor technique. The systems and stations of the modular Production System for Process Automation (MPS® PA) facilitate vocational and further training in line with industrial practice. The actual project phases can be taught in training projects which include: planning, assembly, programming, commissioning, operation, optimisation of control parameters, maintenance and fault finding.

**Our partners**
The laboratory was established within the framework of the project TÁMOP-4.1.1/A-10/1-KONV-2010-0016 and supported by FESTO Ltd Didactic.

**Equipment in the laboratory**
- instrumentation for measuring and evaluation of quality and technological data of filtering, mixing, reactor, charging (bottling), thermo and hydrodynamic measurements, control with opened and closed cycle,
- filtration, mixing, reactor station and bottling station.

**MPS Manufacturing Line Laboratory**

**Purpose of the laboratory**
- Teaching and research of industrial discrete processes;
- study and research of the control of closed and open systems.

**Competence of the laboratory**
Teaching of pneumatics on the basis of the program developed by FESTO Didactic Ltd. in the field of pneumatics, electro-pneumatics, hydraulics, electro-hydraulics, PLC technique, driving technique, mechatronics and sensor technique. The laboratory carries out research on the basis of contracts signed with FESTO Didactic Ltd.

**Our partners**
The laboratory is sponsored by FESTO Didactic Ltd.

**Equipment in the laboratory**
- a 5-cation manufacturing line built by FESTO Didactic Ltd.
- software programming of the production schedule, examination of the advance and automated quality monitoring between actions of the manufacturing
NI ELVIS laboratory

Purpose of the laboratory
The aim is to provide practical courses in basic electrotechnics and electronics, and to grant specialized knowledge and experience to mechatronics students in special areas like data acquisition, Labview programming and research on the system of NI ELVIS (Teaching Laboratory Virtual Instrumentation Suite).

Competence of the laboratory
Based on NI LabVIEW graphical system design software, NI ELVIS, with USB plug-and-play capabilities, offers the flexibility of virtual instrumentation and allows for quick and easy measurement acquisition and display in the field of control, telecommunication, fiber optics, embedded design, bioinstrumentation, digital electronics, and field-programmable gate arrays (FPGAs). Besides our teaching duties, these NI tools enable us to conduct research and software development in different fields of sciences.

Our partners
The laboratory is maintained by National Instruments Hungary Ltd and financed by the project HURO-0901/028/ 2.3.1. „E-Laboratory Practical Teaching for Applied Engineering Sciences”.

Equipment in the laboratory
The NI Educational Laboratory Virtual Instrumentation Suite (NI ELVIS) features an integrated suite of 12 of the most commonly used instruments in the lab (including the oscilloscope, digital multimeter, function generator, variable power supply, and Bode analyser) in a compact form factor for the lab or classroom demonstrations.

NDT (Metallographic) Lab

Purpose of the laboratory
The laboratory is based on NDT testing of raw materials, technological materials and structures like welded joints. The devices in the lab follow the order of an ordinary material testing method. There are several devices for test sample preparation (cutting, grinding, polishing and chemical conservation). Metallographic analysis of the prepared sample is rendered possible by a microscope. Besides, there are several NDT (metallographic) inspection equipment to create a comprehensive analysis of the material.

**Competence of the laboratory**
Supporting the education of basic lectures like material science, technology of structural materials, manufacturing technologies I-III. Supporting our student’s measuring for scientific contests. With the up-to-date equipment and measuring techniques we are able to do different testing and structural analysis of special technological materials as research and scientific activities. Our lab is also a scientific and technical background for PhD students.

**Equipment in the laboratory**
- Cutting, grinding and polishing machines to create samples
- Hardness testers (computer managed HB, HRC, HV)
- Ultrasonic wall thickness measurement equipment
- Ultrasonic hardness tester
- Microscopes (Neophot with CCD & Olympus with CCD up to M=250x digital imaging)
- Image analysis software
- Furnace up to 1300°C (computer managed heating & cooling curve)
- Qualified measuring tools (callipers, gauges, micrometers)

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**Pneumatics laboratory**

**Purpose of the laboratory**
Presentation of the most modern pneumatic systems used in industry and research in the field of pneumatics.

**Competence of the laboratory**
Teaching of pneumatics on the basis of didactic programs of FESTO Ltd in the field of pneumatics, electro-pneumatics, hydraulics, electro-hydraulics, PLC technique, driving technique, mechatronics and sensor technique.

**Our partners**
The laboratory is sponsored by FESTO Didactic Ltd.

**Equipment in the laboratory**
- FESTO teaching package (PLC, VEEP emulator, wires, tools, specifications…),
two-side pneumatic stand system: pneumatic power-supply unit, hose storage,
basic and electro-pneumatics, proportional pneumatic stock.

Robotics laboratory

Purpose of the laboratory
Teaching of robotics and research processes concerning the robotizing of industrial processes.
Presentation of CIM systems and research of the possibilities of integration

Competence of the laboratory
- Use and programming of recycle bin robots, carrying out of examination concerning the operation of robots,
- examination of human-machine communication on intelligent grounds, where robots and humans are present at the same time and perhaps co-operate with each other in space.

Our partners
The laboratory is supported by KUKA Robotics Hungary Ltd, Robot-X Hungary Ltd, Flexlink Systems Ltd.

Equipment in the laboratory
- 3-axe TTT Q-robot multitasking robot, a KR5arc KUKA industrial robot, a KR5Sxx KUKA teaching robot and a SONY SCARA SRX-611 robot connected with a delivery track incorporated into a manufacturing cell,
- 8 pcs LEGO MINDSTORM robot and a sample manufacturing line consisting of 16 Fischertechnik elements developed by the university as well as a FESTO Robotino robot,
- KUKA.Sim Pro software developed for programming offline KUKA robots and their simulation.

Roller Power Test Bench and Diagnostics Lab for Passenger Cars
Purpose of the laboratory
The roller power test bench is appropriate for measuring and diagnosing the vehicle performance and its condition. The installed test bench makes wide range power measurements possible in different speed range in a safe environment. Students can carry out a series of measurements in the laboratory about internal combustion engine performance, exhaust gas analysis and on-board diagnostic (OBD) systems. These measurements may support the degree theses of students.

Competence of the laboratory
The installed measuring equipment of Vehicle Engine Performance Measurement and Diagnostic Laboratory have official calibration and authentication, therefore performance measurements, exhaust gas analyses, emission measurement and diagnostic tests carried out in this laboratory are all certified.

Our partners
Energotest Ltd

Equipment in the laboratory
- Rolling road dynamometer (TMP-350) with CAN bus based measurement data logger unit. The equipment is suitable for performance measurement of two-wheel-drive passenger cars and light duty vans up to 350 kW. Our lab is able provides scientific and technical background for PhD students.
- Exhaust gas analyser instrument (AVL DiGas 480) which is capable of measuring the composition of exhaust gas. The measuring system is also equipped with Diagnostic Trouble Codes scanner, diagnostic software and an Autodata emission database.
- The laboratory is equipped with more wind generators and exhaust gas extractors.

Schneider Electric Knowledge Center

Purpose of the laboratory
The knowledge center established by Schneider Electric Ltd offers complete solutions in the field of energy management, electric energy distribution, control engineering and automation of processes of industry, building automation and security, energy supply and cooling as well as installation and the control of installation systems. The knowledge center is instrumented for the presentation of these systems as well as for carrying out research of building supervision systems.

Competence of the laboratory
The laboratory is suitable for the following activities:
- Teaching of industrial controls by means of small and medium PCs and realization of real industrial processes on twido demonstration tables built with PLCs of type M340.
- Regulation of driving technical models by programming frequency changers (ATV11, ATV31 and ATV71).
- Complex engineering duties by connecting operating models into the network.

**Our partners**
Schneider Electric Hungary Ltd

**Equipment in the laboratory**
- TAC system for realizing a complete building supervision A (TAC 302, 422, 731, 100, 452, 511 OPC panel) and terrain tools,
- let-in/let-out and camera system controlled by an Andover system,
- the laboratory is officially informed about any development carried out by Schneider Electric and given a sample of its products.

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**Water Quality Protection Laboratory**

**Purpose of the laboratory**
The laboratory has all basic tools applied in environmental engineering to ensure a strong practical analytic background for field and laboratory measurements. Several research topics are also connected to the equipment of the laboratory (such as investigation of rain water or greywater reuse in households; thermal water final placement and the environmental effect of thermal water utilization; surface water analysis and environmental status assessment of watercourses surrounding Debrecen).

**Competence of the laboratory**
Environmental engineers get a good experience and knowledge on the prevention of environmental hazards, the abolition of environmental problems, the utilization of natural resources, cleaner technologies, analytical and monitoring methods. The lab is equipped with modern and efficient instrumental analytical devices to get reliable and fast results for water or sludge samples.

**Our partners**
TIKTVF (Green Authority), Debrecen Waterworks Ltd., Hajdú-Bihar County Municipalities Water Works Co., Ltd. Analab Ltd., Scharlab Hungary Ltd., NNK Environmental Management, Information Technology, Sales and Service Ltd.

**Equipment in the laboratory**
Classical and instrumental analytical techniques for investigation of different water or sludge samples:
- DIONEX ICS 3000 ion chromatographic system,
- Shimadzu Vcpn TOC instrument,
- Zetasizer Nano Z zeta potential analyser,
- WTW MultilineP4 electro-analytical set,
- BOD OXITOP IS 12 measurement, Thermostat cabinet,
- Nanocolor Linus spectrophotometer with thermoblock,
- TURB-555 IR Turbidimeter,
- Millipore Milli-Q Integral 3 water purification unit,
- Classical analytical methods (gravimetry and titrimey).

### Welding Lab

**Purpose of the laboratory**

- Instruction, presentation and practice of advanced welding procedures used in industry all over the world,
- to ensure the proper technological environment for the construction of racing cars driven by compressed air or electric motors for student’s competitions.

**Competence of the laboratory**

Introduction of the basic welding processes by welding joints of test specimens. The lab supports the Materials Sciences and Manufacturing Engineering courses.

The laboratory is equipped with eight welding dry boxes for electric arc-welding and one for gas-welding and metal cutting. Students learn and practise four different welding procedures:

- Manual metal arc welding (MMA)
- MIG-MAG gas-shielded arc welding (MIG-MAG)
- Wolfram electrode welding with argon shielding gas (GTAW-TIG, WIG)
- Gas welding, flame cutting, and plasma cutting.

**Equipment in the laboratory**

- MILLER Powcon-300 type welding machines for MMA welding,
- MILLER Synchrowave-250 type welding machines for TIG welding,
- MILLER MIBLU-300 type welding machines for gas-shielded metal-arc welding,
- WELDI TIG-200i DC type welding machines for TIG and MMA welding,
- WELDI AMIGO-250, WELDI MIG-320 Plus, WELDI MIG-420 type welding machines for gas-shielded metal-arc welding.

### ZF Lenksysteme Hungária Automotive Lab

**Purpose of the laboratory**
The ZF Lenksysteme Hungária Automotive Laboratory was established by ZF Lenksysteme Hungária Ltd. in 2014. The Laboratory is suitable for performing activities like electric vehicle construction and assembly for student competitions and for company related projects. Thanks to its modern equipment and top class steering systems, the lab ensures the appropriate background for related research.

**Competence of the laboratory**

The Laboratory is suitable for implementing modern engineering projects. The laboratory is equipped with the products of ZF Lenksysteme Hungária Ltd., mountable steering systems and steering columns. Students have the opportunity to investigate real steering systems in the lab, which is also a scientific and technical background for PhD students.

**Our partners**
ZF Lenksysteme Hungária Ltd

**Equipment in the laboratory**

- Turning lathe (OPTI TU 2807 – D280x700mm, 125-1200 f/p, 850W/400V)
- Welding machine (AC/DC AWI)
- Drillers, Cutters
- Hand tools
- Tool trolleys
- Measuring instruments
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