Semester VI (Third year]
Branch/Course Mechanical Engineering

Course Code	Paper Title	L	T	P	Credits	branch
	Design of Machine Elements	3	1	2	5	102
	Dynamics of Machinery	3	0	3	4.5	102
	Graduate Employability Skills and Competitive Courses (GATE, IES, etc.)	3	0	0	0	102
	Manufacturing Technology	3	0	3	4.5	102
	Open Elective- I	3	0	0	3	102
	Program Elective- I	3	0	0	3	102
	Program Elective- II	3	0	0	3	102

Semester VI (Third year]
Branch/Course Mechanical Engineering

PCC-ME 306	Dynamics of Machinery	3L:0T:3P	4.5 Credits

Objectives:

1. To equip the student with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations.
2. Develop knowledge of analytical and graphical methods for calculating balancing of reciprocating masses.
3. Develop understanding of vibrations and its significance on engineering design.
4. Develop understanding of dynamic balancing, flywheel analysis, gyroscopic forces and moments.

Contents:

Module: 1

Force analysis of mechanism: Dynamics of plane motion of a rigid body, dynamically equivalent two mass system, correction torque, forced in mechanism and machines. **(Lectures 3)**

Module: 2

Turning moment diagram: Fluctuations of crankshaft speed and energy in a direct acting engine mechanism, flywheels. **(Lectures 5)**

Module: 3

Cams: Classification of cams and followers, types of follower and retardation, cam profile and generation of concentric and offset radial cam profiles by graphical method. Cams with specified contours tangent cam with roller follower, circular arc cam with flat follower. **(Lectures 8)**

Module: 4

Analysis of gyroscopic motion : Principle of gyroscope, gyroscopic couple and gyroscopic reaction couple, Gyroscopic effects on the movement of ships, aeroplanes, two wheeled and four wheeled vehicles, gyrostabilizers. **(Lectures 6)**

Module: 5

Effects of inertia of reciprocating masses on engine frame: Unbalanced primary and secondary forces and couples, balancing of primary and secondary forces, partial balancing of locomotives,

balancing of multicylinder in line and radial engines, direct and reverse cranks methods for balancing of radial engines. **(Lecture 8)**

Module: 6

Mechanical vibrations : Basic concepts degree of freedom, types of damping and viscous damping; natural free, damped free and damped forced vibrations of a single degree of freedom spring mass system, reciprocating and rotating unbalance, vibration isolation and transmissibility, whirling of shaft, elementary treatment of two degree of freedom systems torsional vibrations of single rotor and two rotor systems, transverse vibration of simply supported beam energy method, Rayleigh's and Dankerley method. **(Lecture 12)**

Course outcomes:

Upon successful completion of this course the student should be able to:

1. Analyze stabilization of sea vehicles, aircrafts and automobile vehicles.
2. Compute frictional losses, torque transmission of mechanical systems.
3. Analyze dynamic force analysis of slider crank mechanism and design of flywheel.
4. Understand how to determine the natural frequencies of continuous systems starting from the general equation of displacement.
5. Understand balancing of reciprocating and rotary masses.

Text/References Books:

1. Theory of Machines / S.S Ratan/ Mc. Graw Hill Publ.
2. Mechanism and machine theory by Ashok G. Ambedkar, PHI Publications.
3. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age.
4. Theory of Machines / Shiegly / MGH
5. Theory of Machines / Thomas Bevan / CBS Publishers
6. Theory of machines / Khurmi / S.Chand.

Laboratory:

Minimum of 10 Experiment need to be performed

1. To study various types of Links, Pairs, Chain and Mechanism
2. To study inversion of Four Bar Mechanism
3. To study velocity diagram for Slider Crank Mechanism.
4. To study various kinds of belts drives.
5. To study and find coefficient of friction between belt and pulley.
6. To study various types of Cam and Follower arrangement.
7. To plot follower displacement Vs cam rotation graph for various cam follower arrangement.

8. To study Different types of Gears.
9. To study Different types of Gear Trains.
11. To Perform Experiment on Watt, Porter, Proell and Hartnell Governors and prepare Performance Characteristic Curves also analyze Stability & Sensitivity
12. To study gyroscopic effects through models.
13. To determine gyroscopic couple on Motorized Gyroscope.
14. To perform the experiment of Balancing of rotating parts and find the unbalanced couple and forces.
15. To study Dynamically Equivalent System.
16. Determine the moment of inertial of connecting rod by compound pendulum method and trifler suspension pendulum.
17. To study the various types of dynamometers.
18. To find out critical speed experimentally and to compare the Whirling Speed of a shaft with theoretical values

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PCC-ME 307	Manufacturing Technology	3L:0T:3P	4.5 Credits

Objectives:

(i) To provide knowledge on machines and related tools for manufacturing various components.
(ii) To understand the relationship between process and system in manufacturing domain.
(iii) 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:

Module:1

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. **(Lectures 10)**

Module:2

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 microscale machining, Inspection and workpiece quality. **(Lectures 10)**

Module:3

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

Module:4

Unconventional Machining Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters. Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, Dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining **(Lectures 14)**

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:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-PearsonIndia, 2014.
2. Taha H. A., Operations Research, 6th Edition, Prentice Hall of India, 2003.
3. Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.

Laboratory:

1. Measurement of angle using Sine Center / Sine bar / bevel protractor
2. Measurement of alignment using Autocollimator / Roller set
3. Measurement of cutting tool forces using
    a. Lathe tool Dynamometer
    b. Drill tool Dynamometer.
4. Measurement of Screw Threads Parameters using Two wire or Three-wire method.
5. Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator
6. Measurement of gear tooth profile using gear tooth Vernier/Gear tooth micrometer
7. Calibration of Micrometer using slip gauges
8. Measurement using Optical Flats

PCC-ME 308	Design of Machine Elements	3L:1T:2P	5 Credits

Objectives:

This course seeks to provide an introduction to the design of machine elements commonly encountered in mechanical engineering practice, through 1. A strong background in mechanics of materials based failure criteria underpinning the safety-critical design of machine components 2. An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations 3. An overview of codes, standards and design guidelines for different elements 4. An appreciation of parameter optimization and design iteration 5. An appreciation of the relationships between component level design and overall machine system design and performance

Course Contents:

Module: 1

Introduction to design: Steps in design process, design factors, practical considerations in design, selection of materials, strength of mechanical elements, impact load, shock load, fatigue loading, effects of surface, size, temperature and stress concentration, consideration of creep and thermal stress in design. (**Lectures8**)

Module: 2

Design of shafts: stresses in shafts, design of static loads, combined stresses, reversed bending and steady loads, design of shafts based on deflection and strength, critical speed of shafts. Analysis and design of sliding and rolling contact bearings, (**Lectures10**)

Module: 3

Riveted joint: Stresses in riveted joint, design of riveted joints with central and eccentric loads, boiler and tank joints, structural joints.

Bolt Joints: Stresses in bolt joint, design of bolt joints with central and eccentric loads.

Welded joints: types of welded joints, stresses, design of welded joints subjected to axial, torsional and bending loads, welds subjected to fluctuating loads**.** **(Lectures8**)

Module: 4

Design of Clutches: Friction clutches, uniform wear and uniform pressure assumptions, centrifugal clutches.

Brakes: Design of internal expansion elements, assumptions, design of external contraction elements, band type brakes. (**Lectures6**)

Module: 5

Design of transmission elements: spur, helical, bevel and worm gears;

Springs: stresses in helical springs, deflection of helical compression and tension springs, springs subjected to fatigue loading, concentric and helical torsion spring, critical frequency of springs, leaf springs, and design of automotive leaf springs. (**Lectures 8**)

Course Outcomes:

Upon completion of this course, students will get an overview of the design methodologies employed for the design of various machine components.

Data books allowed for Examination:

1. Mahadevan & Balaveera Reddy : Design Data Hand Book
2. Dr. Linghaigh & Prof. Narayana Iyengar, Vol.1 & 2 : Design Data Hand Book
3. P.S.G. Tech : Design Data Hand Book

Text Books:

1. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.
2. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
3. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
4. Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
5. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998

Laboratory:

1. To study the design procedure of Knuckle & Cotter joint.
2. Design of shafts subjected to torsion, bending moment and combined bending and torsion.
3. Design of flat and square key
4. Design and drawing of riveted joints
5. Design and drawing of screw jack
6. Journal Bearing Test Rig