

Branch Name:	Mechanical Engineering
Program Code:	ET402
Course Title:	Design of Machine Elements
Course Code:	2ET4020502
Pre-requisite Course:	-----

Course Objective: -

1. To comprehend the machine design process and become proficient in using it for basic components, general aspects, and considerations that impact the design process and machine element design.
2. Students should compute the design of basic machine components that are directly stressed.
3. To understand the principle of bending and its fundamental equation.
4. To calculate forces for machine parts that are exposed to twisting and direct moments.
5. To comprehend and ascertain the design of machine components exposed to bending and direct forces.
6. To understand the Types and applications of pressure vessels used in industries.
Design of thick and thin cylinders
7. Students can understand the bearing and its various types, selection procedure, and application.

Teaching And Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	4	60	40	20	30	150

Course Contents:

Sr. No.	Topic	Total hours	Weightage (%)
1.	General Considerations in Machine Design. 1.1 General considerations and factors influencing the design of machine elements and design process. 1.2 Various materials are used to manufacture machine elements and their properties. 1.3 Types of loads, types of stresses, the concept of stress concentration, and safety factors. 1.4 Standardization and preferred numbers, numeric examples of preferred numbers.	08	20

2.	Design of simple machine elements subjected to direct stresses. 2.1 Simple machine elements subjected to direct stresses independently and identification of resisting areas (simple numeric examples). 2.2 Design of simple machine elements subjected to uni-axial direct stresses independently. 2.3 Design procedure (with numeric examples), steps, identification of resisting areas, and design of: i. Knuckle joint. ii. Cotter joint. iii. Riveted joints.	09	20
3.	Design of machine elements subjected to bending stresses. 3.1 The principle of bending and its fundamental equation. 3.2 Modulus of various sections, such as an example of pure bending like levers, beams, axles, etc. 3.3 Types of levers. 3.4 Design procedure (with numeric example) Design procedure (with numeric example) of leaf spring.	05	10
4.	Design of machine elements subjected to direct and twisting moments. 4.1 The fundamental equation of the twisting moment with the design procedure. 4.2 Types of shafts. 4.3 Design of shafts (with numeric examples). 4.4 Types of keys, applications of each 4.5 Types of couplings and applications. 4.6 Design flange couplings, Types of springs, terminology related to helical springs, and applications of helical springs.	08	20
5.	Design of machine elements subjected to direct and bending stresses. 2.1 Eccentric loading- 2.2 Concept. 5.3 Illustrations like frame, C-clamp, and Bracket, Design of machine elements like C-clamp and bracket (with examples).	04	10
6.	Design of pressure vessels. 6.1 Types and applications of pressure vessels Design of thick and thin cylinders (with numeric examples).	04	10

7.	Selection procedure for bearings. 7.1 Classification of bearings. 7.2 Bearing designation as per IS. 7.3 Antifriction bearings: types, advantages, applications. 7.4 Selection procedure of anti-friction bearings.	04	10
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List of Practical:

Sr. No	Name of Practical	Approx. Hours.
1.	Preparatory Activity: a. Interpret and write various course-related SI units and their conversions. b. Write typical values of the ultimate tensile strength, yield strength, density, modulus of elasticity, and Poisson's ratio of commonly used materials. c. List normal values of factors of safety for different situations. d. Recall area, volume, section modulus, moment of inertia, the radius of gyration, etc., for commonly used various sections and shapes.	02
2.	Design of simple components: a. Determine the diameter of the rod subjected to tensile load with a factor of safety b. The teacher will assign the sketch of a component/s with loading that induces tensile/compression and shear stresses. The teacher will also assign material, load, and factors of safety. Students are asked to determine the dimensions.	04
3.	The following design shows other assumptions, steps, and final dimensions. a. Knuckle joint, Cotter joint, Flange coupling.	06
4.	Modeling: Create 3D Models of all parts and assemblies (group of 4 students. Each student will perform one) with dimensions designed at experience number 3.	04
5.	Tutorial on twisting moment. The teacher will assign the sketch of a component/s with loading that induces a twisting moment. This may have added one or two types of stress. The teacher will also assign material, a factor of safety, and other required data.	04
6.	Tutorial on bell crank lever design. (The teacher will assign the data- three problems).	02
7.	Tutorial on eccentric loading component design (C-clamp and Bucket). (The teacher will assign the data- one for each component problem.)	02
8.	Tutorial on Pressure vessel design. (The teacher will assign the data- three problems).	02
9.	Write a report on the Selection of bearings.	02

Reference Books:

Sr. No.	Title of Book	Author	Publication
1.	Machine Design.	R.K. Jain.	Khanna Publishers.
2.	Machine Design	R.C. Patel and A.D. Pandya	Acharya Book Depot, 1959.
3.	Design of Machine Elements	Shigley.	Tata McGraw-Hill Edu.
4.	Design Data Book	P.S.G. College of Tec., Coimbatore.	P.S.G. Publication.
5.	A Textbook of Machine Design	R.S. Khurmi and J.K. Gupta	S. Chand.

List of Open-Source Software/learning Websites:

Chapter: 1 Introduction.

i. http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/left_home.html

Chapter 2 Design of Machine elements subjected to direct stresses.

i. http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/left_mod4.html

Chapter 3 Design of Machine elements subjected to Bending stresses.

http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/left_mod7.html.

Chapter 4 Design of Machine elements subjected to direct and twisting moments.

http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/left_mod4.html
http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/left_mod5.html
http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/left_mod8.html

Chapter 5 Design of Machine elements subjected to direct and bending stresses.

http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/left_mod11.html

Chapter 6 Design of Pressure Vessels.

http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/left_mod9.html

Chapter 7 Selection Procedure for Bearings.

<http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Machine%20design1/left>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	These considerations ensure that students completing a machine design course are well-prepared for the challenges of designing machine elements in various engineering applications.	1 Remembering 2 Understanding 3 Applying
CLO2	Students have a comprehensive understanding of the challenges and considerations involved in designing machine elements that experience both axial and torsional loads, preparing them for real-world engineering applications.	1 Remembering 2 Understanding 3 Applying 5 Evaluating

CLO3	Understanding of the principles and practices involved in designing machine elements that experience bending stresses, preparing them for practical applications in engineering.	2 Understanding, 3 Applying
CLO4	Provide a broad range of skills by fusing theoretical understanding with real-world application in the design of machine components that are exposed to twisting and direct moments.	2 Understanding, 3 Applying
CLO5	Integrating theoretical understanding with real-world applications while designing machine components that are exposed to bending and direct loads.	3 Applying 4 Analyze
CLO6	Thorough construction, design, and analysis of pressure vessels, qualifying them for professions in fields like petrochemicals, aerospace, and energy, where pressure vessels are frequently utilized.	3 Applying 4 Analyze 5 Evaluating
CLO7	Students should be able to choose bearings for a variety of engineering applications with knowledge, taking into account elements including load circumstances, environmental considerations, and performance needs.	2 Understanding 3 Applying,

Mapping of CLO with PO and PSO

Course Learning Outcomes	Program Outcomes (Pos)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO1	H	M											H	M	
CLO2	H		M	L				L				L		H	L
CLO3	H	M	M										M		
CLO4			M	L	L				M					M	L
CLO5		H	M	L									H	M	M
CLO6		M	M	L	L				M			L	M	L	
CLO7	M							L				L	H		

H: High, M: Medium, L: Low