

CBCS SCHEME

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15AU53

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022

Design of Machine Elements – I

Time: 3 hrs.

Max. Marks: 80

- Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Assume missing data suitably.
3. Use of Data hand book is permitted.*

Module-1

- 1 a. A beam of uniform rectangular cross section is fixed at one end and carries a load of 1000 N at a distance of 300 mm from the fixed end. The maximum bending stress in the beam is 80 N/mm^2 . Find the width and dept of the beam, if dept is twice that of width. (10 Marks)
b. Explain two theories of failure. (06 Marks)

OR

- 2 a. Discuss factor of safety and its importance in design. (04 Marks)
b. A plate of 45C8 steel ($\sigma_x = 353 \text{ MPa}$) is subjected to the following stress $\sigma_x = 150 \text{ N/mm}^2$, $\sigma_y = 100 \text{ N/mm}^2$ and $\tau_{xy} = 50 \text{ N/mm}^2$. Find the factor of safety by, (i) maximum Principal stress theory (ii) maximum shear stress theory. (12 Marks)

Module-2

- 3 An unknown weight falls through 20 mm on to a collar rigidly attached to the lower end of a vertical bar 2 m long and 500 mm^2 section. If the max instantaneous extension is 2 mm, what is the corresponding stress and value of unknown weight, $E = 200 \text{ GPa}$. (16 Marks)

OR

- 4 a. Explain low cycle fatigue and high cycle fatigue. (06 Marks)
b. A grooved shaft shown in Fig. Q4 (b) below is subjected to an axial pull of 15 KN. Determine the maximum stress induced in the shaft taking stress concentration in to account. (10 Marks)



Fig. Q4 (b)

Module-3

- 5 Design and sketch the assembly of a knuckle joint to connect two MS rods subjected to an axial pull of 100 KN. The allowable stress for rods and pins are 100 MPa, 130 MPa and 60 MPa in tension, crushing and shear respectively. The bending of the pin is prevented by selection of proper fit. (16 Marks)

OR

- 6 A 1.2 m shaft is subjected to a bending moment of 900 N-m and a twisting moment of 600 N-m. The shaft is also subjected to end thrust 1.2 KN. $\frac{D_i}{D_o} = 0.7$ and material of the shaft be cold rolled steel $\sigma_y = 294.2 \text{ MPa}$. Determine D_i , D_o of the shaft considering heavy shock condition, assume $FoS = 3$. (16 Marks)

Module-4

- 7 a. A bracket is supported by means of 4 rivets of same size as shown in Fig. Q7 (a), determine the diameter of the rivet if the max. shear stress is 140 N/mm^2 . (12 Marks)

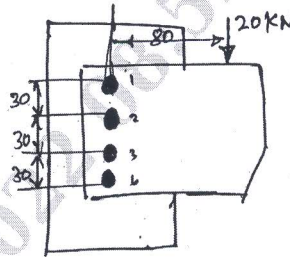


Fig. Q7 (a)

- b. List the types of welded joints and explain any one. (04 Marks)

OR

- 8 a. A bracket supporting a load of $P = 3000 \text{ N}$ is welded to vertical member by four fillet welds as shown in Fig. Q8 (a). Calculate the size of weld if the stress in the throat section is not to exceed 85 MPa . (12 Marks)

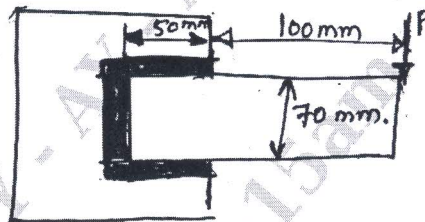


Fig. Q8 (a)

- b. Explain types of Rivets. (04 Marks)

Module-5

- 9 a. A bracket shown in Fig. Q9 (a) below carries a load of 50 kN . Determine the size of bolt if the permissible tensile stress in the bolt material is 200 MPa . (12 Marks)

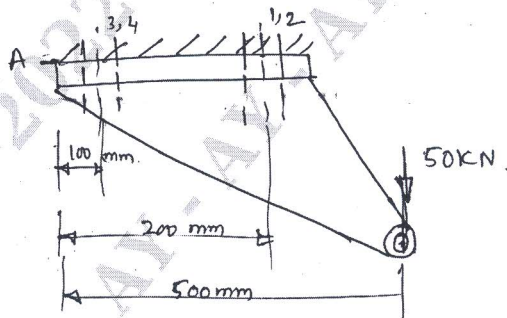


Fig. Q9 (a)

- b. Explain self locking and over hauling. (04 Marks)

OR

- 10 a. A power screw for a jack has square threads of proportions $50 \times 42 \times 8$. The $\pi = 0.1$ at threads at collar is $\pi_{\text{coller}} = 0.12$. Determine the weight that can be lifted by this Jack through a human effort of 400 N through a hand lever of span 400 mm . (12 Marks)
- b. Explain the effect of initial tension in screws. (04 Marks)
