Machine Design 2
Sheet 2 – Clutches

1. Three thrust disk clutches, each with a pair of frictional surfaces, are mounted on a shaft. The hardened-steel clutches are identical, with an inside diameter of 100 mm and an outside diameter of 250 mm. What is the torque capacity of these clutches based on (a) uniform wear and (b) uniform pressure?

2. A pair of disk clutches has an inside diameter of 250mm and an outside diameter of 420 mm. A normal force of 18.5 kN is applied and the coefficient of friction of the contacting surfaces is 0.25. Using the uniform wear and uniform pressure assumptions determine the maximum pressure acting on the clutches. Which of these assumptions would produce results closer to reality?

3. A disk clutch is made of cast iron and has a maximum torque of 210 Nm. Because of space limitations the outside diameter must be minimized. Using the uniform wear assumption and a safety factor of 1.3, determine a) The inner and outer radii of the clutch b) The maximum actuating force needed.

4. The synchronization clutch for the second gear of a car has a major cone diameter of 50 mm and a minor diameter of 40 mm. When the stick shift is moved to second gear, the synchronized clutch is engaged with an axial force of 100 N, and the moment of inertia of 0.005 kg-m^2 is accelerated 200 rad/s^2 in 1 s to make it possible to engage the gear. The coefficient of friction of the cone clutch is 0.10. Determine the smallest cone clutch width that still gives large enough torque. Assume the clutches are worn in.

5. A safety brake for an elevator is a self-locking cone clutch. The minor diameter is 120mm, the width is 60 mm, and the major diameter is 130mm. The force applying the brake comes from a prestressed spring. Calculate the spring force needed if the 2-ton elevator must stop from a speed of 3m/s in a maximum distance of 3 m while the cone clutch rotates five revolutions per meter of elevator motion. The coefficient of friction in the cone clutch is 0.26.