FLUID MECHANICS B. Sc. **Semester 2009 / 2010 / 1**

Planned thematics

W	Date 2008	Topics	Problems to be solved at home after the Lect
(1.)	Lect 1 09 Sep	Definition of Fluid Mechanics. Properties of fluids. Newton's law of viscosity. Gas, steam, liquid. Universal gas law. Tension curve. Cavitation, cavitation erosion. Comparison of gases and liquids.	5.1., 5.15.
	Lect 2 10 Sep	Conference on Modelling Fluid Flow (CMFF'09). Final Programme: www.cmff.hu. Join the Opening Plenary Session, then select a session, according to your interest, out of WS1, IF2, MP, or EF1. The lunch is for registered participants only.	
(2)	Lect 3 16 Sep	Ideal and realistic fluids. Physical quantities (scalar: density, pressure, temperature; vector: velocity). Surface element vector. Volume flow rate, mass flow rate. Mathematical background. Scalar field, vector field. Gradient vector of a scalar quantity, properties of gradient vector. Derivative tensor of a vectorial quantity.	
(3)	Lect 4 23 Sep	Hydrostatic equation: differential and integral form. Force fields (potential: gravity, inertial, centrifugal; non-potential: Coriolis). Example: vertically accelerating elevator. Example: industrial centrifuge.	1.1., 1.2., 1.3., 1.4., 1.5., 1.8., 1.9., 1.10., 1.11., 1.12., 1.13., 1.14., 1.20.
	Lect 5 24 Sep	Kinematics. Lagrangian and Eulerian description. Pathline, streakline, streamline, stream surface, stream tube. Steady, unsteady, quasi-steady flow. Dependence of flow pattern on the selection of the coordinate system (boat). Integral form of continuity equation. Continuity for a stream tube. Possibilities for simplification. Example: Compressor.	2.1.
(4)	Lect 6 30 Sep	Continuity in a pipe, velocity profile. Divergence. Gauss-Ostrogradsky theorem. Rotation. Stokes theorem. Differential form of continuity equation. Possibilities for simplification: steady flow, constant density.	2.3.
(5)	Lect 7 07 Oct	Free vortex. Dynamics. Euler equation. Fluid acceleration. Transformation of term of convective acceleration. Bernoulli equation. Simplifying assumptions. Example: water stealing. Euler equation in natural coordinate system.	3.1., 3.2., 3.3., 3.4., 3.6., 3.8., 3.14.
	Lect 8 08 Oct	Static, dynamic, total pressure and their measurement. Pitot probe, Prandtl probe. Volume flow rate measurements using contraction elements and deduced from velocity measurement.	1.19., 3.5., 3.15., 3.16.
(6)	Lect 9 14 Oct	Comparison of flow rate measurement methods, practical examples. Unsteady Bernoulli equation. Radial fan, Euler equation for turbomachines.	3.9., 3.10., 3.11., 3.12., 3.13.
(7)	Lect 10 21 Oct	Linear momentum equation. Solid body within the control volume. Example: force acting on a plate by a water jet.	4.1., 4.2., 4.3., 4.4., 4.5., 4.6., 4.8., 4.10., 4.14., 4.15., 4.17.,
	Lect 11 22 Oct	Borda outflow orifice. Contraction. Borda-Carnot loss. Pelton turbine. Coanda effect.	4.9., 4.11., 4.12., 4.13., 4.16., 4.18., 4.19., 4.20.
(8)	Lect 12 28 Oct	Heater. Confuser, diffuser. Blade cascade, Kutta-Joukowsky theorem Propulsion theory. Angular momentum equation.	4.15.
(9)	Lect 13 04 Nov	Viscous fluids. Non-Newtonian fluids, rheology. Navier-Stokes equation. Laminar flow in a pipe.	
	Lect 14 05 Nov	Similarity of flows. Dimensionless similarity quantities and their interpretation. Hydraulics. Bernoulli equation extended to hydraulic losses. Pipe friction loss.	
(10)	Lect 15 11 Nov	Dimensional analysis. Pipe friction coefficient. Reynolds experiment, laminar and turbulent pipe flow. Rough pipes, sand roughness, Nikuradse diagram. Moody diagram. Hydraulically smooth pipes.	5.2., 5.3., 5.4., 5.5., 5.6., 5.7., 5.8., 5.9., 5.10.5.11., 5.12.
(11)	Lect 16 19 Nov	Pipes with non-circular cross-section. Open surface channels. Concentrated hydraulic losses: BC, outlet, diffuser, bend, elbow, valve, inlet.	
(12)	Lect 17 25 Nov	Examples in hydraulics: oil lubrication system, air supply system, flow from-tank-to-tank by iteration.	5.13., 5.14., 5.16. 5.17.
(13)	Lect 18 02 Dec	Description of turbulent flows. Boundary layers and their effects. Fluid mechanical forces acting on bodies: cylinder, airfoil.	
	Lect 19 03 Dec	Gas dynamics. Energy equation. Stagnation temperature meter. Bernoulli equation for compressible fluids. Sound speed for gases and solids.	6.7., 6.8., 6.9., 6.10.
(14)	Lect 20 09 Dec	Discharge of an air reservoir through a simple circular orifice, at various pressure ratios. Flow in a Laval nozzle.	6.1., 6.2., 6.3., 6.4., 6.5., 6.6. 6.11.

FLUID MECHANICS B. Sc. BMEGEÁTAG01
Semester 2009/ 2010 / 1
Departmental web site: http://www.ara.bme.hu/english/DOWNLOAD

Schedule:

- **Interactive presentation**

Wednesday 14.15 – 16.00 every week; Thursday 10.15 – 12.00 every odd week; Room D316B
The theoretical background of Fluid Mechanics is presented by the Lecturer. "Lecture Notes in Fluid Mechanics" are available on the web site.
It is strongly recommended for the students to prepare themselves for the interactive presentation using the previous lecture notes. Guided by the Lecturer, the students contribute **voluntarily** in the discussion of the problems. Students of valuable contribution get one premium score per right answer, being collected on a personal data sheet.

- **Excercise: Interactive problem solving**

Friday 12.15 – 14.00; Room D316A
Industry-related and other practical problems are solved by the students in team, supervised by the Exercise Leader.
It is strongly recommended for the students to prepare themselves for the interactive presentation using the previous lecture notes and problem solving notes. Guided by the Lecturer, the students contribute **obligatorily** in the solution of the problems. Students of valuable contribution get one premium score per right answer, being collected on a personal data sheet.

- **Mid-term exams**

Two closed-book mid-term exams, containing simplified numerical problems to be solved, are to be written obligatorily during the semester. Duration: 70 minutes. The students must prepare themselves **individually** at home with use of “Selected Problems in Fluid Mechanics” available on the web site. Preliminary consultation is available. Solution of the problems will be announced after the mid-term exam. Obtainable maximum scores per mid-term exam: 15. Precondition for achievement of the semester: to obtain at least 40 percent of maximum obtainable scores (12 scores total).
- 1st Mid-term exam: on the excercise on the **6th week**
- 2nd Mid-term exam: on the excercise on the **12th week**

- **Laboratory measurements (preliminary information, to be refined on the Excercise)**

Friday 12.15 – 14.00
3-person lab groups are to be formed. Each group has to carry out 3 lab excercises at the Departmental Laboratory. Duration of each excercise: 2 X 45 minutes. The group leaders (different persons from the same group for each excercise) must submit a report on the measurements. The group leader may obtain a maximum number of 15 scores for the report. The lab personnel (the 2 other persons) obtain the 1/6 of scores received by the group leader. (Total maximum scores out of lab excercises: 20). Precondition for achievement of the semester for the group leader: to obtain at least 40 percent of the 15 scores obtainable for the report of the measurement coordinated (6 scores). The schedule for the Labs will be agreed during the semester.
- [lab_report_cover.doc] [htm] Laboratory Reports **must** be submitted in a given format.
- [lab_report_directives.doc] [htm] All necessary instructions for preparing the Laboratory Report are given in this document! Check it before preparing/submitting your Report!

- **Examination**

Thematics for the written examination: to solve complex numerical problems. Duration: 120 minutes. Obtainable maximum scores: 50. Precondition for achievement of the semester: to obtain at least 40 percent of maximum obtainable scores (20 scores).

Evaluation

Obtainable maximum scores

Mid-term exams	30
Lab reports	20
Examination	50
Premium scores	+++
TOTAL	**100**

The premium scores will be used to improve the mark (1 grade improvement is possible), and/or to make up the missing scores necessary to obtain the required minimum 40 percent for the mid-term and final exams – depending upon the decision of the subject responsible.

Scores	**Mark**	
scores < 55	passed	(2)
55 ≤ scores < 70	satisfactory	(3)
70 ≤ scores < 85	good	(4)
85 ≤ scores 100	excellent	(5)

Budapest, on 07 September 2009

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