SUBJECT DATA SHEET AND REQUIREMENTS

last modified: 5th December 2013

MULTIPHASE AND REACTIVE FLOW MODELLING

TÖBBFÁZISÚ ÉS REAKTÍV ÁRAMLÁSOK MODELLEZÉSE

1	Code	Semester Nr. or fall/spring	Contact hours/week (lect.+semin.+lab.)	Requirements p / e / s	Credit	Language
	BMEGEÁTMW17	4.(3.*) fall	2+0+0	p	3	English

*: in case of enrolment in fall

2. Subject's responsible:

Name:	Title:	Affiliation (Department):
Dr. Jenő Miklós SUDA	assistant professor	Dept. of Fluid Mechanics

3. Lecturer:

Name:	Title:	Affiliation (Department):
Dr. Gábor K. SZABÓ	associate professor	Dept. of Hydraulic and Water Resources Engineering (Faculty of Civil Engineering)

4. Thematic background of the subject: Mathematics: practical knowledge of vector and tensor algebra and calculus, ordinary and partial differential equations. Mechanics and thermodynamics: solid knowledge of principles. Fluid mechanics: fluid mechanics of simple fluids, turbulence models, basic flow measurement techniques, basic CFD techniques.

5. Compulsory / suggested prerequisites:

Compulsory: -

Suggested: Computational Fluid Dynamics BMEGEÁTMW02
Flow Measurements BMEGEÁTMW03

6. Main aims and objectives, learning outcomes of the subject:

Understanding the physical phenomena occurring in fluid systems with more than one chemical component or more than one phase. Familiarization with special measurement techniques used in such systems. Outlining the concepts of possible theoretical models and numerical modelling, understanding limitations due to restricted range of validity and computational resources. Detailed study of models used in some typical engineering applications.

7. Method of education: lectures 2h/w, practical classes 0h/w, laboratory 0h/w

8. Detailed thematic description of the subject:

Physical phenomena, major concepts, definitions and modelling strategies. Mass transport in multi-component systems: diffusion and chemical reactions. Modelling chemical reactions: flames, combustion models, atmospheric reactions. Fluid dynamical and thermal phenomena in two-phase pipe flows: flow regimes in vertical, horizontal and inclined pipes. Advanced multi-phase flow instrumentation. Transport through deforming fluid interfaces: jump conditions at discontinuities. Single-fluid and interpenetrating media modelling approaches. Obtaining practical transport equations for multiphase pipe flows by cross sectional integration and cross sectional averaging. Closure relations. Mixture and multi-fluid models. Using experimental correlations. Relevant dimensionless numbers. Gravity and capillary waves. Dispersed particle transport. Sedimentation and fall-out, particle agglomeration and break-up. Bubble growth and collapse. Phase change and heat transfer in single-component systems: boiling, cavitation, condensation. Related heat transport problems and industrial applications. Computational Multi-Fluid Mechanics (CMFD): general methods and limitations, usage of general purpose computational fluid dynamics codes, design of specialized target software. Numerical modelling free surfaces and fluid-fluid interfaces. Review of applications in power generation, hydrocarbon and chemical industry.

9. Requirements and grading
a) in term-period: two mid-term tests and optional submission of CFD model
mid-term test 1.: on the 7th week (max.50 points, min.25% is obligatory for “pass” grade of the 1st test)
mid-term test 2.: on the 13th week (max.50 points, min.25% is obligatory for “pass” grade of the 2nd test)
Although, 25% is the minimum “pass” level of each test separately, for the “pass” grade of both tests together a minimum 40% obtained for 1.+2. tests together is obligatory.
Optionally, submission of one running and realistic CFD model of an individually assigned simple model system is possible (max.50 points). Deadline of the submission of the optional CFD model is the last day of the semester’s 14th week.

Totally max. achievable 100 points equal to 100% as base of the final grading. (Note, that more than 100points may be achieved in case of optional submission of the CFD model.)

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
Retake possibility for tests 1. & 2. is on the next weeks (8th and 14th), repeated retake of the test 1. or 2. is on the 15th week. The CFD model of an individually assigned simple model system is not to be submitted after deadline. Any further movements are due to the Code of Studies and Exams of BME.

11. Consulting opportunities:
Consultation hours: by email appointments and as it is indicated on the department’s website.

12. Reference literature (compulsory, recommended):
- Books:
  - Crowe, C., Sommerfeld, M. & Tsuji, Y.: Multiphase Flows with Droplets and Particles. CRC Press, 1998.
  - Gidaspow, D.: Multiphase Flow and Fluidization. Academic Press, Boston, 1994.
- Lecture notes, hand-outs presented on lectures and seminars
- Downloadable materials: www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATMW17

13. Home study required to pass the subject:

Contact hours	28	h/semester
Home study for the courses	14	h/semester
Home study for the mid-semester checks	10	h/check
Preparation of mid-semester homework (optional)	(28)	h/homework
Home study of the allotted written notes	28	h/semester
Home study for the exam	-	h/semester
Totally:	90	h/semester

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

Name:	Title:	Affiliation (Department):
Dr. Gábor K. SZABÓ	associate professor	Dept. of Hydraulic and Water Resources Engineering (Faculty of Civil Engineering)