Ex/ME/5/T/221/2017(Old)

B.E. MECHANICAL ENGINEERING (PART TIME) EXAMINATION, 2017 (Old)

(2nd Year, 2nd Sem)

Machine Design I

Time:3hrs (Answer any eight from the following) Full marks: 100

Missing data if any are to be reasonably assumed.

1. Two plates, subjected to a tensile force of 50 kN are fixed together by means of three rivets. The plates and rivets are made of material having tensile yield strength 350 N/mm^2. If the factor of safety is 3 then determine- (i) Diameter of the rivets. (ii) The thickness of plate. 12.5

2. Two rods are connected by means of a cotter joint. The inside diameter of the socket collar are 60 and 120 mm respectively. The rods are subjected to a tensile force of 60 kN. The cotter is made of steel 30C8 (σ_{yt}=400 N/mm^2) and the factor of safety is 3. The width of the cotter is five times of thickness. Calculate:
   (i) width and thickness of the cotter on the basis of shear failure; and
   (ii) width and thickness of the cotter on the basis of bending failure. 12.5

3. Two plates, Subjected to a tensile force of 50 kN, are fixed together by means of three rivets as shown in Fig 1. The plates and rivets are made of plain carbon steel 10C4 with tensile yield strength of 250 N/mm^2. The yield strength in shear is 50% of the tensile yield strength, and the factor of safety is 2.5. Neglect the stress concentration, determine:
   (i) the diameter of the rivets; and
   (ii) the thickness of the plates. 12.5

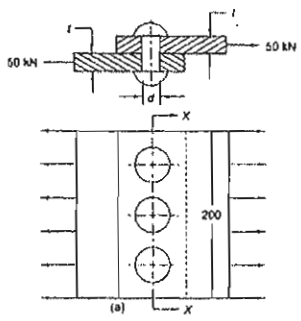


Fig. 1

4. A machine component is subjected to fluctuating stress that varies from 50 to 20 N/mm^2. The corrected endurance limit stress for the machine component is 280 N/mm^2. The ultimate tensile strength and yield strength of material are 600 MPa and 400 MPa respectively. Determine the value of factor of safety using- (i) Soderberg line theory (ii) Goodman line theory (iii) Gerber line theory. 12.5

5. (a) A solid circular shaft of diameter 100 mm is subjected to an axial stress of 50Mpa. It is further subjected to a torque of 10 kNm. Determine the maximum principal stress experienced on the shaft.

   (b) Two shafts A and B are made of same materials. The diameter of the shaft B is twice that of shaft A. Determine the ratio of power which can be transmitted by shaft A to that of shaft B. (6.5+6)

6. A welded connection, as shown in Fig. 2 is subjected to an eccentric force of 7.5 kN. Determine the size of welds if the permissible shear stress for the weld is 120 N/mm^2. Assume static conditions.

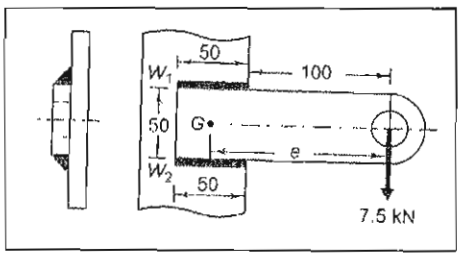


Fig. 2

12.5

7. A non-rotating shaft supporting a load of 2.5 kN is shown in Fig. 3. The shaft is made of brittle material, with an ultimate tensile strength of 300 N/mm^2 and the factor of safety is 2.5. Determine the dimensions of the shaft.

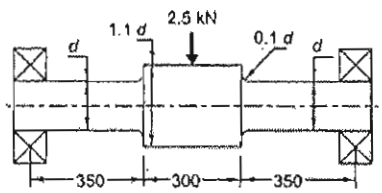


Fig. 3 12.5

8. Explain the different theories of elastic failure as (i) the maximum normal stress theory, (ii) the maximum shear stress theory and (iii) the distortion energy theory of machine component. 12.5

9. The stresses induced at a critical point in a machine component made of steel 45C8 (σ_{yt}= 380 N/mm^2) are as follows:

   σ_x= 100 N/mm^2 σ_y= 40 N/mm^2 τ_{xy}= 80 N/mm^2

   Calculate the factor of safety by (i) the maximum normal stress theory, (ii) the maximum shear stress theory and (iii) the distortion energy theory. 12.5

10. A component machined from a plate made of steel 45C8 (σ_{ut}=620N/mm^2) is shown in Fig.4. It is subjected to a completely reversed axial force of 50 kN. The expected reliability is 90% (reliability factor 0.897) and the factor of safety is 2. The surface finish factor and size factor are 0.76 and 0.85 respectively. Determine the plate thickness t for infinite life, if the notch sensitivity factor is 0.8 and theoretical stress concentration factor 2.27. 12.5

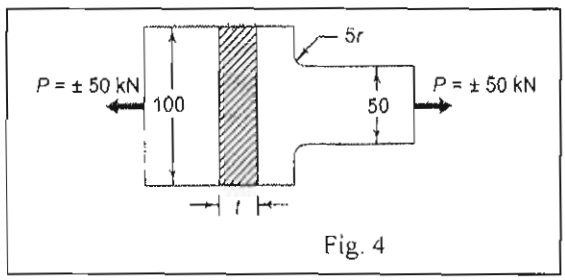
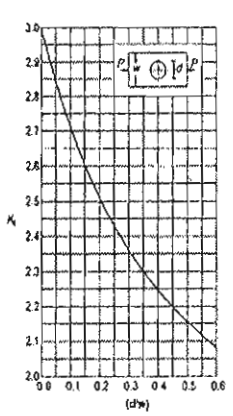
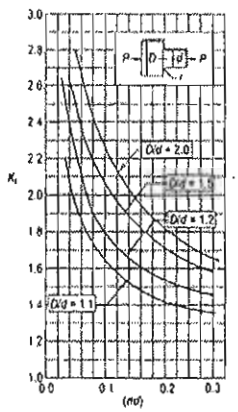
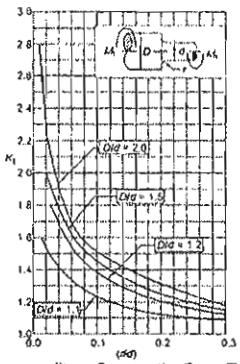
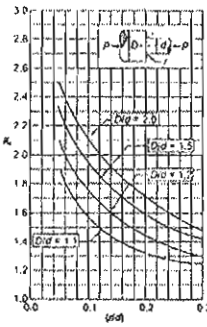


Fig. 4


Stress Concentration Factor (Rectangular Plate with Transverse Hole in Tension or Compression)


Stress Concentration Factor (Flat Plate with Shoulder Fillet in Tension or Compression)


Stress Concentration Factor (Round Shaft with Fillet in Torsion)


Stress Concentration Factor (Round Shaft with Shoulder Fillet in Torsion)