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)

Computational Fluid Dynamics ● Computational Fluid Dynamics

1.2. Neptun code

BMEGEÁTBG26

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	coupled

1.5. Type of assessments (quality evaluation)

mid-term grade

1.6. ECTS

4

1.7. Subject coordinator

name:	Dr. Kristóf Gergely János
post:	associate professor
contact:	kristof@ara.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/BMEGEATBG26/

1.10. Course language

hungarian, english

1.11. Primary curriculum type

mandatory

1.12. Direct prerequisites

Strong prerequisite:	BMEGEÁTBG11
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 get acquainted with the approximation systems applicable in different flow categories, the theoretical foundations of turbulence modeling, numerical solution methods and errors in numerical modeling. Overall, it develops technical thinking and attitudes. The aim of the education is also that the student should be able to recognize and correctly judge the mechanical problems related to the curriculum based on the learned knowledge.

2.2. Learning outcomes

Competences that can be acquired by completing the course:

A. Knowledge

- Knows the finite differentiation method and how to use it for edge measurement tasks.
- Knows the explicit and implicit initial value solving techniques, their stability properties.
- He knows the methods of solving the general convective-diffusive equation and its stability properties.
- He is aware of general numerical methods for solving compressible and uncompressable flows.
- He informed about the theoretical foundations of the finite volume method and the process of CFD analysis.
- He was informed about the mathematical background and physical interpretation of the boundary conditions, as well as the possible methods of modeling flow engineering machines.
- He recalls the role of source members and rupture conditions in flow modeling.
- It recalls the theoretical foundations of turbulence modeling and the main features of each model.
- Systematizes aspects related to numerical mesh compression and quality, boundary layer networking, and other mesh generation methods.
- He is familiar with the modeling of thermal processes and the calculation of heat transfer.
- He is aware of the possible sources of errors and uncertainties inherent in CFD analysis, convergence tests, and error estimation methods.

B. Ability

- It is able to determine the order of accuracy of a numerical method.
- Able to discretize and numerically solve a general initial and boundary value problem.
- It is able to solve the general convective-diffusive equation.
- Analyzes the applicability of simulation analysis in technical problems.
- Selects the appropriate modeling approach.
- Evaluates the applicability of simulation analysis in technical problems.
- Selects the appropriate modeling approach for simulation analysis in technical problems.
- Creates two- and three-dimensional flow models.
- Apply two- and three-dimensional flow models.
- Prepares the modeling of thermal processes, the calculation of heat transfer.
- Prepares convergence tests for CFD analysis.

C. Attitude

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

D. Independence and responsibility

- Independently thinks through the tasks and problems defined in the subject and solves them based on given resources.
- Accepts well-founded critical remarks and criticisms.
- In some situations, as part of a team, you work with your fellow students to solve tasks.
- It supports a systematic approach and complex thinking in its thinking.
- He is critical of engineering commitments made in inadequate quality.

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. Lectures, computational exercises, written and oral communication, use of IT tools and techniques, optional independent and group work tasks, work organization techniques Lectures, computational exercises, written and oral communication, use of IT tools and techniques, optional independent and group work tasks, work organization techniques .

2.4. Support materials

a) Textbooks

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

JH Ferziger, M. Peric: Computational Methods for Fluid Dynamics. 2002, ISBN 3-540-42074-6

b) Lecture notes

Dr. Gergely Kristóf: Numerical modeling of fluid flows, lecture handouts, 2018

Dr. Gergely Kristóf: Numerical modeling of flows, electronic textbook, ISBN 978-963-08-1212-2, distributed by: CFD.HU Kft., 2014,

c) Online materials

http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATBG26

2.5. Validity of the course description

Start of validity:	2020. February 1.
End of validity:	2024. December 31.

II. SUBJECT REQUIREMENT

3. ACHIEVEMENT CONTROL AND EVALUATION

3.1 General rules

A 2.2. The assessment of the learning outcomes set out in point 1 is based on a mid-year written performance measurement (a summary assessment of academic performance), three partial performance assessments (homework) and participation in exercises. The course ends with a mid-term ticket. A 2.2. The assessment of the learning outcomes set out in point 1 is based on a mid-year written performance measurement (a summary assessment of academic performance), three partial performance assessments (homework) and participation in exercises. The course ends with a mid-term ticket.

3.2 Assessment methods

A. Detailed description of mid-term assessments

Mid-term assessment

type:	summative assessment
count:	3
purpose, description:	The subject consists of two semesters covering the same semester, one (I.) is held by the Department of Fluid Mechanics and the other (II.) By the Department of Hydrodynamic Systems. The examination consists of two theoretical sections (I. + II.) Written separately, and a practical enclosure written from the CFD laboratory course material taught by the Department of Fluid Mechanics. The condition for obtaining the mid-term ticket is a result of at least 40% from both theoretical enclosures, and at least 40% completion of the practical task.

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**
Mid-term assessment	100 %

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 85%
very good(5) ● Very Good [B]	85% .. 85%
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% 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

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	42
preparation for laboratory practices	14
preparation for summary assessments	48
additional time required to complete the subject	16
summary	**120**

3.9. Validity of subject requirements

Start of validity:	2020. February 1.
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 is familiar with the general and specific mathematical, scientific and social principles, rules, contexts and procedures needed to operate in the field of engineering.
- Student has the comprehensive knowledge of global social and economic processes.
- Student has the knowledge of the theories and contexts of fundamental importance in the field of engineering and of the terminology which underpins them.

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 apply the theories and related terminology in an innovative way when solving problems in a given 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.

c) attitude

- Student is open and receptive to learning, embracing and authentically communicating professional, technological development and innovation in engineering.
- Student embraces the professional and ethical values associated with the technical discipline.
- Student strives to improve student's own knowledge and that of student's colleagues through continuous self- and peer-learning.

d) independence and responsibility

- Student shares her acquired knowledge and experience through formal, non-formal and informal information transfer with those in her field.
- Student makes professional decisions independently in student's area of activity.
- 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)	-

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)	-