Ex/ME/5/T/221/2018 (Old)

B.E. MECHANICAL ENGINEERING (PART TIME) SECOND YEAR SECOND SEMESTER EXAM 2018 (Old)

Time: 3hrs **Machine Design I** *Full marks: 100*

(Answer any five from the following)
Missing data if any are to be reasonably assumed.

1. (a) Explain the different theories of elastic failure 10
(b) A machine component is subjected to fluctuating stress that varies from 60 to 12 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 560 MPa and 380 MPa respectively. Determine the value of factor of safety using- (i) Soderberg line theory (ii) Goodman line theory (iii) Gerber line theory. 10

2. It is required to design a cotter joint to connect two steel roads of equal diameter. Each rod is subjected to an axial tensile force of 50 KN. The materials of the two rods and cotter is plain carbon steel of Grade 30C8 (σ_{yt}= 400 N/mm^2). Factor of safety of cotter is 3 and other parts are 5. Design and draw the joint and specifies its main dimensions. 20

3. (a) The stresses induced at a critical point in a machine component made of steel 45C8 (σ_{yt}=400N/mm^2) are as follows:
σ_x= 120 N/mm^2 σ_y= 60 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. 10
(b) Explain with neat sketch the stress strain diagram of MS material and also determine the properties of common engineering materials. 10

4. (a) 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 300 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. 10

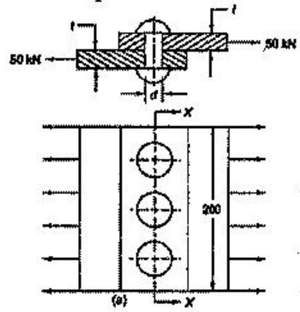


Fig. 1

(b) Two plates, subjected to a tensile force of 60 kN are fixed together by means of three rivets. The plates and rivets are made of material having tensile yield strength 380 N/mm^2. If the factor of safety is 3 then determine- (i) Diameter of the rivets. (ii) The thickness of plate. 10

[Turn over

5. (a) Explain different types of keys with key failure.
(b) 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 150 N/mm^2. Assume static conditions.

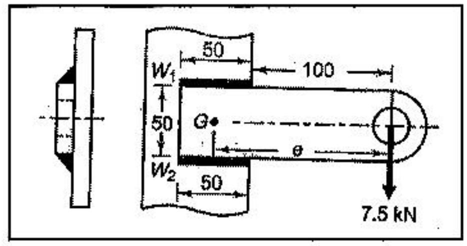


Fig. 2

8+12

6. (a) A component machined from a plate made of steel 45C8 (σ_{ut}=630N/mm^2) is shown in Fig.3. It is subjected to a completely reversed axial force of 50 kN. The expected reliability is 90% (reliability factor 0.9) 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 2.3. 14

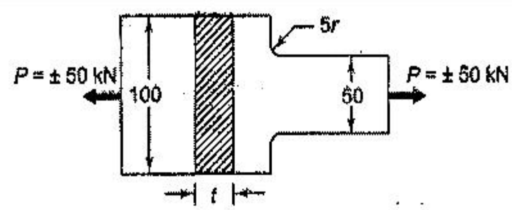
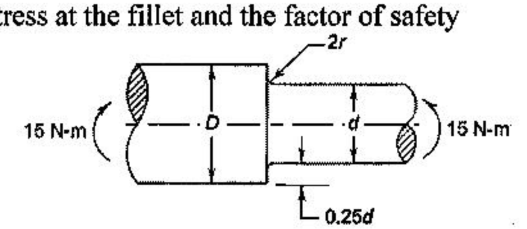


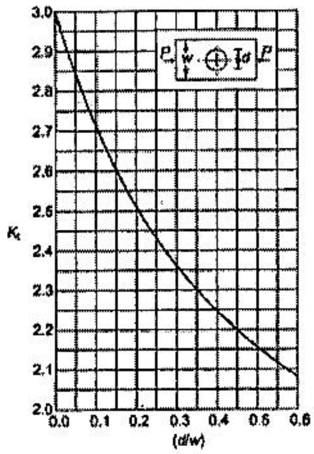
Fig. 3

(b) When the shaft is subjected to fluctuating loads, what will be equivalent tensional moment and equivalent bending moment? 6

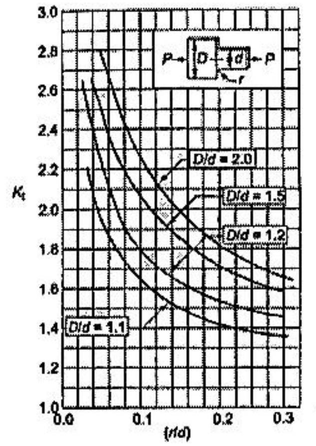
7. A round shaft made of a brittle material and subjected to a bending moment of 15 N-m is shown in Figure below. The stress concentration factor at the fillet is 1.5 and the ultimate tensile strength of the shaft material is 200 N/mm^2. Determine the diameter d, the magnitude of stress at the fillet and the factor of safety



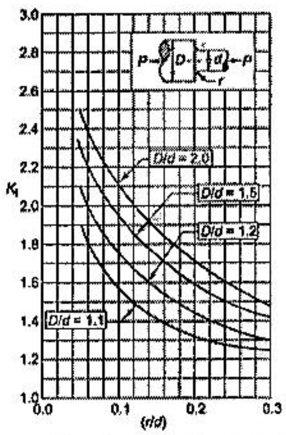
20



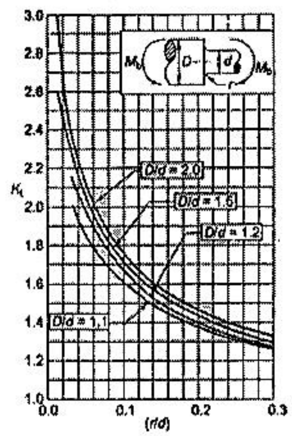
Stress Concentration Factor (Rectangular Plate with Transverse Hole in Tension or Compression)



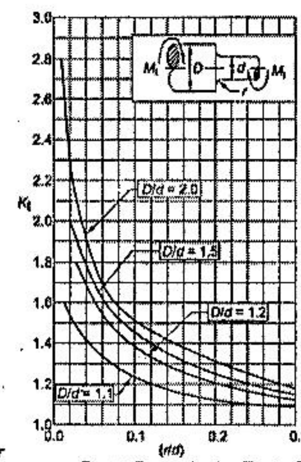
Stress Concentration Factor (Flat Plate with Shoulder Fillet in Tension or Compression)



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



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



Stress Concentration Factor (Round Shaft with Fillet in Torsion)