PCBT4303 **UPSTREAM PROCESS ENGINEERING** (3-0-0)

Module-I: Fluid Transfer concepts and applications
Basic Equations of Fluid Flow: Newtonian and non-Newtonian fluids, Turbulence and its nature, Reynolds number and transition from laminar to turbulent flow, flow in boundary layers, continuity equation, Bernoulli equation, pump work in Bernoulli equation. Flow of Incompressible Fluids: Fluid flow in pipes, friction factor, laminar flow in pipes, Hagen-Poiseuille equation, effect of roughness, friction factor charts, Reynolds numbers and friction factor relationship. Transportation and Metering of Fluids: pipe fittings and valves, positive displacement pumps, centrifugal pumps, blower and compressor, flow measuring devices such as venturimeter, orifice meter, pitot tube and rotameter. Drag force and terminal settling velocity, principles of filtration, centrifuges.

Module -II: Heat Transfer concepts and applications
Heat transfer by conduction in solids: Fourier's Law, thermal conductivity, Steady state conduction, compound resistance in series, heat flow through a cylinder, one dimensional unsteady state heat conduction, heat transfer from extended surface. Heat transfer by convection: Thermal boundary layer, Heat transfer by forced convection, heat transfer by natural convection, heat transfer from condensing vapors, filmwise and dropwise condensation. Heat Transfer equipments like evaporators and heat exchangers and autoclaves of different types.

Module -III: Mass Transfer concepts and applications
Diffusion concepts, Fick's law of diffusion. Phase diagram, temperature concentration diagram, enthalpy concentration diagram, Ideal solution, Roult's Law, relative volatility, azeotropes. Differential distillation, flash vaporization, vacuum and steam distillation. Ternary liquid equilibria, triangular graphical representation, concept of theoretical or ideal stages and multistage continuous operation. Leaching, solid-liquid equilibrium, equipments used in solid-liquid extraction. Single and multiple contact. Overall stage efficiency. Description of adsorption and absorption processes and their applications, types of adsorption, nature of adsorbents adsorption equillibria. Properties and handling of particulate solids, size reduction, screening and particle size distribution.

Text Books
1. McCabe, Smith and Harriot, Unit Operations of Chemical Engineering
2. Foust et al, Principles of Unit Operations.
3. Treybal, R.E. Mass Transfer Operations
4. Badger and Banchero. Introduction to Chemical Engineering.
5. Hollman, Heat transfer, 8th Ed.
6. Foust, Wenzel, Clump, Maus and Andersen, Principles of Unit Operations.
7. Geankoplis, Transport processes and unit operations