CHE 215: Fluid Mechanics

General Information:

Term: 2021 Summer Session **Instructor: Staff** **Language of Instruction: English** **Classroom: TBA** **Office Hours: TBA**
Class Sessions Per Week: 5 **Total Weeks: 5** **Total Class Sessions: 25** **Class Session Length (minutes): 145** **Credit Hours: 4**

Course Description:

Welcome to CHE 215 Fluid Mechanics. As one of those important transport phenomena courses for chemical engineering major students, this course will provide an introduction to fluid mechanics on both macroscopic and microscopic basis. We will start with the macro-side, which introduces principles relevant for systematized observations and fluid-based process design. Later in the semester we will learn the microscopic fundamentals to analyze fluid behaviors, like flow patterns, in great detail.

Topics covered include but are not limited to: Mass, energy, and momentum balances on chemical engineering flow processes and system; Fluid flows in pipes and other common fluid flow devices; Differential equations of fluid mechanics, microscale mass and momentum balance, viscous flow problems; Boundary layers, turbulent flows and computational fluid dynamics (CFD).

Course Materials:

Fluid Mechanics for Chemical Engineers: with Microfluidics, CFD, and COMSOL Multiphysics 5, 3rd Edition, 2017

Publisher: Prentice Hall

Language: English

ISBN-10: 013471282X

ISBN-13: 978-0134712826

Software:

Calculations, simulations or visualization assignment through Microsoft Excel (or other spreadsheet software), MatLab will be useful in this course. Optional CFD software discussion session will be announced later this semester.

Course Assignments:

Quizzes:

There will be 5 quizzes given without announcement. That also emphasizes the importance of attendance. These quizzes will be designed based on materials covered in lectures, classroom discussions and homework. There will be No make-up quizzes.

Homework:

There will be 5 homework assignments based on the material presented in the lectures. Practice through homework problem sets is an important part of the course. You must turn in your homework at the beginning of class. Homework must be completed in acceptable engineering form including a problem statement, labelled drawings of the system considered and all equations and units must be shown.

Note that discussion of homework problems with your classmates is encouraged, but all assignments must be completed individually. Late homework will receive a maximum of 60% of its grade.

Exams:

The exams will be closed book and closed notes. There will be three midterms and one cumulative final exam. Only the final exam is cumulative. However, the second and the

third midterms will still cover certain basic principles learned through the whole semester.

Course Assessment:

Homework	10%
Quizzes	15%
Midterm Exam 1	15%
Midterm Exam 2	15%
Midterm Exam 3	15%
Final Exam	30%
Total	**100%**

Grading Scale (percentage):

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 Schedule:

Week	Topics	Activities
1	Introduction to fluid mechanics	Quiz 1

	Concept of a Fluid Review Units & Dimensions; fluid properties Fluid Statics, Pressure Gradient, Hydrostatic Forces, Forces on flat & curved submerged surfaces Mass and energy balances Bernoulli's Equation; Static, Stagnation, Dynamic and Total Pressure	Homework 1
2	Bernoulli's equation and applications; Discussion of restrictions; Macroscale momentum balance; Control Volume Analysis One-dimensional fluid flow in pipes; Non-circular ducts and compressible flow Choking in compressible flow Pressure Drop for compressible pipe flow Friction	Midterm 1 Quiz 2 Homework 2
3	Drag coefficient; Evaluate the drag force Pumps and compressors Flow in chemical engineering equipment Starting from Continuity Equations Differential equations of fluid mechanics Microscale mass and momentum balances The Navier-Strokes Equations	Quiz 3 Homework 3 Midterm 2
4	Laminar Flow, stream function and differential analysis Flow between parallel plates, circular pipes Velocity profile of a turbulent flow	Quiz 4 Homework 4 Midterm 3

	Summary of viscous flow problems Boundary Layers Prandtl Boundary Layer Equations; Boundary Layers of Flow Past a Flat Plate	
5	Flow Complex Boundary Layers; Integral Boundary Layers Turbulence; Turbulent boundary layers; Drag and Lift Theory of lubrication Non-Newtonian Fluids Introduction to CFD (optional: finite volume, finite element, boundary element)	Quiz 5 Homework 5 Final Exam

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 Huazhong University of Science & Technology'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.