

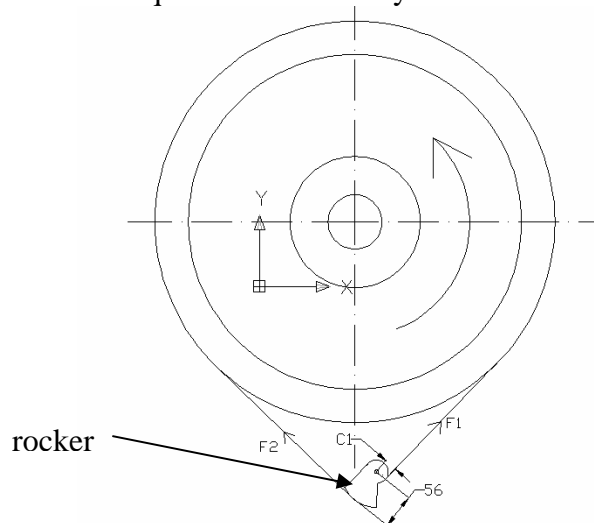
ME 220 Theory of Machines and Design of Machine Elements  
Tutorial 6

1. A friction clutch is used to rotate a machine from shaft rotating at a uniform speed of 250 rpm. The disc type clutch has both of its sides effective, the coefficient of friction being 0.3. The outer and inner diameters of the friction plate are 200 mm and 120 mm respectively. Assuming uniform wear of the clutch, the intensity of pressure is not to be more than  $100 \text{ KN/m}^2$ . If the moment of inertia of the rotating parts of the machine is  $6.5 \text{ Kg/cm}^2$ , determine the time to attain the full speed by the machine and the energy lost in slipping of the clutch. What will be the intensity of pressure, if the condition of uniform pressure of the clutch is considered. Also determine the ratio of power transmitted with uniform wear to that of uniform pressure.

2. A hydraulically operated multi-disk plate has an effective outer diameter of 160 mm and inner diameter of 100. The co-efficient of friction is 0.24 and the limiting pressure is 830 Kpa. There are six planes of sliding present.
- using the uniform wear model, estimate the axial force F and the torque T.
  - Let the inner diameter of the friction pairs d be a variable. complete the following table.

d,mm	50	75	100	125	150
T, Nm					

- What does the table show.
3. A cone clutch has  $D = 330 \text{ mm}$ ,  $d = 306 \text{ mm}$ , a cone length of 60 mm and a coefficient of friction of 0.26. A torque of 200 N m is to be transmitted. For this requirement estimate the actuating force and pressure by both the models
4. The figure shows a band brake designed to prevent "backward" rotation of the shaft. The angle of wrap is  $270^\circ$ , the band width is 54 mm and the coefficient of friction is 0.20. The torque to be resisted by the brake is 200 Nm



- a. What dimension C1 will just prevent backward motion
  - b. If the rocker was designed with C1= 25 mm, what is the maximum pressure between the band and drum at 200 Nm back torque
  - c. If the back torque demand is 10 Nm. what is the largest pressure between the band and the drum
5. A V-belt weighing 1.6 kg/m run has an area of cross section of 750 mm<sup>2</sup>. The angle of wrap is 165° on the smaller pulley which has a groove angle of 40°. The co-efficient of friction is 0.12. The maximum safe stress in the belt is 9.5 N/mm<sup>2</sup>. What is the power that can be transmitted by the belt at the speed of 20 m/sec.
  6. A 50 mm diameter non-rotating shaft of hot rolled steel,  $\sigma_{yp} = 400$  MPa has a steady bending moment of 1000 Nm and a steady torque of 1500 N. Determine if the part will fail by maximum distortion energy theory if  $N_{fs}$  is to be 3.
  7. A 375 x 500 x 12 mm plate of hot rolled steel,  $\sigma_{yp} = 400$  MPa carries a uniform distributed tension of 400 kN on the 375 mm edge. Find the maximum compressive stress on the 500 mm edge if  $N_{fs}$  is to be 2 by the maximum shear stress theory. Find the dimensions of the plate after the loads are applied.
  8. A machine part is to be designed to have a finite life of 200,000 cycles. For 30% of the time the average stress is 620 MPa and the range stress is 350 MPa. For 60% of the time, the completely reversed stress value is 575 MPa. If the material has ultimate strength of 1240 MPa and an endurance limit of 550 MPa, using the Besquin's and Miner's equations find the maximum stress level in the remaining time.