

19BT204 UNIT OPERATIONS

Hours Per Week :

L	T	P	C
3	0	-	3

Total Hours :

L	T	P	WA/RA	SSH/HSH	CS	SA	S	BS
45	0	-	5	45	-	8	1	2



Source:
[https://
 tour.mines.edu/unit-
 operations-lab/](https://tour.mines.edu/unit-operations-lab/)

COURSE DESCRIPTION AND OBJECTIVES:

The main objective of the course is to familiarize students about the basic unit operations, fluid mechanics, fluid measuring devices, size reduction machinery and estimation of average particle size.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Differentiate fluids and fluid flow behaviour.	2
2	Solve mass and energy balance problems using reaction stoichiometry.	1,2,3
3	Determine velocity, pressure drop and frictional losses for fluid flow in closed channels.	3
4	Calculate various process parameters for the design of packed bed and fluidized bed reactors.	3
5	Evaluate fluid transport machinery flow control valves and flow measuring devices.	3,4

SKILLS:

- ✓ *Determination of pressure in static fluids.*
- ✓ *Calculation fluid flow rates and fluid velocity and pressure drop in pipe flow.*
- ✓ *Estimation of power requirement for pumping of fluids.*
- ✓ *Determination of frictional losses in packed bed reactors.*

UNIT - I**L-9**

SCOPE AND FUNDAMENTALS: Application of unit operations and unit processes in Biotech industries; Units and dimensions; Conversion of units; Chemical reaction, Stoichiometry; Material and energy balances for physical and chemical processes.

UNIT - II**L-9**

SIZE REDUCTION AND SEPARATION: Mechanical methods, Ball Mill, Filters, Sieving, Centrifuge, Sedimentation, Settling velocity, Stoke's Law.

UNIT - III**L-9**

FLUID STATICS AND TYPES OF FLUID: Nature of fluids, Hydrostatic equilibrium, Barometric equation, Manometers; Newton's law of viscosity; Concept of Newtonian and Non - Newtonian fluids; Reynolds number, Flow in boundary layers, Boundary layer formation and separation.

UNIT - IV**L-9**

FLUID MECHANICS: Bernoulli's equation and its application; Calculation of power required for pumping fluids; Flow measuring devices - orifice meter, venturi meter and rotameter; Examples from bioprocesses systems; Flow through pipes; Laminar and turbulent flow characterization by Reynolds number; Average velocity pressure drop due to skin friction and foam friction, friction factor chart; Hagen - Poiseuille equation.

UNIT - V**L-9**

FLOW THROUGH SOLIDS: Definition of drag and drag coefficient; Introduction of packed beds; Friction in flow through beds of solids, Derivation of friction factor equations and pressure drop expressions; Fluidization & fluidized bed, Minimum fluidization velocity.

TEXT BOOK:

1. W.L. McCabe, J.C. Smith and P. Harriot, "Unit Operations of Chemical Engineering", 7th edition, McGraw Hill Publications, 2005.

REFERENCE BOOK:

1. P. M.Doran, "Bioprocess Engineering Principles", 2nd edition, Academic Press, 2012.