III Year B.Tech. Mechanical Engg. II-Semester

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ME320 HEAT TRANSFER

Course Description & Objectives:

This course is designed to introduce a basic study of the phenomena of heat to develop methodologies for solving a wide variety of practical engineering problems, and to provide useful information concerning the performance and design of particular systems. A knowledge-based design problem requiring the formulations of solid conduction and fluid convection and the technique of numerical computation progressively elucidated in different chapters will be assigned and studied in detail. As well, to gain experience in designing experiments for thermal systems, the design, fabrication, and experimentation of a thin film heat flux gage will be attempted as part of laboratory requirements.

Course Outcomes:

1. *Understand the basic laws of heat transfer.*
2. *Account for the consequence of heat transfer in thermal analyses of engineering systems.*
3. *Analyze problems involving steady state heat conduction in simple geometries.*
4. *Develop solutions for transient heat conduction in simple geometries.*
5. *Obtain numerical solutions for conduction and radiation heat transfer problems.*
6. *Understand the fundamentals of convective heat transfer process.*
7. *Evaluate heat transfer coefficients for natural convection.*
8. *Evaluate heat transfer coefficients for forced convection inside ducts.*
9. *Evaluate heat transfer coefficients for forced convection over exterior surfaces.*
10. *Analyze heat exchanger performance by using the method of log mean temperature difference.*
11. *Analyze heat exchanger performance by using the method of heat exchanger effectiveness.*
12. *Calculate radiation heat transfer between black body surfaces.*
13. *Calculate radiation heat exchange between gray body surfaces.*

UNIT - I Introduction:

Modes and mechanisms of heat transfer - Basic laws of heat transfer - General discussion about applications of heat transfer.

Conduction Heat Transfer : Fourier's law - General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates.

UNIT - II One Dimensional Steady State Conduction Heat Transfer:
Homogeneous slabs, hollow cylinders and spheres - overall heat transfer coefficient, electrical analogy - Critical radius of insulation. systems with heat sources or Heat generation. Heat transfer through extended surfaces – rectangular fins.

UNIT - III One Dimensional Transient Conduction Heat Transfer:
Systems with negligible internal resistance -Significance of Biot and Fourier Numbers - Chart solutions of transient conduction systems.

UNIT - IV Convective Heat Transfer:
Concepts about Continuity, Momentum and Energy Equations.Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer - Flat plates and Cylinders.
Heat Exchangers : Classification of heat exchangers - overall heat transfer Coefficient and fouling factor -Concepts of LMTD and NTU methods - Heat Exchanger design using LMTD and NTU methods.

UNIT - V Boiling and condensation:
Pool boiling - Regimes, Calculations on Nucleate boiling, Critical Heat flux and Film boiling **:** Film wise and drop wise condensation - Nusselt's Theory of Condensation on a vertical plate.
Radiation Heat Transfer : Emission characteristics and laws of black-body radiation heat exchange between two black bodies - concepts of shape factor - Emissivity - heat exchange between grey bodies -radiation shields - electrical analogy for radiation networks.

DATA BOOK:

1. C. P. Kothandaraman, "Heat And Mass Transfer Data Book", 6th ed., New Age International Publishers Ltd., 2007.

TEXT BOOKS:

1. Holman J.P "Heat transfer" 10th ed., McGraw Hill, London, 2009.
2. R.K.Rajput,"Heat And Mass Transfer", 4th ed., S.Chand & Co, New Delhi, 2008.

REFERENCE BOOKS:

1. R C Sachdeva "Fundamentals of Engineering Heat and Mass Transfer " 4th Edition, New Age International Publishers Ltd., 2009.
2. Sukhatme S.P., "Heat Transfer",4th Edition, University Press India Ltd., 2006.
3. Frank P. Incropera, David P. DeWitt, "Fundamentals of Heat and Mass Transfer", 7th Edition, Wiley Publications, 2011.
4. R Yadav "Heat Transfer", 6th Edition, McGraw Hill Publications, 2004.
5. R.K. Rajput, Thermal Engineering, 8th Edition, Laxmi Publications, New Delhi, 2010.