COURSE TITLE : DESIGN OF MACHINE ELEMENTS
COURSE CODE : 4022
COURSE CATEGORY : A
PERIODS/WEEK : 5
PERIODS/SEMESTER : 90
CREDITS : 4

TIME SCHEDULE

MODULE	TOPICS	PERIODS
1	Introduction Bolts, Nuts and Keys Power screws	22
2	Shafts Couplings	22
	TEST I	3
3	Bearings Cams Governors and Flywheels	20
4	Belt, Rope and Chain drive Gear and Gear trains	20
	TEST II	3
	Total	**90**

OBJECTIVES

Upon completion of the study of this subject, the student will be able to:

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 Explain the general procedure for design
1.1.3 Explain the methods of design – analytical and empirical
1.1.4 Define the 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 important terms used in screw threads
1.2.2 List standard dimensions of screw threads and empirical formulae
1.2.3 Explain the designation of screw threads
1.2.4 Explain the stresses due to static loading, initial stresses and stresses due to external forces, stresses due to combined forces
1.2.5 Computation of size of the screw from above stresses
1.2.6 Design of 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 Explain types of keys
1.2.10 State the proportions of sunk key
1.2.11 Compute the strength of rectangular sunk key and square sunk key
1.2.12 Compute the key size using empirical proportions, simple problems

1.3.0 Analyze the working efficiency of screw jack

1.3.1 Compute the effort, torque required and efficiency of a square threaded screw jack with collar and without collar fiction
1.3.2 Analyze the maximum efficiency of a square threaded screw

1.3.3 Explain overhauling and self locking
1.3.4 Analyze the efficiency of self locking screw jack

MODULE II

2.1.0 Design Shafts and Power Transmitted by Shafts

2.1.1 State the 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 Compute the power transmitted by the shafts subjected to torque
2.1.4 Compute 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
2.2.4 Sketch the above coupling after calculating the dimensions

MODULE III

3.1.0 Justify the basic design procedure of bearings

3.1.1 Explain 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 Compute the proportions of solid journal bearing empirically based on journal diameter and sketch
3.1.5 Explain bearing characteristic number and the significance of bearing modulus
3.1.6 Compute 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 Heat generated in journal bearings - problem solving

3.2.0 Recognize different types of Cams and Followers

3.2.1 Explain various terms of cam terminology
3.2.2 Explain 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 Mention the types of governors
3.3.3 Explain the principle of working of simple watt governor and porter governor
3.3.4 Explain 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 function 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 Derive and compute the length of belt on an open belt and crossed belt
4.1.5 Ratio of belt tensions (no proof)
4.1.6 Compute the power transmitted by a belt
4.1.7 Compute the width of flat belt without considering centrifugal tension
4.1.8 Explain V belt, rope or circular belt drive
4.1.9 Explain chain drive
4.1.10 Mention advantages and disadvantages of chain drive over belt drive

4.2.0 Design Gear proportions and gear trains

4.2.1 Explain the function of gear and friction wheel

4.2.2 Discuss the advantages and disadvantages of gear drive

4.2.3 Explain 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 OUTLINE

MODULE I

Introduction General considerations – General procedure – Design stress and working stress – factor of safety – use of design data book.

Bolts, Nuts and Key

Designation of screw threads – stresses in screwed fastenings due to static loading – initial stresses – stresses due to external forces – simple problems – stresses due to combined forces – design of cylinder covers – simple problems – bolts of uniform strength – types of keys – forces acting on a sunk key – strength of a sunk key – calculation of key size using empirical proportions – simple problems.

Power Screws

Screw jack – torque required to raise and lower the load – efficiency – maximum efficiency overhauling and self locking – efficiency of self-locking - problems

MODULE II

Shafts

Torsional stresses and strains – strength of solid and hollow shaft – comparisons – problems – power transmitted by shaft – problems – working stresses for shafts – design of shaft based on strength and rigidity – shafts subjected to twisting moment only - problems – design of shafts on the basis of torsional rigidity – problems

Compare solid and hollow shaft in terms of their weight, strength and stiffness – problems

Couplings

Shaft couplings – requirement – types – design of sleeve or muff coupling – design of flange coupling-unprotected type – problems

MODULE III

Bearings

Functions of bearings – classification of bearings – Radial bearings – thrust bearings – sliding contact bearings – rolling contact bearings – design of solid journal bearing – 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

Cams

Classification of followers and cams – motion of the followers – uniform velocity, simple harmonic motion – uniform acceleration and retardation – cam terminology – 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 – flywheels – comparison with governors – coefficient of fluctuation of speed – fluctuation of energy – maximum fluctuation of energy – coefficient of fluctuation of energy - turning moment diagram

MODULE IV

Belt, Rope and Chain Drives

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 – angle of contact – problems – centrifugal tension - calculation of width of the belt - 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 – simple gear drive – velocity ratio – gear trains – simple gear train – compound gear train – problems – reverted gear train – epicyclic gear train

REFERENCE 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
4. A text book of Automobile Engineering – T.R. Banger and Nathu Singh
5. Machine Design – Dr. Sadhu Singh.
6. Design of Machine elements - M.R.Thomas.