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10MA53

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019

Design of Machine Elements

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of design data handbook volume I & II is permitted.***
3. ***Assume missing data suitably.***

PART – A

1 a. Explain the following theories of failure:
i) Maximum normal stress theory.
ii) Distortion energy theory. **(06 Marks)**

b. A circular rod of 50 mm diameter is subjected to load as shown in Fig.Q1(b). Determine magnitude of stresses at point A.

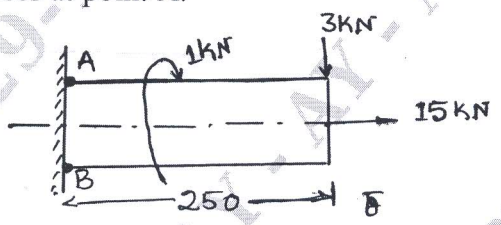

Fig.Q1(b)

(08 Marks)

c. A notched flat plate shown in Fig.Q1(c) is subjected to bending moment of 10 Nm. Determine the maximum stress induced in the member.

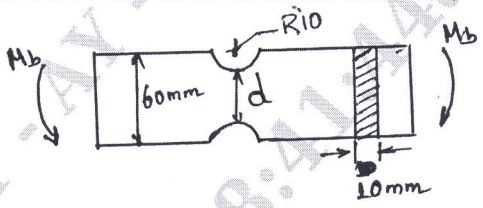

Fig.Q1(c)

(06 Marks)

2 a. Briefly explain the factors effecting the Endurance limit. **(06 Marks)**

b. A cantilever beam made of cold drawn carbon steel (σ_u = 550 MPa; σ_y = 470 MPa; σ_e = 275 MPa) circular cross section shown in Fig.Q2(b) is subjected to load varies form –F to 3F. Determine the maximum load that the cantilever can withstand for an infinite life, using a factor of safety 2.

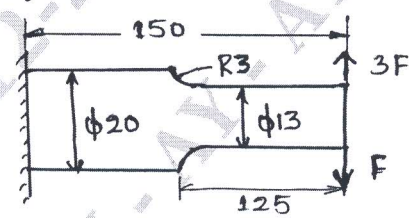

Fig.Q2(b)

(10 Marks)

c. Explain cumulative fatigue damage. **(04 Marks)**

3 a. Derive an equation for instantaneous stress due to axial loading. **(10 Marks)**

b. Design a pin type flexible coupling to transmit 10 kW at 500 rpm. Assume CHO steel as shaft, bolt (pin) and key material (σ_y = 328.6 MPa) and C.I as flange and hub material (σ_{ut} = 124.5 MPa) **(10 Marks)**

4 A shaft is supported by two bearing placed 1100 mm apart. A pulley of dia 620 mm is keyed at 400 mm to the right from the left hand bearing and this drives a pulley directly below it with a maximum tension of 2.75 kN. Another pulley of dia 400 mm is placed 200 mm to the left of right hand bearing and is driven with a motor placed horizontally to the right. The angle of contact of the pulley is 180° and $\mu = 0.3$. Find the diameter of the shaft. Assume $C_m = 3$, $C_t = 2.5$, $\sigma_y = 190$ MPa and $\sigma_{ut} = 300$ MPa. **(20 Marks)**

PART – B

5 a. With a neat sketch, explain the terminologies of spur gear (any six). **(06 Marks)**

b. A spur steel pinion ($\sigma_0 = 200$ MPa) is to drive a steel gear ($\sigma_0 = 140$ MPa). The diameter of the pinion is to be 100 mm and the center distance is 200 mm. The pinion is to transmit 5 kW at 900 rpm. The teeth are 20° full depth. Determine the module, and face width of gears for strength only. **(14 Marks)**

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

b. A welded connection of steel plates as shown in Fig.Q6(b) is subject to an eccentric load of 10 kN. Determine the throat dimension of weld, if the permissible stress is limited to 95 N/mm^2. Assume static conditions.

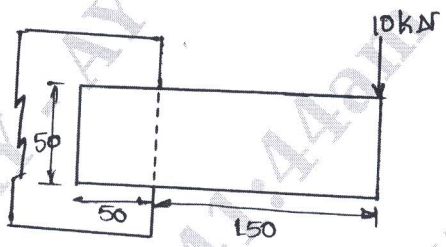

Fig.Q6(b) **(06 Marks)**

c. Explain failure of Riveted joints. **(04 Marks)**

7 a. Derive an equation for stress in helical spring of circular wire. **(08 Marks)**

b. A truck spring has 12 numbers of leaves, two of which are full length leaves. The spring supports are 1m apart and the central band is 70 mm wide. The central load is to be 6 kN with a permissible stress of 200 MPa. Determine the thickness, width and deflection of steel spring leaves if the ratio of total depth to width of the spring is 3. **(08 Marks)**

c. Explain Equalized Stresses in spring leaves. **(04 Marks)**

8 a. Derive Petroff equation. **(08 Marks)**

b. A lightly loaded bearing of 75 mm long and 75 mm diameter is acted on by 1.8 kN radial load. The radial clearance is 0.075 mm and the journal is rotating at 30000 rpm. The bearing is supplied with a lubricant having a viscosity of 3.45×10^{-3} Pas. Determine the frictional power loss in accordance with Petroff's equation. **(08 Marks)**

c. Write advantages and disadvantages of rolling contact bearing. **(04 Marks)**

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