ME 542: Advanced Fluid Mechanics MW 4-6 PM PHO 210

Instructor: Dr. Tyrone M. Porter Office: ENG 319 Office Hour: Fri 4-5 pm or by appointment Email: tmp@bu.edu

Required Textbook/Course website:

Panton, Ronald L. Incompressible Flow, 4th edition, John Wiley and Sons, Inc.

Supplemental Textbooks

Batchelor, G.K. *An Introduction to Fluid Dynamics*, Cambridge University Press. Landau, L.D. and Lifshitz, E.M. *Fluid Mechanics*, Oxford: Pergamon. Lighthill, J. *Waves in Fluids*, Cambridge University Press.

Topics to covered:

- Basic laws/fundamental equations in fluid mechanics: continuity equation, momentum equation (Navier-Stokes equations), energy equation
- Analytical and numerical solutions of the Navier-Stokes equations for Newtonian fluids
- Streamfunctions and velocity potential
- Flows at low and moderate Reynolds numbers
- Boundary layers

Computational Packages:

COMSOL will be featured in the course. Additionally, the textbook does provide MATLAB-based examples and problems related to differential analysis of incompressible flow. There are computer labs with the software uploaded (*i.e.* 3rd floor computer lab in 110 Cummington Mall). Simulations will be used to visualize stress and flow fields within an incompressible fluid

Scheduled lectures:

Lectures 1-3: Review of vector calculus/index notation, basic laws in fluid dynamics, and Navier-Stokes (chapters 3 & 5)

Lectures 4-6: Some solutions to the Navier-Stokes Equations (chapters 7 and 11)

Lectures 7-9: Streamlines and velocity potential (chapter 12)

Lectures 10-13: Flows at low and moderate Reynolds numbers (chapters 14 & 21)

Lectures 14-15: Vorticity dynamics (chapter 13)

Lectures 16-19: Ideal flows in a plane and boundary layers (chapters 18 & 20)

Lecture 20: Dimensional Analysis (chapter 8)