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**BIEEE-002**

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

## Term-End Examination

## December, 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. Missing data, if any, may be suitably assumed.*

**1.** Determine the Z-transform of the following discrete sequences : *2×5=10*

(a) $f(k) = u(k)$

(b) $f(k) = \left(\frac{1}{2}\right)^k u(k)$

**2.** Consider the digital control system as shown in Figure 1. The transfer function of the plant is $G(s) = \frac{1}{s(s+1)}$. Design a lead compensator D(z) in the w-plane such that the phase margin is 50°, the gain margin is at least 10 dB, and the velocity error constant $K_v$ is 2. Assume that the sampling period is 0·2 sec. *10*

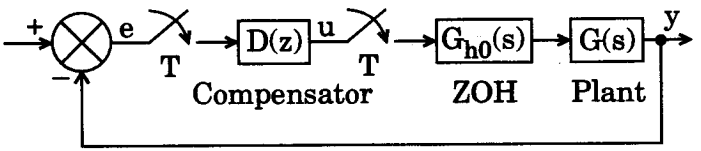


*Figure 1*

**3.** Determine the inverse Z-transform of the following functions : *2×5=10*

(a) $F(z) = \dfrac{3z^2 + 2z + 1}{z^2 - 3z + 2}$

(b) $F(z) = \dfrac{z - 4}{(z-1)(z-2)^2}$

**4.** Obtain the state variable model of the given transfer function in Jordan canonical form : *10*

$$G(s) = \frac{s+3}{(s+2)^2(s+5)}.$$

**5.** Consider a unity feedback system with the plant

$\dot{x} = Ax + bu,$

$y = cx,$

where $A = \begin{bmatrix} 0 & 1 \\ 0 & -2 \end{bmatrix}, b = \begin{bmatrix} 0 \\ k \end{bmatrix}, c = \begin{bmatrix} 1 & 0 \end{bmatrix}.$

Find the range of values of k for which the closed-loop system is stable. *10*

**6.** Investigate the controllability of the following system : *10*

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

$$y(k) = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} x(k)$$

7. Determine the stability of the following system by solving Lyapunov matrix equation : *10*

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

8. Determine the stability of the sampled data control system described by the following characteristic equation : *10*

$$z^3 - 0{\cdot}2z^2 - 0{\cdot}25z + 0{\cdot}05 = 0$$

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

   (a) Discrete Euler-Lagrange equation for optimal digital control system

   (b) Root locus plots

   (c) Stability of discrete system