B.E. Mechanical Engineering (Model Curriculum) Sem-V

PCCME302 : Design of Machine Elements

P. Pages : 2 **GUG/W/22/14069**

Time : Four Hours * 3 2 9 8 * Max. Marks : 80

Notes : 1. All questions carry equal marks.
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. Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.

1. a) What is factor of safety? why it is necessary to use factor of safety? **5**

b) Design a Cotter joint to transmit a tensile load of 120 kN. Assume the allowable stresses for the socket, spigot and cotter material as follows: 1. In tension $\sigma t = 90$ MPa, 2. In crushing $\sigma s = 130$ MPa, 3. In shear $\sigma s = 60$ MPa. **15**

OR

2. a) State the various theories of failures. **5**

b) What are various phases in design process **5**

c) What is stress concentration? What are various methods of reducing stress **5**

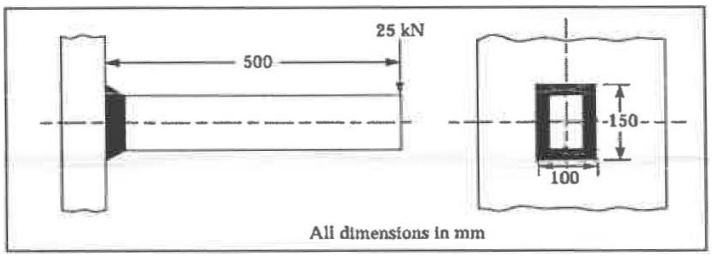
d) What are the manufacturing considerations in design? **5**

3. a) With neat sketches explain the types of failures of riveted joint. **5**

b) Design a double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of 0.95 N/mm^2. Assume joint efficiency as 75%, allowable tensile stress in the plate 90 MPa; compressive stress 140 MPa; and shear stress in the rivet 56 MPa. **15**

OR

4. a) A rectangular cross-section bar is welded to a support by means of fillet welds as shown in Figure. Determine the size of the welds, if the permissible shear stress in the weld is limited to 75MPa. **10**



b) Two lengths of mild steel tie rod having width 200 mm and thickness 12.5 mm are to be connected by means of a butt joint with double cover plates. Design the joint if the permissible stresses are 80 MPa in tension, 65 MPa in shear and 160 MPa in crushing. Make a sketch of the joint. **10**

5. A screw jack is to lift a load of 80 kN through a height of 400 mm the elastic strength of screw material in tension and compression is 200 MPa and in shear 120 MPa. The material for nut is phosphor-bronze for which the elastic limit may be taken as 100 MPa in tension, 90 MPa in compression and 80 MPa in shear. The bearing pressure between the nut and the screw is not to exceed 18 N/mm^2. Design and draw the screw jack. The design should include the design of 1. Screw, 2. Nut, 3. Handle and cup, and 4. Body. **20**

OR

6. a) What is nipping of leaf spring? Why it is necessary? Explain with neat sketches. **5**

b) Explain the design process of bell crank lever. **5**

c) Design a helical compression spring for a maximum load of 1000 N for a deflection of 25 mm using the value of spring index as 5. **10**
The maximum permissible shear stress for spring wire is 420 MPa and modulus of rigidity is 84 kN/mm^2.
Take Wahl's factor, $K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$, where C = Spring index.

7. a) What are the stresses in thin and thick cylindrical pressure vessels when it is subjected to internal pressure ? Explain with neat sketches. **5**

b) A pressure vessel of 250 mm inner diameter is subjected to an internal pressure of $2.5N/mm^2$. Material of cylinder is SAE 1020. The top cover plate is flat circular while bottom cover plate is hemispherical and integral. Determine: **15**

1) Thickness of shell
2) Thickness of bottom cover plate
3) Size and number of bolts required for top cover plate.
4) Gasket for leak proof
5) Thickness of top cover

OR

8. a) Explain the strength and rigidity criteria for shaft design. **5**

b) Explain ASME code for shaft design. **5**

A mild steel shaft transmits 20 kW at 200 rpm. It carries a central load of 900 N and is simply supported between the bearings 2.5 metres apart. Determine the size of the shaft, if the allowable shear stress is 42 MPa and the maximum tensile or compressive stress is not to exceed 56 MPa. What size of the shaft will be required, if it is subjected to gradually applied loads? **10**

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