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

BMEGEÁTBM11

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	1	individual
laboratory exercise	1	individual

1.5. Type of assessments (quality evaluation)

exam

1.6. ECTS

5

1.7. Subject coordinator

name:	Dr. Suda Jenő Miklós (71958230447)
post:	adjunct
contact:	suda@ara.bme.hu

1.8. Host organization

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

1.9. Course homepage

http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATBM11

1.10. Course language

hungarian, english, german

1.11. Primary curriculum type

mandatory

1.12. Direct prerequisites

Strong prerequisite:	BMETE94BG03, BMEGEMMBXM2
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

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 formnula, 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 its 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.
- The student supports a systematic approach and complex thinking in the thinking.
- The student is critical of engineering commitments of inadequate quality.

2.3. Teaching methodology

Mainly chalk&talk type lectures, classroom and laboratory seminars with problem-solving, written and oral communication, use of IT tools and techniques, optional independent and group work, 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: Fluid Mechanics Exercises I.+II. (electronic), 2021

c) Online materials

http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATBM11

2.5. Validity of the course description

Start of validity:	2021. April 26.
End of validity:	2024. April 26.

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. It is mandatory to write the measurement test (MZH). Attendance is checked on the basis of the signed attendance sheet at all times. In other matters related to attendance, the current TVSz: § 14 (3) is authoritative.

3.2 Assessment methods

A. Detailed description of mid-term assessments

1. Mid-term assessment

type: formative assessment, simple

count: 1

purpose, description: Measurement test (MD). Before starting the laboratory measurements, 1 MD will be written in the 3rd preparation session (on the week 5th or 6th). As one of the mandatory conditions for obtaining the signature, thus indirectly the examination ticket, the MD with the qualification “pass” (assessed to at least 50%) is mandatory. This is also the condition for starting the measurements. In case of a “failed” MD final result (after retake, and oral re-retake), “signature denied” will be registered and the student will not be admitted to the examination. A “failed” MD result can be corrected once in a semester at the possible closest to the test and must be retaken before the student's first “A" measurement. The result of an MD of 50% or better does not play a role in the calculation of the examination mark, but indirectly one of the conditions for obtaining the examination mark, as the “pass” MD result is a condition for starting the measurements.

2. Mid-term assessment

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

count: 1

purpose, description: Laboratory measurements (MD, measurement report (MJK) and presentation (MP)): The measurement groups of 4 students take part in the measurements held in the laboratory of the Department of Fluid Mechanics. Prior to this, students can take part in 3 measurement preparation laboratory sessions on the 1st, 3rd, 5th, or on the 2nd, 4th, 6th weeks, depending on their odd/even weekly course selection. After completing the measurement, a measurement report (max. 10 points) and a measurement presentation (max. 10 points) must be submitted, which can be evaluated with a total of max. 20 points. One of the conditions for signature and thus indirectly obtaining the examination ticket is an accepted measurement report evaluated separately for at least 40% (4 points) and an accepted measurement presentation evaluated separately for at least 40% (4 points). Thus, a total of max. 20 points can be obtained from the laboratory sessions, which is included in the exam mark in a 20% weight. The method of conducting and evaluating the measurements is detailed in the "Fluid Mechanics Laboratory Session Requirement System".

3. Mid-term assessment

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

count: 1

purpose, description: Laboratory measurements (MD, measurement report (MJK) and presentation (MP)): The measurement groups of 4 students take part in the measurements held in the laboratory of the Department of Fluid Mechanics. Prior to this, students can take part in 3 measurement preparation laboratory sessions on the 1st, 3rd, 5th, or on the 2nd, 4th, 6th weeks, depending on their odd/even weekly course selection. After completing the measurement, a measurement report (max. 10 points) and a measurement presentation (max. 10 points) must be submitted, which can be evaluated with a total of max. 20 points. One of the conditions for signature and thus indirectly obtaining the examination ticket is an accepted measurement report evaluated separately for at least 40% (4 points) and an accepted measurement presentation evaluated separately for at least 40% (4 points). Thus, a total of max. 20 points can be obtained from the laboratory sessions, which is included in the exam mark in a 20% weight. The method of conducting and evaluating the measurements is detailed in the "Fluid Mechanics Laboratory Session Requirement System".

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: A total of max. 20 points can be obtained from the measurement sessions, which is included in the exam mark in 20% part (weight is 20%). Reward points may be earned on the classroom seminars: they can be added by max. + 5% in the successful exam result. With the exception of the suggested exam grade, the method of calculating the exam mark is based on the mid-term measurement score (converted to max.20 points), the total score of the written exam (max.70p) and the oral exam (max.10p).

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

identifier	**weight**
1 . Mid-term assessment	100 %
2 . Mid-term assessment	50 %
3 . Mid-term assessment	50 %

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	56
mid-term preparation for practices	7
preparation for laboratory practices	14
elaboration of a partial assessment task	4
exam preparation	35
additional time required to complete the subject	34
summary	**150**

3.9. Validity of subject requirements

Start of validity: 2021. April 26.

End of validity: 2024. April 26.

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)	-