COURSE MODULE

Faculty Name:			**Academic Year:** 2024-25				
Department: Mechanical Engineering							
Course Code	**Course Title**	**Core/Elective**	**Prerequisite**	**Contact Hours**			**Total Hrs/ Sessions**
				L	**T**	**P**	
BME602	Machine Design	Core	MOM, Mathematics	3	2	0	52

Course Learning Objectives:

- To explain the principle involved in design of machine elements, subjected to different kinds of forces, from the considerations of strength, rigidity.
- To understand and interpret different failure modes and application of appropriate criteria for design of machine elements.
- Develop the capability to design elements like shafts, couplings and springs, welded joints, screwed joints.
- To learn transmission elements like gears, belts, pulleys, bearings from the manufacturers' catalogue.
- To produce assembly and working drawings of various mechanical systems involving machine elements like clutches and brakes.

Topics Covered as per Syllabus

Module - 1

Introduction and Review: Review of engineering materials and their properties and manufacturing processes; use of codes and standards, selection of preferred sizes. Review of axial, bending, shear and torsion loading on machine components, combined loading.

Design for static strength: Factor of safety and service factor. Failure mode: definition and types., Failure of brittle and ductile materials; even and uneven materials; Stress concentration, stress concentration factor, Theories of failure: maximum normal stress theory, maximum shear stress theory, distortion energy theory, strain energy theory, Columba –Mohr theory and modified Mohr's theory

Fatigue loading: Introduction to fatigue failure, Mechanism of fatigue failure, types of fatigue loading, S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit.

Module - 2

Design of shafts: Torsion of shafts, solid and hollow shaft design with steady loading based on strength and rigidity, ASME and BIS codes for power transmission shafting, design of shafts subjected to combined bending, torsion and axial loading, Discussion on engineering applications.

Design of keys and couplings: Keys: Types of keys and their applications, design considerations in parallel and tapered sunk keys, Design of square and rectangular sunk keys. Couplings: Rigid and flexible coupling types and applications, design of Flange coupling, and Bush and Pin type coupling.

Module - 3

Riveted joints: Types of rivets, riveted materials, Caulking and fullering, analysis of riveted joints, joint efficiency, failures of riveted joints, boiler joints, riveted brackets, Discussion on engineering applications.

Welded joints: Types, strength of butt and fillet welds, eccentrically loaded welded joints, Discussion on

engineering applications.

Spur Gears: Definitions, stresses in gear tooth: Lewis's equation and form factor, design for strength, dynamic load and wear.

Module – 4

Helical Gears: Definitions, transverse and normal module, formative number of teeth, design based on strength, dynamic load and wear.

Bevel Gears: Definitions, formative number of teeth, design based on strength, dynamic load and wear.

Worm Gears: Definitions, types of worm and worm gears, and materials for worm and worm wheel. Design is based on strength, dynamic, wear loads and efficiency of worm gear drives.

Module – 5

Design of Clutches and Brakes: Design of single plate, multi-plate based on uniform pressure and uniforms wear theories. Design of band brakes, block brakes

Lubrication and Bearings: Lubricants and their properties, bearing materials and properties. mechanisms of lubrication, hydrodynamic lubrication, pressure development in oil film, bearing modulus, coefficient of friction, minimum oil film thickness, heat generated, and heat dissipated.

List of Textbooks:

1 Shigley's Mechanical Engineering Design Richard G. Budynas, and J. Keith Nisbett McGraw-Hill Education 10th Edition, 2015
2 Fundamentals of Machine Component Design Juvinall R.C, and Marshek K.M John Wiley & Sons Third Edition 2007 Wiley student edition
3 Design of Machine Elements V. B. Bhandari Tata Mcgraw Hill 4th Ed 2016.

Reference Books:

1. Machine Design- an integrated approach Robert L. Norton Pearson Education 2nd edition.
2. Design and Machine Elements Spotts M.F., Shoup T.E Pearson Education 8 thedition,2006.
3. Machine Component Design Orthwein W Jaico Publishing Co2003.
4. Machine Design Hall, Holowenko, Laughlin (Schaum"s Outline series) Tata McGraw Hill Publishing Special Indian Edition, 2008.
5. Elements of Machine Design H.G.Patil, S.C.Pilli, R.R.Malagi, M.S.Patil IK International First edition,2019.
6. Design of Machine Elements Volume I and II T. Krishna Rao, IK international publishing house2012.
7. Hand book of Mechanical Design G. M. Maithra and L.V.Prasad Tata McGraw Hill 2 nd edition, 2004.

Course Outcomes

At the end of the course, the student will be able to

CO1: Apply codes and standards in the design of machine elements and select an element based on the Manufacturer's catalogue.

CO2: Analyze the performance and failure modes of mechanical components subjected to combined loading and fatigue loading using the concepts of theories of failure.

CO3: Demonstrate the application of engineering design tools to the design of machine components like shafts, springs, couplings, fasteners, welded and riveted joints, brakes and clutches.

CO4: Design different types of gears and simple gear boxes for relevant applications.

CO5: Apply design concepts of hydrodynamic bearings for different applications and select Anti friction bearings for different applications using the manufacturers, catalogue.

Scheme of Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub questions), should have a mix of topics under that module.
3. The students must answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

The Correlation of Course Outcomes (CO's) and Program Outcomes (PO's)

Subject Code: BME602			**TITLE:** Machine Design				**Faculty Name:**				
List of Course Outcomes	**Program Outcomes**										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO-1	3	3	3	2	1	-	-	1	-	2	-	2
CO-2	3	3	3	2	1	-	-	-	-	2	-	2
CO-3	3	3	3	2	2	-	-	-	-	2	-	1
CO-4	3	3	3	2	2	-	-	-	-	2	-	1
CO-5	3	3	3	2	2	-	-	-	-	2	-	1

	Program Specific Outcomes	
	PSO1	**PSO2**
CO-1	-	2
CO-2	-	2
CO-3	2	3
CO-4	2	3
CO-5	2	2

Note: 3 = Strong Contribution 2 = Average Contribution 1 = Weak Contribution - = No Contribution