PVP 14

Code: ME5T5

III B.Tech - I Semester – Regular/Supplementary Examinations – October 2017

DESIGN OF MACHINE MEMBERS-I
(MECHANICAL ENGINEERING)

Duration: 3 hours Max. Marks: 70

*** Assume any missing data wherever necessary and state it clearly.**

PART – A

Answer ***all*** the questions. All questions carry equal marks 11 x 2 = 22 M

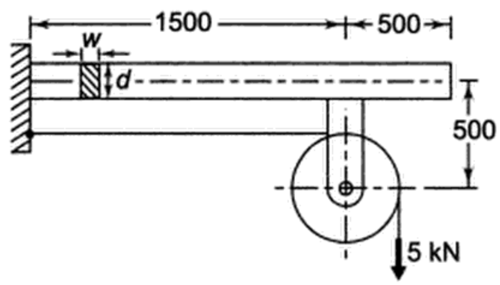
1. a) State maximum principal stress theory.
b)Why is factor of safety so important in design?
c) Draw graphs showing types of sinusoidal cyclic stresses.
d) Write some differences between failure due to static load and fatigue.
e) Draw diamond joint used in riveted joints.
f) Explain the permissible shear, crushing of riveted joints.
g) What is the maximum shear stress plane angle in transverse and parallel lap welded joints?
h) What are the stresses on the bolts due to initial tightening?
i) What are the advantages of using knuckle joint?
j) If the wire diameter of a closed coil helical spring subjected to compressive load is increased from 1 cm to 2 cm, other parameters remaining same, calculate the factor by which the deflection will decrease.
k) Write the definitions of solid length, compressed length and free length and their relation.

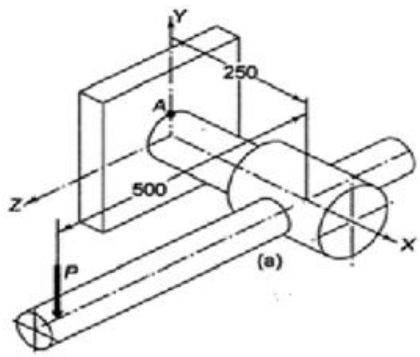
PART – B

Answer any ***THREE*** questions. All questions carry equal marks. 3 x 16 = 48 M

2. a) The cantilever beam of rectangular cross section is used to support a pulley as shown in the Figure.2a . The tension in the wire rope is 5 kN. The beam is made of cast iron FG 200 (ultimate tensile strength =200 N/mm^2) and the factor of safety is 2.5. The ratio of depth to width of the cross section is 2. Determine the dimensions of the cross section of the beam. 8 M

b) The shaft of an overhang crank subjected to a force of P of 1 kN is shown in the Figure.2b . The shaft is made of plain carbon steel 45C8 and the tensile yield strength is 380 N/mm^2. The factor of safety is 2. Determine the diameter of the shaft using the maximum shear stress theory. 8 M





All dimensions are in mm

Figure.2a Figure.2b

3. a) A polished steel bar is shown in Figure.3a, subjected to axial tensile force that varies from zero to P_{max}. It has a groove 2 mm deep and having a radius of 3 mm. The theoretical stress concentration factor and notch sensitivity factor at the groove are 1.8 and 0.95 respectively. The outer diameter of the bar is 30 mm. The ultimate tensile strength of bar is 1250 MPa. The endurance limit in reversed bending is 600 MPa. Find the maximum force that the bar can carry for 10^5 cycles with 90% reliability. Assume surface finish factor K_a= 1, size factor K_b= 0.85, reliability factor K_c=0.897. 8 M

b) A cantilever spring made of 10 mm diameter wire is shown in the Figure.3b. The wire is made of stainless steel 4Cr18Ni10 (ultimate tensile strength S_{ut}=860 N/mm^2 and yield strength S_{yt}=690 N/mm^2). The force P acting at the free end varies from 75 to 150 N. The surface finish of the wire is equivalent to the machined surface. There is no stress concentration and the expected reliability is 50%. Calculate the number of stress cycles likely to cause fatigue failure. Surface finish factor K_a=0.72, size factor K_b=0.85. 8 M

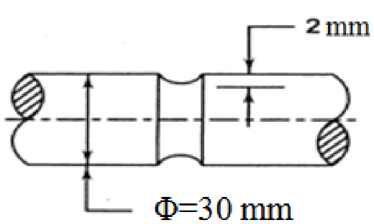


Figure.3a

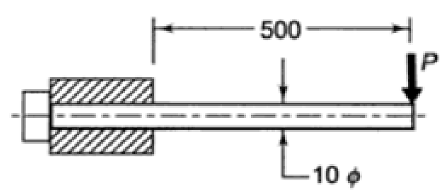


Figure.3b

4. a) Two flat plates subjected to a tensile force P are connected together by means of double strap butt joint as shown in the Figure.4a. The force P is 250 kN and the width of the plate is 200 mm. The rivets and plates are made of the same steel and the permissible stresses in tension, compression and shear are 70, 100 and 60 N/mm^2 respectively. Calculate: i)The diameter of the rivets, ii) The thickness of the plates., iii) The dimension of the seam, viz pitch, transverse pitch and margin. 8 M

b) A circular shaft 50 mm in diameter, is welded to a support by means of a fillet weld, as shown in the Figure.4b. Determine the size of the weld, if the permissible shear stress in the weld is limited to 100 N/mm^2. If instead of applying the force (10 kN), we apply a torsional moment of 2500N-m at the same place, what will be the size of the weld? (All dimensions are in mm) 8 M

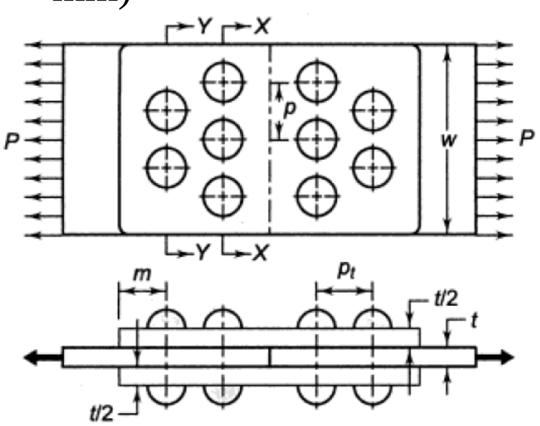


Figure.4a

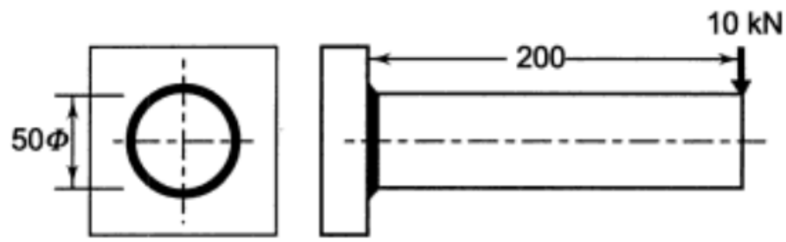


Figure.4b

5. a) The structural connection shown in the Figure.5a is subjected to an eccentric force P of 10 kN with an eccentricity ‘e’ equal to 500 mm from the center of gravity of the bolts. The center distance between bolts 1 and 2 is 200 mm and the center distance between bolts 1 and 3 is 150 mm. All the bolts are identical. The bolts are made from plain carbon steel 30C8 (yield strength S_{yt}=400 N/mm^2) and the factor of safety is 2.5. Determine the size of the bolts. 8 M

b) A steel plate subjected to a force of 5 kN and fixed to a channel by means of three identical bolts is shown in the Figure.5b. The bolts are made from plain carbon steel 45C8 (yield strength S_{yt}=380 N/mm^2) and the factor of safety is 3. Specify the size of the bolts. (All dimensions are in mm) 8 M

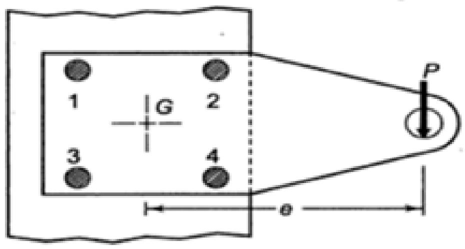


Figure.5a

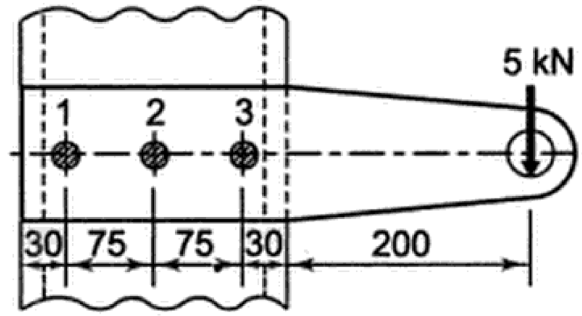


Figure.5b

6. a) Design a leaf spring for the following specifications: Total load: 140kN; Number of springs supporting the load=4; max. number of leaves=10; span of the spring=1000mm; permissible deflection=80mm; Take E=200kN/mm^2 and allowable stress in spring material as 600 MPa. 8 M

b) A railway wagon moving at a velocity of 1.5 m/s is brought to rest by a bumper consisting of two helical springs arranged in parallel. The mass of the wagon is 1500 kg. The springs are compressed by 150 mm in bringing the wagon to rest. The spring index can be taken as 6. The springs are made of oil hardened and tempered steel wire with ultimate tensile strength of 1250 N/mm^2 and modulus of rigidity of 81370 N/mm^2. The permissible shear stress for the spring wire can be taken as 50% of the ultimate tensile strength. Assume the spring has square and ground ends and a gap of 2 mm between adjacent coils when the spring is subjected to the maximum force.

Design the spring and calculate: 8 M

i) wire diameter ii) mean coil diameter
iii) number of active coils iv) total number of coils
v) free length vi) pitch of the coil
vii) required spring rate viii) actual spring rate.