DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Heat and Mass Transfer
Course Number	:	MEC3212
Credits	:	4
Course Category	:	DC
Pre-Requisites (s)	:	None
Contact hours	:	3 – 1 - 0
Type of Course	:	Theory
Course Work	:	Home Assignments 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 Hour) 60%

Course Objective :

To equip graduates with the heat and mass transfer processes that continuously take place in various equipment's employed in process and power industries and formulate simple problems to estimate rate of heat and mass transfer, temperature variation and efficiency.

Course Outcomes :

1. Ability to formulate and analyse heat conduction problems with and without heat generation and through extended surfaces.
2. To analyse 1D unsteady and 2D steady conduction problems and radiative heat exchange between two or more surfaces of different geometries.
3. To understandthe phenomena of forced and free convection and formulate and analyse the governing equations.To possess knowledge of condensation and boiling heat transfer for different applications.
4. To estimate parameters forthe design of heat exchangers and also estimate diffusion and convective Mass transfers occurring in day to day life.

Syllabus

Unit 1: Heat transfer; Over view, General heat conduction equation in Cartesian, Cylindrical and Spherical co-ordinate systems, 1 D steady state heat conduction through composite structures, Variable thermal conductivity, Critical thickness of insulation, 1-D heat conduction with internal heat generation, Heat Transfer through extended surfaces.

Unit 2: 1-D unsteady heat conduction, Heisler Charts, 2-D steady heat conduction, thermal radiation, Solid angle, Intensity of radiation, Radiation Shape factors for simple geometries, Radiation heat transfer between black surfaces and gray surfaces, Radiation shields, Radiation through gases, Solar radiation.

Unit 3: Viscous flow, hydrodynamic and thermal boundary layers, Momentum and energy equations of the laminar boundary layer over a flat plate, Dimensional analysis, Integral momentum analysis of the boundary layers, Free convection heat transfer, Empirical relations for heat transfer, Boiling and condensation heat transfer, Heat Pipe

Unit 4: Classification of heat exchangers, Overall heat transfer coefficient, Log mean temperature difference (LMTD), Heat exchanger effectiveness, NTU-method, Baffled shell and tube type heat exchangers, Heat exchangers design considerations, Diffusion and convective mass transfers, Fick's law of diffusion, Steady state diffusion, Isothermal evaporation of water into air, Convective mass transfer, Evaporative cooling.

Text Books:

1. Heat and Mass Transfer by Altamush Siddiqui, Cengage L. India P. Ltd.
2. Heat Transfer by J. P. Holman, McGraw Hill Pub. Co.

Reference Books:

1. Fundamentals of Heat & Mass Transfer by F. P. Incropera & D. P. Dewitt
2. Heat Transfer- A Practical Approach by Yunus A. Cengel
3. Fundamentals of Engineering Heat & Mass Transfer by R. C. Sachdeva
4. Engineering Heat transfer by C. P. Gupta and R. Prakash
5. Heat and Mass transfer by R. K. Rajput

Academic Schedule: Heat and Mass Transfer- MEC3212

S. No.	Course Contents	Periods
	Unit 1 (13 Periods)	
1.	Heat transfer: Over view; thermal conductivity of solids, liquids and gases.	2
2.	General heat conduction equation in Cartesian, Cylindrical and Spherical co-ordinate systems; One dimensional steady state heat conduction through composite structures.	4
3.	Variable thermal conductivity; Critical thickness of insulation.	2
4.	1-D heat conduction with internal heat generation in plane wall, cylinder and sphere.	2
5.	Extended surfaces, Generalized equation for fins, Fin of uniform cross section: heat transfer rate, temperature distribution & fin efficiency for different conditions at fin tip.	3
	Unit 2 (13 Periods)	
1.	1-D unsteady heat conduction; lumped heat capacity method, temperature-time response of thermocouples; Unsteady conduction with negligible surface resistance and with finite conduction & convection resistances; Heisler Charts	3
2.	Two dimensional (2-D) steady heat conduction	1
3.	Thermal radiation, Plank's distribution law, Monochromatic and total emissive power; derivation of Stefan-Boltzmann and Wien's displacement laws.	2
4.	Proof of Kirchhoff's law for monochromatic and total radiations.	2
5.	Solid angle, Intensity of radiation, Radiative heat exchange between two black surfaces, Shape factor for simple geometries.	2
6.	Heat exchange between non- black surfaces, Electrical Network Method, Radiation shields.	2
7.	Radiation through gases and flames; Solar radiation.	1
	Unit 3 (12 Periods)	
1.	Viscous flow, hydrodynamic and thermal boundary layers, Momentum and energy equations of the laminar boundary layer over a flat plate.	2
2.	Dimensional analysis applied to forced and free convection	1
3.	Integral momentum analysis of the boundary layers for forced convection	2
4.	Liquid metal heat transfer	1
5.	Free convection heat transfer	1
6.	Empirical equations for laminar and turbulent flows over surfaces of various geometries	1
7.	Heat transfer during condensation, film condensation over a vertical surface	2
8.	Phenomenon of boiling, Pool boiling over a heated Nichrome wire; Heat Pipe	2
	Unit 4 (12 Periods)	
1.	Classification of heat exchangers and their temperature distributions; Overall heat transfer coefficient and fouling factors; Log mean temperature difference (LMTD).	2
2.	Heat exchanger effectiveness, NTU-method.	2
3.	Baffled shell and tube type heat exchangers.	1
4.	Heat exchangers design considerations.	1
5.	Introduction, diffusion and convective mass transfers, Fick's law of diffusion	1
6.	General equation of mass diffusion, steady state diffusion; Isothermal evaporation of water into air.	2
7.	Convective mass transfers, mass transfer coefficients, mass transfers through boundary layer, analogy between momentum, heat and mass transfer.	1
8.	Evaporative cooling.	2

Books:

1. Heat and Mass Transfer by Altamush Siddiqui, Cengage L. India P. Ltd.
2. Heat Transferby J. P. Holman, McGraw Hill Pub. Co.
3. Funds. of Heat &*Mass Transfer by F. P. Incropera & D. P. Dewitt
4. Heat Transfer- A Practical Approach by Yunus A. Cengel
5. Funds. ofEngg. Heat & Mass Transfer by R. C. Sachdeva
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