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06ME52

Fifth Semester B.E. Degree Examination, June/July 2013
Design of Machine Elements – I

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Briefly explain the following:
   i) Design considerations **(04 Marks)**
   ii) Design codes and standards **(02 Marks)**
   iii) Stress tensor. **(02 Marks)**

   b. A cantilever circular rod of diameter 50 mm and length 300 mm. Find out the values of principal stress and maximum shear stress under the following conditions:
   i) Applying an axial load of 20 kN
   ii) Applying 4 kN load at end, acting downwards creating bending stresses.
   iii) Applying a torque of 1.5 kN-m. **(12 Marks)**

2 a. What diameter of maximum hole that can be derived in a flat plate shown in Fig.Q2(a). If the stress concentration at step is same as that of a hole. **(06 Marks)**

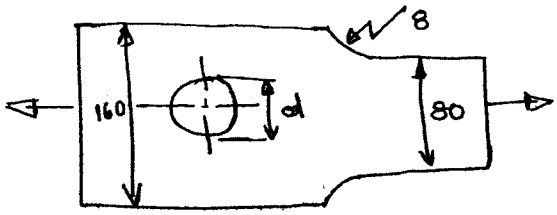


Fig.Q2(a) (All dimensions are in mm)

   b. Explain: i) Distortion energy theory ii) Maximum shear stress theory. **(04 Marks)**

   c. A steel rod 1.5 m long has to resist longitudinally an impact of 2.5 kN falling under a gravity at a velocity of 0.9925 m/s. The maximum computed stress is to be limited to 150 MPa. Determine the diameter of the round bar. **(10 Marks)**

3 a. Derive the Soderberg relationship for designing machine components subjected to variable loads. **(08 Marks)**

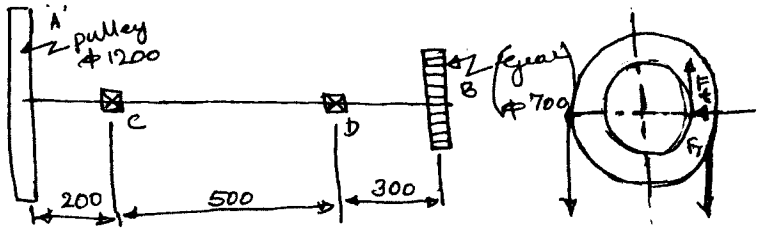
   b. A cast iron shaft with an ultimate strength of 180 MPa is subjected to a torsional load which is completely reversal. The load is to be applied an indefinite number of cycles. If the shaft is 50 mm diameter and is joined with 75 mm diameter shaft with a billed radius of 12.5 mm. Use factor of safety 2. What is the maximum torque that can be applied to the shaft? Take surface factor = 0.75, size factor = 0.85, load factor = 1. **(12 Marks)**

4 a. Explain the steps involved in the design procedure of eccentrically loaded joints with circular base, when load is perpendicular to the bolt axis. **(10 Marks)**

   b. An M10 steel bolt of 125 mm long is subjected to an impact load. The kinetic energy absorbed by the bolt is 2.5 J. Determine (i) stress in the shank of the bolt if there is no thread portion between the nut and the bolt head. (ii) Stress in the shank if the area of the shank is reduced to that of the root area of the thread. **(10 Marks)**

PART – B

5 A pulley A and a gear B are mounted on bearings C and D on a shaft shown in Fig.Q5. The shaft transmits 15 kW at 500 rpm. The tangential force acts vertically upwards. The pulley delivers the power through a belt to another pulley, vertically below the pulley A. The ratio of tensions in the belt is 2. The gear and the pulley weigh 800 N and 2400 N respectively. The permissible shear stress for the material of the shaft is 60 MPa. Determine its diameter. Assume $C_m = 2$, $C_t = 1.5$. (Use $F_r = F_t \tan 20°$). **(20 Marks)**



All dimensions are in mm
Fig.Q5

6 a. Design a cotter joint to carry an axial force of 12 kN. Use the following stresses:
Allowable stress in tension and bending = 40 MPa
Allowable stress in crushing = 80 MPa
Allowable stress shear = 32 MPa
Sketch two views of the joint showing major dimensions. **(15 Marks)**

b. A rectangular sunk key used on a 50 mm diameter shaft and of 14 mm width and 9 mm thickness is required to transmit 40 kW at 300 rpm. Determine the length of the key. If the allowable shear stresses are 56 MPa and allowable crushing stresses are 168 MPa. **(05 Marks)**

7 a. Explain the possible failures of riveted joints by means of simple sketches. **(08 Marks)**

b. Determine the thickness of the plate and size of the weld to be specified for the bracket shown in Fig.Q7(b), where F = 40 kN. Design stress for the plate material is 100 MPa and 80 MPa, normal and shear respectively. Design stress for the throat material is 80 MN/m^2. **(12 Marks)**

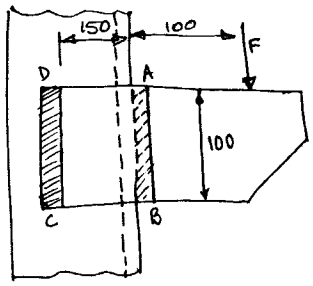


Fig.Q7(b) (All dimensions are in mm)

8 a. Derive an equation for torque required to raise the load on square thread. **(05 Marks)**

b. A power screw having double start square threads of 25 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 10 kN. The outer and inner diameters of screw collar are 50 mm and 20 mm respectively. The coefficient of thread friction and collar friction may be assumed as 0.2 and 0.15 respectively. The screw rotates at 12 rpm. Assuming uniform wear conditions at the collar and allowable bearing pressure of 5.77 N/mm^2, find
i) The power required to rotate the screw
ii) The stresses in the screw
iii) Number of threads of nut in engagement with screw and the height of the nut. **(15 Marks)**

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