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 **L1**
- Compare different types of conduction heat transfer **L2**
- 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 **L3**
- 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 **L3**
- Calculate the radiation heat transfer between two bodies **L2**
- Design a radiation shield for given conditions **L3**
- Examine the effect of greenhouse gases on atmosphere **L4**

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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 **L2**
- identify different regimes of boiling in design of boilers **L3**
- 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. **L3**
- Apply knowledge of conduction heat transfer in the design of insulation of furnaces and pipes. **L3**
- Analyze free and forced convection phenomena in external and internal flows **L4**
- Design of thermal shields using the concepts of black body and non-black body radiation **L5**
- Apply the basics of mass transfer for applications in diffusion of gases. **L3**

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