No. of Printed Pages : 3

BIEEE-002

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

00826

Term-End Examination

June, 2015

BIEEE-002 : DIGITAL CONTROL SYSTEM

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **seven** questions. All questions carry equal marks. Use of scientific calculator is allowed.*

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1. Derive the impulse response of a first order hold from fundamentals in terms of ω and T. *10*

2. (a) State and prove Right Shift (Time delay) Theorem with function f(t) and its Z-transform, F(z). *5*

   (b) State and prove the Final Value Theorem with function f(t) and its Z-transform, F(z). *5*

3. Explain Routh stability criterion on r^{th} plane used to analyse the stability of discrete system. *10*

4. Given the transfer function

$$\frac{Y(z)}{R(z)} = \frac{0 \cdot 3679\ z + 0 \cdot 2642}{z^2 - 2 + 0 \cdot 6321}$$

obtain the linear constant coefficient difference equation. *10*

5. Derive the expression for steady state error in the output of a type-1 discrete system in z-domain in case of unit ramp input. *10*

6. A discrete-time system has state equation given by

$$x(k+1) = \begin{bmatrix} 0 & 1 \\ -10 & -7 \end{bmatrix} x(k).$$

Find out its State Transition Matrix. *10*

7. A second order digital control system is represented by

$$\bar{x}(k+1) = \bar{A}\,\bar{x}(k) + \bar{B}\,\bar{u}(k)$$

$$\text{where } A = \begin{bmatrix} 1 & -1 \\ 0 & 1 \end{bmatrix}, B = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

Obtain the feedback gain matrix G with state feedback control law

$$u(k) = -Gx(k)$$

to place the closed loop eigenvalues at $z_1 = 0{\cdot}4$ and $z_2 = 0{\cdot}6$. *10*

8. Consider the following characteristic equation of a discrete data system :

$$z^3 + 3{\cdot}3\,z^2 + 4z + 0{\cdot}8 = 0$$

Apply Jury's test and comment upon the stability of the system. *10*

9. A discrete data control system is given as :

$$\bar{x}(k+1) = \bar{A}\,\bar{x}(k) + \bar{B}\,\bar{u}(k)$$

$$\text{where } A = \begin{bmatrix} 0 \cdot 5 & 0 \\ 0 & 0 \cdot 2 \end{bmatrix}, B = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

The state feedback control law is

$$\bar{u}(k) = -G\,\bar{x}(k)$$

Obtain the optimal control $u^o(k)$ to minimize the performance index

$$\Delta V(x) = V[x(k+1)] - V[x(k)]$$

where V(x) is the Lyapunov function such that $V(x) = x'(k)Px(k)$. 10

10. Write short notes on any ***four*** of the following : $4 \times 2\frac{1}{2} = 10$

(a) Shannon's Sampling Theorem

(b) Eigenvectors

(c) The Cayley Hamilton Theorem Method

(d) Complete Observability

(e) Phase Lag-Lead Controllers

(f) Pole Placement by State Feedback