UUT511E Advanced Fluid Mechanics
İstanbul Technical University Aerospace Engineering Dept.
Fall 2005

Instructor : Yrd.Doç.Dr.Melike Nikbay Bayraktar
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Classroom: UUB D110
Office Hour: Thursday 12:00-3:00pm
(Except urgent cases, students are required to ask for appointment to have a meeting other than these hours.)

Textbook : Currie, I.G., " Fundamental Mechanics of Fluids", 3rd edition, Marcel Dekker Inc, 2003 (ISBN:0-8247-0886-5)

Contents:

Part I: Governing Equations

1) Basic Conservation Laws

Eulerian and Lagrangian descriptions of motion. Conservation of mass, momentum and energy. Rate of displacement, rotation and deformation tensors. Constitutive relations.

2) Flow kinematics

Pathlines, streamlines, streaklines, vorticity lines

3) Special Forms of the Governing Equations

Helmholtz theorems, Kelvin's theorem, Crocco's theorem.

Part II: Ideal-Fluid Flow

4) Two Dimensional Potential Flow

Complex potential. Blasius theorem, Conformal transformations. General Joukowskii transformation, Schwarz-Christoffel transformation,

5) Three-dimensional Potential Flows

D'Alembert's paradox. Apparent mass.

Part III Viscous Flows of Incompressible Fluids

6) Exact Solutions

Couette, Stokes and stagnation point flows

7) Low-Reynolds-Number Solutions

Stokes and Oseen solutions

8) Boundary Layers

Blasius Solution, Falkner-Skan Solutions, Karman-Pohlhausen Approximation

Reference Books:

- Panton, R.L., "Incompressible Flow", 2nd edition, John Wiley & Sons Inc., 1996 (ISBN: 0-471-59358-3)
- Kundu, P.K., "Fluid Mechanics", Academic Press Inc., 1990 (ISBN: 0-12-428770-0)
- Chorin, A.J. and Marsden, J.E., "A Mathematical Introduction to Fluid Mechanics", 3rd edition, Springer, 1998 (ISBN 0-387-97918-2)

Grading:
Quiz: % 15 (around 4)
Homework: %15 (around 6)
Midterm 1: %20 (November 10th) (in class)
Midterm 2: %20 (December 8th) (in class)
Final Project: %30 (January Final Exam day)(paper & presentation)

Please note that:

- Attendance to class is not obligatory but may be used as a bonus point in your final grade.
- You may have pop-up quiz in this class. You are responsible to bring your textbook and calculator to each class.
- You are responsible to submit organized, clean and clear homework written by a "pen". You should present intermediate formulas, explain computations, underline your final result, otherwise 20 points will be deducted from each messy and unclear homework. You should always present the questions attached to the homework sheet.
- Some of the homeworks may need programming knowledge. Matlab is preferred as a programming and graphics language.
- You will have regularly some reading assignments from your textbook.
- You are responsible to check your emails regularly since some class announcements and homeworks may be sent via email.
- You are responsible to check class webpage for some class announcements from http://atlas.cc.itu.edu.tr/~nikbay/

Prepared by:
Yrd.Doç.Dr. Melike Nikbay-Bayraktar (19.9.2005)