CBCS SCHEME

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18AU53

Fifth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Design of Machine Elements – I

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Design data hand book is permitted.
3. Missing data may be suitably assumed.

Module-1

1 a. Explain the stress-strain diagram for a ductile material and show the salient points on them. **(06 Marks)**

b. Define standards and codes. **(04 Marks)**

c. A point in a structural member subject to plane stress as shown in Fig. Q1 (c). Determine
(i) Normal and tangential intensities on the plane inclined at 45°.
(ii) Principal stresses and their directions.
(iii) Maximum shear stress and directions. **(10 Marks)**

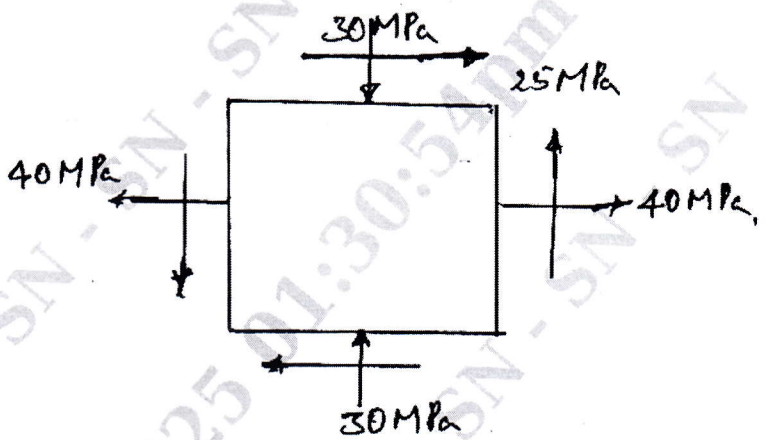

Fig. Q1 (c)

OR

2 a. Explain the following theories of failure:
(i) Maximum normal stress theory.
(ii) Maximum shear stress theory.
(iii) Distortion energy theory. **(10 Marks)**

b. A rod of circular section is subjected to bending moment of 200 kN-m and twisting moment 300 kN-m selecting C45 steel ($\sigma_y = 353$ MPa) and assuming factor of safety as 3. Determine the diameter of rod according to,
(i) Maximum normal stress theory of failure.
(ii) Maximum shear stress theory of failure. **(10 Marks)**

Module-2

3 a. An unknown weight falls through a height of 10mm on a collar rigidly attached to the lower end of the vertical bar 3m long and 600mm^2 in section, the maximum instantaneous extension is 2mm, what is the corresponding stress and the value of unknown weight. Take modulus of elasticity of material of bar is 200 GPa. **(07 Marks)**

b. A flat bar shown in Fig. Q3(b) is subjected to an axial load of 100kN. Assuming that stresses in the bar is limited to 200N/mm^2. Determine the thickness of the bar. **(13 Marks)**

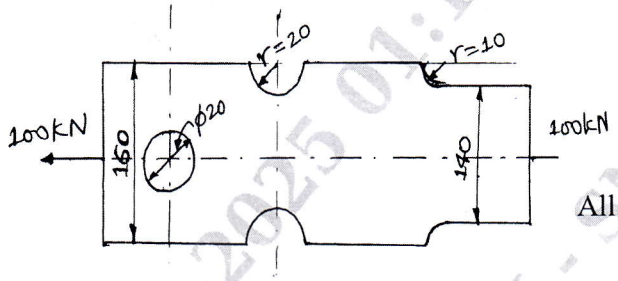

Fig. Q3(b) All the dimensions are in mm

OR

4 a. Derive an expression for impact stress induced in a member subjected to falling weight on a vertical bar. **(05 Marks)**

b. A steel member of circular cross section is subjected to a torsional stress that varies from 0-35MPa and at the same time it is subjected to an axial stress that varies from -14MPa to 28MPa. Neglecting the stress concentration and column effect and assuming that the maximum stresses in torsion and axial load occurs at the same time. Determine the maximum equivalent shear stress and the FOS based upon shear. Material has an endurance limit of 206 MPa and yield stress 408 MPa. The diameter of member is less than 12mm. Take correction factor as L, and surface finish factor as 1. **(15 Marks)**

Module-3

5 Design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression. **(20 Marks)**

OR

6 A shaft is supported by two bearings placed in apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 2.25 kN. Another pulley 400 mm diameter is placed 200 mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulley is 180° and $\mu = 0.24$. Determine the suitable diameter for a solid shaft, allowing working stress of 63 MPa in tension and 42 MPa in shear for the material of shaft. Assume that the torque an one pulley is equal to that on the other pulley. **(20 Marks)**

Module-4

7 a. Explain in brief failures of riveted joints. **(06 Marks)**

b. Design a double riveted butt joint to connect two plates 20 mm thick. The joint is zig-zag riveted and has equal width cover plates. The allowable tensile crushing and sheer stresses for riveted material are 100 MPa, 120 MPa and 60 MPa respectively. Calculate the efficiency of joint also. **(14 Marks)**

OR

8 a. Write the advantages and disadvantages of welded joint over riveted joint. **(06 Marks)**

b. Determine the size of weld required for an eccentrically loaded weld joint as shown in Fig.Q8 (b). The allowable stress in the weld is 75 MPa. **(14 Marks)**

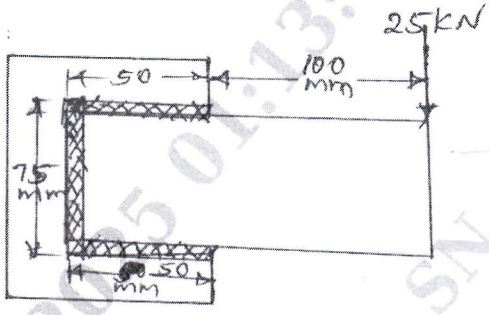

Fig. Q8 (b)

Module-5

9 a. A bolted joint is used to connect two components. The combined stiffness of the two components is twice the stiffness of the bolt. The initial lightening load on the bolt is 10kN. The bolt is further subjected to an external force of 20kN. Determine the size of the bolt if the allowable stress in the bolt is limited to 120Mpa. **(08 Marks)**

b. A bracket is bolted to a vertical support by 7 bolts of equal size as shown in Fig. Q9(b). Determine the size of the bolt, if the allowable shear stress in the bolt material is 40MPa.

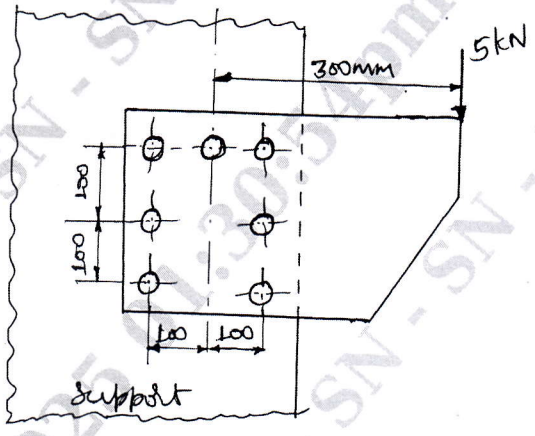

Fig. Q9(b)

All dimensions are in mm. **(12 Marks)**

OR

10 a. Explain Self locking of screw. **(05 Marks)**

b. A machine slide weighing 12kN is raised by a single start square threaded steel screw. The allowable stress in the material is 72.5MPa. The mean diameter of the collar is 40mm. The nut is made of phosphor bronze having design stress of 45MPa. The bearing pressure between the screw and the nut is 9 MPa. Determine the dimensions of screw and nut and the power required to raise the load. The maximum speed of the slide is 0.4m/min. **(15 Marks)**

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