

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

Answer any FIVE Questions
All Questions carry equal marks

1. (a) A journal bearing 80 mm in diameter and 120 mm long runs at 600 rpm. It uses oil having viscosity of 60 centipoises. Radial clearance provided is 0.15 mm. Determine the safe load, bearing can take. Assume sommerfeld number $= 1.43 \times 10^9$
(b) A 75 mm journal bearing 100 mm long is subjected to 2.5 kN at 600 rpm. If the room temperature is 24°C what viscosity of oil should be used to limit the bearing surface temperature at 55°C . $D/C = 1000$.
2. (a) What is the most important advantage gained in using needle bearing?
(b) A 6203 single row deep groove ball bearing has a basic static load rating of 4500 N and basic dynamic load rating of 7350 N. If it is subjected to radial load of 1350 N and axial load of 1260 N, what is the rated life with outer ring stationary?
(c) What is the nominal life in working hours of a deep groove ball bearing 6308, which is carrying a constant radial load of 2.82 kN at a speed of 800 rpm?
3. (a) Find the diameter of steel connecting rod for an engine in which the maximum load on the piston is 700 kN, crank of the engine is 0.60m, radius of connected rod length 3m, factor of safety is 8.
(b) The cylinder of low speed engine is 0.20 m in diameter and the steam pressure is 0.875 MPa. The connecting rod is 1m long and is of rectangular cross section. Width is 2 times the thickness. Find the dimensions of the cross section
4. What are the stresses to which an over hanging shaft is subjected to? How would you proceed to design such a crank shaft.
5. (a) Classify various types of springs with sketches and give their applications.
(b) A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 mm. If the permissible shear stress is 350 Mpa and modulus of rigidity 84 kN/mm^2 , find the axial load which the spring can carry and the deflection per active turn.
6. (a) Prove that the centrifugal tension must be $1/3^{\text{rd}}$ of the maximum tension for maximum power transmission.
(b) Design a cross belt drive having 1.5 m center distance between the two pulleys. The diameter of bigger and smaller pulleys are 'D' and 'd' respectively. The

smaller pulley rotates at 1000 r.p.m. and the bigger pulley at 500 r.p.m. The flat belt is 6 mm thick and transmits 7.5 kW power at belt speed of 13 m/s approximately. The coefficient of belt friction is 0.3 and the density of belt material is 950 kg/m^3 . The permissible tensile stress for the belt material is 1.75 MPa.

7. What should be the module, face width and number of teeth on each gear of a pair of spur gears, a C45 steel pinion driving a cast iron gear, if they are to transmit 18.75 kW at 700 rev/min of the 0.18m pinion in continuous service? The velocity ratio is 3, the teeth are 20° full depth and the load is smooth. Determine the outside and root diameters.
8. The lead screw of a lathe has 50 x 8 threads. The screw must exert an axial pressure of 2500 N in order to drive the tool carriage. The thrust is carried on a collar 110 mm outside diameter and 55 mm inside diameter and the screw rotates at 30 rpm. Determine:
 - (a) the power required to drive the screw and
 - (b) the efficiency of the lead screw. Assume a coefficient of friction of 0.15 for the screw and 0.12 for the collar.

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1. (a) How is lubricating oil designated?
(b) Design a full journal bearing for the following specification
Diameter of the journal = 75 mm
Load on the journal = 3500 N
Length of the journal = 75 mm
Speed = 400 rpm
Minimum film thickness = 0.02 mm.
2. (a) A roller bearing is selected to withstand a radial load of 40 kN and life of 1200 hrs at 600 rpm. What load rating would you look for in searching from manufacturers catalogue if it specifies load at speed 500 rpm and life 3000 hrs
(b) Select a suitable rolling bearing for a 55 mm diameter shaft. The bearing should be capable of withstanding 3 kN radial and 1.5 kN axial load at 750 rpm. The bearing is to have a desired rated life of 2000 hrs at a reliability of 94% . There is a light shock load and inner ring rotates.
3. Check the suitability of I-section 15mm \times 12mm \times 3mm for designing the connecting rod in the case of single cylinder motor cycle engine of 40 mm bore and 50 mm stroke wherein the maximum pressure produced is 3.6 Mpa and in which the connecting rod is 4 times crank.
4. What are the stresses to which an over hanging shaft is subjected to? How would you proceed to design such a crank shaft.
5. (a) Derive an expression for energy stress in helical springs of circular wire.
(b) A closely coiled helical spring is made of 10 mm diameter steel wire, the coiled consisting of 10 complete turns with a mean diameter of 120 mm. The spring carried an axial pull of 200 N. Determine the shear stress induced in the spring neglecting the effect of stress concentration. Determine also the deflection in the spring, its stiffness and strain energy stored by it if the modulus of rigidity of the material is 80 kN/mm².
6. An open belt connects two flat pulleys. The pulley diameters are 300 mm and 450 mm and the corresponding angles of lap are 160° and 210°. The smaller pulley runs at 200 r.p.m. The coefficient of friction between the belt and pulley is 0.25. It is found that the belt is on the point of slipping when 3 kW is transmitted. To increase the power transmitted two alternatives are suggested, namely
(a) increasing the initial tension by 10%, and

- (b) increasing the coefficient of friction by 10% by the application of a suitable dressing to the belt. Which of these two methods would be more effective? Find the percentage increase in power possible in each case and also design the system.
7. What should be the module, face width and number of teeth on each gear of a pair of spur gears, a C45 steel pinion driving a cast iron gear, if they are to transmit 18.75 kW at 700 rev/min of the 0.18m pinion in continuous service? The velocity ratio is 3, the teeth are 20° full depth and the load is smooth. Determine the outside and root diameters.
8. Design screw jack to lift a load of 50 kN with a possible eccentricity of 4 mm. The following data are given:
Allowable compressive stress in the screw material = 100 N/mm^2 , ultimate tensile stress in the tommy bar material = 480 N/mm^2 , coefficient of friction in threads = 0.14, coefficient of collar friction = 0.2.

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1. (a) A 100 mm long and 60 mm diameter journal bearing supports a load of 2500 N at 600 rpm. If the room temperature is 20°C , what should be the viscosity of oil to limit the bearing surface temperature to 60°C ? Diametral clearance = 0.06 mm. Energy dissipation coefficient based on the projected area of the bearing = $210\text{W}/\text{m}^2\text{C}$.
(b) A 250×250 mm bearing carries a load of 108 kN. The bearing rotates at 1500 rpm. The clearance ratio is 670. For full journal bearing the power lost in friction is 14.36 kW. Find the viscosity of the oil.
2. (a) What is the most important advantage gained in using needle bearing?
(b) A 6203 single row deep groove ball bearing has a basic static load rating of 4500 N and basic dynamic load rating of 7350 N. If it is subjected to radial load of 1350 N and axial load of 1260 N, what is the rated life with outer ring stationary?
(c) What is the nominal life in working hours of a deep groove ball bearing 6308, which is carrying a constant radial load of 2.82 kN at a speed of 800 rpm?
3. Following data refers to 4-stroke cycle diesel engine cylinder
Cylinder bore = 0.15 m
Stroke = 0.1875 m
Speed = 1200 rpm
Maximum gas pressure = 5.6 Mpa Determine
(a) The dimensions of an I-section connecting rod of forged steel with an elastic limit compressive stress of 350 Mpa. The ratio of length of connecting rod to the length of crank is 4 and factor of safety is 5
(b) The wrist pin and crank pin dimensions on the basis of the bearing pressure of 10.5 Mpa and 6.5 Mpa.
4. (a) What is the function of a crank shaft?
(b) Explain the different stresses induced in crank pin.
(c) Explain the different stresses induced in crank Web.
(d) How crank shaft bearings are lubricated?
5. A solenoid brake is to be actuated by a helical compression spring of free length 350mm and is to exert a maximum force of 10kN when compressed by 80mm. The outside diameter of the spring should not exceed 180mm. What is the wire diameter, coil diameter and number of coils?

6. An open belt connects two flat pulleys. The pulley diameters are 300 mm and 450 mm and the corresponding angles of lap are 160° and 210° . The smaller pulley runs at 200 r.p.m. The coefficient of friction between the belt and pulley is 0.25. It is found that the belt is on the point of slipping when 3 kW is transmitted. To increase the power transmitted two alternatives are suggested, namely
- (a) increasing the initial tension by 10%, and
 - (b) increasing the coefficient of friction by 10% by the application of a suitable dressing to the belt. Which of these two methods would be more effective? Find the percentage increase in power possible in each case and also design the system.
7. 7.5kW is to be transmitted from a motor shaft rotating at 1440rpm to another shaft with a speed reduction of 3:1. The starting torque may be taken as 50% higher than the mean torque. The gears should be made of heat treated steel and the shaft of mild steel. The pinion should have a minimum of 20 teeth. Design the gear drive.
8. Design screw jack to lift a load of 50 kN with a possible eccentricity of 4 mm. The following data are given:
Allowable compressive stress in the screw material = 100 N/mm^2 , ultimate tensile stress in the tommy bar material = 480 N/mm^2 , coefficient of friction in threads = 0.14, coefficient of collar friction = 0.2.

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1. (a) Define the following terms of journal bearing.
 - i. Bearing characteristic number
 - ii. Bearing modulus
- (b) A bearing for a centrifugal pump has a diameter of 75 mm and a length of 120 mm. The journal is machined so as to give a radial clearance of 0.0015 cm per cm radius. The journal rotates at 1440 rpm and carries a total load of 10, 000 N. Oil is supplied with a viscosity of 30 centipoise at the operating temperature. Determine the coefficient of friction, the actual value of the bearing characteristic number and the heat generated per minute.
2. (a) A roller bearing is selected to withstand a radial load of 40 kN and life of 1200 hrs at 600 rpm. What load rating would you look for in searching from manufacturers catalogue if it specifies load at speed 500 rpm and life 3000 hrs
- (b) Select a suitable rolling bearing for a 55 mm diameter shaft. The bearing should be capable of withstanding 3 kN radial and 1.5 kN axial load at 750 rpm. The bearing is to have a desired rated life of 2000 hrs at a reliability of 94% . There is a light shock load and inner ring rotates.
3. Enumerate the design procedure for the connecting rod section considering it as a simple compression or tension member subjected to fluctuating load
4. What are the stresses to which an over hanging shaft is subjected to? How would you proceed to design such a crank shaft.
5. A solenoid brake is to be actuated by a helical compression spring of free length 350mm and is to exert a maximum force of 10kN when compressed by 80mm. The outside diameter of the spring should not exceed 180mm. What is the wire diameter, coil diameter and number of coils?
6. (a) List out the advantages and disadvantages of V - belts
- (b) A workshop crane is lifting a load of 25 kN through a wire rope and a hook. The rope drum diameter may be taken as 30 times the diameter of the rope. The load is to be lifted with an acceleration of 1 m/s^2 . Calculate the diameter of the wire rope. Take a factor of safety of 6 and young's modulus for the wire rope 80 kN/mm^2 . The ultimate stress may be taken as 1800 MPa. The cross - sectional area of the wire rope may be taken as 0.38 times the square of the wire rope diameter.

7. Determine the module, face, and number of teeth for a pair of gears if they are to transmit 3.75 kW at 1800 rev/min. of the pinion, for intermittent service. The material is to be good grade cast iron and the pinion is to have 18 teeth 20^0 full depth, VR= 2.5.
8. Design screw jack to lift a load of 50 kN with a possible eccentricity of 4 mm. The following data are given:
Allowable compressive stress in the screw material = 100 N/mm^2 , ultimate tensile stress in the tommy bar material = 480 N/mm^2 , coefficient of friction in threads = 0.14, coefficient of collar friction = 0.2.
