5th Semester	RBM5D001	Bioheat and Mass Transfer	L-T-P 3-0-0	3 Credits

Module-I

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

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

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.

Books

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

3. Santhosh K. Gupta, "Numerical Methods for Engineers", New age international publishers,
4. Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, 3 rd edition, Tata-Mcgraw Hill, New Delhi, 2012.