BIEEE-002

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

### Term-End Examination

ᑎᑎ959

### December, 2017

## 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.*

1. Prove that the bilinear transformation maps the left-half of the s-plane into the unit circle in the z-plane. The transformation $z = e^{sT}$ also maps the left-half of the s-plane into the unit circle in the z-plane. What is the difference between the two maps ? *10*

2. Determine the inverse z-transform of

$$G(z) = \frac{z + 0.5}{(z - 0.5)(z - 1)^2}.$$ *10*

3. Predict the nature of the transient response of a discrete time system whose characteristic equation is given by

$$z^2 - 1.9z + 0.9307 = 0.$$

The sampling interval $T = 0.02$ seconds. *10*

4. Consider the system

$$\begin{bmatrix} x_1 (k + 1) \\ x_2 (k + 1) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 (k) \\ x_2 (k) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} (-1)^k$$

$$x_1(0) = x_2(0) = 1$$

$$y(k) = x_1(k)$$

Determine $y(k)$ for $k \geq 1$. *10*
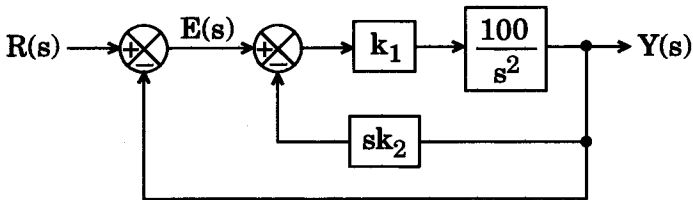
5. Consider Figure 1 in which $R(s) = \dfrac{1}{s}$.



*Figure 1*

Determine the optimal values of $k_1$ and $k_2$ such

that $J = \displaystyle\int_0^\infty \left[ e^2(t) + 0.25u^2(t) \right] dt$ is minimized. *10*

**6.** A linear dynamic time-invariant system is represented by

$$x(k+1) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} x(k) + \begin{bmatrix} 0 & 1 \\ 0 & 0 \\ 1 & 0 \end{bmatrix} u(k).$$

Determine whether the system is completely controllable or not. *10*

**7.** Discuss the design of a digital control system with state feedback. *10*

**8.** Prove that a discrete-time system obtained by zero-order-hold sampling of an asymptotically stable continuous time system is also asymptotically stable. *10*

**9.** Write short notes on any *two* of the following : *2×5=10*

   (a)  Jury's Stability Criterion

   (b)  Advantages of Digital Control

   (c)  Principle of Optimality

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