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

III B.Tech. I Semester Supplementary Examinations, May -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) Mention the composition of materials designated as 40C8, 40Cr1, 40C15S12 and 30Ni4Cr1.
   (b) List various advantages of Aluminium and Magnesium alloys giving their applications in engineering use.

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.

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.

4. (a) What do you understand by the term riveted joint? Explain the necessity of such a joint.
   (b) A double riveted lap joint is made between 15-mm thick plates. The rivet diameter and pitch are 25 mm and 75 mm respectively. If the ultimate stresses are 400 MPa in tension, 320 MPa in shear and 640 MPa in crushing, find the minimum force per pitch which will rupture the joint.
   If the above joint is subjected to a load such that the factor of safety is two, find out the actual stresses developed in the plates and the rivets.

5. A steam engine of effective diameter 300 mm is subjected to a steam pressure of 1.5 MPa. The cylinder head is connected by 8 bolts having yield point 330 MPa and endurance limit at 240 MPa. The bolts are tightened with an initial preload of 1.5 times the steam load. A soft copper gasket is used to make the joint leak-proof. Assuming factor of safety 2, find the size of the bolt required. The stiffness factor for copper gasket may be taken as 0.5.

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.

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.

8. Design and draw a cast iron flange coupling for a mild steel shaft transmitting 90KW at 250 rpm. The allowable shear stress in the shaft is 40Mpa and the angle of twist is not to exceed 1^0 in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30Mpa.

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

III B.Tech. I Semester Supplementary Examinations, May -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?

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.

3. (a) Explain the following methods of reducing stress concentration
      i. Drilled holes
      ii. Using large fillet radius
   (b) A shaft supported as a simple beam, 0.45 mm long, is made of AISI 3120 steel. With the shaft rotating a steady load of 8000 N is applied midway between the bearings. The surfaces are ground. Indefinite life is desired with a factor of safety of 1.6 based on endurance strength. What should be the minimum diameter of the shaft if there are no surface discontinuities? Endurance limit is 630 MPa. Size factor is 0.85 and machine surface finish factor 0.87

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.

5. (a) Show that the normal stress in case of an annular fillet weld subjected to bending is given by
   $$\sigma = (5.66\ M) / (\pi\ s\ d^2)$$
   where M = Bending moment; s = weld size and d = Diameter of cylindrical element welded to the flat surface.
   (b) A 50 mm diameter solid shaft of length 200 mm is welded at one end to a flat plate while the other end is subjected to a load of 10 KN acting vertically downwards. If the size of the weld is 15 mm, find the maximum normal and shear stress in the weld.

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.

7. A steel shaft 800mm long transmitting 15 kW at 400 rpm is supported at two bearings at the two ends. A gear wheel having 80 teeth and 500mm pitch circle diameter is mounted at 200 mm from the left hand side bearing and receives power from a pinion meshing with it. The axis of pinion and gear lie in the horizontal plane. A pulley of 300mm diameter is mounted at 200mm from right hand side bearing and is used for transmitting power from a belt. The belt drive si inclined at 30^0 to the vertical in the forward direction. The belt lap angle is 180^0. The coefficient of friction between belt and pulley is 0.3. Design and sketch the arrangement of the shaft. Assuming the values of safe stresses as 55 N/mm^2 in shear and 80 N/mm^2 in tension. Take torsion and bending factor 1.5 and 2 respectively.

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.

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

III B.Tech. I Semester Supplementary Examinations, May -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) What is meant by Brittleness, Hardness and Plasticity? Why brittleness is undesirable property for materials to be used for Machine Parts?
   (b) Define the terms
      i. Fit
      ii. Basic Size
      iii. Clearance
      iv. Upper Deviation

2. (a) State and explain the maximum principal stress theory and maximum shear stress theory?
   (b) The stresses induced at a critical point in a machine component made of steel 45C8 (S_{yt} = 380 N/mm^2) are as follows:
   σ_x = 100 N/mm^2 ; σ_y = 40 N/mm^2 ; τ_{xy} = 80 N/mm^2.
   Calculate the factor of safety by
      i. the maximum principal stress theory and
      ii. the maximum shear stress theory.

3. (a) Define stress concentration factor.
   (b) A hot rolled shaft is subjected to torsional load that varies from 320 Nm clockwise to 120Nm anti-clockwise and an applied bending moment at a critical section varies from 400Nm to 200Nm. The shaft is of uniform cross section. Determine the required shaft diameter. The material has an ultimate strength of 560MPa and yield strength of 420 MPa. Assume factor of safety to be 2.

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.

5. A mounting plate for a drive unit is fixed to the support by means of four M12 bolts as shown in Figure1. The core diameter of the bolts can be considered as 9.858 mm. Determine the maximum value of 'W' if the allowable tensile stress in bolt material is 60 MPa.

6. (a) Sketch the keys

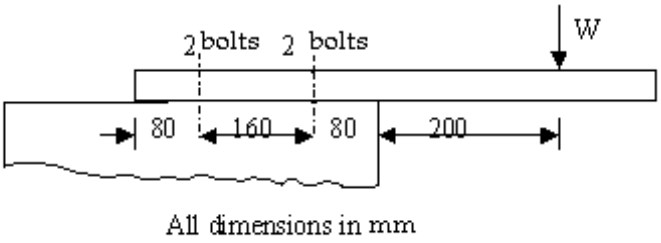

Figure 1:

i. Wood ruff key
ii. Kennedy key
iii. Gib head key

(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; 75Mpa in crushing; 48Mpa in shear.

7. A hollow shaft of 0.5m outside diameter and 0.3m inside diameter is used to drive a propeller of a marine vessel. The shaft is mounted on bearings 6 meter apart and it transmits 5600 KW at 150 rpm. The maximum axial propeller thrust is 500 kN and the shaft weighs 70 kN determine the maximum shear stress developed in the shaft and the angular twist between the bearings.

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 $15MN/m^2$.

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

III B.Tech. I Semester Supplementary Examinations, May -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) Write a brief note on different phases of design.
   (b) Discuss various general considerations that are taken into account while designing a machine element.

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 Max. distortion energy theory.

3. (a) Explain the effect of the following factors on the type of fatigue failure.
      i. Stress distribution
      ii. Strain rate
   (b) Bending stress in a machine part fluctuate between a tensile stress of 280 MPa and compressive stress of 140 MPa. What should be the minimum ultimate tensile strength to carry this fluctuation indefinitely according to
      i. Goodman's formula
      ii. Soderberg's formula

      The factor of safety may be assumed to be 1.75. Assume that yield point is never likely to be less than 55 % of the ultimate tensile strength or greater than 93 % of it.

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.

5. A bracket carrying a load of 15 KN is to be welded as shown in Figure2. Find the size of weld required if the allowable shear stress is not to exceed 80 MPa.

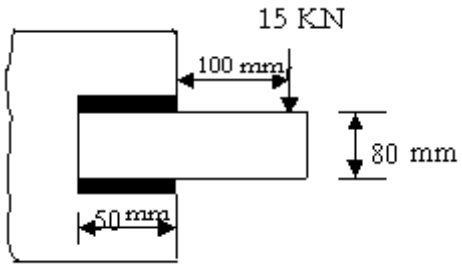

Figure 2:

6. (a) Describe the classification of keys
   (b) Design and draw a sleeve and cotter joint to connect two rods to transmit maximum tensile load of 85 kN. Assume sleeve cotter and rods are made of same material and design stresses in the material are 65 Mpa in tension; 130 in crushing and 50 Mpa in shear.

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.

8. Design a protective type of cast iron flange coupling for a steel shaft transmitting 22 KW at 175 rpm and having an allowable shear stress of 38 N/mm^2. The working stress in the bolts should not exceed 30 N/mm^2. Assume that the same material is used for the shaft and key and that the crushing stress is twice the value of its shear stress. The maximum torque is 30% greater than the full load torque. The shear stress for cast iron is 12 N/mm^2.

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