

I Year – II Semester	L	T	P	C
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FLUID MECHANICS AND MECHANICAL UNIT OPERATIONS				

PRE-REQUISITES: Engineering mechanics and mathematics

COURSE OBJECTIVES: To introduce the students to basic concept of fluid flow conversation laws of transport phenomena, and different size reduction principles and equipment, separation techniques, agitation and mixing.

UNIT-I

Dimensions and units-physical properties of fluids, Classification of fluids – Newtonian & non-Newtonian fluids and their rheological equations. Stream line, path line and streak lines and stream tube, classification of flows-steady & unsteady, uniform & non uniform, laminar & turbulent, rotational & irrotational flows-equation of continuity for one dimensional flow and three-dimensional flows.

UNIT-II

Surface and body forces –Euler’s and Bernoulli’s equations for flow along a stream line, momentum equation and its application on force on pipe bend.

Incompressible Flow in pipes and channels- shear stress and skin friction in pipes, laminar flow in pipes and channels, turbulent flow in pipes and channels, friction from changes in velocity or direction.

UNIT-III

Flow past immersed bodies - Drag and Drag coefficient, friction in flow through beds of solids, Ergun equations and motion of particles through fluids.

Fluidization, Types of fluidization, Applications of fluidization, continuous fluidization, slurry and pneumatic transport.

Transportation and Metering of fluids- pumps – characterization and classification, specifications, characteristics of centrifugal pumps, selection of pumps, Measurement of flowing fluids- variable head meters- Orifice meter, Venturi meter, Pitot tube; Area meters- Rota meter.

UNIT-IV

Properties, handling and mixing of particulate solids: Characterization of solid particles, properties of particulate masses, storage and mixing of solids, types of mixers, mixers for cohesive solids, mixers for free-flowing solids.

Size reduction: Principles of comminution, size reduction equipment-grinders, ultra-fine grinders, cutting machines, Equipment operation. Laws of crushing: Kick’s law, Bond’s law, Rittinger’s law. Screening, Industrial screening equipment, Effectiveness of the screen, differential & cumulative analysis.

UNIT-V

Filtration, cake filters, centrifugal filters, Principles of cake filtration. Separations based on motion of particles through fluids, gravity settling processes and centrifugal settling processes.

COURSE OUTCOMES:

The student will be able

1. To apply the concept of hydrostatic equilibrium
2. To have knowledge on fluid flow phenomena
3. To determine engineering design parameter for laminar and turbulent flows.
4. To have knowledge on various mechanical separation operations used in pharma industry.
5. To have knowledge on different separation techniques used in process industries.
6. To realize the need for mechanical operations in pharmaceutical industry.

TEXT BOOKS:

1. Unit Operations of Chemical Engineering by W.L.McCabe, J.C.Smith & Peter Harriot, McGraw-Hill, 7th ed, 2007.
2. Chemical Engg. Fluid Mechanics by Ron Darby, CRC Press, 2nd Edition, 2001.
3. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH

REFERENCES:

1. Transport processes and unit operations by Christie J. Geankoplis, PHI
2. Unit operations, Vol-1 –Chattopadhyaya, Khanna publishers
3. Principles of Unit Operations, Foust *et al*, 2nd ed., John Wiley, 1999
4. Chemical Engineering, Vol-I, Coulson and Richardson, Pergamon Press

I Year – II Semester	L	T	P	C
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FLUID MECHANICS AND MECHANICAL UNIT OPERATIONS LABORATORY				

PRE-REQUISITES: Fluid Mechanics and Mechanical Unit Operations

COURSE OBJECTIVES: to provide knowledge on flow measuring devices, pumps, and various mechanical unit operations.

List of Experiments

1. Identification of laminar and turbulent flows, Major equipment - Reynolds apparatus
2. Verification of Bernoulli's equation, Major equipment – Bernoulli's Apparatus
4. Calibration of Rotameter, Major equipment – Rotameter Assembly
5. Variation of Orifice coefficient with Reynolds Number Major equipment - Orifice meter Assembly
6. Determination of Venturi coefficient, Major equipment – Venturi meter Assembly
7. Friction losses in Fluid flow in pipes, Major equipment - Pipe Assembly with provision for Pressure measurement
8. Calculation of surface area using pressure drop in a packed bed for different fluid velocities Major equipment - Packed bed with Pressure drop measurement
9. Calculation of minimum fluidization velocity and void fraction in a fluidized bed. Major equipment - Fluidized bed with Pressure drop measurement
10. Studying the Characteristics of a centrifugal pump Major equipment - Centrifugal Pump
11. Determining the time of grinding in a ball mill. Major equipment - Ball mill Apparatus, Sieve shaker, Different sizes of sieves, weighing balance.
12. Calculation of the minimum thickener area using batch sedimentation. Major equipment- Sedimentation apparatus
13. Determining the specific cake resistance and filter medium resistance of a slurry in plate and frame filter press. Major equipment - Plate and frame filter press.
14. Verifying Stoke's law. Major equipment – Stoke's law apparatus

COURSE OUTCOMES:

The student will be able to

1. Estimate the flow rate using flow measuring devices.
2. Estimate average particle diameter for size reduction using different size reduction equipment.
3. Estimate terminal settling velocity.