

Me423.3 Machine Design II – Final Examination

12 April 2001

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 band brake to provide a braking capacity of 3 kilowatts. The brake is to be applied to a flat pulley 0.5 meters in diameter and as wide as you wish. The actuation force should not exceed 200 Newton's, nor should the brake be self locking due to a 0.1 increase in friction. The contact angle should be greater than 200 degrees and less than 270 degrees. Indicate the friction material used, the geometry of the system and all dimensions.

2. Design a roller chain drive to provide a sixty to one speed reduction. The input is five horsepower at 1750 RPM. You have unlimited room for the drive and hope to market it with the slogan "It will last five years or your money back with interest". Assume a five day, fifty week a year usage.

3. Management liked your roller chain speed reducer but now they want a compact speed reducer with an even longer life. Design a prototype spur gear speed reducer for this market. Do only the tooth bending fatigue portion of the design. Show all necessary dimensions and calculations.

4. Management also liked the prototype you designed in question three. It works well and the market looks great now they want the surface fatigue design. Design a prototype spur gear speed reducer for this market. Show all necessary dimensions and calculations. Note, for examination purposes it was not necessary to have done question three.

5. Select a Vee belt speed reducer for a new SAE super-mileage vehicle. Assume an engine output shaft speed of 1000 RPM driving a rear wheel

with an outside diameter of 670 mm. The engine is rated at 3 horsepower. Comment on this choice of power transmission.

6. You are to design a speed reducer for the next Mars flight. The speed reducer has to convert 0.001 HP at 4000 RPM to 5 RPM. You can use either a spur gear system or a planetary gear system. Explain your reasons for the choices you make. For examination purposes design only two meshing gears and do the gear tooth design for bending fatigue only.

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 3.0. The lift weighs 2000 lbs and it is to carry four 200 pound humans and their 100 lbs of tools. They might each carry an additional 50 kg. The acceleration of the lift is to be 16 feet per second per second and the lift operates over 1500 feet. Comment on any safety concerns.

Good Luck In Your New Jobs.