Incompressible Fluid Mechanics, MECH6370, Fall, 2016

Instructor: Dr. William Anderson

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Course description: Students will develop skills to describe kinematics of incompressible fluid motions, with dimensional analysis (and checking) underpinning many of the theoretical developments. Generalized description of transport phenomena and specific applications to mass, momentum (Navier-Stokes Equations), and energy. Brief introduction to potential flow and the use of panel methods. Analysis of simple inviscid flow problems. Boundary layer flows (laminar and turbulent) and order of magnitude analysis. Introduction to compressible flows. *Time-permitting:* Vortex dynamics, vorticity transport, and turbulence. Topics in modeling turbulent flows.

Class time, location: 08:30 am - 09:45 am: Monday, Wednesday, ECSN 2.110

Teaching Assistant: Chao Wang (cxw151530@utdallas.edu)

Office hours, location: Thursday, 4:30 pm - 5:30 pm, Location "TBD"

Textbook # 1: Munson et al.: Fundamentals of Fluid Mech., *J. Wiley & Sons*, 7^{th} Ed.

Textbook # 2: Panton: Incompressible Flow, *J. Wiley & Sons*, 3^{rd} Ed.

Class website: eLearning

Prerequisites: Undergraduate courses in fluid mechanics and partial differential equations

Homework: Homework sets will be due one week after assignment, unless otherwise specified. Homework assignments will be posted to eLearning. Homework will be graded for neatness. You must clearly identify what is given in the problem, what you are required to find, and show your units clearly through the entire problem. Work that is not legible or does not include units will not receive credit. Homework will be requested at the beginning of class, and late submissions will be penalized with a 10% grade reduction for each day late.

Grading Policy: Performance will be measured using homework sets, mid-term test, and a comprehensive final exam. The weight of each task is listed below. You are expected to attend all tests; make-up tests will not be offered without justification (i.e., scheduling conflict with another UT Dallas academic commitment). Grade disputes are welcome but must be submitted via email within one week after the assessment item has been returned. Grade redistribution (i.e. the bell curve) will not be used to determine final grades. Laptops, digital books, and smart phones not allowed on tests or final exams (laptops not allowed in class). Visual recording not permitted in class.

Homework: 30%

Midterm: 30%*

Final: 40%* (Date: TBA)

*A non-programmable calculator is the only electronic device allowed during assessment.

Grading scale A+: 97-100; A: 93-97; A-: 90-93
B+: 87-90 ; B: 83-87; B-: 80-83
C+: 77-80 ; C: 73-77; C-: 70-73
D+: 67-70 ; D: 63-67; D-: 60-63
F: Below 60

Academic Integrity and Honor Code

"*UT Dallas students, staff, and faulty shall act in academic matters with the utmost honesty and integrity.*"

Cheating is wrong. Cheating suppresses scholarly pursuits, creates mistrust, and hinders intellectual growth. Students in this class are required to conduct themselves in accordance with the Rules and Regulations of the Regents of the University of Texas System.

For a full list of university policies, please visit http://go.utdallas.edu/syllabus-policies

THE INFORMATION IN THIS DOCUMENT IS SUBJECT TO CHANGE AT THE DISCRETION OF THE INSTRUCTOR.

Additional Course Considerations: You are expected to attend each class, and you should be prepared with the necessary materials (textbook, printouts from website, calculator, pencil, and paper). You are expected to check your utdallas.edu e-mail address daily. Electronic notices may be used to disseminate information for all members of the class. Throughout the

semester, the instructor may have intermittent, unavoidable professional travel commitments. On these days, the instructor will provide advance notice and class will be administered by a TA.

Email communication: Please format your emails professionally before sending: (i) address the recipient appropriately (e.g., "*Prof. Anderson*", "*Dr. Anderson*", or "*Dear Dr. Anderson*"), (ii) use correct grammar, capitalization, and sentence structure, and (iii) add sufficient closing (e.g., "*Best regards*", or "*Best wishes*").

Course-Learning Outcomes: The official course-learning outcomes for this course are:

1. Understand fluid kinematics and how the Navier-Stokes equations governs behavior of fluids.
2. Derive the Navier-Stokes equations from Newton's laws.
3. Examine exact solutions to the Navier-Stokes equations for laminar flows.
4. Explore boundary layer concepts, turbulence and compressible flows.

Outline (subject to change):

Week	**Dates**	**Description**
1	8-22, 8-24	Introduction and review (hydrostatics)
2	8-29, 8-31	Vector calculus, identities, dimensional analysis
3	9-5, 9-7	Transport
4	9-12, 9-14	Conservation of momentum and inviscid flow
5	9-19, 9-21	Inviscid flow
6	9-26, 9-28	Kinematics of fluid motion
7	10-3, 10-5	Kinematics of fluid motion
8	10-10, 10-12	Potential flow and panel methods
9	10-17, 10-19	Laminar boundary layer analysis (differential, integral)
10	10-24, 10-26	Compressibility
11	10-31, 11-2	Reynolds number effects and turbulence
12	11-7, 11-9	Turbulent boundary layers
13	11-14, 11-16	Turbulence modeling: filtering and techniques
14	11-21, 11-23	"Fall Break", No classes
15	11-28, 11-30	Vortex dynamics and vorticity transport
16	12-5, 12-7	Review
	TBA	**Final Exam**