

III B.Tech II Semester Regular Examinations, Apr/May 2006

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) Distinguish between full and partial journal bearings. [4]
(b) Design a journal bearing for a steam turbine, whose shaft is supported on two bearings one at each side of the turbine, and is coupled with a generator for power production. The weight of turbine with shaft is measured as 40 kN and the shaft rotates at 1500 rpm. Diameter of the shaft is 100 mm. [12]
2. (a) What is the most important advantage gained in using needle bearing? [2]
(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? [8]
(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? [6]
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. (a) Classify various types of springs with sketches and give their applications. [8]
(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 $84kN/mm^2$, find the axial load which the spring can carry and the deflection per active turn. [8]
6. (a) List out the advantages and disadvantages of V - belts [4]
(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. [12]
7. Design a cast iron spur gear drive for a crane hoist to transmit 3.75 kW at 1440 rpm. Maximum gear ratio in the gear box is 4. Each gear is expected to work 2 hours/day for 10 years. Determine the minimum centre distance, required face width and module of the gear. [16]

8. Design a simple screw jack to lift a load of 100 kN having a maximum lift of 260 mm. The screw is made of 40 Ni 14 steel and the nut of phosphor bronze grade A. The stresses for these materials are given below: [16]

| Material | Ultimate tensile/ Compressive strength(N/mm^2) | Shear stress N/mm^2 | Factor of safety |
|-----------------------------|---|--------------------------|------------------|
| Steel screw 40Ni14 | 800 | 340 | 4 |
| Phosphor bronze Grade A nut | 552 | 260 | 5 |

Allowable bearing pressure between screw and nut = $15 N/mm^2$.

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1. (a) Define the following [4]
 - i. Eccentricity of journal bearing
 - ii. Minimum film thickness
- (b) Design a journal bearing for a centrifugal pump running at 1440 rpm. Diameter of the journal is 10 cm and load on each bearing is 2000 kg. The factor ZN/P may be taken as 2800 for centrifugal pump bearings. Assume the followings. [12]

Atmospheric temperature = $30^{\circ}C$
Operating temperature = $75^{\circ}C$
Energy dissipation coefficient = 0.00125
C/D ratio = 0.001
L/D ratio = 1.5
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. Enumerate the design procedure for the connecting rod section considering it as a simple compression or tension member subjected to fluctuating load [16]
4. Design a plain carbon steel crankshaft for a 0.40 m by 0.60m single acting 4-stroke diesel engine to operate at 200 rpm. The mean effective pressure is 0.49 MPa, and the maximum combustion pressure is 2.624MPa at a maximum torsional moment. When the crank angle is 36° , the gas pressure is 0.975 MPa. The ratio of connecting rod length to crank radius is 4.8. The flywheel is used as a pulley the weight of the flywheel 54.50kN and the total belt pull is 6.75kN. Assume the suitable values for the missing data. [16]
5. (a) Classify various types of springs with sketches and give their applications. [8]
- (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 $84kN/mm^2$, find the axial load which the spring can carry and the deflection per active turn. [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. It is desired to determine the proportions of a spur gear drive to transmit 8kW from a shaft rotating at 1200rpm to a low speed shaft, with a reduction of 3:1. Assume that the teeth are 20° full depth involute, with 24 teeth on pinion. The pinion is to be of 40C8 Steel and gear of 30C8 steel. Assume that the starting torque is 130 percent of rated torque. [16]
8. The screw of a press has square threads and is of 60 mm nominal diameter. The maximum unsupported length is 400 mm. The screw is made of 25C4 steel and the nut is of phosphor bronze. Determine the capacity of the press and length of the nut. If the coefficient of friction for the threads is 0.15 and 0.14 for the thrust collar, determine the necessary torque, taking outside and inside diameters of thrust collar to be 100 mm and 30 mm respectively. [16]

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1. (a) What factors should be considered when selecting bearings? [4]
(b) Design a full journal bearing for the following specifications. [12]
Radial load = 30 kN
Journal diameter = 120 mm
Speed of the journal = 500 rpm
Minimum oil film thickness = 0.025 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 [8]
(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. [8]
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. (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 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? [16]
6. (a) Write the procedure for designing a wire rope. [8]
(b) Select a wire rope for a vertical mine hoist to lift a load of 55kN from a depth 300 meters. A rope speed of 500 meters/min is to be attained in 10 seconds. [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 sluice gate weighing 600 kN is raised and lowered by means of two 70 mm square thread screws. The screws are operated by an electric motor running at 600 rpm. A ball thrust bearing is used, reducing the apparent friction coefficient to 0.003 on a 50 mm radius. Bronze nuts and fair lubrication are used. If the gate must be raised at the rate of 10 mm/s, determine:

- (a) the number of revolutions per minute of the screws,
- (b) the power of the motor required to raise the gate, assuming a mechanical efficiency of 0.85 for the speed reduction mechanism, and
- (c) the power required to lower the gate. [16]

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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. Give design consideration in determining [6+6+4=16]
 - (a) Diameter of crank pin
 - (b) Web section
 - (c) Crank shaft diameter
5. (a) Derive an expression for energy stress in helical springs of circular wire. [6]
- (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/mm^2 . [10]

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