MECH 3140: Homework #1

To be worked by Friday, 8/25:

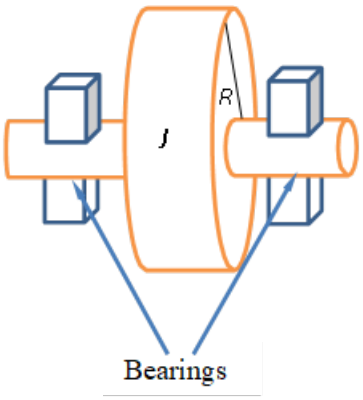
1. Chapter 1, Problems 11, 14, 15

2. Assuming the system starts from rest, solve for the angular velocity as a function of time (i.e., $\theta(t)$) for the model described by the following differential equation:

$$3\dot{\theta} + 9\theta = 18t$$

3. Consider a pulley with a mass moment of inertia of J and supported by two bearings that each have a (constant) coulomb friction torque τ_f acting on the shaft. Assuming the pulley starts from an initial angular velocity of ω_o:

a) Solve for ω(t)
b) Sketch ω(t)
c) Sketch θ(t)
d) What is the final angular position of the pulley?



Supplemental Problems: Chapter 1 Problems 12, 13

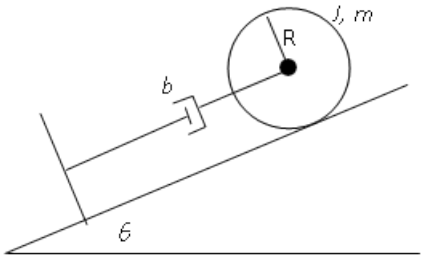
4. Solve the following differential equations (for each state if they are linear/non-linear, homogenous/non-homogenous and identify the input, output, and eigenvalues). Assume the system starts from rest (IC = 0).

a) $m\dot{y} + by = F$
b) $2\dot{x} + 4x = 6\sin(12t)$
c) $5\ddot{x} + 50\dot{x} = 10$

To be worked by Monday 8/28:

5. Work the following problems from Chapter 3: 5, 8-9, 12-13, 19, 28 (assume all pulleys have inertia J_p and radius R_p), 31, 39

6. A wheel attached to a linear damper rolls without slipping as shown. Assume the wheel starts from rest ($\theta(0) = \dot{\theta}(0) = 0$. Find the equation of motion.



Supplemental problems: Chapter 3 Problems: 10, 11, 20, 29, 34