ME 423

Me. 423.3 Machine Design II
Final Examination April 23, 1999

Open Book Examination
Texts, Notes and Calculators are allowed

Students should attempt five (5) of the seven (7)questions.

1. Design a helical extension spring to give a minimum force of 50 lbs and a maximum force after a 0.5 inch extension of 100 lb. Use music wire and design the springs to avoid surge at 10 Hertz. The ends of the hooks should be five inches apart.

2. You are to design a differential band brake to provide a "one way clutch" for a conveyor system. The 15 meter long conveyor is to lift straw parallelepipeds that are one meter long and and have a maximum mass of 75 kg each. The brake should be capable of preventing the load from coming back down in the case of power failure or driving chain failure. The brake drum must be at least 0.05 meters in diameter. Select all dimensions and materials for the brake.

3. Design a two stage "Vee" belt speed reduction system to reduce the output from a 50 hp. gasoline motor running at 600 rpm to between 24 and 26 rpm. Use a service factor of 1.4 and assume that custom sheaves are available.

4. Select a chain drive for a two stage speed reduction system which is to provide speed reduction from a 20 hp. diesel engine running at 314.159 rpm to 10 rpm. The customer promises bonus money depending on the accuracy of the output speed.

5. Design a set of gears to transmit 10w with an input speed of 3450 rpm and an output speed of 51 rpm. The gears are for a scientific instrument and are to be precision made. The gears are to be made as small and as light as possible as it is hoped to get the instrument on a upcoming probe to one of Jupiter's moons. The hollow shafts holding the gears are to be made from Ti-6Al-4V titanium.

6. Choose rolling element bearings for the set of gears in question 5. assuming a 3 year operating period and a two month initial test period to be conducted on Earth. Explain what concerns you might have with respect to operation of the bearings in space and any concerns about flammable materials.

7. A carnival owner has approached you to do an preliminary design of a new and exciting ride. This ride is to feature people being packed into individual pods. The pods will be lifted via an elevator to the top of a 30 meter tower. The pods would be attached to a wire rope to be selected by you and dropped 10 meters at a time. The energy of the fall is to be absorbed by the wire rope attached to the tower and the pod. To cushioned the passengers the rope will be attached to the tower using a triangular plate the base to be attached to the tower and the tip to be fastened to the rope. Select the rope and the plate and address any safety concerns you might have.

Good Luck in your future endeavours !