

**B.Tech. - VIEP - ELECTRICAL ENGINEERING
(BTELVI)**

00525 Term-End Examination
June, 2019

BIEEE-017 : ADVANCED CONTROL SYSTEM

Time : 3 hours

Maximum Marks : 70

Note : Attempt any five questions. All questions carry equal marks. Use of scientific calculator is permitted. Assume data if necessary, wherever required.

1. (a) Derive the solution for non-homogeneous state equation $\dot{X}(t) = AX(t) + BU(t)$ and identify forced response and initial condition response. 7

(b) Using phase variables as state variables, construct phase variable canonical representation for a system characterized by the differential equation

$$\ddot{y} + 6\dot{y} + 11y = u.$$

7

2. (a) Draw the structure for discrete data control system and discuss the functioning of the following :

7

(i) D/A and A/D converters

(ii) Sample and Hold device

(b) Consider the characteristic polynomial

$$F(z) = 2z^4 + 7z^3 + 10z^2 + 4z + 1.$$

Calculate the stability using Jury stability criterion.

7

3. (a) Explain the properties of the non-linear systems. With neat sketches, discuss

(i) ON-OFF relay with dead zone, and

(ii) Backlash.

10

(b) Determine the kind of singularity for the following differential equation :

4

$$\ddot{y} + 3\dot{y} + 2y = 0$$

4. Given the system :

$$\dot{X}(t) = \begin{bmatrix} -2 & 1 \\ 1 & -2 \end{bmatrix} X(t) + \begin{bmatrix} 1 \\ 1 \end{bmatrix} U(t) \quad Y(t) = [1 \ 0] X(t)$$

- (a) Obtain a state diagram in signal flow graph form.
- (b) Determine the transfer function for the system.
- (c) Solve the state equation given and find zero-input response to initial condition $X(0) = [1 \ 1]^T$.
- (d) Obtain the zero-state response to unit-step input.

$$4 \times 3 \frac{1}{2} = 14$$

5. (a) Derive the Riccati equation of continuous time linear state regulator. 7

(b) The system $\dot{x} = -x + u$ is to be transferred from $x(0) = 5$ to $x(1) = 0$ such that performance index

$$J = \frac{1}{2} \int_0^1 (\dot{u})^2 dt$$

is minimized. Find the optimal control. 7

6. (a) Discuss the role of membership function in the design of fuzzy logic system. 7
- (b) Explain with neat diagram, Model Reference Adaptive Control. 7
7. (a) Explain the concept of controllability and observability, with the conditions for complete controllability and observability. 7
- (b) Discuss Lyapunov's stability theorem for continuous time system. 7
-