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)

Gas Dynamics (PhD) ● Gas Dynamics (PhD)

1.2. Neptun code

BMEGEÁT4A17

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)

exam

1.6. ECTS

3

1.7. Subject coordinator

name:	Dr. Farkas Balázs (71421842963)
post:	adjunct
contact:	farkas@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/BMEGEAT4A17/

1.10. Course language

hungarian

1.11. Primary curriculum type

komplex vizsga tárgycsoport PhD tárgy

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

The aim of the course is to introduce students to the gas dynamics processes occurring in high-velocity gas flow. Students will learn the classical mathematical description and calculation methods of emerging wave phenomena, boundary layers, and thermal processes associated with transonic and supersonic flow around the speed of sound. By understanding gas dynamic phenomena, students will be able to recognize how critical flow conditions affect the operation of flow systems and how their adverse effects can be avoided. During the semester, students must solve an individual task related to their doctoral topic and help them present their results.

2.2. Learning outcomes

Competences that can be acquired by completing the course:

A. Knowledge

- Knows the equations describing wave propagation in compressible fluids.
- He is aware of how waves in compressible media can be demonstrated in a flat water channel.
- He knows the basic thermodynamic equations of perpendicular plane shock waves.
- It is able to apply the known relationships in a moving coordinate system, it determines the effect of reflections on the formed pressure wave systems.
- He knows the conditions for the formation of shock waves as well as expansion waves.
- He is aware of the flow conditions of the shockwave tube as well as the Laval tube.
- He is aware of the effect of heat transfer on wall-bounded flows.
- Determines the effect of wall friction on high velocity flow.
- Systematizes the characteristics of transient transonic flows.
- Understands the effect of sudden change of direction on high velocity flow.
- Understands the basic relationships related to numerical flow modeling of compressible media.

B. Ability

- You can use gas tables to determine the value of state variables that change through shock waves.
- By applying a surface theorem, it is able to determine how to reduce wave resistance.
- It is able to determine the characteristics of high-velocity flow in a walled system using the Fanno equation.
- Prepares the sizing of a Laval pipe under given boundary conditions.
- Using Prandtl-Meyer equations, he calculates the state change caused by expansion waves.
- It uses waveforms to calculate the characteristics of the change in state of the gas.
- Interprets the effect of reflected waves in high-speed wind tunnels.
- Outline the processes that take place in the high-velocity flow boundary layers.
- Use Fanno theory to describe the effect of wall friction.
- Determines the effect of heat transfer on high velocity channel flows.
- It determines the initial and boundary conditions of numerical flow models of compressible media and to interpret the obtained results.

C. Attitude

- He constantly monitors his work, results and conclusions.
- It expands your knowledge of gas dynamics through continuous acquisition of knowledge.
- Open to the use of information technology tools.
- It seeks to learn about and routinely use the tools needed to solve gas dynamics problems.
- It develops your ability to provide accurate and error-free problem solving, engineering precision and accuracy.
- It strives for demanding engineering work and makes a decision based on careful consideration.
- It monitors changes in the social, economic and political system.
- He publishes his results in accordance with his professional rules.
- It publishes its opinions and views without offending others.

D. Independence and responsibility

- Collaborates with the instructor and fellow students to expand knowledge.
- Accepts well-founded professional and other critical remarks.
- In some situations, as part of a team, you work with your fellow students to solve tasks.
- With his knowledge, he makes a responsible, informed decision based on his analyzes.
- He feels a responsibility for the sustainable use of the environment and for present and future generations.
- He is committed to the principles and methods of systematic thinking and problem solving.

2.3. Teaching methodology

In the lectures of the subject held at a given time on a pre-arranged weekly basis, the parts of the course related to the individual research topic of the students are presented in the framework of a consultation, which helps to acquire the parts related to the research area independently. Students are given an individual assignment related to their research topic during the semester, which they must solve during the semester and report on the outcome. During the solution of individual tasks, within the framework of the lectures or beyond that, consultation is possible.

2.4. Support materials

a) Textbooks

Tamás Lajos: Fundamentals of Fluid Mechanics. (Tamás Lajos, 2015.) ISBN 978 963 12 2885 4.

b) Lecture notes

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c) Online materials

http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEAT4A17/

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

During the semester, the student solves an independent task closely related to his / her own doctoral research topic. During the semester, the theoretical lectures give each student the theoretical knowledge and methodology needed to solve the problem. Students work independently on their own assignments, and the lecturer is regularly consulted as they progress. At the end of the semester, students present the results in front of each other and prepare a documentation. At the end of the semester, the result of the oral exam consists of the completion of the semester assignment and the quality of the presentation.

3.2 Assessment methods

A. Detailed description of mid-term assessments

Mid-term assessment

type: formative assessment, point-in-time personal act

count: 1

purpose, description: To be developed during the semester, a project task related to PhD research, which helps to deepen the acquisition of the curriculum through theoretical and practical calculations and derivations. The aim of the partial achievement is to examine the existence of knowledge, ability, attitude, and learning outcomes belonging to the autonomy and responsibility competence group. Upon successful completion of the task, the student stabilizes the knowledge acquired in the lectures.

B. Detailed description of assessments performed during the examination period (if relevant)

Elements of the exam:

1. written partial exam

   obligation: mandatory (partial) exam unit, failing the unit results in fail (1) exam result

   description: In the written exam, the lecturer gives three questions and / or calculation tasks from the curriculum, which the students develop over a given period of 120 minutes. In order to develop the written examination task, the students taking the written examination may not use any aids not permitted by the instructor during the written examination and may write their answers only on the official examination sheet issued by the department.

2. oral partial exam

   obligation: mandatory (partial) exam unit, failing the unit results in fail (1) exam result

   description: In the oral exam, the speaker asks three questions from the curriculum, which the students answer in detail at the board after a few minutes of reflection time. In order to develop the oral examination question, the students taking the oral examination may not use any aids not permitted by the instructor during the oral examination. Students can take the oral exam after a successful written exam.

3. practical partial exam

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4. inclusion of mid-term results

   obligation: mandatory (partial) exam unit, failing the unit results in fail (1) exam result description: The method of calculating the result of the mid-year task is as follows: the result of the mid-year task is included in the exam mark in the given 50% proportion. The elaboration of the mid-year task and its presentation in the form of a presentation is a precondition for being eligible for the exam, so it is one of the preconditions for a successful exam. Apart from these, there is no other way to count the result of the mid-year task in the exam mark.

3.3 The weight of mid-term assessments in signing or in final grading

identifier	weight
Mid-term assessment	100 %

The condition for signing is that the score obtained in the mid-year assessments is at least **40%**.

3.4 The weight of partial exams in grade (if relevant)

type	weight
written partial exam	25 %
oral partial exam	25 %
practical partial exam	0 %
inclusion of mid-term results	50 %

3.5 Determination of the grade

grade • [ECTS]	the grade expressed in percents
very good(5) • Excellent [A]	above 95%
very good(5) • Very Good [B]	85% .. 95%
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.

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).

Taking into account the previous result in case of improvement, retaken-improvement:

new result overrides previous result

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
exam preparation	21
additional time required to complete the subject	41
summary	**90**

3.9. Validity of subject requirements

Start of validity: 2020. February 15.

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_engineering_sciences_PhD_programme

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

b) ability

c) attitude

d) independence and responsibility

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)	BSc and MSc level flow theory and flow engineering theory; knowledge of physical and numerical modeling of flows; comprehensive knowledge of the design, performance and evaluation of flow simulation tests

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)	Independent, creative engineering problem-solving ability, ability to recognize and analyze the essential connections between complex flow phenomena and flow engineering processes