

2009.02.09. for Academic Year 2008/2009, Semester 2 (Spring)

Budapesti Műszaki és Gazdaságtudományi Egyetem  
Gépészmérnöki Kar  
Áramlástan Tanszék  
Integrated Engineering MSc

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

## Advanced Flow Measurements (Korszerű áramlásmérés)

I.	Code (kód)	Semester (szemeszter)	Requirements (követelmények)	Credit (kredit)	Language (nyelv)
	BMEGEÁTIE01	1.	lect./sem./lab. (exam / pract. / signat.) 2/0/0 (e)	3	English

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

Name (Név):	Status (Beosztás):	Department (Tanszék):
Dr. János VAD	associate professor	DFM

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*, Jenő Miklós SUDA** Márton BALCZÓ***	*assoc. prof., **assist. prof., ***res. assist.	DFM

### 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:	Áramlástan	BMEGEÁT3030
Suggested:		-

### 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. The course is illustrated by laboratory displays and industrial case studies.

### 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)

<b>Week 1:</b> 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.
<b>Week 2:</b> 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.
<b>Week 3:</b> Measurement of unsteady pressures. Sound and vibration measurements. <b>Laboratory display:</b> Devices for pressure, velocity and temperature measurements. Pneumatic measurements (pressure, temperature, flow rate). Electro-pneumatic systems.
<b>Week 4:</b> Hot wire anemometry. Flow visualization. Introduction to lasers applied to optical flow diagnostics.
<b>Week 5:</b> Laser optical flow measurements. Laser Doppler Velocimetry (LDV). Phase Doppler Anemometry (PDA). Particle Image Velocimetry (PIV).
<b>Week 6:</b> <b>Laboratory display:</b> Wind tunnel techniques. Hot wire anemometry. Laser operation. Laser Doppler Anemometry.
<b>Week 7:</b> <b>Mid-term test 1</b> – Part A: closed book test (theory), Part B: open book test (solution of practical problems)
<b>Week 8:</b> Flow rate measurements with use of contraction elements and deduced from velocity data. Comparison.
<b>Week 9:</b> Specialised flowmeters: ultrasonic, MHD, capacitive cross-correlation technique, Coriolis.
<b>Week 10:</b> Easter holiday
<b>Week 11:</b> Specialised flowmeters: vortex, rotameter, turbine, volumetric.
<b>Week 12:</b> <b>Laboratory display:</b> Ultrasonic flowmetry, MHD flowmetry, rotameters, turbine flowmeters.
<b>Week 13:</b> <b>Mid-term test 2</b> – Part A: closed book test (theory), Part B: open book test (solution of practical problems)
<b>Week 14:</b> The complementary characters of flow measurements and Computational Fluid Dynamics. Industrial case studies.

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

Interactive presentations, laboratory displays.

**9. Requirements (Követelmények):**

- 2 written mid-term tests. Maximum achievable scores:  $2 \times 20 = 40$  scores.
- Premium scores for contribution to the interactive presentations. (to be considered in the final mark)
- Written examination. Maximum achievable scores: 60 scores.

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):**

Thursdays, 12.15 – 13.15, Dr. János VAD

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

- Website of the subject: <http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATIE01>
- 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):**

2 hours / week.

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

Budapest, 9<sup>th</sup> of February 2009

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