II CHE 232 Heat Transfer

Course Outlines

- **Title:** Heat Transfer
- **Code Number:** CHE232
- **Semester:** 3rd
- **Credit hours:** 3
- **Pre-requisites course requirements/ skills:** Basic know how of modes of heat transfer
- **Learning Outcomes:**

  Upon successful completion of the course, the students will be able to

  1. Understand heat transfer modes in engineering systems.
  2. Compare the rates of heat transfer in solids and fluid flow systems by various modes of heat transfer.
  3. Solve problems related to heat transfer in engineering applications.

- **Contents**

  Unit I: Basics of Heat Transfer

  1.1 Thermodynamics and Heat transfer
  1.2 Engineering Heat Transfer
  1.3 Heat and Other Forms of Energy
  1.4 The First law of Thermodynamics
  1.5 Heat transfer mechanisms
  - 1.5.1 Conduction
  - 1.5.2 Convection
  - 1.5.3 Radiation

  1.6 Simultaneous Heat Transfer Mechanisms
  1.7 Problem Solving Techniques

  Unit II: Heat Conduction Equation

  2.1 Steady versus transient heat transfer
  2.2 Multidimensional heat transfer
  2.3 Heat generation
  2.4 One- dimensional heat conduction equation

2.4.1 Heat Conduction Equation in a Large Plane Wall
2.4.2 Heat Conduction Equation in a Long Cylinder
2.4.3 Heat Conduction Equation in a Sphere
2.4.4 Combined One-Dimensional Heat Conduction Equation

2.5 General heat conduction equation
2.5.1 Rectangular coordinates
2.5.2 Cylindrical coordinates
2.5.3 Spherical coordinates

2.6 Boundary and initial conditions
2.7 Steady one-dimensional heat conduction problems
2.8 The thermal resistance concept for steady heat conduction in plane walls
2.9 Heat conduction in multi-layered cylinders and spheres
2.10 Heat transfer from finned surfaces

Unit III: Transient Heat Conduction

1.1 Lumped system analysis
1.2 Transient heat conduction in large plane walls, long cylinders, and spheres

Unit IV: Convection

1.1 Physical mechanisms on convection
1.2 Velocity boundary layer, thermal boundary layer
1.3 Laminar and turbulent flows, heat and momentum transfer in turbulent flow
1.4 Derivation of differential convection equations
1.5 Drag force and heat transfer in external flow
1.6 Parallel flow over flat plates, flow across cylinder and spheres, flow across tube banks
1.7 Internal forced convection, laminar and turbulent flow in tubes, General thermal analysis
1.8 Physical mechanism of natural convection
1.9 Equation of motion and the grashof number, natural convection over finned surfaces

Unit V: Fundamental of Thermal Radiation

5.1 Thermal radiation, blackbody radiation
5.2 Radiation intensity, solid angle, intensity of emitted radiation, radiosity
5.3 Radiation properties, emissivity, absorptivity, reflectivity and transmissivity

Unit VI: Heat Exchangers, furnaces and evaporators

6.1 Types of heat exchangers
6.2 The overall heat transfer coefficient, fouling factor
6.3 Analysis of heat exchangers
6.4 Selection of heat exchangers
6.5 Heat transfer in coiled and jacketed agitated vessels
6.6 Furnaces and evaporators working principles

- **Teaching-learning Strategies**

  The teaching and learning strategy has been designed on the understanding of concepts and the ability to critically analyze and apply the learned content through lectures, discussion, activities, case studies using computer, multi-media and writing board instructional aides.
  Lectures: 3 hours per week

- **Assignments- Types and Number with calendar**

  A minimum of two assignments to be submitted before the written exam of final term.

- **Assessment and Examinations**

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written examination at the mid-point of the semester.
2.	Formative Assessment	25%	It includes: classroom participation, attendance and assignments.
3.	Final Assessment	40%	Written examination at the end of semester.

- **Textbooks and reference readings**

1. Çengel, Y.A., Ghajar, A. (2020), “Heat and mass transfer: Fundamentals and applications”, McGraw Hill.
2. Theodore, L., (2011), “Heat transfer applications for the practicing engineer”, Wiley & Sons
3. Hahn, D.W., Özışık, M.N., (2012), “Heat conduction”, 2nd Edition, Wiley & Sons.
4. Bergman, L.T., Lavine, A.S., Incropera, F.P., DeWitt, D.P., (2020), “Fundamentals of heat and mass transfer”, 8th Edition, Wiley & Sons.
5. Chhabra, R., Shankar, V., (2018) “Coulson and Richardson's Chemical Engineering: Volume 1b: Heat and Mass Transfer: Fundamentals and Applications”, 7th Edition, Butterworth-Heinemann.

6. Holman J.P., (2009), “Heat Transfer”, 10th Edition, McGraw-Hill.
7. Kothandaraman, C.P, (2006), “Fundamentals of heat and mass transfer”, New Age.