B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2012

PRINTING TECHNOLOGY BRANCH

FIFTH SEMESTER – (REGULATION 2004)

ME 552 – DESIGN OF MACHINE ELEMENTS

Use of approved design data book permitted.

Time : 3 hr. Max. Mark :100

Answer ALL Questions

Part A (10 x 2 = 20 Marks)

1 Distinguish clearly between direct stress and bending stress.

2 Explain how stress concentration in a component can be reduced.

3 What is the effect of a keyway cut into the shaft?

4 When a shaft is subjected to fluctuating loads, what will be the equivalent twisting moment and bending moment?

5 Explain atleast two methods of avoiding the tendency of compression spring to buckle.

6 What is nipping and briefly address its role?

7 List the important physical characteristics of good bearing material.

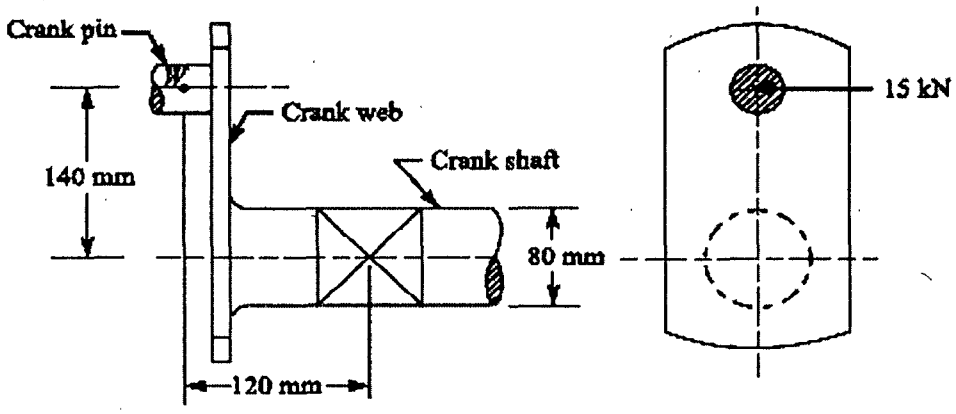
8 Explain with reference to a neat plot the importance of bearing characteristics curve.

9 Briefly explain the design procedure for chain drive.

10 What is a herringbone gear and where are they used?

PART B (5 x 16 = 80 Marks)

11 (i) An overhang crank with pin and shaft is shown in the figure below. A tangential load of 15kN acts on the crank pin. Determine the maximum principal stress and the maximum shear stress at the centre of the crank shaft bearing.



(8)

(ii) A hot rolled steel shaft is subjected to a torsional moment that varies from 330Nm clockwise to 110 Nm counter clockwise and an applied bending moment at a critical section varies from +440 Nm to -220 Nm. The shaft is of uniform cross section and no keyway is present at the critical section. Determine the required shaft diameter. The material has an ultimate strength of 550 MN/m^2 and a yield strength of 410MN/m^2. Take the endurance limit as half the ultimate strength, factor of safety of 2, size factor of 0.85 and surface finish factor of 0.62. (8)

12a A machine shaft 800 mm long transmitting 15kW at 400 rpm is supported at two bearing at the two ends. A gear wheel having 80 teeth and 500 mm pitch circle diameter is mounted at 200mm from the left hand side bearing and receives power from a pinion meshing with it. The axis of pinion and gear lie in the horizontal plane. A pulley of 300mm diameter is mounted at 200 mm from right hand side bearing and is used for transmitting power by a belt. The belt drive is inclined at 30° to the vertical in the forward direction. The belt lap angle is 180°. The coefficient of friction between belt and pulley is 0.3. Design and sketch the arrangement of the shaft assuming the values of safe stresses in shear and tension as 55MPa and 80 MPa respectively. (16)

[OR]

12b A line shaft ABCD, 9 m long, has four pulley A,B,C and D at equal distance apart. Power of 45kW is being supplied to the shaft through the pulley C while the power is being taken off equally from the pulleys A, B and D. the shaft runs at 630 rpm. Calculate the most economical diameters for the various portions of the shaft so that the shear stress does not exceed 55MPa. If the shear modulus is 85GPa, determine the twist of pulley D with respect to the pulley A. (16)

13a Design a concentric spring for an air craft engine valve to exert a maximum force of 5000N under a deflection of 40 mm. Both the springs have same free length, solid length and are subjected to equal maximum shear stress of 850 MPa. The spring index for both the springs is 6. (16)

[OR]

13b A carriage spring 800 mm long is required to carry a proof load of 5000N at the centre. The spring is made of plates 80 mm wide and 7.5 mm thick. If the maximum permissible stress for the material of the plates is not to exceed 190 MPa, determine: (i) the number of plates required, (ii) the deflection of the spring and (iii) the radius to which the plates must be initially bent.
The modulus of elasticity may be taken as 205kN/mm^2. (16)

14a A tentative design of journal bearing results in a diameter of 75mm and a length of 125mm for supporting a load of 20kN. The shaft runs at 1000rpm. The bearing surface temperature is not to exceed 75°C in a room temperature of 35°C. The oil used has an absolute viscosity of 0.01kg/m-s at the operating temperature. Determine the amount of artificial cooling required in watts. Assume d/c=1000. (16)

[OR]

14b The ball bearing is to be selected for an application in which the radial load is 2000N during 90% of the time and 8000N during the remaining 10%. The shaft is to rotate at 150 rpm. Determine the minimum value of the basic dynamic loading rating for 5000 hours of operation with not more than 10% failures. (16)

15a A V-belt drive consists of three V-Belts in parallel on grooved pulleys of the same size. The angle of groove is 30° and the coefficient of friction 0.12. The cross sectional area of each belt is 800 mm^2 and the permissible safe stress in the material is 3 MPa. Calculate the power that can be transmitted between two pulleys 400 mm in diameter rotating at 950 rpm. (16)

[OR]

15b A spur gear made of bronze drives a mid steel pinion with angular velocity ratio of 3.5:1. The pressure angle is 20°. It transmits 5kW at 1800 rpm of pinion. Considering only strength, design the smallest diameter gears and find also necessary face width. The number of teeth should not be less than 15 teeth on either gear. The elastic strength of bronze may be taken as 84 MPa and of steel as 105 MPa. (16)