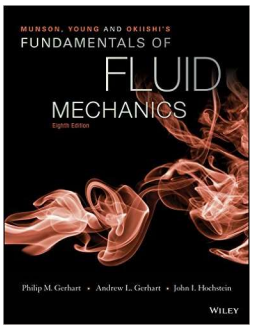

University of California, Merced
ENGR 120
Fluid Mechanics

Fall 2018

Synopsis: This is intended as a first course in fluid mechanics, and includes an Introduction to fluid properties, fluid statics, conservation of mass, energy and momentum, and internal and external flow. Topics include hydrostatic pressure, hydraulic head, friction losses, laminar and turbulent flow, pipe flow, open-channel flow, flow through porous media, and dimensional analysis.

Expected Learning Outcomes: Students completing this course will understand basic fluid mechanics, including fluid properties, fluid statics, the origin of conservation of mass, energy and momentum equations and their application to a range of internal and external flow problems, and laminar and turbulent flow conditions. They will also acquire an introductory knowledge of dimensional analysis, open-channel flow, and flow through porous media. Finally, students will gain experience and skills in with experimentation and data analysis for fluidic systems and creating simple designs for fluidic components and systems.

More specifically, upon completion of this course students will be:

- Able to perform unit conversions related to basic fluid properties, fluid statics, and fluid dynamics.
- Able to analyze hydrostatic forces and moments on submerged and partially submerged surfaces.
- Able to construct an appropriate control volume for a given engineering system and apply the conservation principles of mass, momentum, and/or energy to the control volume.
- Ability to apply differential analysis to the conservation principles of mass, momentum, and/or energy to describe flow characteristics in a flow field.
- Apply dimensional analysis to determine appropriate dimensionless parameters and use the parameters for scaling and other model/prototype problems.
- Able to analyze steady-state flow problems in pipes and open-channel flow, and specify appropriately sized components for a fluid flow system.
- Able to define terms associated with external incompressible flows such as drag, lift, friction and how to estimate these values.
- Able to design and conduct experiments, analyze data, and communicate results in written and oral technical reports.
- Familiar with conception and documentation of the design of simple fluidic systems (e.g., pumps and piping, etc.).

Prerequisites: ENGR 057 and MATH 024 (can be taken concurrently)

Faculty Instructor: Robert Rice, School of Engineering, Department of Civil and Environmental Engineering

Office Hours: **regular office hours (COB1 365) Monday, 4 – 5:30P** or by appointment (in person, by phone 228-4397, or by email (rrice@ucmerced.edu). *Don't hesitate to email me and the TAs---often confusion can be cleared up quickly, and without waiting for office hours!*

Teaching Assistants:

Okan Ciftci (ociftci@ucmerced.edu)

Benyamin Naranjani (bnaranjani@ucmerced.edu

TA Office Hours:

Okan Ciftci, TBD, SE2 1st floor atrium

Benyamin Narajani, TBD, SE2 1st floor atrium

Lectures: Monday/Wednesday 6:30 – 7:45 PM, COB2 140

Lab Sections: The lab meets in SE2 150. **NOTE:** Enrollment is high in this class, so please stay with the lab section for which you registered.

Monday (02L): 1:30 – 4:20PM (Benyamin Narajani)

Wednesday (03L): 10:30 – 1:20PM (Benyamin Narajani)

Friday (04L): 10:30 – 1:20PM (Okan Ciftci)

Friday (05L): 1:30 – 4:20PM (Okan Ciftci)

Textbooks and Supplementary Reading Materials: Readings will be assigned on a regular basis from the required textbook listed below and from class handouts (see schedule). These readings will be supplemented by class notes distributed at the lectures and available on the website. The following textbook is required and is available for purchase at the campus bookstore:

Fundamentals of Fluid Mechanics, 8th Edition, Munson, Young, Okiishi and Huebsch, 8th edition, ISBN 9781118116135, Wiley (2013).

Course Web Site: Course information, including the semester schedule for lecture slides, some handouts, and all assignments and their due dates, is available at the course web site. You can access the course site through Cat Courses: https://canvas.ucmerced.edu/courses/11276.

WileyPlus Web Site: Supplementary material (i.e. practice problems, videos) as well as homework assignments are accessed through the following site: www.wileyplus.com/class/593712.

Course Workload & Grading

Grading: The course grade is determined by performance on problems sets, examinations, and lab reports. Note that attendance is highly recommended for lectures, and mandatory for lab sections. Grades are distributed as follows:

Work Product	**Points**	
Problem sets	**10%**	**(10 sets, drop lowest score)**
Design Problems	**5%**	
Labs	**10%**	**(6 Labs, drop lowest score)**
Exam 1	**15%**	
Exam 2	**15%**	
Exam 3	**15%**	
Final Exam	**30%**	
Total	**100%**	

3 exams -- see lecture schedule; subject to change with lecture pace, etc.

Final exam -- 3:00 – 6:00 PM Thursday, December 13, COB2 140.

All examinations for this course will be closed book and will consist of mixtures of short fundamental questions, and (primarily) problems to solve. The examinations will be designed to test knowledge of concepts and definitions important to an understanding of fluid mechanics, and problem solving skills. Questions on these topics will be drawn from the material presented in lecture and from the homework assignments.

Problem sets (homework assignments) are due on roughly a weekly basis (due dates will be clearly indicated on the assignment). You are strongly encouraged to try the homework on your own first, but you can work together with other students (please make sure you are doing your part to understand the material or you will likely have difficulties with the exams!). *These assignments must be completed in a professional manner on engineering gridded paper (neat/legible, with work process and logic made clear), and will be graded on appearance, effort, and correctness of approach (grading rubric will be provided).* There will be 10 problems sets, and you will be allowed to drop your lowest score. Note, homework will not be graded if not completed on engineering paper.

Labs grades will be based on attendance and participation in the lab, and on the lab report (due 1 week after your lab). The format for lab reports will be provided at the time of the lab (grading rubric will be provided). There will be 6 labs, worth 10 points each, and you will be allowed to drop your lowest score. You **must complete** 5 of 6 labs with a cumulative lab average of 70% in order to pass the course.

Policy on late assignments: Late assignments will not be accepted. Sorry for the need to be strict about this, but it becomes difficult to manage all the assignments with a large class otherwise.

Cell Phone Policy: Anyone texting, social networking, etc. during class will be politely asked to pack-up and continue all activities outside of the classroom. You will be done for the day.

Academic Dishonesty Statement

1. Each student in this course is expected to abide by the University of California, Merced's Academic Honesty Policy. Any work submitted by a student in this course for academic credit will be the student's own work.
2. You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e mail, an e mail attachment file, a diskette, or a hard copy. Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Policy can also be extended to include failure of the course and University disciplinary action.
3. During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.

Accommodations for Students with Disabilities: The University of California Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities based on the principles of independent living, accessible universal design and diversity. I am available to discuss appropriate academic accommodations that may be required for student with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances. Students are encouraged to register with Disability Services Center to verify their eligibility for appropriate accommodations.

ENGR 120 Fluid Mechanics (Fall 2018)

Instructor: Robert Rice, COB1 365
(209) 228-4397 rrice@ucmerced.edu

TAs: Okan Ciftci (ociftci@ucmerced.edu)
Benyamin Naranjani
(bnaranjani@ucmerced.edu)

This is intended as a first course in fluid mechanics. Topics include: fluid properties; fluid statics; conservation of mass, energy, and momentum equations; pipe and other internal flow; Bernoulli equation; hydrostatic pressure; dimensionless numbers; laminar and turbulent flow; velocity head; friction losses (e.g., pipe, valves, fittings); pipe networks; flow measurement; pumps, turbines, and compressible gas flow.

Course Schedule

NOTES:

1) Check on-line for updates! (https://canvas.ucmerced.edu/courses/11276)
2) Many of the assignments will be delivered through the course website (including opening dates, due dates) under the tabs for "assignments" and "resources", as well as Wiley Plus, www.wileyplus.com/class/593712.
3) Sometimes we need to change the schedule, EXAM DATES, etc to accommodate travel, illnesses, etc. **(*** so please read your ENGR 120 Cat Courses announcements)**
4) Note, W+ = WileyPlus assignment

Date	Lecture	Subject and Reading
Aug 22 (Wed)	1	Course overview + Dimensions, units, properties **Reading: Ch 1 (Munson *et al*.)** **Homework 1 Problems: Ch. 1(W+, W+, 68, 73, W+, 86)**
Aug 27 (Mon)	2	Fluid Statics: Pressure, fluid compressibility **Reading: Ch 2 (2.1 - 2.5)**
Aug 29 (Wed)	3	Fluid Statics: Hydrostatic forces, Buoyancy, Rigid body motion **2.6 - 2.12** *****Homework 1 due (COB1 365 - 6:30PM)***** **Homework 2 Problems: Ch. 2(42, 64, W+,W+, 110, 123)**
Sept 3 (Mon)	-	No Class-Labor Day
Sept 5 (Wed)	4	Bernoulli equation **Reading: Ch. 3 (3.1 – 3.4)** **Homework 3 Problems: Ch.3(3, W+, 24, 33, 51, 95, W+)** *****Homework 2 due (COB1 365 – 6:30PM)*****
Sept 10 (Mon)	5	Bernoulli equation **Reading Ch. 3 (3.5 – 3.9)**
Sept 12 (Wed)	6	Exam Review *****Homework 3 due (COB1 365 – 6:30PM)*****
Sept 17 (Mon)	-	**Exam #1 Chapters 1 through 3**
Sept 19 (Wed)	7	Bernoulli equation **Reading Ch. 3 (3.5 – 3.9)** **Homework 4 Problems: Ch.3(W+, 24, 33, 51, 95, W+)**

Sept 24 (Mon)	8	Fluid Kinematics: Velocity Fields and Streamlines and Acceleration and Reynolds transport theorem **4.1 – 4.5**
Sept 26 (Wed)	9	Reynolds transport theorem; Conservation of mass (Continuity eq.) **Reading Ch. 5.1** *****Homework 4 due (COB1 365 -5PM)***** **Homework 5 Problems: Ch.4(3, 4, 8, 10, 18, W+, 35)**
Oct 1 (Mon)	10	Linear momentum (Newton's 2nd Law) **Reading Ch. 5.2**
Oct 3 (Wed)	11	Linear momentum (Newton's 2nd Law) **Reading Ch. 5(5.2-5.3)** *****Homework 5 due (COB1 365 -5PM)***** **Homework 6 Problems: Ch. 5(3, 12, W+, W+, 5.38, 5.45)**
Oct 8 (Mon)	12	1st and 2nd Laws of Thermodynamics **Reading Ch. 5(5.3 – 5.4)**
Oct 10 (Wed)	13	Fluid Element Kinematics **Reading Ch.6(6.1 – 6.2)** *****Homework 6 due (COB1 365 -5PM)***** **Homework 7 Problems: Ch.6(3, 12, W+, W+, 38, 45)**
Oct 15 (Mon)	14	Conservation of momentum; inviscid flow **Reading Ch.6(6.3 - 6.4)**
Oct 17 (Wed)	15	Exam review *****Homework 6 due (COB1 365 -5PM)*****
Oct 22 (Mon)	-	**EXAM #2 Chapters 4 through 6.4**
Oct 24 (Wed)	16	Plane Potential Flows **Reading Ch. 6(6.5-6.6)** **Homework 7 Problems: Ch. 5(97, 99, 106, 124) and Ch. 6(8)**
Oct 29 (Mon)	17	Navier-Stokes equations **Reading Ch. 6(6.8-6.9)**
Oct 31 (Wed)	18	*****Homework 7 due (COB1 365 –5PM)***** **Homework 8 Prob: Ch. 6(W+, W+, W+, 55, 68)**
Nov 5 (Mon)	19	Navier-Stokes equations
Nov 7 (Wed)	20	Dimensional analysis and similitude **Ch 7** *****Homework 8 due (COB1 365 –5PM)***** **Homework 9 Problems Ch. 6(78, W+) and Ch. 7(11, 41, 51, W+, 74)**
Nov 12 (Mon)	21	Laminar flow in pipes **Reading Ch. 8 (8.1 – 8.2)**
Nov 14 (Wed)	22	Exam 3 Review *****Homework 9 due (COB1 365 –5PM)*****
Nov 19 (Mon)	**-**	**Exam #3 Chapters 6, 8, 9**
Nov 21 (Wed)	**-**	**Gobble – Gobble, no class**

Nov 26 (Mon)	23	Turbulent flow in pipes **8.3 – 8.4** **Homework 10 Problems: Ch. 12(W+, 16, 17, 20)**
Nov 28 (Wed)	24	Turbomachinery (Pumps, Turbines) **12.1 - 12.3**
Dec 3 (Mon)	25	Turbomachinery (Pumps, Turbines) **Reading Ch. 12(12.4 - 12.6)**
Dec 5 (Wed)	26	Final Exam Review **Homework 10 Problems:** *****Homework 10 due (COB1 365 –5PM)*****
Dec 13 (Th)	**FINAL**	***** FINAL EXAM 3:00 – 6:00pm COB2 140*****

LAB SCHEDULE

NOTES:

1) Check on-line for updates! (https://canvas.ucmerced.edu/courses/11276)
2) You **must attend your scheduled lab section** unless you make special arrangements in advance with the TAs responsible for the sections.
3) You **must complete** 5 of 6 labs with a cumulative lab average of 70% in order to pass the course.

Week of…	Lab	Topics and Due Dates
Aug 20	-	NO Lab meeting this week
Aug 27	1	Lab #1: Safety Session + **Pressure, hydr. head and error analysis**
Sept 3	--	**Report on Lab #1 due**; NO LAB this week
Sept 10	2	Lab #2: Buoyancy and Archimedes' Principle
Sept 17	--	**No Lab meeting this week**
Sept 24	--	**Report on Lab #2** due; NO LAB this week
Oct 1	3	Lab #3: Pitot-static tube (wind tunnel – 1)
Oct 8	--	**Report on Lab #3**; NO LAB this week
Oct 15	4	Lab #4: Noninvasive pipe flow sensing
Oct 22	--	**Report on Lab #4** due; NO LAB this week
Oct 29	5	Lab #5: Flow over immersed objects (wind tunnel – 2)
Nov 5	--	**Report on Lab #5 due**; NO LAB this week
Nov 12	--	**No Lab meeting this week**
Nov 19	--	**No Lab meeting this week - Gobble-Gobble**
Nov 26	6	Lab #6: Open channel control structures (siphon weir)
Dec 3	--	**Report on Lab #6 due**; NO LAB this week