

## B. Tech Degree IV Semester Examination April 2011

### EE 404 LINEAR SYSTEM ANALYSIS (2006 Scheme)

Time : 3 Hours

Maximum Marks : 100

#### PART – A (Answer ALL questions)

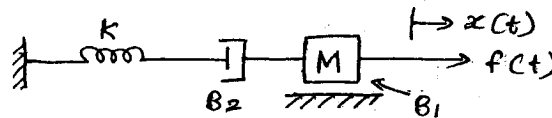
(8 x 5 = 40)

- I. (a) Compare Open loop and Closed loop systems.  
 (b) Define Linear System and Time Invariant System.  
 (c) Explain the Force-Voltage analogy and Force-Current analogy in translational systems.  
 (d) Explain Hydraulic system with an example.  
 (e) Derive the expression for response of a first order system subjected to unit step input.  
 (f) Define the following terms for a second order underdamped system.  
     (i) Delay time  
     (ii) Rise time  
     (iii) Peak time  
     (iv) Maximum overshoot  
     (v) Settling time.  
 (g) Define the following terms for state space models of systems.  
     (i) State  
     (ii) State variables  
     (iii) State vector  
     (iv) State space  
 (h) State and prove the properties of state transition matrix.

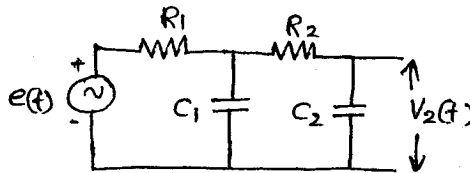
#### PART – B

(4 x 15 = 60)

- II. (a) Determine the transfer function of the system.

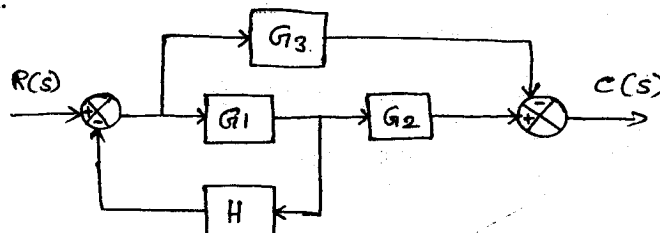


- (b) Find the transfer function of the electrical network shown in the figure.



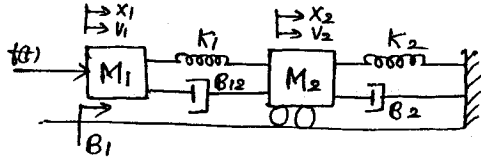
OR

- III. (a) State and explain Mason's Gain formula.  
 (b) Draw the signal flow graph and determine the transfer function for the given block diagram.



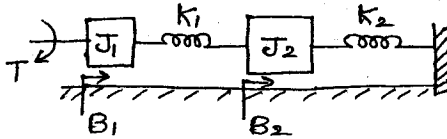
(P.T.O)

- IV. Write the differential equations governing the mechanical system shown in the figure. Draw the force-voltage and force-current electrical analogous circuits for the system.



OR

- V. Write the differential equations governing the mechanical rotational system shown in the figure. Draw the torque-voltage and torque-current electrical analogous circuits.



- VI. Derive the expressions for Rise time, Peak time, Peak overshoot and settling time for a second order underdamped system.

OR

- VII. (a) A unity feedback control system has an open loop transfer function,  $G(s) = \frac{10}{s(s+2)}$ . Find the rise time, percentage overshoot, peak time and settling time for a step input of 12 units.
- (b) For a unity feedback control system the open loop transfer function is  $G(s) = \frac{10(s+2)}{s^2(s+1)}$ . Find the position, velocity and acceleration error constants.

- VIII. (a) Determine the stability of the system whose characteristic equation is  $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$ . Also determine the number of roots lying on right half of s-plane, left half of s-plane and on imaginary axis.
- (b) Explain Liapunov's stability criterion applied to linear systems.

OR

- IX. (a) A linear time covariant system is characterized by the following state equations.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t) \quad \text{and} \quad y_1 = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}, x_1(0) = 1 \text{ and}$$

$x_2(0) = 0$ . Obtain the time response of the system for the unit step function occurring at  $t = 0$ .

- (b) Obtain the state transition matrix of the system.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & -3 \\ -2 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$