Fundamentals of Engineering Design
FED 101
2 credits

Class meetings: FED 101-L53 Monday 8:30 am -11:20 am
         FED 101-007 Wednesday 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: Wednesday, 1-5:00pm;
Please, contact by email for additional meeting
Email: Irina.Molodetsky@njit.edu

FED 101 is an introduction to a chemical engineering process design. The course combines engineering science and elements of the engineering design cycle that the teams of students use to build a laboratory model of a mini-plant prototype.

At the end of this course, the successful students will:
- Know main steps of the engineering design
- Design and build a scale-down lab prototype of a mini-plant
- Know relationship between the flowrates and average flow velocity
- Measure flowrates and static pressure in the flow systems
- Know relationship between energy and pressure in the fluid
- Manipulate different units of pressure and flowrates
- Predict and measure pressure drops in the flow system
- Analyze and present experimental data
- Work in a team of peers, assess and improve collaborative environment

Details about assignments and grading policies are discussed in the “Introduction” lecture.

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.
# Course Schedule

| W1 | Course Introduction. Schedule and grading policy  
Engineering Design Cycle: problem identification  
Engineering Science:  
- Average fluid velocity, $\bar{v}$  
- Volumetric flow rate, $Q$  
- Mass flow rate, $\dot{m}$  
**Instruments and engineering measurements**  
- Flowmeters  
**Design of the experiment**  
- Flowmeter Calibration  
FED Laboratory orientation |
|---|---|
| W2 | **10 minutes quiz #1**  
Data analysis  
- Working with Excel.  
- Making graphs in Excel  
Lab: Construction and measurements  
Manual for the lab experiment and Template for the Lab report are uploaded. |
| W3 | **10 minutes quiz #2**  
**Units and Units Conversion**  
- Primary units, SI, English. Dimension units  
**Concepts**  
- Pressure. Hydrostatic pressure  
**Instruments and engineering measurements**  
- How to measure static pressure in the fluid  
- Bourdon gauge. Absolute pressure and gauge pressure  
Lab: Completion of “Flowmeter calibration” |
<table>
<thead>
<tr>
<th>W4</th>
<th>10 minutes quiz #3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Concepts</strong></td>
<td>- Pressure-Energy relationship</td>
</tr>
<tr>
<td><strong>Instruments and engineering measurements</strong></td>
<td>- Centrifugal pump</td>
</tr>
</tbody>
</table>

Design of Experiment: Exploration of Pressure drops in a flow system  
**Lab:** Construction and measurements  
*Manual for the lab experiment and Template for the Lab report are uploaded.*

<table>
<thead>
<tr>
<th>W5</th>
<th>10 minutes quiz #4</th>
</tr>
</thead>
</table>
| **Exercises and problems solving** | Estimates and Analogy  
**Lab:** Exploration of Pressure drops in a flow system (“Pressure Drops”) |

<table>
<thead>
<tr>
<th>W6</th>
<th>10 minutes quiz #6</th>
</tr>
</thead>
</table>
| **Concepts** | - Single flow through a packed column  
- Laminar and turbulent flows. |
| **Modeling** | - *Ergun equation:* pressure drop calculations (discussion of parameters: effective particle size; void fraction, surface area, $g_c$ conversion factor) |

**Lab:** Completion: “Pressure Drops”

<table>
<thead>
<tr>
<th>W7</th>
<th>10 minutes quiz #7</th>
</tr>
</thead>
</table>
| **Exercises and problems solving.** | Estimates and Analogy  
**Lab demo:** Packed Column |

<table>
<thead>
<tr>
<th>W8</th>
<th>TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discussion of the <strong>application</strong> of spray column and packed columns</td>
<td></td>
</tr>
</tbody>
</table>

**Final design:** discussion of requirements  
Requirements for final design are uploaded.  
Work on the final design (Visio)
<table>
<thead>
<tr>
<th>Week</th>
<th>Activity</th>
</tr>
</thead>
</table>
| W9    | Test – lessons learned  
  **Modeling**  
  - Ergun equation  
  **Lab:** construction |
| W10   | **10 minutes quiz #8**  
  **Lab:** construction and measurements. |
| W11   | **10 minutes quiz #9**  
  **Concepts**  
  - Ergun equation – Viscosity (dynamic and kinematic)  
  - Demo (class)  
  **Lab:** construction and measurements  
  Requirements for final presentation – uploaded |
| W12   | **10 minutes quiz #10**  
  Work on electronic design notebook  
  Work on final presentation |
| W13   | Review Lecture  
  “300-500 words” assignment  
  Meeting with individual teams to give a feedback for submitted ppt slides;  
  **Final report “Pressure Drop measurements” is due**  
  **Peers evaluation form is due** |
| W14   | Prep for Final demo and ppt presentations (see final exam schedule) |

**Grading** (changes may apply)  
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