B.E/B.TECH DEGREE EXAMINATION, DECEMBER 2020

Fifth Semester

ME18503-DESIGN OF MACHINE ELEMENTS

(Regulation 2018)

Time: Three hours Maximum : 80 Marks

(*Use of Approved Design Data Book is permitted*)

Answer **ALL** questions

PART A - (8 X 2 = 16 marks)

1. If σ_1 and σ_3 are the algebraically largest and smallest principal stresses respectively, the value of the maximum shear stress is

   (A) $\frac{\sigma_1+\sigma_3}{2}$ (B) $\frac{\sigma_1-\sigma_3}{2}$

   (C) $\sqrt{\frac{\sigma_1+\sigma_3}{2}}$ (D) $\sqrt{\frac{\sigma_1-\sigma_3}{2}}$

2. A solid shaft transmitting a torque of 5.2 kNm is rotating at 200 rpm. The shaft is not allowed to twist more than 0.5° in a length of 3.5 m. What is diameter of the shaft considering the stiffness for a rigidity modulus of 80 GPa?

   (A) 128 mm (B) 114 mm

   (C) 256 mm (D) 156 mm

3. The close-coiled helical springs 'A' and 'B' are of same material, same coil diameter, same wire diameter and subjected to same load. If the number of turns of spring 'A' is half that of spring 'B', the ratio of deflection of spring 'A' to spring 'B' is

   (a)1/2 (c) 2

   (b) 1 (d) 4

4. Which of these riveted joints produces a double shear in the rivets?

   (A) Single rivet lap joint

   (B) Double rivet lap joint

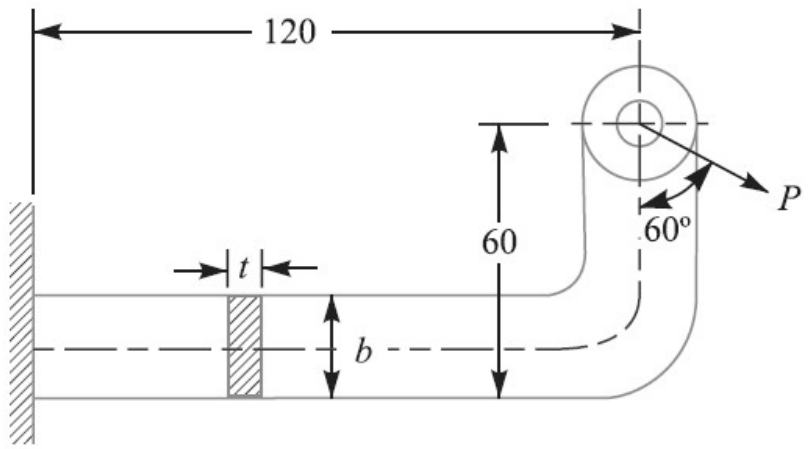
   (C) Double cover single rivet butt joint

   (D) Single cover single rivet butt joint

5. Justify the importance of factor of safety? List the factors considered while selection of factor of safety.
6. Compare hole basis system with shaft basis system. which one is preferred and why?
7. What is meant by solid length of spring? If the total number of turns is 8 and coil diameter is 5mm, what is the solid length of the spring?
8. Differentiate with a neat sketch the fillet welds subjected to parallel loading and transverse loading.

PART B - (4 X16 = 64 marks)

09. **(a)** A wall bracket, as shown in Fig9a. is subjected to a pull of P = 5 kN, at 60° to the vertical. The cross-section of bracket is rectangular having b = 3t. Determine the dimensions b and t, if the stress in the material of the bracket is limited to 28 MPa. **(16)**



All dimensions in mm – Figure 9a

(OR)

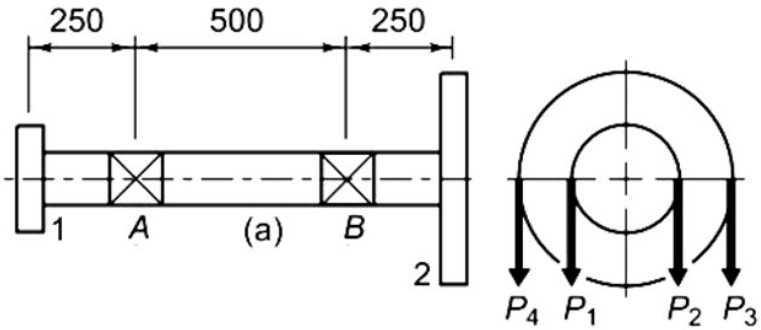
(b) A hot rolled solid steel shaft is subjected to a torsional moment that varies from 420 N-m clockwise to 210 N-m counterclockwise and an applied bending moment at a critical section varies from 600 N-m to -200 N-m. The shaft is of uniform cross-section and no keyway is present at the critical section. Neglect the stress concentration factor. The material has an ultimate strength of 500 MN/m^2 and yield strength of 360 MN/m^2 in tension. The Endurance limit in reversed bending is 250 MN/m^2. Take the yield strength in shear is one-half of the yield strength in tension. Determine the required shaft diameter. **(16)**

Take the following values: Factor of safety = 2.0, Load correction factors = 1.0 in bending, and 0.7 in torsion, Stress concentration factor=1.0, Size effect factor = 0.85, Surface factor = 0.85.

10. (a) The layout of a shaft carrying two pulleys 1 and 2, and supported on two bearings A and B is shown in Fig.10a. The shaft transmits **(16)**

5 kW power at 500 rpm from the pulley 1 to the pulley 2. The diameters of pulleys 1 and 2 are 250 mm and 500 mm respectively. The masses of pulleys 1 and 2 are 10 kg and 30 kg respectively. The belt tensions act vertically downward and the ratio of belt tensions on the tight side to slack side for each pulley is 2.5:1. The shaft is made of plain carbon steel 40C8. Find the diameter of the shaft, if the working stress is 150 MPa in tension and 75 MPa in shear. The combined shock and fatigue factors for bending and torsion may be taken as 1.5 and 1.2 respectively

All dimensions in mm -Figure 10a



(OR)

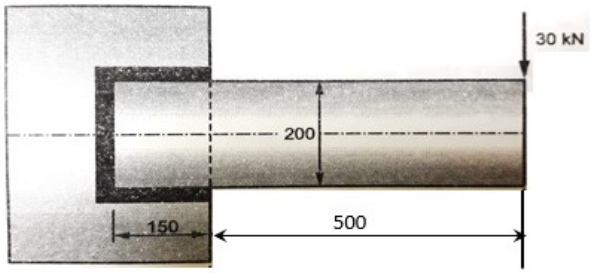
(b) Design a protective type of C.I flange coupling for mild steel shaft transmitting 90 KW at 250 rpm. The allowable shear stress for the shaft material is 40 MPa. The allowable shear stress and crushing stress for key and bolt material are 45 MPa and 85 MPa respectively. The permissible shear stress for CI flange and hub is 14 MPa. The key is having Square cross section and width is equal to thickness. The Number of bolts is 06. The bolts are fitted in reamed holes and are finger tight. After designing the various elements, make a neat sketch of the assembly indicating the important dimensions. **(16)**

11. (a) Design a close coiled helical compression spring for a service load ranging from 2000 N to 3000 N. The axial deflection of the spring for the load range is 15mm. Consider a spring index of 5. Consider Wahl's stress factor effect. The permissible shear stress intensity is 420 MPa and Modulus of rigidity, G= 80 kN/mm^2.Draw a neat sketch of the spring and indicate the main dimensions. **(16)**

(OR)

(b) A semi-elliptical laminated vehicle spring to carry a load of 7000 N is to consist of seven leaves 55 mm wide, two of the leaves extending the full length of the spring. The spring is to be 1.1 m in length and attached to the axle by two U-bolts 80 mm apart. The bolts hold the central portion of the spring so rigidly that they may be considered equivalent to a band having a width equal to the distance between the bolts. Take design stress for spring material as 300 MPa. Consider Length of the pin which is equal to the width of the leaf and Bearing pressure on the pin which may be taken as 8 N/mm^2. Determine: 1. Thickness of leaves, 2. Deflection of spring, 3. Diameter of eye. Sketch the semi-elliptical leaf-spring arrangement. **(16)**

12. (a) A weld bracket as shown in Fig 12a carries a load of 30KN. calculate size of weld if allowable shear stress in the weld is 80N/mm^2 **(16)**



All dimensions in mm – Figure 12a

(OR)

(b) (i) Compare the disadvantages of riveted joints over welding joints **(3)**

(ii) State the difference between Pitch and Back pitch with simple sketch, concerned to Riveted joint **(3)**

(iii) A Double riveted double cover butt joint in plates 10 mm thick is made with 20 mm diameter rivets at 80 mm pitch. **(10)**

The permissible stresses are

Permissible tensile stress in plate σ_t = 120 MPa

Permissible shearing stress in rivets τ = 90MPa

Permissible crushing stress in rivets σ_c = 170 MPa

Find the efficiency of joint, taking the strength of the rivet in double shear as twice than that of single shear