

4 <sup>th</sup> Semester	RBT4C003	Bio Heat and Mass Transfer	L-T-P 3-0-0	3 CREDITS
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**Module-1 CONDUCTION HEAT TRANSFER (10 Hrs.)**

Fundamentals of heat and mass transfer in biological systems - Thermoregulation, Metabolism, Thermal comfort. Temperature in living systems –hyperthermia and hypothermia. Modes of Heat Transfer – Conduction, Convection and Radiation. Basic law of heat conduction – Fourier’s law; thermal conductivity of biological materials, temperature dependence of thermal conductivity, steady state heat conduction through a layered surface with different thermophysical properties (e.g. skin). Effect of metabolism on heat transfer. Transient (unsteady state) heat conduction.

**Module-II CONVECTION HEAT TRANSFER (10 Hrs.)**

Heat transfer with phase change – freezing and thawing. The bio-heat transfer equation for mammalian tissue. Convection heat transfer and the concept of heat transfer coefficient, individual and overall heat transfer coefficient, critical/ optimum insulation thickness, heat transfer through extended surfaces. Radiation exchange between surfaces,

**Module-III DIFFUSION AND MASS TRANSFER (09 Hrs.)**

Mass Transfer: Equilibrium, Mass conservation, and kinetics, Modes of Mass Transfer: Diffusion, Dispersion, and Advection. Governing equations and boundary conditions of mass transfer, Steady and unsteady diffusion mass transfer (e.g. drug delivery), Convection mass transfer, Local and overall mass transfer coefficient, heat and mass transfer analogy. Flow in porous media.

**Module-IV: OPERATIONS (10 Hrs.)**

Principles of gas absorption; Single and Multi component absorption; Absorption with Chemical Reaction; Design principles of absorbers; Industrial absorbers; HTU, NTU concepts. V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCABE-THIELE & ONCHON-SAVARIT Principles; Industrial distillation equipments, HETP, HTU and NTU concepts. Adsorption equilibria – Batch and fixed bed adsorption; Drying-Mechanism-Drying curves- Time of Drying; Batch and continuous dryers.

**Module-V: EXTRACTION (06 Hrs.)**

L-L equilibria, Staged and continuous extraction, Solid-liquid equilibria, Leaching Principles.

**Books**

- Ashim K. Datta, *Biological and Bioenvironmental Heat and Mass Transfer*: Marcel Dekker, Inc., 2002.
- Frank P. Incropera and David P. DeWitt, *Fundamentals of Heat and Mass Transfer*: John Wiley & Sons; 5th edition 2006.