



COURSE NAME : DIPLOMA IN MECHANICAL ENGINEERING

COURSE CODE : ME/MH/MI

SEMESTER/YEAR : SIXTH FOR ME AND SEVENTH FOR MH/MI

SUBJECT TITLE : DESIGN OF MACHINE ELEMENTS

SUBJECT CODE :

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS.	TH	PR	OR	TW	TOTAL
04	--	02	04	100	--	25#	25@	150

TH- Theory

TW- Term Work

PR- practical

#- External

OR- Oral

@- Internal

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 100 and to be entered in mark sheet under the head Sessional Work. (SW)**

RATIONALE:

It is an applied technology subject. A diploma holder in mechanical discipline, is expected to design and draw simple machine components used in industries. Fundamental knowledge of Applied Mechanics, Strength of Materials, Engineering Materials and Theory of Machines is essential. Subject aims at developing analytical abilities to give solutions to engineering design problems.

OBJECTIVES:

The student will be able to:

1. Analyze the various modes of failure of machine components under different load patterns.
2. Design and prepare part and assembly drawings.
3. Use design data books and different codes of design.
4. Select standard components with their specifications from manufacturer's catalogue.
5. Develop drawings on CAD software

LEARNING STRUCTURE:

Application :

To design and draw different machine elements and their assemblies from strength, Ergonomic, aesthetic, maintenance and economic consideration

Procedures :

Analysis of forces & stresses, identification of areas of failure, use of standards, applying strength and empirical relations to design process

Principles :

Modes of failures, Theories of failure, Ergonomics and Aesthetics

Concept :

Stress, Strain, bending moment, torque, principal stresses, factor of safety, stress concentration, fatigue, endurance limit, creep, Friction

Facts :

Cotter and Knuckle joints, Turnbuckle, C-Clamp frame, Pulleys, Shafts, Keys and Couplings, Screws, Bearings, Levers, fasteners, springs.



THEORY:

Topic and Contents	Hours	Marks
1: Introduction to Design 20 Specific Objectives: <ul style="list-style-type: none"> ➤ State the need for the design ➤ List all parameters related to design ➤ Apply basic concepts in design procedure 		
1.1 Basic Design Considerations 4 <ul style="list-style-type: none"> • Design philosophy and Procedures • General Considerations in Design • Types of loads, concepts of stress ,strain, Stress – Strain Diagram for Ductile and Brittle Materials, Types of Stresses such as Tension, Compression, Shear, Bearing pressure • Intensity, crushing, bending and torsion, Principle • Stresses(Simple Numerical) • Concept of Creep ,Fatigue, S-N curve, Endurance Limit. 		
1.2 Factors in Design 4 <ul style="list-style-type: none"> • Factor of Safety and Factors affecting its selection • Stress Concentration – Causes & Remedies • Converting actual load or torque into design load/torque using design factors 	13	20
1.3 Properties of Engineering materials 4 <ul style="list-style-type: none"> • Designation of materials as per IS and introduction to International standards ,advantages of standardization , use of design data book, use of standards in design and preferred numbers series. 		
1.4 Theories of Elastic Failures 4 <ul style="list-style-type: none"> • Principal normal stress theory, Maximum shear stress theory & maximum distortion energy theory. 		
1.5 Modern Design considerations 4 <ul style="list-style-type: none"> • Design for safety, Ecology, societal consideration & Concept of Product Design, System Design & Creativity in Design, Ergonomics and aesthetic considerations in design 		
2: Design of Joints, Levers & Offset links 16 Specific Objectives: <ul style="list-style-type: none"> ➤ Design a joint for a given load to be transmitted ➤ Calculate dimensions of lever/link using allowable bending and shear stress 		
2.1 Design of Cotter Joint, Knuckle Joint, Turnbuckle 8	08	16
2.2 Design of Levers:- Hand/Foot Lever & Bell Crank Lever, 8 Lever for lever safety valve, Design of Off-set links, C – Clamp, Overhang Crank.		

<p>3. Design of Shafts, Keys and Couplings 20</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Design the diameter of a shaft on the basis of equivalent twisting/bending moment and allowable shear stress ➤ Design the section of most commonly used rectangular key on the basis of torque, allowable shear stress and crushing stress ➤ Design a rigid/flexible coupling for connecting two shaft on the basis of torque and allowable shear stress ➤ Design spur gear by taking into account effective tooth load <p>3.1 Design of shaft 6</p> <ul style="list-style-type: none"> • Types of Shafts, Shaft materials, Standard Sizes, • Design of shafts (Hollow and Solid) using strength and rigidity criteria, • ASME code of design for line shafts supported between bearings with one or two pulleys in between or one overhung pulley <p>3.2 Design of key 4</p> <ul style="list-style-type: none"> • Types of keys • Design of rectangular, parallel sunk keys, • Effect of Keyways on strength of shaft. <p>3.3 Design of Couplings 6</p> <ul style="list-style-type: none"> • Flanged coupling • Protected type Flanged coupling, • Bush-pin type flexible coupling. <p>3.4 Design of spur gear 4</p> <ul style="list-style-type: none"> • Lewis equation for static beam strength of spur gear teeth • Power transmission capacity of spur gears in bending • Gear tooth failure modes – Scoring, Pitting & Teeth Breakage 	12	20
<p>4: Design of Power Screws 12</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Draw the different thread profiles used in power screws and state their merits and demerits ➤ Bring out the difference between self locking and overhauling ➤ Design the screw jack/toggle jack under a given loading conditions. <p>4.1 Basic concepts</p> <ul style="list-style-type: none"> • Thread Profiles used for power Screws, relative merits and demerits of each, • Self locking and overhauling property • Torque required to overcome thread friction, efficiency of power screws, types of stresses induced. 6 <p>4.2 Design of Screw Jack, Toggle Jack(only screw and nut). 6</p>	10	12

5: Design of springs 12 Specific Objectives: ➤ Classify the springs on the basis of different criteria ➤ Design Helical spring based on given load conditions 5.1 Classification and Applications of Springs, Spring - terminology, materials specifications. Stresses in springs, Wahl's correction factor, Deflection of springs, Energy stored in springs. 3 5.2 Design of Helical tension and compression springs subjected to uniform applied loads like I.C. engine valves, weighing balance, railway buffers and governor springs. 6 5.3 Leaf springs – construction and application 3	08	12	
6: Design of threaded and welded joints 12 Specific Objectives: ➤ State the applications of fasteners ➤ Design threaded/welded joints under different load conditions 6.1 Stresses in Screwed fasteners, bolts of Uniform Strength. Design of Bolted Joints subjected to eccentric loading. 6 6.2 Design of parallel and transverse fillet welds, axially loaded symmetrical section, Merits and demerits of screwed and welded joint 6	08	12	
Chapter 7: Antifriction Bearings 8 Specific Objectives: ➤ Classify the bearings ➤ Select rolling bearings, for specific applications, using manufacturers catalogue. 7.1 Classification of Bearings – Sliding contact & rolling contact. Terminology of Ball bearings – life load relationship, basic static load rating and basic dynamic load rating, limiting speed. Selection of ball bearings using manufacturer's catalogue.	5	8	

Skills to be developed in Practicals

Intellectual Skills:

1. Understand the basic philosophy and fundamentals of Machine Design.
2. Apply and use the basic knowledge of earlier subjects like mechanical Engineering. materials, strength of materials and theory of machines.
3. Analyze and evaluate the loads, forces, stresses involved in components and subassemblies and decide the dimensions.
4. Understand the modes of failures of m/c components and decide the design criteria and equations.
5. Understand the concept of standardization and selecting standard components.
6. Understand the methods of computer aided design practices.
7. Use of different design data books and IS codes.

Motor Skills:

1. Draw the components assembly as per the designed dimensions.
2. Modify drawings and design as per requirement.
3. Use the different design software.

List of Practicals:

1. Design Project No. 1

Observe the system where transmission of power takes place through shaft, Keys, coupling, pulley and belt drive. Get the required information regarding power transmitted (power output by motor or engine etc.). By selecting suitable materials, design the shaft, key and coupling. Also select suitable Ball Bearing from Manufacturer's catalogue. Prepare design report, details and assembly drawing indicating overall dimensions, tolerances, fits and surface finish. Also prepare bill of materials. (Activity should be completed in a group of maximum four students)

2. Design Project No. 2

Observe the System where transmission of power takes place through power Screws. (e.g. Lead screw of lathe, feed screws of machine tools, Clamping screws, Toggle Jack screw, Bottle type screw Jack.)

Get the required information regarding effort, clamping force, etc., and selecting suitable materials from data book design screw, nut and different simple components in assembly. Prepare design report, details and assembly drawing indicating overall dimensions, tolerances, fits and surface finish. Also prepare bill of materials. (Activity should be completed in a group of maximum four students)

3. Prepare CAD Drawing for project No 1 or 2 in practicals and print out of sheet should be attached .

Assignments :

- Design and draw following components for a given load
Cotter Joint, Knuckle Joint, Turn Buckle, Bell Crank Lever, Off – Set link, Arm of Pulley (One example on each component)
- Design of Helical Springs, Screwed joints, Welded joints with free hand sketches. (One example on each component)

Learning Resources:

1. Books:

Sr. No.	Title	Author	Edition	Publisher
1	Machine Design	RS Khurmi and Gupta	14th	S. Chand
2	Machine Design	VB Bhandari	3rd	Tata Mc-Graw Hill
3	Machine Design	U C Jindal	2 reprint	Pearson Education India
4	Mechanical Engg. Design	Richard G Budynas,J. Keith Nisbett	9th	Tata Mc-Graw Hill
5	Theory and problems of Machine Design	Hall,Holowenko,Laughlin	Reprint 2005	Mc-Graw Hill
6	Design Data Book	PSG	8th	PSG College of Technology Coimbatore
7	Fundamentals of machine components design	Robert C.Juvinall Kurt M Marshek	3rd	Wiley India Edition

2. IS Codes

- a) IS 4218: 1967 ISO Metric Threads
- b) IS 2693: 1964 Cast Iron Flexible Couplings
- c) IS 2292: 1963 Taper keys & Keyways
- d) IS 2293: 1963 Gib Head Keys & Keyways
- e) IS 2389: 1963 Bolts, Screws, Nuts & Lock Nuts
- f) IS 4694: 1968 Square threads
- g) IS 808: 1967 Structural Steel
- h) SKF Catalogue for Bearings