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)

Advanced Fluid Mechanics ● Advanced Fluid Mechanics

1.2. Neptun code

BMEGEÁTNW01

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)	3	-
exercise	-	-
laboratory exercise	-	-

1.5. Type of assessments (quality evaluation)

exam

1.6. ECTS

4

1.7. Subject coordinator

name:	Kristóf Gergely János (71957915589)
post:	associate professor
contact:	kristof@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/BMEGEATNW01

1.10. Course language

english

1.11. Primary curriculum type

mandatory

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 physical effects involved in the formation and propagation of vorticity, the characteristics and description of potential flows, the boundary layer approximation system, the boundary layer stability, the numerical solution of the boundary layer equation, the gas dynamics flow phenomena related computational methods, modeling of hydraulic systems and pipeline transients, and key physical characteristics of atmospheric flows.

2.2. Learning outcomes

Competences that can be acquired by completing the course:

A. Knowledge

- Knows the vorticity transport equation, its derivation, and the physical meaning of the terms.
- Knows the effects involved in the formation and transport of vorticity.
- Being aware of the validity and technical applications of the potential flow model.
- Understands the definition and physical meaning of scalar potentials used to describe the fluid flow phenomena.
- Has a comprehensive knowledge of elementary plane flows.
- Describes wave phenomena in high-velocity gas flows.
- Knows the basic calculation methods of expansion waves, oblique and perpendicular shock waves.
- Understands a method for describing looped hydraulic systems.
- Being informed about the method of calculating transient flows in long tubes.
- Being aware of the basic physical phenomena associated with mesoscale atmospheric flows.

B. Ability

- Able to predict the change in vorticity by thought experiments using Helmholtz-analogy.
- Able to generate and analyze more complex flows from elemental potential plane flows.
- Being able to engineering application and numerical solution of the boundary layer equation.
- Creates the equivalent loop network equivalent of an open network.
- It produces and solves the system of equations describing the constant flow for a looped network.
- Determines the change in physical characteristics in a steady-state gas flow in a channel of variable cross-section that can be considered frictionless.
- Calculates state changes caused by perpendicular and inclined shock waves.
- Using a hodograph, it determines the waves generated in supersonic flow, their reflection, and the spatial distribution of the Mach vector.
- Investigate the application limitations of different atmospheric models.
- Analyzes the significance of atmospheric stability and Coriolis force for a given technical application.

C. Attitude

- Constantly monitors his work, results and conclusions.

- Expands the knowledge of numerical fluid dynamics with continuous acquisition of knowledge.
- Open to the use of information technology tools.
- Seeks to routinely use numerical fluid dynamics methods.
- Develops your ability to provide accurate and error-free problem solving, engineering precision and accuracy.
- Publishes the results in accordance with his professional rules.
- Publishes the opinions and views without offending others.

D. Independence and responsibility

- Collaborates with the instructor and fellow students to expand knowledge.
- Accepts well-founded professional and other critical remarks.
- In some situations, as part of a team, works with the fellow students to solve tasks.
- With the knowledge, makes a responsible, informed decision based on analyzes.
- Is committed to the interests of the group in both leadership and executive roles.

2.3. Teaching methodology

The teaching of the subject takes place in the framework of a lecture involving the independent solution of practical examples. The lectures combine elements of the exploratory and frontal teaching methods in different ways for each topic. Practical examples are solved individually or in small groups. In order to develop presentation skills, students will be introduced to the solution of practical examples, through which they can earn bonus points.

2.4. Support materials

a) Textbooks

STREETER, VL; WYLIE, EB; BEDFORD, KW Fluid Mechanics McGraw-Hill. New York, 1998, ISBN-13: 978-0070857865

SCHLICHTING, Hermann, et al. Boundary-Layer Theory. McGraw-Hill 1974, 2020, ISBN 9783662529195

SHAPIRO, Ascher H. The dynamics and thermodynamics of compressible fluid flow, Vol. 1. Ronald Press, New York, 1953, 2020, ISBN 9780471066910

b) Lecture notes

Dr. Gergely Kristóf: Advanced Fluid Mechanics, lecture notes, 2019

c) Online materials

http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATNW01

2.5. Validity of the course description

Start of validity:	2020. March 3.
End of validity:	2024. December 31.

II. SUBJECT REQUIREMENT

3. ACHIEVEMENT CONTROL AND EVALUATION

3.1 General rules

Learning outcomes are assessed in a written examination, which is a complex, written way of assessing knowledge and ability type competence elements. The written exam consists of questionable questions covering all the topics covered in the curriculum, as well as practical tasks for assessing ability-type competencies, for which we provide tables and graphical aids.

3.2 Assessment methods

A. Detailed description of mid-term assessments

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: Learning outcomes are assessed in a written examination, which is a complex, written way of assessing knowledge and ability type competence elements. The written exam consists of questionable questions covering all the topics covered in the curriculum, as well as practical tasks for assessing ability-type competencies, for which we provide tables and graphical aids.

2. oral partial exam

   obligation: does not apply

   description:

3. practical partial exam

   obligation: does not apply

   description:

4. inclusion of mid-term results

   -

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

identifier	weight

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	100 %
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.

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).

Taking into account the previous result in case of improvement, retaken-improvement:

new result overrides previous result

3.8 Study work required to complete the course

Activity	hours / semester
participation in contact classes	42
exam preparation	28
additional time required to complete the subject	50
summary	**120**

3.9. Validity of subject requirements

Start of validity: 2020. March 3.

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_modelling

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

b) ability

c) attitude

d) independence and responsibility

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)	-