



friction 0.3, a slip of 1.2% at each pulley and 5% friction loss at each shaft, 20% over load. Make the suitable assumptions if necessary.

3. a) What are rolling contact bearings? Discuss their advantages over sliding contact bearings.  
b) Select a single row deep groove ball bearing for a radial load of 4000 N and an axial load of 5000 N, operating at a speed of 1600 r.p.m. for an average life of 5 years at 10 hours per day. Assume uniform and steady load.
4. The areas of the turning moment diagram for one revolution of a multi-cylinder engine with reference to the mean turning moment, below and above the line, are :  
- 32, + 408, - 267, + 333, - 310, + 226, - 374, + 260 and - 244 mm<sup>2</sup>.

The scale for abscissa and ordinate are: 1 mm = 2.4° and 1 mm = 650 N-m respectively. The mean speed is 300 r.p.m. with a percentage speed fluctuation of  $\pm 1.5\%$ . If the hoop stress in the material of the rim is not to exceed 5.6 MPa, determine the suitable diameter and cross-section for the flywheel, assuming that the width is equal to 4 times the thickness. The density of the material may be taken as 7200 kg / m<sup>3</sup>. Neglect the effect of the boss and arms.

5. Design a close coiled helical compression spring for a service load ranging from 2250 N to 2750 N. The axial deflection of the spring for the load range is 6 mm. Assume a spring index of 5. The permissible shear stress intensity is 420 MPa and modulus of rigidity,  $G = 84 \text{ kN/mm}^2$ . Neglect the effect of stress concentration. Draw a fully dimensioned sketch of the spring, showing details of the finish of the end coils.
6. A single dry plate clutch is to be designed to transmit 7.5 kW at 900 r.p.m. Find : (a) Diameter of the shaft, (b) Mean radius and face width of the friction lining assuming plate, and (c) Outer and inner radii of the clutch spring, assuming that the number of springs are 6 and spring index = 6.

The allowable shear stress for the spring wire may be taken as 420 MPa.

7. A differential band brake is operated by a lever of length 500 mm. The brake drum has a diameter of 500 mm and the maximum torque on the drum is 1000 N-m. The band brake embraces 2/3rd of the circumference. One end of the band is attached to a pin 100 mm from the fulcrum and the other end to another pin 80 mm from the fulcrum and on the other side of it when the operating force is also acting.

If the band brake is lined with asbestos fabric having a coefficient of friction 0.3, find the operating force required. Design the steel band, shaft, key, lever and fulcrum pin. The permissible stresses may be taken as 70 MPa in tension, 50 MPa in shear and 20 MPa in bearing. The bearing pressure for the brake lining should not exceed 0.2 N/mm<sup>2</sup>.

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