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

BMEGEÁTBE11

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	individual
laboratory exercise	1	individual

1.5. Type of assessments (quality evaluation)

mid-term grade

1.6. ECTS

5

1.7. Subject coordinator

name:	Dr. Istók Balázs
post:	adjunct
contact:	istok.balazs@gpk.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/BMEGEATBE11

1.10. Course language

hungarian

1.11. Primary curriculum type

mandatory

1.12. Direct prerequisites

Strong prerequisite:	-
Weak prerequisite:	-
Parallel prerequisite:	-
Milestone prerequisite:	-
Excluding condition:	BMEGEÁTBG11

(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 the knowledge necessary to understand and describe the flow of gaseous and liquid fluids, which is important from a technical point of view. Building on this knowledge, the laboratory sessions and seminars will show the students how to solve technical problems related to the flow of a medium. An emphasis will be placed on knowledge related to flow measurements, measurement techniques applied in evaluating flow phenomena occurring in fluid machinery, equipment, and ducts. The students will be evaluated on their ability to learn the theory and apply it to practical problems. These evaluations will be in the form of mid-term exams, tests, and laboratory measurements. This subject prepares the students for their engineering careers by teaching them to recognize fluid mechanics related problems, provides them with the knowledge necessary to solve common problems, and gives them a solid foundation on which they can build in taking on complex assignments.

2.2. Learning outcomes

Competences that can be acquired by completing the course:

A. Knowledge

- Knows Newton's law of viscosity; the peculiarities of Newtonian fluids and the rheological curve of characteristic non-Newtonian fluids, the basics of the Lagrange and Euler descriptions, basic flow concepts.
- Oriented the characteristic ranges of gas, superheated / saturated steam, liquid medium on the pressure-species volume diagram; the ideal gas law; the tension curve of water; the phenomenon and countermeasures of cavitation erosion.
- He is aware of the basic equation of hydrostatics; conditions for its validity and simplification, the continuity equation; conditions for its validity and simplification.
- Understands the Euler equation and the conditions for its application; interpretation of local and convective acceleration, the Bernoulli equation; conditions for its validity and simplification; the concepts of static, dynamic and total pressure, their relationships.
- He knows Thomson (Lord Kelvin), Helmholtz I. and II. vortex theorem, its consequences, the momentum theorem; conditions for simplification, Alievi's theory; the resulting pressure rise relationship.
- He knows 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 detachment.
- Informed the tube friction coefficient of laminar tube flow; its derivation, the basics of dimensional analysis, the condition system of flow similarity, for constant as well as variable density.
- He is aware of the equation of motion of friction media, Navier-Stokes equation, Bernoulli equation extended with lossy term, hydraulic characterization of elements, Nikuradze and Moody diagram; the concept of hydraulically smooth and rough pipes.
- Understands the energy equation; validity and simplification conditions, sound propagation rate, Mach number definition, critical temperature, density, and pressure ratio, simple tank orifice outflow, Laval nozzle

characteristics.

- Understands the components of the force acting on the body placed in the flow; the concept of blunt and streamlined bodies; the aerodynamic force and force factor components.

B. Ability

- Able to identify simple flow problems, to explore and formulate the theoretical background needed to solve them.
- He makes a proposal for the identification of simple flow engineering problems, for the exploration and formulation of the practical background necessary for their solution.
- It is used to estimate basic qualitative flow engineering trends, thereby preparing measures.
- Develops a simplified flow model for practical flow engineering problems.
- It is able to provide an estimate quantified by a practical flow engineering problem model as a basis for engineering design and decision making.
- Apply your knowledge to perform basic flow measurements.
- It proposes the evaluation of the results of basic flow measurement from an engineering point of view.
- Develop your knowledge in the direction of advanced flow measurement technology.
- You will be able to evaluate your knowledge in the direction of advanced numerical fluid science.
- He suggests that he express his thoughts in an orderly form, orally and in writing.

C. Attitude

- Open to expanding knowledge with the instructor and fellow students.
- Open to continuous knowledge acquisition to expand your knowledge.
- It seeks to use information technology tools.
- It seeks to learn about and routinely use the tools needed to solve fluid flow problems.
- Validates for accurate and error-free problem solving.
- It validates the application of the principles of reliable operation, productivity, cost and time efficiency, energy efficiency and environmental awareness in solving flow engineering tasks.
- It seeks to align ethical engineering attitudes and long-term win-win considerations with market competition.

D. Independence and responsibility

- Independently thinks through fluid tasks and problems and solves them based on specific resources.
- He feels responsible for making well-founded critical remarks.
- In some situations, as part of a team, you work with your fellow students to solve tasks.
- He feels responsible in his thinking for a systems approach and a systems approach.
- He performs his work responsibly, to the best of his knowledge.

2.3. Teaching methodology

Lectures, computational exercises, written and oral communication, use of IT tools and techniques, optional independent and group work, work organization techniques. The teaching of the subject takes place in the framework of lectures and classroom practice. The lectures basically introduce the students to the information defined by the knowledge competence elements using the technique of frontal education. The application and skill-level acquisition of knowledge takes place in classroom exercises, where computational tasks and industrial problem-solving case studies have to be solved in groups in an interactive way with the instructor, which also develops teamwork skills, quick decision-making, critical and self-critical approaches.

2.4. Support materials

a) Textbooks

Tamás Lajos: The basics of fluid dynamics. 2015, ISBN 978 963 12 2885 4.

b) Lecture notes

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c) Online materials

Example: http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATBE11

Task collection: http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATBE11

Laboratory measurement preparer: http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATBE11

2.5. Validity of the course description

Start of validity:	2022. April 27.
End of validity:	2026. July 15.

II. SUBJECT REQUIREMENT

3. ACHIEVEMENT CONTROL AND EVALUATION

3.1 General rules

Participation in lectures, exercises and laboratory classes, writing mid-term exams (ZH) is mandatory. The verification is performed on the basis of the signed ZH worksheets, the laboratory measurement and the attendance sheet at the lectures. It is not possible to replace laboratory sessions that have not been attended to without confirmation. In other matters related to presence, the current TVSz is authoritative. A 2.2. The assessment of the learning outcomes set out in point 1 is based on three mid-year written performance measurements (one level assessment and two summative assessment of academic performance), homework, and active participation in the exercises (partial performance assessment).

3.2 Assessment methods

A. Detailed description of mid-term assessments

1. Mid-term assessment

type: diagnostic assessment
count: 1
purpose, description: Prior to beginning the laboratory measurements (5thor 6thweek) one measurement mid-term exam will be taken. A prerequisite for receiving a grade for the semester is receiving a "passing" (min. 50%) mark on the measurement mid-term exam, which is also a prerequisite for participation in the measurements.

2. Mid-term assessment

type: summative assessment
count: 3
purpose, description: During the seminars on the 5th, 9th, and 13thweeks of the semester, three mid-term exams will be taken. The mid-term will consist of the following: a) Write ups on theorems (THE) regarding the applied theoryaccording to a predefined structure, b) Problem solving exercises(EXE), which consist of a written exam reviewing one's ability to solve problems based on the theory and techniques learned during the problem solving exercises. A mid-term exam can only be deemed "passing" if a grade of at least 40% is reached on both the THEand EXEof the same mid-term exam. In order to receive a grade for the semester, one must receive a "passing" grade on all three mid-term exams. The sum of the three mid-term exams, according to the maximum number of points which can be received during the semester, make up 80% of the final grade. Broken down even further, THEmakes up 30%, and EXEmakes up 50% of the final grade.

3. Mid-term assessment

type: formative assessment, point-in-time personal act
count: 1

purpose, description: Measurement groups of 4 students will participate in laboratory measurements to be held in the laboratory of the Department of Fluid Mechanics. Prior to participating in the measurements, the students will participate in 3 preparatory classes to be held on the 1st, 3rd, and 5th, or 2nd, 4th, and 6thweeks of the semester, depending on whether the course is scheduled for +(odd), or # (even) weeks. A prerequisite for participating in the laboratory measurements is the attainment of a passing grade (minimum of 50%) on the measurement mid-term exam, which evaluates the student'sknowledge regarding fluid mechanics measurements. The measurement mid-term exam is to be taken during the laboratory preparatory class held on the 5thor 6thweek of the semester, depending on whether the course is scheduled for the + or # weeks. If a student does not pass the measurement mid-term exam (minimum of 50%), then there is an opportunity to take a retakemeasurement mid-term exam on the week following themeasurement mid-term exam, in a predefined time period which is other than the regularly scheduled class period. If this is not passed (minimum of 50%), then there is one opportunity to take an oral retake measurement mid-term exam, after payment of an additional charge. It is possible to take the oral retake measurement mid-term exam until 4 p.m. of the day preceding the students "A" measurement. The score attained on the measurement mid-term exam does not directly count toward ones mid-semester grade, though needs to be passed in order to pass the class, since a passing grade must be attained in order to participate in the laboratory measurements.

4. Mid-term assessment

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

count: 1

purpose, description: Upon completion of the laboratory measurements, a measurement report (maximum 20 points) must be submitted and a measurement presentation (maximum 20 points) must be held, which are worth atotal of 40 points. In order to receive a mid-semester grade a minimum of 40% (8 points) must be reached on the measurement report and a minimum of 40% (8 points) must be reached on the measurement presentation. From the measurements a totalof 40 points,counting toward 20% of the mid-semester grade, can be reached. A description of the laboratory measurements and the grading system relating to the laboratory portion of the subject are given in a supplementary section of this "SubjectData Sheet and ClassRequirements" entitled "Requirements of the fluid mechanics laboratory measurements".

5. Mid-term assessment

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

count: 1

purpose, description: The leader of the seminars can hand out extra credit points to those who interactively participate in class or due extra credit assignments outside of class. These points can improve the mid-semester grade by up to 10%.

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

Elements of the exam:

1. written partial exam

obligation: does not apply

description:

2. oral partial exam

obligation: does not apply

description:

3. practical partial exam

obligation: does not apply

description:

4. inclusion of mid-term results

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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	75 %
3 . Mid-term assessment	10 %
4 . Mid-term assessment	10 %
5 . Mid-term assessment	5 %

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	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]	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).

Need mid-term assessment to individually complete?

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:

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
preparation for summary assessments	48
additional time required to complete the subject	4
summary	**150**

3.9. Validity of subject requirements

Start of validity: 2022. April 27.

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:

Energy 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 of the scientific and technical theory and practice closely related to the profession of energy engineer, with an appropriate level of manual skills.
- Student has the knowledge of metrology and measurement theory in the field of energy.
- Student has the detailed knowledge and understanding of knowledge acquisition and data collection methods, their ethical limitations and problem-solving techniques in the field of energy.

b) ability

- Student has the ability to process, organise and analyse information collected during the operation of energy and energy supply systems and processes and to draw conclusions from this information.

- Student has the ability to process, organise and analyse energy-related statistical data on socio-economic processes and to draw conclusions from them.
- Student has the ability to contribute original ideas to the knowledge base in the field of energy.

c) attitude

- Student shall apply a systems and process-oriented approach to student's activities, based on a complex approach, with a focus on sustainability and energy awareness.
- Student Will explore and pursue research, development and innovation objectives.
- Student is open to further training for professional development.

d) independence and responsibility

- Student shares the knowledge and experience with those in the field through formal, non-formal and informal information transfer.
- Student evaluates the work of student's subordinates and contributes to their professional development by sharing critical comments.
- Student has the ability to work independently on engineering tasks.

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)	Knows the basic knowledge of the subject, the relevant chapters of physics, mechanics and mathematics.

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 think analytically, interpret tasks independently, be aware of basic physical concepts and phenomena, basic physical metrics, basic derived quantities and their units, mathematical operations, conversions between quantities, engineering approach, numerical technical solution using estimation and rounding, practical technical engineering responsible for independent laboratory work.