SUBJECT DATA SHEET AND REQUIREMENTS

last modified: 5th December 2013

COMPUTATIONAL FLUID DYNAMICS

ÁRAMLÁSOK NUMERIKUS MODELLEZÉSE I.

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

Suggested: Fluid Mechanics (BSc level) BMEGEÁTAG01,-AG11,-AE01,-AM01,-AM11,-AM21,-AKM1,-AT01,-MF03;
Computational Fluid Dynamics (BSc level) BMEGEÁTAG06,-AG26,-AG03,-AM04,-AM05

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 2h/w, laboratory 0h/w

8. Detailed thematic description of the subject:

Lectures:

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

13. Application of User Defined Functions (UDFs) in ANYSYS-Fluent simulation system.
14. 2nd theoretical mid-term test

Seminars (in CFD Laboratory):

1-5. Generation of block-structured meshes with ICEM CFD software.
6-8. Individual assignment. Convergence checking, mesh independency checking, comparison of results of various models with measured data.
9-11. Handing in the **report of the individual assignment**. Group assignment (in groups of 3 students). Convergence checking, mesh independency checking, comparison of results of various models with measured data.
12. Tutorial examples in multiphase flow modelling.
13. Handing in the **report of group assignment**. UDF examples.
14. **Presentation** of the results of group assignments.

9. Requirements and grading

a) in term-period: The evaluation consists of two theoretical tests (of equal value= 25p+25p), individual assignment (25p) and group assignment (25p). The report of individual assignment need to be prepared in PowerPoint format and handed in before the beginning of the 9th week seminar (CFD laboratory) practice. The report of the group assignment is to be handed in of PowerPoint format before the beginning of the seminar (CFD laboratory) of the 13th week. The results of group assignments must be presented on the seminar (CFD laboratory) of the 14th week. Each member of the team receives equal number of points. Condition for the minimum performance: achieving at least 40% of the maximum total points of two theoretical tests (min.20p) and achieving at least 40% in each and every practical assignment. Mid-term evaluation consists of:

tests (max.50p = 50%):		**and**	**practical assignments (max.50p=max.50%):**
1st theoretical test:	max 25p (=max.25%);		individual assignment: max. 25p (=max.25%);
2nd theoretical test:	max 25p (=max.25%);		group assignment: written report: max 15p (=max.15%) presentation: max. 10p (=max.10%);

Totally max. achievable 100 points equal to 100% as base of the final grading. Minimum 40 points (=40%) obtained out of the parts, for each item separately is obligatory.

Grading: 0%-39%: fail(1); 40%-54% pass(2), 55%-69%: satisfactory (3), 70%-84%: good(4), 85%-100%: excellent (5)

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

One retake opportunity is given for the (1st+2nd) theoretical tests on the week after mid-term period (15th week for retakes). In case of late delivery of any practical report its grade is multiplied by a factor being reduced by 5% every day (1, 0.95, 0.9…). More than 12 calendar days after the deadline practical reports are not accepted. Any further movements are due to the Code of Studies and Exams of BME.

11. Consulting opportunities:

Consultation hours: by email & cases-by-case arrangement and as it is indicated on the department's website.

12. Reference literature (compulsory, recommended):

- Students' own self-made lecture notes taken during the lectures are sufficient and the recommend source of information to the preparation for the midterm tests.
- Downloadable materials: www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATMW02

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	23	h/homework
Home study of the allotted written notes	-	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

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