

Fluid Mechanics

University of Colorado – Department of Mechanical Engineering
MCEN 3021-400, MCEN 3021-570
Fall 2016

Instructor: Peter Mitrano
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Office Hours: M/W 4 – 5:00 pm
T/Th 1 – 3:00 pm
Appointments welcome. Feel free to stop by.

Text: Young, Donald F., Bruce R. Munson, Theodore H. Okiishi, and Wade W. Huebsch. *A Brief Introduction to Fluid Mechanics*. 4th ed. Wiley, 2007. (Or similar text)

Extras: Learncheme.com, Learnmeche.com *Fundamentals of Fluid Mechanics* (larger version of Munson text)

Email: A course e-mail list has been established, and all students who are registered for the course are automatically subscribed. Although most course information will be transmitted during classtime, email will be used for various announcements regarding homework questions, feedback on exams, etc. Thus, students are expected to check their email on a regular and frequent basis.

Web site: A course web site will be established through Desire2Learn. This web site will contain some basic information on the course, but is not intended to duplicate all announcements, deadlines, etc. communicated during class or via email.

Prereq: ENGR 261 (minimum grade of C).
Coreq: MATH 236.

Learning Goals

The overall aims of this course is to (i) formulate mechanical-engineering fluids problems in mathematical terms by employing the appropriate balances and/or correlations, (ii) to solve the resulting equations using an appropriate solution method, and (iii) to analyze experimental and theoretical results in both a qualitative and quantitative manner.

Learning Activities

Lectures – meet Tuesdays, Thursdays from 10:00 – 11:20 PM in AEC 204. As a courtesy to the instructors and your fellow classmates, all cell phones, text messaging devices, music players, etc. that can cause distractions during the lecture should be turned off. If you need to receive or make a communication during this time, please do so outside of the lecture room.

Homework

- See HW approach guide further below. Points may be deducted if this approach is not followed.
- Assignments are due at the start of class. If a student comes to class late, his/her homework should be handed in at end of class and will be marked as “late”; 10% will be deducted from late homeworks except for the first instance, which will not be penalized. Homeworks that are handed in during lecture will be penalized by 25%; no exceptions will be granted. Homeworks will not be accepted after the end of class. Exceptions are made in the case of illness, only if proper documentation of the illness is provided. Arrangements should be made in advance in the case of trips out of town. Work will normally be due in advance of such trips.
- Although the total points of various homework sets may vary, all will be normalized and weighted equally at the end of the course. At the end of the semester, the lowest homework grade will be dropped, and no exceptions will be made to drop additional homeworks.
- Each student will hand in her/his own homework assignment. Discussion of homework problems with fellow students is allowed and encouraged; however, direct copying from *any* source is not permitted. If it is believed that a homework set has been graded unfairly, please resubmit within one week for re-grade of entire assignment; include cover page that describes specific concerns on grading.
- For some assignments, only selected problems may be graded. No prior indication will be given.
- On the front page of each homework set, the CU honor pledge should be written and signed by the student. The specific text for the pledge is “On my honor, as a University of Colorado at Boulder student, I have neither given nor received unauthorized assistance on this work.”
- Each new problem should be started on a new page. The full name of each student should be given in the upper-right-hand corner of each page, along with consecutive page numbers. The homework set should be stapled prior to handing in.

Exams

- The exams will be given during scheduled class time. Exams will be closed note, open book. You are permitted one *hand-written* note sheet (front and back). Print outs from the course textbook are permitted.
- If exam accommodations are needed, please provide documentation at least one week in advance.
- No make-up exams will be given. If there is an extreme emergency, contact me *before* exam date for permission to be excused. If excused, the average of the other two exams will be used. If more than one exam is missed, a F will be given for the course.
- Note that for electronic devices other than calculators are not allowed, so if you have an electronic version of the text, printouts of relevant sections would need to be made prior to the exam.
- If it is believed that an exam has been graded unfairly, please resubmit within one week for re-grade of entire exam; include cover page that describes specific concerns on grading.

Grading

Achieving the grade shown will guarantee the corresponding letter grade. Individual requests for extra credit will not be granted.

Homework	20%	A-	90.00
CI completion (2)	4%	B-	80.00
Midterms (2)	42%	C-	70.00
Final Exam	24%	D-	60.00
Project	10%	F	< 60.00
Class participation	1% (EC)		

Important Dates

Oct. 6 (Thursday)	Exam #1 (all exams during class)
Nov. 3 (Thursday)	Exam #2

Project

A group project will be due during the final two weeks of the semester. This project will be to explain, in both written and oral form, the answer to some puzzling questions using principles of fluid mechanics. More details on the project will be handed out later in the semester.

Tentative Schedule

Week	Chapter	Topic	Monday of Week	Tentative Reading
1	1	Intro, Basics	22-Aug	1 -- 16
2	2	Statics	29-Aug	32 - 47
3	2		5-Sep	47 - 52, 57 - 60
4	3	Bernoulli's Eqn	12-Sep	68 - 92
5	3		19-Sep	94 - 96
6	4, 5	CV Macroscopic Balances	26-Sep	Ch. 4, 125 - 131
7	5	(of mass, momentum)	3-Oct	133 - 144
8	6	Differential Balances	10-Oct	175 - 177
9	6	(of mass, momentum)	17-Oct	182 - 185
10	7	Dimensional Analysis	24-Oct	238 - 268
11	8	Viscous Flow	31-Oct	274 - 307
12	8		7-Nov	
13	9	External Flow and	14-Nov	321 - 327, 341 - 361
14	9	Boundary Layers	21-Nov	
15	N/A	Computational Fluid Dynamics	28-Nov	
16	N/A	Talks (time permitting)	5-Dec	

Quality and Presentation of Written Work

Written work in this course must satisfy a quality standard. If it does not, it will be returned to the student ungraded and a zero grade will be recorded. Presentation must be neat and organized. Problem solutions involving derivations and calculations must include explanatory comments between steps and results must be set off clearly. The units must be clearly labeled. Homework assignment solutions must be white paper if typed or computer-printed. Take the time to make your work presentable!

Academic Ethics

If a student violates academic ethics in this course, the consequences will be an automatic F in the course, a letter of reprimand placed in the student's College file, and referral of the matter to the Honor Council for possible further action. The basic rule is that a student may not present as their own the work from any other source.

All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at

<http://www.colorado.edu/policies/honor.html> and at <http://www.colorado.edu/academics/honorcode/>.

Classroom Behavior

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. See policies at <http://www.colorado.edu/policies/classbehavior.html> and at http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code.

Disabilities

If you qualify for accommodations because of a disability, please submit to your professor a letter from Disability Services in a timely manner (for exam accommodations provide your letter at least two weeks prior to the exam) so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact Disability Services at 303-492-8671 or by e-mail at dsinfo@colorado.edu.

If you have a temporary medical condition or injury, see Temporary Injuries under Quick Links at [Disability Services website](#) and discuss your needs with your professor.

Observance of Religious Holidays

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, if course attendance or an exam date conflicts with the observance of a religious holiday, the student must notify the instructor at least two weeks in advance so that appropriate accommodations can be made. See full details at http://www.colorado.edu/policies/fac_relig.html.

Discrimination and Harassment

The University of Colorado at Boulder policy on Discrimination and Harassment, the University of Colorado policy on Sexual Harassment and the University of Colorado policy on Amorous Relationships apply to all students, staff and faculty. Any student, staff or faculty member who believes s/he has been the subject of sexual harassment or discrimination or harassment based upon race, color, national origin, sex, age, disability, creed, religion, sexual orientation, or veteran status should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550. Information about the ODH, the above referenced policies and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at <http://www.colorado.edu/odh>.

Approach to Problem Solution

Mechanical Engineering Fluid Mechanics

The following step-by-step approach to problem solution is highly recommended for all work in this course. As steps #1-6 are most important for the *learning* of the material, the majority of points will be placed on these steps. Points may be deducted if this approach is not followed. Be sure to be neat and staple your assignment.

- 1.) Restate, in a concise fashion, the (known) information that is given in the problem statement (with units). For quantities in which the nomenclature is not obvious, be sure to define accordingly.
- 2.) Draw a schematic diagram of the physical system under consideration. Label each of the quantities pertaining to the diagram, including distances, fluid properties, boundaries, etc. Also, define the coordinate direction.
- 3.) Identify what information needs to be found (unknowns) and their units.
- 4.) List the appropriate mathematical relationships (force balance, momentum balance, ideal gas law, etc.) necessary to solve the problem.
- 5.) List all assumptions (steady-state, incompressible fluid, etc.) appropriate to problem.
- 6.) Solve the governing equations to completion (integration, solution of algebraic expressions, etc.) prior to the substitution of numerical values.
- 7.) Substitute known numerical values using a consistent set of units, and solve for the numerical quantity of interest. Make sure that the number of significant digits is consistent with the data, and draw a box around the final answer.
- 8.) Are the results reasonable (i.e., do they make physical sense)? Are the assumptions used in problem solution valid?