ME 260A/B
ADVANCED FLUID MECHANICS

by

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6113 Etcheverry Hall

ME 260A/B
Advanced Fluid Mechanics
2017-18

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COURSE: ME260A

You are expected to be proficient in fundamental thermodynamics and fluid dynamics, such as those topics covered in ME 105 & 106 and with mathematics inasmuch as it is needed for that proficiency. You must understand how a rigid body behaves under external forces before you can even imagine to understand the behavior of fluids. In particular, you are expected to have derived the equations of motion for continuum at least once. Mathematically, you should be comfortable with vector calculus, ordinary and partial differential equations, and be familiar with complex variables and tensor notation. We will cover the following topics at appropriate levels for this course: (260A) the formulation of the fluid flow problem, potential flows, compressible flows, canonical viscous flows; and (260B) boundary layer theory, creeping flows, vortical flows, point vortices, rotating flows, stability, transition, and turbulence. The homework problems are intended for augmenting the lecture material and, therefore, constitute an essential part of the course.

GRADING: ME260A		LETTER GRADE BOUNDARIES		
Homework ($\sim$ 4)	40%		A	85.0%
Midterm exam (Oct 17)	30%		B	75.0%
Final exam (due Dec 11)	30%		C	65.0%
TOTAL	100%		D	55.0%

POLICY

All members of the UC Berkeley community are bound by our honor code. All assigned material is to be done independently. Unless you have a good reason, no late assignment will be accepted, no makeup will be given.

REFERENCES

1. Batchelor, G. K. 1967 *An introduction to fluid dynamics.* Cambridge.

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5. Flügge, S. ed. 1959, 1963 *Hanbuch der Physik,* Volume VIII/1 (1959) & VIII/2 (1963). Springer-Verlag.

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20. Riley, N. & Drazin, P. G. 2006 *The Navier-Stokes equations: a classification of flows and exact solutions.* Cambridge.

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27. Tennekes, H. & Lumley, J. L. 1972 *A First Course in Turbulence.* MIT Press.

28. Tritton, D. J. 1988 *Physical fluid dynamics,* 2nd edition. Oxford.

29. Van Dyke, M. 1982 *An Album of Fluid Motion.* Parabolic.

30. White, F. 1991 *Viscous fluid flow,* 2nd edition. McGraw-Hill.

31. *Journal of Fluid Mechanics (J.Fluid Mech.)*

32. *Physics of Fluids (Phys. Fluids)*

33. *Annual Reviews of Fluid Mechanics (Ann. Rev. Fluid Mech.)*

34. `http://web.mit.edu/fluids/www/Shapiro/ncfmf.html`, National Committee for fluid Mechanics Films

35. Savaş, Ö. 2017/18 *ME-260A/B Advanced Fluid Mechanics.* Webnotes: `bcourses.berkeley.edu`

Ö. Savaş   August, 2017

6113 Etcheverry Hall   Lectures in 1165 Etcheverry Hall

Office Hours : TuTh 14:15-15:45   Lecture Hours TuTh 12:30-14:00

ME 260A
ADVANCED FLUID MECHANICS
Fall 2017 - working copy

#	date	Topic
1.	*Aug 24*	**<u>Introduction</u>**, Homework assignment, **<u>Formulation</u>** Differentiation Theorems, Continuity
2.	*Aug 29*	Momentum equation, Stress at a point, stress tensor
3.	*Aug 31*	stress tensor, energy equation, Surface force work,
4.	*Sep 5*	differential equations, Motion near a point
5.	*Sep 7*	Constitutive relation, Viscosity , derivation concluded,
6.	*Sep 12*	Preliminaries to flow theorems: Kelvin, Helmholtz, Crocco, Bernoulli
7.	*Sep 14*	**<u>Potential Flow</u>** Euler's equations
8.	*Sep 19*	Bernoulli's, Stream function, Potential flow $\nabla^2\phi = 0$, catalog
9.	*Sep 21*	Potential flow catalog
10.	*Sep 26*	Catalog continued, water waves
11.	*Sep 28*	Water waves – continued
12.	*Oct 3*	**<u>Compressible Flow</u>** Introduction
13.	*Oct 5*	Normal shock waves, Isentropic stream tube flow,
14.	*Oct 10*	Unsteady shock, reflection
15.	*Oct 12*	Riemann Invariants, Centered expansion, shock tube
16.	*Oct 17*	MIDTERM EXAM – *in class, closed book, personal notes only*
17.	*Oct 19*	Shock formation
18.	*Oct 24*	Acoustics
19.	*Oct 26*	**<u>Canonical Viscous Flows</u>**: Parallel flows, Couette, Poiseuilli,
20.	*Oct 31*	Circular flows, Jefferey-Hamel flow
21.	*Nov 2*	Hiemenz flow, Kármán flow, Bödewadt Flow
22.	*Nov 7*	Berker Flow: Corotating eccentric discs
23.	*Nov 9*	Landau jet, suddenly accelerated wall, oscillating wall,
24.	*Nov 14*	Decaying viscous vortex , starting pipe flow
25.	*Nov 16*	Bubble dynamics: Rayleigh - Plesset equation
	Nov 21	APS/DFD Meeting
	Nov 23	THANKSGIVING
26.	*Nov 28*	Sexl-Womersley Flow
27.	*Nov 30*	Starting viscous jet. *Classes end, TAKE HOME EXAM handed out*
	Dec 1	*Formal classes end*
	Dec 8	*Last Day of Instruction*
	Dec 11	Monday 17:00 - *FINAL EXAM DUE*
	Dec 15	Friday: *Semester ends*