

2011.02.07. for Academic Year 2010/2011, Semester 2 (Spring)

Budapesti Műszaki és Gazdaságtudományi Egyetem
Gépészmérnöki Kar
Áramlástan Tanszék
Mechanical Engineering Modelling (MSc)
Fluid Mechanics major (MSc)

Budapest University of Technology and Economics (BME)
Faculty of Mechanical Engineering
Department of Fluid Mechanics (DFM)
Mechanical Engineering Modelling (MSc)
Fluid Mechanics major (MSc)

Flow Measurements

I.	Code (kód)	Semester (szemeszter)	Requirements (követelmények)	Credit (kredit)	Language (nyelv)
	BMEGEÁTMW03	1.	lect./sem./lab. (exam / pract. / signat.) 2/1/1 (p)	5	English

2. Responsible person and Department (Tantárgyfelelős személy és Tanszék):

Name (Név):	Status (Beosztás):	Department (Tanszék):
Dr. János VAD	associate professor	Dept. Fluid Mechanics

BME, DFM, (Bdg. "Ae"), 1111 Budapest, Bertalan L. u. 4 - 6.

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3. Lecturer (Tantárgy előadó(k)):

Name (Név):	Status (Beosztás):	Department (Tanszék):
Dr. János VAD*	*associate professor,	Dept. Fluid Mechanics
Dr. Tamás RÉGERT*	*associate professor,	Dept. Fluid Mechanics
Dr. Jenő Miklós SUDA**	**assistant professor,	Dept. Fluid Mechanics
Márton BALCZÓ***	***research assistant,	Dept. Fluid Mechanics
Csaba HORVÁTH****	****university assistant	Dept. Fluid Mechanics

4. Thematic background of the subject (A tantárgy az alábbi témakörök ismeretére épít):

Fundamentals of Fluid Mechanics

5. Compulsory / suggested pre-requisites (Kötelező/ajánlott előtanulmányi rend):

	Subject name (tárgynév)	Code (tárgykód)
Compulsory:	-	-
Suggested:	Fluid Mechanics	BMEGEÁTAG01 or BMEGEÁTAE01 or BMEGEÁTAM01 or BMEGEÁTAT01 or BMEGEÁTMF03

6. Main objectives of the subject (A tantárgy célkitűzései):

Getting acquainted with the measurement principles, application areas, advantages and limitations of various flow measuring techniques applied in industrial practice as well as in R&D related laboratory activities. Getting skill in solution of measurement-related industrial problems via case studies. Acquiring basic skill in carrying out flow measurements.

7. Detailed thematic description of the subject (A tantárgy részletes tematikája) (tentative, to be agreed):

Interactive Presentations

Date: Mondays, 12.15 – 14.00, **Venue:** DFM (Bdg. Ae), First Floor, classroom at the end of the corridor (Mérlegterem) + DFM Departmental Laboratory

Week 1: Introduction. The need for flow measurements. Practical / industrial necessity of flow measurements in general. Quantities to be measured. Aspects of „being advanced”. Special notes on advanced flow measurements.
Week 2: Measurement of temporal mean pressures: static, total, dynamic. Probes and methods. Manometers. Pressure-based measurement of velocity magnitude and direction. Anemometers, thermal probes. Temperature measurements.
Week 3: Measurement of unsteady pressures. Sound and vibration measurements. Hot wire anemometry. Flow visualization.
Week 4: Laboratory display: Devices for pressure, velocity and temperature measurements. Pneumatic measurements (pressure, temperature, flow rate). Electro-pneumatic systems.
Week 5: Flow rate measurements with use of contraction elements and deduced from velocity data. Comparison.
Week 6: Introduction to the theory, application, and measurement of fluid machinery (turbomachinery).
Week 7: Mid-term exam I – Part A: closed book test (theory), Part B: open book test (solution of practical problems).
Week 8: Easter holiday
Week 9: Specialised flowmeters: ultrasonic, MHD, capacitive cross-correlation technique, Coriolis. Laboratory display: measurements on cooling fans of electric motors.
Week 10: Specialised flowmeters: vortex, rotameter, turbine, volumetric. Laboratory display: Ultrasonic flowmetry, MHD flowmetry, rotameters, turbine flowmeters.
Week 11: Optical flow visualization. Introduction to lasers applied to optical flow diagnostics. Laser optical flow measurements. Laser Doppler Velocimetry (LDV).
Week 12: Phase Doppler Anemometry (PDA). Particle Image Velocimetry (PIV). Stereo PIV.
Week 13: Hot wire anemometry. CTA.

Week 14: Mid-term exam 2 – Part A: closed book test (theory), Part B: open book test (solution of practical problems) Interactive seminars (Industrial case studies, ICS, with optional lab displays) + laboratory exercises Date: Mondays, 14.15 – 16.00, Venue: as for Interactive Presentations + DFM Departmental Laboratory
Week 1: ICS: Fault diagnostics of the air supply system of a gas motor power generator. Development of a dynamic fire extinguishment method. Survey on the air technical system of a pet food production plant.
Week 2: ICS: Optimization of a mineral wool production process. Development of an axial fan of long throw. Visualisation of water coning in the model of an oil production well - Laboratory display
Week 3: ICS: Proposal for noise reduction of an aerobic waste water treatment system. Investigation on a wood chip drying tower. Noise reduction of an airfoil by means of acoustically soft coating.
Week 4: ICS: Optimization of a pharmaceutical fermentation process. Measurement and simulation of an electro-pneumatic brake modulator. Vibration diagnostics on a boiler combustion air supply fan.
Week 5: ICS: Fluid mechanical survey of a gas turbine power plant. Measurements on a silencer built in a cement industry flue gas duct. Investigation of the cooling process applied in sheet metal industry.
Week 6: ICS: Development of a standardised axial fan test facility for testing industrial fans. Testing a wind tunnel via ad hoc measurements. Fluid mechanical survey of a combustion air supply fan of a thermal power plant. Extension of a food industry cooler system. ICS: Survey on a heat power measurement method in a remote heating system. Study on the effect of flow rate measurement noise in a natural gas supply line. Reconstruction of the pump system of a chemical industrial reservoir park. Testing compressors used in air conditioners.
Week 7: Preparation for the laboratory measurements. Laboratory measurements 1.
Week 8: Easter holiday
Week 9: Laboratory measurements 2.
Week 10: Laboratory measurements 3.
Week 11: Practical case studies related to optical flow diagnostics.
Week 12: (Visit to the laboratory of Institute of Physics, Eötvös Loránt University of Science. PIV measurements.) Laboratory display: Laser operation. Laser Doppler Anemometry. Fuel pump PIV.
Week 13: Laboratory display: Wind tunnel techniques. Hot wire anemometry. CTA.
Week 14: Presentation of laboratory measurement results. Evaluation of the course.

8. Mode of education of the subject (A tantárgy oktatásának módja):

Interactive presentations; interactive seminars; laboratory displays and exercises.

9. Requirements (Követelmények):

- 2 written mid-term tests. Maximum achievable scores: $2 \times 30 = 60$ scores.
- Scores for real-time contribution to interactive problem solving. Maximum achievable scores: 20 scores.
- Laboratory report - maximum achievable scores: 10 scores. Submission of report: within 2 calendar weeks of measurement. No repeated laboratory measurement is offered. Absence from the labs is acceptable only with written medical document.
- Presentation of laboratory results: - maximum achievable scores: 10 scores. No repeated presentation is offered. Absence from the presentation is acceptable only with written medical document.

Pre-requisite for achievement of the subject: min. 40 % obtained out of the part-scores, for each item.

Total: 100 scores.

10. Consulting opportunities (Konzultációs lehetőségek):

Mondays, 16.15 – 17.00, Dr. János VAD

11. Reference literature (Jegyzet, tankönyv, felhasználható irodalom):

- Website of the subject: <http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATMW03>
- Compulsory literature: Vad, J. (2008), *Advanced flow measurements*. Műegyetemi Kiadó, 45085. ISBN 978 963 420 951 5.

12. Home study required to pass the subject (A tantárgy elvégzéséhez szükséges tanulmányi munka):

3 hours / week.

13. The data sheet and the requirements are prepared by (A tantárgy tematikáját kidolgozta):

Budapest, 7th of February 2011

<i>Name (Név):</i>	<i>Status (Beosztás):</i>	<i>Department (Tanszék):</i>
Dr. János VAD	associate professor	Dept. Fluid Mechanics