Code No: 07A50304 **R07** **Set No. 2**

III B.Tech I Semester Examinations,May 2011
DESIGN OF MACHINE MEMBERS - I
Common to Mechanical Engineering, Production Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Define "Rigidity". What are the requirements to design a solid shaft for rigidity?
   (b) A shaft made of ductile material is 6 m length between bearings and transmits 15 kW at 900 rpm. It is also subjected to a bending moment of 180 N-m. Determine the diameter of the shaft by taking the working stress in the shaft in shear as 75 N/mm^2. Assume that the shaft is applied with medium shocks. [6+10]

2. (a) Explain what is meant by single shear and double shear?
   (b) A 60 mm diameter solid shaft of length 250 mm is welded at one end to a flat plate while the other end is subjected to a load of 100 KN acting vertically downwards. Determine the size of the weld, if the permissible shear stress in the weld is limited to 120N/mm^2. [6+10]

3. A steam engine of effective diameter 400 mm is subjected to a steam pressure of 2 N/mm^2. The cylinder cover is connected by means of 6 bolts having yield strength of 450 N/mm^2 and endurance limit of 275 N/mm^2. The bolts are tightened with an initial preload of 2.5 times that of steam force. A soft copper gasket is used to make a leak proof joint. The stress concentration factor is 2.5 Determine the size of the bolts. [16]

4. (a) Generally how the springs are classified? Indicate the different types of springs by sketches.
   (b) A truck spring has 12 leaves and is supported at a span length of 1 m, with a central band of 80 mm wide. A load of 6kN is applied at center of spring whose permissible stress is 300 N/mm^2. The spring has a ratio of total depth to width of about 2.5. Determine the width, thickness, deflection and length of all leaves. [6+10]

5. Design a cast iron protective type flange coupling to transmit 16 kW at 900 rpm from an electric motor to a compressor. The service factor may be assumed as 1.5. The following permissible stresses may be used: Shear stress for shaft, bolt and key material is 60 N/mm^2, Crushing stress for bolt and key is 70 N/mm^2, Shear stress for cast iron is 10 N/mm^2. Draw a neat sketch of the coupling. [16]

6. (a) State the advantages of preferred numbers.
   (b) Design a suitable diameter for a circular shaft to transmit 120 kW power at 350 rpm. The shear stress in the shaft is not to exceed 35 N/mm^2 and the

maximum torque exceeds the mean by 50%. Also find the angle of twist in a length of 3 m. Take G= 200 kN/mm^2. [6+10]

7. A steel cantilever is 20m long. It is subjected to an axial load which varies from 15 N (compression) to 45 N (tension) and also a transverse load at its free end which varies from 8 N up to 12 N down. The cantilever is of circular cross section. It is of diameter 2d for the first 5m and of diameter d for the remaining length. Determine its diameter taking a factor of safety of 2. Assume the following values: Yield stress is 3300 N/mm^2, Endurance limit in reversed loading is 3000 N/mm^2 ,Correction factor is 0.7 in reversed axial loading and 1.0 in reversed bending, Stress concentration factor 1.44 for bending and 1.64 for axial loading, Size effect factor 0.85, Surface effect factor 0.90, Notch sensitivity index 0.90. [16]

8. (a) A 1.5 m diameter cast iron pulley is mounted on a 100 mm diameter shaft by means of sunk key of size 50 mm × 50 mm × 150 mm. Determine the maximum torque that can be transmitted by the pulley, if the permissible shear and crushing stresses for the key are 65 and 125 N/mm^2 respectively.

   (b) Design a sleeve and cotter joint to connect two rods to transmit a tensile force of 130 kN. Same material is used for the rod , sleeve and the cotter. The allowable tensile stress is 95N/mm^2, compressive stress is 200 N/mm^2 and shear stress is 45 N/mm^2. [6+10]

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Code No: 07A50304 **R07** **Set No. 4**

III B.Tech I Semester Examinations,May 2011
DESIGN OF MACHINE MEMBERS - I
Common to Mechanical Engineering, Production Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the situation where the flexible couplings are selected?
   (b) Design a protective type flange coupling for the following requirements. Power to be transmitted is 15 kW at 1440 rpm. Flange material is Cast Iron. Shafts and keys are made of medium steel. Assuming appropriate factors, calculate the dimensions of coupling. [6+10]

2. Design a line shaft transmitting power to two machine tools. The power received by the shaft is 40 kW at 500 rpm. The power absorbed by pulley P_1 is 25 kW and the remaining power is absorbed by pulley P_2. The diameter of pulley P_1 is 400 mm and its mass is 50 Kg, the diameter and mass of pulley P_2 are 600 mm and 75 Kg respectively. Assume the belt tension ratio of 2 for both pulleys and the shaft material as steel with $K_m = 2$ and $K_t = 1.5$. Draw the B.M and torque diagrams, assuming maximum principal stress theory. [16]

3. (a) What is meant by nipping of a leaf spring?
   (b) A helical spring is to support a load of 10 kN. The spring is guided by a rod of 40 mm diameter. The spring undergoes a deflection of 40 mm under the load. Determine the diameter of the wire and the number of turns required, Use steel with a factor of safety 3. [6+10]

4. (a) What is a knuckle joint? where it is used?
   (b) Design a knuckle joint to transmit 140 kN force, with permissible stresses in tension, shear and compression are 75 N/mm^2, 60 N/mm^2 150 N/mm^2 respectively. [6+10]

5. A simply supported beam has a cantilever load at the centre which fluctuates from a value of P to 4P. The span of the beam is 500mm and its cross section is circular with a diameter of 60mm. Taking for the beam material an ultimate stress of 700 N/mm^2, a yield stress of 500 N/mm^2, endurance limit of 330 N/mm^2 for reversed bending, and a factor of safety of 1.3, calculate the maximum value of P. Take a size factor of 0.85 and a surface finish factor of 0.9. [16]

6. (a) Derive an expression for the maximum load in a bolt when a bracket with circular base is bolted to a wall by means of 8 bolts.
   (b) A steam engine cylinder of size 350 × 350 mm operates at 3 N/mm^2 pressure. The cylinder head is connected by means of 12 bolts having yield stress of 450 N/mm^2 and the endurance limit of 365 n/mm^2 by using gasket, which renders the effect of external load to be half. Determine the size of bolts, if factor of safety is 2.5 and stress concentration factor is 0.5. [6+10]

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7. (a) What do you understand by the term welded joint? How it differs from riveted joint?

   (b) Determine the length of the weld run for a plate size 120 mm wide and 15 mm thick to be welded to another plate by means of

      i. A single transverse weld and

      ii. Double parallel fillet welds when the joint is subjected to variable loads. [6+10]

8. (a) What is fit? What are the types of fits one can see between machine parts.

   (b) Explain the hole basis and shaft basis system as they apply to difficult bits. [8+8]

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Code No: 07A50304 **R07** **Set No. 1**

III B.Tech I Semester Examinations,May 2011
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Explain the significance of the initial tightening load and the applied load with respect to bolts.
   (b) Two shafts are connected by means of a flange coupling to transmit 400 watts of power at a speed of 300 rpm. The flanges of the coupling are fastened by 8 bolts of same material at a radius of 50 mm. Find the size of the bolts if the allowable shear stress for the bolts is 65 N/mm^2. [6+10]

2. (a) Differentiate between a flat key and feather key.
   (b) A square key is to be used to key a gear to a 50 mm diameter shaft. The length of the hub of the gear is 80 mm. Both shaft and key are made of same material, having an allowable shear stress of 65 N/mm^2. What are the minimum dimensions of the key if 300 N-m of torque is to be transmitted. [6+10]

3. (a) Show with neat sketches the various ways in which a riveted joint may fail
   (b) Design a double riveted lap joint with zig-zag riveting for 12 mm thick plates. Assumeσ_t = 100 N/mm^2, τ = 80 N/mm^2 and σ_c = 130 N/mm^2. [6+10]

4. Design a muff coupling for transmitting 100 kW power at 300 rpm. The design should resist 45% overload. The material of the key and shaft is having allowable shear stress as 65 N/mm^2, whereas for muff the shear stress should not exceed 10 N/mm^2. Also prepare proportioned sketch of the coupling. [16]

5. A steel shaft 1000 mm long transmitting 25 kW power at 600 rpm is supported at two bearings at the two ends. A gear wheel having 70 teeth and 450 mm 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 275 mm diameter is mounted at 200 mm from right hand side bearing and is used for transmitting power from a belt. The belt drive is inclined at 300 to the vertical in the forward direction. The belt lap angle is 1800. 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 45 N/mm^2 in shear and 60 N/mm^2 in tension. Take torsion and bending factor 2.5 and 3 respectively. [16]

6. (a) What are the various factors to be considered to estimate the strength of a given machine.

(b) A pulley is keyed to a shaft midway between the bearings. The shaft is made of cold drawn steel for which the ultimate strength is 600 N/mm^2 and the yield strength is 500 N/mm^2. The bending moment at the pulley varies from -200 kN-mm to +600 kN-mm as the torque on the shaft varies from -40 kN-mm to +140 kN-mm. Obtain the diameter of the shaft for an infinite life. The stress concentration factor for the key way at the pulley in bending and in torsion are 1.8 and 1.5 respectively. Take Factor of safety =1.5, load correction factor = 1 in bending and 0.6 in torsion; size effect factor = 0.85, surface effect factor=0.88. [6+10]

7. (a) Write the significance of stresses and stress concentration considerations in manufacturing design.

   (b) What is meant by preferred numbers and explain their use in engineering design? [8+8]

8. (a) What are the merits of co-axial springs compared to eccentric springs?

   (b) A semi elliptical laminted spring is to carry of load of 5 kN and consists 12 leaves 42 mm wide, two of the leaves being of full length. The spring is to be made 1 m between the eyes and is held at the center by a 60 mm wide band. Assume that the spring is initially stressed so as to induce an equal stress of 700 N/mm^2 when fully loaded. Design the spring for:

   i. Thickness of leaves
   ii. Eye diameter
   iii. Length of leaves Assume E = 2.1 $\times$ 10^5 N/mm^2. [6+10]

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Code No: 07A50304 **R07** **Set No. 3**

III B.Tech I Semester Examinations,May 2011
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) List-out the different types of stresses, to which a screwed fastener is generally subjected.
   (b) The head of a steam engine cylinder of 600 mm diameter is subjected to steam pressure of 1.3N/mm^2. The head is held in place by 16 bolts of M36 size. A soft copper gasket is used to make the joint steam tight. Determine the stress induced in the bolts. [6+10]

2. (a) Explain the keys that are commonly used in general industrial machinery?
   (b) A C.I. pulley of 700 mm diameter transmits 40 kW at 450 rpm. The pulley is secured to the shaft by means of a key. Find the dimension of the key assuming width of key as 0.5 times the diameter of the shaft. Take yield point strength as 325 N/mm^2 for mild steel. [6+10]

3. (a) What are the relative advantages and disadvantages of welded joints over riveted joints.
   (b) A 150 × 100 × 25 mm angle is joined to a frame by two parallel fillet welds along the edge of 150 mm length. If the angle is subjected to a static load of 200 kN, find the length of weld at the top and bottom. The allowable static load per mm weld length is 500 N. [6+10]

4. (a) A shaft running at 700 rpm transmits 18 kW. Assuming allowable shear stress in shaft is 70 N/mm^2, find the diameter of the shaft.
   (b) The engine of a ship develops 640 kW and transmits the power by a horizontal propeller shaft which runs at 160 rpm. It is proposed to design a hollow propeller shaft with inner diameter as 0.5 of the outer diameter. Considering the torsion alone, Calculate the diameter of the propeller shaft if stress in the material is not to exceed 65 N/mm^2 and also the angular twist over a length of 2.5 m is not to be more than 10. The modulus of rigidity of the shaft material is 60 kN/mm^2. [6+10]

5. Design the flexible flange coupling of bush type to transmit 7 kW power at 930 rpm with a service factor of 1.2. Assume design stresses for shaft, bolt and key in shear as 70 N/mm^2, for coupling in shear as 20 N/mm^2, for bushes in bearing as 2 N/mm^2, for key in crushing as 100 N/mm^2 [16]

6. (a) Write the expression for determining the stress and deflection in graduated leaves.

(b) A railway wagon is resting on a 12 helical springs. The wagon, along with goods, weigh 220 kN. The dynamic load on the spring due to irregularities on the rail track may be taken as 40 kN and corresponding amplitude of oscillation being 40 mm. Design the spring with Nickel Chromium steel having yield point of 1.6 kN/mm^2 and endurance limit of 1 kN/mm^2. Spring index may be taken as 6. Take G = 0.8 $\times$ 10^5 N/mm^2. [6+10]

7. A cold drawn steel rod of circular cross-section is subjected to a variable bending moment of 660 kN-mm to 1200 kN-mm as the axial load varies from 5.5 kN to 14.5 kN. The maximum bending moment occurs at the same instant that the axial load is maximum. Determine the required diameter of the rod for a factor of safety 2. Neglect any stress concentration and column effect. Assuming ultimate strength = 550 N/mm^2, yield strength =470 N/mm^2 size factor = 0.85, surface finish factor of 0.89. Correction factors = 1.0 for bending and 0.7 for axial load. The endurance limit in reversed bending may be taken as one half the ultimate strength. [16]

8. (a) What are the different mechanical properties of engineering materials.

   (b) Write notes on any four ferrous materials giving their constituents and applications. [8+8]

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