CBCS SCHEME

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17ME54

Fifth Semester B.E. Degree Examination, Jan./Feb.2021
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 allowed.***
3. ***Assume suitable missing data (if any).***

Module-1

1 a. Define standards and codes. **(04 Marks)**

b. A circular rod of diameter 60 mm is subjected to bending load and torsional load as shown in Fig. Q7 (b). Determine the nature and magnitude of stresses at the critical points. **(16 Marks)**

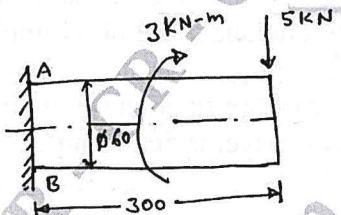

Fig. Q1 (b)

OR

2 a. Define stress concentration and stress concentration factor. **(04 Marks)**

b. Determine the safe load that can be carried by a bar of rectangular cross section as shown in Fig. Q2 (b) limiting the maximum stress to 130 MPa taking stress concentration into account. **(16 Marks)**

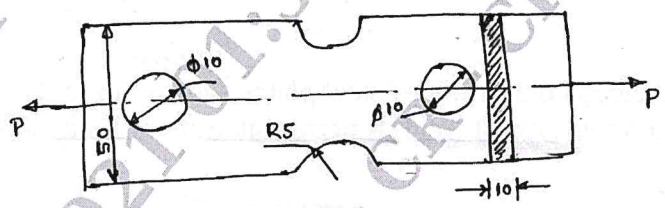

Fig. Q2 (b)

Module-2

3 a. Derive an equation for impact stress due to axial load. **(08 Marks)**

b. A weight of 1 kN is dropped from a height of 50 mm at the free end of a Cantilever beam of effective length 300 mm. Determine the cross section of the Cantilever beam of square cross section. If the allowable stress in material of beam is limited to 80 MPa. ($E = 206.8 \times 10^3$ N/mm^2). **(12 Marks)**

OR

4 a. Derive an equation for Goodman criterion. **(08 Marks)**

b. A piston rod is subjected to a maximum reversed axial load of 110 kN. It is made of steel having an ultimate stress of 90 N/mm^2 and the surface is machined. The average endurance limit is 50% of ultimate strength. Take the size correction coefficient as 0.85 and factor of safety = 1.75. Determine the diameter of the rod. **(12 Marks)**

Module-3

5 A shaft is supported by two bearing placed 1100 mm apart. A pulley of diameter 620 mm is keyed at 400 mm to the right from the left hand bearing and this drives a pulley directly below it with maximum tension of 2.75 kN. Another pulley of diameter 400 mm is placed 200 mm to the left of right bearing and is driven with motor placed horizontally to the right. The angle of contact of pulley is 180° and $\mu = 0.3$. Find the diameter of shaft $C_m = 3.0$, $C_t = 2.5$, $\sigma_y = 190$ MPa, $\sigma_{ut} = 300$ MPa **(20 Marks)**

OR

6 Design a protected type cast iron flange coupling for a steel shaft transmitting 30 kW at 200 rpm. The allowable shear stress in the shaft and key material is 40 MPa. The maximum torque transmitted to be 20% higher than the full load torque. The allowable shear stress in the bolt is 60 MPa and the allowable shear stress in the flange is 40 MPa. **(20 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. Find the diameter of the rivet as shown in Fig. Q7(b). The maximum shearing stress on the most heavily loaded rivet is 56 N/mm^2. **(10 Marks)**

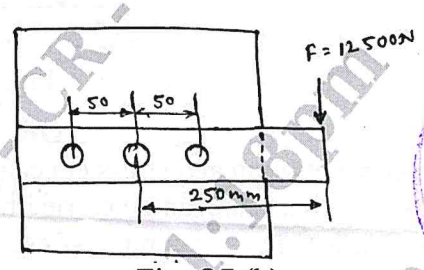

Fig. Q7 (b)

OR

8 a. A welded connection of steel plates shown in Fig. Q8 (a) subjected to eccentric load 10 kN. Determine size of weld. If permissible stress limited to 95 N/mm^2. Assume static conditions. **(10 Marks)**

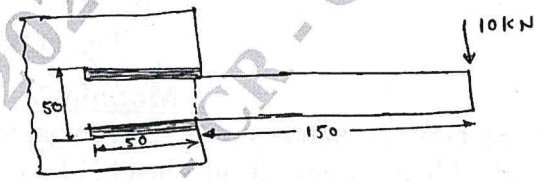

Fig. Q8 (a)

b. Determine the allowable stress in the joint as shown in Fig.Q8 (b), if the size of weld 10 mm. **(10 Marks)**

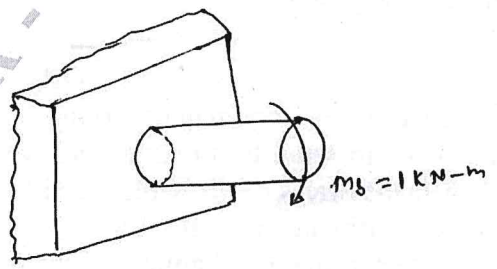

Fig. Q8 (b)

Module-5

9 a. A pulley brocket is as shown in Fig. Q9 (a) supported by 4 bolts, two at A – A and two at B – B. Determine the size of bolts using an allowable shear stress of 25 N/mm^2 for the material of the bolts. **(10 Marks)**

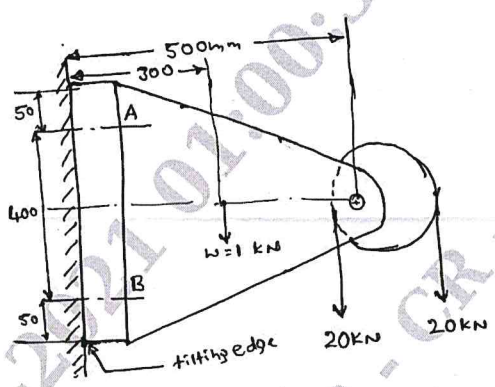

Fig. Q9 (a)

b. The structural connection shown in Fig. Q9 (b) is subjected to eccentric load 10 kN with an eccentricity of 500 mm. The center distance between bolts at 1 and 3 is 150 mm and center distance between 1 and 2 is 200 mm, all bolts are identical. The bolts are made of plain carbon steel with yield strength of 400 MPa and F.O.S is 2.5. Determine size of bolts. **(10 Marks)**

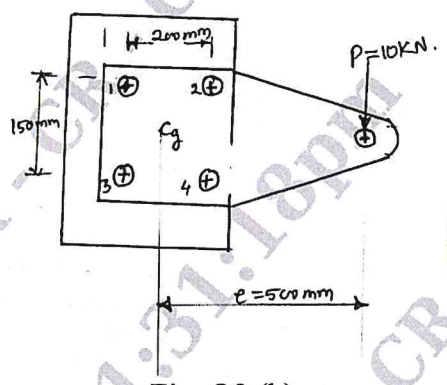

Fig. Q9 (b)

OR

10 a. A power screw for a jack has square threads of propotion $50 \times 42 \times 8$. The coefficient of friction at threads 0.1 and collar 0.12. Determine the weight lifted is jack with human effort of 400 N, through hand lever of span 400 mm. **(10 Marks)**

b. A single threaded power screw has a major diameter restriction of 36 mm. Design the screw if the frictional coefficient for thread and collar 0.13 and 0.1 respectively. Estimate the power input to rotate screw at 1 rpm, if the load lifted is 5 kN. **(10 Marks)**

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