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)

Vehicle Aerodynamics ● Vehicle Aerodynamics

1.2. Neptun code

BMEGEÁTBV25

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	individual

1.5. Type of assessments (quality evaluation)

mid-term grade

1.6. ECTS

3

1.7. Subject coordinator

name:	Dr. Suda Jenő Miklós (71958230447)
post:	adjunct
contact:	suda@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/BMEGEATBV25

1.10. Course language

hungarian

1.11. Primary curriculum type

optional

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 acquaint students with the aerodynamic characteristics of road vehicles and aircraft vehicles and the hydrodynamic characteristics of watercraft. The course builds on BSc level knowledge what has been learned in any BSc level Fluid Mechanics courses, but the subject does not require students to be pre-trained in another subject. The necessary basic knowledge of fluid mechanics and aerodynamics is summarized at the beginning of the semester. During the 3 parts (road vehicles, airplanes and ships) students will learn about the basics of aerodynamics, the history of aerodynamic developments, the flow theory of road vehicles (passenger cars, racing cars, buses, trucks), and airplanes and ships. Measuring and evaluating the aerodynamic parameters (drag and lift coefficients) of your own 1:20 scale car model prepared in a laboratory course will lead you to learn about wind tunnel testing.

2.2. Learning outcomes

Competences that can be acquired by completing the course:

A. Knowledge

- The student knows the main 4 eras, history, outstanding aerodynamic developers and typical vehicles of vehicle aerodynamics developments.
- The student recalls the aerodynamic relationships, quantities, metrics and methods of their determination required for vehicle aerodynamics.
- The student knows the aerodynamic-efficient solutions of passenger cars and the effects of aerodynamic elements and modifications on the aerodynamic parameters of the vehicle.
- The student recalls the aerodynamic-efficient solutions of racing cars and the effects of aerodynamic elements and modifications on the aerodynamic parameters of the vehicle.
- The student knows the aerodynamic-efficient solutions of buses and trucks, and the effects of aerodynamic elements and modifications on the aerodynamic parameters of the vehicle.
- The student recalls the basics of aerodynamic testing in wind tunnels and basic questions of numerical simulation and their role in aerodynamic development.
- The student identifies the aerodynamic parameters and measurements of aircrafts.
- The student is informed about the typical wing profiles used on airplanes, the principles of wing operation.
- The student identifies the aerodynamic characteristics and solutions of propeller-driven aircraft.
- The student is informed about the aerodynamic characteristics and solutions of jet aircraft and supersonic flight.
- The student identifies the aerodynamic characteristics of helicopters.
- The student is aware of the hydrodynamic characteristics of ships.
- The student is aware of the method of determining the viscous(friction) and wave resistance of the hull and the possibilities of reducing it.
- The student is aware of the parameters and hydrodynamic solutions related to the stability of ships.
- The student is aware of the aero- and hydrodynamic characteristics of sailing ships.

B. Ability

- The student is able to comprehensively evaluate vehicle aerodyanmics development solutions.
- The student is capable of characterizing the aero- or hydrodynamic performance of road vehicles, aircraft and ships.
- The student is capable to perform basic calculations on the aero- or hydrodynamic performance of road vehicles, aircraft and ships.
- The student determines the effect of different modifications on the different aero- and hydrodynamic characteristics.
- The student evaluates the effect of different modifications on aerodynamic parameters.
- The student can use their aerodynamic knowledge to evaluate measurement results.
- The student can calculate the aerodynamic parameters of the car model based on the measured characteristics.
- The student can explore the advantages and disadvantages of various aero- and hydrodynamic modifications based on technical and economic considerations.
- The student can interpret vehicles as aero- or hydrodynamic characteristics and the aero- or hydrodynamic behavior of various vehicles.
- The student can analyze simpler vehicle aerodynamics problems.
- The student can explore the theoretical and practical background needed to solve aero- and hydrodynamic problems.
- The student can outline state-of-the-art aerodynamic solutions for road vehicles, aircraft, and ships.
- The student can evaluate the goodness of aerodynamic solutions from wind tunnel measurement data.
- The student can analyze the measurement results of aerodynamic parameters (force coefficient).
- The student can identify correlations between aerodynamic parameters and vehicle behavior.

C. Attitude

- The student can initiate collaboration with the instructor and fellow students to expand knowledge.
- The student expands his knowledge with the continuous acquisition of knowledge and a wide-ranging attitude.
- The student is open to the in-depth use of modern information technology tools.
- The student seeks to become familiar with and routinely use the system of tools needed to solve fluid flow problems.
- The student strives for an independent, accurate, error-free, and responsible solution.
- The student strives to apply the principles of reliable operation, productivity, cost and time efficiency, energy efficiency, and environmental awareness in solving flow engineering tasks.
- The student develops its ability to align ethical engineering attitudes and long-term win-win considerations with market competition.

D. Independence and responsibility

- The student independently thinks through fluid tasks and problems and solves them based on specific resources.
- The student accepts well-founded critical remarks and criticisms.
- In some situations, as part of a team, students work with their fellow students to solve tasks.
- The students support a systematic approach and complex thinking in their thinking.
- The student is critical of engineering commitments of inadequate quality.

2.3. Teaching methodology

Lectures, laboratory measurements, written and oral communication, use of IT tools and techniques, optional laboratory measurement tasks prepared independently and in groups, work organization techniques.

2.4. Support materials

a) Textbooks

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

Schuetz T. (ed.): Aerodynamics of Road Vehicles, 5th ed., 2015, SAE Int, ISBN 978-0-7680-7977-7

Barnard, RH: Road Vehicle Aerodynamic Design - An Introduction (MechAero Publishing, 2009, ISBN 9 780954 073473)

b) Lecture notes

Suda JM: Vehicle Aerodynamics (Road Vehicles - Part 1 Lecture Note), 2021

Balázs Gáti: Vehicle Aerodynamic (Airplanes - Part 2 Lecture Note), 2021

Győző Simongáti: Vehicle Aerodynamic (Ships - Part 3 Lecture Note), 2021

c) Online materials

http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATBV25

https://youtube.com/playlist?list=PLZMS6jtbk5ZRW731GEpejw4Pwmj23Hzuk

2.5. Validity of the course description

Start of validity:	2021. April 26.
End of validity:	2024. April 26.

II. SUBJECT REQUIREMENT

3. ACHIEVEMENT CONTROL AND EVALUATION

3.1 General rules

A 2.2. The assessment of the learning outcomes set out in point 1 is based on a mid-term written test and a measurement lab report and presentation. One of the conditions for obtaining a mid-term ticket: participation in the lectures is obligatory (min. 70%), which is checked according to the regulations of the Code of Studies. Attendance is checked at each lecture with an attendance sheet signed by the student present. Another condition for obtaining a mid-term mark is that the student has a min.40% rated accepted measurement report and min.40% rated accepted presentations.

3.2 Assessment methods

A. Detailed description of mid-term assessments

1. Mid-term assessment

type: summative assessment

count: 1

purpose, description: The acquisition of the knowledge is checked by the 90-minute long (max. 50 points) written mid-term test on the last lecture. The result is included in the term-end grade with a weight of 50%. The test contains 3 questions on the subject of road vehicles, 2 questions on the subject of airplanes and 2 questions on the subject of ships. For the questions of the three subject parts separately min.30%, total average of 40% is required.

2. Mid-term assessment

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

count: 1

purpose, description: Measurement report: In the laboratory course held in the second half of the semester, groups of 2-3 students construct their own 1:20 scale model car and determine the aerodynamic parameters (drag and lift coefficient) of the car by independent wind tunnel measurements. Tests include flow visualization study with photo & video documentation. The results of the measurements are to be summarized in a measurement report (i.e. MJK, max. 40points) and a measurement presentation (i.e. MP, max. 10points). Separately min.40% is the minimum requirement for the acceptance of MJK and MP. The weight of the lab session results is 50% in the mid-term grade.

3. Mid-term assessment

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

count: 1

purpose, description: Measurement presentation: In the laboratory course held in the second half of the semester, groups of 2-3 students construct their own 1:20 scale model car and determine the aerodynamic parameters (drag and lift coefficient) of the car by independent wind tunnel measurements. Tests include flow visualization study with photo & video documentation. The results of the measurements are to be summarized in a measurement report (i.e. MJK, max. 40points) and a measurement presentation (i.e. MP, max. 10points). Separately min.40% is the minimum requirement for the acceptance of MJK and MP. The weight of the lab session results is 50% in the mid-term grade.

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	50 %
2 . Mid-term assessment	40 %
3 . Mid-term assessment	10 %

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 90%
very good(5) ● Very Good [B]	85% .. 90%
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.

At least **70% of** laboratory practices (rounded down) must be actively attended.

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 possible for each assesment separately

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

Completion of unfinished laboratory exercises:

missed laboratory practices must be performed in the teaching term at pre-arranged appointment

Repetition of laboratory exercises that performed incorrectly (eg.: mistake in documentation):

incorrectly performed laboratory practice (e.g. Incomplete/incorrect report) can be corrected upon improved re-submission

3.8 Study work required to complete the course

Activity	**hours / semester**
participation in contact classes	42
preparation for laboratory practices	14
preparation for summary assessments	16
additional time required to complete the subject	18
summary	**90**

3.9. Validity of subject requirements

Start of validity: 2021. April 26.

End of validity: 2024. April 26.

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

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 is familiar with the general and specific mathematical, scientific and social principles, rules, contexts and procedures needed to operate in the field of engineering.
- Student has the knowledge of the theories and contexts of fundamental importance in the field of engineering and of the terminology which underpins them.
- Student has the knowledge of metrology and measurement theory in the field of mechanical engineering.

b) ability

- Student has the ability to apply the general and specific mathematical, scientific and social principles, rules, relationships and procedures acquired in solving problems in the field of engineering.
- Student has the ability to apply the theories and related terminology in an innovative way when solving problems in a given field of engineering.

- Student has the ability to apply an integrated knowledge of machinery, mechanical equipment, systems and processes, materials and technologies for mechanical engineering, and related electronics and information technology.

c) attitude

- Student is open and receptive to learning, embracing and authentically communicating professional, technological development and innovation in engineering.
- Student strives to plan and carry out tasks to a high professional standard, either independently or in a team.
- Student strives to acquire a broad and comprehensive literacy.

d) independence and responsibility

- Student has the ability to work independently on engineering tasks.
- Student takes responsibility for the sub-processes under student's management.
- Student acts independently and proactively in solving professional 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)	-
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)	-