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Q1. A helical compression spring is made of hard drawn spring steel wire of 2 mm diameter and has an outside diameter of 22mm. The ends are plain and ground and there are 8.5 total coils. The spring is wound with a free length such that, when the spring is compressed solid, the stress will not exceed the torsional yield strength.

- a) Find the free length.
- b) What is the pitch of this spring?
- c) What force is needed to compress the spring to its solid length?
- d) What is the spring rate? (5)

Q2. Derive Petroff's equation for coefficient of friction in journal bearings (3)

Q3. List the types of rolling contact bearings (2)

Q4. A worm gear set has a single-thread worm with a pitch diameter of 30mm, a module of 3 mm, and a normal pressure angle of 20°. If the worm meshes with a worm gear having 40 teeth and a face width of 16mm, compute the gear pitch diameter, the center distance, and the velocity ratio. If the worm gear set is transmitting 105 N-m of torque at its output shaft, which is rotating at 30 rpm, compute tangential force on the gear set, efficiency, input speed, and input power. (5) Q5. What are the methods of reducing stress concentration? Describe any two methods with neat diagram. (3)

Q6. Define lead angle and pitch in worm gear. (2)

Q7. A pair of continuously lubricated and carefully cut helical gears is to transmit 15 kW at 5000 rpm of the pinion. Both the gears are made of cast steel (untreated). The centre distance is approximately 200 mm. The velocity ratio is 4:1. The teeth are of 20° full depth involute profile. The helix angle is 25°. Take face width as 15 times the normal module. The gears are subjected to medium shock with 10hrs/day of service. Factor of safety is 1.5. Using the velocity factor to account for the dynamic load, Design the gears based on strength. Also calculate wear load for given load stress factor K=0.420. (5)

Q8. What is the difference between the Gerber curve and Soderberg and Goodman lines? Explain with a neat diagram. (3)

Q9 What is self-locking in worm sets? How this action is produced? (2)

Q10. A full journal bearing 80 mm diameter and 140 mm long has a bearing pressure of 2 MPa. The speed of the shaft is 450 rpm. The bearing is operating with SAE 40 oil at 68 °C in still air. The ambient temperature is 30°C. The diametral clearance is 0.08 mm. Determine the coefficient of friction, minimum film thickness heat generated and oil flow rate. (4)

Q11. Describe stable lubrication and unstable lubrication with a neat diagram. (3)

Q12. What are the important theories of elastic failures? State any two of them. (3)

Q13. A steel plate subjected to a force of 5 kN and fixed to a channel by means of three identical bolts is shown in Fig. The bolts are made from plain carbon steel 45C8 (S_{yt} = 380 N/mm²) and the factor of safety is 3. Specify the size of bolts.



Q14. Describe different types of riveted joints (3)

Q15. The dynamic load carrying capacity of 6306 bearing is 22kN.What is the maximum radial load it can sustain to operate at 600rpm for 2000 hrs. (3)