Code No: RR310305 **Set No. 1**

**III B.Tech I Semester Regular Examinations, November 2006**
**DESIGN OF MACHINE MEMBERS-I**
**( Common to Mechanical Engineering and Production Engineering)**
**Time: 3 hours** **Max Marks: 80**

**Answer any FIVE Questions**
**All Questions carry equal marks**

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1. (a) What are the steps to be followed while designing a machine element? [8]
   (b) Define the following properties of a material:
      i. Ductility
      ii. Toughness
      iii. Hardness and
      iv. Creep. [4+4]

2. (a) State and explain any two theories of failure
   (b) The principal stresses induced at a point in a machine component made of steel 50C4($S_{yt}$ = 460 N/mm$^2$) are as follows:
   Maximum principal stress = 200 N/mm$^2$ and Minimum principal stress = 150 N/mm$^2$. Calculate the factor of safety by
      i. maximum shear stress theory and
      ii. distortion energy theory. [6+10]

3. (a) Explain the effect of the following factors on the type of fatigue failure.
      i. Stress distribution
      ii. Manner of loading
      iii. Strain rate
      iv. Type of material
   (b) Determine the diameter of a circular rod made of ductile material with fatigue strength (complete stress reversal) Endurance limit = 280 MPa and a tensile yield strength of 350 MPa. The member is subjected to a varying axial load from 700 kN to 300 kN. Assume Fatigue stress concentration factor = 1.8 and Factor of Safety = 2. [8+8]

4. A bracket in the form of a plate is fitted to a column by means of four rivets A, B, C and D in the same vertical line as shown in Figure4. AB = BC= CD = 60 mm. E is the mid-point of BC. A load of 100 KN is applied to the bracket at a point F which is at a horizontal distance of 150 mm from E. The load acts at an angle of $30^0$ to the horizontal. Determine the diameter of rivets, which are made of steel having a yield stress in shear of 240 MPa. Take a factor of safety of 1.5.

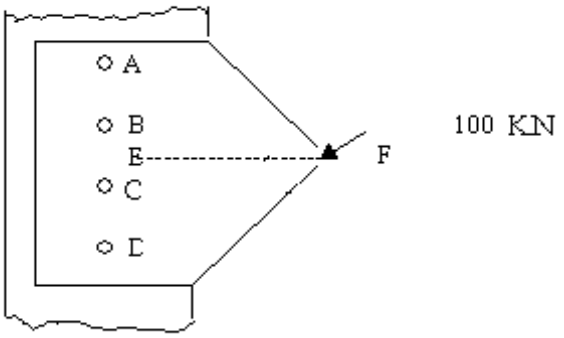


Figure 4

[16]

5. (a) What are the relative advantages and disadvantages of welded joints over riveted joints.

   (b) A 125 X 95 X 10 mm angle is joined to a frame by two parallel fillet welds along the edge of 125 mm length. If the angle is subjected to a static load of 180 kN, find the length of weld at the top and bottom. The allowable static load per mm weld length is 430N. [6+10]

6. (a) Describe the purpose of gib in cotter joint? What are the applications of cotter joints?

   (b) Design a knuckle joint to transmit 140 kN, with permissible stresses in tension; shear and compression are 75 Mpa ; 60 Mpa and 150 Mpa respectively.[6+10]

7. (a) Derive the equation for torque acting upon a hollow shaft from the torsion equation.

   (b) Find the diameter of a solid shaft to transmit 25 kW at 300 rpm. Take the maximum allowable shear stress as 50 N/mm$^2$. If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside to outside diameter is 0.6. [6+10]

8. (a) Write a short note on universal coupling.

   (b) Design a solid muff coupling made of cast iron to connect two shafts transmitting 35KW at 150rpm with a capability of 25% maximum torque greater than the mean torque. The shaft and key are made of mild steel for which permissible shear and crushing stress are 30MN/m$^2$ and 80MN/m$^2$ respectively. Permissible shear stress in CI is 15MN/m$^2$. [6+10]

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Code No: RR310305 **Set No. 2**

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**DESIGN OF MACHINE MEMBERS-I**
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**Time: 3 hours** **Max Marks: 80**

**Answer any FIVE Questions**
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1. (a) What is meant by "Hole basis system" and "Shaft basis system".
   (b) What are the types of fits? Explain them with the help of neat diagrams. [6+10]

2. (a) Briefly explain shear stress and shear strain?
   (b) Calculate the diameter of the solid shaft to transmit 50 kW at 180 rpm. If the angle of twist in a length of 4 meters is not to exceed $0.4^0$. The allowable stress in the material is 70 MPa and modulus of rigidity is 84 GPa. [4+12]

3. (a) Explain the effect of the following factors on the type of fatigue failure
      i. Range of imposed stress
      ii. Surface treatement
   (b) A stepped shaft transmits a torque varying from 800 N m to 1200 N m. The ratio of diameter is 1.5 and the stress concentration factor is 1.2. Determine the diameter of the shaft for an infinite life for a design factor of safety 1.8. The ultimate tensile strength of the material of the shaft is 600 MPa. Yield stress of the material is 450 MPa. Consider the size effect and surface finish effect. [6+10]

4. (a) Design the procedure for designing a lozenge joint.
   (b) A triple riveted lap joint with zig-zag riveting is to be designed to connect two plates of 6 mm thickness. Determine the diameter of the rivet, pitch of rivets and distance between the rows of the rivets. Indicate how the joint will fail. Also, find the efficiency of the joint. The permissible stresses are 120 MPa in tension, 100 MPa in shear and 150 MPa in crushing. [6+10]

5. (a) What are the relative advantages and disadvantages of welded joints over riveted joints.
   (b) A 125 X 95 X 10 mm angle is joined to a frame by two parallel fillet welds along the edge of 125 mm length. If the angle is subjected to a static load of 180 kN, find the length of weld at the top and bottom. The allowable static load per mm weld length is 430N. [6+10]

6. (a) It is required to design a square key for fixing a gear on a shaft of 30 mm diameter; to transmit 20 kW power at 720 RPM. The key is made of 50 C4 steel with $f_{yt}$ =460 Mpa and FOS=3.The yield strength and compressive strength of key material is assumed to be equal. Design the key.

(b) Design a knuckle joint to withstand a tensile load of 60 kN using steel with the permissible stresses in tension 63 Mpa; in crushing 75 Mpa; in shear 50 Mpa. [6+10]

7. (a) What is the advantage and limitation of hollow shaft over solid shaft.

(b) A steel solid shaft transmitting 15KW at 200 rpm is supported on two bearings 750mm apart and has two gears keyed to it. The pinion having 30 teeth of 5mm module is located 100mm to the left of the right hand bearing and delivers power horizontally to the right. The gear having 100 teeth of 5mm module is located 150mm to the right of the left hand bearing and receiver power in a vertical direction from below. Using an allowable stress of $55MN/m^2$ in shear, determine the dia of the shaft. [4+12]

8. (a) Write a short note on universal coupling.

(b) Design a solid muff coupling made of cast iron to connect two shafts transmitting 35KW at 150rpm with a capability of 25% maximum torque greater than the mean torque. The shaft and key are made of mild steel for which permissible shear and crushing stress are $30MN/m^2$ and $80MN/m^2$ respectively. Permissible shear stress in CI is $15MN/m^2$. [6+10]

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Code No: RR310305 **Set No. 3**

**III B.Tech I Semester Regular Examinations, November 2006**
**DESIGN OF MACHINE MEMBERS-I**
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**Time: 3 hours** **Max Marks: 80**

**Answer any FIVE Questions**
**All Questions carry equal marks**

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1. (a) Distinguish
   i. Elastic Deformation from Plastic Deformation.
   ii. Hardness from toughness.
   (b) Discuss briefly the Important Factors to be considered in the selection of Materials. [8+8]

2. (a) Define factor of safety for :
   i. Ductile materials and
   ii. Brittle materials
   (b) Discuss the various stresses and the corresponding deformations that exist in machine components under load. [6+10]

3. (a) What do you understand by fatigue?
   (b) A section of a shaft of diameter d is joined to a section of a diameter 1.5d with a fillet, which produces an actual stress concentration factor of 1.2 for the shaft in torsion. The material has a yield point in tension of 560 MPa and endurance limit of 288 MPa in reversed torsion. Using a size factor of 0.85, surface finish factor of 0.85 and Size correction factor = 0.6, determine the size of the shaft required for a torque which varies from zero to 2400Nm on the shaft at the smaller diameter. Use design factor 2. [6+10]

4. (a) What is the difference between caulking and fullering? Explain with the help of neat sketches.
   (b) A double riveted double cover butt joint in plates 20-mm thick is made with 25 mm diameter rivets at 100 mm pitch. The permissible stresses are 120 MPa in tension, 100 MPa in shear and 150 MPa in crushing. Find the efficiency of joint, taking the strength of the rivet in double shear as twice than that of single shear. [6+10]

5. A pillar crane having a circular base of 600 mm diameter is fixed to the foundation of concrete base by means of four bolts. The bolts are of size 30 mm and are equally spaced on a bolt circle diameter of 500 mm. The load lifted by the pillar crane is 60 KN and is at a distance of 1.5 m from the centre of the base. Find the maximum stress induced in the bolt material. [16]

6. (a) Describe the purpose of gib in cotter joint? What are the applications of cotter joints?

(b) Design a knuckle joint to transmit 140 kN, with permissible stresses in tension; shear and compression are 75 Mpa ; 60 Mpa and 150 Mpa respectively.[6+10]

7. (a) Derive the equation for torque acting upon a hollow shaft from the torsion equation.

   (b) Find the diameter of a solid shaft to transmit 25 kW at 300 rpm. Take the maximum allowable shear stress as 50 N/mm$^2$. If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside to outside diameter is 0.6. [6+10]

8. The shaft and the flange of a marine engine are to be designed for flange coupling, in which the flange is forged on the end of the shaft. The following particulars are to considered in the design.
   Power of the engine = 3MW
   Speed of the engine = 100 rpm.
   Permissible shear stress in bolts and shaft = 60Mpa
   Number of bolts used = 8
   Pitch circle diameter of bolts = 1.6 x diameter of shaft. Find

   (a) Diameter of shaft

   (b) Diameter of bolts

   (c) Thickness of flange

   (d) Diameter of flange. [4+4+4+4]

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Code No: RR310305 **Set No. 4**

**III B.Tech I Semester Regular Examinations, November 2006**
**DESIGN OF MACHINE MEMBERS-I**
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**Time: 3 hours** **Max Marks: 80**

**Answer any FIVE Questions**
**All Questions carry equal marks**

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1. (a) What are preferred numbers? Mention their advantages.
   (b) State the mechanical properties of metals and explain briefly. [6+10]

2. (a) Discuss the significance of Factor Safety in Design.
   (b) Determine the maximum thickness of the steel sheet into which holes of 20mm size can be punched. The ultimate tensile strength of the sheet material is 250 Mpa. The allowable compressive stress during the punching operation in the hardened end of the punch is limited to 400 MPa. [6+10]

3. (a) Explain the following methods of reducing stress concentration
      i. Using undercut shoulders
      ii. Added grooves
   (b) A round shaft made of cold finished AISI 1020 steel is subjected to a variable torque whose maximum value is 700 KN-m. For a factor of safety of 1.5 on the Soderberg criterion, determine the diameter of the shaft if
      i. The torque is reversed
      ii. The torque varies from zero to maximum
      iii. The torque varies from 300 N m to a maximum.

   Assume,
   Correction factor for type of loading other than bending = 0.6
   Size correction factor = 0.85
   Surface correction factor = 0.87
   Ultimate tensile strength =550 MPa.
   Yield strength = 460 MPa [6+10]

4. (a) Enumerate the different types of riveted joints.
   (b) Two plates 16 mm thick are joined by a double riveted lap joint. The pitch of each row of rivets is 90 mm. The rivets are 25 mm in diameter. The permissible stresses are 140 MPa in tension, 80 MPa in shear and 160 MPa in crushing. Find the efficiency of the joint. [6+10]

5. A bracket carrying a load of 15 KN is to be welded as shown in Figure5. Find the size of weld required if the allowable shear stress is not to exceed 80 MPa.

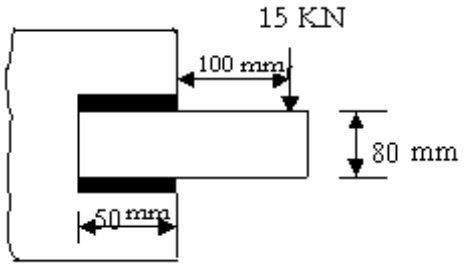


Figure 5

[16]

6. (a) A feather key is 12mm wide and is to transmit 700N-m torque from a 400mm diameter shaft. The steel key has an allowable stress in tension and compression of 120Mpa and an allowable shear stress of 575Mpa. Determine the required length of key. If the key dimensions are reversed as 9mm wide and 12mm deep, what would have been the required length of key for same load and material.

   (b) Design a cotter joint to withstand an axial load varying from 45kN in tension to 45 kN in compression. The allowable for the steel used in the joint are 60Mpa in tension; 70 Mpa in crushing; 45 Mpa in shear. [6+10]

7. (a) What type of stresses are induced in shafts?

   (b) A solid circular shaft is subjected to a bending moment of 3000N-m and a torque of 10,000N-m. The shaft is made of 45C8 steel having ultimate tensile stress of 700Mpa and a ultimate shear stress of 500Mpa. Assuming a factor of safety as 6, determine the diameter of shaft. [6+10]

8. Design a flange coupling of the protected type to connect two shafts 100mm diameter. The shafts transmit 100KW at 200 rev/min. The materials for shaft, key, bolts and flanges are given below:

| Part Name | Material | Yield stress N/mm$^2$ | Tensile strength N/mm$^2$ |
|---|---|---|---|
| Shaft key | 50C12 Steel | 390 | 710 |
| Bolts | 45C8 Steel | 350 | 650 |

The flanges are made of FG 200 gray Cast Iron having shear strength of 230N/mm$^2$ and compressive strength of 720N/mm$^2$. A factor of safety of 3 in desired for all parts. [16]

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