CBCS SCHEME

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17AU53

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Design of Machine Elements – I

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Write short notes on :
i) Failure of brittle materials
ii) Failure of ductile materials
iii) Criteria for selection of FOS. **(08 Marks)**

b. A point in a structural member subjected to plane stress as shown in Fig.Q1(b). Determine the following :
i) Normal and tangential stress
ii) Principal stresses and their direction
iii) Maximum shear stress and the direction of the plane on which if occur.

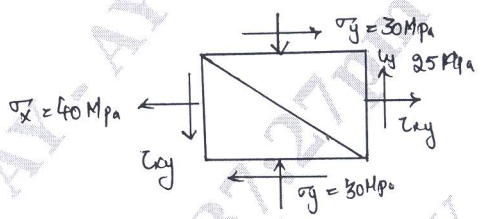

Fig.Q1(b) **(12 Marks)**

OR

2 a. Describe the theories of failure – with generation expressions. **(08 Marks)**

b. A rod of circular section is to sustain a torsional moment 300kNm and bending moment 200 kNm selecting C45 steel (σ_y = 353MPa) and assuming factor of safety = 3. Determine the diameter of rod as per following theories of failure.
i) Maximum shear stress theory
ii) Distortion energy theory. **(12 Marks)**

Module-2

3 a. Determine the safe load that can be carried by a bar of rectangular cross section as shown in Fig.Q3(a). The maximum stress is limited to 130MPa taking stress concentration into account.

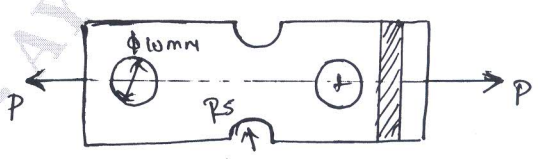

Fig.Q3(a) **(12 Marks)**

b. A bar of rectangular cross-section with side ratio (b/d) as 2 is 300mm long. if is subjected to axial impact by a load of 1.5kN that falls on to it form a height of 10mm. Determine the sectional dimensional of the bar σ_{all} = 120MPa. **(08 Marks)**

OR

4 a. Explain Soderberg and Goodman relationship equation. **(08 Marks)**

b. A cantilever beam made of cold drawn carbon steel (σ_a = 550MPa; σ_1 = 275 MPa) of circular cross-sation is subject to load which varies from – F to 3F. Determine the maximum load that this member can withstand for infinite life using FOS 2. (Refer Fig.Q4(b)).

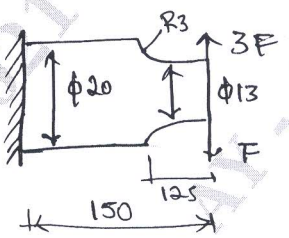

Fig.Q4(b) **(12 Marks)**

Module-3

5 a. Design a square key for a gear shaft of diameter 25mm. 20KW at 1000rpm is transmitted from the shaft to the gear. σ_{yt} = 450MPa ; FOS = 3 ; $\sigma_{yt} = \sigma_{yc}$. Determine the dimensions of the key. **(10 Marks)**

b. Design and sketch the assembly of a knuckle joint to connect two mild steel rods subjected to an axial pull of 100kN. The allowable stresses for rods and pin are 100MPa, 130MPa, 60MPa in tension crushing and shear respectively. The bending of the pin is presented by selection of proper fit. **(10 Marks)**

OR

6 a. Prove that a Hollow shaft is always stronger than a solid shaft with usual notations. **(08 Marks)**

b. A shaft is mounted between bearings located 9.5m part and transmits 10,000KW at 90pm. The shaft weighs 66000N, has outside diameter = 450mm and inner diameter = 300mm. Determine the stress induced in the shaft and the angular deflection between the bearings. Do not neglect the weight of the shaft. (K_b = 1.5 and K_f = 1.0). **(12 Marks)**

Module-4

7 a. A double rivetted tap joint is to be made between 9mm plates. If the safe working stresses in tension crushing and shear are 80, 120, 60MPa respectively. Design the Rivetted joints. **(10 Marks)**

b. Determine the diameter of rivet for a bracket riveted as shown n Fig.Q7(b). The allowable normal and shear stresses are 120 MPa and 60 MPa respectively.

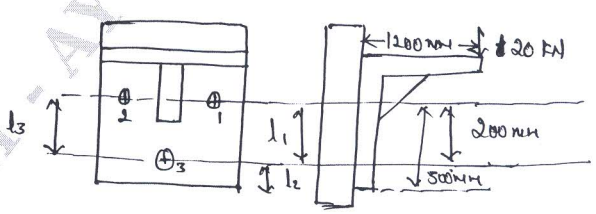

Fig.Q7(b) **(10 Marks)**

OR

8 a. A plate of 80mm wide and 10mm thick is to be welded to another plate by means of parallel fillet welds. The plates are subjected to a load of 50kN. Find the length of weld so that maximum stress does not exceed 50MPa. Consider the joint under static loading and then under dynamic loading. **(10 Marks)**

b. A welded connection is as shown in Fig.Q8(b). If the allowable stress is 100MPa. Determine the size of the weld.

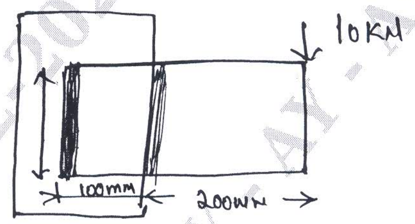

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. Explain the types of threads and its terminologies. With a neat sketch. **(10 Marks)**

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

OR

10 Design a screw jack with a lift of 300mm to lift a load of 50kN. Select C-40 steel (σ_y = 328.6MPa) for the screw and soft phosphor bronze (σ_{ut} = 345MPa and σ_y = 138MPa) for nut. **(20 Marks)**

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