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16BT204 PROCESS ENGINEERING PRINCIPLES

Hours Per Week :

L	T	P	C
3	1	-	4

Course Description and Objectives:

This course offers the basic engineering principles and calculations used in bioprocess engineering. This will offer them a clear-cut idea about basic concepts of fluid flow and its applications in biotech industries. The main objective of the course is to familiarize students about the basic unit operations, fluid mechanics, fluid measuring devices, size reduction machinary and estimation of average particle size.

Course Outcomes:

Upon completion of the course, the student will be able to

CO1: Understand the application of engineering principles in Biotech industry.

CO2: Solve material and energy balance problems by using the principles of chemical reaction stoichiometry

CO3: Determine energy losses for fluid flowing through solid boundaries.

CO4: Evaluate the design parameters of packed beds and settling operations.

CO5: Investigate various fluid transport machinery, valves and fittings.

SKILLS:

- ✓ *Determine types of fluid flow.*
- ✓ *Estimate pressure drop and frictional losses in pipe flow.*
- ✓ *Estimate average particle size.*

UNIT - 1 L-9, T-3

BASIC CONCEPTS AND CALCULATIONS: Application of engineering principles in biotech Industries; Introduction to unit operations and unit processes; Units and dimensions, basic quantities and derived units; Conversion of units; Chemical reaction, stoichiometry, conversion, yield; Analysis of degrees of freedom; Material and energy balances for physical and chemical processes, recycle, bypass, purge calculations, excess air and theoretical oxygen requirement.

UNIT - 2 L-9, T-3

FLUID STATICS AND DYNAMICS: Nature of fluids, hydrostatic equilibrium, barometric equation, manometers; Newton's law of viscosity; Concept of Newtonian and Non - Newtonian fluids; Different types of Non-Newtonian fluids with examples in bioprocesses; Reynolds number, flow in boundary layers, boundary layer formation and separation.

UNIT - 3 L-9, T-3

FLUID MECHANICS: Bernoulli's equation and its application; Calculation of power required for pumping fluids; 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 - 4 L-9, T-3

FLOW PAST IMMERSED BODIES: 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; Motion of particles through fluids, terminal velocity.

UNIT - 5 L-9, T-3

FLUID TRANSPORTATION MACHINERY: Different types of pumps; Calculation of pump horse power; Flow measuring devices- orifice meter, venturi meter and rotameter; Size reduction unit operations, calculation of average particle size, efficiency of size reduction and screening; Different types of valves used in bioprocess industries.

TEXT BOOKS :

1. P. M.Doran, "Bio-Process Engineering Principles", 1st edition, Academic Press, 2007.
2. W.L. McCabe, J.C. Smith and P. Harriot, "Unit Operations of Chemical Engineering", 7th edition, McGraw Hill Publications, 2005.

REFERENCE BOOKS :

1. D.G.Rao, "Introduction to Biochemical Engineering", 1st edition, Tata McGraw Hill Publications, 2005.
2. S. K. Ghosal, S. K. Sanyal and S. Dutta, "Introduction to Chemical Engineering", 1st edition, Tata McGraw Hill Publications, 2007.

ACTIVITIES:

- *Verify Bernoulli's theorem.*
- *Estimate centrifugal pump efficiency.*
- *Measure fluid velocity in a pipe.*
- *Estimate pressure drop in fluidized bed reactor.*