CHE 260
Fluid Flow
Spring 2025

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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 (hard copy) solutions must be submitted at the beginning of class on due date; papers submitted after that, but before 4:00 PM (hard copy) the following day will lose 10% of grade.

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

Important Dates:
February 25 Exam #1
April 7 Last Day to Withdrawal
April 8 Exam #2
May 10-16 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

AI Policy: This course expects students to work without artificial intelligence (AI) assistance in order to better develop their skills in this area. As such, AI usage is not permitted throughout this course under any circumstance.

CHE 260
Fluid Flow
Specific Course Goals

The student will be able to:

1. define what a fluid is and understand fluid properties
2. work with the units of fluid dynamics variables and convert between different unit systems
3. classify different types of fluids based on their rheological behavior
4. understand scales and basic dimensional analysis
5. qualitatively explain laminar and turbulent flows and calculate Reynolds Number
6. know the definition for the friction factor and be able to compute it
7. analyze pressure-driven flow in pipes and other conduits
8. know the definition for the drag coefficient and be able to compute it
9. be able to compute the terminal velocity of an object
10. analyze flow in porous media
11. formulate and solve the equation of hydrostatics
12. understand the concepts of velocity and deformation in fluid mechanics
13. derive and apply the microscopic mass balance (continuity equation)
14. understand the concepts of the stress vector and tensor in fluid mechanics
15. derive and apply the microscopic momentum balance (Cauchy and Navier Stokes equations)
16. solve microscopic mass and momentum balances for unidirectional flows
17. understand the concepts of time-averaging and Reynolds stress
18. derive and apply the macroscopic balances for mass, momentum, and mechanical energy
19. describe different types of fluid moving devices and their characteristics
20. analyze and design a pipeline system using macroscopic mass and mechanical energy balances

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 (4.1-4.5)

EXAM #1

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

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

VII. Unidirectional flows (7.1-7.7)

EXAM #2

VIII. Turbulent flow (10.1-10.4, 10.7)

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

X. Flow in pipeline systems: friction losses and pumps (12.1-12.4, 12.6)

FINAL EXAM