

CE 321 Fluid Mechanics for Civil Engineers

Credit hours: 3, contact hours: 44

Instructor: Leslie Hopkinson, ESB 649, 304-293-9932, Leslie.Hopkinson@mail.wvu.edu

Office hours: M 11:00-11:50 am, W 9:00-9:50 am, or by appointment

Required text: D. D. Gray, corrected hardback reprint, 2010. *A First Course in Fluid Mechanics for Civil Engineers*, Water Resources Publications, Highlands Ranch, CO, (<http://www.wrpllc.com/books/fcfm.html>), 487 pages.

Supplement: D. D. Gray, 2013. Problem Supplement for A First Course in Fluid Mechanics for Civil Engineers, Version 4.0, 158 pages.

Course description: Fluid properties, statics, and kinematics. Conservation laws for mass, momentum, and mechanical energy. Concepts of piezometric head and grade lines. Dimensional analysis and similitude. Weir and orifice flow. Introduction to flow in pipes and open channels.

Prerequisites: MATH 261, MAE 242

Required course for BSCE.

Expected learning outcomes: Having successfully completed this course, the student will be able to:

	Student Outcome
Describe basic fluid properties and understand how these influence fluid statics and movement (e.g. density, specific weight, specific gravity, and viscosity);	A
Calculate pressure distributions in a static fluid and evaluate forces on surfaces/objects submerged in a fluid;	A, E
Calculate flow characteristics (e.g. pressure, discharge, velocity);	E, K
Apply mass and momentum conservation equations; and,	
Determine energy losses in pipe flows.	

CE 321: Spring 2015 Tentative Course Schedule (The schedule of topics listed below is subject to change.)

wk	#		Date	Topics	Assignments
1	1	M	Jan.12	Course Introduction	
	2	W	14	Scope of fluid mechanics, units	
	3	F	16	Properties related to mass	
2		M	19	<i>Martin Luther King's Birthday Recess: University Closed</i>	<i>No Class</i>
	4	W	21	Perfect gas law, viscosity, stress, Pascal's law	
	5	F	23	Variation of pressure, barometer	<i>HW 1</i>
3	6	M	26	Absolute pressure, gage pressure, piezometers	
	7	W	28	Piezometric head, manometers	
	8	F	30	Devices for measuring pressure, Hydrostatic thrust	<i>HW 2</i>
4	9	M	Feb. 2	Hydrostatic thrust	
	10	W	4	Kinematics of flow	
	11	F	6	Kinematics of flow, Euler equation	<i>HW 3</i>
5	12	M	9	Euler equation	
	13	W	11	Forced and free vortices	
	14	F	13	<i>****Test 1****</i>	<i>****Test 1****</i>
6	15	M	16	Bernoulli equation	
	16	W	18	Bernoulli equation, ideal free jet, Pitot tube	
	17	F	20	Pitot-static tube, continuity equation, flowmeters	<i>HW 4</i>
7	18	M	23	Continuity equation, siphon,	
	19	W	25	Steady and unsteady flows, weirs	
	20	F	27	Weirs, Euler in rectangular coordinates	<i>HW 5</i>
8	21	M	Mar. 2	Principle of balance, Continuity equation	
	22	W	4	Principle of balance, Continuity equation	
	23	F	6	Principle of balance, Continuity equation	<i>HW 6</i>
9	24	M	9	Principle of balance, Continuity equation	
	25	W	11	Viscosity, laminar flow	
	26	F	13	<i>****Test 2****</i>	<i>****Test 2****</i>
10	27	M	16	Laminar pipe flow, Navier-Stokes eq., Energy balance	
	28	W	18	Energy balance, Mechanical Energy Equation	
	29	F	20	PHL, THL	<i>HW 7</i>
			22-27	<i>Spring Recess</i>	<i>No Class</i>
11	30	M	30	Dimensional Analysis	
	31	W	April 1	Dimensional Analysis	
		F	3	<i>Friday Before Easter Recess: University Closed</i>	<i>No Class</i>
12	32	M	6	Dimensional Analysis	
	33	W	8	Friction factor in laminar flow	
	34	F	10	Friction factor in turbulent flow	<i>HW 8</i>
13	35	M	13	Pipe flow	
	36	W	15	Pipe flow	
	37	F	17	Momentum equation	<i>HW 9</i>
14	38	M	20	Applying the momentum equation	
	39	W	22	Applying the momentum/open channel flow equation	
	40	F	24	<i>****Test 3****</i>	<i>****Test 3****</i>
15	41	M	27	Open Channel flow	
	42	W	29	Open Channel flow	
	43	F	May 1	Open Channel flow	
<i>****Final Exam: Thursday May 7, 8:00 am – 10:00 am</i>					

Class Website: Use your MIX account to access the eCampus system at <https://ecampus.wvu.edu>. Homework, additional material, and announcements will be posted there. Check our eCampus webpage often.

Grading and Evaluation: Each student's grade in the course will be determined as follows:

In-class assignments	5%
Homework assignments	10%
Test 1	20%
Test 2	20%
Test 3	20%
Comprehensive final exam	25%

In-class Assignments: Attendance will not be recorded for grading purposes but is necessary to receive credit for in-class assignments and quizzes. **There will be no make-up in-class assignments. Nonattendance grade is 0.0%.**

Homework Assignments: Homework (a paper copy) will be collected at the beginning of the lecture. Due dates will be given on each assignment (usually due on a weekly basis), and assignments will be posted on eCampus. **Late homework will not be accepted.** You are expected to be present in class to submit your homework, and **no homework will be accepted outside of scheduled lecture without prior approval.** Homework is due at the beginning of the course period. Homework must be prepared and presented in a professional manner. See the end of this document for guidelines for homework preparation. Late homework or homework failing to meet the professional guidelines will result in a grade of 0.0%. **It is not acceptable for you to submit homework that is in whole or in part the work of someone else. Any evidence of cheating on homework will result in a grade of 0.0%.** Academic dishonesty will be reported. I will drop your lowest homework grade when calculating final grades.

Exams: Tests will be closed book, closed notes. Only pens, pencils, and a calculator (with no internet access) will be permitted. **No make-up tests will be permitted without prior approval. Nonattendance grade is 0.0%.**

Final Grade Determination: The final numerical grade (based on the usual 0-100% range) will be calculated based on the grades earned by the student in exams, homework, and in-class assignments, using the grade weights listed above. The final letter grade assigned based on the following scale: 90.0-100%=A; 80.0- 89.9%=B; 70.0-79.9%=C; 60.0-69.9%=D; 0-59.9%= F. The grade ranges may be lowered at the discretion of the instructor, but the minimums will not be raised.

Social Justice Statement: West Virginia University is committed to social justice. I concur with that commitment and expect to foster a nurturing learning environment based upon open communication, mutual respect, and non-discrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in

this class will be appreciated and given serious consideration. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with Disability Services (293-6700).

Academic Honesty Statement: The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the Student Conduct Code:

http://studentlife.wvu.edu/office_of_student_conduct/student_conduct_code.

Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see me *before* the assignment is due to discuss the matter.

Class Policies:

- You are expected to turn in your own work—not work that has been copied from someone else. Turning in homework copied from someone else will result in a grade of 0.0% for all involved. Academic dishonesty will be reported.
- Class attendance and punctuality are expected.
- To preserve the privilege of obtaining individual help, each student must attend class regularly.
- A full-function hand-held calculator is essential.
- Do not sleep, read the paper, text, use electronic media, study for other classes, or talk to neighbors except when assigned to do so.
- **The use of cell phones, smart phones, or other mobile communication devices is disruptive, and is therefore prohibited during class. Except in emergencies, those using such devices must leave the classroom for the remainder of the class period.**
- Students are permitted to use computers/tablets during class for note-taking and class-related work only. Those using computers during class for work not related to that class must leave the classroom for the remainder of the class period.
- No video recording, audio recording, or photography of lectures without prior approval.

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Spring 2015**

Guidelines for Homework Preparation

NOTE: Refer to these guidelines every time you prepare a homework assignment.

Homework failing to follow these guidelines *WILL NOT BE GRADED* and will earn a grade of 0.0.

- All homework solutions must be neatly and clearly presented in an orderly fashion on 8.5 x 11 inch paper.
 - Write on one side of the paper only.
 - Name and page number/total number of pages on each page—neat and readable (e.g. Last Name, 4/5).
 - All problem solutions should have the following elements:
 - 1. Given:**
 - The problem statement need not be copied, but the given and required information should be listed.
 - Sketches and free body diagrams (where appropriate) drawn with a straightedge or neatly by hand should be included.
 - All dimensional quantities must have the appropriate units given.
 - 2. Find:**
 - Provide a brief statement of the problem objectives.
 - 3. Solution:**
 - State assumptions. Text can and should be used to explain your process.
 - Reference tables, graphs, etc. when appropriate.
 - All equations used must be written in general symbol form before specific numerical values are substituted into the equations; i.e. the problem must be solved using symbols until the last step when the numerical values (including units) are substituted for the symbols.
 - All dimensional quantities must have the appropriate units given. It is not necessary to give units for every value in the middle part of the computations.
 - Final answer should be clearly marked for each problem, with units and appropriate number of significant digits. (i.e. Box your answers.)
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- Check answers with commons sense.
 - Pages secured with a staple---Do not fold or paper-clip! Loose papers will not be graded.
 - Neatness counts. Messy work is unprofessional and will not be graded.
- You (or any engineering colleague) should be able return to your work at a later date and understand your solution.