ME 030: Fluid Mechanics

Term: 2020 Winter Session Instructor: Staff Language of Instruction: English Classroom: TBA Office Hours: TBA
Class Sessions Per Week: 6 Total Weeks: 4 Total Class Sessions: 25 Class Session Length (minutes): 145 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%
Total	**100%**

Course Schedule:

Week 1- Class 1	Week 1- Class 2
Overview of the course; Go through syllabus; Concept of a Fluid	Concept of a Fluid (Cont.); The Fluid as a Continuum; Dimensions and Units; Properties for the Velocity Field;
Week 1- Class 3	Week 1- Class 4
Thermodynamic Properties of a Fluid Viscosity and Other Secondary Properties;	***Quiz 1*** Flow Paterns: Streamlines, Streaklines, and

Basic Flow Analysis Techniques;	Pathlines; Pressure Distribution in a Fluid Pressure and Pressure Gradient;
Week 1- Class 5	Week 1- Class 6
Equilibrium of a Fluid Element; Hydrostatic Pressure Distributions; Application to Manometry	Hydrostatic Forces on Plane Surfaces; Hydrostatic Forces on Curved Surfaces; Hydrostatic Force in Layered Fluids;
Week 2- Class 7	Week 2- Class 8
Quiz 2 Buoyancy and Stability; Forces on flat, submerged surfaces; Forces on curved submerged surfaces	Pressure Distribution in Rigid-Body Motion; Pressure Measurements; Integral Relations for a Control Volume;
Week 2- Class 9	Week 2- Class 10
Midterm Exam 1	Newton's Second Law F=ma along a Streamline; F=ma Normal to a Streamline; Physical Interpretation;
Week 2- Class 11	Week 2- Class 12
Static, Stagnation, Dynamic and Total Pressure; Introduction to Bernoulli's Equation Static, Stagnation, Dynamic and Total Pressure;	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
Week 3- Class 13	Week 3- Class 14
Quiz 3 Fluid Kinematics; The Velocity Field; The Acceleration Field; Control Volume and System Representations	Control Volume Analysis (CVA); Conservation of Mass - The Continuity Equation; Newton's Second Law - The Linear Momentum;

Week 3- Class 15	Week 3- Class 16
Quiz 4 The First Law of Thermodynamics - The Energy Equation Similitude, Dimensional Analysis, and odeling;	Buckingham Pi Theorem; Determination of the Pi Terms Common Dimensionless Groups in Fluid Mechanics;
Week 3- Class 17	Week 3- Class 18
Modeling and Similitude; Viscous Flow in Pipes; General Characteristics of Pipe Flow	***Midterm Exam 2***
Week 4- Class 19	Week 4- Class 20
Pipe Flow – Laminar; Pipe Flow – Turbulent; Pipe Flow – Minor losses, Open Channel Flow	Pipe Flow – Minor losses, Open Channel Flow(Cont.) Differential Analysis: Conservation of Mass; Stream Function;
Week 4- Class 21	Week 4- Class 22
Differential Analysis: Newton's 2nd Law N-S Equations; Basic solutions;	***Quiz 5*** Dimensional Analysis of Pipe Flow; Pipe Flow Examples Flow Over Immersed Bodies;
Week 4- Class 23	Week 4- Class 24
General External Flow Characteristics; Boundary Layers: Basic Equations; Flat Plate BL	Boundary Layers: δ, δ^* and θ; Turbulent boundary; Layers;
Week 4- Class 25	***Final Exam (Cumulative): TBA***
Drag; LiftFlow Review for final	

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.