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## Fifth Semester B.E. Degree Examination, July/August 2022 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 missing data suitably.

### Module-1

- 1 a. Draw the stress- strain diagram for a ductile material and show salient points. (08 Marks)  
b. A circular rod of 60mm diameter is subjected to bending load and Tensile load as shown in Fig Q1(b). Determine the nature and magnitude of stress at the critical points.

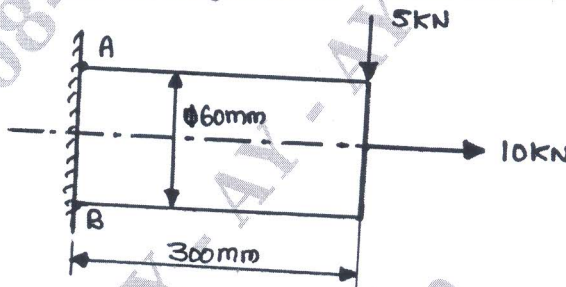


Fig Q1(b)

(08 Marks)

OR

- 2 a. Explain the following Theories of failure.  
i) Maximum normal stress theory ii) Maximum shear stress theory. (08 Marks)  
b. A material has a maximum yield strength in tension and compression of  $\sigma_y = 100\text{MPa}$ , Compute the factor of safety for the following theories of failure using following stress.  
i) Maximum Normal Stress Theory ii) Maximum shear stress Theory.  
Stress : i)  $\sigma_1 = 70\text{MPa}$  ;  $\sigma_2 = 70\text{MPa}$  ;  $\sigma_3 = 0$   
ii)  $\sigma_1 = 0\text{MPa}$  ;  $\sigma_2 = -30\text{MPa}$  ;  $\sigma_3 = -70\text{MPa}$ . (08 Marks)

### Module-2

- 3 a. Derive an expression for impact stress due to an axial load. (08 Marks)  
b. A grooved shaft shown in Fig Q3(b) if to transmit 5kW at 120rpm. Determine the diameter of the shaft at the groove it is made of C15 steel. Take factor of safety as 2 and  $\sigma_y = 235.4\text{MPa}$ .

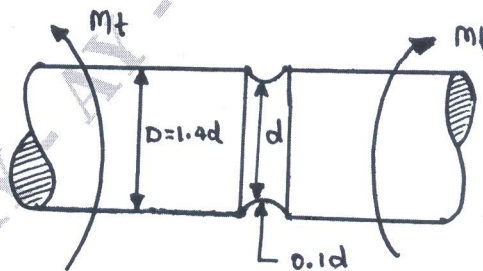


Fig Q3(b)

(08 Marks)

OR

- 4 a. What is stress concentration and how it can be reduced. (08 Marks)  
b. Define endurance limit. State and explain the factors for modifying it. (08 Marks)

**Module-3**

- 5 a. Prove that square key is equally strong in shear and compression. (08 Marks)  
 b. Design a knuckle joint to connect two mild steel rods subjected to an axial pull of 100kN. The allowable stress for rods and pin are 100MPa, 130MPa and 60MPa in Tension crushing and shear respectively. The bending of the pin is prevented by selection of proper fit. (08 Marks)

OR

- 6 A horizontal piece of commercial shafting is supported by two bearing 1.5m apart. A keyed  $20^\circ$  involutes and 175mm in diameter is located 400mm to the left of the right bearing and is driven by a gear directly behind it. A 600mm diameter pulley is keyed to the shaft 600mm to the right of the left bearing and drives a pulley with a horizontal belt directly behind it. The tension ratio of the belt is 3 to 1, with the slack side on Top. The drive transmits 45kW at 330rp. Take  $K_b = K_t = 1.5$ . Calculate the necessary diameter of the shaft and angular deflections in degrees. Use allowable shear stress 40MPa and  $G = 8 \times 10^9 \text{N/mm}^2$ . (16 Marks)

**Module-4**

- 7 a. Sketch and explain different types of Riveted joints. (08 Marks)  
 b. A bracket is supported by means of 4 rivets of same size as shown in Fig Q7(b). Determine the diameter of rivet if the maximum shear stress is  $140 \text{N/mm}^2$ .

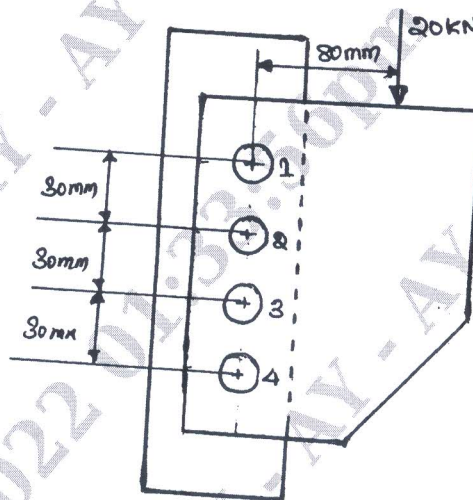


Fig Q7(b)

(08 Marks)

OR

- 8 a. Two plates are joined by means of fillet welds as shown in Fig Q8(a). The leg dimension of the weld is 10mm and the permissible shear stress at the throat cross-section is  $75 \text{N/mm}^2$ . Determine the length of each weld.

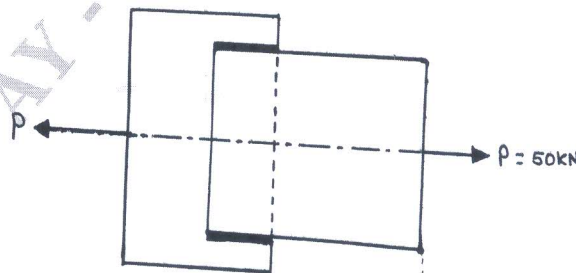


Fig Q8(a)

(08 Marks)

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

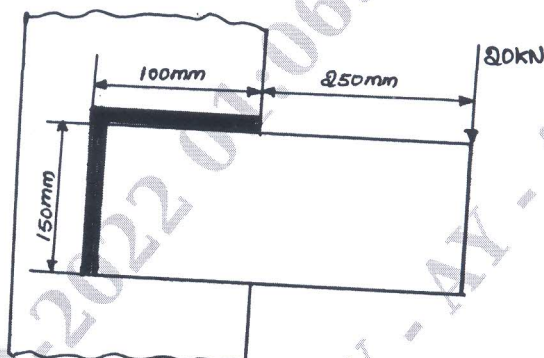


Fig Q8(b)

(08 Marks)

**Module-5**

- 9 a. Sketch and explain forms of screw threads. (08 Marks)  
 b. The structural connection shown in Fig Q9(b) is subjected to an eccentric load 'P' of 10kN with an eccentricity of 500mm. Determine size of bolt by taking FOS as 2.5 and  $\sigma_{yt} = 400\text{MPa}$ .

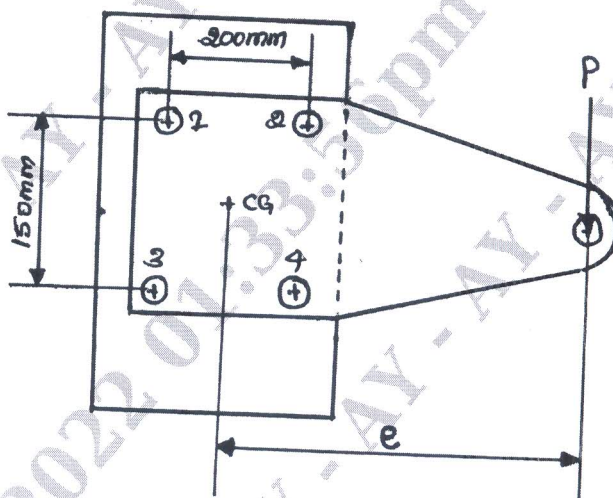


Fig Q9(b)

(08 Marks)

**OR**

- 10 a. Sketch and explain forms of threaded profile used for power transmission. (08 Marks)  
 b. Derive an expression for torque required to raise a load in power screws. (08 Marks)

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