Roll No .....

MEIC-102

M.E./M. Tech., I Semester

Examination, June 2016

Linear Control System

Time : Three Hours

Maximum Marks : 70

Note: i) Answer any five questions.

ii) All questions carry equal marks.

1. a) The transfer function of a system is given by

$$\frac{Y(s)}{V(s)} = \frac{s^2 + 3s + 2}{s^3 + 9s^2 + 26s + 24}$$

Determine state model. Use direct decomposition method.

b) Obtain the state transition matrix $\phi(t)$ of the following system.

$$\begin{bmatrix} X_1^{\bullet} \\ X_2^{\bullet} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Obtain also the inverse of the state transition matrix $\phi^{-1}(t)$.

2. Determine the state model for the electrical circuit shown in figure 1. Select state and output variables.

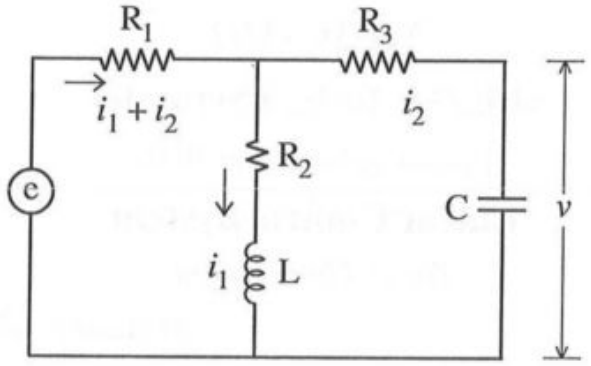

Figure 1

3. For the system given below :

Obtain (i) Zero input response (ii) Zero state response (iii) Total response

$$X^{\bullet} = \begin{bmatrix} 0 & 1 \\ -2 & -1 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$

Where $x_1(o) = 1$, $x_2(o) = 0$ and $u(t) = 1$

4. a) List the properties of state transition matrix.

b) Check for controllability and observability of a system having following coefficient matrices

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}, \quad B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} \text{ and } \quad C^T = \begin{bmatrix} 10 \\ 5 \\ 1 \end{bmatrix}$$

5. A discrete time system has state and output equation given b

$$x_1(k+1) = \frac{1}{4} x_1(k) + u(k)$$

$$x_2(k+1) = \frac{1}{8} x_1(k) + \frac{1}{8} x_2(k) + u(k)$$

$$y(k) = \begin{bmatrix} \frac{1}{2} & 0 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix}$$

Solve for the output $y(k)$ when $u(k)$ = unit impulse an$x(o) = 0$

6. Determine the pulse transfer function and stability of the sampled data control system shown in figure 2 for sampling time (a) T = 0.5 sec., (b) T = 1 sec.

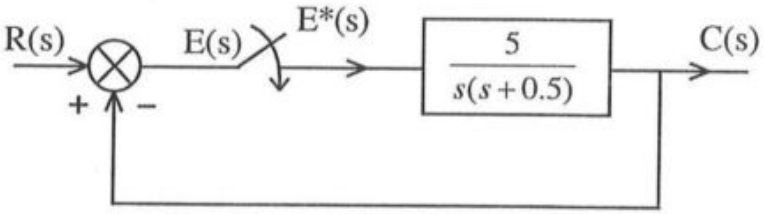

Figure 2

7. Explain different model reduction methods for distributed parameter system.

8. Write short notes (any two) :

a) Lyapunov stability for discrete system

b) Hold circuit

c) Stability of distributed system