ME610 – Boundary Layer Theory

Spring 2012

Course Syllabus

Objectives

- Provide a general review of basic concepts, physics and mathematical descriptions of viscous flow;
- Introduce Navier-Stokes equations and some of the exact solutions;
- Understand the boundary layer model and different analytic methods;
- Introduce flow instability and transition from laminar flow to turbulence;
- Introduce turbulence and modeling;
- Introduce advanced topics in applied fluid mechanics.

Prerequisite

ME610 must be preceded by an undergraduate course in fluid mechanics or aerodynamics (ME309 or equivalent) and should be preceded by an intermediate course in fluid mechanics (ME509, or equivalent), as well as engineering mathematics.

Meeting Time

Mon/Wed/Fri 12:30-1:20pm, ME 2053

Instructor

Prof. Jun Chen

Office: ME 2145 / CHAF 129

Phone: 765-494-7050 Email: junchen@purdue.edu

Office Hour

Wed/Fri 1:30-2:30pm (appointment preferred)

Textbook*

- Schlichting, H. and Gersten, K., ***Boundary Layer Theory, 8th ed.***, Springer, 2000.

Reference Books*

- Panton, R. L., ***Incompressible Flow***, 3rd Edition, J. Wiley,
- Oertel, H., et al., ***Prandtl-Essentials of Fluid Mechanics***, 3rd ed., Springer. §
- Nayfeh, A.H., ***Introduction to Perturbation Techniques***, New York: Wiley, 1993.
- Van Dyke, M., ***Perturbation Methods in Fluid Mechanics***, Stanford: Parabolic, 1975.

* The textbook and the reference books are reserved in Purdue Engineering Library.

§ Digital book is available through Purdue Library.

General Policy

- Attendance: class attendance is required.
- Homework: homework will be assigned periodically and the due date will be given in the assignment sheet.
- Exams: one mid-term and one final exam will be scheduled. Both exams will be open book, open notes and taken in class (2.5 hours).
- In-class presentation: In order to develop the ability to critically evaluate the literature, every student is asked to give on in-class presentation near the end of the semester. Everyone need select a course-related topic on fluid mechanics. *A title and abstract must be submitted before Feb. 29, 2012 for approval.* Each presentation should be 20 minutes followed by 5-minutes for Q&A.
- Group discussion on course materials, including homework and presentation, is permitted, but each student must finish exams INDEPENDENTLY and NO TEAMWORK is allowed. Violations will subject to academic sanctions.

Grade Policy

- Homework:(20%)
- Midterm (30%) and final exam (30%)
- In-class Presentation: 20%
- Letter grade (+/-)

Emergency Plan

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. Relevant information about changes in this course will be disseminated by course email list and Purdue Blackboard system.

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Progress Schedule *

Week	Date	Topic
1	Jan 9, 11, 13	Introduction, Vector & Tensor Calculus
2	Jan 16 Jan 18 & 20	Martin Luther King Jr. Day (No Class) Kinematics & Basics Laws
3	Jan 23, 25, 27	Navier-Stokes Equations & Solutions
4	Jan 30, Feb 1, 3	Exact solutions of N-S equations
5	Feb 6, 8, 10	Vorticity Dynamics
6	Feb 13, 15, 17	Asymptotic Analysis Methods
7	Feb 20, 22, 24	Laminar Boundary Layer
8	Feb 27 Feb 29 Mar 2	MIDTERM EXAM No Class – Presentation Title/Abstract Due Fundamentals of Heat and Mass Transfer
9	Mar 5, 7, 9	Thermal Boundary Layer
10	Mar 12-17	Spring break (No Class)
11	Mar 19, 21, 23	Instability and Transition to Turbulence Equations for Turbulent Flows Introduction to Turbulence Models
12	Mar 26, 28, 30	Turbulent Boundary Layer
13	Apr 2, 4, 6	Introduction to Numerical and Experimental Methods
14	Apr 9, 11, 13	Basics of Boundary Layer Separation and Control Advanced Topics on Boundary Layers
15	Apr 16, 18, 20	In-class Presentation (TBD)
16	Apr 23, 25, 27	In-class Presentation (TBD)
17	Apr 29-May 5	Final Exam (TBD)

* Subject to change.