Mechanical System Modeling and Design Exam 1 Winter 1998

February 27, 1998

1. Linearize the following equation about its nominal operating point when $\bar{F} = -1$.

$$\ddot{x} + \dot{x}^3 + x = F(t)$$

2. For the following system of equations

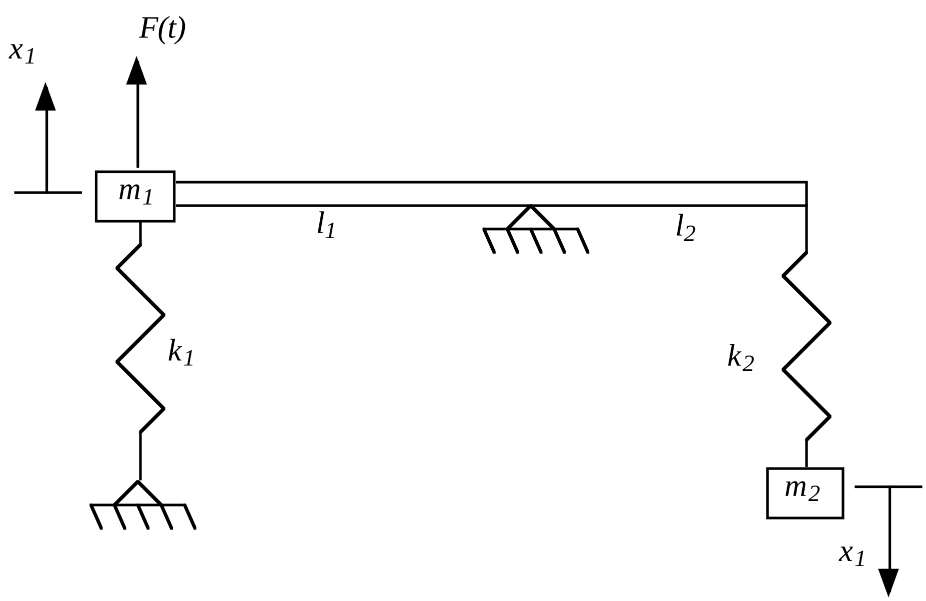
   (a) How many states does the system modelled by the following equations have?

   (b) Put the equations of motion in state space form.

$$\frac{d^4y}{dt^4} + a\frac{d^2y}{dt^2} + b\left(\frac{dy}{dt}\right) + c(y - x) = f_1(t)$$

$$\frac{d^2x}{dt^2} + c(x - 2y) = f_2(t)$$

3. Derive the equations of motion for the following system. Assume the rod is massless and neglect any damping at the pivot.



4. Draw the block diagram for the system of equation in problem 2 using the blocks below. Signs, # of ports, and directions may be changed, of course.