

Module-3

- 5 A horizontal piece commercial shafting is supported by two bearings 1.5 m apart. A keyed gear 20 involute and 175 mm in dia is located 400 mm to the left of the right bearing and is driven by a gear directly behind it. A 600 mm diameter pulley is keyed to the shaft 600 mm to the right of the left bearing and drives a pulley with a horizontal belt directly behind it. The tension ratio of the belt is 3 to 1, with the slack side on top. The drive transmit 45 KW at 330 rpm. Take $K_b = K_t = 1.5$. Calculate the necessary diameter of the shaft and angular deflection in degrees. Use allowable shear stress 40 MPa and $G = 80 \times 10^9 \text{ N/mm}^2$. (16 Marks)

OR

- 6 a. What are the advantages and disadvantages of hollow shaft over solid shaft? (06 Marks)
 b. In an axial flow rotary compressor the shaft is subjected to a maximum torque of 1500 N-m and a maximum bending moment of 3000 N-m. Neglecting the axial load on the compressor shaft, determine the diameter of compressor shaft. The shear stress in the shaft material is limited to 50 N/mm^2 , also design a hollow shaft for the above compressor taking inner diameter as 0.6 times the outer diameter. What percentage of material is saved in the hollow shaft? Assume minor shock condition. (10 Marks)

Module-4

- 7 A reciprocating machine running at 360 rpm is driven by 12 KW, 1440 rpm motor through a $14\frac{1}{2}^\circ$ involute spur gear. The center distance between the drive being 250 mm. The pinion is made of heat treated cast steel of 450 BHN and the gear is of untreated cast-steel. Assume light shock conditions and 8-hours per day operations. The allowable static stress of pinion $\sigma_{01} = 191.295 \text{ N/mm}^2$ and allowable static stress of gear $\sigma_{02} = 137.35 \text{ N/mm}^2$. Determine:
 i) Module, face width and the number of teeth on each gear
 ii) Check the gears for wear. (16 Marks)

OR

- 8 Design a steel helical gear pair from the following data:
 Power transmitted $N = 30 \text{ KW}$; Speed of pinion $n_1 = 1500 \text{ rpm}$; Pressure angle in diametral plane $2t = 20^\circ$ Full depth involute; Helix angle $\beta = 30^\circ$; Velocity ratio $i = 4$; Number of teeth on pinion $Z_1 = 24$; Static stress for cast steel $\sigma_{01} = \sigma_{02} = 50.71 \text{ N/mm}^2$; BHN for gear material = 350. (16 Marks)

Module-5

- 9 a. Derive the Petroff's equation for C.O.F for hydrodynamic bearing. (06 Marks)
 b. A 75 mm long full journal bearing of diameter 75 mm supports a radial load of 12 kN at the shaft speed of 1800 rev/min. Assume ratio of diameter to the diametral clearance as 1000. The viscosity of oil is 0.01 PaS at the operating temperature. Determine the following:
 i) Sommerfield number
 ii) The coefficient of friction based on McKee equation
 iii) Amount of heat generated. (10 Marks)

OR

- 10 a. Derive an expression for the shear stress induced in a helical compression spring, with usual notations. (06 Marks)
 b. A railway Wagon weighing 50 kN and moving with a speed of 8 km/hr has to be stopped by four buffer springs in which the maximum compression allowed is 220 mm. Find the number of turns or coils in each spring of mean diameter 150 mm. The diameter of spring wire is 25 mm. Take $G = 84 \text{ GPa}$. Also find the shear stress. (10 Marks)

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