

ME 322, Applied Fluid Mechanics and Thermodynamics, Winter 2004

Portland State University, Maseeh School of Engineering and Applied Science

Class meets: 4:00-5:50PM, Tuesdays and Thursdays, Rm 155, Science Bldg II

Course Objectives

Apply the fundamentals established in EAS 361 to flow systems encountered in engineering design. Topics covered include viscous flows in pipes, external flows (boundary layers), compressible flow, and turbomachines (pumps). The final part of the course covers the thermodynamics of gas mixtures, with special emphasis psychometrics and air-conditioning processes.

Prerequisites: Admission to ME or CE Programs, EAS 361, ME 321

Textbook(s)...let's talk.

1. Young, D.F., Munson, B.R., Okiishi, T.H., A Brief Introduction to Fluid Mechanics, 2nd edition, 2001, John Wiley and Sons, Inc. (YMO)
2. Çengel, Y.A., Boles, M.A., Thermodynamics: An Engineering Approach, third(?) edition, 1998, McGraw-Hill, New York (ÇB)

Or ...

1. Young, D.F., Munson, B.R., Okiishi, T.H., Fundamentals of Fluid Mechanics, 3rd (1998) or 4th (200x) editions, 2001, John Wiley and Sons, Inc. (YMO)
2. ...some thermo book that handles gas mixtures and intro to combustion.

Instructor

Mark Weislogel, Assoc. Professor, Dept. of Mechanical Engineering

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Web site for the course: ...will get bulletin board going.

Office Hours: Tuesdays and Thursdays, 2:00-4:00PM, Rm 328 SBII, or by appt.

Policies

The midterm exam will last one class period. The final exam will be comprehensive. Both exams are mandatory. Potential conflicts must be resolved well before the exam dates.

Students are expected to turn in homework assignments that are substantially the result of their own work. However, students are encouraged to participate in study groups to discuss assignments, share advice, ideas, etc. Copying homework, cheating on tests—not good, I'll cry, get mad, punish everyone.

Grading...Cumulative grades will be based on the following approximate weights:

Homework 20%, Midterm Exam 40%, Final Exam 40%.

Approximate Course Outline to Midterm Exam

Class	Topic	Reading (YMO)
Internal Viscous Flows		
1	Another "introduction to fluids" lecture overview viscous flow in pipes, laminar flow	8.1
2	Control volume approach for laminar flow, applications	8.2
3	Turbulent viscous flow in pipes transition, turbulent shear stress, velocity profile, Moody Chart	8.3-8.4
4	Minor losses, Noncircular ducts, applications	8.4
5	Pipe systems, flow metering	8.5-8.6
External Viscous Flows		
6	Flow over immersed bodies Introduction to lift and drag, boundary layers, flat plate	9.1-9.2
7	Momentum integral, transition to turbulence	9.2
8	Turbulent boundary layers, B.L. separation	9.2
9	B.L. Stability, Terminal velocity, test prep.	9.3
10	Midterm Exam	

Approximate Course Outline from Midterm to Final Exam

Class	Topic	Reading
Compressible Flows		(CB)
11	Overview compressible flow Mach number, ideal gas thermodynamics, speed of sound	16.1-16.2
12	Converging/diverging duct flow Theory and applications	16.3-16.4
13	Non-isentropic flow Adiabatic flow with friction in constant area ducts, Normal shocks, examples	16.5
Turbomachinery		(YMO)
14	Introduction to Turbomachines Energy and angular momentum considerations, Centrifugal pumps	11.1-11.3
15	Pump characteristics NPSH, matching systems and pumps	11.4
16	Pump characteristics, turbines similarity laws, axial flow and mixed flow pumps	11.5-11.7
Gas Mixtures		(CB)
17	Introduction to real gases mass and mole fractions, p-v-T behavior of ideal and real gases, properties of ideal and real gas mixtures	12.1-12.3
18	Gas-Vapor and Psychometrics dry and moist air, specific and relative humidity, dew point, adiabatic temperature saturation, wet-bulb temperature, psychometric chart	13.1-13.5
Flow Systems with Chemical Reactions		
19	Introduction to flows with chemical reactions Fuels and combustion, theoretical and actual combustion Processes, enthalpy of formation, enthalpy of combustion	14.1-14.3
20	First law analysis of reacting systems Adiabatic flame temperature	14.1-14.3
<u>Finals week, Final exam</u>		