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AME 309 - Dynamics of Fluids (4.0 units)

Syllabus for fall semester 2013

Tue,Thu 10:00-11:50am, MHP 106

Instructor: Prof. Veronica Eliasson, eliasson@usc.edu.
Office hours: RRB 220, Tuesday 2-4pm, Thursday 1:30-3:30pm.

TA: Stelios Koumlis, koumlis@usc.edu
Office hours: TBA
Textbook: Frank White, Fluid Mechanics, 7th Ed, McGraw-Hill, Inc.

Grading:
Homework: 1/5 of final grade.
Project: 1/5 of final grade.
Midterm exams: $2 \times 1/5$ of final grade.
Final exam: 1/5 of final grade.
Note: All exams will be open book (F. White, 7th Ed. is the only book allowed), your own class room notes and homework assignments with solutions and calculators. No computers.

Topics

1. Characterizing a fluid and the state-of-stress in a fluid. (Week 1)
2. Fluid statics: manometry, forces on submerged surfaces. (Week 2-3)
3. Conservation of mass. (Week 4)
4. Conservation of momentum. (Week 5)
5. Conservation of energy. (Week 6)
6. Bernoulli's equation along a stream tube with and without losses. (Week 6)
7. Concepts from dimensional analysis. (Week 7)
8. Equations of motion in differential form. (Week 8)
9. Flow in pipes and ducts with losses. (Week 9)
10. Boundary layer flows. (Week 10)
11. Compressible flow (subsonic & supersonic flow, shock waves). (Week 11-12, 14)
12. Flow past bluff bodies. (Week 13)
13. Flow in open channels (friction, channel transitions, hydraulic jumps). (Week 15)

Midterm

There will be two midterm exams in the course.

Homework

Homework will usually be assigned weekly and will be due the following week. Homework will not be accepted late for unexcused reasons. Under no conditions should you attempt to complete your homework the night before it is due, because it will require more than one evening's work.

No late homework will be accepted.

Important rules and tips

1. Print your name on each page of your homework and staple pages together.

2. Homework is to be done in a manner befitting professional engineers. Hence it is to be on 8.5×11" paper with writing on only one side of each page. Be sure that mistakes are clearly erased and carefully crossed out so that someone can read and follow your work without difficulty.

3. It is necessary that you present your work neatly, logically and professionally. To receive full credit on homework and exam problems, *all* of the following *must* be shown:

(a) Write down the given data at the beginning of the problem solution.

(b) Include a free-hand sketch of the problem.

(c) State the assumptions to be used in the problems (e.g. incompressible flow) and write the equations to be used in symbolic form. Indicate where you obtained the equations and verify that the assumptions embedded within the equations are consistent with the problem you are attempting to solve.

(d) Work through the UNITS un your calculations, showing conversion of units etc., and be sure to include both the numerical value and the units in your answer. You should be consistent in the system of units you use.

(e) Algebraic steps are an important part of your work and should be shown.

(f) All digits of the given data should be used in intermediate calculations, but round off the final numbers and report the *significant* digits consistent with the accuracy of the data. For example, if the data are given to 3 significant digits, *do not* present and answer with 8 significant digits. If some of the data have only one digit given, e.g. the velocity is 8 m/s, you should assume that two digits are implied, i.e. 8.0 m/s. In this case, your answer should usually contain two significant digits, although three digits will be accepted. Generally, you should have three significant digits in your answer, unless you can justify more or less based upon the given data.

4. Remember that the most important aspect of homework and exam solutions (typically 80-90% of the final grade) is the method and not the correct answer. Thus, be sure to indicate how the solution was obtained by indicating each step in the solution and where the data was acquired.

5. Place a box around each answer so that the grader knows you have arrived at an answer.

Weekly schedule

Week	Concept	Reading	HW	Project
1 Aug 27, 29	Introduction, kinematics	Ch. 1.1-1.14		
2 Sep 3, 5	Fluid properties & submerged bodies	Ch. 1 & Ch. 2.1-2.4		
3 Sep 10, 12	Forces on submerged surfaces, buoyancy	Ch. 2.5-2.10	HW 1 Due	
4 Sep 17, 19	Control volume, Reynold's transport theorem	Ch. 3.1 & Ch 3.2	HW 2 Due	
	Conservation of mass	Ch. 3.3		
5 Sep 24, 26	Conservation of momentum + examples	Ch. 3.4, 3.6	HW 3 Due	
6 Oct 1, 3	Conservation of energy, Bernoulli's equation	Ch. 3.5, 3.7	HW 4 Due	
7 Oct 8, 10	Midterm Exam 1 on October 8	Ch. 1-3		
	Dimensional analysis	Ch. 5		Teams formed
8 Oct 15, 17	Differential equations, stream function, vorticity	Ch. 4	HW 5 Due	Progress report 1
9 Oct 22, 24	Velocity potential, pipe flow	Ch. 4.9, Ch. 6		Progress report 2.
10 Oct 29, 31	Boundary layer flows	Ch. 7.1-7.4 + 7.6	HW 6 Due	Progress report 3
11 Nov 5, 7	Compressible flows	Ch. 9.1-9.4	HW 7 Due	Progress report 4
12 Nov 12, 14	Midterm Exam 2 on November 12 ,			Progress report 5
	Compressible flows	Ch. 9.5		
13 Nov 19, 21	Bluff bodies	Ch. 7		
14 Nov 26, 28	Bluff bodies, Thanksgiving	Ch 9.6		
15 Dec 3, 5	Flow in ducts + Review	Ch. 10.1-10.2	HW 8 Due	Final report due.
16 Dec 17	Final exam 8:00-10:00am			

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