

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL ENGINEERING (19)

DESIGN OF MACHINE ELEMENTS

SUBJECT CODE: 2151907

B.E. 5th SEMESTER

Type of course: Under Graduate

Prerequisite: Machine Design and Industrial Drafting.

Rationale: Determining configurations and parameters of various components of a mechanical system is a crucial stage of development. This requires functional and structural analysis of elements. The course aims to provide fundamental knowledge for material selection, analysis of components subjected to fluctuating loads, design of components like spring, pressure vessels and transmission system like belts, chain and ropes.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		PA (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction: Design procedure, Selection of preferred sizes, Aesthetic and Ergonomic considerations in Design, Manufacturing considerations in Design, Mechanical Properties of Materials, Effect of Alloying elements and heat treatment on properties of steels, Materials Selection in Machine Design, IS coding of steels and Cast Irons.	7	15%
2	Design Against Fluctuating Loads: Stress Concentration, Endurance limit and Fatigue failure, Factors affecting endurance limit, S-N Diagram, Design for reversed stresses and cumulative damage, Fluctuating stresses: Soderberg, Gerber, Goodman and Modified-Goodman criteria, Combined stresses.	7	20%
3	Design of Springs: Classification of springs, Helical Spring: Style of ends, Stresses, Correction Factors, and Deflection, Design against static and fluctuating loads, Concentric springs, surge phenomenon. Helical Torsion and Spiral Springs, Belleville spring, shot peening of springs. Multi-Leaf Spring: Terminology, Nipping, and Design of multi-leaf spring.	8	15%
4	Belt and Chain Drives: Flat Belt Drive: Belt Construction, Flat Belt Drive: Length of the Belt: Open and Cross drive types, Ratio of Tensions on tight side to slack side, Condition for maximum power transmission, Creep phenomenon, Methods for tensioning, Selection of Belts from catalogues, Design of Pulley for flat belt drive. Timing belt selection. V-Belt Drive: Nomenclature, Selection of V-Belts from catalogues. Chain Drive: Nomenclature of roller chains, Length and power rating of	11	25%

	chains, Design of chain drive.		
5	Pressure Vessels: Thin cylinders and spherical vessels, Wire wound cylinders. Thick cylinders: Principal stresses in cylinder subjected to internal/external pressure, Lamé's equation, Clavarion's and Bernie's equations, Autofrettage, Compounding of cylinders, Gasketed Joints, Thickness of cylindrical and spherical shells, Design of End closures, Area compensations for nozzles. Introduction to Design codes.	11	25%

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	15	15	10	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. V B Bhandari, Design of Machine Elements, 3/e, McGraw Hill.
2. R C Juvinall, Fundamentals of Machine Component Design, 4/e, Wiley.
3. P C Gope, Machine Design: Fundamentals and Applications, 1/e PHI.
4. R L Norton, Machine Design An Introduction, Pearson.
5. E J Hearn, Mechanics of Materials, BH.

Course Outcome:

After learning the course the students should be able to:

1. Carryout preliminary selection of materials for mechanical components.
2. Analyse components subjected to fluctuating loads.
3. Design springs for mechanical application.
4. Design and select belt and chain drives.

List of Experiments:

1. Exercise on material selection for given application.
2. Measure and compare properties of steel with different alloying elements.
3. Design of mechanical components subjected to fluctuating loads.
4. Determine fatigue strength of a material.
5. Design of springs.
6. Design of belt drives.
7. Design of chain drives.
8. Study performance of a belt drive for different tension (tightening) levels.
9. Design of pressure vessels. Exercise should include demonstration of use of codes (ASME Section VIII Div 2 and IS 2825 (1969)).

Design based Problems (DP)/Open Ended Problem:

1. Design a spring for suspension system of a vehicle and validate the same.
2. Design a pressure vessel using conventional method learned, and using standard codes. Compare both the design.

Major Equipment:

1. Belt drive setup.
2. Moore's Test rig.

List of Open Source Software/learning website:

1. www.nptel.com

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU