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)

Medical robots and devices ● Medical robots and tools

1.2. Neptun code

BMEGEGTBM72

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	-	-
laboratory exercise	2	coupled

1.5. Type of assessments (quality evaluation)

mid-term grade

1.6. ECTS

4

1.7. Subject coordinator

name:	Dr. Zentay Péter Zoltán
post:	associate professor
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1.8. Host organization

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

1.9. Course homepage

http://manuf.bme.hu/?page_id=517

1.10. Course language

hungarian, english

1.11. Primary curriculum type

mandatory

1.12. Direct prerequisites

Strong prerequisite:	BMEGEGTBM01
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 course introduces the main types of robots used for health purposes, the health environment including the non-institutional health environment, the traditional solution of the health task, the environment and the specific relationship between robots, the application cases. The aim is for the students to get acquainted with the methods needed to produce a user and technical requirements system for a medical robot or robot application. It presents the structure of medical robots and related peripherals, tools, the related mechanical, sensor technology, IT, energy, control technology problems and their solutions. The aim is for students to be able to deepen their acquired, acquired theoretical knowledge through laboratory exercises.

2.2. Learning outcomes

Competences that can be acquired by completing the course:

A. Knowledge

- 1. knows the types of medical robots, their application technical characteristics, their treatment-therapeutic-diagnostic-service task system, their safety-related solutions, testing and qualification.
- 2. is familiar with the standards and regulations for medical devices and medical robots.
- 3. is familiar with the method of compiling the list of user and technical-IT requirements.
- 4. understands the concepts of the degree of autonomy and the level of automation used in service robots, the method of determining them.
- 5. understands the selected mechanical, sensor technology, IT, energy, control technology problems and their solutions.
- 6. understands the typical settings, modes of operation, operation, programming and maintenance of teleoperative surgery, upper limb rehabilitation, social elderly care, hospital logistics, and intelligent toilet robots.
- 7. understands the usual peripherals and tools of medical robot applications, the characteristics of the implants / prostheses installed, and their manufacturability aspects.
- 8. understands the peculiarities of the medical and medical technology industry, the conditions in Hungary, development trends (surface mapping, production planning, NC programming).
- 9. understands the construction, manufacturing technology, sharpening and sterilization of medical hand tools, instruments (surgical scissors, knives and chisels, saws, pliers, pliers, hooks, spreaders, dilators, suture needles, injection needles).
- 10. systematizes the structure and production technology of dentures, dental tools and instruments, and the related rapid prototyping procedures.
- 11. systematizes the characteristics of prostheses, the design and manufacturing technology of hip and knee prostheses.
- 12. is aware of the applicability of CAD / CAM systems in the design and manufacture of prostheses.

B. Ability

- 1. Capable of compiling user and IT requirements lists for a medical robotic application, including transforming health requirements into technical IT requirements.
- 2. develop a conceptual design of a medical robot application.
- 3. is able to select and systemize medical robots, peripheral and safety equipment.
- 4. defines the mechanical, sensor technology, IT, energy, control technology development tasks of medical robot applications.
- 5. define the research plan for clinical and field trials on medical robots.
- 6. prepares the geometric model of the hip prosthesis and the material separation machining program with CAD / CAM system.
- 7. examines the design and manufacturing technology of medical hand tools, dentures, dental tools, prostheses.
- 8. is able to document the results of medical robot application and medical tool, prosthesis, prosthesis design in a concise way that is understandable to those involved.
- 9. expresses his thoughts in an orderly form, orally and in writing.
- 10. apply international robotics roadmaps in the list of requirements for medical robot applications.
- 11. apply the design requirements for hip and knee prostheses.
- 12. develops the manufacturing technology of dentures, dental tools and devices, the related rapid prototyping procedures.

C. Attitude

- 1. is open to collaborating with the instructor and fellow students in expanding knowledge.
- 2. expands his knowledge by continuous acquisition of knowledge in the literature.
- 3. strives to get to know and routinely use the tools required for the design of medical robotic applications and medical hand tools, dentures, dental tools, prostheses design, production technology problems.
- 4. strives for accurate and error-free problem solving.
- 5. open to the use of information technology tools.
- 6. Creates confidence in the design of healthcare robot applications, robot controls, information technology and medical hand tools, dentures, dental tools, prosthesis solutions.
- 7. strives to apply the principles of economy and quality in the solution of robot application, medical hand tools, dental prosthesis, dental tool, prosthesis design tasks.

D. Independence and responsibility

- 1. makes decisions in the design of medical robotic applications, medical hand tools, dentures, dental tools, prostheses, the selection of devices, the consideration of problems and their solution based on specific sources.
- 2. accepts the well-founded critical remarks.
- 3. cooperates in certain situations - as part of a team - with his / her fellow students in solving the tasks.
- 4. is committed to a systemic approach in its thinking.
- 5. make a decision on the CAD / CAM system suitable for the preparation of the geometric model of the hip prosthesis and the material separation machining program.

2.3. Teaching methodology

The course includes frontal lectures, individual essay making, and laboratory measurements. Lectures include “chalk-and-talk” type teaching as well as electronic presentations if needed. The acquired knowledge is further deepened by the geometric modeling of a hip prosthesis and the production of a material separation machining program on laboratory exercises for motion rehabilitation, minimally invasive surgery, tele-operation, hospital logistics, elderly care, wearable robots, CAD / CAM system. Instructors are open for personal consultation at the request of students.

2.4. Support materials

a) Textbooks

-

b) Lecture notes

1. Bruno Siciliano, Oussama Khatib: Springer Handbook of Robotics, Springer, 2016
2. Aimee Van Wynsberghe. Healthcare Robots: Ethics, Design and Implementation. Ashgate Pub-lishing Company, Brookfield, VT, USA. 2015.
3. Bertóti-Marosi: Technical surface science and its applications in biomedicine, B + V publisher 2005

c) Online materials

1. Electronic notes: http://manuf.bme.hu/?page_id=517
2. Picture collection: http://manuf.bme.hu/?page_id=517

2.5. Validity of the course description

Start of validity:	2024. February 1.
End of validity:	2028. July 15.

II. SUBJECT REQUIREMENT

3. ACHIEVEMENT CONTROL AND EVALUATION

3.1 General rules

Learning outcomes are assessed on the basis of three mid-year written performance measurements (summary academic performance assessment) and active participation in internships and laboratories (partial performance assessment). Student participation in laboratory exercises should reflect previously defined knowledge, skills, attitudes, and autonomy competencies. The condition for signing is: (1) participation in all laboratory measurements, (2) successful submission of laboratory protocols, (3) successful submission of the essay, (4) successful completion of written tests. The final grade is determined on the basis of a score calculated on the basis of the essay and the weighted sum of the two written tests.

3.2 Assessment methods

A. Detailed description of mid-term assessments

1. Mid-term assessment

type: summative assessment

count: 2

purpose, description: A complex, written way of evaluating the knowledge and ability type competence elements of the subject in the form of a dissertation. The dissertation basically focuses on the application of the acquired knowledge, so it focuses on the recognition and solution of the problem, ie in addition to theoretical questions, practical (calculation) tasks must be solved during the performance evaluation. The curriculum section on which the assessment is based covers the theoretical knowledge given in the lectures and the skills acquired in the laboratory exercises. The available working time is 45 minutes per performance evaluation.

2. Mid-term assessment

type: formative assessment, simple

count: 1

purpose, description: An essay-like elaboration of a topic that can be selected from a list of topics in accordance with the knowledge, ability, attitude, and competence-type competence elements of the subject. In addition to the literature review, the student is expected to analyze a technical problem and its solution in depth. The elaboration of the essay can proceed in a personal consultation with the instructors of the subject. The uniform assessment principles, which are announced in the first lesson of the semester, are defined jointly by the person in charge of the subject and the teachers of the subject.

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	60 %
2 . Mid-term assessment	40 %

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 91%
very good(5) ● Very Good [B]	86% .. 91%
good(4) ● Good [C]	71% .. 86%
satisfactory(3) ● Satisfactory [D]	56% .. 71%
sufficient(2) ● Pass [E]	41% .. 56%
insufficient(1) ● Fail [F]	below 41%

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% 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?

yes

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 possible for each assesment separately

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 upon improved re-submission

3.8 Study work required to complete the course

Activity	**hours / semester**
participation in contact classes	56
preparation for laboratory practices	14
preparation for summary assessments	32
elaboration of a partial assessment task	4
additional time required to complete the subject	14
summary	**120**

3.9. Validity of subject requirements

Start of validity: 2024. February 1.

End of validity: 2028. 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 the knowledge of biomechatronic systems, their design, development principles, operation and maintenance methods.

b) ability

- 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.
- Student has the ability to review and understand the latest research findings in the field of mechatronics and apply them in their work.

c) attitude

- Student strives to plan and carry out tasks to a high professional standard, either independently or in a team.
- Student strives for self-learning and self-development through active, individual and autonomous learning.

d) independence and responsibility

- Student takes the initiative in solving technical problems.

- 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)	Knowledge of teaching biomechanics and medical devices.

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)	Able to understand and acquire knowledge elements that fit non-standardized educational material.