Semester V (Third year]

Branch/Course Mechanical Engineering

Semester-5	Code	Course Name	L	T	P	Credits
	PCC- ME 508	Heat Transfer	3	1	2	5
	PCC- ME 509	Solid Mechanics	3	1	2	5
	PCC- ME 510	Manufacturing Technology	3	0	2	4
	PCC- ME 511	kinematics &Theory of machine	3	1	2	5
	HSMC - 504	Humanities I	3	0	0	3
	MC-504	Essence of Indian Traditional Knowledge	0	0	0	0

PCC-ME 508	Heat Transfer	3L:1T:0P	4 credits

Objectives:

The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.

Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.

The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

Contents :

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer- approximate solution to unsteady conduction heat transfer by the use of Heissler charts.**(12)**

Heat convection,basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection. **(8)**

Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.**(8)**

Types of heat *exchangers, Analysis and design of heat exchangers using bothLMTD and*ε-NTU methods.**(6)**

Boiling and Condensation heat transfer, Pool boiling curve **(3)**

Introduction mass transfer, Similarity between heat and mass transfer **(3)**

Total number of hours (40 lectures + 12 tutorials)

Course Outcomes:

After completing the course, the students will be able to formulate and analyze a heat transfer problem involving any of the three modes of heat transfer

The students will be able to obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer

The students will be able to design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.

Text Books:

A. Bejan, Heat Transfer John Wiley, 1993

J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.

F.P.Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.

MassoudKaviany, Principles of Heat Transfer, John Wiley, 2002

Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill, 2002

PCC-ME 509	Solid Mechanics	3L:1T:0P	4 credits

Objectives:

The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.

Course Contents:

Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions

Constitutive equations: Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition.

Plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems.
Application to thick cylinders, rotating discs, torsion of non-circular cross-sections, stress concentration problems, thermo-elasticity, 2-d contact problems.
Solutions using potentials. Energy methods. Introduction to plasticity.

Course Outcomes:

Upon completion of this course, students will be able understand the deformation behavior of solids under different types of loading and obtain mathematical solutions for simple geometries.

Text Books:

G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press, 2004.

Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.

Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international, 1969.

PCC-ME 511	Kinematics and Theory of Machines	3L:1T:2P	5 credits

Objectives:

To understand the kinematics and rigid- body dynamics of kinematically driven machine components

To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link

To be able to design some linkage mechanisms and cam systems to generate specified output motion

To understand the kinematics of gear trains

Contents :

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains-Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint-Rocker mechanisms**(8)**

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics-

Coincident points- Coriolis component of acceleration- introduction to linkage synthesis-three position graphical synthesis for motion and path generation**(8)**

Classification of cams and followers- Terminology and definitions- Displacement diagrams-Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers**(8)**

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics**(8)**

Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication-friction clutches- belt and rope drives- friction in brakes **(8)**

(Total: 40 lectures + 12 tutorials)

Course Outcomes:

After completing this course, the students can design various types of linkage mechanisms for obtaining specific motion and analyse them for optimal functioning

Text Books:

Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
CleghornW.L. , Mechanisms of Machines, Oxford University Press, 2005.

Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill, 2009.

Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988.

PCC-ME 510	Manufacturing Technology	4L:0T:0P	4 credits

Objectives:

To provide knowledge onmachines and related tools for manufacturing various components.
To understand the relationship between process and system in manufacturing domain.

To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.

Course Contents:

Tooling for conventional and non-conventional machining processes: Mould and die design,

Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; press tools – configuration, design of die and punch; principles of forging die design. **(12)**
Metrology: Dimensions, forms and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly. Process metrology for emerging machining processes such as micro-scale machining, Inspection and workpiece quality. **(16)**

Assembly practices: Manufacturing and assembly, process planning, selective assembly, Material handling and devices. **(6)**

Linear programming, objective function and constraints, graphical method, Simplex and duplex algorithms, transportation assignment, Traveling Salesman problem; Network models: shortest route, minimal spanning tree, maximum flow model- Project networks: CPM and PERT, critical path scheduling; Production planning& control: Forecasting models, aggregate production planning, materials requirement planning. Inventory Models: Economic Order Quantity, quantity discount models, stochastic inventory models, practical inventory control models, JIT. Simple queuing theory models.**(16)**

Course Outcomes:

Upon completion of this course, students will be able to the tooling needed for manufacturing, the dimensional accuracy and tolerances of products, assembly of different components and the application of optimization methods in manufacturing.

Text Books:

Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014.

Taha H. A., Operations Research, 6th Edition, Prentice Hall of India, 2003.
Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.

PROJ-ME 306	**Project I**	**(30 hours)**

Objectives:

This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.