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

BMEGEÁTNW19

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	coupled

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/BMEGEATNW19

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

The course introduces students to the field of vehicle aerodynamics. The student gains insight into the aerodynamics of streamlined and bluff bodies. After summarizing the basic knowledge of aerodynamics and a historical summary of vehicle aerodynamic developments, the aerodynamics of passenger cars, racing cars, buses and trucks and the ways to solve aerodynamic problems will be described in detail. Students will learn knowledge of vehicle aerodynamics wind tunnel measurement techniques and basics of CFD simulations. In the second half of the semester, groups of students perform a wind tunnel parameter analysis of the aerodynamic parameters of a self-designed and self-constructed car model and a flow visualization study of the flow field around the car model as part of a laboratory project task. In addition to acquiring theoretical knowledge, the evaluation and analysis of the results of laboratory measurements provide insight into the practical study of aerodynamic parameter change.

2.2. Learning outcomes

Competences that can be acquired by completing the course:

A. Knowledge

- The student is familiar with the concepts of the field of vehicle aerodynamics.
- The student knows the historical steps of vehicle aerodynamic developments.
- The student is aware of the characteristics of the flow space around bluff and streamlined bodies and the factors influencing aerodynamic characteristics.
- The student knows the derivation and calculation of aerodynamic forces, moments, and their coefficients.
- The student has a comprehensive knowledge of the possibilities of changing the aerodynamic parameters of cars, racing cars, buses and trucks, the theoretical and practical possibilities of modifications.
- The student knows the measurement methods, factors and parameters of wind tunnel measurement technology that are important from the point of view of vehicle flow, the main types, construction and operating principle of wind tunnels.
- The student is informed about the theoretical background of the corrections applied during the wind tunnel measurements, the method of calculation and the method of conversion to the real aerodynamic parameters.
- The student names the factors and parameters of vehicle numerical simulation (CFD) that are important from the point of view of vehicle flow, and the key issues that are important for modeling.
- The student defines the relationship between vehicle aerodynamic parameters and vehicle-specific aerodynamic performance losses, and how to calculate it.
- The student is informed about the current development directions, key issues and modern practical solutions of vehicle aerodynamics.

B. Ability

- The student uses the concepts of the field of vehicle aerodynamics.
- The student analyzes the major steps in the history of road vehicle aerodynamics.

- The student interprets the characteristics of the flow space around bluff and streamlined bodies and the factors influencing aerodynamic characteristics.
- The student is able to derive and calculate aerodynamic forces, moments and their coefficients.
- The student identifies the possibilities of changing the aerodynamic parameters of cars, racing cars, buses and trucks, the theoretical and practical possibilities of modifications.
- The student applies the measurement and evaluation methods of wind tunnel testing techniques that are important from the point of view of vehicle aerodynamics.
- The student determines the correction factors used in wind tunnel model testing and conversion to aerodynamic parameters of a real vehicle.
- The student is able to determine the factors and parameters of vehicle aerodynamics numerical simulation (CFD) that are important in this topic.
- The student calculates the vehicle-specific aerodynamic performance loss based on vehicle aerodynamic parameters.
- The student outlines current engineering solutions, key issues and state-of-the-art practical solutions for vehicle aerodynamics.

C. Attitude

- The student constantly monitors his work, results and conclusions.
- The students continuously expand their knowledge of vehicle aerodynamics.
- The student is open to the use of information technology tools.
- The student seeks to learn about and routinely uses a set of tools to solve vehicle aerodynamics problems.
- The students develop their ability to provide accurate and error-free problem solving, engineering precision and accuracy.
- The student strives for demanding engineering work and makes a decision based on careful consideration.
- The student monitors changes in the social, economic and political system.
- The student publishes his results in accordance with his professional rules.
- The student publishes its opinions and views without offending others.

D. Independence and responsibility

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

2.3. Teaching methodology

The teaching of the subject takes place in the framework of lectures and laboratory practice. The lectures basically introduce the students to the information determined by the knowledge competence elements using the technique of frontal education. The application and skill-level acquisition of knowledge takes place in laboratory exercises, where an issued project work has to be solved in groups, which also develops teamwork skills. The project work must be presented at the end of the semester.

2.4. Support materials

a) Textbooks

Aerodynamics of Road Vehicles (5th ed.), Editor Thomas SCHUETZ, SAE International, 2016, ISBN 978-0-7680-7977-7

Road Vehicle Aerodynamic Design - An introduction. (3rd ed.), RH Barnard, MechAero Publishing, 2009. ISBN 9 780954 073473

Race Car Aerodynamics: Designing for Speed (ed.), J. Katz, Bentley Publishing, 2006. ISBN 978-0-8376-0142-7

b) Lecture notes

Suda Jenő Miklós: Vehicle Aerodynamics, lecture notes, 2021, Budapest

Suda Jenő Miklós: Vehicle Aerodynamics, Lab session guidelines, 2021, Budapest

c) Online materials

http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATNW19

2.5. Validity of the course description

Start of validity:	2020. March 3.
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 a mid-year written summary performance measurement as well as a partial performance measurement. Summative academic performance appraisal is a complex, written way of assessing the knowledge and ability type competence elements of the subject in the form of an in-house dissertation, which requires the necessary lexical knowledge during the performance appraisal, the available working time is 90 minutes. Partial performance evaluation (laboratory measurement, evaluation and presentation of results): a complex way of evaluating the knowledge, ability, attitude, and independence and responsibility type competence elements of a subject, the form of which is the group measurement task and measurement presentation.

3.2 Assessment methods

A. Detailed description of mid-term assessments

1. Mid-term assessment

type: summative assessment

count: 1

purpose, description: Summative assessment collectively examines and measures students 'learning outcomes defined by knowledge and ability type competencies. Accordingly, the summative assessment assesses the acquisition of the designated theoretical knowledge and the ability to apply the knowledge and apply it to the computational tasks. They will be completed on the date specified in the academic performance evaluation plan, expected to be the 13th week of education. 50 points can be obtained in the summary performance evaluation.

2. Mid-term assessment

type: formative assessment, simple

count: 1

purpose, description: The basic goal of partial performance assessment is to examine the existence of attitudes and learning outcomes belonging to the autonomy and responsibility competence group. The way to do this is to create, evaluate and present a project task that can only be created in groups. Assignments and the assignment of groups of up to 4 people must be finalized by the third week of education. The content and form requirements and evaluation principles of the measurement task to be performed are included in the measurement manual. It will be completed on the date specified in the academic performance evaluation plan. It is anticipated that the wind tunnel measurements of the measurement groups will be shown in Figures 11-13. during the school weeks at a time outside the timetable, the measurement presentation will take place at the last 14th week lecture. A maximum of 50 points can be obtained with the measurement task.

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	50 %

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 **85% 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

Can the submitted and accepted partial performance assessments be resubmitted until the end of the replacement period in order to achieve better results?

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:

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

Completion of unfinished laboratory exercises:

missed laboratory practices may be performed in the teaching term at pre-arranged appointment, non-mandatory

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
elaboration of a partial assessment task	4
additional time required to complete the subject	14
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 theoretical and practical knowledge and methodological skills to design, manufacture, model, operate and manage complex engineering systems and processes
- Student has the knowledge of the scientific theories (mathematical, mechanical, fluid mechanics, thermal and electronic) and computational methods relevant to mechanical engineering research and development.
- 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.
- Student has the ability to plan and carry out tasks independently and to a high professional standard.
- Student has the ability to learn, develop and improve own knowledge.

c) attitude

- Student shall strive for continuous self-training in engineering modelling and in other fields related to student's work, in accordance with student's professional objectives.
- Student has the ability to plan and carry out tasks to a high professional standard, either independently or in a team.
- 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.
- Student has the ability to take responsibility for managing the professional work of a small or large group.
- Student independently selects and applies relevant problem-solving methods when solving professional tasks.

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)	-