RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Mechanical Engineering, VII-Semester

ME- 701 Heat and Mass Transfer

Course Objectives:
After studying this course, students will be able to
1. Know about the basic concept of heat transfer and its modes.
2. Solve problems based on conduction, convection, and radiation.
3. Differentiate the modes of heat transfer i.e. conduction, convection, and radiation
4. Understand the working principle and types of heat exchangers.
5. Understand the concept of boiling and condensation, mass transfer.

Syllabus:
Unit-1 Basic Concepts: Modes of heat transfer, Fourier's law, Newton's law, Stefan Boltzman law; thermal resistance and conductance, analogy between flow of heat and electricity, combined heat transfer process; Conduction: Fourier heat conduction equation, its form in rectangular, cylindrical and spherical coordinates, thermal diffusivity, linear one dimensional steady state conduction through a slab, tubes, spherical shells and composite structures, electrical analogies, critical-insulation-thickness for pipes, effect of variable thermal conductivity.

Unit 2 Extended Surfaces (fins): Heat transfer from a straight and annular fin (plate) for a uniform cross section; error in measurement of temperature in a thermometer well, fin efficiency, fin effectiveness, applications; Unsteady heat conduction: Transient and periodic conduction, heating and cooling of bodies with known temperatures distribution, systems with infinite thermal conductivity, response of thermocouples.

Unit 3 Convection: Introduction, free and forced convection; principle of dimensional analysis, Buckingham 'pie' theorem, application of dimensional analysis of free and forced convection, empirical correlations for laminar and turbulent flow over flat plate and tubular geometry; calculation of convective heat transfer coefficient using data book.

Unit 4 Heat Exchangers: Types- parallel flow, counter flow; evaporator and condensers, overall heat transfers coefficient, fouling factors, log-mean temperature difference (LMTD), method of heat exchanger analysis, effectiveness of heat exchanger, NTU method;
Mass transfer: Fick's law, equi-molar diffusion, diffusion coefficient, analogy with heat transfer, diffusion of vapour in a stationary medium.

Unit 5 Thermal Radiation : Nature of radiation, emissive power, absorption, transmission, reflection and emission of radiation, Planck's distribution law, radiation from real surfaces; radiation heat exchange between black and gray surfaces, shape factor, analogical electrical network, radiation shields.
Boiling and condensation: Film wise and drop wise condensation; Nusselt theory for film wise condensation on a vertical plate and its modification for horizontal tubes; boiling heat transfer phenomenon, regimes of boiling, boiling correlations.

References:

1. Sukhatme SP; Heat and mass transfer; University Press Hyderabad
2. Holman JP; Heat transfer; TMH
3. Nag PK; heat and Mass Transfer; TMH
4. Domkudwar,Heat and Mass Transfer,Dhanpt Rai & Co.
5. Sachdeva R.C., Fundamentals of Engineering Heat and Mass Transfer, New Age Science
6. Dutta BK; Heat Transfer Principles And App; PHI Learning
7. Mills AF and Ganesan V; Heat transfer; Pearson
8. Cengel Yunus A; Heat and Mass transfer;TMH
9. Yadav R; Heat and Mass Transfer; Central India pub-Allahabad
10. Incropera FP and Dewitt DP; Heat and Mass transfer; Wiley

List of Experiments (Pl. expand it):

1 Conduction through a rod to determine thermal conductivity of material
2 Forced and free convection over circular cylinder
3 Free convection from extended surfaces
4. Parallel flow and counter flow heat exchanger effectiveness and heat transfer rate
5. Calibration of thermocouple
6 . Experimental determination of Stefen-Boltzman constant

Evaluation

Evaluation will be continuous an integral part of the class as well through external assessment.