

B.E. Mechanical Engineering (Model Curriculum) Semester-V  
**PCCME302 - Design of Machine Elements**

P. Pages : 2

Time : Four Hours



**GUG/W/23/14069**

Max. Marks : 80

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- Notes :
1. All questions carry marks as indicated.
  2. Due credit will be given to neatness and adequate dimensions.
  3. Assume suitable data wherever necessary.
  4. Illustrate your answers wherever necessary with the help of neat sketches.
  5. Use of slide rule, Design data book is permitted.
  6. Solve Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6, Q. 7 or Q. 8.

1. a) Explain general design procedure with flow chart. 5
- b) Define stress concentration. Explain two methods for reducing the stress concentration during design of mechanical element. 5
- c) Draw two dimensional views of knuckle joint. 10

**OR**

2. a) Why taper is provided on cotter? State its values. 4
- b) Design and draw a cotter joint to support a load varying from 30 kN in compression to 30 kN in tension. The material used is carbon steel for which the following allowable stresses may be used. The load is applied statically. Tensile stress = Compressive stress = 50MPa; Shear stress = 35 MPa and Crushing stress = 90MPa. 16
3. a) Explain the types of riveted joint depending on the way plates are connected. 5
- b) What is an eccentric riveted joint? Explain the method adopted for designing such a joint? 10
- c) What is bolt of uniform strength? Explain. 5

**OR**

4. a) Discuss the standard location of elements of a welding symbol. 10
- b) A plate 100 mm wide and 12.5mm thick is to be welded to another plate by means of parallel fillet welds. The plates are subjected to a load of 50 kN. Find the length of the weld so that the maximum stress does not exceed 56 MPa. Consider the joint first under static loading and then under fatigue loading. Assume stress concentration factor for parallel fillet weld as 2.7. 10
5. a) State and explain type of screw threads used for power screw. 5
- b) A power screw having double start square threads of 25 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 10 kN. The outer and inner diameters of screw collar are 50 mm and 20 mm respectively. The coefficient of thread friction and collar friction may be assumed as 0.2 and 0.15 respectively. The screw rotates at 12 rpm. Assuming 15

uniform wear condition at the collar and allowable thread bearing pressure of  $5.8 \text{ N/mm}^2$ , find:

1. Torque required to rotate the screw;
2. Stress in the screw; and
3. Number of threads of nut in engagement with screw.

**OR**

6. a) Sketch semi-elliptical leaf spring with details. **5**
- b) Explain the following terms of the spring: **5**
- |                |                 |
|----------------|-----------------|
| 1) Free length | 2) Solid height |
| 3) Spring rate | 4) Spring index |
| 5) Active turn |                 |
- c) Find the maximum shear stress and deflection induced in a helical spring of the following specifications, if it has to absorb 1000 Nm of energy. Mean diameter of spring = 100 mm; Diameter of steel wire, used for making the spring = 20 mm; Number of coils = 30; Modulus of rigidity of steel =  $85 \text{ kN/mm}^2$ . **10**
7. a) A thin cylindrical pressure vessel of 500 mm diameter is subjected to an internal pressure of  $2 \text{ N/mm}^2$ . If the thickness of the vessel is 20 mm. Find the hoop stress, longitudinal stress and the maximum shear stress. **5**
- b) Design the rectangular key for a shaft of 50 mm diameter. The shearing and crushing stresses for the key material are 42 MPa and 70 MPa. **5**
- c) The hydraulic cylinder 400 mm bore operates at a maximum pressure of  $5 \text{ N/mm}^2$ . The piston rod is connected to the load and the cylinder to the frame through hinged joints. The allowable tensile stress for cast steel cylinder and end cover is 80 MPa and for piston rod is 60MPa. **10**  
Design :1. Cylinder, 2. Pistonrod, 3. Hinge pin, and 4. Flat endcover.

**OR**

8. a) Compare the weight, strength and stiffness of a hollow shaft of the same external diameter as that of solid shaft. The inside diameter of the hollow shaft being half the external diameter. Both the shafts have the same material and length. **10**
- b) A solid circular shaft is subjected to a bending moment of 3000 Nm and a torque of 10000 Nm. The shaft is made of 45C8 steel having ultimate tensile stress of 700 MPa and a ultimate shear stress of 500MPa. Assuming a factor of safety as 6, determine the diameter of the shaft. **5**
- c) State the type of stresses developed during designing the shaft. Also, state the equations. **5**

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