

Subject Code: 1ET4020502	Subject Name: Design of Machine Elements
Pre-Requisite:	

RATIONALE:

The production of machine elements required their shape, size, tolerance, and material which are important factors that are obtained with various designs. For designing, it is necessary to have a good knowledge of Mathematics, Engineering Mechanics, Strength of Materials, Theory of Machines, Workshop Processes, Engineering Drawing, etc. Students have learned these subjects in previous semesters. This course curriculum provides the students' knowledge of the design process, as well as familiarity with the design of components subjected to various stresses and moments like direct stress, bending stress, twisting moment, and combined stresses. In this course, students will learn the design of machine components/elements like cotter joint, knuckle joint, power screw, levers, helical and leaf springs, couplings, pressure vessels, bearings, etc.

COURSE OBJECTIVE: -

1. To understand the procedure of machine design and develop an ability to apply it for simple componentsGeneral consideration and factors influencing the design of machine elements and design process.
2. Students to calculate the Design of simple machine elements subjected to direct stresses
3. To understand the Principle of bending and its fundamental equation.
4. To determine forces for machine elements subjected to direct and twisting moments.
5. To understand and determine the Design of machine elements subjected to direct and bending stresses.
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, application, and various calculations.

TEACHING AND EXAMINATION SCHEME:

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

Subject Contents			
Sr. No.	Topic	Total hours	Weightage (%)
1.	General consideration in machine Design - General consideration and factors influencing the design of machine elements and design process. - Various materials are used in the manufacturing of machine elements and their properties. - Types of loads, types of stresses, the concept of stress concentration, and factors of safety. - Standardization and preferred numbers, numeric examples on preferred numbers.	08	20
2.	Design of simple machine elements subjected to direct stresses. - Simple machine elements subjected to direct stresses independently and identification of resisting areas (simple numeric examples). - Design of simple machine elements subjected to uni-axial direct stresses in dependently. - Design procedure (with numeric examples), steps, identification of resisting areas, and design of: i. Knuckle joint. ii. Cotter joint. iii. Riveted joints. iv. Welded joint-fillet & lap joint. V. Threaded fasteners & screw jack.	09	20

3.	Design of machine elements subjected to bending stresses. • Principle of bending and its fundamental equation. • Modulus of various sections, an example of pure bending like levers, beams, axle, etc. • Types of levers. • Design procedure (with numeric example) of levers including a cross-section of arms, bosses, and pins. • Design procedure (with numeric example) of leaf spring.	05	10
4.	Design of machine elements subjected to direct and twisting moments. • The fundamental equation of twisting moment with the design procedure. • Types of shafts with important features of each. • Design of shafts (with numeric examples). • Types of keys, applications of each • Types of couplings and applications. • Design of muff and flange couplings Types of spring, terminology related to helical spring, and applications of helical spring.	08	20
5.	Design of machine elements subjected to direct and bending stresses. • Eccentric loading- • Concept. • Illustrations like frame, C-clamp, Bracket, • Design of machine elements like C-Clamp, bracket, (with numeric examples).	04	10
6.	Design of pressure vessels. • Types and applications of pressure vessels Design of thick and thin cylinders (with numeric examples).	04	10
7.	Selection procedure for bearings. • Classification of bearings.	04	10

	- Bearing designation as per IS. - Antifriction bearings: types, advantages, applications. - Selection procedure of anti-friction bearings.		
Total		42	100

COURSE OUTCOMES

The theory should be taught and practices should be carried out in such a manner that students can acquire different learning objectives in the cognitive, psychomotor, and affective domains to demonstrate the following course outcomes.

- i. Identify various failures and calculate resisting areas of machine elements.
- ii. Use preferred numbers and standardization to select element/element dimensions.
- iii. Design machine element subjected to:
 - a: Direct stresses. b: Bending stresses. c: Twisting stresses. d: Combined stress.
- iv. Design of thin and thick cylinder pressure vessels.
- v. Select appropriate bearing for given situation/application.
- vi. Calculate important bearing characteristics.

List of Practical/ Experiments

1.	Preparatory Activity : - Interpret and write various course-related SI units and their conversions. - Write normal values of ultimate tensile strength, yield strength, density, and modulus of elasticity and Poisson's ratio of commonly used materials. - List normal values of factors of safety for different situations. - Recall area, volume, section modulus, a moment of inertia, the radius of gyration, etc. for commonly used various sections and shapes.
2.	Design of simple components: - Determine the diameter of rod subjected to tensile load with a factor of safety - 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.

3.	Design following showing other assumptions, steps, and final dimensions. • Knuckle joint. • Cotter joint. • Screw jack. • Flange coupling.
4.	Modeling: Create 3D Models of all parts and assemblies (In a group of 4 students. Each student will perform one) with dimensions designed at experience number 3.
5.	The teacher will assign the sketch of a component/s with loading that induces twisting moment. This may have added one or two types of stress/es. The teacher will also assign material, a factor of safety, and other required data. (Like kW, rpm, Torque, etc.).
6.	Tutorial on bell crank lever design. (Teacher will assign the data- three problems).
7.	Tutorial on eccentric loading component design(C-clamp and Bucket). (Teacher will assign the data- one for each component problem).
8.	Tutorial on Pressure vessel design. (Teacher will assign the data- three problems).
9.	Write a report on Selection of Bearing

List of References:

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 Software/Learning Websites

Chp: 1 Introduction.

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

Chp: 2 Design of Machine elements subjected to direct stresses.

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

Chp: 3 Design of Machine elements subjected to Bending stresses.

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

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

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

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

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

Chp: 6 Design of Pressure vessels.

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

Chp: 7 Selection Procedure for bearings.

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