EE474/ECG695: Linear Systems

Spring 2008, 3 credits: Test 1

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PROBLEM 1 : (10 points) What is the state of the circuit shown in Figure 1. Is the circuit state controllable? Is it state observable? Explain the reasoning for your answers.
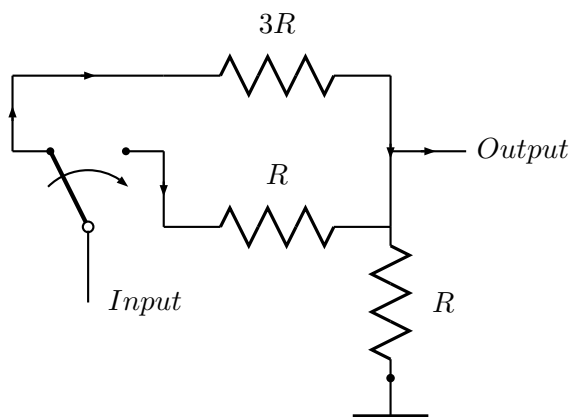

Figure 1: Switched Circuit

PROBLEM 2 : (10 points) Reduce the following nonlinear differential equation into two first order nonlinear differential equations.

$$\frac{d^2y}{dt^2} - 2y^3 + u\frac{dy}{dt} = 0$$

Take the nominal initial condition to be $y(t_0) = 1$, $\dot{y}(t_0) = -1$ at $t_0 = 1$ and nominal control to be $u(t) = 0$, then the nominal trajectory is $\phi_1(t) = t^{-1}$ and $\phi_2(t) = -t^{-2}$, then find the linearized dynamics of the system.

PROBLEM 3 : (10 points) Find the matrix state equations in the first canonical form for the system

$$\ddot{y} + 5\dot{y} + 6y = \dot{u} + u$$

PROBLEM 4 : (10 points) Find the matrix state equations in the Jordan canonical form for the system

$$\ddot{y} + 5\dot{y} + 6y = \dot{u} + u$$