

CBCS Scheme

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15AU53

Fifth Semester B.E. Degree Examination, June/July 2018 Design of Machine Elements – I

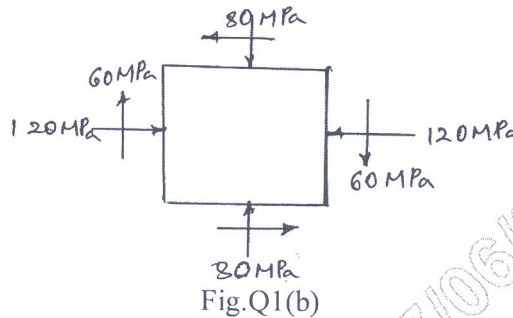
Time: 3 hrs.

Max. Marks: 80

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

Module-1

- 1 a. Draw the stress-strain diagram for a ductile material and show the salient points. (06 Marks)
b. Stresses in a two dimensional stressed body as shown in Fig.Q1(b). Determine :
i) Principal stresses and their directions
ii) Maximum shear stress and their planes. (10 Marks)



OR

- 2 a. Explain the following theories of failure :
i) Maximum normal stress theory
ii) Maximum shear stress theory. (06 Marks)
b. A bar of diameter 50 mm is subjected to an axial tensile load of 10kN and a twisting moment of 3kN-m. The bar is made up of steel C30 has yield strength 294MPa. Find the factor of safety according to :
i) Maximum normal stress theory
ii) Maximum shear stress theory. (10 Marks)

Module-2

- 3 a. What is stress concentration? Explain the methods to reduce stress concentration. (06 Marks)
b. A rectangular cross section bar 200mm long is subjected to an impact by a load of 1kN that falls on to it from a height of 10mm from rest. Determine the dimension of rectangular bar if depth is twice the width. The allowable stress of material is 125MPa. Also find the deformation due to impact. Take $E = 206\text{GPa}$. (10 Marks)

OR

- 4 A cantilever beam is subjected to a load varying from $-F$ to $+3F$ as shown in Fig.Q4. Determine the maximum load that the member can withstand for infinite life. The material of the beam is cold drawn SAE 1025 has the following properties. FOS = 2, Notch sensitivity = 0.9, size factor = 0.85, surface finish factor = 0.88, $\sigma_u = 550\text{MPa}$, $\sigma_y = 470\text{MPa}$ and $\sigma_{en} = 275\text{MPa}$. (16 Marks)

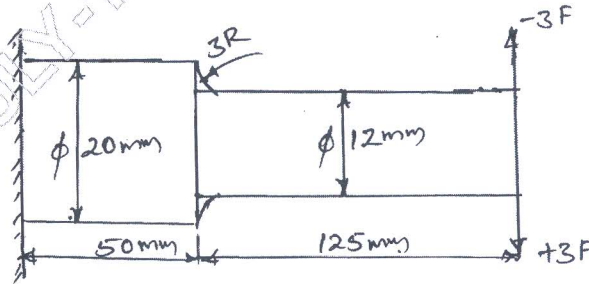


Fig.Q4

Module-3

- 5 a. Design a riding CI flange coupling is used to transmit 50kW at 300 rpm. The allowable shear stress for the shafts and key is 40MPa, the shear for CI flange is 15MPa. (08 Marks)
 b. Design a knuckle joint for connecting two steel rods to sustain an axial pull of 150kN. The working stress in the material is 80MPa in tension, 40MPa in shear and 120MPa in crushing. (08 Marks)

OR

- 6 A shaft supported by two bearings placed 1.2m apart. A 600mm diameter pulley is mounted at a distance of 300mm to right of left hand bearing and drives a pulley directly below it with help of belt having maximum tension of 2kN. Another pulley 400mm diameter is placed 200mm to the left of right hand bearing and driven with motor and belt placed horizontally to the right. The angle of contact for both pulleys is 180° and $\mu = 0.25$. Determine the diameter of shaft if allowable stresses of 63MPa in tension and 40MPa in shear. (16 Marks)

Module-4

- 7 a. Explain the failures of riveted joint. (06 Marks)
 b. Design double riveted double strap with unequal cover plates butt joint with zig-zag riveting for a pressure vessel. The internal diameter of vessel is 1m and internal pressure of 2.2 MPa. Taking the allowable values of stresses are, $\sigma_t = 120\text{MPa}$, $\sigma_c = 165\text{MPa}$ and $\tau = 93\text{MPa}$. (10 Marks)

OR

- 8 a. Determine the allowable stress in the joint as shown in Fig.Q8(a). If size of weld is 10mm. (06 Marks)

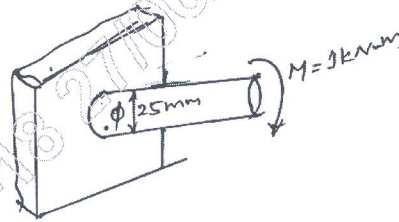


Fig.Q8(a)

- b. Determine the size of weld for a welded joint subjected to load as shown in Fig.Q8(b), the permissible shear stress for weld material is 75MPa. (10 Marks)

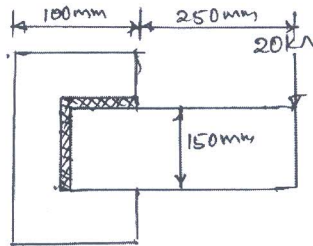


Fig.Q8(b)

Module-5

- 9 a. The cylinder head of a reciprocating air compressor is held in place by ten bolts. The total joint stiffness is four times the bolt stiffness. Each bolt is tightened to an initial tension of 5kN. The total external force acting to separate the joint is 20kN. Find the size of the bolts that the stress in bolts is not to exceed 100MPa. (08 Marks)
- b. The structure is subjected to eccentric load of 10 kN with eccentricity 500mm as shown in Fig.Q9(b). Determine the size of bolt if all bolts are identical and have yield strength 400MPa with FOS as 2.5. (08 Marks)

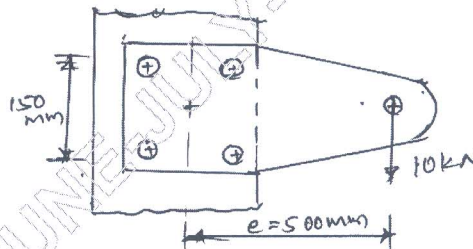


Fig.Q9(b)

OR

- 10 a. Drive the condition for self locking of square thread with collar friction. (06 Marks)
- b. A square threaded power screw has nominal diameter of 30mm and a pitch of 6mm with double start. Load on screw is 6 kN and mean diameter of thrust collar is 40mm. The coefficient of friction for screw is 0.1 and for collar is 0.09. Determine : i) torque required to raise the load ii) overall efficiency iii) is the screw self locking. (10 Marks)
