

CH 254 FLUID FLOW OPERATIONS

CREDITS= 6 (L = 4, T=0, P = 2)

- 1 **Review of fluid statics:** Definition of fluid; surface tension; capillarity; vapor pressure; bulk modulus. Pressure at a point; fluid forces on plane and curved surfaces. Pressure measurement. 2 Hours
- 2 **Kinematics of flow:** Types of flow; definitions and classifications of steady, unsteady, uniform, non-uniform, laminar and turbulent flows, stream lines, stream tubes, velocity, velocity potential & stream function. 3 Hours
- 3 **Integral analysis of flow:** Equation of continuity (Euler's equation); Bernoulli's equation. Applications of Bernoulli's equation. 4 Hours
- 4 **Elements of model studies:** similitude; dimensionless numbers & forces; scaling up. 1 Hours
- 5 **Viscous flow:** Flow in circular & non-circular pipes and parallel plates. Calculation of pressure drop and friction. 2 Hours
- 6 **Boundary layer theory:** Concept of boundary layer; boundary layer growth along a flat plate. Boundary layer thickness. 4 Hours
- 7 **Turbulent flow:** Definition. Prandtl's mixing length; velocity distribution for flow through pipe. Universal velocity profile, Darcy's equation; losses in pipe-fittings and valves. 4 Hours
- 8 **Compressible flow:** Isothermal and adiabatic flow, Velocity of propagation of pressure wave. Gas flow in converging and diverging nozzles. Flow in a pipe, shock waves (water hammer and surges). 7 Hours
- 9 **Flow past immersed bodies:** Drag coefficients; Flow of solids through fluid; settling velocities; terminal setting velocity, stokes' law, Newton's law. 5 Hours
- 10 **Transportation and metering of fluids:** Reciprocating, Centrifugal & rotary pumps, fans, blowers & compressors: their selection & characteristics. Flow meters, their selection and characteristics. Concept of multiphase flow. 8 Hours

REFERENCE BOOKS:

Title: Unit operations of chemical engineering
Author: W C McCabe & J C Smith
Publisher: McGraw Hill

Title: Chemical engineering, vol. I
Author: J M Coulson and J F Richardson
Publisher: Pergamon press

Title: Perry's Handbook for Chemical Engineers
Author: J H Perry & Chilton
Publisher: McGraw Hill

LIST OF EXPERIMENTS:

- (1) To obtain the coefficient of discharge for the given venturimeter and obtain its relationship with Reynolds' no.
- (2) To calibrate the given Rotameter.
- (3) To obtain the coefficient of discharge for the given orifice meter and obtain its relationship with Reynolds' no.
- (4) To study the flow and determine critical Reynolds no.
- (5) To determine the discharge co-efficient of the given v-notch.
- (6) To verify the Bernoulli's theorem.
- (7) To determine the viscosity of the given liquids using Stoke's law.
- (8) To determine the viscosity of a given liquid by measuring efflux time of a given tank. Also determine the diameter of a given capillary and compare.
- (9) To determine relation between friction factor and Reynolds number for the given flowing fluid through circular pipe.
- (10) To obtain relation between friction factor and Reynolds number for flow of water through annulus.
- (11) To determine the resistance offered by various pipe fittings and express them in terms of equivalent straight pipe length.
- (12) To study characteristics curves for a centrifugal pump.