

# 16CH202 MOMENTUM TRANSFER

Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P	WA/RA	SSH/HSB	CS	SA	S	BS
45	-	30	20	45	-	5	5	5



## Course Description and Objectives:

This course deals with fundamentals of fluid flow and its application to chemical process industries including pipe flow, fluid machinery. The objective of this course is to familiarize students with basic concepts of fluid statics, fluid dynamics, compressible and incompressible fluids, fluidization, transportation and metering of fluids.

## Course Outcomes:

The student will be able to:

- understand basic principles of fluid mechanics.
- analyze fluid flow problems with the application of the momentum and energy equations.
- analyze pipe flows as well as fluid machinery.

## SKILLS:

- ✓ *Application of fluid mechanics concepts to solve real life problems.*
- ✓ *Estimate physical properties of fluids in motion and at rest.*
- ✓ *Measurement of flowing fluids.*
- ✓ *Selection of pumps for engineering applications.*

**ACTIVITIES:**

- Calibration of rotameter.
- Separation of immiscible liquids using decanter.
- Calibration of manometer.
- Design of Venturi meter.
- Design of Orifice meter.

**UNIT - 1****L-10**

**DEFINITIONS AND PRINCIPLES** : Unit operations, Unit systems, Dimensional analysis, Basic concepts. Fluid Statics: Nature of fluids, Hydrostatic equilibrium, Manometers.

**FLUID FLOW PHENOMENA** : Laminar flow, Shear stress, Viscosity, Turbulence, Eddy viscosity, Flow in boundary layers.

**UNIT - 2****L-9**

**BASIC EQUATIONS OF FLUID FLOW** : Mass balance, Mass velocity, Momentum balance, Bernoulli equation, Mechanical energy balance equation, Correction factors, Pump work.

**UNIT - 3****L-9**

**FLOW OF INCOMPRESSIBLE FLUIDS** : Shear stress distribution in pipes, Relation between skin friction parameters, Laminar flow in pipes, Hagen-poiseuille equation, Laminar flow of non-Newtonian liquids, Velocity distribution for turbulent flow, Friction factor chart.

**FLOW OF COMPRESSIBLE FLUIDS** : Mach number, Basic equations.

**UNIT - 4****L-8**

**FLOW PAST IMMERSED BODIES** : Drag, Drag Coefficient, Stagnation point, Friction in flow through beds of solids, Motion of particles through fluids, Terminal velocity, Motion of spherical particles. Fluidization: Conditions for fluidization, Minimum fluidization velocity.

**UNIT - 5****L-9**

**TRANSPORTATION AND METERING OF FLUIDS** : Pipes, Fittings, Valves, Joints, Pumps, Developed head and Power requirement in pumps, Suction lift and cavitation, Positive displacement pumps, Centrifugal pumps, Measurement of flowing fluids: Classification of measuring devices, Venturi meter, Orifice meter, Rotameter.

**LABORATORY EXPERIMENTS****LIST OF EXPERIMENTS**

Total Hours-30

1. Identification of laminar and turbulent flows.
2. Verification of Bernoulli's Equation.
3. Measurement of flowing fluid using Venturi meter.
4. Measurement of flowing fluid using Orifice meter.
5. Determination of friction loss in fluid flow through pipes.
6. Determination of friction loss in fluid flow through fittings.
7. Determination of pressure drop in packed bed.
8. Determination of pressure drop in fluidized bed.
9. Determination of characteristics of centrifugal pump.
10. Determination of characteristics of reciprocating pump.

**TEXT BOOKS:**

1. W.L. McCabe, J.C. Smith and P. Harriot, "Unit Operations of Chemical Engineering", 7<sup>th</sup> edition, McGraw-Hill, 2005.
2. Chattopadhyay. P, "Unit Operations of Chemical Engineering Vol-1 ", 1<sup>st</sup> edition, Khanna Publishers, 2012.

**REFERENCE BOOKS:**

1. C. J. Geankoplis, "Transport Processes and Unit Operations", 3<sup>rd</sup> edition, Prentice Hall of India, 1993.
2. A.S. Foust, "Principles of Unit Operations", 2<sup>nd</sup> edition, John Wiley & Sons, 1981.