

**III B.Tech II Semester Supplementary Examinations,
November/December 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) How is lubricating oil designated? [4]
(b) Design a full journal bearing for the following specification [12]
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) What is equivalent static load. [2]
(b) The radial reaction on a bearing is 9000 N. It also carries a thrust of 5000 N. The speed of the shaft is 1000 rpm. The outer ring stationary. Expected average life of bearing is about 25,000 hours. The load on the bearing is smooth, the service is 8 hours/day. Select, [14]
 - i. Suitable roller bearing
 - ii. What is the rated 90% life of selected bearing?
 - iii. Compute the probability of the selected bearing surviving 25,000 hours
3. The following data refer to a 4-stroke single cylinder vertical engine [16]
Piston diameter = 125mm
Stroke=150mm
Speed of the engine=1200 r.p.m
Weight of the reciprocating parts = 45N
Design stress for the material used = 80N/sq.mm
Design bearing stress=10N/sq.mm
Design stress for bolts=35N/sq.mm
Design a suitable connecting rod and check for stresses due to inertia.
4. What are the stresses to which an over hanging shaft is subjected to? How would you proceed to design such a crank shaft. [16]
5. A safety valve of 60 mm diameter is to blow off at a pressure of 1.2 N/mm^2 . It is held on its seat by a close coiled helical spring. The maximum lift of the valve is 10 mm. Design a suitable compression spring of spring index 5 and providing an initial compression of 35 mm. The maximum shear stress in the material of the wire is limited to 500 MPa. The modulus of rigidity for the spring material is 80 kN/mm^2 . Calculate: [16]

- (a) Diameter of the spring wire,
 - (b) Mean coil diameter,
 - (c) Number of active turns, and
 - (d) Pitch of the coil. Take wahl's factor, $K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$ where C is the spring index.
6. (a) Design a cast iron pulley of 630mm diameter to transmit 10kW at a speed of 500 r.p.m. The center plane of the pulley overhangs the nearer bearing by 300mm. The belt ends are parallel and horizontal and the belt tension ratio is 2:1. [8]
- (b) Design a belt pulley to transmit 10kW at 180 r.p.m. The velocity of the belt is not to exceed 500 meter / minute and the maximum tension is not to exceed 15 N/mm width. The tension on the slack side is one half that on the tight side. Calculate all the dimensions of the pulley. Sketch neatly the sectional elevation and end view showing all leading dimensions. [8]
7. (a) Explain how the effect of dynamic load is considered in gear design. [4]
- (b) A shaft running at 250 rpm is driven by a 15kW motor running at 876 rpm through a pairs of 20° full depth spur gears. If the central distance is to be approximately 400 mm (± 3 mm allowed), design the spur gear drive. Use C30 and C45 Steels for pinion and gear respectively. [12]
8. (a) Enumerate the differences between differential screw, ball screw and compound screw. [6]
- (b) Explain step by step procedure to design a lathe machine bed. [10]

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1. (a) What are the dimensionless parameters used in designing hydrodynamic bearing? Explain their significance. [6]
(b) A 3 kN load is supported by a journal bearing of 75 mm diameter and 75 mm long. Diametral clearance 0.05 mm and bearing is lubricated by an oil of 0.0207 PaS viscosity at operating temperature. Determine the maximum speed of rotation of bearing when it is capable of dissipating 80 watts by heat transfer. 1 centipoise = 10^{-3} PaS. [10]
2. (a) What do you understand by the term antifriction bearing. What are their advantages over journal bearings? [6]
(b) A ball bearing for a drilling machine spindle of 40 mm diameter is rotating at 3000 rpm. It is subjected to a radial load of 2000 N and an axial thrust of 750 N. It is to work at 45 hours per week for one year. Select and specify a suitable ball bearing. [10]
3. Enumerate the design procedure for the connecting rod section considering it as a simple compression or tension member subjected to fluctuating load [16]
4. What are the stresses to which an over hanging shaft is subjected to? How would you proceed to design such a crank shaft. [16]
5. At the bottom of a mine shaft, a group of 10 identical close coiled helical springs are set in parallel to absorb the shock caused by the falling of the cage in case of a failure. The loaded cage weights 75 kN, while the counter weight has a weight of 15 kN. If the loaded cage falls through a height of 50 meters from rest, find the maximum stress induced in each spring if it is made of 50 mm diameter steel rod. The spring index is 6 and the number of active turns in each spring is 20. Modulus of rigidity, $G = 80 \text{ kN/mm}^2$. [16]
6. Design a horizontal belt drive for a centrifugal blower, the blower is belt driven at 600 r.p.m. by a 15 kW, 1750 r.p.m. electric motor. The center distance is twice the diameter of the larger pulley. The density of the belt material = 1500 kg/m^3 ; max allowable stress = 4 MPa; $\mu_1 = 0.5$ (motor pulley); $\mu_2 = 0.4$ (blower pulley); peripheral velocity of the belt = 20 m/s. Determine the following: [16]
 - (a) Pulley diameters
 - (b) Belt length

- (c) Cross-sectional area of the belt
 - (d) Minimum initial tension for operation without slip
 - (e) Resultant force in the plane of the blower when operating with an initial tension 50 percent greater than the minimum value.
7. (a) How much is the recommended reduction for a single spur gear pair? [2]
- (b) Design a pair of spur gears to transmit 40kW from a shaft running at 1500 rpm to another shaft with a speed reduction of 4. Assume a load factor of 1.75. [14]
8. (a) With the help of neat sketch, explain the mechanism of compound screw. [6]
- (b) Discuss the important steps to be taken into consideration while designing the machine spindles. [10]

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1. (a) Differentiate between hydrostatic and hydrodynamic bearing. [4]
(b) Design a hydrodynamic full journal bearing for a centrifugal pump of 200mm diameter of 200 mm × 200 mm to support a load of 20 kN. Speed of the journal is 1500 rpm. [12]
2. (a) What is meant by square bearing? [2]
(b) Select a suitable spherical roller bearing from SKF series 222C to support a radial load of 4 kN and an axial load of 2 kN. Minimum life required is 10,000 hours at 1000 rpm. For the selected bearing find. [14]
 - i. The expected life under the given loads
 - ii. The equivalent load that can be supported with a probability of survival of 95% with 10,000 hours
3. The following data refer to a 4-stroke single cylinder vertical engine [16]
Piston diameter = 125mm
Stroke=150mm
Speed of the engine=1200 r.p.m
Weight of the reciprocating parts = 45N
Design stress for the material used = 80N/sq.mm
Design bearing stress=10N/sq.mm
Design stress for bolts=35N/sq.mm
Design a suitable connecting rod and check for stresses due to inertia.
4. (a) What is the function of a crank shaft? [4x4=16]
(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) Discuss the phenomenon of surge in spring, and how do you eliminate surge in spring? [8]
(b) With the aid of a diagram explain the modified soderberg line method for various stresses in a spring. [8]
6. (a) Prove that the centrifugal tension must be $1/3^{rd}$ of the maximum tension for maximum power transmission. [6]

- (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. [10]
7. A steel pinion having a B.H.N. of 250 has 60° , 20° stub teeth, and rotates at 1000 rev/min. The module is 2.5mm and the width of the face is five times the pitch. The mating gear has 200 teeth, determine the necessary module, pitch diameter, and width of face for 20° Full depth teeth. [16]
8. (a) Enumerate the differences between differential screw, ball screw and compound screw. [6]
- (b) Explain step by step procedure to design a lathe machine bed. [10]

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1. (a) What do you understand by boundary lubrication in journal bearings? [4]
(b) The following data refer to a journal bearing
Diameter of the journal = 100 mm
Length of the journal = 175 mm
Load = 28 kN
Speed = 250 rpm
C/D = 0.001
Determine the coefficient of friction and heat generated. [12]
2. (a) What is meant by square bearing? [2]
(b) Select a suitable spherical roller bearing from SKF series 222C to support a radial load of 4 kN and an axial load of 2 kN. Minimum life required is 10,000 hours at 1000 rpm. For the selected bearing find. [14]
 - i. The expected life under the given loads
 - ii. The equivalent load that can be supported with a probability of survival of 95% with 10,000 hours
3. Design a connecting rod for a double acting steam engine having 500mm cylinder diameter and 750 mm stroke. The piston is subjected to a maximum pressure of 200 N/sq. mm. The length of the connecting rod is 1500 mm. Connecting rod is made of 20Mn steel with a factor of safety 2 on endurance limit. [16]
4. What are the stresses to which an over hanging shaft is subjected to? How would you proceed to design such a crank shaft. [16]
5. (a) What are the factors to be considered for design of springs subjects to fatigue loading? [6]
(b) A helical torsion spring of mean diameter 60 mm is made of a round wire of 6 mm diameter. If a torque of 6 N-m is applied on the spring, find the bending stress induced and the angular deflection of the spring in degrees. The spring index is 10 and modulus of elasticity for the spring material is 200 kN/mm^2 . The number of effective turns may be taken as 5. [10]
6. (a) Prove that the centrifugal tension must be $1/3^{rd}$ of the maximum tension for maximum power transmission. [6]

- (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. [10]
7. (a) Does the accuracy of gear profile influence the spur gear design? Explain. [4]
- (b) A pair of mating carefully cut spur gears have 20° full depth teeth of 4 mm module. The number of teeth on pinion and gear are 38 and 115 respectively. The face width is 40mm. If the pinion and gear are made of Steel with core hardness of 200 and surface hardness of 300, Calculate the safe power that can be transmitted when the pinion is to run at 1200 rpm. [12]
8. (a) Discuss the important points to be taken into account while selecting a proper material for various elements of machine tools. [6]
- (b) Discuss the various types of power threads. Discuss their relative advantages and disadvantages. [10]
