COURSE TITLE : DESIGN OF MACHINE ELEMENTS
COURSE CODE : 5021
COURSE CATEGORY : A
PERIODS/ WEEK : 5
PERIODS/ SEMESTER : 75
CREDIT : 5

TIME SCHEDULE

MODULE	TOPIC	PERIODS
1	Introduction to Design of machine elements. Design of bolt, nuts and keys. Power screws.	20
2	Shaft and coupling	15
3	Bearing. Cam. Governor and fly wheel	20
4	Belt, rope and chain drive. Gear and gear train.	20
	TOTAL	75

COURSE OUTCOME   :

sl.no.	sub	student will be able to
1	1	Understand the factors governing the design of machine elements.
	2	Comprehend the design of Nut, Bolt, Keys using empirical and analytical method
	3	Appreciate the working and efficiency of power screws.
2	4	Understand the design of shaft and power transmission
	5	Comprehend the design of coupling by analytical and empirical method.
	6	Understand the basic design procedure for bearings.
3	7	Comprehend the construction of Cam and Follower and purpose of governor and fly wheel.
	8	Understand the application of belt, rope and chain drive.
	9	Appreciate the design of gear proportion and gear train.

SPECIFIC OUTCOME

MODULE I

1.1.0   Understand the factors governing the Design of Machine elements
1.1.1   List the factors governing the design
1.1.2   Define the general procedure for design
1.1.3   Illustrate the methods of design – analytical and empirical
1.1.4   Explain design stress, working stress and factor of safety
1.2.0   Design of Bolts, Nuts and Keys using analytical and empirical methods
1.2.1   Define the important terms used in screw threads
1.2.2   List the standard dimensions of screw threads and empirical formulae
1.2.3   Explain the designation of screw threads

1.2.4   Identify the stresses due to static loading, initial stresses and stresses due to external forces, stresses due to combined forces

1.2.5   Estimate the size of the screw from above stresses

1.2.6   Design cylinder covers

1.2.7   Simple problems related to design of cylinder covers

1.2.8   Explain the bolts of uniform strength

1.2.9   Classify the various types of keys

1.2.10   Determine the proportions of sunk key

1.2.11   Calculate the strength of rectangular sunk key and square sunk key

1.2.12   Select the key size using empirical proportions, simple problems

1.3.0   Analyze the working efficiency of screw jack

1.3.1   Determine the effort, torque required and efficiency of a square threaded screw jack with collar and without collar fiction

1.3.2   Calculate the maximum efficiency of a square threaded screw

1.3.3   Describe overhauling and self locking

1.3.4   Calculate the efficiency of self locking screw jack

MODULE II

2.1.0   Design Shafts and Power Transmitted by Shafts

2.1.1   State torsion equation and explain each term

2.1.2   Design the diameter of solid and hollow shafts from strength and rigidity considerations

2.1.3   Determine the power transmitted by the shafts subjected to torque

2.1.4   Calculate the diameter of shaft considering strength and stiffness

2.1.5   Compare solid and hollow shafts in terms of their weight, strength and stiffness

2.2.0   Design coupling using analytical and empirical methods and check for safety

2.2.1   State the purpose of couplings

2.2.2   Design the dimensions of muff coupling

2.2.3   Design the dimensions of rigid flange coupling and check for safety 4

2.2.4   Draw the above coupling after calculating the dimensions

MODULE III

3.1.0   Justify the basic design procedure of bearings

3.1.1   State the functions of bearings

3.1.2   Classify the bearings

3.1.3   Explain generally as to what is meant by sliding contact and rolling contact bearings

3.1.4   Estimate the proportions of solid journal bearing empirically based on journal diameter and sketch

3.1.5   Explain the bearing characteristic number and the significance of bearing modulus

3.1.6   Determine the proportions of a foot step bearing empirically based on shaft diameter and sketch

3.1.7   Design of journal bearing given the load allowable bearing pressure and l/d ratio

3.1.8   Solve simple problems involving the design of solid journal bearings and foot step bearings

3.1.9   Calculate the Heat generated in journal bearings

3.2.0   Recognize different types of Cams and Followers

3.2.1   Define various terms of cam terminology

3.2.2   Explain the various displacement diagrams
3.2.3   Draw the cam profiles of a disc cam with offset and without off set for knife edge and roller follower

3.3.0   Appreciate the purpose and uses of Governors and Flywheels
3.3.1   Explain the function of governors
3.3.2   list the types of governors
3.3.3   Illustrate the principle of working of simple watt governor and porter governor
3.3.4   Identify the terms used in governors – height of governors, equilibrium speed, mean equilibrium speed, maximum and minimum equilibrium speed, sleeve lift, sensitiveness, stability and hunting of governors
3.3.5   Explain the functions of fly wheel
3.3.6   Compare the functions of flywheel with governor
3.3.7   Explain fluctuation of speed, fluctuation of energy, coefficient of fluctuation speed, coefficient of fluctuation of energy, energy stored in fly wheels, turning moment diagrams

MODULE IV

4.1.0   Appreciate the application of Belt, Rope and Chain Drive
4.1.1   State the application of belt drives
4.1.2   Explain the terms open belt, crossed belt, angle of lap belt, slack and tight sides, velocity ratio, slip, creep, centrifugal tension and power transmitted
4.1.3   Solve simple problems related to V.R. and slip
4.1.4   Calculate the Length of belt of an open belt and crossed belt (No derivation.)
4.1.5   State the Ratio of belt tensions (no proof)
4.1.6   Determine the power transmitted by a belt
4.1.7   Calculate the width of flat belt without considering centrifugal tension
4.1.8   Illustrate V belt, rope or circular belt drive
4.1.9   State the advantages and disadvantages of chain drive over belt drive
4.2.0   Design Gear proportions and gear trains
4.2.1   State the function of gear and friction wheel
4.2.2   Mention the advantages and disadvantages of gear drive
4.2.3   Illustrate the spur gear nomenclature including addendum, deddendum, module, pitch circle, circular pitch, pitch point, diametric pitch, clearance
4.2.4   Explain simple gear train, compound gear train, reverted gear train and epicyclic gear train
4.2.5   **Solve simple problems on simple and compound gear trains**

CONTENT DETAILS

MODULE I

Introduction - General considerations – General procedure - Design stress and working stress - factor of safety – introduction to design data book.
 Bolts, Nuts and Key
 Designation and nomenclature of screw thread - stresses in screwed fastenings due to static loading - initial stresses -stresses due to external forces – Estimation of screw size - stresses due to combined forces -simple problems - design of cylinder covers - simple problems - bolts of uniform strength –

Types of keys - forces acting on a sunk key - strength of a sunk key – Square and rectangular - calculation of key size using empirical proportions - simple problems.

Screw jack - Torque required to raise and lower the load – square threaded screw jack with collar (without collar friction)- Self-locking screw jack – efficiency and overhauling - simple problems.

MODULE II

Tensional stresses and strains (Review) - strength of solid and hollow shaft - comparisons - problems – power transmitted by shaft – simple problems - working stresses for shafts - design of shaft based on strength and rigidity - shafts subjected to twisting moment and bending moment – simple problems - design of shafts on the basis of torsional rigidity- simple problems -Compare solid and hollow shaft in terms of their weight, strength and stiffness –simple problems.

Couplings

Shaft couplings - requirement - types -design of sleeve or muff coupling - design and sketch flange coupling using calculated values-unprotected type –simple problems.

MODULE III

BEARINGS

Functions - classification of bearings - Radial bearings - thrust bearings - sliding contact bearings - rolling contact bearings - design and sketch solid journal bearing based on journal diameter, bearing pressure and L/D ratio- friction in journal bearing -design of thrust bearing considering uniform pressure - flat pivot or foot step bearing-coefficient of friction and bearing characteristic number - heat generated in journal bearings –Problems from each of the above

Cams

Classification of followers and cams - cam terminology -motion of the followers - uniform velocity, simple harmonic motion - uniform acceleration and retardation - displacement diagrams -construction of cam profile with reciprocating followers - knife edge follower, follower axis passes through the cam axis and offset - roller follower, follower axis passes through the cam axis and offset

Governors and Flywheels

Functions of the governors - types of governors - simple watt governor - porter governor –terms in governors –height of governor ,equilibrium speed, mean equilibrium speed, maximum & minimum equilibrium speed, sleeve fit, sensitiveness, stability and hunting of governors

Flywheels

Functions-comparison with governors – fluctuation of speed, fluctuation of energy, coefficient of fluctuation of speed, coefficient of fluctuation energy-Energy stored in flywheels- Turning moment diagrams.

MODULE IV

BELT, ROPE AND CHAIN DRIVE

Types of belts - flat belt, circular belt or rope, V-belt - types of flat belt drives - open and crossed belt drive - compound belt drive - stepped or cone pulley drive - velocity ratio - slip - creep -problems - length of an open belt - length of crossed belt - problems - power transmitted by a belt -ratio driving tensions for flat belt drive (no proof) - angle of contact - problems - centrifugal tension - calculation of

width of the belt (without considering centrifugal tension) – problems V-belt drive - rope or circular belt drive - chain drive – advantages and disadvantages over belt drive.

Gears and Gear Trains

Functions of gears - friction wheels - advantages and disadvantages of a gear drive - spur gear nomenclature – addendum, dedendum, module, pitch circle, circular pitch, pitch point, diametric pitch, and clearance.

Simple gear drive - Velocity ratio - gear trains - simple gear train - compound gear train - reverted gear train - epicyclic gear train –simple problems on simple and compound gear trains-number of teeth and gears.

TEXT BOOKS

1. A text book of Machine Design   -   R.S. Khurmi and J.K. Gupta

2. A text book of Theory of Machines   - R.S. Khurmi and J.K. Gupta

3. A text book of Strength of Materials   - Dr. R.K. Bansal

REFERENCE

1. A Text book of Automobile Engineering   -   T.R. Banger and Nathu Singh

2. Machine Design   -   Dr. Sadhu Singh.

3. Design of Machine elements   M.R.Thomas.