B.Tech III Year II Semester

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA 19AME62 – HEAT TRANSFER

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Course Objectives: The objectives of the course are to make the students learn about

- To impart the basic laws of conduction, convection and radiation heat transfer and their applications
- To familiarize the convective heat transfer concepts
- To explain basics of radiation heat transfer
- To make conversant with the heat transfer analysis related to thermal systems like heat exchangers, evaporator, and condenser.

UNIT – 1: Introduction to heat transfer

10 Hrs

Introduction: Basic modes of heat transfer- rate equations- generalized heat conduction equation - steady state heat conduction solution for plain and composite slabs - cylinders - critical thickness of insulation- heat conduction through fins of uniform cross section- fin effectiveness and efficiency.

Unsteady State Heat Transfer Conduction- Transient heat conduction- lumped system analysis and use of Heisler charts.

Learning Outcomes:

At the end of this unit, the student will be able to

Identify the phenomenon related to different modes of heat transfer
 Compare different types of conduction heat transfer
 Apply concept of thermal resistance and its importance in practical problems
 L3

UNIT – II: Convection 10 Hrs

Convection: Basic concepts of convection—heat transfer coefficients - types of convection —forced convection and free convection.

Free Convection -development of hydrodynamic and thermal boundary layer along a vertical plate – use of empirical relations for convective heat transfer on plates and cylinders in horizontal and vertical orientation

Forced convection in external flow—concepts of hydrodynamic and thermal boundary layer—use of empirical correlations for flow over plates and cylinders. Fluid friction — heat transfer analogy, approximate solution to laminar boundary layer equation for external flow. Internal flow — Use of empirical relations for convective heat transfer in horizontal pipe flow.

Learning Outcomes:

At the end of this unit, the student will be able to

Apply the convective heat transfer principles
 Use analogy between fluid friction and heat transfer to solve engineering problems
 L3

UNIT – III: Radiation 10Hrs

Radiation heat transfer – thermal radiation – laws of radiation - Black and Gray bodies – shape factor-radiation exchange between surfaces - Radiation shields - Greenhouse effect.

Learning Outcomes:

At the end of this unit, the student will be able to

Apply the principles of radiation heat transfer
 Calculate the radiation heat transfer between two bodies
 Design a radiation shield for given conditions
 Examine the effect of greenhouse gases on atmosphere

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Page 1 of 2

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UNIT - IV: Heat Exchangers

8 Hrs

Heat Exchangers: Types of heat exchangers- parallel flow- counter flow- cross flow heat exchangers- overall heat transfer coefficient- LMTD and NTU methods- fouling in heat exchangers.

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the working of different types of heat exchangers L2
- Calculate the heat transfer in heat exchangers L2
- Design a heat exchanger for a given application L3

UNIT - V: Boiling and Condensation & Mass transfer

8 Hrs

Boiling and Condensation: Different regimes of boiling- nucleate, transition and film boiling – condensation - filmwise and dropwise condensation.

Mass Transfer: Conservation laws and constitutive equations - Fick's law of diffusion, isothermal equi-mass - Equimolal diffusion - diffusion of gases and liquids- mass transfer coefficient.

Learning Outcomes:

At the end of this unit, the student will be able to

- interpret the basic modes of condensation heat transfer
- identify different regimes of boiling in design of boilers
- explain the basic mechanism of mass transfer L2
- differentiate between mass transfer due to convection and diffusion L4

Text Books:

- 1. P.K. Nag, Heat Transfer, 3/e, Tata McGraw-Hill, 2011.
- 2. J.P.Holman, Heat Transfer, 9/e, Tata McGraw-Hill,2008.
- 3. S. C. Arora & S. Domkundwar, A Course in Heat and Mass Transfer, Dhanpat Rai & CO.(P) LTD-Delhi, 2007.

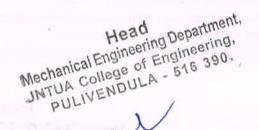
Reference Books:

- 1. F. P. Incropera and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, 6/e, John Wiley, 2007.
- 2. Cengel. A. Yunus, Heat Transfer- A Practical Approach, 4/e, Tata McGraw-Hill, 2007.
- 3. S.P. Sukhatme, A Textbook of Heat Transfer, Universities Press, 2005
- 4. Lienhard and Lienhard, A Heat and Mass Transfer, Cambridge Press, 2011.
- **5.** C.P. Kothandaraman and S. Subramanyan, Heat and Mass Transfer databook, New Age Publications, 2014.

Course Outcomes:

At the end of this Course the student will be able to

- Apply the concepts of different modes of heat transfer.
- Apply knowledge of conduction heat transfer in the design of insulation of furnaces and pipes.
- Analyze free and forced convection phenomena in external and internal flows
- Design of thermal shields using the concepts of black body and non-black body radiation
- Apply the basics of mass transfer for applications in diffusion of gases. L3



Page 2 of 2