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)

Hemodynamics ● Hemodynamics

1.2. Neptun code

BMEGEVGNX26

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	-	-

1.5. Type of assessments (quality evaluation)

mid-term grade

1.6. ECTS

3

1.7. Subject coordinator

name:	Dr. Paál György
post:	university professor
contact:	gypaal@hds.bme.hu

1.8. Host organization

Department of Hydrodynamic Systems (http://www.hds.bme.hu/)

1.9. Course homepage

http://www.hds.bme.hu/oktatas.php?sm=1&lang=EN&xml=BMEGEVGNX26

1.10. Course language

hungarian, english

1.11. Primary curriculum type

mandatory elective

1.12. Direct prerequisites

Strong prerequisite: -

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 basic concepts of blood flow from the point of view of mechanical engineering. Its topics include the basic concepts of physiology; history and modern solutions of blood pressure measurement; function of arterial and venous blood flow, basic concepts of signal processing, medical image processing, flow simulation methods. A basic knowledge of measurement concepts and signal processing tools is essential for this. The class covers computational fluid dynamics, medical imaging; boundary conditions, biomechanical processes; and the study of time-varying biological processes. as well as problem areas. Within the framework of the class, students complete 2 homework assignments in close connection with the theory. They report on their knowledge in two summative performance evaluations.

2.2. Learning outcomes

Competences that can be acquired by completing the course:

A. Knowledge

- Knows the theory of blood pressure measurement, measurement methods.
- He/she is aware of the methods of medical image processing, their errors and their treatment.
- He/she can differentiate between the types of blood pressure signals, and their interpretation.
- Knows the mathematical methods and boundary conditions of computational fluid dynamics.
- He/she is aware of the rheological and boundary condition models found in the literature.
- Systematizes model neglections used in blood flow simulations.
- He/she is informed about the most modern scientific publications in hemodynamics.
- Understands the theory of oscillometric blood pressure measurement method.
- Knows the methods and possibilities of non-invasive blood pressure measurement.
- He/she is aware of the methods of one- and three-dimensional blood flow simulations.

B. Ability

- Able to choose the appropriate measurement method from the blood pressure measurement methods.
- It is able to eliminate errors and deficiencies that occur during image processing.
- Identifies the biomechanical mechanisms associated with the type of waveform.
- Applies computational fluid dynamics methods in solving hemodynamic problems.
- He/she uses his/her existing knowledge of rheological and boundary condition modeling of blood flow simulations correctly.
- It appropriately handles modelling simplifications used in blood flow simulations.
- Evaluates the latest scientific publications in blood flow science.
- Able to perform measurements based on the oscillometric blood pressure measurement method.
- Handles non-invasive blood pressure measuring instruments appropriately.
- The student uses his knowledge of one- and three-dimensional blood flow simulations.

C. Attitude

- He/she constantly monitors his work, results and conclusions.
- Applying the acquired engineering knowledge, he/she strives to get to know the phenomena and to explain the underlying laws.
- Open to the use of information technology tools.
- He/she seeks to implement the principles of energy efficiency and environmental awareness.
- He/she develops his/her ability to provide accurate and error-free problem solving, engineering precision and accuracy.
- He publishes his results according to the professional rules.
- He/she communicates his/her opinions and views without offending others.

D. Independence and responsibility

- Collaborates with the instructor to expand his/her knowledge.
- He/she readily accepts well-founded professional and other critical remarks.
- In some situations, as part of a team, he/she works with his/her fellow students to solve tasks.
- With his/her knowledge, he/she makes a responsible, well-founded decision based on his/her analysis.
- He/she independently thinks over tasks and problems and solves them based on the given resources.
- He/she is committed to the principles and methods of systemic thinking and problem solving.

2.3. Teaching methodology

The lectures basically introduce students to the information defined by the knowledge competence elements using the method of frontal education. Some of the lectures come with pre-published slide shows so students can add their own notes to the lecture. Based on the material of the lectures, the appropriate preparation for the partial performance evaluations can be achieved. During the project tasks, the competence elements can be deepened by performing and evaluating measurements and / or calculations closely related to the topic of the subject. To develop teamwork skills, students work in groups during project assignments and then create presentations and posters in groups about the work done.

2.4. Support materials

a) Textbooks

Gábor Halász: Modeling in Biomechanics, University of Technology Publishing House 2007, ISBN 9789634209171

Westerhof N. et al .: Snapshots of Hemodynamics, Springer, 2019, ISBN 9783319919317

Harring and Paterson: Levick's Introduction to Cardiovascular Physiology, Taylor & Francis Inc, 2018, ISBN 9781498739849

b) Lecture notes

Antal Huba ed .: Notes on measurement techniques, www.tankonyvtar.hu, 2013

c) Online materials

http://www.hds.bme.hu/oktatas.php?sm=1&lang=EN&xml=BMEGEVGNX26

2.5. Validity of the course description

Start of validity:	2020. March 9.
End of validity:	2024. December 31.

II. SUBJECT REQUIREMENT

3. ACHIEVEMENT CONTROL AND EVALUATION

3.1 General rules

Learning outcomes are assessed on the basis of two mid-year partial performance measurements. The first one is a project-type task; partial performance assessment in the form of a complex, written assessment of the elements of the subject's knowledge, ability and independence and responsibility type competences in the form of student documentation. At the end of the semester, an A3 format mini poster should be made about the completed task. The student is expected to appear prepared in the consultations. The other partial performance assessment is a method of assessing the knowledge, ability, attitude, and autonomy and responsibility type competence elements of the subject, which is an independently prepared summary of a scientific paper.

3.2 Assessment methods

A. Detailed description of mid-term assessments

1. Mid-term assessment

type: formative assessment, project-based, complex

count: 1

purpose, description: Project-type partial performance evaluation examines and assesses the knowledge, ability, and autonomy and responsibility type competence elements of the subject. This is a complex, written way of evaluating, in the form of student documentation. As far as the nature of the task is concerned, it is solving a hemodynamic problem with modeling tools. When submitting the problem statement, applied methods and solutions; the documentation should be prepared around the results and summary. An A3 mini poster about the work should also be presented at the end of the semester. The student can get 80 points in the evaluation.

2. Mid-term assessment

type: formative assessment, simple

count: 1

purpose, description: The basic goal of partial performance assessment is to examine the existence of learning outcomes belonging to the competence group of ability, attitude, and autonomy and responsibility. One way to do this is to have an independent summary of up to two pages of a recent scientific paper. A maximum of 20 points can be earned with the summaries. The deadline for submitting summaries is the end of the 14th educational week.

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	80 %
2 . Mid-term assessment	30 %

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 **0%** (rounded down) of lectures.

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).

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

yes

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	28
elaboration of a partial assessment task	34

additional time required to complete the subject	28
summary	**90**

3.9. Validity of subject requirements

Start of validity: 2020. March 9.

End of validity: 2024. December 31.

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:

Mechanical 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 understanding of the basic facts and limits of the knowledge and activity systems in the field of engineering and of the expected directions of development and improvement.
- Student has the knowledge and understanding of computer modelling and simulation tools and methods relevant to the field of engineering.
- Student is familiar with the general and specific mathematical, scientific and social principles, rules, contexts and procedures needed to operate in the field of engineering.

b) ability

- Student has the ability to apply the general and specific mathematical, scientific and social principles, rules, relationships and procedures acquired in solving problems in the field of engineering.
- Student has the ability to approach and solve specific problems within student's field of specialisation in a multi-disciplinary and interdisciplinary manner.
- Student has the ability to organise cooperation with experts from related disciplines in problem solving.

c) attitude

- Student strives to plan and carry out tasks to a high professional standard, either independently or in a team.
- Using student's technical knowledge, Student will seek to gain a better understanding of observable phenomena and to describe and explain their laws.
- Student strives to organise and carry out their tasks in accordance with environmental, health and sustainability standards.

d) independence and responsibility

- Student demonstrates responsibility for sustainability, health and safety culture and environmental awareness.
- Student shares her acquired knowledge and experience through formal, non-formal and informal information transfer with those in her field.
- Student acts independently and proactively in 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)	economic (micro and macroeconomic) knowledge,

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)	-