SYSTEM ANALYSIS   **Spring 2015**

| **Midterm Exam SOLUTION** | **Date: April 21, 2015 (Tu)** |
| **Closed book, closed note** | **19:00~21:00** |

Student ID #: _____   Name: _____

[1] (20points) Describe followings:
    (1) Linear Dynamic Systems
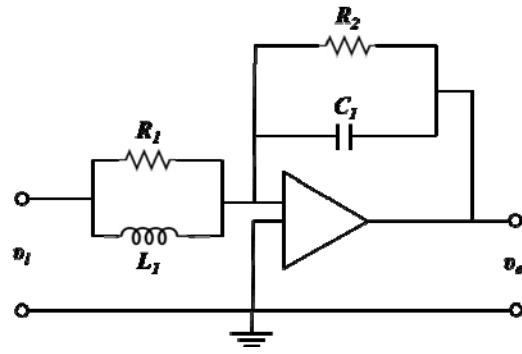
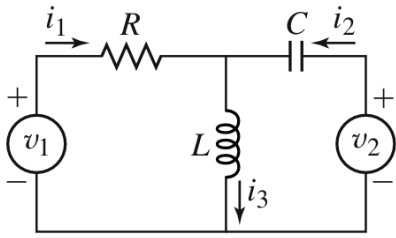| Problem No (points)	Points
1(20)	
2(10)	
3(10)	
4(10)	
5(10)	
6(10)	
7(10)	
Total(80)	

    (2) Transfer Function

(3) state, state space, and state equation

(4) Time constant, natural frequency, damping ratio

[2] (10 points) Obtain the transfer function $V_o(s)/V_i(s)$ for the op-amp system shown in Figure below.

[3] (10 points) Obtain the transfer function $V_2(s)/V_1(s)$ for electric circuit shown in Figure below

[4] (10points) Consider a system described as following state equation.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 2 \\ 0 & -1 & 3 \\ 0 & 0 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u, \quad y = \begin{bmatrix} 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

(1) Obtain the transfer function $Y(s)/U(s)$.

(2) Compute the unit step response.

[5] (10points) Consider a mechanical system shown in the figure. Assuming no slip condition, compute the natural frequency of the system. The mass of the roller is m and the moment of inertia is J.
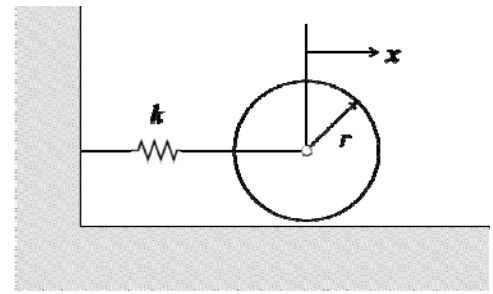
[6] (10points) Consider a system represented as a transfer function. Obtain the state model for the transfer function model

$$\frac{Y(s)}{U(s)} = \frac{10}{3s^2 + 6s + 10}$$

(1) Obtain the state model for the transfer function model

(2) Sketch the step input response of the system

[7] (10points) A system is represented as a block diagram as below. Obtain the transfer function $\dfrac{Y(s)}{U(s)}$.