Code No: R32035 **R10** **Set No: 1**

III B.Tech. II Semester Regular/Supplementary Examinations, May/June -2014

DESIGN OF MACHINE MEMBERS-II

(Mechanical Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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(Data books may be allowed)

1. a) Explain about classification of bearings. [10M + 5M]

   b) A journal bearing is to be designed for a centrifugal pump for the following data : Load on the journal = 12 kN ; Diameter of the journal = 75 mm ; Speed = 1440 r.p.m; Atmospheric temperature of the oil = 16°C ; Operating temperature of the oil = 60°C; Absolute viscosity of oil at 60°C = 0.023 kg/m-s. Give a systematic design of the bearing.

2. a) Explain the various types of cylinder liners. [5M+10M]

   b) Design a cast iron trunk type piston for a single acting four stroke engine developing 75 kW per cylinder when running at 600 r.p.m. The other avialable data is as follows: Maximum gas pressure = 4.8 N/mm^2; Indicated mean effective pressure = 0.65 N/mm^2; Mechanical efficiency = 95%; Radius of crank = 110 mm; Fuel consumption = 0.3 kg/BP/hr; Calorific value of fuel (higher) = 44×10^3 kJ/kg; Difference of temperatures at the centre and edges of the piston head =200ºC; Allowable stress for the material of the piston = 33.5 MPa; Allowable stress for the material of the piston rings and gudgeon pin = 80 MPa; Allowable bearing pressure on the piston barrel = 0.4 N/mm^2 and allowable bearing pressure on the gudgeon pin = 17 N/mm^2.

3. Design a side crankshaft for a 500 mm × 600 mm gas engine. The weight of the flywheel is 80 kN and the explosion pressure is 2.5 N/mm^2. The gas pressure at maximum torque is 0.9 N/mm^2 when the crank angle is 30º. The connecting rod is 4.5 times the crank radius. Any other data required for the design may be assumed. [15M]

4. A crane hook carries a load of 6 kN, the line of the load being at a horizontal distance of 3.25 cm from the inside edge of a horizontal section through the centre of curvature, the centre of curvature being 4 cm from the same edge. The horizontal section is a trapezium whose parallel sides are 1.5 cm and 3 cm and perpendicular distance apart by 3.25 cm. Find the greatest tensile and compressive stresses in the hook. [15M]

5. a) Explain, with the help of neat sketches, the types of various flat belt drives [6M]
   b) Derive the expression for Length of an Open Belt Drive [9M]

6. a) Explain the phenomenon of interference in involute gears. What are the conditions to be satisfied in order to avoid interference? [6M] b) A 15 kW and 1200 r.p.m. motor drives a compressor at 300 r.p.m. through a pair of spur gears having 20° stub teeth. The centre to centre distance between the shafts is 400 mm. The motor pinion is made of forged steel having an allowable static stress as 210 MPa, while the gear is made of cast steel having allowable static stress as 140 MPa. Assuming that the drive operates 8 to 10 hours per day under light shock conditions, find from the standpoint of strength, (i) Module; (ii) Face width and (iii) Number of teeth and pitch circle diameter of each gear. Check the gears thus designed from the consideration of wear. The surface endurance limit may be taken as 700 MPa. [9M]

7. a) Differentiate between differential screw and compound screw. [5M]
   b) A power screw having double start square threads of 25 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 10 kN. The outer and inner diameters of screw collar are 50 mm and 20 mm respectively. The coefficient of thread friction and collar friction may be assumed as 0.2 and 0.15 respectively. The screw rotates at 12 r.p.m. Assuming uniform wear condition at the collar and allowable thread bearing pressure of 5.8 N/mm^2, find: (i) the torque required to rotate the screw; (ii) the stress in the screw; and (iii) the number of threads of nut in engagement with screw. [10M]

8. a) What is a lever ? Explain the principle on which it works. [5M]
   b) A hand lever for a brake is 0.8 m long from the centre of gravity of the spindle to the point of application of the pull of 300 N. The effective overhang from the nearest bearing is 100 mm. If the permissible stress in tension, shear and crushing is not to exceed 66 MPa, design the spindle, key and lever. Assume the arm of the lever to be rectangular having width twice of its thickness. [10M]

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Code No: R32035 **R10** **Set No: 2**

III B.Tech. II Semester Regular/Supplementary Examinations, May/June -2014

DESIGN OF MACHINE MEMBERS-II

(Mechanical Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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(Data books may be allowed)

1. a) Classification of sliding contact bearings. [5M]

   b) Design a suitable journal bearing for a centrifugal pump from the following available data : Load on the bearing = 13.5 kN; Diameter of the journal = 80 mm; Speed = 1440 r.p.m.; Bearing characteristic number at the working temperature (75°C) = 30 ; Permissible bearing pressure intensity = 0.7 N/mm^2 to 1.4 N/mm^2; Average atmospheric temperature = 30°C. Calculate the cooling requirements, if any. [10M]

2. a) Explain the various stresses induced in the connecting rod. [5M]

   b) Determine the dimensions of an *I*-section connecting rod for a petrol engine from the following data: Diameter of the piston = 110 mm; Mass of the reciprocating parts = 2 kg; Length of the connecting rod from centre to centre = 325 mm; Stroke length = 150 mm; R.P.M. = 1500 with possible overspeed of 2500; Compression ratio = 4 : 1; Maximum explosion pressure = 2.5 N/mm^2. [10M]

3. Design a cast iron piston for a single acting four stroke engine for the following data: Cylinder bore = 100 mm ; Stroke = 125 mm ; Maximum gas pressure = 5 N/mm^2 ; Indicated mean effective pressure = 0.75 N/mm^2 ; Mechanical efficiency = 80% ; Fuel consumption = 0.15 kg per brake power per hour ; Higher calorific value of fuel = 42 × 103 kJ/kg ; Speed = 2000 r.p.m. Any other data required for the design may be assumed.[15M]

4. Derive the necessary equations involved in Winkler-Bach theory to determine the stresses in a curved beam. [15M]

5. a) Discuss the different types of pulleys used in belt drives [5M]

   b) A pulley of 0.9 m diameter revolving at 200 r.p.m. is to transmit 7.5 kW. Find the width of a leather belt if the maximum tension is not to exceed 145 N in 10 mm width. The tension in the tight side is twice that in the slack side. Determine the diameter of the shaft and the dimensions of the various parts of the pulley, assuming it to have six arms. Maximum shear stress is not to exceed 63 MPa. [10M]

6. Design a spur gear drive required to transmit 45 kW at a pinion speed of 800 r.p.m. The velocity ratio is 3.5 : 1. The teeth are 20° full-depth involute with 18 teeth on the pinion. Both the pinion and gear are made of steel with a maximum safe static stress of 180 MPa. Assume a safe stress of 40 MPa for the material of the shaft and key. [15M]

7. a) Discuss the various types of power threads. [5M]

   b) The lead screw of a lathe has square threads of 24 mm outside diameter and 5 mm pitch. In order to drive the tool carriage, the screw exerts an axial pressure of 2.5 kN. Find the efficiency of the screw and the power required to drive the screw, if it is to rotate at 30 r.p.m. Neglect bearing friction. Assume coefficient of friction of screw threads as 0.12. [10M]

8. a) Discuss the design procedure of a rocker arm for operating the exhaust valve [5M]

   b) A foot lever is 1 m from the centre of shaft to the point of application of 800 N load. Find : (i) Diameter of the shaft, (ii) Dimensions of the key, and (iii) Dimensions of rectangular arm of the foot lever at 60 mm from the centre of shaft assuming width of the arm as 3 times thickness. The allowable tensile stress may be taken as 73 MPa and allowable shear stress as 70 MPa. [10M]

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Code No: R32035 **R10** **Set No: 3**

III B.Tech. II Semester Regular/Supplementary Examinations, May/June -2014

DESIGN OF MACHINE MEMBERS-II

(Mechanical Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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(Data books may be allowed)

1. a) Advantages and Disadvantages of Rolling Contact Bearings Over Sliding Contact Bearings [5M] b) Select a single row deep groove ball bearing for a radial load of 4000 N and an axial load of 5000 N, operating at a speed of 1600 r.p.m. for an average life of 5 years at 10 hours per day. Assume uniform and steady load. [10M]

2. a) Explain the various types of crankshafts. [5M]
   b) Design a side or overhung crankshaft for a 250 mm × 300 mm gas engine. The weight of the flywheel is 30 kN and the explosion pressure is 2.1 N/mm^2. The gas pressure at the maximum torque is 0.9 N/mm^2, when the crank angle is 35° from I. D. C. The connecting rod is 4.5 times the crank radius. [10M]

3. Design a piston for a four stroke diesel engine consuming 0.3 kg of fuel per kW of power per hour and produces a brake mean effective pressure of the 0.7 N/mm^2. The maximum gas pressure inside the cylinder is 5 N/mm^2 at a speed of 3500 r.p.m. The cylinder diameter is required to be 300 mm with stroke 1.5 times the diameter. The piston may have 4 compression rings and an oil ring. The following data can be used for design: Higher calorific value of fuel = 46 × 103kJ/kg; Temperature at the piston centre = 700 ^0K; Temperature at the piston edge = 475 ^0K; Heat conductivity factor = 46.6 W/m/K; Heat conducted through top = 5% of heat produced; Permissible tensile strength for the material of piston = 27 N/mm^2; Pressure between rings and piston = 0.04 N/mm^2; Permissible tensile stress in rings = 80 N/mm^2; Permissible Pressure on piston barrel = 0.4 N/mm^2; Permissible pressure on piston pin = 15 N/mm^2; Permissible stress in piston pin = 85 N/mm^2. Any other data required for the design may be assumed. [15M]

4. A crane hook carries a load of 6 kN, the line of the load being at a horizontal distance of 3.25 cm from the inside edge of a horizontal section through the centre of curvature, the centre of curvature being 4 cm from the same edge. The horizontal section is a trapezium whose parallel sides are 1.5 cm and 3 cm and perpendicular distance apart by 3.25 cm. Find the greatest tensile and compressive stresses in the hook. [15M]

5. a) What are the advantages and disadvantages of *V*-belt drive over flat belt drive? [5M] b) A-*V* belt is to transmit 20 kW from a 250 mm pitch diameter sheave to a 900 mm diameter pulley. The centre distance between the two shafts is 1000 mm. The groove angle is 40° and the coefficient of friction for the belt and sheave is 0.2 and the coefficient of friction between the belt and flat pulley is 0.2. The cross-section of the belt is 40 mm wide at the top, 20 mm wide at the bottom and 25 mm deep. The density of the belt is 1000 kg/m^3 and the allowable tension per belt is 1000 N. Find the number of belts required. [10M]

6. a) Explain the following terms used in helical gears : (i) Helix angle; (ii) normal pitch; and (iii) axial pitch. [6M] b) A pair of helical gears are to transmit 15 kW. The teeth are 20° stub in diametral plane and have a helix angle of 45°. The pinion runs at 10 000 r.p.m. and has 80 mm pitch diameter. The gear has 320 mm pitch diameter. If the gears are made of cast steel having allowable static strength of 100 MPa; determine a suitable module and face width from static strength considerations and check the gears for wear, given σ_{es} = 618 MPa. [9M]

7. a) Discuss the various types of power threads. Discuss their relative advantages and disadvantages. [6M] b) The lead screw of a lathe has Acme threads of 60 mm outside diameter and 8 mm pitch. It supplies drive to a tool carriage which needs an axial force of 2000 N. A collar bearing with inner and outer radius as 30 mm and 60 mm respectively is provided. The coefficient of friction for the screw threads is 0.12 and for the collar it is 0.10. Find the torque required
to drive the screw and the efficiency of the screw. [9M]

8. a) Explain the design procedure of a lever for a lever safety valve. [7M]
b) A hand lever for a brake is 0.8 m long from the centre of gravity of the spindle to the point of application of the pull of 300 N. The effective overhang from the nearest bearing is 100 mm. If the permissible stress in tension, shear and crushing is not to exceed 66 MPa, design the spindle, key and lever. Assume the arm of the lever to be rectangular having
width twice of its thickness. [8M]

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Code No: R32035 **R10** **Set No: 4**

III B.Tech. II Semester Regular/Supplementary Examinations, May/June -2014

DESIGN OF MACHINE MEMBERS-II

(Mechanical Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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(Data books may be allowed)

1. a) List the basic assumptions used in the theory of hydrodynamic lubrication. [5M]
   b) Design a journal bearing for a centrifugal pump running at 1440 r.p.m. The diameter of the journal is 100 mm and load on each bearing is 20 kN. The factor *ZN/p* may be taken as 28 for centrifugal pump bearings. The bearing is running at 75°C temperature and the atmosphere temperature is 30°C. The energy dissipation coefficient is 875 W/m^2/°C. Take diametral clearance as 0.1 mm. [10M]

2. a) What are the methods and materials used in the manufacture of crankshafts. [5M]
   b) Design a side crankshaft for a 500 mm × 600 mm gas engine. The weight of the flywheel is 80 kN and the explosion pressure is 2.5 N/mm^2. The gas pressure at maximum torque is 0.9 N/mm^2 when the crank angle is 30º. The connecting rod is 4.5 times the crank radius. Any other data required for the design may be assumed. [10M]

3. Design a cast iron trunk type piston for a single acting four stroke engine developing 75 kW per cylinder when running at 600 r.p.m. The other avialable data is as follows: Maximum gas pressure = 4.8 N/mm^2; Indicated mean effective pressure = 0.65 N/mm^2; Mechanical efficiency = 95%; Radius of crank = 110 mm; Fuel consumption = 0.3 kg/BP/hr; Calorific value of fuel (higher) = 44 × 10^3 kJ/kg; Difference of temperatures at the centre and edges of the piston head =200ºC; Allowable stress for the material of the piston = 33.5 MPa; Allowable stress for the material of the piston rings and gudgeon pin = 80 MPa; Allowable bearing pressure on the piston barrel = 0.4 N/mm^2 and allowable bearing pressure on the gudgeon pin = 17 N/mm^2. [15M]

4. Derive the necessary equations involved in Winkler-Bach theory to determine the stresses in a curved beam. [15M]

5. a) Write the design procedure for a chain drive. [8M]
   b) Derive the relation for the ratio of driving tensions of a *V*-belt. [7M]

6. Design a pair of helical gears for transmitting 22 kW. The speed of the driver gear is 1800 r.p.m. and that of driven gear is 600 r.p.m. The helix angle is 30° and profile is corresponding to 20° full depth system. The driver gear has 24 teeth. Both the gears are made of cast steel with allowable static stress as 50 MPa. Assume the face width parallel to axis as 4 times the circular pitch and the overhang for each gear as 150 mm. The allowable shear stress for the shaft material may be taken as 50 MPa. The form factor may be taken as $0.154 - (0.912 / T_E)$, where T_E is the equivalent number of teeth. The velocity factor may be taken as, $350/(350 + v)$ where v is pitch line velocity in m / min. The gears are required to be designed only against bending failure of the teeth under dynamic condition. [15M]

7. a) What is self locking property of threads and where it is necessary? [5M]

   b) The lead screw of a lathe has Acme threads of 60 mm outside diameter and 8 mm pitch. It supplies drive to a tool carriage which needs an axial force of 2000 N. A collar bearing with inner and outer radius as 30 mm and 60 mm respectively is provided. The coefficient of friction for the screw threads is 0.12 and for the collar it is 0.10. Find the torque required to drive the screw and the efficiency of the screw. [10M]

8. a) What is a lever ? Explain the principle on which it works [5M]

   b) A hand lever for a brake is 0.8 m long from the centre of gravity of the spindle to the point of application of the pull of 300 N. The effective overhang from the nearest bearing is 100 mm. If the permissible stress in tension, shear and crushing is not to exceed 66 MPa, design the spindle, key and lever. Assume the arm of the lever to be rectangular having width twice of its thickness. [10M]

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