BULLETIN

UNIVERSITY OF DEBRECEN

ACADEMIC YEAR 2016/2017

Mechatronical Engineering MSc

FACULTY OF ENGINEERING

Coordinating Center for International Education

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CHAPTER 1
DEAN'S WELCOME

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 asin 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 predecessors: Debrecen University of Agricultural Sciences. Debrecen Medical University. Wargha István College of Education, Hajdúböszörmény. Kossuth Lajos University of Arts and Sciences.

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

Accreditation dates and statute numbers: Debrecen University of Agricultural Sciences: 17th December 1996, MAB/1996/10/II/1. Debrecen Medical University: 5th July 1996, OAB/1996/6/II/6 Wargha István College of Education, Hajdúböszörmény: 5th July 1996, OAB/1996/6/II/2 Kossuth Lajos University of Arts and Sciences: 5th July1996, OAB/1996/6/II.5. University of Debrecen: 3rd October 2012, MAB/2012/8/VI/2.

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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Vice-Dean for Scientific Affairs:	Ferenc Kalmár PhD
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Head of Directory Office:	Ms. Noémi Dr. Bíró Siposné
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Address:	4028 Ótemető u. 2-4.
Phone:	+36-52-415-155/77741
Head of Students' Administration Office:	Tibor Balla
Phone:	+36-52-415-155/77767
Administrator for Foreign Students:	Ms. Ágnes György
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E-mail:	agnes@eng.unideb.hu
Head of English program Office:	Zsolt Tiba PhD habil.
International Relationship Coordinator:	Ms. Zita Szilágyi Popovicsné
Address:	4028 Debrecen, Ótemető u. 2-4.
E-mail:	programcoordinator@eng.unideb.hu

CHAPTER 4
DEPARTMENTS OF THE FACULTY OF ENGINEERING

DEPARTMENT OF ARCHITECTURE

Ótemető u. 2-4., Debrecen, 4028
Phone: +36 (52) 415-155/ 78704
Web: http://epitesz.eng.unideb.hu/

Professor, Head of Department		Antal Puhl DLA
College Professor		Gábor Mátyás Csanády DLA
		Marcel Ferencz DLA
Associate Professor		Balázs Falvai DLA
		Péter Kovács M.D., DLA, Ph.D., D.Sc.
		Tamás Szentirmai DLA
		Dávid Török DLA
Assistant Lecturer		Béla Bogdándy
		Miklós János Boros
		Ferenc Kállay
	Ms.	Anita Kántor
		Gábor Zombor
Secretary	Ms.	Anita Tóth-Szél

DEPARTMENT OF BASIC TECHNICAL STUDIES

2-4 Ótemető street, Debrecen, 4028
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E-mail: magdi@eng.unideb.hu, Web: http://www.eng.unideb.hu/userdir/mat/

College professor, Head of Department		Imre Kocsis Ph.D.
College Professor		Gusztáv Áron Sziki Ph.D.
College Associate Professor	Ms.	Mária Krauszné Princz Ph.D.
		Balázs Kulcsár Ph.D.
	Ms.	Rita Nagyné Kondor Ph.D.
Assistant Lecturer	Ms.	Adrien Árvainé Molnár
	Ms.	Éva Csernusné Ádámkó
		Csaba Gábor Kézi
	Ms.	Erika Perge
		Attila Vámosi
Secretary	Ms.	Sándorné Anton

DEPARTMENT OF BUILDING SERVICES AND BUILDING ENGINEERING

Ótemető street 2-4., Debrecen, 4028
Phone: +36-52-415-155 / 77770 Fax: +36-52-415-155 / 77713
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college professor, head of department		Ferenc Kalmár Ph.D.
college associate professor, deputy head of department		Ákos Lakatos Ph.D.
College Associate Professor	Ms.	Tünde Klára Kalmár Ph.D.
Assistant Lecturer		Béla Bodó
		Imre Csáky
		Sándor Hámori
		Gábor L. Szabó
		Ferenc Szodrai
		Zoltán Verbai
Departmental Engineer		Attila Kerekes
Emeritus		András Zöld Ph.D.
Secretary		Lola Csibi

DEPARTMENT OF MECHANICAL ENGINEERING

2-4 Ótemető street , Debrecen, 4028
Phone: +36-52-415-155 / 77776
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College professor, Head of Department	Ms.	Istvánné Ráthy Dr. Ph.D.
College Professor, Deputy Head of Department		Lajos Dr. Fazekas Ph.D.
		Tamás Mankovits Ph.D.
College Professor		Zsolt Tiba Dr. habil.
Associate Professor	Ms.	Ágnes Battáné Gindert-Kele Dr. Ph.D.
		György Juhász Ph.D.
College Associate Professor		Sándor Bodzás Ph.D.
Assistant Lecturer		Gábor Balogh
		Krisztián Deák
		József Menyhárt Ph.D.
		Sándor Pálinkás Ph.D.

Departmental Engineer		Zsolt Békési
		András Gábora
		Dávid Huri
Senior Lecturer		Sándor Hajdu
Technical Lecturer		Márton Lévai
		István Székács
Secretary	Ms.	Judit Bak

DEPARTMENT OF ENGINEERING MANAGEMENT AND ENTERPRISE

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College Professor, Dean, Head of Department	Ms.	Edit Szűcs Dr. habil.
Titular Professor		Tibor Szász Ph.D.
College Professor		Géza Lámer Ph.D.
College Senior Lecturer	Ms.	Éva Dr. Bujalosné Kóczán
Associate Professor		István Budai Ph.D.
	Ms.	Judit T. Kiss Ph.D.
Master Lecturer	Ms.	Tünde Jenei
Assistant Lecturer		Tibor Balla M.Sc.
	Ms.	Anita Dr. Mikó-Kis
		Attila Halczman M.Sc.
	Ms.	Kata Anna Váró
Departmental Engineer		Róbert Sztányi
Engineering Lecturer		Gyula Mikula
Senior Lecturer	Ms.	Éva Diószeginé Zentay
	Ms.	Andrea Emese Matkó Ph.D.

DEPARTMENT OF CIVIL ENGINEERING

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College Professor	György Csomós Ph.D.

		János Major Ph.D. habil.
Associate Professor		József Garai Ph.D. habil.
	Ms.	Kinga Nehme Ph.D.
College Associate Professor		Sándor Fehérvári Ph.D.
	Ms.	Gabriella Hancz Ph.D.
Assistant Lecturer	Ms.	Krisztina Kozmáné Szirtesi
	Ms.	Beáta Pataki
		Ádám Ungvárai
		Zsolt Vadai
		Zsolt Varga
		László Tamás Vincze
Departmental Engineer		József Kovács
		Zsolt Martonosi
	Ms.	Beáta Szakács
		László Tarcsai
Engineering Lecturer		János Bíró
Senior Lecturer	Ms.	Herta Czédli Ph.D.
		László Radnay Ph.D.
Assistant Lecturer Practitioner		János Bíró
Invited Lecturer		Zoltán Bereczki
		Titusz Igaz
		Péter Lugosi
		István Szabó Ph.D., C.Sc.
Secretary	Ms.	Mónika Tóthné Csákó

DEPARTMENT OF ELECTRICAL ENGINEERING AND MECHATRONICS

2-4 Ótemető street, Debrecen, 4028
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Associate Professor, Head of Department	Géza Husi Ph.D. habil.
Associate Professor	Péter Tamás Szemes Ph.D.
College Associate Professor	János Tóth Ph.D.
Master Lecturer	István Ákos Bartha
Assistant Lecturer	Sándor Piros Ph.D.
	Attila Vitéz

Departmental Engineer		Gyula Attila Darai
		István Nagy Ph.D.
Secretary	Ms.	Nóra Tóth
PhD Student	Ms.	Emese Bánóczy-Sarvajcz
		István Pógár

DEPARTMENT OF CHEMICAL AND ENVIRONMENTAL ENGINEERING

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College professor, Head of Department	Ms.	Ildikó Bodnár Ph.D.
College Assistant Professor		Sándor Fórián
College Professor		Lajos Gulyás Ph.D.
College Associate Professor		Norbert Boros Ph.D.
	Ms.	Andrea Keczánné Üveges Ph.D.
Assistant Lecturer		Dénes Kocsis
Secretary	Ms.	Andrea Dr. Labodáné Makay

COORDINATING CENTER FOR INTERNATIONAL EDUCATION

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Assistant	Ms.	Ibolya Kun
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Head of English Program Office		Zsolt Tiba Dr. habil.
International Relationship Coordinator	Ms.	Zita Popovicsné Szilágyi
	Ms.	Erika Thomas

CHAPTER 5
ACADEMIC CALENDAR OF THE FACULTY OF ENGINEERING

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

Opening ceremony of the academic year	11th September 2016
1st semester registration week	From 12th September till 16th September 2016
Repeat period of exam courses announced for the 1st semester of the academic year 2015/2016	From 12th September till 16th September 2016
1st semester study period of MSc and BSc program	From 19th September till 23rd December 2016 (14 weeks). In case of finalist courses: from 19th September till 18th November 2016 (9 weeks).
1st semester study period of BSc dual program	From 19th September till 16th December 2016 (13 weeks).
Reporting period (Drawing week) of Msc, BSc and BSc dual program	From 31st October till 4th 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 12th December till 16th December 2016 (5 working days without scheduled lessons, consultation schedule announced previously).
1st semester exam period	From 27th December 2016 till 10th February 2017 (7 weeks). From 21st November till 23rd December 2016 (5 weeks) for graduating students

Deadline of submitting degree theses and dissertations	According to the decision of the departments but in 21 days in proportion to the first day of the final exam.
Final exams (according to the decision of the departments)	At least one occasion in January 2017 The departments shall advertise the date of the final exam until 15th September 2017
2nd semester registration week	From 13th February till 17th February 2017
2nd semester study period of MSc and BSc program	From 20th February till 26th May 2017 (14 weeks). In case of finalist courses: from 20th February till 28th April 2016 (10 weeks).
2nd semester study period of BSc dual program	From 20th February till 19th May 2017 (13 weeks).
Reporting period (Drawing week) of Msc, BSc and BSc dual program	From 27th March till 31st March 2017 (5 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 15th May till 19th May 2017 (5 working days without scheduled lessons, consultation schedule announced previously).
2nd semester exam period	From 29th May till 14th July 2017 (7 weeks). From 24th April till 26th May 2017 (5 weeks) for graduating students.
Deadline of submitting degree theses and dissertations	According to the decision of the departments but in 21 days in proportion to the first day of the final exam.
Final exams (according to the decision of the departments)	At least one occasion between 5th and 23rd June 2017. The departments shall advertise the date of the final exam until 15th February 2017.

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.

11th week:
Lecture: Application of transfer function Definition and analysis of stability Examples for analysis of stability in case of non-feedback systems.
Practical: AC-Driven and Demodulated Electronic Scale I.

12th week:
Lecture: The visualization of the frequency transfer function The lumped parameter model of the systems described by vector field.
Practical: AC-Driven and Demodulated Electronic Scale II.

13th week:
Lecture: Concentrated parameter systems described with vector field models SISO LTI classical control systems.
Practical: Brushless Motor Control I.

14th week:
Lecture: State space representation Complex design example including measurements Sliding Mode Control of an uninterrupted Power Supply.
Practical: Brushless Motor Control II.

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

Requirements

Topics:
Basic concepts, mathematical description of physical phenomena. Definition of a real physical system. Definition of signals. Inputs and outputs. Definition of a system. Definitions of linear and non-linear systems Definition of a parameter and a variable. Theory of a distributed and concentrated parametric description. Description of deterministic and stochastic systems. Concept of causality. A deterministic description with lumped parameters. The concept of static systems. The concept of dynamic systems. General principles of dynamical systems, Linear, quantized, single in and output systems. Linear, quantized, one input-output system, Generalized derivative. A state, a state variable, a state equation. Basic tasks, solvability of the most important basic tasks, Complex tasks, The concept of stability State space representation. Variable structure systems, Basic methods of analyses. Mathematical methods to investigate SISO LTI systems, Investigation in time region (Dividing into components), analyses in frequency domain. Switch mode. Examination of SISO LTI systems. Transfer functions. Determining a transfer function with the help of a block diagram. Block diagrams. Application of transfer functions. Definition and analysis of stability. Examples for analysis of stability in case of non-feedback . The visualization of a frequency transfer function. A lumped parameter model of the systems described by a vector field. Concentrated parameter systems described by vector field models. SISO LTI classical control systems. State space representation. A complex design example including measurements. Sliding mode control of an uninterrupted Power supply. The class will use LabVIEW—based control electronics.
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

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:

Score	Grade
0-39	fail (1)
40-52	pass (2)
52-63	satisfactory (3)
64-71	good (4)
72-80	excellent (5)

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
Debreceni Egyetem , ISBN: 978-963-473-520-5
Radu CătălinȚarcă : Advanced methatronics - Coursebook
ISBN: 978-963-473-508-3
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

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 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:
Score Grade

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
3rd ed.2006. ISBN: 978-0131856721
John Essick: Hands-On Introduction to LabVIEW for Scientists and Engineers
3rd ed. .2015. ISBN: 978-0190211899
Ed Doering: NI myRIO Project Essential Guide
2014 March ed.. National Technology and Science Press, 2014.

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:
Lecture: Sensors for feedback: Measurement of position, speed and acceleration, signal filtering. Absolute and relative encoders.
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: controlability 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.

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:

Score	Grade
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

Asif Sabanovics, and Kouhei Ohnishi: Motion Control Systems
John Wiley & Sons, 2011. ISBN: 978-0-470-82573-0
Robert Bishop: Modern Control Systems with LabView
NTS Press, 2012. ISBN: 978-1-934891-18-6
Robert Bishop: Mechatronics Handbook
CRC Press, ISBN: 0-8493-0066-5

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

1st week:
Lecture: Introduction of electronic system concepts.
Practical: Accident prevention instructions.

2nd week:
Lecture: Semiconductors, operations.
Practical: Examining electrical passive filter circuits.

3rd week:
Lecture: Operation of a transistor, practical basic circuits with a transistor.
Practical: Examination of a common emitter amplifier transistor.

4th week:
Lecture: Optoelectronic components: LED, phototransistor, optocoupler, displays.
Practical: Examination of optocoupler.

5th week:
Lecture: Basic concepts of digital technology, Boolean algebra.
Practical: Operation and configuration of basic logical circuits.

6th week:
Lecture: Basic logical functions and methods of their implementation.
Practical: Building SR flip-flop from level driven NAND gates.

7th week:
Lecture: Mid-term test.
Practical: Revision of missed out measurements.
Self Control Test.

8th week:
Lecture: Low-voltage networks of facilities.
Practical: Calculating problems, Case studies.

9th week:
Lecture: Power (heavy current) networks of facilities.
Practical: Calculating problems, Case studies.

10th week:
Lecture: Protection against electric shock, Lightning protection.
Practical: Calculating problems, Case studies.

11th week:
Lecture: Information and communication networks.
Practical: Calculating problems, Case studies.

12th week:
Lecture: Electrical equipment of facilities. Switchgears.
Practical: Calculating problems, case studies.

13th week:
Lecture: Electric drives and transformers.
Practical: Calculating problems, case studies.

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

Requirements

Topics:
The course focuses on the theory and application of the following: Linear and non-linear systems. Semiconductor physics. Analogies. Non-linear elements. Periodic excitation. Transient phenomena. Sampling systems. Special electric magnetic materials, sensors. Analogue electronic amplifiers, operational amplifiers and applications. Passive and active filters. Electronic units in controllers, process control. Principles and methods of telemetry. Micro-electromechanical systems. Circuit simulation methods. Laboratory and computer exercises help to promote understanding and mastery of the curriculum.
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:

Score	Grade
0 - 49	fail (1)
50 - 59	pass (2)
60 - 69	satisfactory (3)
70 - 79	good (4)
80 - 100	excellent (5)

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

A.I.E.E John Henderson: Electrotechnics HardPress Publishing, 2012.
János Tóth: Electrical Actuators, Course Book University of Debrecen, 2012.
David Crecraft, David Gorham: Electronics 2003.

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:
Lecture: Organization structures: Matrix, Functional, Divisional, Line.
Seminar: SWOT analyzes.

3rd week:
Lecture: Management gurus: Fayol, Taylor, Mintzberg, Porter, Weber, Mayo.
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:
Lecture: Work performance: determining work performance, analyzing the problems, finding a solution.
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.

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.
A, for a signature:
Attendance at lectures is recommended, but not compulsory. Participation at practice classes 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. Attendance at practice classes will be recorded by the practice leader. 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 is an end-term test in the 15th week. Students have to sit for the test.
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:

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

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
Widden Books, 2001.
Schwart, T – Loehr, J. : The Power of Full Engagement: Managing Energy, Not Time, Is the Key to High Performance and Personal Renewal
Free Press, 2005.
Mancini, M. : Time management
McGraw-Hill Companies, 2003.
Taylor, J. : Decision Management System
IBM Press, 2012.

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**

1st week:
Lecture: Modeling with differential equations. Initial and boundary value problems.
Seminar: Exercises and problems related to the topics of the lecture.

2nd week:
Lecture: Fundamentals of differential equations. Existence and uniqueness theorems.
Seminar: Exercises and problems related to the topics of the lecture.

3rd week:
Lecture: Solution of certain non-linear ordinary differential equations.
Seminar: Exercises and problems related to the topics of the lecture.

4th week:
Lecture: Numerical methods for ordinary differential equations. Picard-iteration, power series solutions.
Seminar: Exercises and problems related to the topics of the lecture.

5th week:
Lecture: Euler method, Runge-Kutta method.
Seminar: Exercises and problems related to the topics of the lecture.

6th week:
Lecture: Structure of the solutions of linear differential equations. Linear systems of differential equations with constant coefficients, higher order linear differential equations.
Seminar: Exercises and problems related to the topics of the lecture.

7th week:
Lecture: Stability of linear differential equations.
Seminar: Exercises and problems related to the topics of the lecture.

8th week:
Lecture: Orthonormal systems in Hilbert spaces, trigonometric Fourier series.
Seminar: Exercises and problems related to the topics of the lecture.

9th week:
Lecture: Fourier integral, Fourier transform, inverse Fourier transform.
Seminar: Exercises and problems related to the topics of the lecture.

10th week:
Lecture: Laplace transform, inverse Laplace transform. Residuum theorem.
Seminar: Exercises and problems related to the topics of the lecture.

11th week:
Lecture: Solution of initial value problems with Laplace-transform.
Seminar: Exercises and problems related to the topics of the lecture.

12th week:
Lecture: Generator function method, z-transform, inverse z-transform, application for the solution of differential equations.
Seminar: Exercises and problems related to the topics of the lecture.

13th week:
Lecture: Discrete Fourier transform, fast Fourier-transform.
Seminar: Exercises and problems related to the topics of the lecture.

14th week:
Lecture: Classification of second order partial differential equations. Solution of certain second

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:
Modeling with differential equations. Initial and boundary value problems. Fundamentals of differential equations. Existence and uniqueness theorems. Solution of certain non-linear ordinary differential equations. Numerical methods for ordinary differential equations. Picard-iteration, power series solutions. Euler method, Runge-Kutta method. Structure of the solutions of linear differential equations. Linear systems of differential equations with constant coefficients, higher order linear differential equations. Stability of linear differential equations. Orthonormal systems in Hilbert spaces, trigonometric Fourier series. Fourier integral, Fourier transform, inverse Fourier transform. Laplace transform, inverse Laplace transform. Residuum theorem. Solution of initial value problems with Laplace-transform. Generator function method, z-transform, inverse z-transform, application for the solution of differential equations. Discrete Fourier transform, fast Fourier-transform. Classification of second order partial differential equations. Solution of certain second order partial differential equations.
A, for signature:
Attendance on the lectures is recommended, but not compulsory. Participation at practice is compulsory. Student must attend the practices and my not miss more than three practice during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Student can't make up a practice with another group. The attendance on 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 practices should be made up for at a later date, to be discussed with the tutor. Students are required to bring the necessary utensil (e.g. calculator) for the course with them to each practice. Active participation is evaluated by the teacher in every class. If 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 there are two tests: the mid-term test is in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.
B, for grade: The course ends in exam, the grade is calculated as: - 60% from the exam - 20%-20% from the two tests The minimum requirement for passing is 60%, the grade for the final mark is given according to the following table:

Score	Grade
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 once can take a retake test covering the whole semester material.

Required reading materials

Greenberg, M. D.: Advanced Engineering Mathematics
Prentice Hall, 1998.
Polyanin, A.D., Manzhirov, A.V.: Handbook of Mathematics for Engineers and Scientists
Chapman & Hall, 2007.
Burghes, D. N.: Modelling with Differential Equations
John Wiley & Sons, 1981.
Logan, J. D.: Applied Partial differential equations
Springer, 2004.
Randall, R.: Frequency Analysis
Bruel & Kjaer, 1987.
Chapra, S. C.: Numerical Methods for Engineers
Mc Graw Hill, 2006.
Dyke, P.: An Introduction to Laplace Transforms and Fourier Series
Springer, 2014.

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.

Requirements

Topics:
Formulation of control models. General properties of linear systems: reachability, controllability, stabilizability, observability, detectability, reconstructibility. State variables, dynamic feedback, realization. Linear and quadratic optimal control with finite and infinite time horizon. Time-optimal control of linear systems. Non-linear control systems. Existence of optimal controls. Pontryagin's maximum principle. Dynamic programming.
A, for a signature:
Attendance at lectures is recommended, but not compulsory. Participation at practice is compulsory. Students must attend the practices and must 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 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 practices 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) to the course with them to each practice class. Active participation is evaluated by the teacher in every class. If student's behavior or conduct doesn't meet the requirements of active participation, the teacher can evaluate their participation as an absence due to the lack of active participation in class.
During the semester there are two tests: the mid-term test is 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 exam, the grade is calculated as: - 60% from the exam - 20%-20% from the two tests The minimum requirement for passing is 60%, the grade for the final mark is given according to the following table:

Score	Grade
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 once can take a retake test covering the whole semester material.

Required reading materials

Sontag, E. D.: Mathematical Control Theory
Springer, 1998.
Vincent, T. L., Grantham, W. J.: Nonlinear and Optimal Control Systems
John Wiley & Sons, 1997.
Macki, J., Strauss, A.: Introduction to Optimal control Theory
Springer, 1982.

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.
Practical: Design of root locus and Routh–Hurwitz stability criterion method.

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.

Requirements

Required reading materials

Dorf, R.C., Bishop, R.H: Modern Control Systems
10th. Pearson / Prentice Hall, 2005.

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.

8th week:
Lecture: Mounting plates. Printed wiring boards technology. A multi-layer, high-density integrated cable wiring.
Practical: Surface Mount Technology.

9th week:
Lecture: Implants, bore and surface mounting technologies. Interface assembly automation.
Practical: Solder paste screen printing, assembly, reflow soldering.

10th week:
Lecture: Bore and surface mount soldering technologies.
Practical: Solder paste screen printing, assembly, reflow soldering.

11th week:
Lecture: Semiconductor chip implantation and wire bonding technologies. Production of protective coatings, encapsulation technologies.
Practical: Soldering compatible technologies through hole reflow.

12th week:
Lecture: The assembly and inspection procedures bonding technologies: optical observation, X-ray structural analyses, acoustic microscopy.
Practical: Soldering compatible technologies through hole reflow.

13th week:
Lecture: Materials Testing procedures. Error Analytics.
Practical: Optical, X-ray examination and functional modules mounted circuits.

14th week:
Lecture: The module circuits and devices, mechanical and thermal design.
Practical: Optical, X-ray examination and functional modules mounted circuits. Mid-term test No.2.
Self Control Test

15th week:
Lecture: Re-take test
Self Control Test

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:

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:

Score	Grade
0-49	fail (1)
50-64	pass (2)
65-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

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
Delmar Cengage Learning , 2014. ISBN: 978-1-133-94851-3
Neil Sclater: Electronic Technology Handbook
978-0070580480 , 1999. ISBN: 978-0070580480
The HDI Handbook
URL: http://www.hdihandbook.com/download.php

Subject: **INDUSTRIAL APPLICATIONS OF MECHATRONICS SYSTEMS: VEHICLES, BUILDING AUTOMATION AND ROBOTICS I.**
Year, Semester: 1st year/2nd semester
Lecture: **2**
Practical: **6**

1st week:
Lecture: Vehicles: drive train systems.
Practical: Practice on selected topics.

2nd week:
Lecture: Vehicles: electrical vehicles I.
Seminar: Practice on selected topics.
Practical: Practice on selected topics.

3rd week:
Lecture: Vehicles: Electrical vehicles II.
Practical: Practice on selected topics.

4th week:
Lecture: Building automation, introduction and applications.
Practical: Practice on selected topics.

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

6th week:
Lecture: Building automation: supervisory control systems.
Practical: Practice on selected topics.

7th week:
Lecture: Building automation: HVAC control systems.
Practical: Practice on selected topics.

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

9th week:
Lecture: Building automation: energy management systems II.
Practical: Practice on selected topics.

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:
Introduction to Mechatronics Systems. System analysis, performance and behaviors.
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
Second Edition . Dekker Mechanical Engineering, ISBN: 978-1466560857
D. Karnop, D. Margolis, R. Rosenberg : System dynamics: Modeling, simulation, and control of mechatronic systems
John Wiley and sons, 2012. ISBN: 047088908x

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.

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:

Score	Grade
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

Dr. Tamás Szabó: Mechatronical Modelling
2014.
Cory L. Clark: LabView Digital Signal Processing
McGraw-Hill, 2005. ISBN: 0-07-144492-0

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:

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:

Score	Grade
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

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
CMPBOOKS, 2005. ISBN: 1 57802 134 9
National Instruments : LabVIEWTMReal-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 to 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:
Materials, bulk and surface properties. A size effect in material properties. The most important bulk properties for designing of engineering components, their definitions and determination procedures. General tendency of the steel developments. Applied material science in development of steels. Material selection strategies. The Ashby material selection procedure. Examples in material selections. (in personal tasks). "Knowledge" vs. "technology". Nano-materials vs. Nanotechnology. Composite materials (GFRP, CFRP, BFRP, MMC). Materials for different applications, like nanotechnology in informatics, in safety of banknotes, materials in lighting, soldering materials, metallic glasses, solar cells, superconductivity, magnetic properties, 3D-Printing, Rapid prototyping, etc.(in personal tasks).
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

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:

Score	Grade
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, 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
McG-Hill RAW International Editions, 1990.
William F. Smith: Foundations of Materials Science and Engineering
McG-Hill RAW International Editions, 1993.
M. F. Ashby: Materials Selection in Mechanical Design
Third Edition. ELSEVIER, 2005.
C. Newey, G. Weaver: Materials Principles and Practice
Open University. Butterworths, 1990.
R.A. Flinn, P.K.Trojan: Engineering Materials and Their Applications
Houghton Miffin Company, 1986.
D.R. Askeland: The Science and Engineering of Materials
Chapman and Hall, 1996.
T.H. Courtney: Mechanical Behavior of Materials
McG-Hill RAW International Editions, 1990.

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

images, movies.

3rd week:
Lecture: Display images on a screen. Scene lighting.
Practical: Image display and lighting examples.

4th week:
Lecture: Calibrating cameras and images.
Practical: Image and camera calibration examples.

5th week:
Lecture: Basic Image processing: Region of Interest, and basic operators.
Practical: Basic operations examples.

6th week:
Lecture: Filters: gaussian, gradient, laplacian, and smoothing.
Practical: Filtering examples.

7th week:
Lecture: Morphology: dilatation, erosion, particle removal.
Practical: Morphology examples.

8th week:
Lecture: Mid-term test. Pattern matching: searching and identifying.
Practical: Pattern matching examples.
Self Control Test.

9th week:
Lecture: Locating objects on image to inspect.
Practical: Locating objects example.

10th week:
Lecture: Finding measurement points using edge detection.
Practical: Edge detection examples.

11th week:
Lecture: Color pattern matching.
Practical: Color pattern matching examples.

12th week:
Lecture: Coordinating transform between image space and real world space.
Practical: Coordinating transform examples.

13th week:
Lecture: Identifying parts under inspections.
Practical: Examples of Part identification.

14th week:
Lecture: Reading barcodes and data Matrix.
Practical: Barcode reading examples.

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

Requirements

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

Score	Grade
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

Patric R. Goebel: Image Acquisition and Processing with LabView
CRC Press, 2004. ISBN: 0-8493-1480-1
Richard Szeliski: Computer Vision:Algorithms and Applications
Springer, 2011. ISBN: 978-1-84882-935-0
NI Vision for LabVIEW User Manual
National Instruments, 2005. ISBN: 371007B-01

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: **Practical:** Task of simulation, overview, sample	examples.

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

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: Methatronics control systems. Coursebook
Debreceni Egyetem , ISBN: 978-963-473-520-5
Géza Husi: Methatronics control systems. Laboratory handbook
Debreceni Egyetem , ISBN: 978-963-473-521-2
LjubisaRistic (ed.): Sensor Technology and Devices
Artech House, 1994.
E. Schrüfer: Elektrische Messtechnik
Carl HanserVerlag, 1992.
Analog Devices: Practical Design Techniques for Sensor Signal Conditioning
1992.

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.

7th week:
Lecture: Driver and interface programs development for mechatronics systems. Dynamic performances evaluation of mechatronics systems.
Practical: Scheduled lab sessions, but you will mostly work in the lab on a self-scheduled basis.

8th week:
Lecture: Mid-term test.
Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis in the lab.
Self Control Test.

9th week:
Lecture: Mechatronics systems industrial applications. Significant laboratory-based design experiences.
Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis in the lab.

10th week:
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.
Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis in the lab.

11th week:
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.
Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis in the lab.

12th week:
Lecture: Digital logic; analog interfacing and power amplifiers.
Practical: Scheduled lab sessions, but you will mostly work in the lab on a self-scheduled basis.

13th week:
Lecture: Measurement and sensing; electromagnetic and optical transducers.
Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis in the lab.

14th week:
Lecture: Control of mechatronics systems.
Practical: Scheduled lab sessions, but students mostly work on a self-scheduled basis in the lab.

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

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

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 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:

Score	Grade
0-39	fail (1)
40-52	pass (2)
52-63	satisfactory (3)
64-71	good (4)
72-80	excellent (5)

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
Springer Verlag, 2012. ISBN: 978-3-642-17531-2
D. Shetty, R. Kolk : Mechatronics systems design
Second Edition.2010. ISBN: 143906198x
D. Karnop, D. Margolis, R. Rosenberg : System dynamics: Modeling, simulation, and control of mechatronic systems
John Wiley and sons, 2012. ISBN: 047088908x
Stepping motor control systems
U.T. PRES, Cluj, 2004. ISBN: 973-662-104-9
Szász Csaba: Digital controlsystems-Applications
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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,

- 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

• 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: IEEExplore, 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.

CHAPTER 10
MODEL CURRICULUM

Compulsory courses													
1st year													
		1st semester					2nd semester						
Subjects	**Neptun code**	L	S	P	Exam	Crd.	L	S	P	Exam	Crd.	**Prerequisites of taking the subject**
Advanced systems	**MFADV51C04-EN**	2		3	ESE	4						None
Application of the Theory of Differentia Equations	**MFMAT51C04-EN**						2	2		ESE	4	None
Basics of Management	**MFMEN51X07-EN**	4	2		AW5	7						None
Computing Systems	**MFHAT51L03-EN**			3	ESE	3						None
Control theory	**MFIRE51C05-EN**						3		1	ESE	5	None
Digital Servo Drives	**MFDSH51C04-EN**	2		1	AW5	4						None
Electronics Technology	**MFETN51C04-EN**						2		1	AW5	4	None
Industrial applications of mechatronics systems: vehicles, building automation and robotics I.	**MFEFB51C04-EN**						2		6	AW5	4	None
Material Science	**MFMAT51C04-EN**						2	1		AW5	4	None
Measurement and Modeling	**LabView Control Design**						2	2		ESE	5	None

Compulsory courses												Prerequisites of taking the subject
1st year (continued)												
Subjects	Neptun code	1st semester					2nd semester					
		L	S	P	Exam	Crd.	L	S	P	mExa	Crd.	
Real-time Embedded Programming	**MFRTP51C05-EN**						2	2		ESE	5	None
Selected Chapters from Electronics	**MFVFE51C03-EN**	2		1	ESE	3						None
Theory of Optimal Control	**MFMAT52C0-EN**						2	2		ESE	4	None

Compulsory courses												
2nd year												
Subjects	Neptun code	1st semester					2nd semester					Prerequisites of taking the subject
		L	S	P	mExa	Crd.	L	S	P	mExa	Crd.	
Computer simulation	**MFSIM51C02-EN**								2	AW5	2	None
Design of mechatronics systems	**MFDMS51C04-EN**						3		2	AW5	6	None
Image Processing	**MFKEP51C03-EN**	2		1	AW5	3						None
Industrial applications of mechatronics systems: vehicles, building automation and robotics II	**MFEFB52C04-EN**	1		3	AW5	4						None