Spring 2020

FED 101-012: Fundamentals of Engineering Design for Chemical Engineers

Irina Molodetsky

FED 101 _ Fundamentals of Engineering Design

Credits and contact hours

1-2-2 (1 lecture hr/wk – 2 lab hr/wk – 2 course credits)

Class meetings:
FED 101-L53 Thursday, 8:30 am - 11:20 am

Room 411 Tiernan Hall (Computer Lab)\Room 206 Tiernan Hall (FED Lab)

Instructor: Dr. Irina Molodetsky
Room 350 Tiernan Hall
Office hours: Tuesday, 1:00-5:00pm;

Please, contact by email for additional meetings
Email: Irina.Molodetsky@njit.edu

Textbook

N/A

Specific course information

a. Description:

Teams of students work on open-ended engineering projects. Sections are offered to represent an introduction to real-world engineering design problems in a specific engineering discipline. Topics covered include introduction to basic engineering design elements, processes, measurements, product and project design and development, with hands-on experiments in a specific major area. Students also learn to use engineering tools for computer-aided design and simulation. Technical writing and oral presentation along with project management skills are emphasized.

b. Prerequisites: N/A
Co-requisites: Hum 101 and Math 110 or Math 131 or Math 111

c. Required, Elective, or Selective Elective – Required

Specific goals for the course

a. The student will be able to:

1. choose, install and take the measurements from the Bourdon gauges
2. calculate absolute pressure and use it in the ideal gas equation of state
3. calculate hydrostatic pressure and apply correction to static pressure drop
4. install correctly variable area flowmeter in the flow system and take the measurements
5. calculate flow average velocity in a given geometry pipe using flowmeter reading
6. calibrate variable area flowmeter and define precision and accuracy
7. install and operate centrifugal pump; estimate a pump head

8. write the energy conservation for ideal flow system
9. calculate static and dynamic pressure in the pipe element of their flow system
10. estimate overall mechanical energy losses in their design
11. predict pressure drops in both water and air flows moving through the packed columns
12. perform unit conversions for mass, length, flowrate, velocity, volume, force, pressure
13. write dimension of physical quantities using dimension symbols
14. Use Excel to analyze and present collected data and compare them to predictions
15. Use Visio to communicate the specific design
16. Design the flow system to satisfy given functional and quality requirements
17. Construct the flow system using tools and laboratory specific techniques
18. Identify the laboratory safety risks and follow the safety rules
19. Report a laboratory experiment following the required template
20. Work in a team to plan, design, construct and present the results following two reporting formats

b. This course explicitly addresses the following student outcomes: 1,3,5,6

Topics

1. Instruments and measurements. Accuracy, precision, tolerance, errors.
2. Laboratory safety and engineering ethics
3. Static pressure in liquids. Gauges. Absolute and gauge pressure
4. Different system of units. Primary units. Dimension symbols
5. Energy-Pressure relationship in the fluid.
6. Flowmeters. Design of experiment: calibration of flowmeter
7. Centrifugal pump: Head, efficiency. Energy conservation and energy losses.
8. Flow through the packed column: prediction (Ergun equation) and measurement
9. Scale down flow system: engineering design to meet the requirements

Details about assignments and grading policies are discussed in the "Introduction" lecture uploaded on Canvas

Course Schedule

		Introduction. Schedule and grading policy
W1	Concepts	• Pressure. Hydrostatic pressure
	Instruments and Engineering Measurements	• How to measure static pressure in the fluid • Bourdon gauge. Absolute pressure and gauge pressure
	Lab	• Orientation. Safety rules and lab safe practices

W2	Quiz1	
	Dara Analysis	• Working with Excel. • Statistical errors. Accuracy. Precision. • Making graphs in Excel
	Lab	• Laboratory experiment "Flowmeter calibration"
W3	Quiz2	
	Concepts	• Average fluid velocity, $\bar{v}$ • Volumetric flow rate, Q • Mass flow rate, $\dot{m}$
	Instruments and Engineering Measurements	• Flowmeters • Calibration • Design of Experiment "Flowmeter calibration"
	Lab	• Construction "Flowmeter calibration"
W4	Quiz3	
	Concepts	• Units and units conversions • Primary units, SI, English. Dimension units
	Problems solving	• Ideal gas. Equation of State of Ideal gas. • Absolute pressure, gauge pressure • Units
	Lab	Completion of "Flowmeter calibration"
W5	Quiz4	
	Concepts	• Pressure-Energy relationship • Ideal flow system.
	Instruments and Engineering Measurements	• Centrifugal pump. Pump Head • Design of Experiment "Pump Characterization"
	Lab	Construction of "Pump Characterization"
W6	Quiz5	
	Problems solving	Discussion and problem solving related to Pump characterization experiment
	Lab	Lab experiment "Pump Characterization"
	HW	Practice take-home test 1
W7	Quiz6	
	Problems	Team exercises

	solving	
	Lab	Completion “Pump Characterization”
	HW	Practice take-home test 2
W8	TEST	
		Introduction of the final project. P&ID
W9	Quiz7	
	Concepts	• Single flow through a packed column • Laminar and turbulent flows. • Ergun equation: pressure drop calculations (discussion of parameters: effective particle size; void fraction, surface area, g_c conversion factor)
	Lab	Demo of the packed column
W10	Quiz8	
	HW	Prediction of the Pressure drops. Discussion of the assignment
	Lab	Construction of the flow system
W11	Quiz9	
	Concept	Dynamic and kinematic viscosity
	Lab	Construction and measurements of the pressure drops
	HW	300-500 words
W12	Quiz 10	
	Lab	Construction and measurements of the pressure drops
	Data Analysis	Comparison of the predicted and experimental pressure drops

Grading

A 90 and above
B+ 85 and above
B 80 and above
C+ 70 and above
C 60 and above
D 50 and above
F below 50

Policy on 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"*

www.njit.edu/academics/pdf/academic-integrity-code.pdf

If you need accommodations due to a disability please contact Chantonette Lyles, Associate Director of Disability Support Services, Fenster Hall Room 260 to discuss your specific needs. A Letter of Accommodation Eligibility from the Disability Support Services office authorizing your accommodations will be required.