

CBCS SCHEME

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17ME54

Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024 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 permitted.
3. Assume missing data suitably.

Module-1

- 1 a. Explain different mechanical properties of engineering materials. (05 Marks)
b. Define codes and standards. (05 Marks)
c. A bar of 50 mm diameter fixed at one end is subjected to a torsional load of 1 kNm in addition to an axial pull of 15 kN. Determine the principal stresses if the length of shaft is 250 mm. (10 Marks)

OR

- 2 a. Explain Rankines theory and Guest theory of failure. (04 Marks)
b. Define stress concentration factor and explain different methods to reduce stress concentration. (04 Marks)
c. A bar of rectangular section as shown in Fig. Q2 (c) is subjected to an axial pull of 500 KN. Calculate its thickness if allowable tensile stress is 200 MPa. (12 Marks)

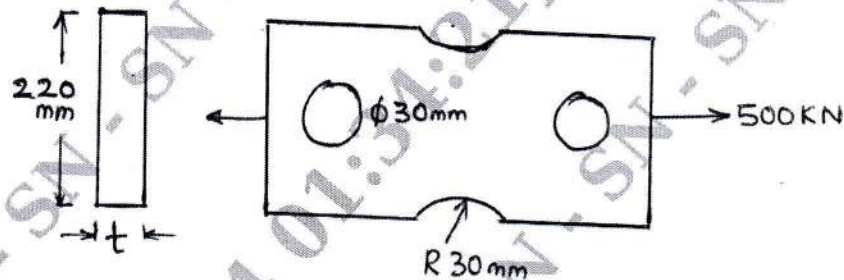


Fig. Q2 (c)

Module-2

- 3 a. Derive the expression for instantaneous stress due to impact bending at centre of the simply supported beam. (08 Marks)
b. A Cantilever beam 50 mm of width and 150 mm depth is 1.5 m long. It is struck by a weight 1000 N that falls from a height of 10 mm at its free end. Determine the impact factor, instantaneous maximum deflection, instantaneous maximum stress and instantaneous maximum load. Take $E = 20.6 \times 10^4 \text{ N/mm}^2$. (12 Marks)

OR

- 4 a. Derive Goodman's relation for a member subjected to fatigue loading. (05 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

- b. A Cantilever beam made up of cold drawn carbon steel of circular cross section is as shown in Fig. Q4 (b). It is subjected to a load which varies from $-F$ to $3F$. Determine the load that the member can withstand for an infinite life. Take FoS, Factor of Safety 2, stress concentration factor K_t as 1.42, notch sensitivity as 0.9, yield stress 470 N/mm^2 endurance stress as 275 N/mm^2 , size factor as 0.85 and surface factor as 0.89. (15 Marks)

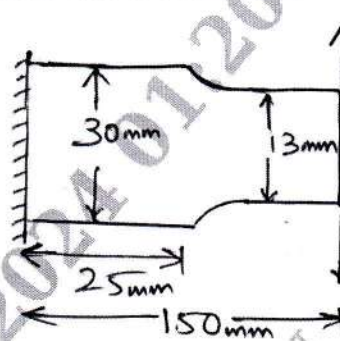


Fig. Q4 (b)

Module-3

5. A solid steel shaft running at 600 rpm is supported on bearings 600 mm apart. The shaft receives 40 kW through a 400 mm diameter pulley weighing 400 N located 300 mm to the right of left bearing by a vertical flat belt drive. The power is transmitted from the shaft through another pulley of diameter 600 mm weighing 600 N located 200 mm to the right of right bearing. The belt drives are at right angles to each other and ratio of belt tensions is 3. Determine the size of shaft necessary, if the allowable shear stress in the shaft material is 40 MPa and the loads are steady. (20 Marks)

OR

6. a. Design a socket and spigot cotter joint to sustain an axial load of 100 kN. The material selected for a joint has the following design stresses in tension is 100 N/mm^2 , 150 N/mm^2 in compression and 60 N/mm^2 in shear. (10 Marks)
- b. In a flange coupling to connect two coaxial shaft of diameter 80 mm to transmit 60 kW at 200 rpm, 6 bolts of $M14 \times 1.5$ are used on a bore circle diameter of 240 mm. The hub diameter is 150 mm and the flange thickness is 20 mm. Determine,
- Shear stress induced in shaft.
 - Shear stress induced in bolt.
 - Shear stress induced in key.
 - Shear stress induced in flange.

If the allowable shearing stress on the key is 80 MPa.

(10 Marks)

Module-4

7. a. A double riveted lap joint is to be made between 9 mm plates. If the safe working stresses in tension, crushing and shear are 80 N/mm^2 , 120 N/mm^2 and 60 N/mm^2 respectively, design the riveted joint. (10 Marks)

- b. Determine the diameter of rivet for the joint as shown in Fig. Q7 (b). The allowable stress in the rivets is 100 N/mm^2 . (10 Marks)

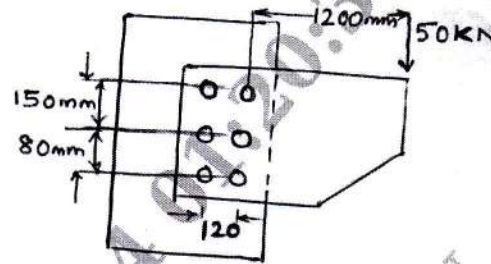


Fig. Q7 (b)

OR

- 8 a. A welded connection of steel plates as shown in Fig. Q8 (a) is subjected to an eccentric load of 10 kN. Determine the throat dimensions of weld, if the permissible stress is limited to 95 N/mm^2 . Assume static condition. (10 Marks)

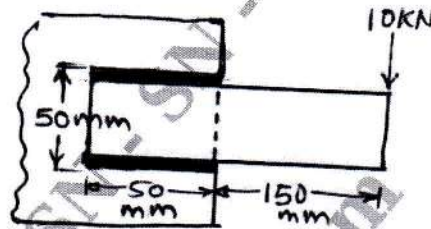


Fig. Q8 (a)

- b. A plate of 80 mm wide and 10 mm thick is to be welded to another plate by means of two parallel fillet welds. The plates are subjected to a load of 50 kN. Find the length of weld so that maximum stress does not exceed 50 N/mm^2 . Consider the joint static loading and then under dynamic loading. Refer Fig. Q8 (b) (10 Marks)

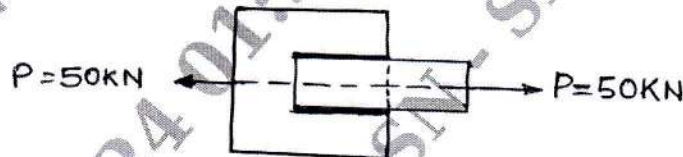


Fig. Q8 (b)

Module-5

- 9 a. A bracket is fixed to wall by means of 4 bolts and loaded as shown in Fig. Q9 (a). Calculate the size of bolts if the load is 10 kN and allowable shear stress in the bolt material is 40 MPa. (10 Marks)

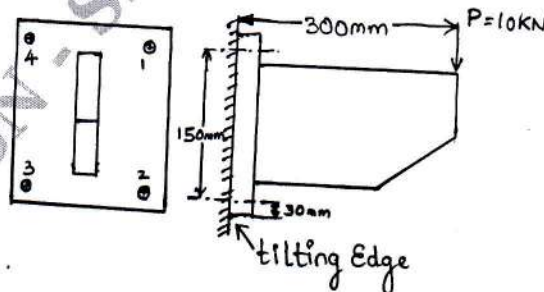


Fig. Q9 (a)

- b. A steel bracket subjected to a force of 12 kN and fixed to a channel is as shown in Fig. Q9 (b). Determine the size of bolts if the allowable shear stress in the material is 75 N/mm^2 . (10 Marks)

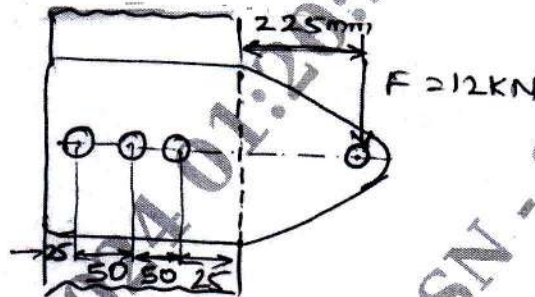


Fig. Q9 (b)

OR

- 10 a. Define Power screw and give same application. (03 Marks)
 b. Explain the terms: (i) Pitch (ii) Lead (02 Marks)
 c. A weight of 500 N is raised at a speed of 6 m/min by two screw rods with square threads of $50 \times 8 \text{ mm}$ cut on them are driven through a bevel gears drives by a motor. Determine
 (i) Torque required to raise the load.
 (ii) Speed of rotation of screw rod assuming threads are of double start.
 (iii) The maximum shear stress in the screw rod.
 (iv) Efficiency
 (v) Length of nut.
 (vi) Check for overhauling. (15 Marks)
