Fundamentals of Engineering Design
FED 101
2 credits

Class meetings: Thursday, 10:00 am -12:55 pm

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

Instructor: Dr. Irina Molodetsky
Room 350 Tiernan Hall
Office hours: Monday, 1-2:30pm; Thursday: 3-5:00 pm
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Room 321A Tiernan Hall
Email: cdd23@njit.edu

What you will learn from taking this course:
• Conceptual understanding of relationship between energy, pressure and fluid flow
• Elements of the flow system design
• How to measure the flow rate and relationship between the mass flowrate, volumetric flow rate and average flow velocity
• How to measure static pressure in the fluid
• How to design and build a model flow system
• How to predict and measure energy losses in a single flow system
• Different unit systems and how to perform unit conversion
• Introduction to measurements, data analysis and data reporting
• Working as a team

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 Syllabus and Schedule

<table>
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<tr>
<th>Week</th>
<th>Activity</th>
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| **W1** | **Course Introduction.**  
> Instruments and engineering measurements  
>  • How to measure pressure in the gas, in liquid  
>  • How to quantify/measure fluid flow  
>  • How to control fluid flow  

Energy-Pressure relationship in the fluid  
>  • Pressure (gas, liquid, solid) . Static pressure. Pascal law  
| **W2** | **10 minutes quiz #1**  
BERTOULLI equation. Fluid flow characteristics  
>  • Average fluid velocity, \( \bar{v} \)  
>  • Volumetric flow rate, \( Q \)  
>  • Mass flow rate, \( \dot{m} \)  

Flowmeters  
>  • How to measure the flow rate  
>  • Principle of the rotameter (one of the types of flowmeters)  
>  • How to measure the gas (air) flowrate (air)  
>  • What are STP conditions in Engineering and SI unit systems  

Excel.  
> Statistical errors. Accuracy. Precision.  

Design of the experiment: calibration of the flowmeter  

Safety lecture.  
Lab: Construction and measurements: calibration of flowmeter  
| **W3** | **10 minutes quiz #2**  
Units. Primary units, SI, English. Dimension units  
Exercises  
Centrifugal pump.  
>  • Energy conversions in the flow system with a pump.  
>  • Head (units conversions)  

Introduction to Visio  
Design of the experiment: centrifugal pump  
Lab: construction of the experiment |
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<th>Week</th>
<th>Event</th>
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| W4   | 10 minutes quiz #3  
Problem solving session (unit conversions)  
Lab: centrifugal pump  
Final report “Calibration of Flowmeter” is due |
| W5   | 10 minutes quiz #4  
Exercises and problems solving (Static, hydrostatic and dynamic pressure; ideal gas eq.of state -units)  
Study guide for the test |
| W6   | 10 minutes quiz #5  
Problem solving session (Bernoulli equation)  
Single flow through a packed column  
Laminar and turbulent flows. Re number.  
Introduction to a final design project. Design of the experiment  
Practice test #1 – homework |
| W7   | 10 minutes quiz #6  
Single flow through a packed column  
Laminar and turbulent flows. Re number. Ergun equation  
Ergun equation: pressure drop calculations (discussion of parameters: effective particle size; void fraction, surface area, $g_c$ conversion factor)  
Practice test #2 - homework |
| W8   | TEST  
Work on the final design (Visio)  
Discussion of the application of spray column, packed columns |
| W9   | 10 minutes quiz #7  
Test –lessons learned, unit conversions  
Ergun equation (Excel)  
Analysis of the final design: discussion of requirements  
Lab: construction |
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<th>10 minutes quiz #8</th>
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<tr>
<td>W10</td>
<td>Lab: construction and measurements</td>
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<th>10 minutes quiz #9</th>
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<tr>
<td>W11</td>
<td>S.Ergun paper – discussion of the concepts</td>
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<td>– Viscosity (dynamic and kinematic)</td>
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<td>Two-phase flows in the packed column</td>
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<td>– Demo in the lab</td>
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<td>Lab: construction and measurements</td>
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<td>Requirements for final presentation - uploaded</td>
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<th>10 minutes quiz #10</th>
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<td>W12</td>
<td>Review lecture and “300 words” assignment</td>
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<td>Individual final reports are due</td>
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<td>Work on final presentation (data analysis)</td>
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| W13                     | Meeting with individual teams to give a feedback for submitted ppt slides; |

| W14                     | Final demo and ppt presentations           |