SUBJECT DATASHEET

I. SUBJECT DESCRIPTION

1. GENERAL DATA

1.1. Subject name (in Hungarian, in English)

Multiphase and Reactive Flow Modelling ● Multiphase and Reactive Flow Modelling

1.2. Neptun code

BMEGEÁTNW27

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	-	-
laboratory exercise	-	-

1.5. Type of assessments (quality evaluation)

mid-term grade

1.6. ECTS

3

1.7. Subject coordinator

name:	Dr. Havasi-Tóth Balázs (79649277576)
post:	adjunct
contact:	havasitoth@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/BMEGEATNW27

1.10. Course language

english

1.11. Primary curriculum type

mandatory elective

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

Within the framework of the course, we discuss the specific physical phenomena occurring in liquid media containing several liquid phases and several chemical constituents and their modeling for technical purposes. Students will become familiar with the laws of such systems, the basic concepts of their physical, mathematical and numerical models, and some specific measurement procedures. The models used for some technical applications are described in detail, as well as the limitations of the validity of the models and the available computational resources.

2.2. Learning outcomes

Competences that can be acquired by completing the course:

A. Knowledge

- Systematizes the different levels of modeling for technical purposes.
- Identifies the basic mechanisms of chemical component transport.
- Understands the meaning of reaction kinetic terms in the transport equations of multicomponent media.
- Distinguishes the characteristic flow patterns of simpler two-phase tube flows.
- Informed about the meaning and measurement methods of quantities characteristic of multiphase flows.
- The student is aware of alternative ways of mathematically describing phase boundary surfaces.
- The student is aware of the discontinuous transition of fluid dynamics quantities at phase boundary surfaces.
- Understands the main approach principles of numerical models of multiphase media.
- Knows basic numerical models of multiphase flows.
- Understands the physical background of special processes in liquids containing dispersed particles.
- The student is aware of the role of dimensional analysis in identifying the defining processes of complex systems.

B. Ability

- Designs the modeling process for a specific technical problem.
- Identifies the dominant phenomena and processes of a complex system.
- Defines the dimensionless parameters of the input and output of a complex system.
- Selects the most appropriate diffusion model of chemical components for a given problem.
- Defines the reaction kinetic processes essential to describe a chemical system.
- The student correctly infers the expected pattern of a two-phase tube flow.
- Designs the measurable and measurable quantities needed to determine the operating state of a multiphase system.
- Selects the model best suited for numerical analysis of a given multiphase flow.
- Defines the required source terms and constitutional relations in a numerical fluid dynamics model.
- Identifies the determinants to be modeled in liquids containing a given dispersed particles.
- Quantitatively describes the transport phenomena that take place at phase boundary surfaces.

C. Attitude

- The student constantly monitors his work, results and conclusions.
- Expands your professional knowledge through continuous acquisition of knowledge.
- Open to critical analysis and mastery of new numerical methods.
- Seeks to validate its numerical models under both experimental and operational conditions.
- Develops your ability to provide accurate and error-free problem solving, engineering precision and accuracy.

D. Independence and responsibility

- Collaborates with the instructor and fellow students during the lectures.
- Accepts well-founded professional and other critical remarks.
- The student is committed to the principles and methods of systematic thinking and problem solving.
- Having the knowledge, the student makes a responsible, well-founded proposal based on his analyzes.
- Critically evaluates the decision alternatives that lie ahead.

2.3. Teaching methodology

The teaching of the subject takes place in the framework of a lecture. During the lessons, the presenter interprets the slide covering the majority of the subject's knowledge, and adds oral and illustrated explanations on the board. The lectures will update the related background and background knowledge, clarify their conceptual framework, and introduce specific terminology in the field. We place emphasis on promoting in-depth study of the curriculum, for which purpose the speaker tries to activate with questions and to encourage the audience to develop an accountable one with the unique means of accountability.

2.4. Support materials

a) Textbooks

S. Osher, R. Fedkiw: Level Set Methods and Dynamic Implicit Surfaces, Springer, 2003, ISBN 9780387954820.

G. Tryggvason, R. Scardovelli, S. Zaleski: Direct Numerical Simulations of Gas – Liquid Multiphase Flows, Cambridge, 2011, ISBN 9780521782401.

Damien Violeau: Fluid Mechanics and the SPH Method: Theory and Applications, OUP, Oxford, 2012, ISBN 0199655529

b) Lecture notes

KG Tailor: Multiphase and Reactive Flow Modeling, 2018.

c) Online materials

http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATNW27

http://www.thermopedia.com/videos/

2.5. Validity of the course description

Start of validity:	2021. May 31.
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 (one quarterly) mid-year written summary performance measures. Summative academic performance assessment is a complex, written way of assessing the knowledge and ability type competence elements of a subject, in the form of an in-house dissertation consisting mostly of multiple-choice test tasks, which requires knowledge of the given quarter. The available working time is 60 minutes.

3.2 Assessment methods

A. Detailed description of mid-term assessments

1. Mid-term assessment

type:	formative assessment, point-in-time personal act
count:	1
purpose, description:	Partial performance assessment measures students' learning outcomes determined by knowledge and ability, attitude-type competencies. This can be obtained on the basis of questions related to the theoretical knowledge assigned to the lessons, lesson activity, interactive question / answer activities. During the semester, in addition to the two summative performance evaluations, a maximum of 15% can be obtained for this partial performance evaluation, which appears in the mid-term ticket at 15%.

2. 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. In addition to the designated theoretical knowledge, both summative assessments assess the ability to apply it to a technical problem. For their fulfillment at the time specified in the study performance evaluation plan, it is expected that the 6-9. and takes place in the 14th week of education.

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	15 %

2 . Mid-term assessment	85 %

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 93%
very good(5) • Very Good [B]	80% .. 93%
good(4) • Good [C]	70% .. 80%
satisfactory(3) • Satisfactory [D]	55% .. 70%
sufficient(2) • Pass [E]	43% .. 55%
insufficient(1) • Fail [F]	below 43%

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.

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

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:

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

3.8 Study work required to complete the course

Activity	hours / semester
participation in contact classes	28
preparation for summary assessments	32
additional time required to complete the subject	30

summary	**90**

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.
- Student strives to carry out their work in a complex approach based on a systems and process-oriented thinking.
- In the course of student's work, Student will explore the possibility of setting research, development and innovation objectives and strive to achieve them.

d) independence and responsibility

- Student acts independently and proactively in solving technical 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)	Knows the basic concepts and notations of vector and tensor algebra, is familiar with writing partial differential equations. Secure knowledge of the principles of mechanics and thermodynamics. In the field of fluid dynamics, knowledge of the fluid dynamics of simple fluids, the phenomenon of turbulence, basic flow measurement techniques and the basics of numerical fluid dynamics (CFD) modeling.

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)	-