Florida International University
Department of Civil and Environmental Engineering

CWR 3201 Fluid Mechanics

(Fall 2018)

Catalog Data:

A study of the properties of fluids and their behavior at rest and in motion. Continuity, momentum, and energy principles of fluid flow

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Office hours: Wednesday 10:45-11:45 am, Thursday 10:00-11:30 am
Thursday 3:00-5:00 pm

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Office hours: Monday 1-3 pm, Tuesday 3-5 pm

Lecture location and time:
Wednesdays and Fridays 9:30 am - 10:45 am - Classroom: EC 2410 (Engineering Center)

Textbook: Mechanics of Fluids (Fifth edition), by M.C. Potter, D.C. Wiggert and B.H. Ramadan. Previous edition (4th edition, 2014) is also acceptable.

Course Description:

This course is an introduction to fluid mechanics, and emphasizes fundamental concepts, principles, and problem-solving techniques. Topics to be covered include fluid properties, fluid statics, fluid kinematics, control volume analysis, dimensional analysis, conservation principles, and internal flows (pipe flow) with applications to pipe systems and networks. A basic introduction to open channel flow is also studied.

Course Pre-requisites and Co-requisites

Pre-requisites: MAC 2312, MAP 2302, and EGN 3321 or EGM 3503. Co-requisite: CWR 3201L.

Course Objectives

1. To study and be familiar with physical quantities and terms important in fluid statics and flow.
2. To study and analyze problems with fluids under static conditions.
3. To study and analyze problems with fluids in motion.
4. To study and apply dimensional analysis and similitude to solve fluid mechanics problems.
5. To study flow in pressurized pipes and in open channels.

Course Outcomes

Upon completion of this course, students should be able to:

1. Recognize the properties that distinguish fluids from other forms of matter, and the broad range of engineering applications that involve fluid mechanics.
2. Apply the concepts of vector fields (velocity, force, acceleration) and scalar fields (pressure, density, temperature), to engineering analysis of fluids systems, and to the interpretation of flow physics

through the conservation principles (i.e., laws).

3. Differentiate fluid flows, including steady and unsteady, viscous and inviscid, laminar and turbulent.
4. Apply Newton's Second Law to the analysis of fluids at rest, for the calculation of pressure variation, forces and moments on submerged surfaces, and buoyancy.
5. Apply control volume methods based on mass, momentum, and energy conservation, as appropriate, to the analysis and design of engineering fluids systems.
6. Apply basic principles of dimensional homogeneity to engineering analysis, and apply dimensional analysis and similitude to the representation of data. Properly interpret the Reynolds number and other fundamental non-dimensional parameters.
7. Apply mass, momentum, and energy conservation to steady internal (pipe) flows, correctly interpret and apply laminar and turbulent flow models, and estimate head loss and power requirements in pipe systems.
8. Recognize how flow in open channels differs from pressurized flow in pipes, and apply mass, momentum, and energy conservation principles for the calculation of flow areas, longitudinal slope, velocity, and flow rates in open channels.
9. Apply fundamental knowledge of fluid mechanics to the analysis of specific instruments used in measurements of fluid-flow characteristics.

Grading

Homework (10%)
Exam 1 (25%) September 21
Exam 2 (30%) October 26
Final Exam (35%) during finals week; date and time to be set by the University.

Letter grades will be based on the weighted average specified above and assigned as follows:

92.0 or higher	A
90.0 – 91.99	A-
88.0 – 89.99	B+
82.0 - 87.99	B
80.0 – 81.99	B-
78.0 – 79.99	C+
65.0 - 77.99	C
45.0 - 64.99	D
44.99 or lower	F

Note: The lowest score of one homework will be dropped.

Grade Disputes

If a student feels that an exam or a homework set was graded unfairly, or if there is an error in the grading, it should be brought to the attention of the instructor within one week after the graded material is handed back. Scores will not be reconsidered beyond one week after they are handed back.

Participation

There is no specific score for class participation. However, participation (or lack thereof) may influence your final grade if you are in the borderline. Class attendance is documented by signing the class roll; late arrival or early departures are considered absences. You are expected to attend all scheduled lectures and participate in class discussions.

Academic Misconduct:

Students are expected to uphold the standards of academic integrity and the policies of the University regarding conduct. Cheating and plagiarism will not be tolerated; these offenses could result in failing the course, and suspension or expulsion from the University.

Refer to the FIU Student Code of Conduct for full details on what constitutes academic dishonesty and misconduct, as well as the procedures for resolution of pertaining matters within the University judiciary procedures - http://integrity.fiu.edu/

Class Website

Use your account to access the Canvas system at https://canvas.fiu.edu/. Homework, additional material, and announcements will be posted there. Check your Canvas webpage often.

Relationship to ABET Objectives & Outcomes

This course is required for all students. Its contents relate and make a partial contribution to the following objectives:

Outcome (a): An ability to apply knowledge of mathematics, science, and engineering principles. *Example: Use mass and energy conservation principles to determine flow rate and head loss in pipeline networks.*

Outcome (e): An ability to identify, formulate, and solve engineering problems. *Example: Use control volume analysis to determine forces and moments associated with fluid flow in a pipeline to determine resultant force and torque transmitted to pipe supports.*

Outcome (k): An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. Example: *Use the equation solver package in Microsoft Excel for the solution of non-linear equations derived in the solution of open-channel flow problems.*

Requirements for Homework

All homework problems, unless otherwise directed by your instructor, should follow the Rowan Engineering Format. This format is used for most professional engineering work. Unless otherwise directed by your instructor, you should use engineering paper for all homework assignments.

1. Headers: The five boxes at the top of each sheet of engineering paper that you use for a homework assignment should contain the following information from left to right:
   a) put the staple (which is the required homework binder) in the first (small) box
   b) print the course name and section in the second (large) box. Example: CWR3201-RH1
   c) print the assignment name and number in the third (large) box. Example: Homework #4
   d) print your full name in the fourth (large) box, you may include your ID number right below
   e) print the page number / total number of pages in the fifth (small) box

2. Writing Mechanics: All homework should be:
   a) carefully printed and not written in cursive
   b) printed in pencil and not in ink
   c) neat and clean, i.e. printed on the lines with no smudges or cross-outs

3. Calculations: All homework calculations should:
   a) include at least one complete sample for every type of calculation presented
   b) include all units for each term in each equation and the units must balance
   c) use the appropriate number of decimal figures (usually two or three) for all numbers
   d) clearly indicate the final solution by boxing it in a rectangle

4. Problem Order: Problems should be presented
   a) in the order assigned
   b) delimited by a horizontal line (use a ruler)
   c) with a new problem starting right below the horizontal line
   c) with the designated problem number, from textbook or instructor.
   d) using only the front side of each sheet of engineering paper

5. Problem Essentials: Problem solutions should include the following items in order:
   a) homework problem number listed at beginning of problem
   b) the given information - the information that will be used to solve the problem
   c) the required information - the information or solution that we are looking for
   d) a straight-edge diagram or diagrams that clearly illustrate the problem
   e) the solution of the problem including all required steps and calculations

6. Evaluation: Double-check all of your calculations to make sure that:
   a) all of your math is correct, i.e. you made no errors in using the calculator or computer
   b) all of your equations are correct, i.e. you made no errors in manipulating equations
   c) all of your units balance, i.e. you derived the correct units for the desired solution

Homework Grading:

Homework will be graded according to the following criteria:

1. Format:
   - Given:
   - Find:
   - Solution:
     a. Analysis (force diagram, coordinates, type of problem, and number of unknowns)
     b. Assumptions and equations
     c. Answers
2. Use of proper paper and steps clearly labeled;
3. Neatness/legibility;
4. Schematic, complete with appropriate control volume and appropriate assumptions;
5. Clearly developed and correct analysis;
6. Algebraic expression of solution.

Only for Office of Distance Education (ODE) Students

This course is not a fully online course; class video lectures will be posted on our Canvas system (https://canvas.fiu.edu/) and it is essential for the ODE students to watch the videos on a regular basis to ensure understanding of lectures content.

ODE students will take all their exams at the Engineering Center (FIU). The room will be timely announced by the instructor. Rules and procedures will be the same as for regular students. The exam time will be from 5:00 to 6:30 pm. Dates are the same as posted in the schedule above.

All assignments requested during the lecture and posted on Canvas are mandatory for all students and must be submitted on time.

Instructions for submission

1. Upload the HW in Canvas (https://canvas.fiu.edu/).
2. Send only one pdf file for each HW.
3. Name the file with your name and HW number. Ex.: Saul_Franco_Homework#1.pdf
4. HW scans must be clear. It is suggested to use an Scanner or a phone application such as Genius Scan. PICTURES WILL NOT BE ACCEPTED.

Course Schedule (Preliminary, Subject to change)

Week	Day	Date	Topics	Chapter	Material for HW	Out date	Due date
1	1	22-Aug	Course Introduction	-	HW #1	24-Aug	5-Sep
	2	24-Aug	Basic Concepts and Units	1			
2	3	29-Aug	Properties of Fluids	1			
	4	31-Aug	Viscosity and Surface Tension	1			
3	5	5-Sep	Pressure and Manometers	2	HW #2	5-Sep	19-Sep
	6	7-Sep	Fluid Statics, Hydrostatic Forces on Sub. Surfaces	2			
4	7	12-Sep	Buoyancy and Stability	2			
	8	14-Sep	Linearly Accelerating Containers, Rotating Containers	2			
5	9	19-Sep	Exam review				
	10	21-Sep	**EXAM 1**				
6	11	26-Sep	Fluid Kinematics, Eulerian - Lagrangian Formulations, Flow visualization	3	HW #3	19-Sep	10-Oct
	12	28-Sep	Bernoulli Equation	3			
7	13	3-Oct	Flow Measurement (e.g., weirs, orifices, Parshall flume)	4			
	14	5-Oct	Reynolds Transport Theorem	4	HW#4	10-Oct	24-Oct
8	15	10-Oct	Conservation of Mass	4			
	16	12-Oct	Conservation of Energy	3			
9	17	17-Oct	Momentum Equation	3, 13			
	18	19-Oct	Angular momentum	4			
10	19	24-Oct	Exam review				
	20	26-Oct	**EXAM 2**				
11	21	31-Oct	Dimensional Analysis and Similarity	6	Hw #5	24-Oct	2-Nov
	22	2-Nov	Pipe Flows, Laminar, Turbulent / Moody Chart	7,11	HW #6	2-Nov	14-Nov
12	23	7-Nov	Minor Losses, Pipes in Series and Parallel	11			
	24	9-Nov	Pipe networks (water distribution network)	11			
13	25	14-Nov	Pumps (Performance and system characteristics)	12	HW #7	14-Nov	21-Nov
	26	16-Nov	Cavitation and pump selection	12			
14	27	21-Nov	Open Channel - Steady Uniform Flow (Manning's Eq.)	10	HW #8	21-Nov	5-Dec
	28	23-Nov	Storm sewer, Single sewer line (*)	10			
15	29	28-Nov	Best hydraulic sections/Gradually Varied Flow	10			
	30	30-Nov	Steady-Rapidly Varied Non-uniform Flow	10			
16	29	5-Dec	Finals week (date and time of final exam is set by the University)				
	30	7-Dec					

***(*) Important Note*: Nov. 23 is holiday. The university will be closed this day. This lecture will be recovered at a time and location arranged in class.**