

**CBEMS 120A MOMENTUM TRANSFER**  
(Required for ChE; Elective for EnE and MSE)

- Catalog Data:** **CBEMS 120A Momentum Transfer (Credit Units: 4)** Macroscopic and differential mass balances; macroscopic and differential linear and angular momentum balances, mechanical energy balances; Ideal fluids, Newtonian and non-Newtonian fluids and turbulence. Applications to chemical processes. Prerequisites: CBEMS40A, Mathematics 3D. (Design units: 1)
- Textbook:** Munson, Bruce R., Young, Donald F., & Okiishi, Theodore H., *Fundamentals of Fluid Mechanics*, 4<sup>th</sup> edition, John Wiley & Sons, 2003
- References:**
- Coordinator:** Vasana Venugopalan
- Course Objectives:** To design and control chemical processes, a chemical engineer must understand the principles of fluid flow. This course is an introduction to the basic concepts fluid statics and dynamics. The course builds on concepts introduced in chemical engineering calculations (ChE 40) and thermodynamics (ChE60), as well as calculus and differential equations.
- Course Outcomes:** Students will:  
Apply the principles of hydrostatics to read a manometer or calculate forces and moments applied to a submerged body.  
Apply the control volume formulation of mass, momentum and energy conservation to fluid systems.  
Apply the Navier-Stokes equations to determine the velocity distributions of simple laminar flows.  
Apply the principles of dimensional analysis to identify the dimensionless group of variable governing the fluid flow in a given situation.  
Apply the principles involved in internal flow to determine head loss involved in laminar and turbulent flows through pipes and pipe fittings.  
Calculate drag and lift forces/coefficients associated the relative motion of solid objects within a fluid.
- Prerequisites By Topic:** Chemical Engineering Thermodynamics, and Ordinary Differential Equations.
- Lecture Topics:** Fluid Properties  
Conservation Laws for Closed Systems  
Thermodynamics Review and Fluid Statics  
Conservation of Mass for Open Systems  
Conservation of Momentum for Open Systems  
Conservation of Energy for Open Systems  
Differential View of Fluid Motion  
Differential Form of Conservation Laws  
Dimensional Analysis  
Analytic Solutions for Laminar Flows  
Boundary Layers

External Flows  
Internal Flows

**Class Schedule:** Meets for 4 hours of lecture each week for 10 weeks.

**Computer Usage:** Computer literacy and basic skills are required for performing analysis using special software for pipe system design.

**Laboratory Projects:**

**Professional Component:** Contributes toward the Chemical Engineering Topics Courses and Major Design experience.

**Relationship to Program Outcomes:** ChE: This course relates to Program Outcomes a, c, e, k, and m as stated at:

<http://undergraduate.eng.uci.edu/degreeprograms/chemical/mission>

MSE: This course relates to Program Outcomes a and e as stated at:

<http://undergraduate.eng.uci.edu/degreeprograms/materials/mission>

**Design Content Description:**

*Approach:* Lectures on design and analysis of pipe networks.

*Lectures:* 100%

*Laboratory Portion:* 0%

**Grading Criteria:**

Weekly homework: 15%

Midterm exams (2): 50%

Final Exam: 35%

100%

**Estimated ABET Category Content:**

Mathematics and Basic Science: 0 credit units or 0%

Engineering Science: 3 credit units or 75%

Engineering Design: 1 credit units or 25%

**Prepared by:** Vasan Venugopalan **Date:** July 2006

**CEP Approved:** Fall 2001