No. of Printed Pages : 4

BIEEE-017

B.Tech. – VIEP – ELECTRICAL ENGINEERING (BTELVI)

Term-End Examination

00354

June, 2014

BIEEE-017 : ADVANCED CONTROL SYSTEM

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any* ***seven*** *questions. Each question carries equal marks.*

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1. Consider the electrical circuit of Figure 1.

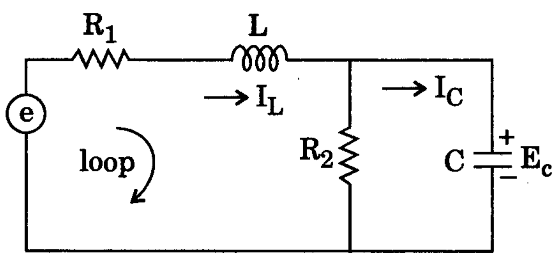

Figure 1

(a) Identify a set of state variable.

(b) Draw the signal flow graph of the circuit in terms of the state variables identified in part (a).

(c) From the signal flow graph, determine the transfer function $E_c(s)/E(s)$. *10*

2. State and explain Lyapunov stability theorem. Investigate the system described by *10*

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

3. The state variable model of open loop system is described by

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -3 & 2 \end{bmatrix}, \; B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

(a) Check the stability of the system.

(b) The system's loop is now closed by a state feedback

$$u(t) = -K\,x(t)$$

where $K = [K_1, K_2, K_3]$ is the feedback matrix of constant gains. Determine the constraints on the elements of K for the system to be stable. *10*

4. Find Z-transform of the discrete ramp function *10*

$$g(K) = K, \quad K \geq 0$$
$$= 0, \quad K < 0$$

5. Consider the second order system of Figure 2 wherein it is desired to find optimum damping factor (ζ) which minimizes the integral square error i.e. *10*

$$J = \int_0^\infty e^2(t)\,dt$$

for the initial condition

$$c(0) = 1,\ c(0) = 0$$

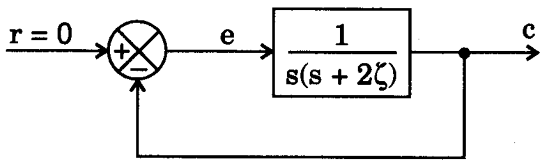

Figure 2

6. Determine the controllability and observability of the system described by the state equation. Find out the transfer function and draw the block diagram. *10*

$$\dot{x}(t) = \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -3 \end{bmatrix} x(t) + \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix} u(t),$$

$$y(t) = [1\ \ 0\ \ 2]\ x(t)$$

7. Obtain the state transition matrix in the form e^{At} and determine the time response for the system,

$X = Ax$ where $A = \begin{bmatrix} 0 & 1 \\ -2 & 0 \end{bmatrix}$ and $x_1(0) = 1$, $x_2(0) = 10$. *10*

8. (a) Define the term fuzzy logic and algorithms. 5

(b) Discuss about the "Steady-State Riccati-Equation". 5

9. (a) Define the term Controllability and Observability of a discrete time system. 5

(b) Discuss system analysis by phase-plane method. 5

10. Consider the system shown in figure 3. This system involves complex poles.

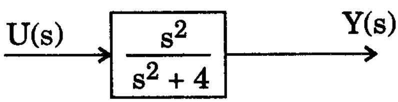

Figure 3

Determine whether the system is stable or asymptotically stable in the sense of Lyapunov. 10