

Branch Name:	Mechanical Engineering
Program Code:	ET101
Course Name:	Machine Element and System Design
Course Code:	2ET1010501T
Pre-requisite Course:	Engineering Materials and Applications; Mechanics of Deformable Solids

Course Objectives:

1. To understand the concepts of stress, strain and principle stresses
2. To learn about coplanar concurrent and non-concurrent force system
3. To understand the fundamentals of shear force and bending moment
4. To apply the laws/concepts mechanics to simple machines.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								
					Theory (Marks)				Practical (Marks)				Total (Marks)
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
4	3	1	-	4	24	60	16	40	-	-	-	-	100

Course Contents:

Sr. No	Topic	Total Hours	Weightage (%)
1	Module I: Introduction Anatomy of machines; Functional dissection of motorcycle, washing machine, sewing machine, etc. into machine elements including gears, rack and pinions, cams, chains, belts, pulleys, flywheels, bearings, shafts, keys, brakes, etc.; Design considerations – Limits, fits and standardization; Friction and lubrication.	04	15
2	Module II: Free-body Diagrams Force analysis of machine elements and machine systems and its applications such as power screws and couplings, clutches and brakes.	08	20
3	Module III: Failure Theories Static failure theories including normal stress theory, shear stress theory, distortion energy theory; von Mises stress; Factor of safety; Stress concentration factors; Fatigue failure theories: mean and alternating stresses, yield, ultimate, and endurance strength; Goodman, Gerber, and Soderberg lines.	08	25
4	Module IV: Design of Machine Elements Springs – Helical compression, tension, torsional and leaf springs; Fasteners – threaded fasteners, bolted joints, preloaded bolts, rivets and welded joints; Shafts – shafts under static and fatigue loadings; Keys; Sliding and rolling contact bearings; Transmission elements – transmission ratio and efficiency of spur, helical, bevel and worm gears; belt and chain drives;	08	25

5	Module V: Mechanical Systems Case studies on automobile suspensions, automatic transmissions, material conveyor systems, hoisting elements etc.	04	15
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List of Tutorials:

The students will have to solve at least five examples and related theory from each topic as an assignment/tutorial.

1. Case study of functional dissection of any one of the motor motorcycles, washing machine, sewing machine, etc.
2. Case study of Design problem based on any specific type of Power screws, Couplings or clutches.
3. Case study of Design problem of machine components based on theories of failure.
4. Case study of Design problem related to springs, shafts, bearings, gears, belt or chain drives.
5. Case study of Design of Conveyor systems.
6. Case study of Design of Hoisting elements.

Reference Books:

1. Mechanical Engineering Design by J.E. Shigley, and C.R., Mischke, McGraw-Hill, 2017.
2. Design of Machine Elements, by M.F. Spotts, Prentice-Hall India, 2018
3. Design of Machine Elements by V B Bhandari, Tata McGraw Hill, 2018
4. Machine Design by Sadhu Singh, Khanna Book Publishing, 2021.
5. Design Data Book by PSG, DPV Printers, 2020
6. Design Data Book by K Mahadevan, and K Balveera Reddy, CBS Publishers & Distributors Pvt Ltd, 2020
7. Machine Design by R S Khurmi and J K Gupta, S. Chand & Company Ltd, 2017.

E-Resources:

1. <https://archive.nptel.ac.in/courses/112/105/112105124/>

Course Learning Outcomes (CLO):

CLO	Description	Bloom's Taxonomy Level
CLO1	Understand the anatomy of the machines and apply to the machines.	1 Remembering 2 Understanding
CLO2	Understand the forces and apply the machine elements and systems.	3 Applying 4 Analyze
CLO3	To understand safety-critical design of machine components using failure criteria based on mechanics of materials.	2 Understanding 4 Analyze
CLO4	To understand the origins, nature and applicability of empirical design principles, relevant codes, standards and design guidelines for different machine elements.	2 Understanding 4 Analyze
CLO5	To appreciate the relationships between component level design and overall machine system design and performance	4 Analyze 5 Evaluating
CLO6	To apply the design philosophy to different mechanical systems.	5 Evaluating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CLO1	M		M			M						L	M	M
CLO2		H	M			M	M					L	M	L
CLO3	M	H	M	M		M	M					L	M	L
CLO4	H	M	M	M	M								M	
CLO5	H	L	M										L	
CLO6	M			M	H	M					L		H	

H: High, M: Medium, L: Low