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

III B.Tech I Semester Examinations,November 2010
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) Under what conditions Bush pin type Flexible coupling is suggested?
   (b) A split sleeve coupling is required to transmit 100 kW at 1440 rpm. The permissible stress in the shaft is 49 N/mm^2. Assuming that the two halves of the coupling are connected by 12 bolts, determine the diameter of the bolts, if the permissible stress for the bolt material is 65 N/mm^2, and coefficient of friction between the shaft and split sleeve is 0.2. [6+10]

2. (a) Explain any one method of avoiding the tendency of a compression spring to buckle.
   (b) A close coiled helical compression spring of 16 active coils has a spring stiffness of 45 N/mm. It is cut into two springs having 7 and 9 turns. Determine the spring stiffness of resulting springs. [6+10]

3. (a) Explain the significance of engineering materials in Mechanical Engineering design.
   (b) Discuss the importance of Preferred numbers in design. [8+8]

4. A steam boiler is to be designed for a working pressure of 3.5 N/mm^2 with its inside diameter 2 m. Give the design calculations for the longitudinal and circumferential joints for the following working stresses for steel plates and rivets. In tension 85 N/mm^2 , In shear 65 N/mm^2 , In crushing 150 N/mm^2. Draw the joint to a suitable scale. [16]

5. (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]

6. (a) Define stress concentration factor? What are the different methods to reduce the stress concentration factor?
   (b) A steel connecting rod is subjected to a completely reversed axial load of 10 kN. Suggest suitable size of the rod using a factor of safety 2. The Ultimate strength of the material is 11 kN/mm^2 and yield strength is 9.3 kN/ mm^2.

The value of A, factor for correction for type of loading may be taken as 0.85 and size factor as 0.85. Neglect the column action and the effect of stress concentration. [6+10]

7. (a) What is a cotter joint? Explain with the help of a neat sketch, how a cotter joint is made?

   (b) Design a cotter joint to connect two mild steel rods for a pull of 40 kN. The maximum permissible stresses are 65 N/mm^2 in tension, 70 N/mm^2 in shear and 85 N/mm^2 in crushing. Draw a neat sketch of the joint. [6+10]

8. (a) Explain the method of determining the size of the bolt when the bracket carries on eccentric load perpendicular to the arms of the bolt.

   (b) An air compressor cylinder of effective diameter 300 mm is subjected to air pressure of 4.5 N/mm^2. The cylinder head is connected by means of 40 bolts, having yield strength of 450 N/mm^2 and endurance limit of 350 N/mm^2. The bolts are tightened with an initial pre load of 2.5 times that of the external force. A gasket is used to make the joint leak proof. Assume stress concentration factor of 3.5 and factor of safety of 2.5. Determine the required size of the bolt. [6+10]

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

III B.Tech I Semester Examinations,November 2010
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. 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]

2. (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]

3. (a) Explain the need in computing endurance limit of given component.
   (b) A pulley is keyed to a shaft midway between two anti- friction bearings. The bending moment at the pulley varies from 250 kN-mm to 750 kN-mm and the torsional moment in the shaft varies from 100 kN-mm to 300 kN-mm. The frequency of the variation of the load is same as the shaft speed. The shaft is made of a cold drawn steel having an ultimate strength of 550 N/mm^2 and yield strength of 450 N/mm^2. Determine the required diameter for an infinite life. The stress concentration factor for the key way in bending and torsion may be taken as 1.8 and 1.5 respectively. The factor of safety is 2.0. Take size factor =0.85 and surface finish factor=0.88. [6+10]

4. (a) Explain the terms
      i. Pitch
      ii. Lead
      iii. Single and multi-start threads with respect to bolted joints.
   (b) The effective diameter of the cylinder is 250 mm and its maximum pressure of the steam acting on the cylinder cover is 2.5 N/mm^2. Find the size of the studs required to fit the cover. [6+10]

5. (a) Develop an expression for the maximum shear stress induced in all around circular fillet weld subjected to Torsion.
   (b) A plate 100 mm wide and 10 mm thick is to be welded with another plate by means of transverse welds at the ends. If the plates are subjected to a load of

70 kN, find the size of weld for static as well as fatigue load. The permissible tensile stress should not exceed 70 N/mm^2. [6+10]

6. (a) Discuss classifications and application of various keys
   (b) A 20 kW power is transmitted at 900 rpm, from a motor shaft, through a key, to a machine shaft by a means of a pulley and a belt. Design the key. Take the allowable shear stress and crushing stress as 35 N/mm^2 and 120 N/mm^2. [6+10]

7. Design a shaft and flange for a diesel engine in which protective type of flange coupling is to be adopted for power transmission. The following data is available for design. Power of engine is 125 kW, Speed of the engine is 500 rpm, Maximum permissible stress in the shaft is 46 N/mm^2, Maximum permissible twist in the shaft is 1^0 in length of shaft equal to 20 times the diameter of the shaft. Maximum torque is 2.25 times Mean torque, Pitch circle diameter of the bolts is 4 times diameter of the shaft, Maximum permissible stress in the bolts is 25 N/mm^2. Determine:
   (a) Number of bolts and
   (b) Diameter of bolts. [16]

8. (a) Derive an expression for stress induced in a square bar due to shock load.
   (b) An unknown weight falls through 100 mm on a collar rigidly attached to the lower end of a vertical bar 3m long and 500 mm^2. If the maximum instantaneous extension is known to be 3 mm, what are the corresponding stresses and the value of unknown weight? Take E=2×10^5 N/mm^2. [6+10]

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

III B.Tech I Semester Examinations,November 2010
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) Which material is generally used for a cotter? Why the taper is given on a cotter?
   (b) Two rod ends are to be joined by means of a cotter joint, by using a sleeve and two cotters. The joint is subjected to an axial load of 120 kN, which alternately changes slowly from tension to compression. The permissible stresses for the rods, sleeve and cotter material are 100 N/mm^2 in tension, 80 N/mm^2 in shear, and 150 N/mm^2 in compression. [6+10]

2. (a) Define the terms
      i. pitch
      ii. Nominal diameter
      iii. Root diameter corresponding to bolted joints.
   (b) A flanged bearing is fastened to a frame by means of 6 bolts spaced equally on 550 mm bolt circle. The diameter of bearing flange is 750mm and a load of 200 kN acts at a distance 350 mm from the frame. Determine the size of the bolts, assuming tensile stress as 120 N/mm^2 for the bolts. [6+10]

3. (a) What is concentric spring? Explain its significance in automobiles.
   (b) Design a coil spring for a spring loaded governor to give a deflection of 55 mm under an axial load of 125 N. The mean radius of the coil is 30 mm and the wire diameter is 10 mm. Take G = 0.8x10^5 N/mm^2.Check the spring for buckling. Give a neat sketch of the spring in the uncompressed state. [6+10]

4. (a) Deduce design equation for a hollow shaft subjected to bending moment M, torque T and axial thrust F_a.
   (b) Determine the diameters of a hollow shaft, transmitting a torque of 450 N-m, and subjected to a bending moment of 600 N-m. Assume the shock and fatigue factors in torsion and bending as 1.2 and 1.3 respectively. The ratio of outer to inner radii is 1.5. Find the diameter, if the shaft is a solid one. Compare the weights of hollow and solid shafts. [6+10]

5. (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]

6. Design a rigid sleeve coupling to connect two shafts and to transmit 28.5 kW power at 1200 rpm. The allowable shear stress in the material of the shaft is 75 N/mm^2. The material of the shaft and key is same and the coupling is required to transmit 25% overload. The material of the sleeve is cast iron, the allowable shear stress for which is 18 N/mm^2. Make a neat sketch of the designed sleeve coupling showing side view and sectional elevation. [16]

7. (a) Explain the terms
   i. Diagonal pitch
   ii. Margin in connection with riveted joints

   (b) A triple riveted lap joint with chain riveting is to be designed to connect two plates of 8 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 150 N/mm^2 in tension, 120 N/mm^2 in shear and 130 N/mm^2 in crushing. [6+10]

8. (a) Explain the importance of fluctuating stresses in design of machine elements.

   (b) A hot rolled steel shaft is subjected to a torsional moment that varies from 430 N-m clockwise to 210 N-m counterclockwise and an applied bending moment at a critical section varies from 540 N-m to -320 N-m. The shaft is of uniform cross-section and no key way is present at the critical section. Determine the required shaft diameter. The material has an ultimate strength of 650 N/mm^2 and yield strength of 450 N/mm^2. Take the endurance limit as half the ultimate strength, factor of safety as 2, size factor as 0.85 and surface finish factor as 0.62. [6+10]

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

III B.Tech I Semester Examinations,November 2010
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) 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) Derive an expression for stresses in helical springs of circular wire.
   (b) A helical spring is made from a wire of 8 mm diameter and has outside diameter of 80 mm. If the permissible shear stress is 360 N/mm^2 and modulus of rigidity 84 kN/mm^2, find the axial load which the spring can carry and the deflections per active turn. [6+10]

3. (a) What is caulking and why is it necessary?
   (b) A double riveted lap joint is made between 20 mm thick plates. The rivet diameter and pitch are 30 mm and 80 mm respectively. If the ultimate stresses are 450 N/mm^2 in tension and 350 N/mm^2 in shear and 540 N/mm^2 in crushing, find the minimum force per meter, which will rupture the joint. If the above joint is subjected to a load such that the factor of safety is 3, find out the actual stresses developed in the plates and the rivets. [6+10]

4. (a) Describe the purpose of gib in cotter joint? What are the applications of cotter joints?
   (b) Design and draw a cotter joint to support a load varying from 3 kN in compression to 4 kN in tension. The material used is carbon steel for which the following allowable stresses may be used. The load is applied statistically. Tensile stress = compressive stress = 500 N/mm^2, shear stress = 350 N/mm^2 and crushing stress = 900 N/mm^2. [6+10]

5. 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]

6. (a) Explain various factors influencing the endurance limit.
   (b) A circular bar of 1000 mm length is supported freely at it two ends. It is acted upon by a central concentrated cyclic load having a minimum value of 50 kN and a maximum value of 100 kN. Determine the diameter of the bar by

taking a factor of safety of 1.6, size effect of 0.85, surface finish factor of 0.88. The material properties are given by: ultimate strength is 650 N/mm^2, yield strength is 500 N/mm^2 and endurance strength is 350 N/mm^2. [6+10]

7. A solid shaft is supported on two bearings 2 meters apart and rotates at 500 rpm. Two pulleys whose diameters are 800 mm and 600 mm respectively are mounted on the shaft at distances 400 mm and 1200 mm respectively to the right of the left hand bearing. A 20^0 involute gear of 300 mm diameter is keyed to the shaft at a distance of 200 mm to the left of right hand bearing. A power of 50 kW is supplied to the gear, out of which 30 kW is transmitted by bigger pulley weighing 600 N and 20 kW is transmitted by the smaller pulley whose weight measures 450 N. The drive from bigger pulley is vertically downward and from smaller pulley is horizontal. The tension ratio for both the pulleys is 2. Design the shaft for the working stress of 45 N/mm^2 in shear and 80 N/mm^2 in tension. Assume the combined shock and fatigue factors for bending and torsion as 2 and 1.5 respectively. [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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