BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS

FACULTY OF MECHANICAL ENGINEERING

SUBJECT DATASHEET

I. SUBJECT DESCRIPTION

1. GENERAL DATA

1.1. Subject name (in Hungarian, in English)

Mechatronics ● Mechatronics

1.2. Neptun code

BMEGEMIBMMH

1.3. Type

study unit with contact hours

1.4. Course types and number of hours (weekly / semester)

course type	number of hours (weekly)	nature (connected / stand-alone)
lecture (theory)	2	-
exercise	2	coupled
laboratory exercise	-	-

1.5. Type of assessments (quality evaluation)

mid-term grade

1.6. ECTS

5

1.7. Subject coordinator

name:	Dr. Budai Csaba
post:	associate professor
contact:	budai@mogi.bme.hu

1.8. Host organization

Department of Mechatronics, Optics and Mechanical Engineering Informatics (https://www.mogi.bme.hu)

1.9. Course homepage

https://www.mogi.bme.hu/tantargyak/BMEGEMIBMMH

1.10. Course language

hungarian

1.11. Primary curriculum type

mandatory

1.12. Direct prerequisites

Strong prerequisite:	BMEGEMIBMMA
Weak prerequisite:	-
Parallel prerequisite:	BMEVIAUA049
Milestone prerequisite:	-
Excluding condition:	BMEGEMIBMME

(the subject cannot be taken if you have previously completed any of the following subjects or groups of subjects)

2. AIMS AND ACHIEVEMENTS

2.1. Aim

The aim of this course is to supplement the approach and formal methods introduced in the basics of Mechatronics with an exact mathematical toolkit that can be used to model the mechanical, electrical and computer control parts of mechatronic equipment in a uniform way. It presents methods for writing the equations needed to describe mechatronic equipment from different perspectives (mechanical and electrical), points out the advantages and disadvantages of each approach. He describes further methods for analyzing the operation of mechatronic devices, and finally addresses some of the basic issues of the synthesis.

2.2. Learning outcomes

Competences that can be acquired by completing the course:

A. Knowledge

- The student recalls the concepts and formal methods introduced in the basics of Mechatronics.
- The student is aware of ways to generally describe finite-dimensional dynamical systems.
- Describes linear time invariant (LTI) systems with state space representation, using similarity transformations, and in canonical form.
- Describes the classical control theory equations of a linear, single-input, single-output time-invariant system, applying the concept of a generalized derivative as necessary.
- Knows the most important ways of writing equations of finite-dimensional dynamical systems (concentrated parameter description of systems that can be described by a vector field with two- and four-pole elements and ideal sources, Newton-Euler equations).
- The student understands the most important ways of writing the equations of finite-dimensional dynamical systems (in the case of mechanical systems, the principle of virtual work, with a second kind of Lagrange equation).
- It distinguishes between the methods of plotting the structure and bond graph and the block diagram of complex mechatronic systems.
- The student is aware of the concept of continuous-time pulse and hop response, as well as the convolution of input signals and responses broken down into time domain components.
- It summarizes the definition of the Fourier and Laplace transforms and the most important rules for their use.
- Defines the solution of the equations of LTI systems in state space representation and Laplace transform.
- Knows the concept of transmission and frequency transmission function and how to write it.
- The student knows the linear amplitude spectrum of periodic signals, as well as the frequency and power density spectra of general signals, the similarities and differences between them.
- Understands how to display the frequency transfer function (Nyquist and Bode diagram).
- It organizes the transfer function of the basic members (P, I, D, PI, PD, PID, dead time) as well as the Nyquist and Bode diagram.
- It includes the most important types and structures of analog filters in the system.

B. Ability

- Able to draw a structure graph of complex mechatronic systems.
- Solves linearly independent node and loop equations written on the basis of a structure graph using the method of node potentials and loop currents in the time, frequency, and operator domains.
- Solves equations written on the basis of prior knowledge of complex mechatronic systems using a transfer function and a state space representation.
- Defines the bond graph of complex mechatronic systems.
- Defines a block diagram of complex mechatronic systems.
- Analyzes the operation of the system in the frequency range based on a block diagram of complex mechatronic systems.
- Apply the expansion and endpoint theorems to Laplace transform functions.
- Calculates the continuous-time convolution of complex mechatronic systems.
- Calculates the continuous-time pulse and jump response of complex mechatronic systems.
- Identifies state space representations and their relationship in LTI systems.
- Calculates the transfer function of a complex mechatronic system.
- Uses the Nyquist and Bode diagrams of the base members in a problem solution.
- It designs the most important commonly used analog filter types.
- With his IT knowledge, he is able to solve complex, computationally intensive tasks.
- Able to express his / her thoughts in an orderly form, orally and in writing.

C. Attitude

- He seeks collaboration with the instructor and fellow students.
- It expands your knowledge by constantly acquiring knowledge and orientation.
- Open to use a variety of information technology tools.
- It seeks to learn about and routinely use the tools needed to solve mechatronic problems.
- It strives for accurate and error-free problem solving during its studies.

D. Independence and responsibility

- Performs the steps required to solve mechatronic tasks independently using the given resources.
- The student accepts well-founded critical remarks about his work.
- In some situations, as part of a team, you work with your fellow students to solve tasks.
- It supports the application of a systems approach to solving its tasks.
- The student conscientiously checks his readiness, work and task solutions.

2.3. Teaching methodology

Lectures with a formal teaching method, in the classroom, with a projected presentation. Computational exercises in the classroom with guided and independent problem solving. Written and oral communication with faculty and fellow students. Use of information technology tools and techniques in learning and problem solving. Tasks created independently and in group work using work organization techniques.

2.4. Support materials

a) Textbooks

-

b) Lecture notes

-

c) Online materials

http://www.mogi.bme.hu/tantargyak/BMEGEMIBMME

https://mogi.bme.hu/TAMOP/mechatronikai_berendezesek_tervezese/index.html

https://mogi.bme.hu/TAMOP/rendszertechnika/index.html

2.5. Validity of the course description

Start of validity:	2022. July 15.
End of validity:	2027. July 15.

II. SUBJECT REQUIREMENT

3. ACHIEVEMENT CONTROL AND EVALUATION

3.1 General rules

The assessment of learning outcomes consists of 3 compulsory and 1 optional mid-year performance measures. Compulsory performance measurement is the 2 summary study performance evaluations (indoor dissertation) and the 1 partial performance evaluation (homework). The condition for obtaining the mid-term grade is the completion of at least 40% of the total number of points available in the compulsory mid-term examinations and the achievement of the required minimum participation in the internships. With the active participation in the sessions (optional mid-year performance measurement), additional points can be obtained, which can be included in the grade if at least a sufficient mid-term grade is obtained. Due to its nature, active participation cannot be replaced, improved or otherwise replaced or replaced.

3.2 Assessment methods

A. Detailed description of mid-term assessments

1. Mid-term assessment

type: summative assessment

count: 2

purpose, description: Summarizing academic performance evaluation is a complex, written way of evaluating the competence-type competence elements of the subject and knowledge in the form of a dissertation. The dissertation basically focuses on the application of the acquired knowledge, so it focuses on problem recognition and solution solution, ie practical (calculation) tasks must be solved during performance evaluation. The part of the curriculum on which the assessment is based is determined by the lecturer of the subject in agreement with the supervisors. The condition for the sufficient completion of the dissertation is that the total score obtainable in the dissertation is at least 40%.

2. Mid-term assessment

type: formative assessment, project-based, complex

count: 1

purpose, description: Partial performance assessment (homework) is a complex way of assessing the competence elements of the subject's knowledge, ability, attitude, and independence and responsibility type, the form of which is the individual homework. The condition for the sufficient completion of homework is to achieve a result of at least 40%, taking into account the observance of the pre-specified formal requirements. Pursuant to Section 122 (2) of the BME TVSZ, the value of the available score decreases by 20% during late submission.

3. Mid-term assessment

type: formative assessment, point-in-time personal act

count: 1

purpose, description: Partial performance assessment (active participation) is a simplified way of assessing the competence elements of the subject's knowledge, ability, attitude, and independence and responsibility type, which takes the form of a prepared appearance and active participation in the internship process. The uniform assessment principles are defined jointly by the person in charge of the course and the lecturer of the course.

B. Detailed description of assessments performed during the examination period (if relevant)

Elements of the exam:

1. written partial exam
   -
2. oral partial exam
   -
3. practical partial exam
   -
4. inclusion of mid-term results
   -

3.3 The weight of mid-term assessments in signing or in final grading

identifier	**weight**
1 . Mid-term assessment	70 %
2 . Mid-term assessment	30 %
3 . Mid-term assessment	15 %

3.4 The weight of partial exams in grade (if relevant)

type	**weight**
written partial exam	0 %
oral partial exam	0 %
practical partial exam	0 %
inclusion of mid-term results	0 %

3.5 Determination of the grade

grade ● [ECTS]	**the grade expressed in percents**
very good(5) ● Excellent [A]	above 90%
very good(5) ● Very Good [B]	85% .. 90%
good(4) ● Good [C]	70% .. 85%
satisfactory(3) ● Satisfactory [D]	55% .. 70%
sufficient(2) ● Pass [E]	40% .. 55%
insufficient(1) ● Fail [F]	below 40%

The lower limit specified for each grade already belongs to that grade.

3.6 Attendance and participation requirements

Must be present at at least **0%** (rounded down) of lectures.

At least **70%** the exercises (rounded down) must be actively attended.

3.7 Special rules for improving, retaken and replacement

The special rules for improving, retaken and replacement shall be interpreted and applied in conjunction with the general rules of the CoS (TVSZ).

Need mid-term assessment to individually complete?

NO

Can the submitted and accepted partial performance assessments be resubmitted until the end of the replacement period in order to achieve better results?

NO

The way of retaking or improving a summary assessment for the first time:

the summative assessments can be retaken or improved only combined

Is the retaking-improving of a summary assessment allowed, and if so, than which form:

retake or grade-improving exam not possible

Taking into account the previous result in case of improvement, retaken-improvement:

out of multiple results, the best one is to be taken into account

The way of retaking or improving a partial assessment for the first time:

partial assesment(s) in this group can be improved or repeated once up to the end of the repeat period

3.8 Study work required to complete the course

Activity	**hours / semester**
participation in contact classes	56
mid-term preparation for practices	14
preparation for summary assessments	32
elaboration of a partial assessment task	30
additional time required to complete the subject	18
summary	**150**

3.9. Validity of subject requirements

Start of validity:	2022. July 15.
End of validity:	2027. July 15.

4. ADDITIONAL INFORMATION

4.1 Primary course

The primary (main) course of the subject in which it is advertised and to which the competencies are related:

Mechatronics engineering

4.2 Link to the purpose and (special) compensations of the Regulation KKK

This course aims to improve the following competencies defined in the Regulation KKK>

a) knowledge

- Student has the knowledge and application in context of the scientific and technical theories and causal relationships relevant to the profession of mechatronics engineer.
- Student has acquired a theoretically sound, systems-oriented and practice-oriented engineering mindset.

b) ability

- Student has the ability to design complex mechatronic systems globally, based on a systems- and process-oriented, theoretically sound way of thinking.
- Student has the ability to apply student's comprehensive theoretical knowledge in practice in the field of equipment, processes and systems that integrate mechanics synergistically with electronics, electrical engineering and computer control.

c) attitude

- Student strives to carry out their work in a complex approach based on a systems and process-oriented mindset.
- Student strives to develop professional competences.
- Student is committed to high quality work and strives to communicate this approach to student's colleagues.

d) independence and responsibility

- Student shares gained knowledge and experience with those working in the field through formal, non-formal and informal information transfer.
- Student takes an independent and proactive approach to solving professional problems.

4.3 Prerequisites for completing the course

Knowledge type competencies

(a set of prior knowledge, the existence of which is not obligatory, but greatly facilitates the successful completion of the subject)	-

Ability type competencies

(a set of prior abilities and skills, the existence of which is not obligatory, but greatly contributes to the successful completion of the subject)	-