MEEG 332 Fluid Mechanics II

Spring 2019
Lecture: Kirkbride 204
MWF 2:30-3:20pm
Prof. Joseph Kuehl, Office SPL 210
Office Hours M 12:30pm-1:30pm, W 9:30am-10:30am or by prior arrangement

Discussion:
Wednesday, 12:20PM - 1:10PM Sharp 109 (Vaselli, Strongin)
Wednesday, 1:25PM - 2:15PM ISE 205 (Driscoll, Galanek)
Friday, 12:20PM - 1:10PM Gore 115 (Palmer, Silverman)
Friday, 1:25PM - 2:15PM ISE 205 (Palmer, Silverman)

Teaching Assistants:
Graduate: Armani Batista, Charles McMahon
Undergraduate: Gustavo Vasselli, Haley Strongin, Greg Driscoll, Mary Galanek, Michael Palmer, Benjamin Silverman

Prerequisites:
MEEG331 (Fluid Mechanics I) or equivalent
MATH352 (Engineering Mathematics II)

Textbook: "Fluid Mechanics" Plus Mastering Engineering with Pearson eText – Access Card Package, 2nd Edition by Russell C. Hibbeler

Problem Set and Quiz Policy: Weekly (approximate) homework assignments will be assigned through the Pearson eText (online homework system). I encourage students to work collaboratively, but each student will be responsible for his/her own submission. Short in class quizzes will be given weekly (approximate) to assess understanding and pace. Quizzes are taken independently.

Computational Fluid Dynamics: Three Coding Challenges will be assigned throughout the semester. Details will be provided in class.

Attendance Policy: Attendance is monitored, but not graded.

Software Usage: You will frequently be expected to use either MATLAB (recommended) or Python w/matplotlib plotting package to solve engineering problems in this course. MATLAB is available in the e-calc labs, but I highly recommend obtaining a personal copy ($45 at `https://www.mathworks.com/academia/student_version.html`); Python is a free and cross-platform alternative but is less user-friendly. If you use it, I recommend the Anaconda package which is prepackaged with Numpy, SciPy, and matplotlib libraries.

Grading: Problem Sets ($\approx$ 10 = 25%), Quizzes ($\approx$ 10 = 5%), Coding Challenges (3x5%=15%), Midterm Exams (2x15%=30%), Final Exam (25%). The instructor reserves the right to curve the grades. Curves (expect for final exam) will be presented in class, but not published.

Percentile	University Letter Grade
90 - 100	A
80 - 90	B
70 - 80	C
60 - 70	D
< 60	F

COURSE OUTLINE

Chapter 8: Dimensional Analysis and Similitude. Dimensional Analysis, Dimensionless numbers, Buckingham Pi Theorem.

Chapters 9 and 10: Viscous Flow in Ducts/Pipes. Laminar and turbulent flows; flow in pipes, dimensional analysis, friction factor; exact solution for a circular pipe; time averaged turbulent flow; Moodys chart; types of generic pipe-flow problems; flow in noncircular ducts; minor losses in pipe systems; flow measurement.

Chapter 11: Flows over External Surfaces. boundary layers; momentum relations for BL flows; BL thickness; the BL equations, adverse pressure gradient, separation; the turbulent BL; aerodynamic forces; forces on lifting bodies.

Chapter 13: Compressible Flow. The speed of sound, Mach number; adiabatic and isentropic steady flow; isentropic flow with area change; normal shock; the converging-diverging nozzle; two-dimensional supersonic flow.

Computational Fluid Dynamics. Coding challenges.

Course Schedule*

#	Date	Due Date	Topic (Approximate)	Reading
1	11-Feb		Intro and course overview	
2	13-Feb		Dimensional Analysis	Ch 8: Sec. 1
3	15-Feb		Dimensionless Numbers	Ch 8: Sec. 2
4	18-Feb		Buckingham Pi Theorem	Ch 8: Sec. 3
5	20-Feb		Buckingham Pi Theorem	Ch 8: Sec. 4
6	22-Feb		Similitude	Ch 8: Sec. 4
7	25-Feb		numerical modeling	in class
8	27-Feb	Coding 1	numerical modeling	in class
9	1-Mar		Flow between parallel plates	Ch 9: Sec. 1
10	4-Mar		Flow in a smooth pipe	Ch 9: Sec. 3
11	6-Mar		Navier-Stokes Solutions	Ch 9: Sec. 2, 4
12	8-Mar		Fully Developed Flow	Ch 9: Sec. 5, 6
13	11-Mar		Reynolds stress/turb flow	Ch 9: Sec. 7, 8
14	13-Mar		Moody Diagram	Ch 10: Sec. 1
15	15-Mar		Minor losses	Ch 10: Sec. 2
16	18-Mar	Coding 2	3-types of pipe problems	Ch 10: Sec. 3
17	20-Mar		Hydraulic diameter	Ch 10: Sec. 3
18	22-Mar		Pipe Systems	Ch 10: Sec. 4
19	25-Mar		Flow in Porous Media	Notes
20	27-Mar		Flow Measurement	Ch 10: Sec. 5
21	29-Mar	Midterm 1	–	
	spr.bk.		–	
22	8-Apr		BL theory	Ch 11: Sec. 1
23	10-Apr		Laminar BL	Ch 11: Sec. 2
24	12-Apr		Momentum Integral	Ch 11: Sec. 3
25	15-Apr	Coding 3	Similarity solutions	Ch 11: Sec. 4, 5
26	17-Apr		Turbulent BL	Ch 11: Sec. 4, 5
27	19-Apr		Lift and Drag	Ch 11: Sec. 6
28	22-Apr		Pressure Gradients	Ch 11: Sec. 7
29	24-Apr		Drag Coefficient	Ch 11: Sec. 8, 9, 10
30	26-Apr		Airfoil Theory	Ch 11: Sec. 11
31	23-Apr		review	–
32	29-Apr	Midterm 2	–	
33	1-May		Intro to Compressible flow	Ch 13: Sec. 1
34	3-May		Waves	Ch 13: Sec. 2, 3
35	6-May		Stagnation	Ch 13: Sec. 4
36	8-May		Isentropic Relations	Ch 13: Sec. 5
37	10-May		Nozzles and Friction	Ch 13: Sec. 6, 7
38	13-May		Heat Transfer	Ch 13: Sec. 7, 8
39	15-May		Normal Shockwaves	Ch 13: Sec. 9, 10
40	17-May		Oblique Shockwaves/Mach Cones	Ch 13: Sec. 11, 12
41	20-May		Review	

*outline is subject to change, notifications will be given in class

†Not on Hmwk/Quiz/Exam