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

BMEGEÁTNW02

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	-	-

1.5. Type of assessments (quality evaluation)

mid-term grade

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/BMEGEATNW02

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

Acquisition of the theoretical foundations of the finite volume method, turbulence modeling, introduction to the modeling of multiphase flows. Mesh generation, model validation, practical mastery of the application of more complex physical models based on hydraulic models. Understanding the theoretical foundations of issues crucial to the effectiveness of numerical flow models, such as numerical differentiation and integration techniques, methods for separating the pressure-velocity relationship, wind weighting, and methods for solving the Poisson equation.

2.2. Learning outcomes

Competences that can be acquired by completing the course:

A. Knowledge

- He has a comprehensive knowledge of numerical integration and differentiation methods.
- He knows the basic problems and solution methods of numeirus flux calculation.
- He is familiar with general concepts used in numerical flow theory.
- He has a comprehensive knowledge of the minds of the finite volume method.
- He is aware of the factors influencing the formation and propagation of turbulence.
- He is aware of the effects of tubulence on flow and the physical characteristics that can be used to describe turbulence.
- Systematizes turbulence modeling methods.
- Knows the appearance of multiphase flows.
- Systematizes models suitable for describing multiphase flows.
- Knows the operating principle of the models used to describe multiphase flows and the scope of the models.

B. Ability

- Independently able to model external and internal flows typical of mechanical practice.
- Able to evaluate the quality of a numerical mesh and create a good quality numerical mesh.
- Recognizes problems in numerical solutions and is able to solve them by choosing the right method.
- Designs numerical modeling of thermally coupled flows (e.g., natural flows).
- Selects the appropriate turbulence model for the practical task.
- Defines spatially and temporally varying boundary conditions.
- Evaluates the quality of the match between the numerical model and the measurement data.
- Prepares the programming of the numerical solver to increase the efficiency of the analysis.
- It independently selects the model suitable for solving the given multiphase flow problem.
- Explores the need for user functions to solve a modeling problem.

C. Attitude

- He constantly monitors his work, results and conclusions.
- It expands your knowledge of numerical fluid dynamics with continuous acquisition of knowledge.
- Open to the use of information technology tools.

- It seeks to routinely use numerical fluid dynamics methods.
- It develops your ability to provide accurate and error-free problem solving, engineering precision and accuracy.
- He publishes his results in accordance with his professional rules.
- It publishes its 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, you work with your fellow students to solve tasks.
- With his knowledge, he makes a responsible, informed decision based on his analyzes.
- He 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 lectures and laboratory practice. The lectures basically introduce the students to the information determined by the knowledge competence elements using the technique of frontal education. The application and skill-level acquisition of knowledge takes place in laboratory exercises, where guided exercises and individual and group project work have to be solved, which also develops independence and teamwork skills. Project work must be presented at the end of the semester.

2.4. Support materials

a) Textbooks

JHFerziger and M.Peric, 2002: Computational Methods for Fluid Dynamics, ISBN 3-540-42074-6, Springer-Verlag, Heidelberg

COST 732, 2012: Model Evaluation Guidance and Protocol Document, COST Action 732: Quality Assurance and Improvement of Microscale Meteorological Models, edited by Rex Britter and Michael Schatzmann, May 1, 2007, ISBN 3-00-018312-4

b) Lecture notes

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

c) Online materials

http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATNW02

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 on the basis of two mid-year written summary performance measurements and two partial performance measurements. Summative academic performance appraisal is a complex, written way of assessing the knowledge and ability type competence elements of the subject in the form of an in-house dissertation, which requires the necessary lexical knowledge during the performance appraisal, the working time is 60 minutes. Partial performance assessment (homework): a complex way of evaluating the knowledge, ability, attitude, and autonomy and responsibility type competence elements of the subject, the form of which is individual and group homework.

3.2 Assessment methods

A. Detailed description of mid-term assessments

1. Mid-term assessment

type:	summative assessment
count:	2
purpose, description:	Summative assessments collectively examine and assess students ’learning outcomes defined by knowledge and ability type competencies. Accordingly, each summative assessment assesses the acquisition of the designated theoretical knowledge as well as the existence of the knowledge and skills acquired in practice. Each summative assessment focuses 65% on theoretical knowledge and 35% on application skills. They will be completed on the date specified in the academic performance assessment plan, scheduled for the 7th and 14th weeks of education. A total of 50 points can be obtained in summary performance evaluations. A minimum of 40% is achievable.

2. Mid-term assessment

type:	formative assessment, simple
count:	2
purpose, description:	The basic goal of partial performance assessment is to examine the existence of attitudes and learning outcomes belonging to the autonomy and responsibility competence group. The way to do this is to create an individual and a group project that can be created in groups, followed by a presentation in front of the practical group. Group assignments and the assignment of groups of up to 4 people must be finalized by the second week of education. The content and form requirements and evaluation principles of the prepared project dissertation are included in the terms of reference. It will be completed on the date specified in the study performance assessment plan, expected to be in the 14th week of education. You can earn up to 50 points with this 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
1 . Mid-term assessment	50 %
2 . Mid-term assessment	50 %

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 **70%** the exercises (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

Can the submitted and accepted partial performance assessments be resubmitted until the end of the replacement period in order to achieve better results?

NO

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 not possible

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

new result overrides previous result

The way of retaking or improving a partial assessment for the first time:

partial assesment(s) in this group cannot be improved or repeated, the final result is assessed in accordance with Code of Studied 122. § (6)

3.8 Study work required to complete the course

Activity	**hours / semester**
participation in contact classes	56
mid-term preparation for practices	14
preparation for summary assessments	32
elaboration of a partial assessment task	8
additional time required to complete the subject	10
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

- Student has the knowledge of modern experimental and numerical modelling techniques.

b) ability

- Student has the ability to apply and put into practice the knowledge acquired, using problem-solving techniques.

c) attitude

- Student has the ability to plan and carry out tasks to a high professional standard, either independently or in a team.

d) independence and responsibility

- Student has the ability to take responsibility for managing the professional work of a small or large group.

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)	-