Program :	**Diploma in Mechanical Engineering / Manufacturing Technology**
Course Code : **5021**	Course Title: **Design of Machine Elements**
Semester : **5**	Credits: **4**
Course Category: **Program Core / Elective**	
Periods per week: **4 (L:3, T:1, P:0)**	Periods per semester: **60**

Course Objectives:

- To provide fundamental knowledge of Machine design to identify, design and draw simple machine components used in small and medium scale industries.
- To identify types of mechanisms, fasteners and welded joints
- To familiarize the design of shafts, keys and construction of cam profile
- To identify the applications of flywheels and governors.

Course Prerequisites:

Topic	Course Code	Course Name	Semester
Basic knowledge in problem solving		Mathematics I & II	1 & 2
Basics of mechanics and force system		Engineering Mechanics	2
Concept of Simple Stresses and Strains, Concept of Torsion in Shafts		Strength of materials	3

Course Outcomes

On completion of the course, the student will be able to:

COn	Description	Duration (Hours)	Cognitive Level
CO1	Explain types of mechanisms, fasteners and welded joints and identify them for specific applications	16	Applying
CO2	Apply the basic theory of design of shafts and keys for mechanical power transmission	13	Applying
CO3	Explain the applicability of cams, flywheels and governors in the design of mechanical systems	14	Applying
CO4	Describe the various types of mechanical power transmission devices and their selection on specific applications	15	Applying

Series Test		2	

CO-PO Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3						
CO2	3						
CO3	3	3	3				
CO4	3						

3-Strongly mapped, 2-Moderately mapped,   1-Weakly mapped

Course Outline

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Explain types of mechanisms, fasteners and welded joints and identify them for specific applications**		
M1.01	Identify the factors governing the design of machine elements	3	Understanding
M1.02	List the different types of kinematic links and mechanism with inversion	3	Understanding
M1.03	Explain the types of fasteners, both permanent and temporary and solve problems on welded joints	7	Applying
M1.04	Identify the types of riveted joints	3	Understanding

Contents:
General Considerations in Machine Design; Design stress, working stress and factor of safety

Simple mechanisms: Definition and explanation of the terms- Kinematic link or element, Kinematic pair, kinematic chain, mechanism, inversion of mechanism; types of constrained motions, classification of kinematic pairs; types of kinematic chain-four bar chain, single slider crank chain, double slider crank chain

Fastener: types of fastener -permanent and temporary

Permanent fastener- types; **Welded joints:** Types of welded joints-Lap joint or fillet joint and butt joint; weld terms- leg or size of the fillet weld, throat thickness; strength of axially loaded symmetrical welded sections- transverse fillet weld, parallel fillet weld,

combination of transverse and parallel welds (Simple numerical problems)

Riveted joints: Types, lap joint-single riveted, double riveted (chain and zigzag), butt joint - single cover single riveted, double cover single riveted (no numerical problems)
Temporary fastener- types; Advantages and dis advantages of threaded joints; forms of thread, Designation and nomenclature of screw thread

CO2	Apply the basic theory of design of shafts and keys for mechanical power transmission		
M2.01	Describe the types of shafts, materials and standard sizes	3	Understanding
M2.02	Design of shafts and power transmitted by shafts	6	Applying
M2.03	List and design different types of keys	4	Applying
	Series Test-I	1	

Contents:
Shafts: Types of Shafts; Shaft materials; Standard Sizes; Design of Shafts (Hollow and Solid)-shaft design on strength basis- shafts subjected to twisting moment ,shafts subjected to bending moment, shaft design on torsional rigidity basis (numerical problem using simple analytical equation); compare solid and hollow shaft in terms of their weight, strength and stiffness, power transmitted by shaft (Simple numerical problems).
Keys: Types of keys, Design of Sunk Keys, Square and rectangular, calculation of key size using empirical proportions (Simple numerical problems).

CO3	Explain the applicability of cams, flywheels and governors in the design of mechanical systems		
M3.01	Recognize different types of cams and followers and Drawing of the profile of disc cam with knife-edge and roller follower with and without offset with reciprocating motion	6	Applying
M3.02	List the types, functions and terminology of the governor	2	Understanding
M3.03	List the functions, applications and terminology of the flywheel	2	Understanding
M3.04	Compare Flywheel and Governor	1	Understanding
M3.05	Describe the functions and list the classification of couplings	1	Understanding
M3.06	Describe the functions and list the classification of bearings	2	Understanding

Contents:

Cams and Followers: Concept; Definition and application of Cams and Followers; Classification of Cams and Followers; Different follower motions and their displacement diagrams like uniform velocity, SHM, uniform acceleration and Retardation; Drawing of profile of disc cam with knife-edge and roller follower with and without offset with reciprocating motion

Flywheel: Concept, function and application of flywheel with the help of turning moment diagram for single cylinder 4-Stroke I.C. Engine (no numerical problems); elementary level idea of coefficient of fluctuation of energy, Coefficient of fluctuation of speed and its significance;

Governors: Types - explanation with neat sketches (Centrifugal, Watt, and Porter); Concept, function and applications& Terminology of Governors; Comparison between Flywheel and Governor (No Numerical problems). Couplings and bearings – functions and classification

CO4	**Describe the various types of mechanical power transmission devices and their selection on specific applications**		
M4.01	List the different types of power drives like belt, chain, rope and gear drive	2	Understanding
M4.02	List the types and describe terminology of belt drives and solve simple problems to find belt length	6	Applying
M4.03	Describe the advantages & disadvantages of chain and rope drive	1	Understanding
M4.04	List the types, terminology of gear drives and solve simple problems related to gear drives	6	Applying
	Series Test -II	1	

Contents:

Power Transmission: Types of Drives – Belt, Chain, Rope, Gear drives & their comparison;

Belt Drives - flat belt, V– belt & its applications; Material for flat and V-belt; open belt and crossed belt ,Angle of lap, Belt length (no derivation), Slip and Creep; Determination of Velocity Ratio, Ratio of tight side and slack side tension; Centrifugal tension and Initial tension; Condition for maximum power transmission (no derivation)- Simple numerical problems related to slip, velocity ratio, length of open belt and crossed belt;

Chain Drives – Advantages & Disadvantages

Rope Drives – Types, applications, advantages & limitations of rope drive;

Gear Drives – Spur gear terminology; Types of gears and gear trains, their selection for different applications; Train value & Velocity ratio for the compound, reverted and simple epicyclic gear train (Simple problems on simple and compound gear train to find the size, teeth and speed of gears)

Text /Reference:

T/R	Book Title/Author
1	S. S. Rattan, "Theory of machines," Tata McGraw-Hill publications., 2017.
2	R.K.Bansal, "Theory of machines," Laxmi publications., 2016.
3	Sadhu Singh, "Theory of machines," Pearson., 2011.
4	V.B.Bhandari, "Design of Machine Elements," Tata McGraw-Hill publications., 2017.
5	Sadhu Singh, "Machine Design," Khanna Book Publishing., 2019.
6	Ajeet Singh, "Fundamentals of Machine Design Vol I & II," Cambridge., 2019.
7	A text book of Machine Design - R.S. Khurmi and J.K. Gupta
8	A text book of Theory of Machines - R.S. Khurmi and J.K. Gupta

Online Resources

Sl No	Website Link
1	https://nptel.ac.in/courses/112105125/
2	https://nptel.ac.in/courses/112107146/
3	https://nptel.ac.in/courses/112/105/112105124/
4	https://nptel.ac.in/courses/112/106/112106137/
5	https://nptel.ac.in/courses/112/107/112107147/