Budapesti Műszaki és Gazdaságtudományi Egyetem

Budapest University of Technology and Economics

Gépészmérnöki Kar

Faculty of Mechanical Engineering

Áramlástan Tanszék

Department of Fluid Mechanics

Mechanical Engineering Modelling (MSc)

Mechanical Engineering Modelling (MSc)

Fluid Mechanics major (MSc)

Fluid Mechanics major (MSc)

Large-Eddy Simulation in Mechanical Engineering
(Nagy örvény szimuláció a gépészetben)

1.	Code (kód)	Semester (szemeszter)	Requirements (követelmények)	Credit (kredit)	Language (nyelv)
	BMEGEÁTMW05	3.	lect./sem./lab. (**exam** / **p**ract. / **signat**.) 1/1/0 (p)	3	English

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

Name (név):	Status (beosztás):	Department (tanszék):
Dr. Gergely KRISTÓF	associate professor	Dept. Fluid Mechanics

3. Lecturer (A tantárgy előadója):

Name (név):	Status (beosztás):	Department (tanszék):
Máté Márton LOHÁSZ	assistant professor	Dept. Fluid Mechanics

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

Basics of turbulence theory.

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

	Subject name (tárgynév)	Code (tárgykód)
Compulsory pre-requisites:	-	-
Suggested pre-requisites:	-	-

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

To get familiar with the concept of Large-Eddy Simulation, its widely used techniques. A secondary objective is to gain knowledge about post-processing techniques specially suited for instantaneous and steady 3D flow data. Applications from turbulent heat transfer and noise production will be shown.

7. Detailed thematic description of the subject (A tantárgy részletes tematikája):

Motivations why to use Large-Eddy Simulation (LES).

Filtering of the incompressible Navier-Stokes equations, basic filter properties.

Numerical requirements of the simulation.

Subgrid scale modelling approaches.

Interacting error dynamics.

Practical aspect of the simulation (domain time and mesh requirements).

Special LES boundary conditions: inlet turbulence generation.

Hybrid and zonal LES/RANS approaches.

Postprocessing of LES results: flow topology description, vortex detection methods.

Case studies: internal cooling channel, flow around an airfoil, near field of a jet.

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

The theory will be tough in the form of lectures.
Tutorials are prepared to enable the students to carry out a Large-Eddy Simulation on their own. Typical test cases are prepared to enable the student to easily experiment on simulation parameters or to gain experience in post-processing the results.

9. Requirements (Követelmények):

2 homeworks (both documented and presented) and 2 written midterm exams.
1st exam: 7th week (not in the time of the lecture) (delayed submission one week later with 20% penalty)
2nd exam: 14th week (not in the time of the lecture) (delayed submission one week later with 20% penalty)

1st homework: 10th week
2nd homework: 13rd week
Presentation of the homeworks: 14th week

10. Consulting opportunities (Konzultációs lehetőségek):

Two consultation for each homework (2 and 1 weeks before submission) and one for each exam (two days before the exam).

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

– Website of the subject: http://www.ara.bme.hu/oktatas/tantargy/NEPTUN/BMEGEATMW05

-Lesieur, M.; Métais, O. & Comte, P. Large-Eddy Simulations of Turbulence Cambridge University Press, 2005
-Pope, S.B. Turbulent Flows, Cambridge University Press, 2000
-Sagaut, P. Large Eddy Simulation for incompressible Flows. An Introduction Springer, 2002
-Geurts, B.J. Elements of direct and large-eddy simulation R.T. Edwards, Inc., 2003

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

2 homeworks including report writing and presentation.

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

Budapest, 5th of January 2009

Name (név):	Status (beosztás):	Department (Tanszék):
Máté Márton LOHÁSZ	assistant professor	Dept. Fluid Mechanics