

**B.Tech. - VIEP - ELECTRICAL ENGINEERING
(BTELVI)****Term-End Examination**

00243 December, 2016

BIEEE-017 : ADVANCED CONTROL SYSTEM*Time : 3 hours**Maximum Marks : 70*

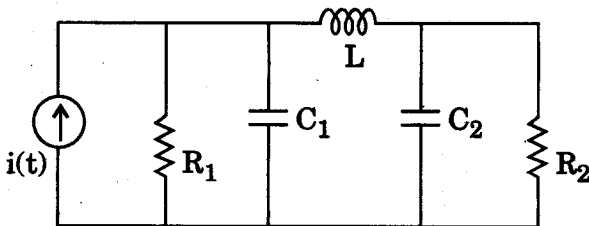
Note : Attempt any five questions. All questions carry equal marks. Symbols used have their usual meaning. Use of scientific calculator is permitted.

1. (a) Write the state variable formulation of the network shown in Figure 1. Assume

$$R_1 = R_2 = 1 \Omega; L = 1 \text{ H}$$

$$C_1 = C_2 = 1 \text{ F.}$$

7

*Figure 1*

- (b) A system is characterised by the transfer function

$$\frac{Y(s)}{U(s)} = \frac{2}{s^3 + 6s^2 + 11s + 6}$$

Represent the state model in Diagonal Canonical form.

7

2. (a) Show that the following system is uncontrollable :

7

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -0.5 & 0 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u \text{ and}$$

$$y = \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

- (b) Explain the principles of duality with reference to state controllability and observability.

7

3. (a) What is a sampler ? Explain. Also discuss the quantization, and sample and hold circuit.

7

(b) Consider the system shown in the Figure 2.

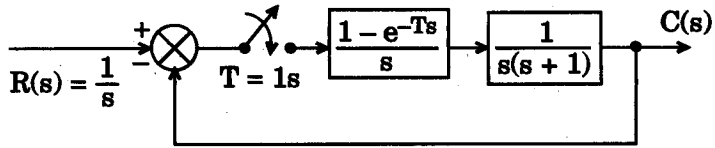


Figure 2

Suppose a gain factor K is added to the plant. Determine the range of K for stability using Jury test. Determine the s -plane frequency at which the system will oscillate when marginally stable.

7

4. (a) Explain the following terms :

7

- (i) Positive definiteness
- (ii) Negative definiteness
- (iii) Semi-definiteness

(b) Consider a linear homogeneous system

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

Formulate Lyapunov's function to test the stability of the system from the first principle.

7

5. (a) What are inherent non-linearities ? Explain these non-linearities.

7

(b) What is the significance of phase plots ? Explain the various steps of plotting phase plane trajectories by isocline method.

7

6. (a) Define describing function and obtain its expression. What are the assumptions made to analyse a function by describing function method? 7
- (b) Find out the singular points for the following system :
$$\ddot{y} - 8\dot{y} + 17y = 34$$
Sketch the phase portrait. 7
7. (a) State and explain Riccati equation. 7
- (b) State and explain Hamilton-Jacobi equation. 7
8. (a) With a neat diagram, give the scheme for self-tuning control system. 7
- (b) Define the term performance index as used in self-adaptive control system. Give its general characteristics. 7
-