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10ME52

Fifth Semester B.E. Degree Examination, June/July 2015
Design of Machine Element – I

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. Use of design data hand book is permitted.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. A shaft as shown in Fig.Q.1(a) is subjected to bending land of 3kN, torque of 1×10^6 N-mm and an axial force of 15kN. Calculate the stresses at 'A' and 'B'. **(12 Marks)**

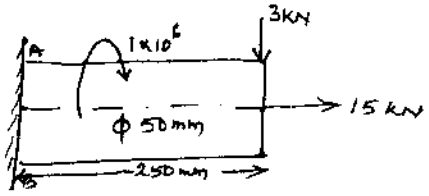

Fig.Q.1(a)

b. What is mechanical engineering design? State the steps involved in mechanical engineering design. **(04 Marks)**

c. Explain biaxial and triaxial stresses with neat sketches. **(04 Marks)**

2 a. State and explain the theories of failure applicable to i) Ductile ii) Brittle materials. **(06 Marks)**

b. What is stress concentration? Explain the factors affecting the stress concentration. **(04 Marks)**

c. A rectangular beam of 100mm width and 200mm depth is freely supported over a span of 2m. A load of 10kN is dropped on the middle of beam from a height of 10mm. Find the maximum instantaneous deflection and stress induced in the beam. Take $E = 2 \times 10^5$ MPa. **(10 Marks)**

3 a. Explain with the neat sketches, the different types of varying stresses. **(05 Marks)**

b. Write a note on S-N diagram. **(05 Marks)**

c. A steel cantilever is 200mm long. It is subjected to an axial load which varies from 150N (compression) to 450N (tension) and a transverse load at its free end which varies from 80N (up) to 120N (down). The cantilever beam is of circular in cross section having a diameter of 2d for the first 50mm and diameter 'd' for the remaining length. Determine its diameter assuming the following:

Factor of safety	= 2
Yield stress	= 330 MPa
Endurance limit	= 300 MPa
Stress concentration factor	= 1.44 for bending 1.64 for axial loading
Correction factors	= 0.7 for reverse axial loading 1 for bending
Size factor	= 0.85
Surface correction factor	= 0.9
Notch sensitivity	= 0.9

(10 Marks)

4 a. Two circular plates with 2d and d as outer and inner diameters are clamped together by means of a bolt as shown in Fig.Q.4(a). The bolt is made of plain carbon steel (σ_y = 380 MPa, E = 207 GPa) while the plates are made of aluminium [E = 71 GPa]. The initial pre load is 5kN in the bolt and external force acting on the joint is 10kN. Determine the size of bolt if factor of safety = 02. Take σ_t = 152 N/mm^2. **(08 Marks)**

b. An offset bracket is fixed to a vertical steel column by means of four bolts as shown in Fig.Q.4(b). Determine the diameter of bolts. Take σ_t = 100MPa. **(12 Marks)**

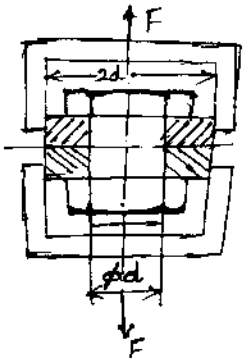

Fig.Q.4(a)

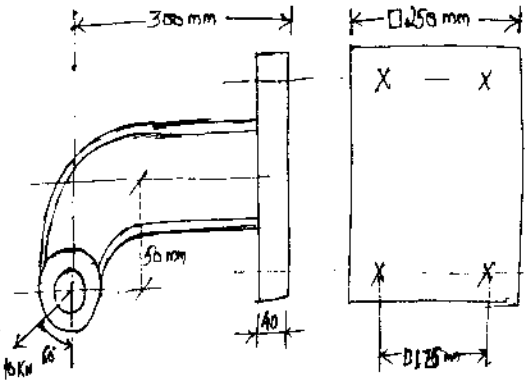

Fig.Q.4(a)

PART – B

5 A shaft is supported in bearings 600mm apart. It carries a pulley of diameter 500mm at 250mm to the right of left bearing and another pulley of diameter 380mm at 130mm to the of right bearing. The belt drive in left pulley is vertically downward while that on the right pulley is horizontal. The permissible shear stress is not to exceed 42MPa. The maximum tension in smaller pulley is not to exceed 5500N, coefficient of friction is 0.3 and angle of contact is 180°. Find the diameter of shaft. **(20 Marks)**

6 a. Design a Cotter Joint to resist a load of 12kN which acts along the axis of rod having following permissible stresses.
σ_c = 80 N/mm^2 σ_t = 40N/mm^2 and τ = 32 N/mm^2. **(10 Marks)**

b. Design a protective CI flange coupling for a steel shaft transmitting 15kW at 200rpm and having an allowable shear stress of 40MPa. The working stress in the bolt should not exceed 30MPa. Assume that the same material is used for shaft and key and the existing stress is twice its value in shear stress. The maximum torque is 25% greater than the full load torque. The shear stress for CI is 14 MPa. **(10 Marks)**

7 a. An eccentrically loaded bracket is welded to a support as shown in Fig.Q.7(a). The permissible shear stress for the weld material is 80MPa. Determine the size of the weld. **(10 Marks)**

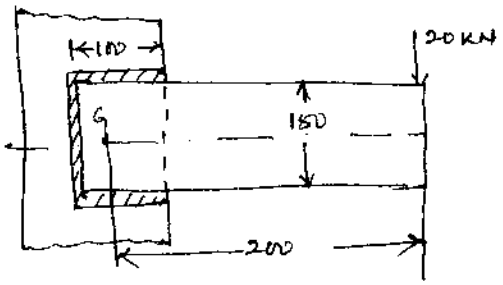

Fig.Q.7(a)

b. Two plates of 10mm thick each are to be joined by means of a single riveted double strap butt joint. Determine the rivet diameter, pitch, strap thickness and efficiency of joint. Take σ_t = 80 MPa and τ = 60MPa. **(10 Marks)**

8 a. An electric motor driven power screw moves a nut in a horizontal plane against a force of 75kN at 300mm/min. The screw has a single thread of 6mm pitch on a major diameter of 40mm. The friction coefficient at screw threads is 0.1. Estimate the power of the motor. **(10 Marks)**

b. A vertical 2-start square threaded screw of 100mm mean diameter and 20mm pitch supports a vertical load of 18kN. The nut of screw is fitted in the hub of a gear wheel having 80 teeth which meshes with a pinion of 20 teeth. The mechanical efficiency of pinion and gear wheel drive is 90%. The axial thrust on screw in taken by a collar bearing 250mm outside diameter and 100mm inside diameter. Assuming uniform pressure conditions, find the diameter of pinion shaft and height of nut when friction coefficient for vertical screw and nut is 0.15 and that of collar bearing is 0.2. Take τ = 50MPa and P_b = 1.4 MPa. **(10 Marks)**

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