**CHEN 2610 - TRANSPORT I (3)**

**Required Core Course**

**2015-2016 Catalog Data Lec (3).** Introduction to fluid statics and dynamics; dimensional analysis; compressible and incompressible flows; design of flow systems; introduction to fluid-solids transport including fluidization, flow through process media and multiphase flows.

**Prerequisites** P/C: MATH 2630 or MATH 2637, Pr. PHYS 1600 or PHYS 1607, and completion of CHEN 2100 with grade of C or better; P/C: ENGR 2010

**Schedule** Three one-hour class sessions per week.

**Course Objectives** This course introduces students to fluid dynamics and the processes and phenomena associated with fluid and fluid-solid transport. Students learn and employ the concepts and equations for flowing systems important to chemical and biological processes.

**Textbooks**

Elger, Williams, Crowe, Robertson, Engineering Fluid Mechanics, 10e, 2013, 9781118164297, Wiley

**Topics Covered**

1. Introduction to fluid dynamics (1 week)
2. Fluid statics (1 week)
3. Flowing fluids (2 weeks)
4. Control volume approach (1 week)
5. Momentum in fluid systems (1.67 weeks)
6. Energy in fluid systems (1 week)
7. Dimensional analysis and similitude (0.67 week)
8. Surface resistance and drag (1.67 weeks)
9. Flow through conduits (2 weeks)
10. Special topics (1 week)
11. Design and problem solving in fluid transport systems (1 week, during weeks 3, 7, and 11)
12. Exams (1 week, 3 exams given weeks 5, 9, 14)

**Course Outcomes:** Upon successful completion of this course, students should be able to:

1. Employ the hydrostatic equation to calculate the pressure and resulting forces acting on submerged objects.
2. Solve problems involving manometry concepts.
3. Solve problems involving buoyancy concepts.
4. Solve problems involving absolute and gauge pressure concepts.
5. Solve problems involving mass flow rate, volumetric flow rate, velocity profile, and average velocity concepts.
6. Employ the continuity equation for steady flow to calculate flow rates in conduits of constant and varying cross section including branched flow.
7. Explain the concepts of Newtonian and non-Newtonian fluid, viscosity, laminar and turbulent flow, shear, shear stress, shear rate, fluid momentum.
8. Develop force and momentum balances in potential flow and viscous flow situations.
9. Calculate the friction factor and losses for laminar and turbulent flow in pipe using the friction factor plot and appropriate equations.
10. Calculate the mechanical energy loss due to friction in a piping system containing various kinds of valves and fittings.
11. Employ a mechanical energy balance to calculate flow rates, pipe sizes, power requirements, and pump sizes for specific piping configurations.
12. Describe the characteristics of centrifugal and positive displacement pumps, and using pump curves select an appropriate pump to deliver a specified flow rate.
13. Employ the concept of dimensional analysis to develop dimensionless numbers used in fluid mechanics.
14. Explain the concepts of a boundary layer, skin drag, and form drag.
15. Calculate the drag on a submerged object of simple shape in a flowing fluid using drag coefficient correlations.
16. Explain the concepts of porosity, void fraction, specific volume, specific surface area, particle equivalent diameter.
17. Calculate pressure drop or flow rate for flow through packed beds in various flow regimes.

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| **Contribution of Course to Meeting ABET Criteria 5 (Curriculum)** | | |
| **Math and Basic Sciences** | **Engineering Topics** | **General Education** |
| 0 Credits | 3 Credits | 0 Credits |

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| **Relationship of Course to Student Outcomes (PO’s)** | | | | | | | | | | | | |
| **Student Outcome** | **A** | **B** | **C** | **D** | **E** | **F** | **G1** | **G2** | **H** | **I** | **J** | **K** |
| **Level of Coverage** | **S** | **I** | **I** | **I** | **S** | **I** | **I** | **I** | **I** | **I** |  |  |

**Date of Preparation and Person(s) Preparing This Description:**June 9, 2016: Elizabeth Lipke, Tom Hanley and Xinyu Zhang