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)

Cyber-physical production systems ● Cyber physical manufacturing

1.2. Neptun code

BMEGEGTBM71

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)	3	-
exercise	1	-
laboratory exercise	2	coupled

1.5. Type of assessments (quality evaluation)

mid-term grade

1.6. ECTS

6

1.7. Subject coordinator

name:	Dr. Erdős Ferenc Gábor
post:	associate professor
contact:	erdos.ferenc.gabor@gpk.bme.hu

1.8. Host organization

Department of Manufacturing Science and Engineering (https://manuf.bme.hu)

1.9. Course homepage

https://manuf.bme.hu/?page_id=12584

1.10. Course language

hungarian

1.11. Primary curriculum type

mandatory

1.12. Direct prerequisites

Strong prerequisite:	BMEGEGTBM01, BMEGEGTBM61
Weak prerequisite:	-
Parallel prerequisite:	-
Milestone prerequisite:	-
Excluding condition:	-

(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 the course is to acquaint students with the main principles of cyber-physical production systems, to acquaint them with the basic methods by which physical devices (hardware) and their virtual representation (software) are inseparably connected and interact with other similar devices (network).). The course pays great attention to the functional and information integration of production planning, production management, cell and workplace control, in summary.

2.2. Learning outcomes

Competences that can be acquired by completing the course:

A. Knowledge

- 1. Knows the main types and functions of production equipment.
- 2. Knows the main principles and important equipment of production logistics.
- 3. Distinguish between production scheduling data representations and how they are used.
- 4. Is aware of methods for modeling lower order kinematic constraints.
- 5. Is aware of methods for modeling open kinematic chain machines with a kinematic graph.
- 6. Summarizes the use of regular expressions to process structured input files.
- 7. Summarize the characteristics of data collection systems and their uses.
- 8. Recalls modeling methods for discrete event simulation procedures.
- 9. Recalls virtual commissioning procedures and the theoretical foundations of these procedures.
- 10. Summarizes techniques for synchronizing real (physical) and digitally simulated (cyber) production.

B. Ability

- 1. Able to model a digital copy of a real production system.
- 2. Able to analyze and program simple data mining problems.
- 3. Ability to analyze the operation of production systems digitally using simulation.
- 4. Calculates the motion trajectory of a controlled point on machining machines.
- 5. Interprets data stored in structured input files and processes it digitally.
- 6. Calculates the interpolations of computer motion simulations of NC machines.
- 7. Calculates the digital copy of the machining NC machine or robot.
- 8. With his IT knowledge, he interprets simple condition monitoring tasks.
- 9. Having the knowledge of IT, determines the algorithms of simple machine calibration tasks.
- 10. Defines the solution of mathematical problems using functional programming methods.

C. Attitude

- 1. Seeks to collaborate with the instructor and fellow students in expanding knowledge.
- 2. Strives for knowledge that can be expanded with continuous acquisition of knowledge.
- 3. Open to the use of information technology tools.
- 4. Seeks to become familiar with and routinely use the toolkit needed to solve the problem.

- 5. In the course of his work, he is open to the implementation of accurate and error-free task solutions.

D. Independence and responsibility

- 1. Independently thinks through tasks and problems and solves them based on specific resources.
- 2. Collaborates to improve substantiated critical remarks.
- 3. In some situations, as part of a team, you work with your fellow students to solve tasks.
- 4. The sub-task assigned to it by the measuring group is performed independently and responsibly.
- 5. Take responsibility for the content and quality of the minutes submitted by the group.

2.3. Teaching methodology

During the teaching of the subject, the lecture and practice are separated from each other, both in terms of content and methodology. The lectures basically introduce students to the information defined by the knowledge competence elements using the technique of frontal education. The lectures have pre-published slide shows, so students can add their own notes to the lecture. The lectures are complementary to the main (on-line) written study materials, and are not sufficient to achieve adequate preparation. Independent practical sessions promote the application and skill-level acquisition of knowledge with a different theme from the lectures and the method of the mirrored classroom. During the exercises, the knowledge previously acquired at home and independently is solved partly jointly and partly individually with the help of the practice leader.

2.4. Support materials

a) Textbooks

-

b) Lecture notes

-

c) Online materials

-

2.5. Validity of the course description

Start of validity:	2021. September 1.
End of validity:	2026. July 15.

II. SUBJECT REQUIREMENT

3. ACHIEVEMENT CONTROL AND EVALUATION

3.1 General rules

Learning outcomes are assessed on the basis of 3 mid-year written performance measurements (one partial and two summative academic performance assessments). Summarizing academic performance evaluation: a complex, written way of evaluating the competence-type competence elements of the subject and knowledge in the form of an indoor dissertation, the dissertation focuses on the application of the acquired knowledge, so it focuses on problem recognition and solution, on the other hand, asks for the necessary lexical knowledge during the performance appraisal, the working time available is 90 minutes; Partial performance assessment (homework): a complex way of evaluating the knowledge, ability, attitude, as well as independence and responsibility type competence elements of the subject, the form of which is the individual homework.

3.2 Assessment methods

A. Detailed description of mid-term assessments

1. Mid-term assessment

type: summative assessment

count: 2

purpose, description: Summative assessments collectively examine and assess students 'learning outcomes defined by knowledge and ability type competencies. Accordingly, each summative assessment assesses the acquisition of the designated theoretical knowledge as well as the existence of the knowledge and skills acquired in practice. Each summative assessment focuses 65% on theoretical knowledge and 35% on application skills. They will be completed on the date specified in the academic performance evaluation plan, expected to be in the 7th and 12th weeks of education. Each of the two summary performance evaluations can earn 100-100 points.

2. Mid-term assessment

type: formative assessment, project-based, complex

count: 1

purpose, description: The basic goal of partial performance evaluation is to solve a project-type task independently. During the project task, the design and modeling of a 3R parallel manipulator of a small mechatronic machine and the production of its main components must be solved. You must document the functional plans for solving project tasks and demonstrate the correct operation of the program using a cyber physical simulator system. 100 points can be obtained in the partial performance evaluation.

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	67 %
2 . Mid-term assessment	33 %

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]	72% .. 85%
satisfactory(3) ● Satisfactory [D]	65% .. 72%
sufficient(2) ● Pass [E]	50% .. 65%
insufficient(1) ● Fail [F]	below 50%

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

3.6 Attendance and participation requirements

Must be present at at least **50%** (rounded down) of lectures.

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

At least **70% of** laboratory practices (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?

yes

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:

each summative assessment can be retaken or improved

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:

new result overrides previous result

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

Completion of unfinished laboratory exercises:

missed laboratory practices may be performed in the repeat period, non-mandatory

Repetition of laboratory exercises that performed incorrectly (eg.: mistake in documentation):

incorrectly performed laboratory practice (e.g. Incomplete/incorrect report) can be corrected by repeating the practice

3.8 Study work required to complete the course

Activity	**hours / semester**
participation in contact classes	84
mid-term preparation for practices	7
preparation for laboratory practices	14
preparation for summary assessments	32
elaboration of a partial assessment task	30
additional time required to complete the subject	13
summary	**180**

3.9. Validity of subject requirements

Start of validity: 2021. September 1.

End of validity: 2026. 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.

b) ability

- Student has the ability to develop independently the theoretical knowledge and to apply new theory to the practical solution of complex mechatronic design problems of an unconventional nature.

c) attitude

- Based on student's acquired knowledge, Student plays an integrative role in the integrated application of engineering disciplines (in particular mechanical, electrical and computer engineering) and in the technical support of all disciplines where engineering applications and solutions are required by professionals in the field.

d) independence and responsibility

- Student shares gained knowledge and experience with those working in the field through formal, non-formal and informal information transfer.

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)	-