# Course Learning Objectives - CBE 240

## Fluid Flow and Heat Transfer (4)

### At the conclusion of this course, the student should be able to:

1. Explain the concepts of Newtonian and non-Newtonian fluid, viscosity, laminar and turbulent flow, Reynolds number, fluid friction in pipe flow, pipe roughness, and friction factor.
2. Calculate velocity and momentum profiles.
3. Describe the characteristics of centrifugal and positive displacement pumps; select an appropriate pump to deliver a specified flow rate in a flow system of known characteristics.
4. Calculate pressure drop for flow through a packed bed, for liquids and for ideal gases at constant temperature.
5. Describe and analyze the physical phenomena associated with the heating and cooling of solids and fluids, the vaporization of liquids, and the condensation of vapors.
6. Apply Fourier's law and energy conservation principles to calculate steady-state and transient heat flows and temperature profiles for heat conduction in simple geometries.
7. Derive and apply the Mechanical Energy balance.
8. Derive a Momentum Balance for fluid flow in a conduit.
9. Explain the relationship between heat transfer and fluid flow.
10. Describe the various methods of heat transfer and explain their interrelationship.
11. Perform a detailed design of a shell and tube heat exchanger.
12. Develop differential shell balances for continuity and momentum in various geometries and convert to the appropriate coordinate system.
13. Derive the differential equations of continuity and motion and apply to simple geometries.
14. Describe how dimensionless groups are used to facilitate the solution of fluid flow and heat transfer problems.
15. Apply numerical methods to the solution of steady state and unsteady state heat transfer problems.