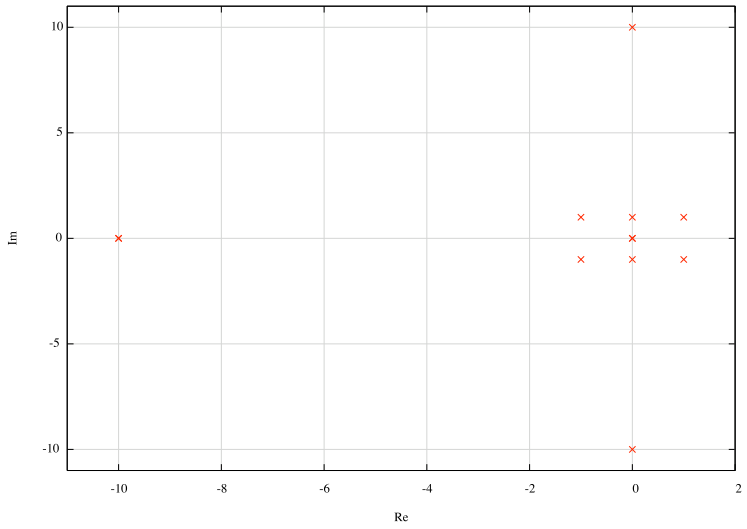
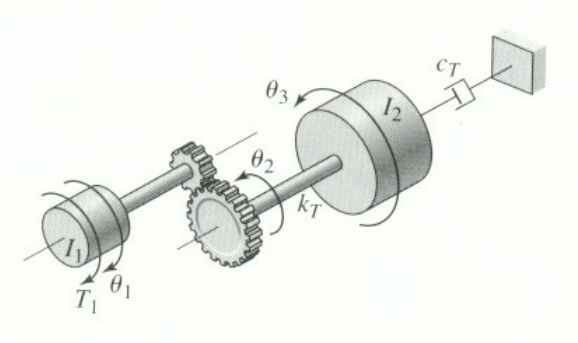
Mechanical Systems Modeling and Design, Exam 2 Spring 2005

1. Write down the values of the poles plotted on the complex axis below in order of importance (from most important to least important). Define their behavior, and sketch what their contribution to the response looks like.



2. (a) Derive the equations of motion for the system below. Generate the simulink block diagram.

   (b) Derive the equations of motion for the system below presuming a deadband. Sketch the force between the gears as a function of angular position of the two gears. Label it with necessary explanations.



3. Presuming a model given by

$$10\ddot{x} + \dot{x}(1 - y^2) + 3x - 2y = f(t) \quad (1)$$

$$\ddot{y} + 3\dot{y} + 3y - 2x = 0 \quad (2)$$

with a nominal force of $f_0 = 1$ and a velocity sensor on the first state:

(a) generate the state-space model,

(b) linearize them about their nominal values.

4. Derive the equations of motion for the system below and put them in state space form for the cases:

   (a) assuming linear resistances and negligible inertance.

   (b) using the Darcy equation.

   Remember to use consistent variables. i.e. q_m *for flow rate.*