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)

Fluid Mechanics ● Fluid Mechanics

1.2. Neptun code

BMEGEÁTBM21

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	coupled

1.5. Type of assessments (quality evaluation)

exam

1.6. ECTS

5

1.7. Subject coordinator

name:	Dr. Suda Jenő Miklós
post:	adjunct
contact:	suda.jeno.miklos@gpk.bme.hu

1.8. Host organization

Department of Fluid Mechanics (https://www.ara.bme.hu/)

1.9. Course homepage

http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATBM21

1.10. Course language

hungarian, english, german

1.11. Primary curriculum type

mandatory elective

1.12. Direct prerequisites

Strong prerequisite:	BMETE94BG03, BMEGEMMBXN2
Weak prerequisite:	-
Parallel prerequisite:	-
Milestone prerequisite:	-
Excluding condition:	BMEGEÁTBM11

(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

Students will acquire knowledge related to the flow, knowledge and description of liquid and gaseous media that is important for technical applications. Using laboratory sessions and classroom seminars with problem-solving exercises, the course introduces students to solving engineering tasks related to the fluids engineering. Particular emphasis will be placed on knowledge of measurement techniques related to the fluid mechanics measurement, flow processes in machines, equipment, and channels/pipelines. Students gain skills in recognizing and solving frequent problems in their engineering work during the mid-semester practical problem-solving problems and applied theoretical tasks, as well as in acquiring theoretical knowledge in laboratory measurements and their practical application. Based on the acquired knowledge, they can undertake to solve more complex tasks through self-education.

2.2. Learning outcomes

Competences that can be acquired by completing the course:

A. Knowledge

- The student knows Newton's law of viscosity; the properties of real/ideal fluids, the rheological curves of various types of fluids, the basics of the Lagrangian and Eulerian descriptions of fluid motion; the concepts of streamline, streakline, pathline, stream surface, stream tube, steady/unsteady flows.
- The student identifies the characteristic ranges of fluids: gas, superheated steam, saturated steam, liquid medium, compared on the pressure-specific volume diagram; the ideal gas law; the tension curve of water; the phenomenon and countermeasures of cavitation.
- The student recalls the basic equation of hydrostatics; conditions for its validity and simplification, the continuity equation; conditions for its validity and simplification.
- The student knows the Euler equation and the conditions of its application; interpretation of substantial, local, and convective acceleration, the Bernoulli equation; conditions for its validity and simplification; the concepts of static, dynamic and total pressure, their relationships.
- The student knows the vortex theorem of Thomson (Lord Kelvin), Helmholtz (I. and II.), their physical meaning, interpretations, and consequences.
- The student interprets the momentum theorem and the conditions for its simplification.
- The student recalls the Reynolds experiment, the Reynolds number, and its illustrative meaning, the characteristics of laminar and turbulent flows, the concept and main features of the boundary layer, the conditions and countermeasures of the boundary layer (flow) separation.
- The student is aware of the friction coefficient of laminar channel flow; the derivation steps of the formula, the basics of dimensional analysis (Buckingham's theorem), the condition system of the similarity of flows, for constant and variable density.
- The student can define the equation of motion of viscous fluid flows, the Navier-Stokes equation, the Bernoulli equation extended by the hydraulic losses; hydraulic characterization of system components, Nikuradze and

Moody diagram; the concept of hydraulically smooth and rough pipes, hydraulic equivalent diameter.

- The student has knowledge of the components of the force acting on the body immersed in the flow; the concept of bluff and streamlined bodies; on the aerodynamic force and force coefficients.

B. Ability

- The student identifies simple fluids engineering and fluid mechanical measurement problems.
- The student is able to explore and articulate the practical background needed to solve simple fluids engineering problems.
- The student prepares estimates of basic qualitative fluids engineering trends.
- The student applies simplified flow modeling to practical fluid flow problems.
- The student calculates a quantified estimate based on a model of a practical fluids engineering problem as a basis for engineering design and decision making.
- The student is able to perform and evaluate basic fluid mechanical measurements.
- The student plans the evaluation of the results of basic fluid mechanical measurement from an engineering point of view.
- The student uses the knowledge for advanced-level flow measurement studies.
- The student uses the knowledge for advanced-level numerical flow simulation.
- The students develop their ability to express their thoughts in an orderly form, orally and in writing.

C. Attitude

- The student initiates collaboration with the instructor and fellow students to expand knowledge.
- The student expands his knowledge with the continuous acquisition of knowledge and a wide-ranging attitude.
- The student is open to the in-depth use of modern information technology tools.
- The student seeks to become familiar with and routinely use the system of tools needed to solve fluid flow problems.
- The student strives for an independent, accurate, error-free and responsible solution.
- The student strives to apply the principles of reliable operation, productivity, cost and time efficiency, energy efficiency, and environmental awareness in solving flow engineering tasks.
- The student develops their ability to align ethical engineering attitudes and long-term win-win considerations with market competition.

D. Independence and responsibility

- The student independently thinks through fluid tasks and problems and solves them based on specific resources.
- The student accepts well-founded critical remarks and criticisms. In some situations, as part of a team, the students work with their fellow students to solve tasks.
- In some situations, as part of a team, the students work with their fellow students to solve tasks.
- The student supports in thinking with a systematic approach and a complex thinking.
- The student is critical of engineering commitments of inadequate quality.

2.3. Teaching methodology

Mainly chalk&talk type lectures also with additional ppt presentations, classroom seminars and laboratory sessions with problem-solving, written and oral communication, use of IT tools and techniques, optional independent and group work, and work organization techniques.

2.4. Support materials

a) Textbooks

Tamás Lajos: Fundamentals of Fluid Mechanics. 2015, ISBN 978 963 12 2885 4.

b) Lecture notes

Jenő Miklós Suda: Feladatgyűjtemény I. rész (online, tárgyhonlapon), 2024 (in Hungarian)

Jenő Miklós Suda: Feladatgyűjtemény II. rész (online, tárgyhonlapon), 2024 (in Hungarian)

c) Online materials

http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATBM21

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

A 2.2. The assessment of the learning outcomes set out in points 1 and 2 takes place in a written and oral examination, to which the assessment score obtained for the task performed in the mid-term laboratory measurements is added. Attendance of at least 70% of lectures and 100% of classroom exercises and 100% of the laboratory sessions is mandatory. Attendance is checked on the basis of the signed attendance sheet at all lab course events. In other matters related to attendance, the current Code of Studies is authoritative.

3.2 Assessment methods

A. Detailed description of mid-term assessments

1. Mid-term assessment

type:	formative assessment, point-in-time personal act
count:	1
purpose, description:	Laboratory measurements (measurement report MJK: The students' measuring groups of 4 take part in the measurements held in the laboratory of the Department of Fluid Mechanics. Depending on their course schedule, the students take part (in the 8th-14th weeks) of the measurement preparatory laboratory session, "A" and "B" measurements, and in presentation lab sessions. After completing the measurement, a measurement report (max. 10 points) and a measurement presentation (max. 10 points) must be prepared, which can be evaluated for a maximum of 20 point (min. 8 points) and a separate presentation rated at 40% (min 4 points). Details see in the attached "Fluid Mech laboratory practice requirement system" (moodle).

2. Mid-term assessment

type:	formative assessment, point-in-time personal act
count:	1
purpose, description:	Laboratory measurements (lab presentation MP: The students' measuring groups of 4 take part in the measurements held in the laboratory of the Department of Fluid Mechanics. Depending on their course schedule, the students take part (in the 8th-14th weeks) of the measurement preparatory laboratory session, "A" and "B" measurements, and in presentation lab sessions. After completing the measurement, a measurement report (max. 10 points) and a measurement presentation (max. 10 points) must be prepared, which can be evaluated for a maximum of 20 point (min. 8 points) and a separate presentation rated at 40% (min 4 points). Details see in the attached "Fluid Mech laboratory practice requirement system" (moodle).

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

Elements of the exam:

1. written partial exam

    obligation: mandatory (partial) exam unit, failing the unit results in fail (1) exam result description: Written exams evaluation: The exam, which can be evaluated for max. 100 points, consists of three parts: mid-term points (max. 20points), written exam (max. 70 points, 120 minutes) and oral exam (max. 10 points). The written exam may include practical problem-solving examples and theoretical test questions. The condition for a successful written exam is a written partial exam result of at least 40% (min. 28 points). The written exam contains 5 test questions and 4-5-6 calculation problems to be solved from the entire semester material. A successful written exam is also a condition for admission to the oral exam.

2. oral partial exam

obligation: mandatory (partial) exam unit, failing the unit results in fail (1) exam result

description: Oral performance evaluation: In the same afternoon of a given exam day, the announcement of the results of the written partial exam is followed by an oral exam, in which the student takes an oral exam. There are pre-announced oral exam questions, one question is selected with a preparation time of up to 15 minutes prior to oral exam. The condition for a successful oral exam is a result of at least 40% (min. 4 points) of the oral part. In case of a failed oral exam, we provide the student with the opportunity to take a retake (immediate repeated oral exam) with another question draw, but in which only max. 4 points can be obtained. A successful written partial exam result can be retained within a given exam period.

3. practical partial exam

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4. inclusion of mid-term results

obligation: mandatory (partial) exam unit, but failing the unit does not results in fail (1) exam result

description: Inclusion of mid-term results: There is no mandatory mid-term during the semester. A total of max. 20 points can be obtained from the lab course (measurement report and presentation), which is counted in a 20% proportion of the exam mark. Additional plus points can be collected during the classroom seminars. They can be counted as max. +15 plus points in the exam mark. With the exception of the offered exam mark, the exam mark is calculated based on the score of the lab points (converted to a maximum of 20 points), the total score of the written (max. 70p) and the oral exam (max. 10p) (or by adding any extra points). See the detailed scoring guide (pdf) on the subject website.

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

identifier	**weight**
1 . Mid-term assessment	10 %
2 . Mid-term assessment	10 %

The condition for signing is that the score obtained in the mid-year assessments is at least **40%**.

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

type	**weight**
written partial exam	70 %
oral partial exam	10 %
practical partial exam	0 %
inclusion of mid-term results	20 %

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 **70%** (rounded down) of lectures.

At least **85%** the exercises (rounded down) must be actively attended.

At least **85% 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).

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

Completion of unfinished laboratory exercises:

missed laboratory practices must be performed in the teaching term at pre-arranged appointment

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	70
mid-term preparation for practices	14
preparation for laboratory practices	14
exam preparation	35
additional time required to complete the subject	17
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.
- Student has the knowledge of the main properties and applications of mechanical and electrical materials used in mechatronics.

b) ability

- Student has the ability to perform laboratory tests on materials used in the field of mechatronics, to statistically evaluate and document test results and to compare experimental and theoretical results.
- Student has the ability to process and organise information collected during the operation of mechatronic systems and processes, to analyse it in different ways and to draw theoretical and practical conclusions.
- Student has the ability to design complex mechatronic systems globally, based on a systems- and process-oriented, theoretically sound way of thinking.

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.
- In student's work, will explore and pursue research, development and innovation objectives, Student is committed to enriching the field of mechatronics engineering with new knowledge and scientific results.
- Student strives to carry out their work in a complex approach based on a systems and process-oriented mindset.

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 appreciates the work of student's subordinates and contributes to their professional development by sharing critical comments.
- 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)	-