Department of Civil and Environmental Engineering

CIVE 300 - Fluid Mechanics (Spring 2018)

Instructor
Professor Karan Venayagamoorthy
Email: vskaran@colostate.edu
Website www.engr.colostate.edu/~vskaran
Tel: (970) 491-1915

Office hours: MW 1.30 –2.30 PM in A207E – Engineering Building, or by appointment

Teaching Assistants: Matthew Klema, A4A Engineering (adjacent to Thermal/Fluids Laboratory) 491-4897.
Office hours: **F 1.00 PM– 3.00 PM**

Mason Garfield, A4A Engineering (adjacent to Thermal/Fluids Laboratory) 491-4897.
Office hours: **TR 12.30 PM– 1.30 PM**

Lectures: MWF 10.00 -10.50 AM, Wagar 133

Class website: https://colostate.instructure.com/

Textbook: Fundamentals of Fluid Mechanics – 8th edition, by by Philip Gerhart, Andrew Gerhart and John Hochstein, John Wiley and Sons, 2016.

Laboratory Course (CIVE301): This is a required one credit course. It is best you take this course concurrently with CIVE300 to maximize your learning experience. A syllabus for the laboratory component, along with details on preparation and submission of lab reports, will be provided in the first lab session to be held during the second week of classes.

Course Prerequisite: CIVE 261 - Engineering Mechanics – Dynamics, Math 340 - Differential Equations (or concurrent registration) and MECH237/MECH337 (or concurrent registration).

Overview: This is an introductory course in fluid mechanics/hydraulics for Civil Engineers. From water supply to stormwater drainage and flood routing to design of hydraulic structures to pollutant transport, a thorough understanding of civil and environmental engineering systems requires an excellent working knowledge of the fundamentals of fluid mechanics. CIVE 300 is also a prerequisite for hydraulic engineering (CIVE 401), advanced fluid mechanics (CIVE502), fluid turbulence (CIVE604), computational fluid dynamics (CIVE607) and possibly many other courses.

Course Objectives: By the end of this course, you should expect to be able to:

- Develop a clear understanding of the basic physical principles that govern the static and dynamic behavior of fluids.
- Have the ability to apply analytical and mathematical skills needed to describe and predict fluid behavior.
- An ability to apply fundamental principles and skills to the engineering solution of some practical fluid systems problems such as flow in pipes and open channels.

You should also expect to:

- Take responsibility for your learning
    - Read textbook on your own
    - Ask questions from me, your classmates and yourself
    - Turn in excellent assignments demonstrating your knowledge of the solution
- Tap into your existing intuition, strengths, and passion to learn fluid dynamics
- Become an active participant in your fluid mechanics education, taking full advantage of lectures, texts, homework, office hours and everyday life!

COURSE LOGISTICS

Course website: https://colostate.instructure.com/. The Canvas website will be used to post homework assignments and solutions, practice exams, lecture notes, announcements etc. You can also check your grades online.

Textbook and reading assignments: *Fundamentals of Fluid Mechanics* – 8th edition, by Philip Gerhart, Andrew Gerhart and John Hochstein, John Wiley and Sons, 2016. Reading will be assigned periodically to complement lectures. Students are expected to read the assigned material prior to the corresponding lecture. You are responsible for the material in the assigned sections of the textbook as well as for what is presented in lectures.

Homework: Assignments will be posted weekly on the Canvas class webpage. Please note that reading assignments may be examined via pop-up quizzes. **Home works are due by the end of class every Friday**. **No late homework assignments will be accepted except for legitimate reasons acceptable to the instructor**. Note that though all problems must be turned in, three problems out of each homework assignment will be indicated by the instructor as candidates for grading and only one of those three will be thoroughly graded. Points will be deducted for problems that were assigned but not worked. While you are encouraged to discuss assignments with each other, you may not look or copy anyone else's written work.

Your solution to homework problems should:

- Formulate/define the problem
- Indicate the solution procedure clearly
- Draw your conclusions by highlighting the answers with correct units!
- Must be submitted using Engineering paper or letter size white paper.

- All homework submissions should be stapled, with **Fluid Mechanics CIVE 300 – Spring 18, Assignment No., Name and CSUID** written on top of first page. Please write your name on top of all other pages in case bindings get loose.

You are expected to arrange your work in a neat and orderly manner. This will not only help others to understand your work but will aid your thought process.

Exams: There will be 2 midterm exams and a final exam. Material in the exams will be drawn from lectures and the textbook. Collaboration or copying from others during an exam will not be tolerated and may result in zero credit and referral to Student Conduct Services. All exams are closed book. However, I will allow each student to bring in one single-sided letter size paper with his/her handwritten notes and formulae. No other resources will be allowed during the exams.

Course Evaluation: Assignments and exams will be weighted as follows:

Homework	10%
Quizzes, other assignments & attendance	10%
2 Midterm exams (25% each)	50%
Final Exam	30%

Term grades for this course will use the +/- grading system as described in the CSU catalog. Grading will be assigned according to a traditional grade scale at a minimum, i.e. A=90-100%, B=80-89%, C=70-79%, D=60-69, F <60%.

Makeup exam policy: For folks who can not attend regular exams due to university business duty, serious illness, or family emergency (all with written proof or statement), a makeup exam may be arranged AFTER the regular exam. Please inform the instructor as soon as possible. No exceptions will be made without a legitimate reason and a timely arrangement. There are no make-ups for pop-up quizzes.

Academic Integrity: Academic dishonesty is a serious issue. University rules including academic penalty and further investigation by the university authorities will be strictly enforced in this course. *Please note that this course will adhere to the Academic Integrity Policy of the Colorado State University General Catalog (Page 7) and the Student Conduct Code*." Please review these documents for details regarding these rules. Also, the honor pledge system will be used in this course. The following honor pledge (not compulsory) shall be included in all exams and assignments in this course:

***I pledge on my honor that I have not received or given any unauthorized assistance in this exam (replace with assignment as required),* followed by your signature.**

How to survive and thrive in this course: Find a study group! Take advantage of office hours! If you have a question, ask it. Enjoy the fascinating subject of fluid mechanics and its numerous applications in engineering!

Main Topics

1. Fundamental Concepts Relating to the Characteristics of Fluids
    - Continuum formulation
    - Viscosity
    - Pressure

2. Fluid Statics
    - Hydrostatic pressure distribution
    - Forces on submerged surfaces
    - Stability of floating bodies

3. Fluid Kinematics and Governing Principles of Fluid Motion
    - Control Volumes and Reynolds Transport Theorem
    - Conservation of mass (continuity)
    - Conservation of momentum
    - Conservation of energy
    - Simple applications

4. Dimensional Analysis and Similitude
    - Dimensional analysis/Buckingham Pi theorem
    - Modeling and similitude

5. Viscous Flow in Ducts and Conduits
    - Laminar and turbulent flows
    - Pipe flow examples
    - Pipe flow rate measurement

6. Flow over Immersed Bodies
    - General external flow characteristics
    - Boundary layer characteristics
    - Drag and Lift, Drag Coefficients

7. Open Channel Flow
    - Steady flow in open channels
        - uniform flow
        - specific energy
        - critical flow
        - surges/hydraulic jumps
        - gradually varied flow

TENTATIVE COURSE S7HEDULE:

Jan. 16 First lecture
February 28 Midterm Exam #1
April 9 Midterm Exam #2
May 4 Last lecture
May 10 Final Exam **7.30 - 9.30 am**!

Week of (week #)	**Topics**	**Reading (Text Chapters**
Jan. 15 (1)	Introduction to Fluid mechanics, Dimensions, Units, Analysis of Fluid Behavior, Fluid Properties	1.1-1.9
Jan. 22 (2)	Fluid Properties, Fluid Statics – Pressure Distribution,	1.6-1.9, 2.1-2.4,
Jan. 29 (3)	Fluid Statics – Gages, Manometers, Force on Plane Surface, Force on Curved Surface,	2.5-2.7, 2.8-2.9, 2.10-2.11
Feb. 5 (4)	Fluid Statics – Buoyancy, Flotation and Stability, Pressure Variation in a Fluid with Rigid-Body Motion, Bernoulli Equation	2.11-2.12, 3.1-3.2
Feb. 12 (5)	Pressure Variation Normal to a Streamline, Static, Stagnation, Dynamic and Total pressure, Energy line and Hydraulic Grade Line, Restrictions	3.3-3.6 3.7-3.8
Feb. 19 (6)	Fluid Kinematics, Control Volumes and Reynolds Transport Theorem	4.1-4.2, 4.3-4.4
Feb. 26 (7)	Conservation of Mass – The Continuity Equation, The Linear Momentum Equation **Midterm #1 (Feb. 28), Evening Exam**	5.1-5.2
Mar. 5 (8)	The Principle of Linear Momentum, Energy Equation,	5.2, 5.3
Mar. 12 (9)	**SPRING BREAK – NO CLASSES**	
Mar. 19 (10)	Dimensional Analysis, Similitude and Modeling	7.1-7.4, 7.5-7.9
Mar. 26 (11)	Viscous Flow in Pipes, Characteristics of Pipe flow, Laminar Flow	8.1-8.2
April 2 (12)	Turbulent Flow in Pipes, Losses in Pipe Flows, Pipe Flow Examples	8.3-8.5
April 9 (13)	**Midterm #2 (April 9), Evening Exam** Flow over Immersed Bodies – External Flow, Lift and Drag Concepts, Boundary Layer Characteristics	9.1-9.2
April 16 (14)	Friction drag and Pressure Drag, Drag Coefficients. Open-Channel Flow – General Characteristics	9.3, 10.1
April 23 (15)	Open-Channel Flow - Surface Waves, Energy Considerations	10.2-10.3
Apr 30 (16)	Open Channel Flow – Uniform Depth Channel Flow, Review, **Last lecture on May 8**	10.4-10.6
May 10	**Final Exam (7.30 - 9.30 am)!**	