



## ME 030: Fluid Mechanics

Term: 2020 Winter Session

Instructor: Staff

Language of Instruction: English

Classroom: TBA

Office Hours: TBA

Class Sessions Per Week: 5

Total Weeks: 3

Total Class Sessions: 15

Class Session Length (minutes): 240

Credit Hours: 4

### Course Description:

This course addresses the properties of fluids, the principles that govern their behavior and how to apply the laws of motion to both static and moving fluids. Students will discuss topics including: hydrostatics; static forces on submerged surfaces; flowing fluids; Bernoulli's equation; continuity, momentum, and energy equations; differential equations of fluid motion; irrotational flow; dimensional analysis; boundary layer theory; drag and lift; closed conduit flow.

Prerequisites: PHYS 021 General Physics II, CHEM 021 General Chemistry II, and MATH 028 Differential Equations.

### Course Materials:

***Fluid Mechanics: Fundamentals and Applications***, Cengel and Cimbala, 4th Ed., McGraw Hill, 2017

### Course Format and Requirements:

The basic rules of classroom etiquette apply in this course. There is no talking out of turn or during lectures unless called upon to answer a question. If you have a question you will be given every opportunity to ask for the answer. You are encouraged to ask questions since extra credit



may be given for thoughtful questions. You are also responsible for lecture notes, any course material handed out, and attendance in class, while attendance will not to be formally recorded. Active participation in the classroom is a great way to generate the discussion necessary to fully grasp the material.

Laptop and cell phone regulation: Please turn off all cell phones during lecture. No texting during class lectures.

### **Attendance**

Students are expected to attend and participate in class. Strong attendance and participation are good indicators of success. Each student is responsible for all course material, announcements, quizzes and exams made in class, whether or not the student attended that day's class.

### Grading Scale:

**A+: 98%-100%**

**A: 93%-97%**

**A-: 90%-92%**

**B+: 88%-89%**

**B: 83%-87%**

**B-: 80%-82%**

**C+: 78%-79%**

**C: 73%-77%**

**C-: 70%-72%**

**D+: 68%-69%**

**D: 63%-67%**

**D-: 60%-62%**

**F: Below 60%**

### Course Assignments:

#### **Quizzes**

Quizzes will be given on a random basis, sometimes announced ahead of time and others will be unannounced. Make-up quizzes will be given only for excused absences.

#### **Homework**



Homework will be assigned daily and is considered due the following class period. Homework problems may occasionally be collected at the beginning of class and may be graded. No late papers will be accepted, they must be turned in at the beginning of class. Homework must be in acceptable engineering form including a problem statement, labeled drawings of the system considered and all equations and units must be shown or the problem will not be graded.

### Exams

Two midterm exams and a cumulative final examination will be given. Exams will be closed-book and notes unless otherwise announced. Absence at examination time is excusable only in case of illness of the student or similar emergency. An unexcused absence from an exam will result in a zero grade on that exam. If an error has been made in grading your exam, you must resubmit your entire exam for regrading.

### Course Assessment:

Quizzes 5	10%
Homework	10%
Midterm Exams 1	25%
Midterm Exams 2	25%
Final Exam	30%
<b>Total</b>	<b>100%</b>

### Course Schedule:

Class 1	Class 2
Overview of the course; Go through syllabus; Concept of a Fluid; The Fluid as a Continuum	Dimensions and Units; Properties for the Velocity Field; Thermodynamic Properties of a Fluid; Viscosity and Other Secondary Properties; Basic Flow Analysis Techniques
Class 3	Class 4
Flow Patterns: Streamlines, Streaklines, and	Hydrostatic Pressure Distributions;



<p>Pathlines;          Pressure Distribution in a Fluid;          Pressure and Pressure Gradient;          Equilibrium of a Fluid Element;</p>	<p>Application to Manometry          Hydrostatic Forces on Plane Surfaces;          Hydrostatic Forces on Curved Surfaces;          Hydrostatic Force in Layered Fluids;          Buoyancy and Stability;</p>
Class 5	Class 6
<p><b><u>Midterm Exam 1</u></b></p> <p>Forces on flat, submerged surfaces;          Forces on curved submerged surfaces</p>	<p>Forces on flat, submerged surfaces (Cont.);          Forces on curved submerged surfaces (Cont.);          Pressure Distribution in Rigid-Body Motion;          Pressure Measurements</p>
Class 7	Class 8
<p>Integral Relations for a Control Volume;          Newton's Second Law:  <math>F=ma</math> along a Streamline;  <math>F=ma</math> Normal to a Streamline;          Physical Interpretation          Introduction to Bernoulli's Equation;          Static, Stagnation, Dynamic and Total Pressure;</p>	<p>Bernoulli's Equation – Theory;          Example of Use of the Bernoulli Equation          The Energy Grade Line and the Hydraulic Grade Line;          Restrictions on the Use of the Bernoulli Equation</p>
Class 9	Class 10
<p>Fluid Kinematics;          The Velocity Field;          The Acceleration Field          Control Volume and System Representations          Control Volume Analysis (CVA);</p>	<p><b><u>Midterm Exam 2</u></b></p> <p>Conservation of Mass - The Continuity Equation;          Newton's Second Law - The Linear Momentum;          The First Law of Thermodynamics - The Energy Equation</p>
Class 11	Class 12
<p>Similitude, Dimensional Analysis, and</p>	<p>Modeling and Similitude;</p>



Modeling; Buckingham Pi Theorem; Determination of the Pi Terms; Common Dimensionless Groups in Fluid Mechanics;	Viscous Flow in Pipes; General Characteristics of Pipe Flow Pipe Flow – Laminar;
Class 13	Class 14
Pipe Flow – Turbulent; Pipe Flow – Minor losses, Open Channel Flow; Differential Analysis: Conservation of Mass; Stream Function Differential Analysis: Newton’s 2nd Law	N-S Equations; Basic solutions; Dimensional Analysis of Pipe Flow; Pipe Flow Examples; Flow Over Immersed Bodies; General External Flow Characteristics; Boundary Layers: Basic Equations;
Class 15	<b><u>Final Exam (Cumulative): TBA</u></b>
Flat Plate BL    Boundary Layers: $\delta$ , $\delta^*$ and $\theta$ ; Turbulent boundary; Layers; Drag; Lift	

**Academic Integrity:**

Students are encouraged to study together, and to discuss lecture topics with one another, but all other work should be completed independently.

Students are expected to adhere to the standards of academic honesty and integrity that are described in the Shanghai Normal University’s *Academic Conduct Code*. Any work suspected of violating the standards of the *Academic Conduct Code* will be reported to the Dean’s Office.

Penalties for violating the *Academic Conduct Code* may include dismissal from the program. All students have an individual responsibility to know and understand the provisions of the *Academic Conduct Code*.



**Special Needs or Assistance:**

Please contact the Administrative Office immediately if you have a learning disability, a medical issue, or any other type of problem that prevents professors from seeing you have learned the course material. Our goal is to help you learn, not to penalize you for issues which mask your learning.