MEEG 301-18f

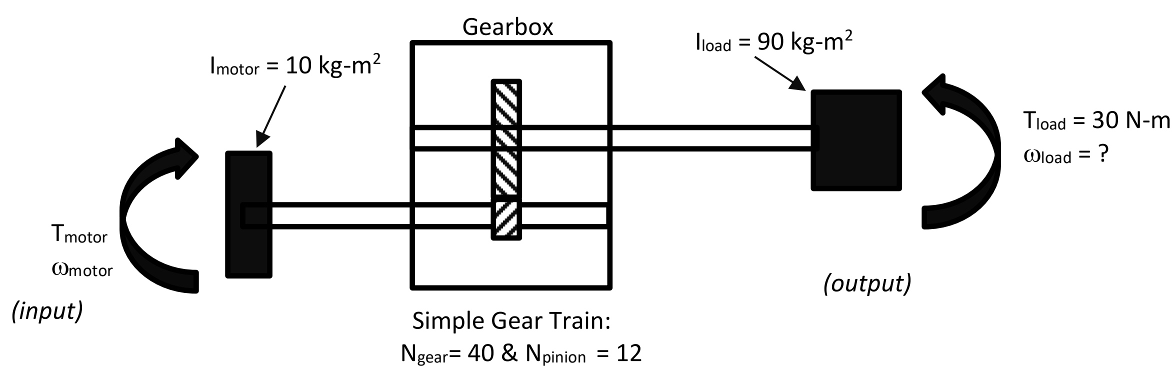
Machine Design – Kinematics

Homework #7 – Dynamics Fundamentals

One hardcopy due by 5p on 7 December in 131 SPL. Upload required Solidworks files by 11:55p on 7 December.

1. Problem 10-37 from your book using only row c from Table P10-1. To receive full credit, compute the mass moment of inertia and CG location using both hand calculations (Excel is acceptable), and with Solidworks. Hand in a hardcopy of your hand calculations and a printout of your Solidworks results. Also, upload your Solidworks solid model (along with the model from Problem #4) to Canvas.

2. For the AC motor drive system model shown below, compute the following:
   a) Gear ratio (N represents the number of teeth on a pinion or gear)
   b) Average angular acceleration of the i) input and ii) output if the motor starts at rest reaches a steady angular velocity of 3,450 RPM in 0.5 second during startup.
   c) The steady angular velocity of load after startup.
   d) Reflected inertia seen by the motor resulting from the load inertia. Assume that the pinion, gear and shafts have negligible mass.
   e) The torque on the motor due to the load torque, assuming this torque is constant over time.
   f) Magnitude of the total motor torque (T_{motor}) required to change the motor speed (ω_{motor}) from rest to 1,750 RPM in 0.5 second during startup. Again, assume the load torque (T_{load}) is constant.
   g) Plot motor torque vs time from t = 0 to 3 seconds. What value of torque should be used for the design of the elements of the system (for strength) if this torque profile is the expected loading on the system in the future?



3. Repeat 3d) from the previous problem if the inertia of the pinion is 1 kg-m^2 and the inertia of the gear is 10 kg-m^2. Again, assume the inertia of the shafts are negligible.

4. Mass Moment of Inertia Estimates and Balancing with Solidworks.

Flywheels are a rotating mechanical component used to store and release kinetic energy to mechanical devices and machines. The key design variables are center of gravity, mass (m), mass moment of inertia (Izz), Outer Diameter (D), Bore (inner diameter) (d), and Maximum Thickness (t). The axis ZZ is the center of rotation.

Using Solidworks, design a flywheel with the following attributes:

- 240 lbm*in^2 < Izz < 250 lbm*in^2
- m < 18 lbm
- 13 < D ≤ 14 in
- t ≤ 3 in
- d = 0.750 in
- Runout must be less than 0.0005 in. (i.e. concentricity of the CG and center of rotation is 0.0005 in)
- The front and back faces (sides) must be parallel within 0.002 inches
- Material = Machined low carbon steel

Once your flywheel has the required physical attributes, create standard 3rd angle orthographic views of your flywheel that also include an isometric view in the upper right corner of the drawing. Submit this fully dimensioned engineering drawing hardcopy, along with a printout of your mass properties of the flywheel computed using Solidworks. Upload your Solidworks solid model file to Canvas. Extra credit: Use standard GD&T callouts, symbols and datums on your engineering drawing to insure the concentricity and parallel requirements will be met when machined. Also, include a standard keyway in the flywheel for the bore specified.