

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

**Term-End Examination**

00936

**June, 2016**

**BIEEE-017 : ADVANCED CONTROL SYSTEM**

*Time : 3 hours*

*Maximum Marks : 70*

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

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1. (a) Determine the solution of state model

$$\dot{x} = Ax + Bu, y = Cx$$

Also draw the block diagram for the given state model.

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- (b) Consider the following transfer function :

$$\frac{Y(s)}{U(s)} = \frac{2s^2 + 6s + 7}{(s + 1)^2 (s + 2)}$$

Represent it in Jordan Canonical form.

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2. (a) The dynamic equations of a system are given as

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

$$\mathbf{y} = [1 \quad 0] \begin{bmatrix} \mathbf{x}_1 \\ \mathbf{x}_2 \end{bmatrix}$$

Test the controllability and the observability of the system. 7

- (b) Explain the procedure for designing state observer. 7

3. (a) Find out the response of the system described by the difference equation

$$\mathbf{x}(k+2) - 5\mathbf{x}(k+1) + 6\mathbf{x}(k) = \mathbf{u}(k)$$

Given that  $\mathbf{x}(0) = 0$  and  $\mathbf{x}(1) = 1$ . 7

- (b) Explain the bilinear transformation with its significance. 7

4. (a) Discuss the concept of Lyapunov's first and second method of stability theorems. 7

- (b) Determine whether the following quadratic form is positive definite : 7

$$Q(\mathbf{x}_1, \mathbf{x}_2, \mathbf{x}_3) = 10\mathbf{x}_1^2 + 4\mathbf{x}_2^2 + \mathbf{x}_3^2 + 2\mathbf{x}_1\mathbf{x}_2 - 4\mathbf{x}_2\mathbf{x}_3 - 4\mathbf{x}_1\mathbf{x}_3.$$

5. (a) Explain self-tuning regulators in detail. 7
- (b) Verify that for the backlash non-linearity as shown in figure 1, the describing function  $N$  in case sinusoidal input is given by

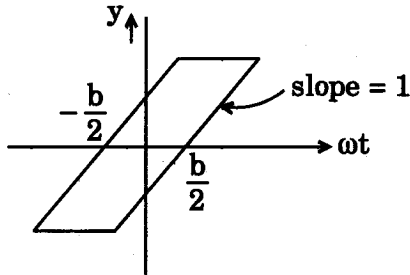


Figure 1

$$N = \sqrt{\left(\frac{A_1}{x}\right)^2 + \left(\frac{B_1}{x}\right)^2} \frac{\tan^{-1} \frac{B_1}{A_1}}{A_1} \text{ for}$$

$|x| > \frac{b}{2}$ . Also sketch the curve  $y$  vs  $\omega t$ . 7

6. (a) Find out the singular points for the following system :

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

Sketch the phase portrait. 7

- (b) Discuss the stability criteria in terms of describing function. 7

7. (a) State and explain the optimality principle and principle of invariant imbedding. 7

- (b) State the two point boundary value problem and give its solution in terms of Euler-Lagrange equation. 7

8. (a) What do you understand by Adaptive Control ? Explain the features of Model Reference Adaptive Control. 7
- (b) Draw the block diagram of simple fuzzy logic control system and explain the various blocks. 7
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