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10AU52

Fifth Semester B.E. Degree Examination, May 2017
Design of Machine Elements – I

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. *Missing data may be suitably assumed.*
3. *Use of data book is permitted.*

PART – A

1 a. Define factor of safety and explain the criteria for selection of factor of safety. **(05 Marks)**

b. A bar of 50 mm diameter fixed at one end is subjected to a torsional load of 1 KN-m in addition to an axial pull of 15 KN. Determine the principal stresses if the length of the shaft is 250 mm. **(05 Marks)**

c. A point in a structural member subjected to plane stress as shown in Fig. Q1 (c). Determine the following:
(i) Normal and tangential stress intensities on plane MN inclined at an angle of 45°.
(ii) Principal stresses and their direction of the planes on which it occurs. **(10 Marks)**

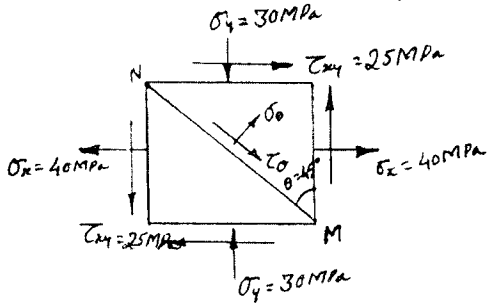

Fig. Q1 (c)

2 a. Define theory of failure, name any five and explain any two theory of failure. **(06 Marks)**

b. A shaft of 50 mm diameter is stepped down to 40 mm with a fillet radius of 5 mm as shown in Fig. Q2 (b). If allowable shear stress is 50 N/mm^2, determine the power that can be transmitted at 1200 rpm. **(06 Marks)**

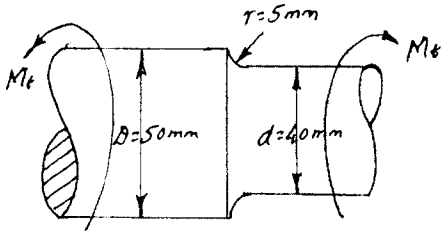

Fig. Q2 (b)

c. A cantilever beam of width 50 mm, depth 150 mm is 1.5 m long. It is struck by a weight of 1000 N that falls from a height of 10 mm at its free end. Determine the following, if $E = 20.6 \times 10^4$ N/mm^2
(i) Impact factor
(ii) Instantaneous maximum deflection
(iii) Instantaneous maximum stress.
(iv) Instantaneous maximum load. **(08 Marks)**

3 a. Derive Soderberg equation. **(06 Marks)**

b. A steel cantilever member shown in Fig. Q3 (b) is subjected to loads shown in Fig. Q3 (b). Determine the required diameter at the change of section for infinite life using a factor of safety of 2. Strength properties are $\sigma_u = 550$ MPa, $\sigma_y = 470$ MPa, $\sigma_{-1} = 275$ MPa. Notch sensitivity index q = 1 **(14 Marks)**

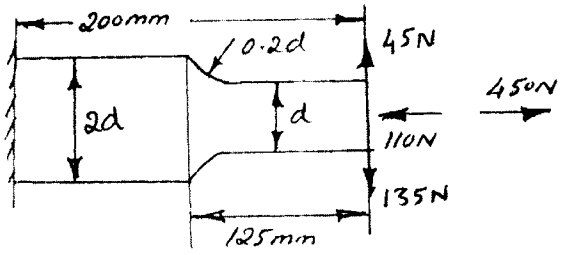

Fig. Q3 (b)

4 a. Design a sleeve type cotte joint to connect two tie rods subjected to an axial pull of 60 KN. The allowable stress of C30 materials used for rods and cotters are $\sigma_t = 65\,N/mm^2$. $\sigma_C = 75\,N/mm^2$, $\tau = 35\ N/mm^2$. Cast steel is used for sleeve and allowable stresses $\sigma_t = 70\,N/mm^2$, $\sigma_c = 110\,N/mm^2$ and $\tau = 45\,N/mm^2$. **(10 Marks)**

b. Design a protected type cast iron flange coupling for a steel shaft transmitting 30 KW at 200 rpm. The allowable shear stress is shaft and key material is 40 MPa. The maximum torque transmitted to be 20% greater than full load torque. The allowable shear stress in bolt is 60 MPa and the allowable shear stress in the flange is 40 MPa. Take KEYWAY factor $\eta = 0.75$ **(10 Marks)**

PART – B

5 A horizontal piece of commercial shafting is supported by two bearing 1.5 m apart. A keyed gear 20° involute and 175 mm in diameter is located 400 mm to left of right bearing and is driven by a gear directly behind it. A 600 mm diameter pulley is keyed to shaft 600 mm to right to left bearing and drives a pulley with a horizontal belt directly behind it. The tension ratio of belt is 3 : 1, with the slack side on top. The drive transmits 45 KW at 330 rpm. Take $K_b = K_t = 1.5$, calculate the necessary diameter of shaft and angular deflection in degrees. Use allowable shear stress 40 MPa, and $G = 80 \times 10^9\,N/mm^2$. **(20 Marks)**

6 a. What are stresses in screw fastening due to static loading and explain stresses due to external forces? **(05 Marks)**

b. Two shafts are connected by means of flange coupling to transmit 10 KW and 1000 rpm. The flanges of coupling has four bolts and pitch circular diameter of them is 150 mm. Determine size of bolt, if permissible shear stress of material of bolt is 50 MPa. **(05 Marks)**

c. The structural connection is as shown in Fig. Q6 (c). The bolts are made up of same material and are identical having yield strength in tension of 400 MPa and FOS is 2.5. Determine size of bolt. **(10 Marks)**

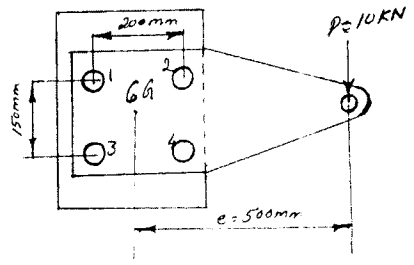

Fig. Q6 (c)

7 a. Write a note on failure of Riveted joints with neat sketch. **(05 Marks)**

b. Design a triple riveted butt joint to join 2 plates of thickness 10 mm. The pitch of rivets in the extreme rows, which are in single shear is twice the pitch of rivets in the inner rows which are double shear. Design stress of materials are, (i) Plate in tension $\sigma_t = 120$ MPa. (ii) Rivet in compression $\sigma_c = 160$ MPa. (iii) Rivet in shear $\tau = 80$ MPa. Draw neat sketch of joint in two views. **(15 Marks)**

8 a. A weld connected steel plate as shown in Fig. Q8 (a) is subjected to eccentric load of 10 KN. Determine throat dimension of weld, if permissible stress is limited to 95 N/mm^2. Assume static condition. **(12 Marks)**

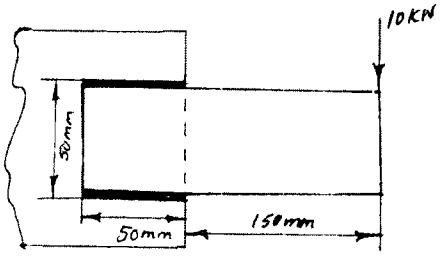

Fig. Q8 (a)

b. A split nut used with a lead screw is propelled at a speed 5 m/min, against a load of 20 KN, along the spindle of a square thread (single start) having nominal diameter of 30 mm and pitch of 6 mm. The axial thrust is absorbed by a collar of 100 mm outside diameter and 70 mm inside diameter. Take thread friction $\mu = 0.14$ and that of collar friction $\mu_c = 0.147$ coefficient.

Determine :

(i) Power required to drive.

(ii) Height of Bonze not required if allowable bearing pressure is 17 MPa.

(iii) Efficiency of drive. **(08 Marks)**

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