



# GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Mechanical Engineering / Mechanical Engineering (CAD/CAM)

/Mechatronics Engineering

Subject Code: DI04000251

Subject Name : Design of Machine Elements

W. e. f. Academic Year:	2025-26
Semester:	4 <sup>th</sup>
Category of the Course:	PCC

<b>Prerequisite:</b>	(1) Engineering Materials Science (DI01000181) (2) Mechanical Drafting ( DI02000121 ) (3) Basics of Applied Mechanics (DI03000201)
<b>Rationale:</b>	For production of machine parts and components it is required that specific shape and size of machine parts are determined and their drawings are prepared. We also have to select specific material for that product. This process is called as design. This course curriculum provides the students' knowledge of design process, as well as familiarity with 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 design of machine components/elements like cotter joint, knuckle joint, levers, helical and leaf springs, couplings, pressure vessels, bearings, etc.

### Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
CO-1	Identify various failures and its resisting areas of machine element.
CO-2	Make use of preferred number for standardization of element dimensions in given range.
CO-3	Design machine element subjected to Direct, Bending, and Twisting and Combined load.
CO-4	Determine the safe dimensions of thin and thick cylinder pressure vessel.
CO-5	Calculate important characteristics of sliding and antifriction bearing.

### Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE(E)	PA(M)	PA(I)	ESE(V)	
3	0	2	4	70	30	20	30	150



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## Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	<b>Introduction:</b> 1.1 General consideration and factors influencing the design of machine elements and design process. 1.2 Various materials used in manufacturing of machine elements and their properties. 1.3 Types of loads, types of stresses, concept of stress concentration and factor of safety. 1.4 Standardization and preferred numbers, numeric examples on preferred numbers.	08	20
2.	<b>Design of machine elements subjected to direct stresses:</b> 2.1 Illustration of 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.	10	20
3.	<b>Design of machine elements subjected to bending stresses:</b> 3.1 Principle of bending and its fundamental equation. 3.2 Modulus of various sections, example of pure bending like levers, beams, axle, etc. 3.3 Types of levers. 3.4 Design procedure (with numeric example) of levers including cross section of arms, bosses and pins. 3.5 Design procedure (with numeric example) of leaf spring.	06	10
4.	<b>Design of machine elements subjected twisting moments:</b> 4.1 Fundamental equation of twisting moment with design procedure. 4.2 Types of shafts with important features of each. 4.3 Design of shafts (with numeric examples). 4.4 Types of keys, applications of each and design procedure (with numeric examples). 4.5 Types of couplings and applications.	09	20



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	4.6 Design of muff and flange couplings (with numeric examples). 4.7 Types of helical spring, terminology related to helical spring and applications of helical spring (with numeric examples).		
5	<b>Design of machine elements subjected to direct and bending stresses:</b> 5.1 Eccentric loading- i. Concept, ii. Illustrations like frame, C-clamp, Bracket, Column of drilling machine etc. iii. Design of machine element like C-Clamp, bracket, Column of drilling machine. (with numeric examples).	04	10
6	<b>Design of pressure vessels:</b> 6.1 Types and applications of pressure vessels used in industries. State Range of pressure also. 6.2 Design of thick and thin cylinders (with numeric examples). 6.3 Design of thin spherical shell (with numeric examples).	04	10
7	<b>Selection procedure for bearings:</b> 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. 7.5 Calculation for anti-friction bearings: basic dynamic load, load rating, equivalent load, bearing life.	04	10
<b>Total</b>		<b>45</b>	<b>100</b>

### Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
26	43	31	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)



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## References/Suggested Learning Resources:

### (a) Books:

Sr. No.	Title of Books	Author	Publication& ISBN
1.	Machine Design	R.K.Jain	Khanna Publishers
2.	Machine Design	TVS Murthy and N.Shanmugam	Anuradha publications
3.	Machine Design	Pandya and Shah	Charotar Publishing House Pvt. Limited
4.	Machine Design	R.C.Patel and A.D.Pandya	Acharya Book Depot, 1959.
5.	Design of Machine Elements	Shigley	Tata McGraw-Hill Education
6.	Design Data Book	P.S.G. College of Technology, Coimbatore	P.S.G. Publication
7.	Design Data Book	K. Mahadevan&Balveera Reddy	S. Chand
8.	A Text book of Machine Design	R.S.Khurmi and J.K.Gupta	S. Chand
9.	Design of machine elements	V.B.Bhandari	McGraw-Hill

### (b) Open source software and website:

1. Chpapter:1 Introduction.

I. <https://youtu.be/m9l1tVXyFp8>

II. <https://youtu.be/joLY82CpmGo>

III. <https://youtu.be/yH04FSBiCdk>

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

I. <https://youtu.be/OT6VcqVooGY>

II. <https://youtu.be/J9Aj17MAyLY>

III. <https://youtu.be/C5ZPaCvoigw>

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



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- I. <https://youtu.be/XSK4iupjbwY>
- II. <https://youtu.be/r04WynzyK-U>
- III. <https://youtu.be/E0hrPYAr8pA>
4. Chapter:4 Design of Machine elements subjected to direct and twisting moments.
  - I. <https://youtu.be/G0bShPqHn5c>
  - II. [https://youtu.be/uGxfchLe-\\_I](https://youtu.be/uGxfchLe-_I)
  - III. <https://youtu.be/QfhIea6KzZA>
  - IV. <https://youtu.be/46quOD7V-cQ>
5. Chapter: 5 Design of Machine elements subjected to direct and bending stresses.
  - I. <https://youtu.be/E0hrPYAr8pA>
  - II. [https://youtu.be/\\_\\_\\_py5xbKHGA](https://youtu.be/___py5xbKHGA)
  - III. <https://youtu.be/1oMjw1YIGwg>
6. Chapter: 6 Design of Pressure vessels.
  - I. <https://youtu.be/hTL8JMmfSC0>
  - II. <https://youtu.be/erW4HZ5I928>
7. Chapter:7 Selection Procedure for bearings.
  - I. <https://youtu.be/q4E9yaulqyc>

## Suggested Course Assignment List

1. Preparatory Activity.
2. Standardization using preferred number.
3. Design of simple components subjected to direct load.
4. Design of simple components subjected to bending load.
5. Design of simple components subjected to twisting moment.
6. Design of simple components subjected to eccentric load.
7. Design of Cotter joint.
8. Design of Knuckle joint.
9. Design of Flange coupling.



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10. Design of pressure vessel.
11. Calculation of features/characteristics of Bearings.

### List of Laboratory/Learning Resources Required:

1. Assorted levers, Leaf Springs, shafts, keys, Helical Spring, C-clamps, frames, other machine components.
2. Wooden models (with cut sections) of knuckle joint, cotter joint, flange coupling
3. Assorted bearings.
4. Educational charts/models of different machine elements subjected to various stresses.

### Suggested Project List:

1. Prepare model of simple mechanical element to show different types of stress induced in it.
2. Prepare a tabulated summary which shows the standard value of factor of safety based on types of load and types of material. Take reference of design data book.
3. Prepare a chart to represent different shapes like Round bar, Square bar, Steel flat, Different section like L, T, I and C and sizes of some structural members as per IS Code.
4. Prepare a chart to shows stress concentration acting on simple mechanical element.
5. Prepare a chart to represents all possible failure of cotter joints.
6. Prepare a chart to represents all possible failure of Knuckle joints.
7. Prepare a chart to represents all possible failure of flange coupling.
8. Collect different types of rivet.
9. Prepare model of different types of riveted joints. (like single riveted, double or triple riveted, lap joint or butt joint, single cover or double cover)
10. Prepare a demonstration model of the failure of Riveted Joint.
11. Prepare a tabulated summary to show moment of inertia and modulus of section for common sections.
12. Collect a semi elliptical leaf spring from scrap and prepare model to represents elements of leaf spring.



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13. Collect the different types of keys used in industry.
14. Prepare model to represent failure of key.
15. Prepare chart/model to represent failure of thin cylinder.
16. Prepare chart to represent stress distribution in thick cylinder.
17. Prepare chart to represent construction of anti-friction bearing.
18. Prepare chart to represent different types of sliding contact bearing.
19. Prepare chart to represent different types of rolling contact bearing.

### **Suggested Activities for Students:**

1. Download and present various presentations related to stresses in machine elements.
2. Download and present various presentations related to failure of machine elements.
3. Download and present various presentations related to design of machine elements.
4. Prepare/Download a dynamic animation to illustrate the following:
  - i. Knuckle joint.
  - ii. Cotter joint.
  - iii. Flange Coupling

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