CBCS SCHEME

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15AU53

Fifth Semester B.E. Degree Examination, Aug./Sept.2020
Design of Machine Elements – I

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. What are factors to be consider for selection of material for a design of machine component? **(06 Marks)**

b. A point in a structural member subjected to plane stress in Fig.Q1(b). Determine following:
(i) Normal and tangential stress intensive on plane MN inclined at an angle 45°.
(ii) Principal stresses and their direction.
(iii) Maximum shear stress and direction of them.

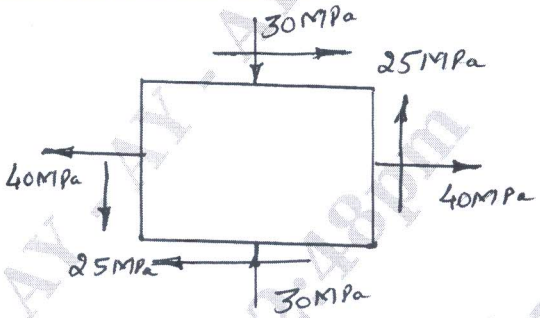

Fig.Q1(b) **(10 Marks)**

OR

2 a. Define and explain any two theories of failure. **(04 Marks)**

b. A mild steel shaft of 60 mm diameter is subjected to a bending moment of 25×10^5 N-mm and torque M_t. If yield point of steel in tension is 230 N/mm^2, find maximum value of this torque without causing yielding of shaft.
(i) Maximum principal stress theory
(ii) Maximum shear stress theory
(iii) Maximum distribution energy theory of failure.
Let FOS = 1.5. **(12 Marks)**

Module-2

3 a. A flat plate subjected to a tensile force of 5 kN is as shown in Fig.Q3(a), σ_u = 200 MPa for the material used. Determine thickness of plate. If factor of safety is 2.

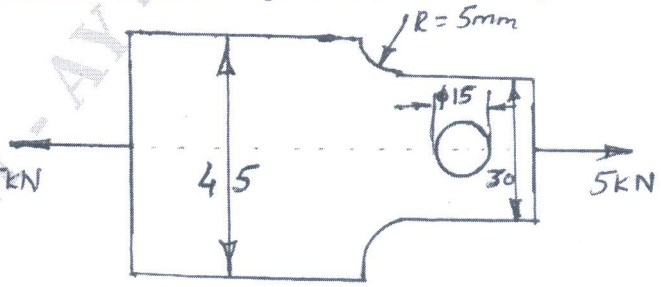

Fig.Q3(a) **(08 Marks)**

b. An unknown weight fall through 20 mm on to a collar rigidly attached to the lower end of vertical bar 2m long and 500 mm^2 section. If the maximum instantaneous extension is known to be 2 mm, what is the corresponding stress and the value of unknown weight? Take E = 200 GPa. **(08 Marks)**

OR

4 A cantilever beam made up of cold drawn carbon steel (σ_u = 55 MPa, σ_y = 470 MPa, σ_{-1} = 275 MPa) of circular cross-section is subjected to load which varies from –F to 3F. Determine the maximum load that member can withstand for on infinite life. FOS 2. [Refer Fig.Q4]

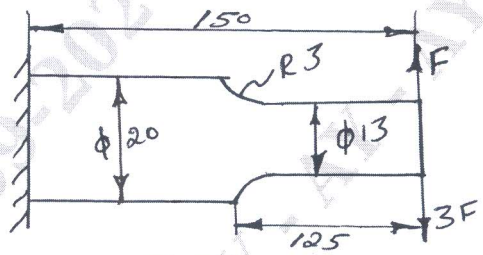

Fig.Q4 **(16 Marks)**

Module-3

5 a. Prove that a square key is equally strong in shear and compression. **(06 Marks)**

b. Design the Knuckle joint to connect two mild steel rods subjected to axial pull of 100 kN, the allowable stress are 100 MPa, 13 MPa and 60 MPa in Tension, Crushing and Shear respectively. The bending of pin is prevented by selecting proper fit. **(10 Marks)**

OR

6 A horizontal shaft is supported by two bearings 1.5 m apart. A keyed gear 20° involute and 175 mm in diameter is located 400 mm to the left of right bearing and is driven by a gear directly behind it. A 600 mm diameter pulley is keyed to the shaft 600 mm to the right of the left bearing and drives a pulley with a horizontal belt directly behind it. The tension ratio of belt is 3 to 1 with slack side on top. The drive transmits 45 KW at 330 rpm. Take K = 1.5. Calculate the necessary diameter of the shaft and angular deflection in degrees. Use allowable shear stress 40 MPa and G = 80×10^3 N/mm^2. **(16 Marks)**

Module-4

7 a. Explain various possible modes of failure of riveted joint. **(06 Marks)**

b. A double riveted lap joint is to be made between 9 mm plates. If the safe working stress in tension, crushing and shear are 80 MPa, 120 MPa, 60 MPa respectively. Design the riveted joint. **(10 Marks)**

OR

8 a. A 16 mm thick plate is welded to a vertical support by two fillet welds as shown in Fig.Q8(a). Determine the size of weld if permissible shear stress for the weld materials is 75 MPa.

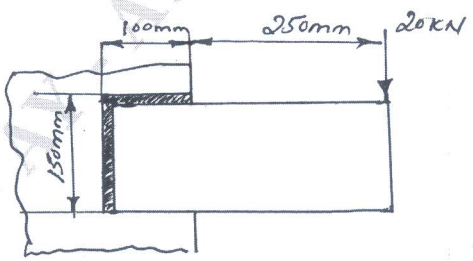

Fig.Q8(a) **(10 Marks)**

b. Determine the size of weld required for the joint shown Fig.Q8(b). If the allowable shear stress in weld is limited to 80 MPa.

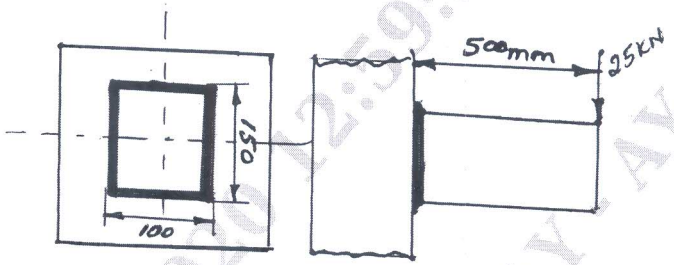

Fig.Q8(b) **(06 Marks)**

Module-5

9 a. The cylinder head of a steam engine is subjected to a steam pressure of 0.7 MPa. It is held in position by means of 12 bolts. A soft copper gasket is used to make the joint leak-proof. The effective diameter of cylinder is 300 mm. Find the size of the bolts so that the stress in the bolts is not to exceed 100 MPa. **(06 Marks)**

b. The structural connection shown in Fig.Q9(b) subjected to an eccentric load P of 10 kN with an eccentricity of 500 mm. The centre distance between bolts at 1 and 3 is 150 mm and the centre distance between bolts at 1and 2 is 200 mm. All bolts are identical. The bolts are made of plain carbon steel having σ_y = 400 MPa and FOS = 2.5. Determine size of bolts.

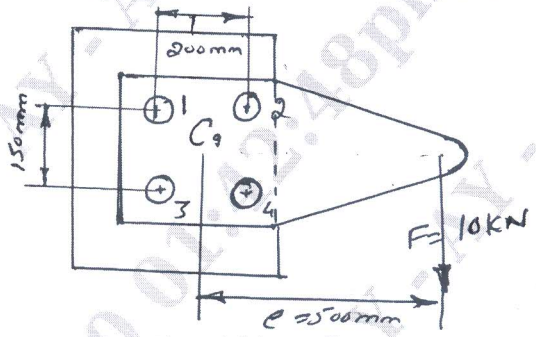

Fig.Q9(b) **(10 Marks)**

OR

10 a. Explain overhauling of screws. **(04 Marks)**

b. A triple-threaded power screw is used in a screw jack, has a nominal diameter of 50 mm and a pitch of 8 mm. The threads are square shape and length of nut is 48 mm. The screw jack is used to lift a load of 7.5 kN. The coefficient of friction at the threads is 0.12 and the collar friction is negligible. Calculate:

(i) Principle shear stress in the screw rod
(ii) Transverse shear stresses in screw and nuts
(iii) Unit Bearing Pressure for threads
(iv) State whether the screw is self locking **(12 Marks)**

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