5th Semester	RME5C003	Heat Transfer	L-T-P 3-0-0	3 Credits

MODULE-I **(12 HOURS)**

Introduction:
Modes of heat transfer: conduction, convection, and radiation ,Mechanism & basic lawsgoverning conduction, convection, and radiation heat transfer; Thermal conductivity,Thermal conductance &Thermal resistance, Contact resistance, convective heat transfercoefficient, radiation heat transfer coefficient , Electrical analogy, combined modes of heat
transfer. Initial conditions *and* Boundary conditions of 1st, 2nd and 3rd Kind.

Heat Conduction:
The General heat conduction in Cartesian, polar-cylindrical and polar-spherical coordinates,Simplification of the general equation for one and two dimensional steady transient conduction with constant/ variable thermal conductivity with / without heatgeneration. Solution of the one dimensional steady state heat conduction problem in case ofplane walls, cylinders and spheres for simple and composite cases. Critical insulationthickness, Heat transfer in extended surfaces (pin fins) without heat generation, Long fin,short fin with insulated tip and without insulated tip and fin connected between two heatsources. Fin efficiency and fin effectiveness. Conduction in solids with negligible internaltemperature gradient (Lumped heat analysis).

MODULE-II **(12 HOURS)**

Convective Heat Transfer:
Introduction to convective flow - forced and free. Dimensional analysis of forced and freeconnective heat transfer. Application of dimensional analysis, physical significance ofGrashoff , Reynolds, Prandtl, Nusselt and Stanton numbers.Conservation equations for mass, momentum and energy for 2-dimensional convectiveheat transfer in case of incompressible flow, Hydrodynamic and thermal boundary layersfor flow over a flat plate. Critical Reynolds number; general expressions for drag coefficientand drag force Reynolds-Colbourn analogy. Thermal boundary layer; general expression forlocal heat transfer coefficient; Average heat transfer Coefficient; Nusselt number. Flowinside a duct- velocity boundary layer, hydrodynamic entrance length and hydrodynamically developed flow; flow through tubes (internal flow). Use of empirical relationsfor solving turbulent conditions for external and internal flow.Mechanism of heat transfer during natural convection, Experimental heat transfercorrelations for natural convection in the following cases(a) Vertical and horizontal plates(b) Inside and outside flows in case of tubes

Module-III **(8 HOURS)**

Radiative heat exchange :
Introduction, Radiation properties, definitions of various terms used in radiation heattransfer; Absorptivity,reflectivity & transmissivity.Emissive power & emissivity, Kirchoff'sidentity, Planck's relation for monochromatic emissive power of a black body, Derivation ofStefan-

Boltzmann law and Wien's displacement law from Planck's relation, Radiation shapefactor, Relation for shape factor and shape factor algebra. Heat exchange between blackbodies through non-absorbing medium. Gray bodies and real bodies, Heat exchangebetween gray bodies. Radiosity and Irradiation, Electrical analogy and radiation networkfor 2-body and 3-body radiations exchange in non-absorbing medium, Radiation shields.

Module-IV **(8 HOURS)**

Heat transfer for boiling liquids and condensing vapours :
Types of condensation, use of correlations for condensation on vertical flat surfaces,horizontal tube and; regimes of pool boiling, pool boiling correlations. Critical heat flux,concept of forced boiling. Numerical problems.
Heat Exchangers :
Introduction, Types of heat exchanger, The overall heat transfer coefficient and foulingfactors, LMTD and _ - NTU analysis of heat exchangers.

Books :

[1] Heat Transfer Incropera and Dewitt, Willey publications
[2] Heat Transfer :J.P.Holman, TMH Publications
[3] Heat Transfer: P.S.Ghosdastidar, Oxford University Press
[4] Fundamentals of Engineering Heat and Mass Transfer: R.C.Sachdeva, New Age InternationalPublishers, 4th Edition
[5] Heat Transfer by P.K. Nag, TMH
[6] Heat Transfer by S.P. Sukhatme, TMH
[7] Heat Transfer: A.F.Mills and V.Ganesan, Pearson Education, 2nd Edition
[8] Heat and Mass Transfer: Domkundwar and Arora, Danpatrai and sons
[9] Heat Transfer :R.K.Rajput, Laxmi Publications
[10] Heat and Mass Transfer: A Practical Approach, Y.A.Cengel, Tata Macgraw Hills Education Private Limited

Digital Learning Resources:

NPTEL MOOCs:

Course Name:	Heat Transfer
Course Link:	https://nptel.ac.in/courses/103/105/103105140/
Course Instructor:	Prof. Sunando Dasgupta, IIT Kharagpur

Course Name:	Fundamentals of Convective Heat Transfer
Course Link:	https://swayam.gov.in/nd1_noc20_me81/preview
Course Instructor:	Prof. AmareshDalal, IIT Guwahati