CHE 260
Fluid Flow
Fall 2023

Instructor: David C. Venerus
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Office Hours: Mon & Wed 1:00-2:30 PM, or by appointment.

Teaching Assistant: NONE

Course Description: CHE260 - Fluid Flow (3-0-3) This course considers the principles of molecular and turbulent transport of momentum, particularly as they apply to pressure drop calculations in piping systems, packed columns, and other flow devices. Flow around submerged objects is also considered. Prerequisite: CHE 201 or CHE 210, CHE 230; Corequisite: MATH 222

Course Objectives:

1. Provide students with the knowledge and fundamentals of fluid mechanics as well as the tools/skills needed to design complex flow systems, including packed and fluidized beds.
2. Develop mathematical models of physical phenomena and apply these to solve engineering problems in fluid mechanics.
3. Provide exposure to other engineering topics such as process safety, energy conservation, and pollution prevention in designing fluid flow systems.

Textbook: *An Introduction to Chemical Engineering Fluid Mechanics*, William M. Deen (WMD), Cambridge University Press (2016).

Grading: Exam #1 (30%), Exam #2 (30%), Final Exam (30%), Homework (10%)

Canvas: Announcements, Assignments, Solutions, etc., posted at https://canvas.njit.edu/

Homework: Student (hardcopy) solutions must be submitted at the beginning of class on due date; papers submitted after that, but before 4:00 PM (to the CME office only) the following day will lose 10% of grade. One question from each assignment chosen at random will graded.

Exams: Exams will be open textbook (hard copy only); other materials are not permitted.

Important Dates:
October 12 Exam #1
November 13 Last Day to Withdraw
November 21 Exam #2
December 18-22 Final Exam Week

Expectations and Rules:

1. Students are expected to attend all lectures and to be seated before the lecture begins.
2. During class, students are expected to be attentive, take notes, and be prepared to answer questions.
3. Students are expected to have completed the reading assignment before lecture.
4. Students are expected to bring a calculator to all lectures and exams.
5. All exams are open textbook only. Assistance from anyone during an exam is **prohibited**. If there is evidence that a student has received assistance from someone and/or used other materials during an exam, the student will receive a score of **zero** for the exam.
6. Cell phone use is **not** permitted during lectures and exams.

Computer Skills: Several problems will be assigned that require basic numerical methods to solve. It is each student's responsibility to be familiar with the use of computing software such as MS Excel and MATLAB, or similar computing tools.

ADA Statement: Reasonable accommodations will be made for students with documented disabilities. In order to receive accommodations, students must obtain a letter of accommodation from the Office of Accessibility and Resources. Please go to https://www.njit.edu/studentsuccess/accessibility/ for further information.

Academic Integrity: Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu

CHE 260
Fluid Flow
Specific Course Goals

The student will be able to:

1. define what a fluid is and obtain fluid properties
2. work with the units of fluid dynamics variables and convert between different unit systems
3. formulate and solve the equation of hydrostatics
4. classify different types of fluids based on their rheological behavior
5. explain laminar and turbulent flows and calculate Reynolds Number
6. formulate and solve macroscopic (overall) mass and momentum balances
7. formulate and solve differential (shell) mass and momentum balances
8. predict mechanical friction losses based on correlations for different components of pipe systems
9. formulate and solve overall mass and mechanical energy balance equations for flow in pipe systems
10. describe different types of fluid moving devices and their characteristics
11. size (design) a pump based on the use of overall mass and mechanical energy balance equations for flow in pipe systems
12. describe different types of flow measurement devices
13. formulate and solve overall mass and mechanical energy balance equations for different flow measurement devices
14. formulate and solve overall mass and mechanical energy balance equations for flow past immersed objects
15. formulate and solve overall mass and mechanical energy balance equations for flow in packed beds
16. solve equations numerically using appropriate software and writing appropriate code

This course explicitly addresses the ABET student outcomes 1, 3, 4, and 7

CHE 260
Fluid Flow
Outline (WMD)

I. Introduction: fluid properties, dimensions, and scales (1.1-1.5)

II. Flow in pipes and the friction factor (2.1-2.6)

III. Flow past solids and in porous media (3.1-3.6)

IV. Fluid statics (4.1-4.3, 4.5)

EXAM #1

V. Fluid kinematics and the microscopic mass balance (5.1-5.5, 5.7)

VI. Stress and the microscopic momentum balance (6.1-6.7)

VII. Unidirectional flows (7.1-7.4, 7.6)

EXAM #2

VIII. Turbulent flow (10.1-10.3, 10.7)

IX. Macroscopic balances for mass, momentum, and energy (11.1-11.6)

X. Flow in pipeline systems: friction losses and pumps (12.1-12.3, 12.6)

FINAL EXAM