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

III B.Tech I Semester Regular Examinations, November 2005
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) How do you classify materials for engineering use?
   (b) Write a note on important non-metallic materials of construction in engineering practice? [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. Type of material
      ii. Surface treatement
      iii. Range of imposed stress
   (b) A leaf spring in an automobile is subjected to cyclical stresses.
   The average stress = 150 MPa, variable stress = 50 MPa, Ultimate stress = 630 MPa, Yield point stress = 350 MPa and endurance limit = 150 MPa. Estimate under what factor of safety the spring is working, by Goodman and Soderberg formulae. [6+10]

4. (a) Explain the following terms in connection with riveted joints
      i. Pitch
      ii. Back pitch
      iii. Diagonal pitch
      iv. Margin
   (b) A double riveted butt joint, in which the pitch of the rivets in the outer rows is twice that in the inner rows, connects two 16 mm thick plates with two cover plates each 12 mm thick. The diameter of the rivets is 22 mm. Determine the pitches of the rivets in the two rows if the working stresses are not to exceed the following limits:
   Tensile stress in plates = 100 MPa, Shear stress in rivets = 75 MPa and bearing stresses in rivets and plates = 150 MPa.
   Make a fully dimensioned sketch of the joint showing atleast two views. [8+8]

5. A bracket carrying a load of 15 KN is to be welded as shown in Figure1. Find the size of weld required if the allowable shear stress is not to exceed 80 MPa. [16]

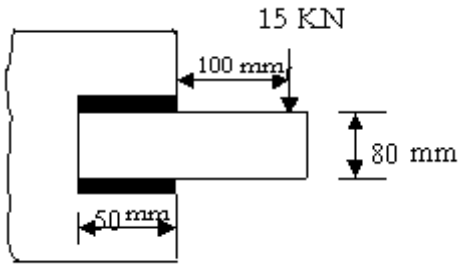

Figure 1:

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) Explain about various types of stresses acting on a rotating shaft?

   (b) A line shaft is driven by means of a motor placed vertically below it. The pulley on the line shaft is 1.5metre in diameter and has belt tensions 5.4KN and 1.8KN on the tight side and slack side of the belt respectively. Both these tensions may be assumed to be vertical. If the pulley be overhang from the shaft, the distance of the centre line of the pulley from the centre line of the bearing being 400mm. Find the diameter of the shaft. Assuming maximum allowable shear stress of $42N/mm^2$. [6+10]

8. (a) Give the classification of couplings.

   (b) Design a bushed pin type of flexible coupling required to transmit 25hp at 1000rpm. The coupling is to be connected between a motor and a centrifugal pump each having their shaft diameter of 50mm and 40mm respectively.[6+10]

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

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DESIGN OF MACHINE MEMBERS-I
(Common to Mechanical Engineering and Production Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) How do you classify materials for engineering use?
   (b) Write a note on important non-metallic materials of construction in engineering practice? [6+10]

2. (a) What is Factor of Safety ? Explain its role in mechanical Design.
   (b) A bolt is subjected to an axial force of 10KN with a transverse shear force of 5 KN . The permissible tensile stress at elastic limit is 100 MPa and the poison's ratio is 0.3 for the bolt material. Determine the diameter of the bolt required according to
      i. Max. principal stress theory
      ii. Max. shear stress theory
      iii. Max. principal strain theory
      iv. Max. strain energy theory, and
      v. Max. distortion energy theory. [6+10]

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. Two lengths of mild steel tie rod having width 200 mm are to be connected by means of Lozenge joint with two cover plates to withstand a tensile load of 180 KN. Completely design the joint, if the permissible stresses are 80 MPa in tension, 65 MPa in shear and 160 MPa in crushing. Draw a neat sketch of the joint.[12+4]

5. The cylinder head of a 200 mm X 350 mm compressor is secured by means of 12 studs of rolled mild steel having yield point stress of 350 MPa and endurance limit of 240 MPa. The gas pressure is 1.5 MPa. The initial tension in the bolts, assumed to be equally loaded such that a cylinder pressure of 3 MPa is required for the joint to be on the point of opening. The joint is made leak-proof by using copper gasket, which renders the effect of external load to be half. Determine the size of bolts, if factor of safety is 2 and stress concentration factor is 2.8 [16]

6. (a) It is required to design a square key for fixing a gear on a shaft of 60 mm diameter; to transmit 5 kW power at 480 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 75 kN using steel with the permissible stresses in tension 63 Mpa; in crushing 75 Mpa; in shear 50 Mpa. [6+10]

7. A horizontal nickel steel shaft rests on two bearings, A at the left and B at the right end and carries two gears C and D located at distances of 250mm and 400mm respectively from the centre line of the left and right bearings. The pitch diameter of the gear C is 600mm and that of gear D is 200mm. The distance between the centre line of the bearings is 2400mm. The shaft transmits 20KW at 120rpm. The power is delivered to the shaft at gear C is taken out at gear D in such a manner that the tooth pressure F_{tC} of the gear C and F_{tD} of the gear D act vertically downwards.
   Find the diameter of the shaft, if the working stress is 100Mpa in tension and 56Mpa in shear. The gears C and D weighs 950N and 350N respectively. The combined shock and fatigue factors for bending and torsion may be taken as 1.5 and 1.2 respectively. [16]

8. Design and draw a muff coupling to transmit 50Hp at 120 rpm. The shaft and key are made of the same material having allowable shear stress of $30N/mm^2$ and compressor stress of $80N/mm^2$. The flange is made, as cast Iron with allowable shear stress is $15N/mm^2$. [12+4]

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

III B.Tech I Semester Regular Examinations, November 2005
DESIGN OF MACHINE MEMBERS-I
(Common to Mechanical Engineering and Production Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) State the advantages and Drawbacks of Cast Iron as an Engineering Material.
   (b) What are alloy steels? State the effect of Chromium, Nickel, Manganese and Vanadium. [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) 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) 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. For supporting the travelling crane in a workshop, the brackets are fixed on steel columns as shown in Figure1. The maximum load that comes on the bracket is 12 KN acting vertically at a distance of 400 mm from the face of the column. The vertical face of the bracket is secured to a column by four bolts, in two rows (two in each row) at a distance of 50 mm from the lower edge of the bracket. Determine the size of bolts if the permissible tensile stress for the bolt material is 84 MPa. Also find the cross-section of the arm of the bracket which is rectangular.

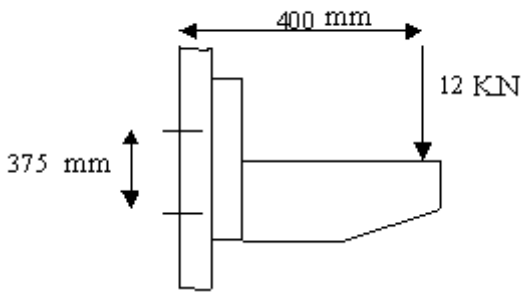

Figure 1:

[16]

6. (a) Derive suitable equations in terms of torque, cross section of key for same shaft and key material.

   (b) Design a cotter joint to withstand an axial load varying from 48 kN in tension to 48 kN in compression. The allowable for the steel used in the joint are 60Mpa in tension; 75Mpa in crushing; 48Mpa in shear. [6+10]

7. (a) What do you understand by torsional rigidity and lateral rigidity?

   (b) A cylindrical shaft made of steel of yield strength 700Mpa is subjected to static loads consisting of a bending moment of 10KN-m and a torsional moment of 30KN-m. Determine the diameter of the shaft using two different theories of failures and assuming a factor of safety of 2. [6+10]

8. Design and draw a bush type flexible flange coupling to transmit 15Hp at 960 rpm allowable shear stress for the shaft and key may be taken as 53.5N/mm^2. the shear stress in the bolts should not exceed 35N/mm^2. the bearing pressure between the bush and coupling should be 2N/mm^2. [12+4]

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

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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) Select suitable materials for the manufacture of the following:
   i. Machine tool spindle
   ii. valve spring
   iii. condenser tubes
   iv. connecting rod.
   (b) What are alloy steels? Discuss the effect of adding different alloying elements in steel? [8+8]

2. (a) Discuss the failure theories related to Ductile Materials.
   (b) A short cast iron column of hollow circular cross-section with 250mm outside diameter and 150 mm inside diameter carries a vertical load of ' P' acting at a point 100mm from the axis of the column. The allowable stress is limited to 40 MPa in compression and 20 MPa in tension. Find the maximum load the column can carry. [8+8]

3. (a) Explain the effect of the following factors on the type of fatigue failure.
   i. Surface treatement
   ii. Manner of loading
   iii. train rate
   iv. Type of material
   (b) A bar of circular cross-section is subjected to alternating tensile forces varying from a minimum of 200 kN to a maximum of 500 kN. It is to be manufactured of a material with an ultimate tensile strength of 900 MPa and an endurance limit of 700 MPa. Determine the diameter of bar using safety factors of 3.5 related to ultimate tensile strength and 4 related to endurance limit and a stress concentration factor of 1.65 for fatigue load. Use Goodman straight line as basis for design. [8+8]

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]

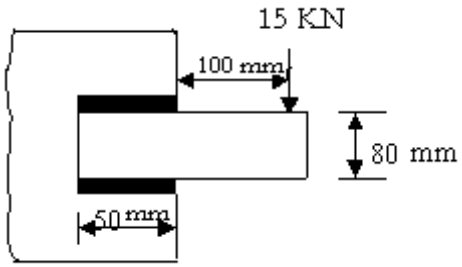

Figure 1:

5. A bracket carrying a load of 15 KN is to be welded as shown in Figure1. Find the size of weld required if the allowable shear stress is not to exceed 80 MPa. [16]

6. (a) Describe the design procedure of sunk keys.
   (b) Design a cotter joint to withstand an axial load varying from 50kN in tension to 50kN 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 and draw a muff coupling to transmit 50Hp at 120 rpm. The shaft and key are made of the same material having allowable shear stress of $30N/mm^2$ and compressor stress of $80N/mm^2$. The flange is made, as cast Iron with allowable shear stress is $15N/mm^2$. [12+4]

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