SUBJECT DATASHEET

I. SUBJECT DESCRIPTION

1. GENERAL DATA

1.1. Subject name (in Hungarian, in English)

Laser-Optical Flow Measurements ● Laser-Optical Flow Measurements

1.2. Neptun code

BMEGEÁTNG39

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/BMEGEATNG39

1.10. Course language

hungarian

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 modern laser-optical flow measurement procedures. They gain insight into the working principle of LDA, PDA, PIV and PTV(S) measurement techniques. They learn about their advantages/disadvantages, from the lasers used to particle dynamics (seeding/tracer problematic) considerations to signal processing and evaluation. After a summary of the basics and a historical summary of the laser-optical measurement methods, they will be described with the help of each measurement method, sometimes with the help of invited speaker(s). In the second half of the semester, students prepare an independent homework assignment of laser-optical flow measurement as part of a project assignment. In addition to putting theoretical knowledge into practice, evaluating the results of self-measurement and calculating measurement uncertainty is an excellent opportunity to compare laser-optical measurement techniques with other flow measurement methods.

2.2. Learning outcomes

Competences that can be acquired by completing the course:

A. Knowledge

- The student is familiar with the concepts in the field of laser-optical flow measurement.
- The student knows the historical steps in the development of laser-optical measurement methods.
- The student is aware of the advantages/disadvantages of laser optical flow measurement, its general characteristics and the factors influencing the measurement.
- The student is familiar with the derivation and calculation of the expression of the flow rate (or particle sizes in the case of PDA and PTV(S)) measured using the measurement techniques discussed.
- The student has a comprehensive knowledge of the operating principle of laser light sources, their parameters influencing their measurement accuracy, and their theoretical and practical possibilities.
- The student knows the measurement criteria, influencing factors, and parameters important for laser-optical flow measurement methods, the main types, structures, and operating principles of measurement techniques.
- The student is informed about the extended equations of motion for the primary (carrier) phase, taking into account the effect of the particles introduced into the flow, about the parameters of the primary phase important from the point of view of measurement technology, and how to calculate them.
- The student is informed about the secondary (dispersed) particulate phase. The basic equation of particle dynamics, the metrologically important parameters of the particles introduced into the flow, and the method of their calculation.
- The student defines the formulas of the main parameters and characteristic numbers for turbulence modification and seeding/trace problematics in particle-laden flows, the method of calculation and the correlations and relationships between them.
- The student is informed about the advantages/disadvantages, application areas, development directions, key issues and state-of-the-art practical solutions of laser-optical flow measurement.

B. Ability

- The student uses the concepts of the field of laser-optical flow measurement.
- The student analyzes the major steps in the history of laser-optical flow measurement.
- The student interprets the characteristics of laser-optical flow measurement techniques and the factors influencing them.
- The student is able to analyze the connection between the measured signal and flow velocity (and particle size for PDA and PTV(S)) for the various measurement techniques.
- The student identifies the characteristics of laser light sources used in measurement techniques and their theoretical and practical significance in terms of flow measurement accuracy.
- The student applies the fundamental measurement and evaluation methods of laser-optical measurement techniques.
- The student determines the correction factors and particle dynamics parameters used in laser-optical measurements, taking into account the effect of the particles introduced into the flow.
- The student is able to determine the factors and parameters of the seeding/tracer problematics for the primary and secondary phase, and to evaluate the measurement results based on them.
- The student is able to calculate the seeding/tracer parameters based on the parameters of the carrier and particulate phases and is able to make corrections to the measured results.
- The student outlines up-to-date engineering solutions for laser-optical measurement techniques, key issues in terms of advantages/disadvantages, and state-of-the-art practical solutions.

C. Attitude

- The students constantly monitor their work, results and conclusions.
- The students continuously expand their knowledge of state-of-the-art laser-optical flow measurement.
- The student is open to the use of information technology tools.
- The student seeks to understand and routinely use the equipment required to solve laser-optical flow measurement 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 students publish their results in accordance with his professional rules.
- The students publish their 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, well-founded 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 systems 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 practices, where a published project work has to be solved individually / in groups, which teaches self-employment and also develops teamwork skills. The project work must be presented at the end of the semester.

2.4. Support materials

a) Textbooks

Springer Handbook of Experimental Fluid Mechanics (Eds .: Tropea, Yarin, Foss), Springer-Verlag, 2007, ISBN 978-3-540-25141-5

Particle Image Velocimetry - A Practical Guide (Raffel, Willert, Scarano, Kähler, Wereley, Kompenhans) Springer-Verlag, 2018, ISBN 978-3-319-68851-0

Laser Doppler and Phase Doppler Measurement Techniques (Albrecht, Damaschke, Borys, Tropea), Springer-Verlag, 2003, ISBN 978-3-540-67838-0

b) Lecture notes

Jenő Miklós Suda: Laser-optical flow measurement, lecture note, 2019, Budapest

c) Online materials

http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATNG39

2.5. Validity of the course description

Start of validity:	2020. March 3.
End of validity:	2024. August 31.

II. SUBJECT REQUIREMENT

3. ACHIEVEMENT CONTROL AND EVALUATION

3.1 General rules

Learning outcomes are assessed on the basis of a mid-term tests (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, as well as independence and responsibility type competence elements of the subject, the form of which is the individual / 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 aim of the 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 expected that the measurements of the measurement groups will be shown in Figures 7-13. during the school weeks at an off-schedule time, 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 **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

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. August 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

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 metrology and measurement theory in the field of mechanical engineering.
- Student has the detailed knowledge of the rules for the preparation of technical documentation.

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 deal with problems creatively, to solve complex problems in a flexible way, and to engage in lifelong learning and commitment to diversity and value-based approaches.

c) attitude

- Student strives to meet and enforce quality standards.

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

d) independence and responsibility

- Student has the ability to work independently on engineering tasks.
- Student takes initiative in solving technical problems.
- Student takes responsibility for the sub-processes under student's management.

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)	-