MECH 431
Dynamic System Analysis

Exam I

Thursday, 12, July 2006

Duration: 60 minutes

Open Book Exam

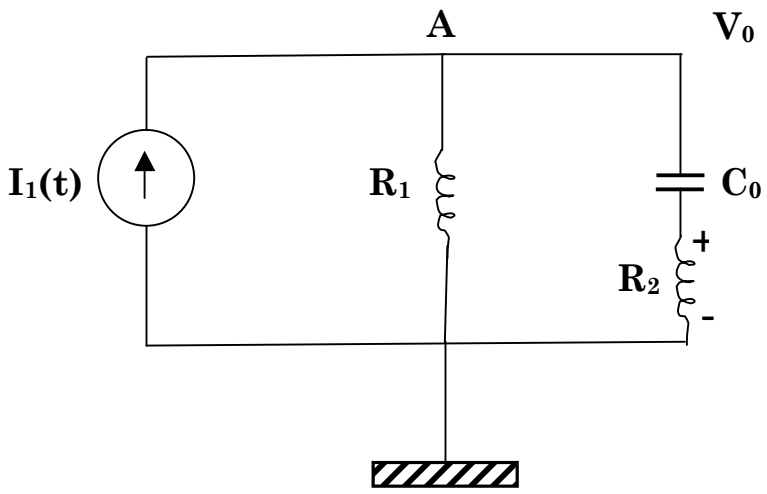
Write clearly your derivations and answers on the question sheet

Name:

ID#:

Problem I [40 Pts]

Consider the circuit shown below



a. Define the state variables

b. Write the model equation in state-variable form

c. Write the I/O equation relating the voltage across R_1, V_A, as output to the input current $I_1(t)$

Problem 2 [20 Pts]

Draw a block diagram to represent the following equations,

a. $\dot{x} = -4x + 6y + 2u(t)$
$\dot{y} = -2x - 3y$

b. $\ddot{y} + 2y + 3y^3 = 5u(t)$

Problem 3 [40 Pts]

The system shown below is fluid rotor system in which the larger container rotates due to an applied torque $\tau(t)$. The angular **position** of the large container is θ_1. As the large container rotates, the fluid inside it also rotates and due to viscosity, it forces the inner cylinder to rotate and the angular position of the inner cylinder is θ_2 which in turn induces a rotation in the outer cylinder (the one to the right). The inertias of each rotor are denoted by J and the viscosity of the fluids are denoted by B. K is the torsional stiffness of the linkage bar.

a. Define the state-variables for the system and the components to which they are associated

b. Derive the model equations for the system and write them in state-variable form.

c. Write down the block diagram of the system clearly indicating the significance of each link you made.