Paper Code(s): MEC-212	**L**	**P**	**C**
Paper: Machine Design – I	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand ab-initio design concepts under various constraints, stress concentration and dynamic loading. Also analyse the design of static joints and pipes.
2.	To conceptualise joints for power transmission in rotating parts, suspension parts and in leverage.
3.	To analyse bolted & screwed fastenings and structural plates joining for complex engineering applications under myriad of loads.
4.	To thoroughly understand the design procedure for speed variation effects in toothed elements and power screws.

Course Outcomes (CO)

CO 1	Grasp the systematic design procedure & design principles considering constraints of various methods of manufacture and effect of static & dynamic forces on joints for rods.
CO 2	Synthesis of keyed-coupled shafts and stress analysis of flexible elements & levers.
CO 3	Design analysis of fastening threads and various temporary & permanent joints for plates.
CO 4	Analyse the effect of changing speeds on designed toothed elements and efficient power transmitting devices.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	3	2	2	2	1	1	2	3
CO 2	3	3	3	3	3	2	2	2	1	1	2	3
CO 3	3	3	3	3	3	2	2	2	1	1	2	3
CO 4	3	3	3	3	3	2	2	2	1	1	2	3

UNIT-I

Introduction: Systematic Design Process (SDP), Basic principles for mechanical design, Use of standards. Manufacturing consideration in design of casting & machining parts.
Dynamic and fluctuating stresses, fatigue failure and endurance limit, design under combined direct & varying stresses. Stress concentration, causes and remedies in design.
Factor of safety and it's affecting factors, Tolerances and fits as per BIS, Materials selection, Designation of steels. Detailed design procedure of Spigot & Socket Cotter joint, Knuckle joint, Pipe joint. Numerical Design Problems.

UNIT-II

Shafts, keys and couplings: Transmission Shafts, materials, design of shafts on strength & rigidity basis and under combined torsional and bending loads as per ASME code. Keys, types and applications. Design of rigid and pin bushed flexible couplings.
Levers, types, Design of Bell crank lever.

Springs and their applications, design of close coiled helical springs. Numerical Design Problems.

UNIT-III

Riveted & Welded Joints: Types of riveted joints, Failure modes, strength equations, joint efficiency, Riveted joint for boiler shells, Riveted joints under direct and eccentric loads. Welded joints, strength of parallel, transverse & combined filled welded joints, axially loaded unsymmetrical welded joint, eccentrically loaded welded joints, welded joints subjected to bending moment and torsional moment.
Threaded Joints: Types of screwed fastenings, Initial tightening loads in bolts, Torque requirement, Uniform strength bolt, Direct & eccentrically loaded bolted joints. Numerical Design Problems.

UNIT - IV

Power Screws: Types of threads of power screws - Square, trapezoidal & Acme threads, Torque requirement, efficiency, irreversibility & self-locking, Complete analysis of design of screw jack.
Spur Gear: Classification of Gears, spur gear terminology, Gear tooth failure, Lewis equation for beam strength of tooth, dynamic and wear loads. Numerical Design Problems.

Textbook(s):
1. V.B. Bhandari, “Design of Machine elements”, Tata McGraw Hill Education Private Ltd. Third Edition (2012)
2. Maleeve Hartman and O.P. Grover, “Machine Design”, CBS Publishers& Distributors Pvt. Ltd. Sixth Edition (2015)

References:
1. K. Mahadevan, “Design Data Book”, CBS Publishers & Distributors.
2. J.E. Shigley & C.R. Mischke, "Mechanical Engineering Design”, Tata McGraw Hill Co. Inc.
3. P.C. Sharma and D.K Aggarwal., “Machine Design”, S.K. Kataria & Sons.
4. R.C. Juvinal andK.M. Marshek, “Fundamentals of Machine component Design”, Wiley India .
5. R.I. Norton, “Machine Design” Pearson.