

27 April 2000

ME 493

Time 180 minutes – OPEN BOOK – Notes and Textbook Allowed.

Candidates may use Electronic Calculators and should attempt five (5) of the seven (7) questions.

All questions are of equal value.

1. Design a helical tension spring that will exert an approximately uniform force under deflections of up to 1 inch. The force should be at least 18 pounds and should not exceed 22 pounds under movements of 0.75 inches. The hooks must fit over  $\frac{3}{16}$  inch pins and the body should not exceed two inches in length and one inch in outside diameter.
2. Design a leaf spring to have 1.5 meters between the fixed pivots. It is to be used under essentially static load conditions. The maximum central load should not exceed 2400N and the leaves should not be more than 0.1 meter wide. The deflection at maximum load should not exceed 0.2 meters.
3. Design a gear and pinion to transmit 50 kW with a pinion speed of 850 rpm. The gear speed should be 600 rpm. Design to prevent surface failure. The gears should have a 99 % reliability for 15 years at 6000 hours per year and the pinion diameter should not exceed 0.2m. Assume a service factor of 1.2.
4. Select a roller chain drive for the above power transmission conditions. The center distance should not exceed 70 inches.
5. Select a Vee belt speed reducer to input 3 hp at 1700 rpm and output the power at 825 rpm. Use a service factor of 1.1 and a center distance between 50 and 70 inches.
6. A band brake is being considered for a safety device. It is to act on a 4.0 inch drum and apply a torque of 400.0 in lb. The wrap angle is to be 270 degrees. Design the system. Include materials, maximum pressures and the proposed lever design.
7. Select wire rope and sheaves for a mine lift. Assume that the lift is to be raised by a single wire rope used in a way that gives it a mechanical advantage of 2.0. The lift weighs 1000 lbs and it is to carry four 95 percentile male humans. ( MIL-STD 1472D indicates that each person would have a mass of 96.0 kg ) They might each carry an additional 50 kg. The acceleration of the lift is to be 333 fpm/s and the lift operates over 2000 feet.

Good Luck In Your New Jobs