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Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019 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 Handbook is permitted.
3. Missing data may be suitably assumed.

Module-1

- 1 a. Explain the basic design procedure used in design? (06 Marks)
 b. An element is acted upon by the following stresses.
 $\sigma_x = 120\text{MPa}$ $\sigma_y = 90\text{MPa}$ $\sigma_{xy} = 30\text{MPa}$
 i) Compute the stresses on a plane inclined at 20°
 ii) Find the principal stresses and their location?
 iii) Find the maximum shear stress and its location? (10 Marks)

OR

- 2 a. Explain theories of failures
 i) Max. Normal stress theory
 ii) Max. shear stress theory
 iii) Distortion energy theory. (06 Marks)
 b. Determine the diameter of the rod to sustain a combined torsional load of 1500N-m and a bending moment of 1000N-m by following theories of failure. Material selected for the rod has a value of 300MPa and 180MPa for normal and shear stress at yield point. Take $\text{FOS} = 2.5$, i) MSST ii) DET. (10 Marks)

Module-2

- 3 a. A bar of rectangular cross section with side ratio (b/d) as 2 is 300mm long. It is subjected to an axial impact by a load of 1.5kN that falls on to it from a height of 10mm . Determine the sectional dimensions of the bar. Take $\sigma_{\text{all}} = 120\text{MPa}$. $E = 210\text{GPa}$ (08 Marks)
 b. A SAE 1025 water quenched plate ($\sigma_y = 400\text{MPa}$) of rectangular cross section shown in Fig Q3(b). is subjected to tensile load of 45kN Take $\text{FOS} = 2.5$. Find the thickness of the plate?

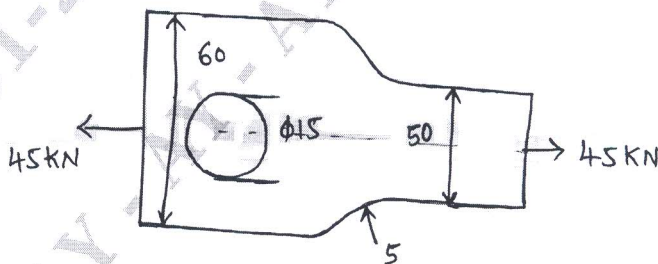


Fig Q3(b)

(08 Marks)

OR

- 4 a. Derive Soderberg equation? (06 Marks)
 b. A shaft made of steel is subjected to torque fluctuating between 400N-m (cw) and 200N-m (ccw) $\sigma_y = 600\text{MPa}$. Endurance strength in torsion is 200MPa , size of surface factors are 0.85 and 1. Take $\text{FOS} = 2$. (10 Marks)

Module-3

- 5 a. 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 the rods 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)
- b. Design a square key for a gear shaft of diameter 25mm, 20kW power at 1000rpm is transmitted from the shaft to gear. $\sigma_{yt} = 450\text{MPa}$; FOS = 3 ; $\sigma_{yt} = \sigma_{yc}$. Determine the dimensions of the key. (08 Marks)

OR

- 6 A horizontal piece of commercial shafting is supported by 2 bearing 1.5m apart. A keyed gear 20° involute and 175mm in diameter is located 400mm to the left of 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 left bearing and drives a pulley with a horizontal belt directly behind it. The tension ratio of the belt is 3. The drive transmits 45kW at 330rpm. Take $K_b = K_t = 1.5$. Calculate the necessary diameter of the shaft. Use allowable shear stress 40MPa and $G = 80 \times 10^3 \text{ MPa}$? (16 Marks)

Module-4

- 7 a. A double rivetted lap 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 joint? (08 Marks)
- b. Determine the diameter of rivet for a bracket rivetted as shown in Fig Q7(b). The allowable normal and shear stresses are 120MPa and 60MPa respectively. (08 Marks)

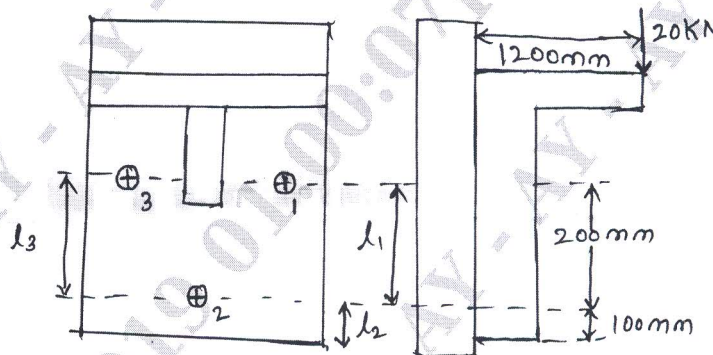


Fig Q7(b)

OR

- 8 a. A welded connection is as shown in Fig Q8(a) if the allowable stress is 100MPa. Determine the size of weld. (08 Marks)

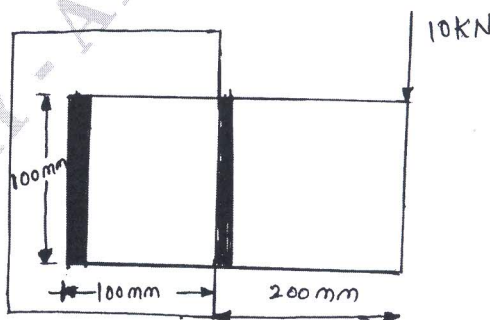


Fig Q8(a)

- b. 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? (08 Marks)

Module-5

- 9 a. Explain type of threads and its terminologies. (08 Marks)
b. Derive an expression for torque required to lower the load on square threaded screw. (08 Marks)

OR

- 10 a. Explain self locking and overhauling. (04 Marks)
b. A square threaded power screw has nominal diameter of 44mm and a pitch of 7mm with double threads. The load on the screws 6kN and mean diameter of thrust washer is 50mm, co-efficient of friction is 0.12. Determine :
i) The torque required to raise the load
ii) The torque required to lower the load
iii) Efficiency
iv) Weather the screw is self locking? (12 Marks)

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