

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

Term-End Examination

June, 2017

00504

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.

1. (a) What are the merits of state space approach ? Define state, state variables and state space. 7

(b) Obtain the output response $y(t)$ of the following system :

$$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} -1 & -0.5 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0.5 \\ 0 \end{bmatrix} u(t),$$

$$y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}, \quad \begin{bmatrix} x_1(0) \\ x_2(0) \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

where $u(t)$ is the unit-step input defined for time $t \geq 0$. 7

2. (a) Define controllability and observability. Find the controllability of the system with

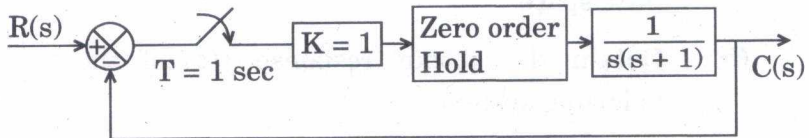
system matrix $A = \begin{bmatrix} 3 & 0 \\ 2 & 4 \end{bmatrix}$ and input

matrix $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$.

- (b) In any dynamical system, prove that the necessary and sufficient condition for arbitrary pole placement in that system is completely state controllable.

3. (a) What is a hold device ? How is it contributing in digital control design ?

- (b) Determine the closed loop stability of the system shown below when $K = 1$:



4. (a) What is a phase plane plot ? Describe any one method of drawing a phase plane plot.

- (b) Apply the Lyapunov method to check the stability for a discrete time system.

$$x_1(k + 1) = 2x_1(k) + 0.5x_2(k) - 5$$

$$x_2(k + 1) = 0.8x_2(k) + 2$$

5. (a) Explain the properties of non-linear systems. With neat sketches, explain the following : 7

(i) Relay with dead zone

(ii) Backlash

(iii) Saturation

(b) What are singular points and how are they classified ? 7

6. (a) In optimal control design, explain the fixed end point problem and derive the Euler-Lagrange equation. 7

(b) Given a second order plant

$$\dot{x}_1(t) = x_2(t), \quad x_1(0) = 2$$

$$\dot{x}_2(t) = -2x_1(t) + x_2(t) + u(t), \quad x_2(0) = -3$$

and the performance index is

$$J = \frac{1}{2} \int_0^{\infty} [2x_1^2(t) + 6x_1(t)x_2(t) + 5x_2^2(t) + 0.25u(t)] dt.$$

Obtain the feedback optimal control law. 7

7. (a) With a suitable example, explain the architecture of an Artificial Neural Network. Describe Pitts model. 7
- (b) Explain the Fuzzy Inference System. Differentiate between the Mamdani model and Sugeno model. 7
8. Write short notes on any *two* of the following : $2 \times 7 = 14$
- (a) Genetic Algorithm
- (b) Bilinear Transformation
- (c) Linearization around an Operating Point
-