BULLETIN

UNIVERSITY OF DEBRECEN

ACADEMIC YEAR 2016/2017

Mechatronical Engineering MSc

FACULTY OF ENGINEERING

Coordinating Center for International Education
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Welcome to the Faculty of Engineering!

This is an exciting time for you, and I encourage you to take advantage of all that Faculty of Engineering UD offers you during your bachelor’s or master's studies. I hope that your time here will be both academically productive and personally rewarding. Think creatively and be confident. The Faculty of Engineering of the University of Debrecen is at the forefront of the education and training of engineers in the North-Great-Plain Region of Hungary. It is a dynamically developing Faculty with over 3000 students and a highly-qualified and enthusiastic teaching staff of about 80 members. We offer 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 industry and educational partners at home and abroad.

The Faculty was awarded the Quality Prize in 2011 by the Ministry of Education as recognition of its efforts in this field.

I wish you every success in your studies and hope to meet you personally in the near future.

Best wishes,

Edit Szűcs
Dean
CHAPTER 2
THE HISTORY OF THE UNIVERSITY AND DEBRECEN

The history of higher education in Debrecen dates back to the 16th century. The Calvinist Reformed College, established in 1538, played a central role in education, teaching in the native language and spreading Hungarian culture in the region as well as in the whole country. The College was a sound base for the Hungarian Royal University, founded in 1912. Apart from the three academic faculties (arts, law, theology) a new faculty, the faculty of medicine was established, and the University soon became one of the regional citadels of Hungarian higher education. Today the University of Debrecen is classified as a “University of National Excellence” and offers the highest number of academic programs in the country, hence it is one of the best universities in Hungary. Its reputation is a result of its quality training, research activities and the numerous training programs in different fields of science and engineering in English. With 14 faculties and a student body of almost 30,000, of which about 3700 are international students, the University of Debrecen is one of the largest institutions of higher education in Hungary.

Date of Foundation: 1912 Hungarian Royal University of Sciences 2000 University of Debrecen
Legal status of the University of Debrecen: state university
Founder of the University of Debrecen: Hungarian State Parliament
Supervisory body of the University of Debrecen: Ministry of Education
Number of Faculties at the University of Debrecen: 14
- Faculty of Law
- Faculty of Medicine
- Faculty of Humanities
- Faculty of Health
- Faculty of Dentistry
- Faculty of Economics and Business (before 1 August 2014 the predecessors of the Faculty were the Faculty of Applied Economics and Rural Development and the Faculty of Economics and Business Administration)
- Faculty of Child and Adult Education
- Faculty of Pharmacy
- Faculty of Informatics
- Faculty of Agricultural and Food Sciences and Environmental Management (before 1 March 2010 the name of the Faculty was the Faculty of Agriculture)
- Faculty of Engineering
- Faculty of Public Health
- Faculty of Sciences and Technology
- Faculty of Music

Number of accredited programs at the University of Debrecen:
73 degree programs with the pre-Bologna 5-year-system university education, 41 supplementary degree programs offering transfer-degree continuation of studies towards the university degree (MSc), 50 degree programs with the pre-Bologna 3-year-system college education, 67 BSc and 78 MSc programs according to the Bologna system, 5 unified one-cycle linear training programs, 35
specializations offering post-secondary vocational certificates and 159 vocational programs.  

**Number of students at the University of Debrecen: 28812**  
According to time of studies: 22888 full-time students, 5899 part-time students having corresponding classes and 25 part-time students having evening classes or distance education according to education level: 944 students at post-secondary vocational level, 17406 students at BSc, 3112 students at MSc, 21 students at college level, 190 students at university level (MSc), 5320 students at one-cycle linear training, 954 students at vocational programs, 865 students at PhD, 3741 foreign students.  

**Full time teachers of the University of Debrecen: 1421**  
194 full college/university professors and 1055 lecturers with a PhD.
CHAPTER 3

ADMINISTRATION UNITS OF THE FACULTY OF ENGINEERING

Dean: Ms. Edit Szűcs Dr. habil.
E-mail: dekan@eng.unideb.hu

Vice-Dean for Educational Affairs: Géza Husi PhD habil.
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DEPARTMENTS OF THE FACULTY OF ENGINEERING

CHAPTER 4
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Péter Kovács M.D., DLA, Ph.D., D.Sc.
Tamás Szentirmai DLA
Dávid Török DLA

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Ms. Rita Nagyné Kondor Ph.D.

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Ms. Éva Csemusné Ádámkó
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Ákos Lakatos Ph.D.
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Béla Bodó
Imre Csáky
Sándor Hámori
Gábor L. Szabó
Ferenc Szodrai
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College Professor: Géza Lámer Ph.D.
College Senior Lecturer: Ms. Éva Dr. Bujalosné Kóczán
Associate Professor: István Budai Ph.D.
Master Lecturer: Ms. Tünde Jenei
Assistant Lecturer: Tibor Balla M.Sc.
Ms. Anita Dr. Mikó-Kis
Attila Halczan M.Sc.
Ms. Kata Anna Váró
Departmental Engineer: Róbert Sztányi
Engineering Lecturer: Gyula Mikula
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International Relationship Coordinator
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Ms. Erika Thomas
# ACADEMIC CALENDAR OF THE FACULTY OF ENGINEERING

Faculty calendar of the academic year 2016/2017  
Faculty of Engineering, University of Debrecen

<table>
<thead>
<tr>
<th>Event</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening ceremony of the academic year</td>
<td>11&lt;sup&gt;th&lt;/sup&gt; September 2016</td>
</tr>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; semester registration week</td>
<td>From 12&lt;sup&gt;th&lt;/sup&gt; September till 16&lt;sup&gt;th&lt;/sup&gt; September 2016</td>
</tr>
<tr>
<td>Repeat period of exam courses announced for the 1&lt;sup&gt;st&lt;/sup&gt; semester of the academic year 2015/2016</td>
<td>From 12&lt;sup&gt;th&lt;/sup&gt; September till 16&lt;sup&gt;th&lt;/sup&gt; September 2016</td>
</tr>
</tbody>
</table>
| 1<sup>st</sup> semester study period of MSc and BSc program        | From 19<sup>th</sup> September till 23<sup>rd</sup> December 2016  
  (14 weeks).  
  In case of finalist courses: from 19<sup>th</sup> September till 18<sup>th</sup> November 2016 (9 weeks). |
| 1<sup>st</sup> semester study period of BSc dual program           | From 19<sup>th</sup> September till 16<sup>th</sup> December 2016  
  (13 weeks). |
| Reporting period (Drawing week) of MSc, BSc and BSc dual program   | From 31<sup>st</sup> October till 4<sup>th</sup> November 2016  
  (3 working days without scheduled lessons, consultation schedule announced previously). |
| Reporting period (Drawing week, term for elaborating tasks apart from the finalist courses) of BSc program | From 12<sup>th</sup> December till 16<sup>th</sup> December 2016  
  (5 working days without scheduled lessons, consultation schedule announced previously). |
| 1<sup>st</sup> semester exam period                                | From 27<sup>th</sup> December 2016 till 10<sup>th</sup> February 2017  
  (7 weeks).  
  From 21<sup>st</sup> November till 23<sup>rd</sup> December 2016  
  (5 weeks) for graduating students |
<table>
<thead>
<tr>
<th><strong>Deadline of submitting degree theses and dissertations</strong></th>
<th>According to the decision of the departments but in 21 days in proportion to the first day of the final exam.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Final exams (according to the decision of the departments)</strong></td>
<td>At least one occasion in January 2017 The departments shall advertise the date of the final exam until 15\textsuperscript{th} September 2017</td>
</tr>
<tr>
<td><strong>2\textsuperscript{nd} semester registration week</strong></td>
<td>From 13\textsuperscript{th} February till 17\textsuperscript{th} February 2017</td>
</tr>
<tr>
<td><strong>2\textsuperscript{nd} semester study period of MSc and BSc program</strong></td>
<td>From 20\textsuperscript{th} February till 26\textsuperscript{th} May 2017 (14 weeks). In case of finalist courses: from 20\textsuperscript{th} February till 28\textsuperscript{th} April 2016 (10 weeks).</td>
</tr>
<tr>
<td><strong>2\textsuperscript{nd} semester study period of BSc dual program</strong></td>
<td>From 20\textsuperscript{th} February till 19\textsuperscript{th} May 2017 (13 weeks).</td>
</tr>
<tr>
<td><strong>Reporting period (Drawing week) of Msc, BSc and BSc dual program</strong></td>
<td>From 27\textsuperscript{th} March till 31\textsuperscript{st} March 2017 (5 working days without scheduled lessons, consultation schedule announced previously)</td>
</tr>
<tr>
<td><strong>Reporting period (Drawing week, term for elaborating tasks apart from the finalist courses) of BSc program</strong></td>
<td>From 15\textsuperscript{th} May till 19\textsuperscript{th} May 2017 (5 working days without scheduled lessons, consultation schedule announced previously).</td>
</tr>
<tr>
<td><strong>2\textsuperscript{nd} semester exam period</strong></td>
<td>From 29\textsuperscript{th} May till 14\textsuperscript{th} July 2017 (7 weeks). From 24\textsuperscript{th} April till 26\textsuperscript{th} May 2017 (5 weeks) for graduating students.</td>
</tr>
<tr>
<td><strong>Deadline of submitting degree theses and dissertations</strong></td>
<td>According to the decision of the departments but in 21 days in proportion to the first day of the final exam.</td>
</tr>
<tr>
<td><strong>Final exams (according to the decision of the departments)</strong></td>
<td>At least one occasion between 5\textsuperscript{th} and 23\textsuperscript{rd} June 2017. The departments shall advertise the date of the final exam until 15\textsuperscript{th} February 2017.</td>
</tr>
</tbody>
</table>
CHAPTER 6

ACADEMIC PROGRAM FOR MECHATRONICAL ENGINEERING MSC

Department of Electrical Engineering and Mechatronics

Subject: ADVANCED SYSTEMS
Coordinator: Géza Husi
Year, Semester: 1st year/1st semester
Lecture: 2
Practical: 3

1st week:
Lecture: Basic concepts, mathematical description of physical phenomena. Definition of a real physical system.
Practical: Controls Review and Introduction to LabVIEW programming on myRIO.

2nd week:
Lecture: Definition of signal The inputs and outputs. The definition of the system. Definitions of linear and non-linear systems.
Practical: LabVIEW programming on the myRIO.

3rd week:
Lecture: Governing equations of linear elasticity: equilibrium equation, constitutive equation, kinematic equation, boundary conditions.
Practical: Real-time Control; Using myRIO with LabVIEW to implement closed-loop control of an RC filter I.

4th week:
Lecture: Definition of parameter and variable Theory of distributed and concentrated parametric description Description of deterministic and stochastic systems
Practical: Real-time Control; Using myRIO with LabVIEW to implement closed-loop control of an RC filter II.

5th week:
Lecture: Concept of causality Deterministic description with lumped parameters. The concept of static systems.
Practical: Real-time Control; Using myRIO with LabVIEW to implement closed-loop control of an RC filter III.

6th week:
Lecture: The concept of dynamic systems.
General principles of dynamical systems, Linear, quantized, a single in and output system, Linear, quantized, an input-output system, Generalized derivative.
Practical: Analog Feedback Systems I.

7th week:
Lecture: State, state variable, state equation Basic tasks, solvability of the most important basic tasks, Complex tasks, The concept of stability State space representation.
Practical: Analog Feedback Systems II.

8th week:
Lecture: Mid-term test.
Self Control Test.

9th week:
Lecture: Variable structure systems, Basic methods of analysis, Mathematical methods to investigate SISO LTI systems, Investigation in time region (Dividing into components).
Practical: Electronic Scale I.

10th week:
Lecture: Analysis in frequency domain Switch mode Examination of SISO LTI systems Transfer function, Determining the transfer function with the help of the block diagram Block diagrams.
Practical: Electronic Scale II.
**ACADEMIC PROGRAM FOR MECHATRONICAL ENGINEERING MSC**

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>11th week:</td>
<td>Application of transfer function</td>
<td>AC-Driven and Demodulated Electronic Scale I.</td>
</tr>
<tr>
<td></td>
<td>Definition and analysis of stability Examples for analysis of stability in case of non-feedback systems.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Practical:</strong></td>
<td>Brushless Motor Control I.</td>
</tr>
<tr>
<td>12th week:</td>
<td>The visualization of the frequency transfer function The lumped parameter model of the systems described by vector field.</td>
<td>AC-Driven and Demodulated Electronic Scale II.</td>
</tr>
<tr>
<td></td>
<td><strong>Practical:</strong></td>
<td></td>
</tr>
<tr>
<td>13th week:</td>
<td>Concentrated parameter systems</td>
<td></td>
</tr>
<tr>
<td>14th week:</td>
<td>State space representation Complex design example including measurements Sliding Mode Control of an uninterrupted Power Supply.</td>
<td>Brushless Motor Control II.</td>
</tr>
<tr>
<td>15th week:</td>
<td>End-term test.</td>
<td>Self Control Test.</td>
</tr>
</tbody>
</table>

### Requirements

**Topics:**

A, for a signature:
Attendance at lectures is recommended, but not compulsory. Participation at practice is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can’t make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments to the course with them to each practice class. Active participation is evaluated by the teacher in every class. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack
CHAPTER 6

of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

B, for a grade:
The course ends in a mid-semester grade (AW5) based on the test results. The minimum requirement for both mid-term and end-term tests is 50%. Based on the score of the tests separately, the grade for the tests is given according to the following table:

<table>
<thead>
<tr>
<th>Score</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-39</td>
<td>fail (1)</td>
</tr>
<tr>
<td>40-52</td>
<td>pass (2)</td>
</tr>
<tr>
<td>52-63</td>
<td>satisfactory (3)</td>
</tr>
<tr>
<td>64-71</td>
<td>good (4)</td>
</tr>
<tr>
<td>72-80</td>
<td>excellent (5)</td>
</tr>
</tbody>
</table>

If the score of the sum of the two tests is below 40, the student once can take a retake test of the whole semester material.

Required reading materials

Péter Korondi: Systems and control BME
Géza Husi: Methatronics control systems - Coursebook
Radu CătălinȚarcă : Advanced methatronics - Coursebook
Clarence W. De Silva: Mechatronics: An Integrated Approach

Subject: COMPUTING SYSTEMS
Coordinator: Péter Tamás Szemes
Year, Semester: 1st year/1st semester
Practical: 3

1st week:
**Practical:** Introduction to computer systems for mechatronics applications. Introduction to LabView development environment.

2nd week:
**Practical:** Introduction to embedded systems: hardware and software components, real time control, communication and user interfaces. "LabView Environment and NI devices. Data flow oriented programming: acquire, analyze, present".

3rd week:
**Practical:** Industrial communication networks: wired and wireless. "How to create VI and project controls and Indicators: numeric, Boolean controls and functions palette. Searching for controls, Vis, and Functions".

4th week:
**Practical:** Introduction to LabView: as a development environment for engineering applications. Trouble shooting and Debugging VIs.

5th week:
**Practical:** LabView basics I: Variable types, loops, and graphs. LabView data types, documenting code, loops: while and for.

6th week:
**Practical:** Measurement fundamentals: data acquisition: signals and grounding, timing VI, plotting data, case structures.

7th week:
**Practical:** LabView basics II: clusters and arrays, creation, manipulation. Relating data: arrays (array controls and indicators), two
**ACADEMIC PROGRAM FOR MECHATRONICAL ENGINEERING MSC**

- Dimensional arrays, indexing, manipulating arrays clusters: cluster controls and indicators, definitions of assembling and disassembling cluster types: custom controls.

**8th week:**
**Practical:** Mid-term test. Storing measurement data with LabView: file I/O, I/O High Level Files, I/O Low-level Files, Opening, Reading, Writing, Closing, Checking Errors.

**Self Control Test**

**9th week:**
**Practical:** Measurement and analysis with LabView: Measurement of amplitude, frequency, noise, in-time and frequency domain. Data Acquisition: Hardware and Software, Simulating DAQ device, Measuring analog output, Using counters.

**10th week:**
**Practical:** Communication with Instruments: MAX and VISA technology. MAX: measurement and automation explorers, instrument control: instrument I/O assistant, VISA.

**11th week:**
**Practical:** Advanced programming I.: sequential Programming and state machines. Sequential programming (sequence structure), state machine programming (with while loop and case structure), state machines (controlling and transitions), using parallelism.

**12th week:**
**Practical:** Parallelism: single loop and multiple loop architectures. Single loop architectures, multiple loop architectures, timing design Pattern.

**13th week:**
**Practical:** Communicating among multiple loops: global variables and race conditions. Variables, functional global variables, race conditions, synchronizing a data transfer.

**14th week:**
**Practical:** Project development with LabView: Desktop applications, embedded control systems. Embedded control development with NI RIO (reconfigurable I/O) devices.

**15th week:**
**Practical:** End-term test.

**Self Control Test**

**Requirements**

**Topics:**
This series of lectures covers the topics related to embedded computer systems for controlling, measurement and intelligent analysis oriented to mechatronics systems.

**A, for a signature:** Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and cannot miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can’t make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. During the semester there are two tests: the midterm test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

**B, for a grade:**
The course ends in an examination (ESE). The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

<table>
<thead>
<tr>
<th>Score</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 6

0-59 fail (1)
60-69 pass (2)
70-79 satisfactory (3)
80-89 good (4)
90-100 excellent (5)

If the score of any test is below 60, the student can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. An offered grade: It may be offered for the students if the average of the mid-term and end-term tests is at least good (4). The offered grade is the average of them.

Required reading materials

Jefrey Travis, Jim Kring: LabView for Eveyone: Graphical Programming Made Easy and Fun

John Essick: Hands-On Introduction to LabVIEW for Scientists and Engineers

Ed Doering: NI myRIO Project Essential Guide

Subject: DIGITAL SERVO DRIVES
Coordinator: Péter Tamás Szemes
Year, Semester: 1st year/1st semester
Lecture: 2
Practical: 1

1st week:
Lecture: Introduction to servo drives and applications.
Practical: Servo drives examples and application: robotics, pumps and fans.

2nd week:
Lecture: Electrical motors: AC, DC, and special.
Practical: Electric motors and applications, load profiles.

3rd week:
Lecture: Electrical drive circuits for motors.
Practical: Electrical drive circuits examples: one phase and tri-phase bridges.

4th week:
Lecture: Drive control units, digital control devices: DSP, digital signal processing.
Practical: PWM switching, I/O glue logic, field communication drivers.

5th week:
Practical: Electric traction motor models.

6th week:
Lecture: Control theory of drives: models, and controls. Open and closed loop control, speed and position control.
Practical: An open looped speed control system, Closed looped speed control system, Disturbance rejection, step response.

7th week:
Lecture: Performance of control loops: an example on a second order system: over and under damped system, natural frequency.
Practical: Response of a second order system, a Rotor Winder control system.

8th week:
Lecture: Mid-term test. PID control of motors:
speed and position control.
**Practical:** An example on PID motor control, PID parameter tuning. Effects of non-linearity.

9th week:
**Lecture:** Observers: controllability and observation.
**Practical:** a Remote Controlled vehicle system, a Satellite trajectory control.

10th week:
**Lecture:** Servo drive system modeling with Bond graph.
**Practical:** Bond graph examples of electromechanical and drive systems.

12th week:
**Lecture:** Servo drive communication II. CAN and CAN open.

**Practical:** Communication with CAN and CAN open devices, a data exchange.

13th week:
**Lecture:** Variable speed drives and AC motors.
**Practical:** Commissioning of VSD.

14th week:
**Lecture:** Motor modeling and control: from design to applications.
**Practical:** Design and commission of servo drives.

15th week:
**Lecture:** End-term test.
**Self Control Test.**

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**Requirements**

Topics:
This series of lectures covers the topics related to servo drive systems: design, theory of operation, motors, electronics drive circuits and control devices.

A, for a signature:
Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can’t make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

B, for a grade:
The course ends in an examination (ESE). The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

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<td>good (4)</td>
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<td>excellent (5)</td>
</tr>
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</table>

If the score of any test is below 60, the student can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. An offered grade: It may be offered for the students if the average of the mid-term and end-term tests is at least good (4). The offered grade is the average of them.
## Required reading materials

*Asif Sabanovics, and Kouhei Ohnishi: Motion Control Systems*
*Robert Bishop: Modern Control Systems with LabView*
*Robert Bishop: Mechatronics Handbook*

**Subject:** SELECTED CHAPTERS FROM ELECTRONICS  
**Coordinator:** Sándor Piros  
**Year, Semester:** 1st year/1st semester, 1st year/2nd semester  
**Lecture:** 2  
**Practical:** 1

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Practical</th>
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<tr>
<td>1st week</td>
<td>Introduction of electronic system concepts.</td>
<td>Accident prevention instructions.</td>
</tr>
<tr>
<td>2nd week</td>
<td>Semiconductors, operations.</td>
<td>Examining electrical passive filter circuits.</td>
</tr>
<tr>
<td>3rd week</td>
<td>Operation of a transistor, practical basic circuits with a transistor.</td>
<td>Examination of a common emitter amplifier transistor.</td>
</tr>
<tr>
<td>4th week</td>
<td>Optoelectronic components: LED, phototransistor, optocoupler, displays.</td>
<td>Examination of optocoupler.</td>
</tr>
<tr>
<td>5th week</td>
<td>Basic concepts of digital technology, Boolean algebra.</td>
<td>Operation and configuration of basic logical circuits.</td>
</tr>
<tr>
<td>6th week</td>
<td>Basic logical functions and methods of their implementation.</td>
<td>Building SR flip-flop from level driven NAND gates.</td>
</tr>
<tr>
<td>7th week</td>
<td>Mid-term test.</td>
<td>Revision of missed out measurements. Self Control Test.</td>
</tr>
<tr>
<td>8th week</td>
<td>Low-voltage networks of facilities.</td>
<td>Calculating problems, Case studies.</td>
</tr>
<tr>
<td>9th week</td>
<td>Power (heavy current) networks of facilities.</td>
<td>Calculating problems, Case studies.</td>
</tr>
<tr>
<td>10th week</td>
<td>Protection against electric shock, Lightning protection.</td>
<td>Calculating problems, Case studies.</td>
</tr>
<tr>
<td>11th week</td>
<td>Information and communication networks.</td>
<td>Calculating problems, Case studies.</td>
</tr>
<tr>
<td>13th week</td>
<td>Electric drives and transformers.</td>
<td>Calculating problems, case studies.</td>
</tr>
</tbody>
</table>
14th week:
Lecture: End-term test.
Practical: Revision of missed out measurements.

Requirements

Topics:

A, for a signature:
Attendance at lectures is recommended, but not compulsory. Participation at practice is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does more than three, the subject will not be signed and the student must repeat the course. Students can’t make up a practice with another group. Attendance at practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, being discussed with the tutor. Students are required to bring the necessary utensil (e.g. calculator) with them to each occasion of the course. Active participation is evaluated by the teacher in every class. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence due to the lack of active participation in class. During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week. Students have to sit for the tests.

B, for a grade:
The minimum requirement of the mid-term and the end-term test is 50% separately. The course ends in a mid-semester grade (AW5), the grade is calculated as: - 20%-20% from the two tests, - 60% from the exam. The minimum requirement for passing is 50%, the grade for the final mark is given according to the following table:

<table>
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<tr>
<th>Score</th>
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<tr>
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</table>

If the score of any test is below 50%, the student once can take a retake test of the whole semester material.

Required reading materials

CHAPTER 6

Department of Engineering Management and Enterprise

Subject: BASICS OF MANAGEMENT
Coordinator: Edit Szűcs
Year, Semester: 1st year/1st semester
Lecture: 4
Seminar: 2

1st week:
Lecture: Define leadership, roles or personality to be a leader, soft skills.
Seminar: Group work, situational tasks, discussions with Dispute methods.

2nd week:
Seminar: SWOT analyzes.

3rd week:
Seminar: Pest model.

4th week:
Lecture: Functions of management: Planning, Organising, Directing, Controlling, Innovation and Representation.
Seminar: Situational tasks in group work.

5th week:
Lecture: Leadership theories: trait theory, behavioural theories, the contingencialist leadership models, Hersey and Blanchard.
Seminar: Tests, which measure leadership styles.

6th week:
Lecture: Leadership styles: autocratic, bureaucratic, Laissez-faire, democratic, transformational leadership.
Seminar: Tests, which measure leadership styles, discussing results.

7th week:
Lecture: Leadership qualities: most important leadership skills and qualities, generic leadership traits, what you have to know, what you need to do, how to turn the core leadership functions into skills.

Seminar: Tests, which measure leadership qualities, discussing results.

8th week:
Lecture: Time management, energy management: taming time, a few myths about managing your time, lining up your ducks: prioritize!, knowing your time management style, how you relate to time.
Seminar: Techniques to manage time and energy.

9th week:
Lecture: Problem-solving: What is a problem? How can it be solved?
Seminar: Why-why analysis, 80/20 theory, Fishbone diagram.

10th week:
Seminar: Tests, which measure work performance, discussing results.

11th week:
Lecture: Emotional Intelligence: Determining emotional intelligence, highlighting the EM’S role and effecting in leadership.
Seminar: Tests, which measure emotional intelligence, discussing the results.

12th week:
Lecture: Work styles and work environment in the context of leadership style: Work styles, work environment, how a leader can influence work style and the environment.
Seminar: Tests, which measure work styles and the work environment, discussing the results.

13th week:
Lecture: Coaching: defining what a coach is,
which tasks a coach has, a coaching authoritarian leadership.

Seminar: Case studies.

### 14th week:

Lecture: Stress caused by leadership: signs of stress, recognizing symptoms.

Seminar: Stress tests.

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## Requirements

Topics:
In the basics of management lessons students gain an insight into the key areas of leadership. During the course new management trends are going to be introduced, such as coaching, authoritarian leadership, time- and energy management, and appointed emotional intelligence. In the framework of practical lessons the students’ leadership skills, emotional intelligence and their soft skills are going to be measured and analyzed.

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B, for a grade:
The course ends in a mid-semester grade (AW5) based on the average of the grades for the participation and the average of the test results, the mid-semester grade is calculated as an average of them: - an average grade of the practice - a grade of the test The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the test, the grade for the test is given according to the following table:

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If the score of the test is below 60, once the student can take a retake test of the whole semester material.

## Required reading materials

*Gordon, T. : Leader Effectiveness Training*


*Mancini, M. : Time management*

*Taylor, J. : Decision Management System*
# Department of Basic Technical Studies

**Subject:** APPLICATION OF THE THEORY OF DIFFERENTIAL EQUATIONS  
**Coordinator:** Imre Kocsis  
**Year, Semester:** 1st year/2nd semester  
**Lecture:** 2  
**Seminar:** 2

<table>
<thead>
<tr>
<th>Week</th>
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<th>Seminar</th>
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<tbody>
<tr>
<td>1st week</td>
<td>Modeling with differential equations. Initial and boundary value problems.</td>
<td>Exercises and problems related to the topics of the lecture.</td>
</tr>
<tr>
<td>3rd week</td>
<td>Solution of certain non-linear ordinary differential equations.</td>
<td>Exercises and problems related to the topics of the lecture.</td>
</tr>
<tr>
<td>5th week</td>
<td>Euler method, Runge-Kutta method.</td>
<td>Exercises and problems related to the topics of the lecture.</td>
</tr>
<tr>
<td>6th week</td>
<td>Structure of the solutions of linear differential equations. Linear systems of differential equations with constant coefficients, higher order linear differential equations.</td>
<td>Exercises and problems related to the topics of the lecture.</td>
</tr>
<tr>
<td>7th week</td>
<td>Stability of linear differential equations.</td>
<td>Exercises and problems related to the topics of the lecture.</td>
</tr>
<tr>
<td>8th week</td>
<td>Orthonormal systems in Hilbert spaces, trigonometric Fourier series.</td>
<td>Exercises and problems related to the topics of the lecture.</td>
</tr>
<tr>
<td>9th week</td>
<td>Fourier integral, Fourier transform, inverse Fourier transform.</td>
<td>Exercises and problems related to the topics of the lecture.</td>
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<td>10th week</td>
<td>Laplace transform, inverse Laplace transform. Residuum theorem.</td>
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<td>11th week</td>
<td>Solution of initial value problems with Laplace-transform.</td>
<td>Exercises and problems related to the topics of the lecture.</td>
</tr>
<tr>
<td>12th week</td>
<td>Generator function method, z-transform, inverse z-transform, application for the solution of differential equations.</td>
<td>Exercises and problems related to the topics of the lecture.</td>
</tr>
<tr>
<td>13th week</td>
<td>Discrete Fourier transform, fast Fourier-transform.</td>
<td>Exercises and problems related to the topics of the lecture.</td>
</tr>
<tr>
<td>14th week</td>
<td>Classification of second order partial differential equations. Solution of certain second order partial differential equations.</td>
<td>Exercises and problems related to the topics of the lecture.</td>
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order partial differential equations. 

Seminar: Exercises and problems related to the topics of the lecture.

15th week: 
Lecture: End-term test.
Self Control Test.

Requirements

Topics:

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CHAPTER 6

Required reading materials

Greenberg, M. D.: Advanced Engineering Mathematics
Polyanin, A.D., Manzhirov, A.V.: Handbook of Mathematics for Engineers and Scientists
Burghes, D. N.: Modelling with Differential Equations
Logan, J. D.: Applied Partial differential equations
Randall, R.: Frequency Analysis
Chapra, S. C.: Numerical Methods for Engineers
Dyke, P.: An Introduction to Laplace Transforms and Fourier Series

Subject: THEORY OF OPTIMAL CONTROL
Coordinator: Imre Kocsis
Year, Semester: 1st year/2nd semester, 1st year/2nd semester
Lecture: 2
Seminar: 2

1st week:
Lecture: Formulation of control models.
Seminar: Exercises and problems related to the topics of the lecture.

2nd week:
Lecture: General properties of linear systems: reachability, controllability, stabilizability.
Seminar: Exercises and problems related to the topics of the lecture.

3rd week:
Lecture: General properties of linear systems: observability, detectability, reconstructibility.
Seminar: Exercises and problems related to the topics of the lecture.

4th week:
Lecture: State variables, dynamic feedback, realization.
Seminar: Exercises and problems related to the topics of the lecture.

5th week:
Lecture: Linear and quadratic optimal control with finite and infinite time horizon I.
Seminar: Exercises and problems related to the topics of the lecture.

6th week:
Lecture: Linear and quadratic optimal control with finite and infinite time horizon II.
Seminar: Exercises and problems related to the topics of the lecture.

7th week:
Lecture: Time-optimal control of linear systems.
Seminar: Exercises and problems related to the topics of the lecture.

8th week:
Lecture: Non-linear control systems I.
Seminar: Exercises and problems related to the topics of the lecture.

9th week:
Lecture: Non-linear control systems II.
Seminar: Exercises and problems related to the topics of the lecture.

10th week:
Lecture: Existence of optimal controls I.
Seminar: Exercises and problems related to the topics of the lecture.

11th week:
Lecture: Existence of optimal controls II.
Seminar: Exercises and problems related to the topics of the lecture.

12th week:
Lecture: Pontryagin's maximum principle.
Seminar: Exercises and problems related to the topics of the lecture.

13th week:
Lecture: Dynamic programming I.
Seminar: Exercises and problems related to the topics of the lecture.

14th week:
Lecture: Dynamic programming II.
Seminar: Exercises and problems related to the topics of the lecture.

15th week:
Lecture: End-term test.
Self Control Test.

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CHAPTER 6

Required reading materials

Sontag, E. D.: Mathematical Control Theory

Vincent, T. L., Grantham, W. J.: Nonlinear and Optimal Control Systems

Macki, J., Strauss, A.: Introduction to Optimal control Theory

Department of Electrical Engineering and Mechatronics

Subject: CONTROL THEORY
Coordinator: Sándor Piros
Year, Semester: 1st year/2nd semester
Lecture: 3
Practical: 1

1st week:
Lecture: Introduction to feedback control systems.
Practical: Examples of industrial control systems. Description of a physical system by differential equations, to derive it’s transfer function.

2nd week:
Lecture: Analysis of state feedback controller theory.
Practical: Examples for a second and a third order physical system.

3rd week:
Lecture: Control design for a mechanical system.
Practical: Desired behavior of a second order system: damping, over shoot, steady state error, settling time calculation.

4th week:
Lecture: Design of a control system in state space.

5th week:
Lecture: Introduction of a state variable model.
Practical: Examples of state space systems in case of different state variables. RC low pass filter, DC motor

6th week:
Lecture: Analysis of state feedback controller theory.
Practical: Examples for a second and a third order physical system. Relation between a transfer function and state space representation of a system.

7th week:
Lecture: State representation is not unique.
Practical: Deriving controller canonical form directly from Mason’s formula.

8th week:
Lecture: Mid-term test
Practical: Preparing a block diagram of controllability and observable canonical form.
Self Control Test.

9th week:
Lecture: Time response.
Practical: State space transformations: transition matrix, general solution, forced solution.

10th week:
Lecture: Introducing new state variables.
Practical: Determine transformation matrix to transform system for a new state vector.

11th week:
Lecture: State feedback design.
**Practical:** Closed loop equation of a DC motor state feedback control system. Control law, closed loop system matrix, comparing to PID controller.

**12th week:**
**Lecture:** State feedback design, pole placement, prototype control.
**Practical:** Tracking problem, servo system. Observer, equation of observer, reduced order observer. Finding suitable control for a reduced order system.

**13th week:**
**Lecture:** Introduction to digital control systems.
**Practical:** Discrete time signal, z-transform, discrete transfer function. Root locus design in z domain. Transfer function of zero order hold. Integral controllers, differentiators. How to implement PID controller. Dead beat controller design.

**14th week:**
**Lecture:** Revision
**Practical:** End-term test.
**Self Control Test.**

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**Requirements**

**Required reading materials**

*Dorf, R.C., Bishop, R.H: Modern Control Systems*  

Subject: **ELECTRONICS TECHNOLOGY**  
Coordinator: **János Tóth**  
Year, Semester: 1st year/2nd semester  
Lecture: 2  
Practical: 1

**1st week:**
**Lecture:** Electronics technologies systematized by products.  
**Practical:** Printed circuit board technology.

**2nd week:**
**Lecture:** Components, integrated circuits, mounting plates, modules and circuits implementation possibilities devices.  
**Practical:** Printed circuit board technology.

**3rd week:**
**Lecture:** Micro-electronic devices and components technology.  
**Practical:** Drilling, hole metallization, design preparation, deposition.

**4th week:**
**Lecture:** Vacuum technology. Thin Layers and layers of semiconductors and amending overlay coating technologies.

**Practical:** Drilling, hole metallization, design preparation, deposition.

**5th week:**
**Lecture:** Layers pattern-making procedures: photolithography, etching procedures.  
**Practical:** Thin-film technology, vacuum deposition and photolithography pattern making.

**6th week:**
**Lecture:** Hole and surface mount components.  
**Practical:** Thin-film technology, vacuum deposition and photolithography pattern making.

**7th week:**
**Lecture:** Chips and chip-sized components.  
**Practical:** Surface Mount Technology. Mid-term test No.1.  
**Self Control Test.**
### CHAPTER 6

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>9th week</td>
<td>Implants, bore and surface mounting technologies. Interface assembly automation.</td>
<td>Solder paste screen printing, assembly, reflow soldering.</td>
</tr>
<tr>
<td>10th week</td>
<td>Bore and surface mount soldering technologies.</td>
<td>Solder paste screen printing, assembly, reflow soldering.</td>
</tr>
<tr>
<td>11th week</td>
<td>Semiconductor chip implantation and wire bonding technologies. Production of protective coatings, encapsulation technologies.</td>
<td>Soldering compatible technologies through hole reflow.</td>
</tr>
<tr>
<td>12th week</td>
<td>The assembly and inspection procedures bonding technologies: optical observation, X-ray structural analyses, acoustic microscopy.</td>
<td>Soldering compatible technologies through hole reflow.</td>
</tr>
<tr>
<td>14th week</td>
<td>The module circuits and devices, mechanical and thermal design.</td>
<td>Optical, X-ray examination and functional modules mounted circuits. Mid-term test No.2.</td>
</tr>
<tr>
<td>15th week</td>
<td>Re-take test</td>
<td>Self Control Test</td>
</tr>
</tbody>
</table>

### Requirements

**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.

**Requirements**

A, for a signature:
Attendance at lectures is recommended, but not compulsory. Participation at practice is compulsory. Students must attend practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can’t make up any practice with another group. Attendance at practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence due to the lack of active participation in class. During the semester there are two tests in the 7th and 14th week. Students have to sit for the tests.

B, for a grade:
ACADEMIC PROGRAM FOR MECHATRONICAL ENGINEERING MSC

The course ends in an examination. The minimum requirement for the mid-term tests and the examination respectively is 50%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

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<th>Score</th>
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<tr>
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<td>fail (1)</td>
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<tr>
<td>50-64</td>
<td>pass (2)</td>
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<td>65-79</td>
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<tr>
<td>80-89</td>
<td>good (4)</td>
</tr>
<tr>
<td>90-100</td>
<td>excellent (5)</td>
</tr>
</tbody>
</table>

If the score of any test is below 50, the student can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Required reading materials**

*Earl Gates: Introduction to Basic Electricity and Electronics Technology*

*Niel Sclater: Electronic Technology Handbook*

*The HDI Handbook*
URL: http://www.hdihandbook.com/download.php

Subject: **INDUSTRIAL APPLICATIONS OF MECHATRONICS SYSTEMS: VEHICLES, BUILDING AUTOMATION AND ROBOTICS I.**

Year, Semester: 1\textsuperscript{st} year/2\textsuperscript{nd} semester

Lecture: 2
Practical: 6

1\textsuperscript{st} week:
**Lecture:** Vehicles: drive train systems.
**Practical:** Practice on selected topics.

2\textsuperscript{nd} week:
**Lecture:** Vehicles: electrical vehicles I.
**Seminar:** Practice on selected topics.
**Practical:** Practice on selected topics.

3\textsuperscript{rd} week:
**Lecture:** Vehicles: Electrical vehicles II.
**Practical:** Practice on selected topics.

4\textsuperscript{th} week:
**Lecture:** Building automation, introduction and applications.
**Practical:** Practice on selected topics.

5\textsuperscript{th} week:
**Lecture:** Building automation: sensors, actuators and field control devices.
**Practical:** Practice on selected topics.

6\textsuperscript{th} week:
**Lecture:** Building automation: supervisory control systems.
**Practical:** Practice on selected topics.

7\textsuperscript{th} week:
**Lecture:** Building automation: HVAC control systems.
**Practical:** Practice on selected topics.

8\textsuperscript{th} week:
**Lecture:** Building automation: energy management systems I. Mid-term test.
**Practical:** Practice on selected topics.
**Self Control Test.**

9\textsuperscript{th} week:
**Lecture:** Building automation: energy management systems II.
**Practical:** Practice on selected topics.
CHAPTER 6

10th week:
Lecture: Robotics: introduction and applications.
Practical: Practice on selected topics.

11th week:
Lecture: Robotics: industrial robots and applications.
Practical: Practice on selected topics.

12th week:
Lecture: Robotics: mobile robots and applications.
Practical: Practice on selected topics.

13th week:
Lecture: Robotics: intelligent robotics with intelligent space I.
Practical: Practice on selected topics.

14th week:
Lecture: Robotics: intelligent robotics with intelligent space II.
Practical: Practice on selected topics.

15th week:
Lecture: End-term test.
Self Control Test.

Requirements

Knowledge:
Mechatronics in industrial and consumer products.
Overview of application areas: vehicles, buildings and robotics.

Vehicles as mobile machines 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 visualization.

Competence:
Modeling of vehicle dynamics. Control system design.
Data acquisition and analysis for vehicles.

Required reading materials

Thomas D. Gillespie: Fundamentals of Vehicle Dynamics
ISBN: 978-1560911999

Dean Karnopp: Vehicle Dynamics, Stability, and Control

D. Karnop, D. Margolis, R. Rosenberg : System dynamics: Modeling, simulation, and control of mechatronic systems
Subject: **MEASUREMENT AND MODELLING**  
Coordinator: **Péter Tamás Szemes**  
Year, Semester: 1st year/2nd semester  
Lecture: 2  
Seminar: 2

**1st week:**  
**Lecture:** Introduction to measurement and modelling for mechatronics.  
**Seminar:** Introduction to LabView and NI hardware for data acquisition and modeling.

**2nd week:**  
**Lecture:** Measurement theory, measurement methods, measurement errors, measurement data validation.  
**Seminar:** DAQ and RIO application example with LabView.

**3rd week:**  
**Lecture:** Electrical instruments: digital storage oscilloscope, signal generators.  
**Seminar:** Generating analog and digital signals with LabView.

**4th week:**  
**Lecture:** Digital Filters: FIR and IIR filters.  
**Seminar:** Building Digital Filters with LabView.

**5th week:**  
**Lecture:** Spectral analysis: fundamentals, Spectrum analyzer.  
**Seminar:** Spectral analysis with LabView.

**6th week:**  
**Lecture:** Simulation of dynamic systems.  
**Seminar:** Dynamic system modeling examples in LabView.

**7th week:**  
**Lecture:** Simulation of systems with state machines.  
**Seminar:** State machine implementation in LabView.

**8th week:**  
**Lecture:** Mid-term test. Acquired signal based system identification.  
**Seminar:** System identification with NI LabView.

**9th week:**  
**Lecture:** Mid-Term Test.  
**Seminar:** DAQ system design examples from signal to visualization.  
Self Control Test.

**10th week:**  
**Lecture:** Measurement and analysis of analog filter circuits with NI ELVIS II.  
**Seminar:** Active how-pass filters, active high pass filters, stability analysis.

**11th week:**  
**Lecture:** Measurement and analysis of analog signal generator circuits with NI ELVIS II.  
**Seminar:** A periodic wave generator: sine, rectangle, etc., non-periodic wave generation, digital pattern generation.

**12th week:**  
**Lecture:** Measurement and analysis of sequential digital circuits with NI ELVIS II.  
**Seminar:** Realization of digital logic function, adder, multiplexer, demultiplexer circuits.

**13th week:**  
**Lecture:** Measurement and analysis of MCU based digital circuits with NI ELVIS II.  
**Seminar:** Mixed circuit with PIC microcontroller.

**14th week:**  
**Lecture:** Measurement and analysis of communication circuits with NI ELVIS II.  
**Seminar:** Digital bus driver and receiver, CAN bus, RS485 bus.

**15th week:**  
**Lecture:** End-term test.  
Self Control Test.
CHAPTER 6

Requirements

Topics:
This series of lectures covers the topics related to measurement, data acquisition, signal analysis, dynamical and event driven system modeling.

A, for a signature:
Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can’t make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

B, for a grade:
The course ends in an examination (ESE). The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

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If the score of any test is below 60, the student can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. An offered grade: It may be offered for the students if the average of the mid-term and end-term tests is at least good (4). The offered grade is the average of them.

Required reading materials

Dr. Tamás Szabó: Mechatronical Modelling
2014.

Cory L. Clark: LabView Digital Signal Processing

Subject: REAL-TIME EMBEDDED PROGRAMMING
Coordinator: Péter Tamás Szemes
Year, Semester: 1st year/2nd semester
Lecture: 2
Seminar: 2

1st week:
Lecture: Introduction to real time systems with LabView.
Seminar: Setup Real-time and embedded system.

2nd week:
Lecture: Program development style:
### ACADEMIC PROGRAM FOR MECHATRONICAL ENGINEERING MSC

Configuration, deployment, and debug.  
**Seminar**: Introduction and workflow with real-time development environment.

**3rd week:**  
**Lecture**: RTOS Concepts and Definitions.  
**Seminar**: Examples to RTOS architecture.

**4th week:**  
**Lecture**: RTOS Building Blocks: threads, mutex and message queues.  
**Seminar**: Examples: threads and mutex.

**5th week:**  
**Lecture**: Threads: lifetime, thread services, thread states.  
**Seminar**: Example of threads application.

**6th week:**  
**Lecture**: MUTEX: Mutual exclusion.  
**Seminar**: Examples of mutex application.

**7th week:**  
**Lecture**: Memory management of a multitask system.  
**Seminar**: Examples of memory management.

**8th week:**  
**Lecture**: Internal System clock and application timer.  
**Seminar**: Examples of application timer in threads.

**9th week:**  
**Lecture**: Mid-Term Test.  
**Seminar**: Multithread software examples.  
**Self Control Test**.

**10th week:**  
**Lecture**: Event notification with semaphores.  
**Seminar**: Examples of event notification and semaphore.

**11th week:**  
**Lecture**: Thread communication with message Queues.  
**Seminar**: Examples of communication with message queues.

**12th week:**  
**Lecture**: Reliability and fault tolerance.  
**Seminar**: Measurement of reliability and fault tolerance.

**13th week:**  
**Lecture**: Scheduling of threads.  
**Seminar**: Examples of multitask scheduling.

**14th week:**  
**Lecture**: Distributed Systems.  
**Seminar**: Examples of distributed system programming.

**15th week:**  
**Lecture**: End-term test.  
**Self Control Test**.

### Requirements

Topics:  
This series of lectures covers the topics of real-time and embedded programming theory and practical considerations.

A, for a signature: Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can’t make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. During the semester there are two tests: the mid-
term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

B, for a grade: The course ends in an examination (ESE). The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

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</tbody>
</table>

If the score of any test is below 60, the student can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. An offered grade: It may be offered for the students if the average of the mid-term and end-term tests is at least good (4). The offered grade is the average of them.

Required reading materials

*Alan Burns, Andy Wellings: Real-Time System and Programming Languages*
3rd. Addison-Wesley, 2001. ISBN: 0 201 72988 1

*Edward L. Lamie: Real-Time Embedded Multithreading with ThreadX and ARM*

*National Instruments: LabVIEWTM Real-Time Module User Manual*
April, 2003.

Department of Engineering Management and Enterprise

Subject: MATERIAL SCIENCE
Coordinator: László Tóth
Year, Semester: 1st year/2nd semester
Lecture: 2
Seminar: 1

1st week:
**Lecture:** Brief history of materials sciences. Definition of Materials and its consequences. Design procedures of engineering structures.
**Seminar:** Basic behaviors of material behaviors and their experimental determinations.

2nd week:
**Lecture:** Size effects in material behaviors. Bulk and surface behaviors. Phase and TTT diagrams, Basic problems of strengthening of metals and alloys.
**Seminar:** Effects of alloying elements.

3rd week:
**Lecture:** Fe-Fe3C phase diagram. Effects of alloying elements.
**Seminar:** Distribution and discussion of material selection related personal tasks.

4th week:
**Lecture:** Basic concepts of material selection procedures. Ashby concept.
**Seminar:** Discussion of individual problems of material selection.

5th week:
**Lecture:** Effects of plastic deformation, solution and precipitation procedures on basic behavior of steel.
**Seminar:** Discussion of individual problems of material selection.
6th week:
**Lecture:** General tendency in material application. Nano-materials, nano-technology.
**Seminar:** Distribution and discussion of application oriented individual tasks.

7th week:
**Lecture:** Composite materials and their properties, application fields (Fibers reinforced plastics)
**Seminar:** Presentation and discussions of material selections related to individual tasks.

8th week:
**Lecture:** Metal matrix composites and their properties, application fields.
**Seminar:** Presentation and discussions of material selections related to individual tasks.

9th week:
**Lecture:** Ceramic materials and their properties and application fields.
**Seminar:** Presentation and discussions of the material selections related individual tasks.

10th week:
**Lecture:** Application oriented material behaviors. Magnetic properties.
**Seminar:** Presentation and discussions of the material selections related to individual tasks.

11th week:
**Lecture:** Application oriented material behaviors. Conductivity properties.
**Seminar:** Presentation and discussions of application related to individual tasks.

12th week:
**Lecture:** Application oriented material behaviors. Conductivity properties.
**Seminar:** Presentation and discussions of the application related individual tasks.

13th week:
**Lecture:** 3D-printing technologies and their materials. Rapid prototyping technologies and materials.
**Seminar:** Presentation and discussions of the application related individual tasks.

14th week:
**Lecture:** Brief overviews of the semester’s knowledge’s, experiences of the individual problems.
**Seminar:** Presentation and discussions of the application related individual tasks.

15th week:
**Lecture:** End-term discussions.
**Self Control Test**

**Requirements**

Topics:

A, for a signature: Attendance at lectures is strongly recommended, but not compulsory and can not miss more than three times. Participation at practice is compulsory. Students must attend practice classes and may not miss more than three occasions during the semester and they have to present both individual tasks. In case a student misses more than three times, the subject will not be signed and the student must repeat the course. The attendance at practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs
CHAPTER 6

to be presented. Active participation is evaluated by the teacher in every class. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate their participation as an absence due to the lack of active participation in class. During the semester the two individual problems of the students will be presented and on the basis of their qualities (contents and formats) a recommended grade (mark) can be reached.

B, for a grade:
The course ends in an exam, the grade is calculated as: - 50% from the exam (written and verbal exams) - 25%-25% from the two individual tasks The minimum requirement for passing is 60%, the grade for the final mark is given according to the following table:

<table>
<thead>
<tr>
<th>Score</th>
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</tr>
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<tbody>
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<tr>
<td>90-100</td>
<td>excellent (5)</td>
</tr>
</tbody>
</table>

If the score of any test is below 60, once the student can take a retake test covering the whole semester material.

Required reading materials

*William F. Smith: Principles of Materials Science and Engineering*

*William F. Smith: Foundations of Materials Science and Engineering*

*M. F. Ashby: Materials Selection in Mechanical Design*

*C. Newey, G. Weaver: Materials Principles and Practice*

*R.A. Flinn, P.K.Trojan: Engineering Materials and Their Applications*

*D.R. Askeland: The Science and Engineering of Materials*
Chapman and Hall, 1996.

*T.H. Courtney: Mechanical Behavior of Materials*

Department of Electrical Engineering and Mechatronics

Subject: IMAGE PROCESSING
Coordinator: Péter Tamás Szemes
Year, Semester: 2nd year/1st semester
Lecture: 2
Practical: 1

1st week:
Lecture: Introduction to images and image processing.
Practical: Image file types: introduction, open and view.

2nd week:
Lecture: Introduction to cameras, Image acquisition hardware.
Practical: Image capturing with LabView: still
<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd week</td>
<td>Display images on a screen. Scene lighting.</td>
<td>Image display and lighting examples.</td>
</tr>
<tr>
<td>4th week</td>
<td>Calibrating cameras and images.</td>
<td>Image and camera calibration examples.</td>
</tr>
<tr>
<td>5th week</td>
<td>Basic Image processing: Region of Interest, and basic operators.</td>
<td>Basic operations examples.</td>
</tr>
<tr>
<td>6th week</td>
<td>Filters: gaussian, gradient, laplacian, and smoothing.</td>
<td>Filtering examples.</td>
</tr>
<tr>
<td>7th week</td>
<td>Morphology: dilatation, erosion, particle removal.</td>
<td>Morphology examples.</td>
</tr>
<tr>
<td>9th week</td>
<td>Locating objects on image to inspect.</td>
<td>Locating objects example.</td>
</tr>
<tr>
<td>10th week</td>
<td>Finding measurement points using edge detection.</td>
<td>Edge detection examples.</td>
</tr>
<tr>
<td>11th week</td>
<td>Color pattern matching.</td>
<td>Color pattern matching examples.</td>
</tr>
<tr>
<td>12th week</td>
<td>Coordinating transform between image space and real world space.</td>
<td>Coordinating transform examples.</td>
</tr>
<tr>
<td>13th week</td>
<td>Identifying parts under inspections.</td>
<td>Examples of Part identification.</td>
</tr>
<tr>
<td>14th week</td>
<td>Reading barcodes and data Matrix.</td>
<td>Barcode reading examples.</td>
</tr>
<tr>
<td>15th week</td>
<td>End-term test.</td>
<td>Self Control Test.</td>
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</tbody>
</table>

Requirements

Topics:
This series of lectures covers the topics related to image processing and computer vision for industrial applications.

A, for a signature:
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B, for a grade:
CHAPTER 6
The course ends in an examination (ESE). The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

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If the score of any test is below 60, the student can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS. An offered grade: It may be offered for the students if the average of the mid-term and end-term tests is at least good (4). The offered grade is the average of them.

**Required reading materials**

*Patric R. Goebel: Image Acquisition and Processing with LabView*

*Richard Szeliski: Computer Vision: Algorithms and Applications*

*NI Vision for LabVIEW User Manual*

Subject: **INDUSTRIAL APPLICATIONS OF MECHATRONICS SYSTEMS: VEHICLES, BUILDING AUTOMATION AND ROBOTICS II**
Coordinator: Péter Tamás Szemes
Year, Semester: 2nd year/1st semester
Lecture: 1
Practical: 3

**Required reading materials**

*In Partnership with NJATC: Building Automation: Control Devices and Applications*
ISBN: 978-0826920003

*In Partnership with NJATC: Building Automation Integration with Open Protocols*
ISBN: 978-0826920126

*Steve Doty and Wayne C. Turner: Energy Management Handbook*
Eighth. ISBN: 978-1466578289

Subject: **COMPUTER SIMULATION**
Coordinator: Géza Husi
Year, Semester: 2nd year/2nd semester
Practical: 2

1st week: Task of simulation, overview, sample examples.
Practical: Task of simulation, overview, sample 40
ACADEMIC PROGRAM FOR MECHATRONICAL ENGINEERING MSC

2nd week:
Practical: Digital simulation of constant systems; Instructing-oriented and block oriented construction of systems. Description of constant and sampling systems.

3rd week:
Practical: Block oriented types of the general computational blocks of simulation systems.

4th week:
Practical: Realization of integration formula, bindings, data flow programming (computation order); simulation of big time constant difference (stiff systems).

6th week:
Practical: Definition of a discreet events, simulating models' running time, style.

7th week:
Practical: Optimization of the parameters of technical systems; search of the parameters of technical systems in a structure (identification).

8th week:
Practical: Mid-term test.
Self Control Test.

9th week:
Practical: Hardware-in-the-loop (HIL) simulation. project tasks.

10th week:
Practical: Hardware-in-the-loop (HIL) simulation. project tasks.

11th week:
Practical: Hardware-in-the-loop (HIL) simulation. project tasks.

12th week:
Practical: Hardware-in-the-loop (HIL) simulation. project tasks.

13th week:
Practical: Hardware-in-the-loop (HIL) simulation. project tasks.

14th week:
Practical: Hardware-in-the-loop (HIL) simulation. project tasks.

15th week:
Practical: End-term test.
Self Control Test.

Requirements

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 formulas, 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 models' 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.

A, for a signature:
Attendance at lectures is recommended, but not compulsory. Participation at practice is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can’t make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, being discussed with the tutor. Students are required to bring the drawing tasks and
CHAPTER 6
drawing instruments to the course with them to each practice class. Active participation is evaluated
by the teacher in every class. If a student’s behavior or conduct doesn’t meet the requirements of
active participation, the teacher may evaluate his/her participation as an absence because of the lack
of active participation in class. During the semester there are two tests: the mid-term test in the 8th
week and the end-term test in the 15th week. Students have to sit for the tests.
B, for a grade:
The course ends in a mid-semester grade (AW5) based on the Hardware-in-the-loop (HIL)
simulation. project task.

Required reading materials

Géza Husi: Mechatronics control systems. Coursebook
Géza Husi: Mechatronics control systems. Laboratory handbook
Ljubisa Ristic (ed.): Sensor Technology and Devices
E. Schrüfer: Elektrische Messtechnik
Carl Hanser Verlag, 1992.
Analog Devices: Practical Design Techniques for Sensor Signal Conditioning

Subject: DESIGN OF MECHATRONICS SYSTEMS
Coordinator: Géza Husi
Year, Semester: 2nd year/2nd semester
Lecture: 3
Practical: 2

1st week:
Lecture: Mechatronics systems classification. Mechatronics system architectures.
Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis.

2nd week:
Lecture: Modeling and simulation of mechatronics systems. Mechatronics system’s actuators.
Practical: Scheduled lab sessions, but you will mostly work in the lab on a self-scheduled basis.

3rd week:
Lecture: Electrical machines for mechatronics applications. Power electronic converters design and development for mechatronics systems.
Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis in the lab.

4th week:
Lecture: Current source and voltage source, PWM converters design.
Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis in the lab.

5th week:
Lecture: Sensors interfacing to mechatronics systems. Design of data acquisition systems and implementation of mechatronics systems.
Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis in the lab.

6th week:
Lecture: Mechatronics systems programming. Drivers and interface programs development for mechatronics systems.
Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis in the lab.
### Academic Program for Mechatronical Engineering MSC

<table>
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<th>Week</th>
<th>Lecture</th>
<th>Practical</th>
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<tr>
<td>7th</td>
<td>Lecture: Driver and interface programs development for mechatronics systems. Dynamic performances evaluation of mechatronics systems.  &lt;br&gt;Practical: Scheduled lab sessions, but you will mostly work in the lab on a self-scheduled basis.</td>
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<td>8th</td>
<td>Lecture: Mid-term test.  &lt;br&gt;Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis in the lab.  &lt;br&gt;Self Control Test.</td>
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<td>9th</td>
<td>Lecture: Mechatronics systems industrial applications. Significant laboratory-based design experiences.  &lt;br&gt;Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis in the lab.</td>
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<tr>
<td>10th</td>
<td>Lecture: 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 I.  &lt;br&gt;Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis in the lab.</td>
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<td>11th</td>
<td>Lecture: 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 II.  &lt;br&gt;Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis in the lab.</td>
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<td>12th</td>
<td>Lecture: Digital logic; analog interfacing and power amplifiers.  &lt;br&gt;Practical: Scheduled lab sessions, but you will mostly work in the lab on a self-scheduled basis.</td>
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<tr>
<td>13th</td>
<td>Lecture: Measurement and sensing; electromagnetic and optical transducers.  &lt;br&gt;Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis in the lab.</td>
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<tr>
<td>14th</td>
<td>Lecture: Control of mechatronics systems.  &lt;br&gt;Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis in the lab.</td>
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<tr>
<td>15th</td>
<td>Lecture: End-term test.  &lt;br&gt;Self Control Test.</td>
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</table>

## Requirements

Topics:
This course deals with the integration of the mechanical and electrical engineering disciplines within a unified framework. The topics are: Mechatronics systems classification, A mechatronics system in architecture, Modeling and simulations of mechatronics systems, actuators of a Mechatronics system. Electrical machines for mechatronics applications. Power electronic converters design and development for mechatronics systems. Current source and voltage source PWM converters design. Sensors interfacing to mechatronic systems. Data acquisition systems design and implementation for mechatronics systems. Mechatronics systems programming. Driver and interface programs development for mechatronics systems. Dynamic performances evaluation of mechatronics systems. Mechatronics 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 mechatronics systems.

A, for a signature:
Attendance at lectures is recommended, but not compulsory. Participation at practice is compulsory. Students must attend the practice classes and may not miss more than three times during the
CHAPTER 6

In case a student does so, the subject will not be signed and the student must repeat the course. Students can’t make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments to the course with them to each practice class. Active participation is evaluated by the teacher in every class. If a student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

B, for a grade:
The course ends in a mid-semester grade (AW5) based on the test results. The minimum requirement for both mid-term and end-term tests is 50%. Based on the score of the tests separately, the grade for the tests is given according to the following table:

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<td>0-39</td>
<td>fail (1)</td>
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<tr>
<td>40-52</td>
<td>pass (2)</td>
</tr>
<tr>
<td>52-63</td>
<td>satisfactory (3)</td>
</tr>
<tr>
<td>64-71</td>
<td>good (4)</td>
</tr>
<tr>
<td>72-80</td>
<td>excellent (5)</td>
</tr>
</tbody>
</table>

If the score of the sum of the two tests is below 40, the student once can take a retake test of the whole semester material.

Required reading materials

K. Janschek: Mechatronics systems

D. Shetty, R. Kolk: Mechatronics systems design

D. Karnop, D. Margolis, R. Rosenberg: System dynamics: Modeling, simulation, and control of mechatronic systems

Stepping motor control systems

Szász Csaba: Digital control systems - Applications
Chapter 7
Internship

Internship Guide to Mechatronics Engineering MSc, Building Mechatronics Specialization

Students specializing in Mechatronics Engineering MSc have to carry out a 6-week long internship involved in the model curriculum. The internship course must be signed up for previously via the NEPTUN study registration system in the 3rd semester. Its execution is the significant requirement of getting a leaving certificate (absolutorium).

I. Objective of the internship, competences

Students get acquainted with professional work in conformity with their specialist at a company or institution and join in the daily working process. They have to resolve tasks independently assigned by their supervisor and gain experiences may be utilized later in the labour market. During the internship common and professional competences may be acquired. Common competences: to precise working on schedule either individually or in team, to take part in talking shops applying correct technical terms. Professional competences: applying professional skills gained during the training and acquiring new knowledge.

II. Places suitable for internship

All the organizations, institutions and companies, provide students with the opportunity to acquire proficiency in accordance with their specialization in the field of operation, repairing technology, installation, management and development of different machines and vehicles, may be a suitable place.

III. Documents necessary for commencing and completing the internship

The numbers of document copies is equivalent with the number of signers. The document types which must be signed are here: Invitation Letter, Internship Cooperation, “Megállapodás” (Company in Hungary), Student Agreement (Company abroad) The submission deadline is May 2017 to secretariat (Ms. Nóra Tóth, room 120). Evaluation Sheet and Certificate must be submitted till September 2017 to Ms. Nóra Tóth. 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 and the Student Agreement (or its signature) in time, the specialist responsible will refuse the Internship Certificate.

IV. Execution of the Internship and its certification

1. The duration of the internship is 6 weeks.
2. Besides completing the internship, students have 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. It is expedient to choose a topic which may be appropriate either for participating in the National Scientific Students' Associations Conference ("OTDK") or a thesis.
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 Mechatronics Engineering. The deadline of submitting the Essay and the “Evaluation Sheet and Certificate”: September 2017, office 120 (Ms. Nóra Tóth) Summary of the tasks and deadlines regarding the internship.
   - a student has to sign up for the Internship course via the NEPTUN in the spring semester,
   - Contacting the company and providing for the Invitation Letter (1 copy) must be submitted to the secretariat, for the Internship Cooperation (2 original copies, company is abroad) or “Internship Cooperation with Company in Hungary” (4 original copies, company is in Hungary) and for the Student Agreement (3 original copies) respectively signed by the company till May 2017. Please remember that it is the student’s responsibility to meet the deadline given! Having the documents signed by the Dean of the Faculty and sending copies to the company by post is the duty of the secretariat.
   - executing the 6 weeks internship in the summertime,
CHAPTER 8
- providing for the Evaluation Sheet and Certificate form at the end of the internship and submitting it together with the essay to Mr. Géza Husi responsible for the internship program at the department till September 2017.

V. Exemption
A partial exemption may be required by the student who has completed an internship in the secondary school and it is certified by the secondary school certificate. The request for partial exemption can be submitted till May 2017. After this deadline requests are denied. The copy of the secondary school certificate and the written request addressed to Dr. Géza Husi specialist responsible must be submitted to Ms. Nóra Tóth secretary (office 120). In case of any problem arising from the internship please contact Mr Géza Husi head of the Department of Electrical and Mechatronic Engineering (office 120, tothnora@eng.unideb.hu) or Ms. Nóra Tóth secretary (office 120, tothnora@eng.unideb.hu).
CHAPTER 8

THESIS

The 'Thesis 1' course may be signed up for in the beginning of the semester via the NEPTUN system after negotiating it with the internal tutor (supervisor). Its prerequisite is that all the subjects of the 1st year in the Model Curriculum must be completed in two closed semesters. The prerequisite of registering on the 'Thesis 2' course is that the 'Thesis 1' course must be complied. In some reasonable cases 'Thesis 1' and 'Thesis 2' courses can be complied parallel during one semester with the Head of Department’s permission if it is suggested by the tutor. In this case a student must provide such an output and efficiency which are equivalent with the work of 360 hours (24 hours per week for 15 weeks) and the subjects can be evaluated with a grade by the supervisor. The criteria of the courses are decided by the supervisor.

The chosen topic must be announced on The Thesis topic Announcement Form. This form must be signed by the external tutor and the supervisor naming the tasks must be being elaborated.

The plan of the Thesis can be submitted any time during the elaborating and it can be modified at once. After handing in a student has the right to take the forthcoming a final exam, if he/she has the credits subscribed, complied the subjects of criteria (internship, Physical Education). A final exam must be applied for at the Registrar’s Office. The date of application is the last workday of the 8th week of an exact academic year.

During the semester students have to give an account of the actual state of the thesis to the internal tutor at least three times, which is certified on the Consultation Sheet. The Consultation Sheet is made out and managed by the supervisor. The thesis can be submitted at the end of the semester after approving it by the supervisor on the Consultation Sheet. The grade gained for it is not identical with the grade of the evaluation of the Thesis, it is merely a grade of the "Thesis" course. The precondition of approving the course must be negotiated with the supervisor however in general 80% readiness of the thesis is the minimum requirement. The Consultation Sheet signed by the supervisor must be bound into the thesis!

A Thesis must be done within the confines of subjects 'Thesis 1' and 'Thesis 2'. A Thesis can be done of a given topic from a company with the approval and later declaring of the Department by a student (from the internship place or somewhere else) or can be elaborated a topic according to a student decision outprinted by the Department. A Thesis can be the continuance of an earlier study or a started work of (TDK) National Council of Student Research Societies.

A Thesis is not a second thesis. It is in proof of that a candidate has complied all the requirements of an exact field of science (mechatronics) and he/she is able to occupy engineering positions at the highest level, to control mechatronics engineers with BSc degrees, to start an individual scientific research. Therefore the requirements of a Thesis content is much stricter. According to a significant rule that using parts or quoting from earlier theses is forbidden but allusion is permitted. Quotation and takeover from the student’s earlier presented essay of National Council of Student Research Societies (TDK) are permitted with an eligible allusion if it hasn’t been used to his/her thesis.

Documents for the confidentiality of a Thesis or a Thesis

- Confidentiality Agreement between the University and the Company – must be filled in in 4 copies, be signed and hand in Room 120. One copy must be bounded into the Thesis.
- Confidentiality Agreement between the Student and the Company

Formal requirement of a Thesis
• outer cover: the title ‘Thesis’, student’s name, year
• inner cover: names of the university, the faculty and the major, student’s name, the title of the Thesis, year of handing in, supervisor’s and tutor’s names.
• declaration of the Thesis topic (original signed by the head of the Department of Mechatronics)
• Evaluation Sheet of the Thesis (only one copy, it remains at the Department)
• Plagiarism Statement and one passport photo (4x4 cm) in good quality not older than one year
CHAPTER 9

• Table of Contents
• A summary in English and in Hungarian
• Main part:

Introduction: defining the given task, the aim of the plan, reasonableness of the task, a short summary of the thesis structure (maximum 3 pages).

1. Theoretical summary (minimum 30 pages): literary and theoretical summary of the thesis topic. Theoretical summary means a compiled summary based on the latest publications on the topic of the Thesis which uses theories, the results of earlier researches, experimentation, and engineering creations done by others. A theoretical summary must contain the necessary theoretical deductions (with eligible allusions), the familiar scientific or/and engineering results. A Theoretical summary must be compiled from at least 30 professional brochures (books, articles) and publications about conferences of which one third can become from the Internet. (These data bases can be reached from university network after logged in the eduroam: IEEEExplore, eisz, Scopus, Science direct, database of the library.

2. Main chapter: working out of the task

3. Summary: evaluating the results, presenting opportunities of further development.

4. Acknowledgments: for any help you got during a working out process. (optional)

5. Bibliography: guide according to ISO 690:2010, mechatronics engineers use the allusion forms of IEEE authority traditionally which is equivalent with ISO 690:2010 standards. Allusion handling is in MS Word.

6. Appendix (optional)

The spread of a Thesis (from cover to appendix) is approximately 90 pages with line spacing 1.5. There must be 55-60 characters (including space characters) in a line. The minimum of its spread is 70 pages, the maximum is 110 pages. In a Thesis you must take care of correct and literary language usage. Symbols used in Mathematics and Physics must be written in cursive. The vector quantitative in physics must be written in bold cursive, and the tensor quantitative in bold standards. One copy of a sort Hungarian summary (5-6 pages) about the carried out research and work must be handed in. In its bibliography only the summary’s literature must be named. It is worth knowing that this summary summarizes the research and work not the Thesis so references on the Thesis must be avoided. Such sentences cannot be in it as ‘My Thesis contains 6 chapters.’ or ‘The second part of my Thesis is a summary of literature.’ A Thesis can be mentioned as a source-string listed in the bibliography, its author is a student his/her a tutor and the head of the Department. A Thesis must be handed in in electronic form, recorded on CD as well.

You can find all the formal documents you need to download on the website of the Faculty here: http://www.eng.unideb.hu (English Page/Thesis)
CHAPTER 9
ABOUT A STATE EXAM

About a State Exam
A student can start a state exam if his/her Thesis and its summary has been evaluated at least with sufficient by a reviewer and the Department.
A state exam is separated into three parts according to the Curriculum.
Part 1: Topics of Professional subjects in Mechatronics: Measurements and modeling, dynamics of Mechatronics systems (10-10 themes given by the Department)
Part 2: Thesis defense (a presentation about the Thesis, then answering theoretical and practical questions and remarks)
In case a Thesis is made in a Laboratory of the Department the Exam Board can have a view of its results at the scene. A Graduating student must prepare for it in previous days, tools must be taken suitable till the presentation. If the object of a Thesis is moveable and can be moved to the Department (e.g.: a mobile robot, an electronic car etc.) its presentation can take place during a thesis defense. If a production cannot be presented (as it does not exist, cannot be moved to the Department) the presentation must be filled in with such videos or photos to be proved that the work done is the student’s own. Main parts of the presentations are:
1. The title of a Thesis, its author’s name
2. The content of a presentation
3. Problem posing, a task to be solved
4. A theoretical approach of the solution, physical, mechanical, electronic principles, reductions, a summary of the used principles, knowledge to the problem solving
5. Presentation of the solution (main steps to the solution and their results) in 1-3 slides
6. Records in 1-2 slides
7. Conclusion, suggestions, possibilities for further development
8. Acknowledgments (for firms or consultants) in 1 slide
The parts of the presentation from 3 to 7 must contain drawings, correspondences, equations to present the work, textural descriptions must be avoided. A video (moving film) can also be used to present part 6 if it makes sense.
After reviewing Examiners may ask a candidate to react on the written review and answer the reviewer’s questions. Otherwise own theoretical and practical questions can be asked about the thesis topic.
A state exam is unsatisfactory if
- A student’s written state exam is unsatisfactory, he/she does not gain at least 40%.
- A student’s presentation on theme questions of any subject group is unsatisfactory (In such case the state exam must be retaken on this subject group, its earliest date is the next exam period).
- A Thesis defense is unsuccessful. In such case a Thesis must be corrected according to the review, the thesis defense must be repeated, its earliest date is the next exam period.
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<th>Neptun code</th>
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<th>2nd semester</th>
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