CBCS SCHEME

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18AU53

Fifth Semester B.E. Degree Examination, June/July 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. Missing data if any may be suitably assumed.
3. Use of design data hand book is permitted.

Module-1

1 a. Explain Codes and Standards. Also list few organizations. **(05 Marks)**

b. A steel member has a torque of 100 N-m and an axial load of 9000 N, applied as shown in Fig. Q1 (a). What are the magnitudes of maximum shear stress, maximum normal stress and minimum normal stress. **(15 Marks)**

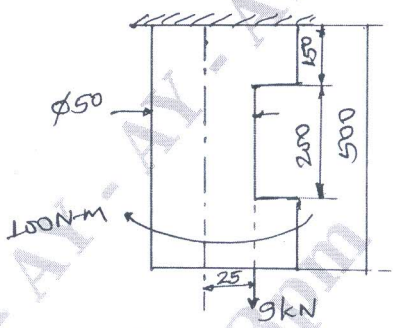

Fig. Q1 (a)

OR

2 a. Explain any two theories of failure. **(04 Marks)**

b. A mild steel shaft of 60 mm diameter is subjected to bending moment 25×10^5 N-mm and torque T. If the yield stress in tension is 300 MPa. Find the maximum value of torque according to,
(i) Maximum principal stress theory.
(ii) Maximum shear stress theory.
(iii) Maximum distortion energy theory.
Take FOS = 1.5 **(16 Marks)**

Module-2

3 a. A bar of rectangular cross section is subjected to an axial pull of 500 KN. Calculate its thickness if the allowable tensile stress in the bar is 200 MPa. **(14 Marks)**

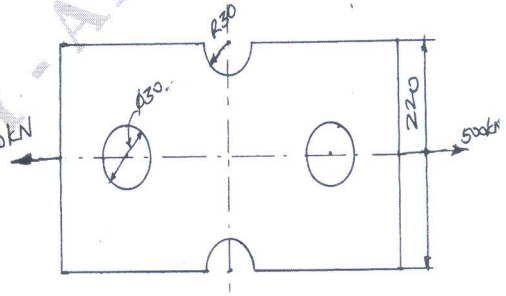

Fig. Q3 (a)

b. Derive an expression for impact stress due to bending loading. **(06 Marks)**

OR

4 a. Derive an expression for Soderberg criteria. **(05 Marks)**

b. A steel member of circular cross section is subjected to a torsional stress that varies from 0 to 35 MPa and at the same time it is subjected to an axial stress that varies from −14MPa to 28 MPa. Neglecting the stress concentration and column effect and assuming that maximum stress in torsion and axial load occurs at the same time. Determine 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 12 mm. Take correction factor as 1 and surface finish factor as 1. **(15 Marks)**

Module-3

5 a. Design Knuckle joint for following specification axial load 80 kN, ultimate stress 450 MPa. Assume FOS = 4.5 and allowable crushing stress is 1.2 times the tensile stress. **(14 Marks)**

b. A square key is used to key a gear and a shaft of diameter 35 mm. The hub length of the gear is 60 mm, both key and shaft is made of same material having allowable shear stress of 55 MPa. What are the dimensions of the key according to maximum shear stress theory if 395 N-m of torque is to be transmitted? **(06 Marks)**

OR

6 A uniform circular carbon steel shaft made of SAE1025 annealed is mounted on two bearings 850 mm apart as shown in Fig. Q6. The shaft carries a gear A at 200 mm to the right of the left bearing and a pulley B at 250 mm to left of the right bearing. The gear is subjected to horizontal force of 3500 N and a vertical upward force of 9600 N. The pulley is driven by a belt with a tension on tight side to be 6000 N and as the slack to be 2000 N. The shock and fatigue factors for bending and torsion as $K_m = 2$ and $K_t = 1.5$ respectively and weight of pulley to be 1500 N. Design the diameter of the shaft for yield stress taking FOS as 3. Draw neatly the sketch with loading and bending moment. **(20 Marks)**

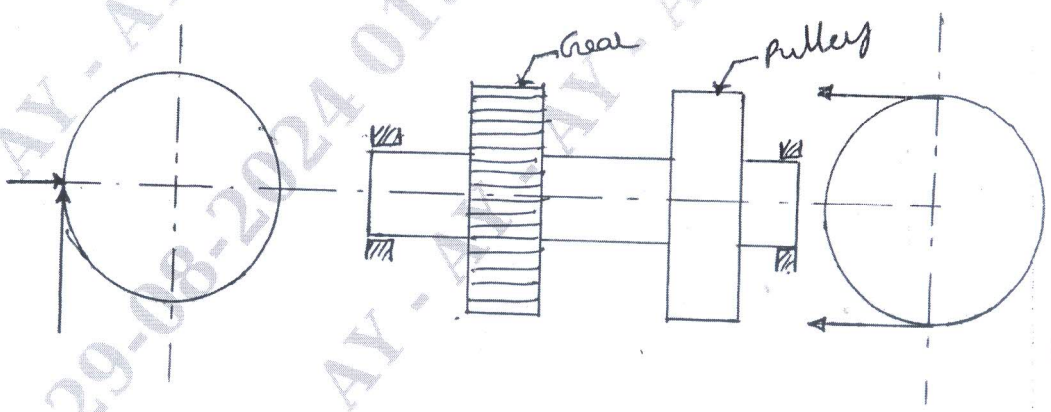

Fig. Q6

Module-4

7 a. List advantages and disadvantages of riveted joint over welded joint. **(06 Marks)**

b. Two lengths of a flat tie bar of 15 mm thick are connected by butt joint with equal cover plates on either side. If 400 kN is acting on the tie bar, design the joint such that the section of the bar is not reduced by more than are rivet hole. Working stresses for the material of the bar are 85 MPa in tension, 60 MPa in shear and 110 MPa in crushing. **(14 Marks)**

OR

8 a. A pulley has been fabricated by welding the rim of pulley to the annular web plate by a weld of size 3mm × 3mm where as hub is welded to the web plate by 5mm × 5mm weld as shown in Fig. Q8 (a). Determine the safe power the safe power that can be transmitted by this pulley and welded pulley considering only welded joint. Assume speed of rim as 1000 rpm. **(15 Marks)**

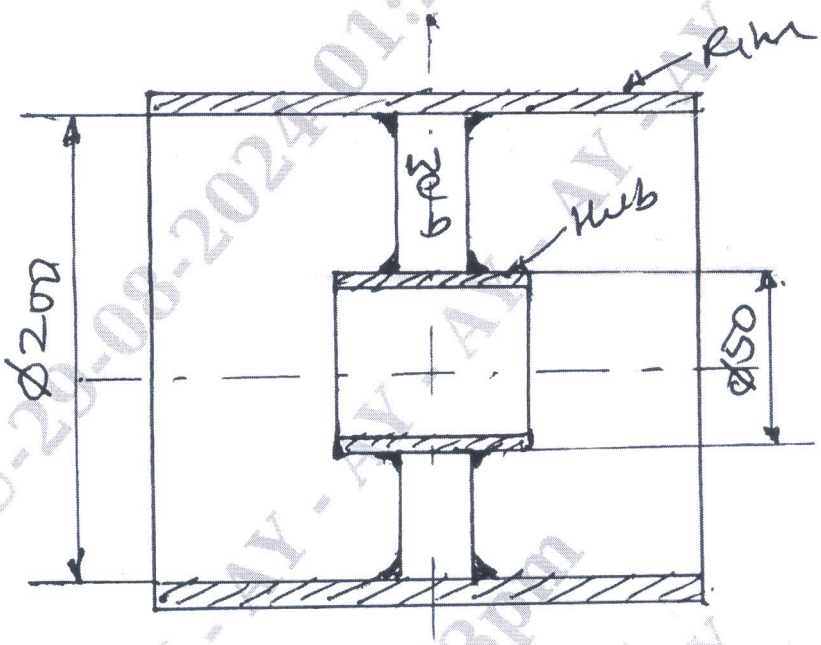

Fig. Q8 (a)

b. A 50 mm diameter solid shaft is welded to a flat by 10 mm fillet weld. Find the maximum torque that the welded joint, can sustain if the maximum shear stress intensity in the weld material is not to exceed 80 MPa. **(05 Marks)**

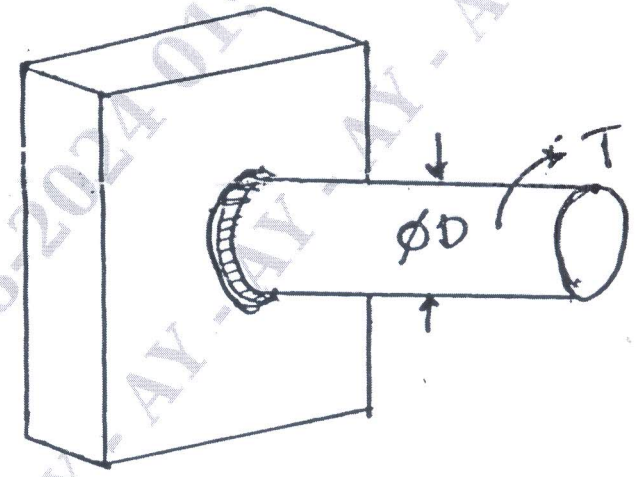

Fig. Q8 (b)

Module-5

9 a. Brackets are fixed on a steel column as shown in the Fig. Q9 (a) for supporting a travelling crane in a workshop. The maximum load that comes on the bracket is 12 kN, acting vertically at a distance of 400 mm from the face of the column. The vertical face of the bracket is secured to the column by four bolts in two rows (two in each row) at a distance of 50 mm from the lower edge of the bracket. Determine the size of the bolts if the permissible value of the tensile stress for the bolt material is 84 N/mm^2. Also find the cross section of the arm of the bracket which is rectangular. Assume depth of the arm of the bracket b = 250 mm. **(10 Marks)**

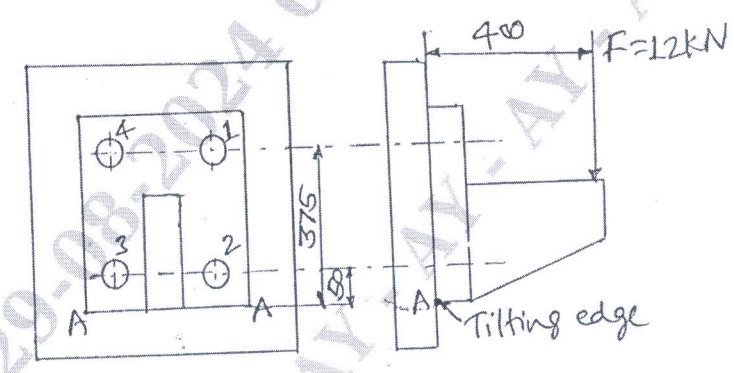

Fig. Q9 (a)

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.

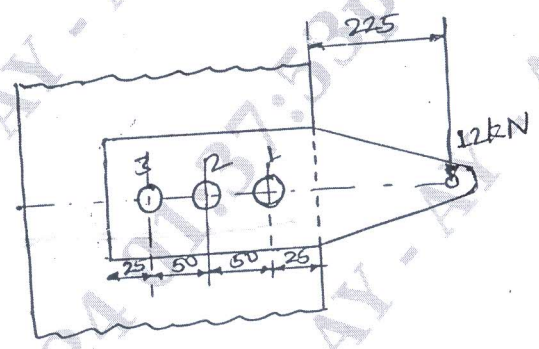

Fig. Q9 (b)
All dimensions are in mm **(10 Marks)**

OR

10 a. Derive an expression for torque required to raise the load on square threaded screw. **(10 Marks)**

b. A square threaded power screw has a nominal diameter of 30 mm and a pitch of 6 mm with double threads. The load on the screw is 6 kN and the mean diameter of the thrust collar is 40 mm. The co-efficient of friction for the screw is 0.1 and the collar is 0.09. Determine

(i) Torque required to raise the screw against load.
(ii) Torque required to lower the screw with load.
(iii) Overhauling efficiency. **(10 Marks)**

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