Fall 2020

CHE 260-001: Fluid Flow

David Venerus

CHE 260
Fluid Flow
Fall 2020

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Office Hours: Fri 9:30 AM -12:00 PM, or by appointment.

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 230; Corequisites: CHE 240 and 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 Fluid Mechanics (IFM), 1st Ed.*, Faith Morrison, Cambridge University Press (2013).

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

Canvas: Announcements, assignments, solutions etc., posted at https://canvas.njit.edu/

Homework: Homework solutions must be scanned (single .pdf file) and uploaded to Canvas before due date/time for grading by TA.

Exams: Exams will be conducted during class and distributed using Canvas. Student solutions must be scanned (single .pdf file) and uploaded to Canvas.

Important Dates:
September 10 No Lecture
October 8 Exam #1
November 9 Last Day to Withdraw
November 12 Exam #2
December 15-21 Final Exam Week

Class Format:

1. Course will be offered in converged mode with one-half the class being able to attend lectures in person and the other half attending lectures virtually on WebEx.
2. Classroom assignments will be arranged using the Back2Classroom app. Using the app, students enrolled in a converged learning class have been automatically assigned to their in-person class date.
3. Students will be sent a calendar invite, which must be opened. Students assigned a seat for a converged learning class will have the ability to manage their in-person seat assignments.
4. Students can choose to attend class remotely even when scheduled to attend physically.
5. Students who wish to attend a class session outside of their normal rotation will be able to use the app to request a booking; based on the availability of seats and the number of students requesting an in-person seat assignment (outside of the normal in-person rotation), the app will assign a seat.
6. To attend a lecture using WebEx go to: `https://njit.webex.com/meet/venerus` (CWID required to enter meeting).
7. Detailed instructions can be found at: https://back2classroom.njit.edu/getting-started-faculty.

Expectations and Rules:

1. Students are expected to attend all lectures either in person or virtually and to be seated or logged on to WebEx before the lectures begins.
2. During class, students are expected to be attentive, take notes and be prepared to answer questions from the instructor.
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 and notes only (internet use **not allowed**) and assistance from anyone during an exam is **prohibited**. If there is evidence that a student has received assistance from someone and/or from the internet 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. The NJIT Honor Code and Standards of Academic Integrity will be enforced in this course. Any violation will be immediately brought to the attention of the Dean of Students.

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 (IFM)

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1. Introduction and Motivation (1.1)
2. Mass and Mechanical Energy Balances (1.2)
3. Mathematics in Fluid Mechanics (1.3)
4. Fluid Behavior (2.1-2.4, 2.11)
5. Modelling Fluids (3.1-3.3)

   EXAM #1
6. Molecular Fluid Stresses (4.1-4.3, 5.1-5.2)
7. Microscopic (Differential) Balance equations (6.1-6.3)
8. Internal Flows (7.1-7.2)

   EXAM #2
9. Macroscopic (Integral) Balance Equations (9.1-9.2)
10. Flow in Packed and Fluidized Beds

    FINAL EXAM