SUBJECT DATA SHEET AND REQUIREMENTS

last modified: 2th September 2014

COMPUTATIONAL FLUID DYNAMICS I.

ÁRAMLÁSOK NUMERIKUS MODELLEZÉSE I.

1	Code	Semester Nr. or fall/spring	Contact hours/week (lect.+semin.+lab.)	Requirements p / e / s	Credit	Language
	BMEGEÁTMW02	1.(2.*)spring	2+2+0	p	5	English

*: in case of enrolment in fall

2. Subject's responsible:

Name:	Title:	Affiliation (Department):
Dr. Gergely KRISTÓF	associate professor	Dept. of Fluid Mechanics

3. Lecturer:

Name:	Title:	Affiliation (Department):
Dr. Gergely KRISTÓF	associate professor	Dept. of Fluid Mechanics
Dr. Máté Márton LOHÁSZ	invited lecturer	GEA EGI Co.Ltd.

4. Thematic background of the subject: Fluid mechanics

5. Compulsory / suggested prerequisites:
Compulsory: Fluid mechanics (BSc level)
Suggested: Computational Fluid Dynamics (BSc level)

6. Main aims and objectives, learning outcomes of the subject: To deliver basic concepts of finite volume method and turbulence modelling. To introduce multi-phase flow modelling methodologies. To give practical skills in meshing and model validation as well as in construction of complex physical models being coupled to a hydraulic model.

7. Method of education: lecture 2h/w, seminar 0h/w, laboratory 2h/w

8. Detailed thematic description of the subject:

1-2.lectures: Numerical approximations of derivatives and integrals. Discretisation of divergence, gradient and Laplace operator by means of finite volume method.
3-5. lectures: Characteristics of turbulence and turbulence modelling.
6. lecture: Numerical modelling of incompressible flows, resolution of pressure-velocity coupling in terms of psi-omega method and pressure correction method.
7. lecture: 1st theoretical test.
8. lecture: Application of finite volume discretisation method in a one-dimensional case. Stability of the central differencing scheme, upwinding, and numerical diffusion.
9. lecture: Solution of algebraic systems which are obtained by the discretisation of the governing equations of fluid flows. Iterative methods, multigrid methods.
10. lecture: Compressible flow modelling. Method of characteristics, application of finite volume method.
11-12. lectures: Introduction to multiphase flow modelling.
13. lecture: Application of User Defined Functions (UDFs) in Ansys-Fluent simulation system.
14. lecture:2nd theoretical test.

Laboratory practices:

1-5. lab: Generation of block-structured meshes with ICEM CFD software.
6-9. lab: Individual assignment. Convergence checking, mesh independency checking, comparison of results of various models with measured data.

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10-11. lab: Handing in the report of the individual assignment. Group assignment (in groups of 3). Convergence checking, mesh independency checking, comparison of results of various models with measured data.
12. lab: Tutorial examples in multiphase flow modelling.
13. lab: Handing in the report of group assignment. UDF examples.
14. lab: Presentation of the results of group assignments. Multiphase flow examples.

9. Requirements and grading

a) in term-period: The subject in concluded with a practical mark. The evaluation consists of two theoretical tests (of equal value), individual assignment and group assignment. Practical assignments have a 50% share in midterm points. Condition for the midterm signature: achieving at least 40% of the maximum total points of two theoretical tests and achieving at least 40% in each and every practical assignment. One retake opportunity is given for the theoretical tests on the retake week (15th education week).
25 points can be achieved with the individual assignment, the report of which need to be prepared in PowerPoint format before the beginning of the 10th week laboratory practice.
15 points can be achieved with the group assignment. Each member of the team is equally evaluated. The group report is to be handed in in PowerPoint format before the beginning of the laboratory of the 13th week.
In case of late delivery of the practical reports the results are multiplied by a factor being reduced by 5% every day (1, 0.95, 0.9…). More than 12 days after the deadline practical reports are not accepted.
10 points can be achieved by the presentation of the results of group assignments on the laboratory of the 14th week. Each member of the team receives equal number of points.
Midterm evaluation consist of

- individual assignment: max. 25p;
- group assignment: max 15p written report, plus max. 10p presentation;
- 1st theoretical test: max 25p;
- 2nd theoretical test: max 25p.

Evaluation of practical marks (1,2,3,4,5) is according to the usual lower limits (0,40,70,85).

b) in examination period: -

c) The students are subject to disciplinary measures against the application of unauthorized means at mid-terms, term-end exams and homework and the application of the 1/2013. (I.30.) Dean's Order must be followed.

10. Retake and repeat: Retaking of theoretical tests will be possible by 1 occasion on the retake week.

11. Consulting opportunities:

- According to the consultation times indicated on the web page of the lecturer of the subject.
- On cases-by-case arrangement.

12. Reference literature (compulsory, recommended):

- Self-made lecture notes taken during the lectures are sufficient and the recommend source of information to the preparation for the midterm tests. Lecture notes in PowerPoint format can also be downloaded from the web page of the subject.
- The web page of the subject can be found on the web page of the Department of Fluid Mechanics or by entering the following URL: http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATMW02
- Recommended book for further reading:
  Ferziger, J. H. & Peric, M.: Computational Methods for Fluid Dynamics, Springer,2002, ISBN 3-540-42074-6

13. Home study required to pass the subject:

Contact hours	56	h/semester
Home study for the courses	28	h/semester
Home study for the mid-semester checks	10	h/check
Preparation of mid-semester homework	10	h/homework
Home study of the allotted written notes	28	h/semester
Home study for the exam	-	h/semester
Totally:	150	h/semester

14. The data sheet and the requirements are prepared by:

Name:	Title:	Affiliation (Department):
Dr. Gergely KRISTÓF	associate professor	Dept. of Fluid Mechanics