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

BMEGEÁTBM04

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)	1	-
exercise	-	-
laboratory exercise	2	individual

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
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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/BMEGEATBM04

1.10. Course language

hungarian, english

1.11. Primary curriculum type

mandatory

1.12. Direct prerequisites

Strong prerequisite:	BMEGEÁTBM11
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 teaching the subject is to acquaint with the procedure of numerical modeling of flows. Enable the independent construction of flow models and flow-connected thermal models, as well as the evaluation of the accuracy and reliability of modeling. Explain the principle of the finite volume method, the types of boundary conditions, the basics of turbulence modeling, several commonly used turbulence models, the requirements for the numerical mesh, and the mesh generation methods. As a practical application, it covers channel flows, streamlined bodies, flow engineering machines, and modeling of room flows.

2.2. Learning outcomes

Competences that can be acquired by completing the course:

A. Knowledge

- Knows the theoretical foundations of the finite volume method and the process of CFD analysis.
- Knows the mathematical background and physical interpretation of boundary conditions, as well as possible methods for modeling flow engineering machines.
- Knows 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.
- It recalls the main features of turbulence models.
- It recalls aspects related to the compression and quality of the numerical mesh.
- He is knowledgeable about boundary layer networking and other mesh generation methods.
- He was informed about the modeling of thermal processes and the calculation of heat transfer.
- He was aware of the possible sources of errors and uncertainties inherent in CFD analysis.
- He is aware of convergence tests and error estimation methods for CFD analysis.

B. Ability

- Able to judge the applicability of simulation analysis in technical problems.
- Able to select an appropriate modeling approach for simulation analysis in technical problems.
- Creates two- and three-dimensional flow models.
- Apply two- and three-dimensional flow models.
- Handles coupled thermal fluid models.
- Determines the accuracy of modeling based on the error estimate for CFD simulations.
- Evaluates the accuracy of modeling by performing error estimation.
- Prepares the modeling of thermal processes, the calculation of heat transfer.
- Calculates errors and uncertainties inherent in CFD analysis.
- 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: The basics of fluid dynamics. 2015, ISBN 978 963 12 2885 4.

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

b) Lecture notes

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c) Online materials

https://mersz.hu/dokumentum/m543anm__1

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 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

1. Mid-term assessment

type: summative assessment

count: 1

purpose, description: The condition for obtaining a mid-term ticket is to achieve a result of at least 40% of your theoretical indoor score. We provide an opportunity to replace the theoretical confinement in the 14th week of education. 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.

2. Mid-term assessment

type: formative assessment, simple

count: 3

purpose, description: A maximum of 22 points can be obtained with a PowerPoint presentation summarizing the results of an independent practical task. Summary 1 should be submitted before the 9th, Summary 2 should begin before the 12th training week, and Summary 3 should be submitted by 4 pm at the end of Week 14 by uploading the files to the Poseidon system. In case of late submission of summaries, the score of the result is taken into account by a multiplier (1, 0.9, 0.8, etc.) decreasing by 10% per day. With a delay of more than 6 days, the practical task cannot be submitted.

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	34 %
2 . Mid-term assessment	66 %

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% 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

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

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 repeat period

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	16
elaboration of a partial assessment task	12
additional time required to complete the subject	36
summary	**120**

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 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 be creative in problem solving and flexible in complex tasks, as well as a lifelong learner, committed to diversity and value-based approaches.
- Student has the ability to develop independently the theoretical knowledge and to apply new theory to the practical solution of complex mechatronic design problems of an unconventional nature.

c) attitude

- 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 plan and carry out tasks to a high professional standard, either independently or in a team.
- Student strives to develop professional competences.

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)	-