No. of Printed Pages : 4

BIEEE-009

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

Term-End Examination

December, 2016

00243

BIEEE-009 : DIGITAL CONTROL SYSTEM DESIGN

Time : 3 hours *Maximum Marks : 70*

Note :

*(i) Attempt any **seven** questions.*

(ii) All questions carry equal marks.

(iii) Symbols used have their usual meaning.

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1. (a) What is linear discrete time system ? Define the stability of a discrete time system. 5

(b) Determine the z-transform function of the system shown in the Figure 1.

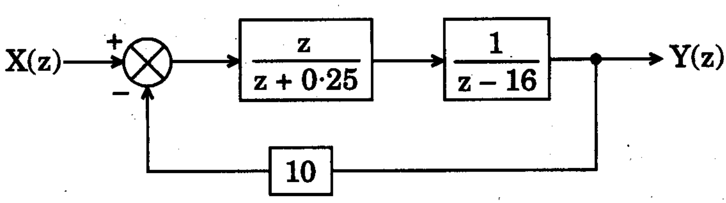

Figure 1

Also determine whether or not the system is stable. 5

2. (a) Explain the difference between Zero order hold and First order hold. *5*

(b) Prove that if the impulse response of the continuous time systems and discrete time systems has to be matched, then $z = e^{sT}$, where T is the sampling period. *5*

3. (a) Why should a hold device follow a sampler while converting a continuous changing function into sampled form ? *5*

(b) Determine the range of values of the sampling time T for which the system shown in Figure 2 will be stable. *5*

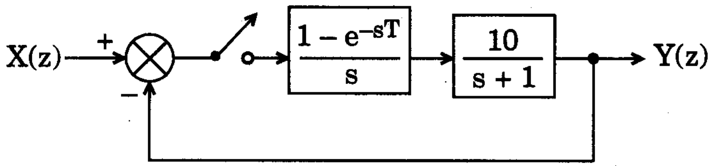

Figure 2

4. Determine the characteristic equation of the system shown below in z-domain. Ascertain the stabillity using a bilinear transformation and Routh array. *10*

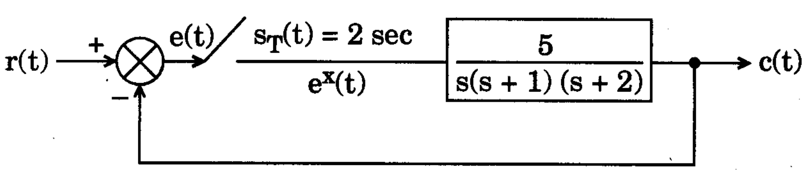

Figure 3

5. The digital compensator of a closed-loop computer control system is described by the difference equation

$$e_2(k+1) + a\, e_2(k) = b e_1(k).$$

The state variable model of the system is given by

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

$$y = cx$$

with $A = \begin{bmatrix} 0 & 1 \\ 0 & -1 \end{bmatrix}$; $b = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$; $c = [1 \;\; 0]$.

Obtain the discrete time state model for the system. 10

6. (a) State Cayley-Hamilton theorem. 5

(b) Given the matrix $F = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}$.

Determine $\phi(k) = F^k$ using Cayley-Hamilton technique. 5

7. Consider the system

$$x(k+1) = F\, x(k) + g\, u(k)$$

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

with $F = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$; $g = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$

$x(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ and $u(k) = (-1)^k$.

Find the closed form solution for y(k) for $k \geq 1$. 10

8. (a) Explain when a linear system is said to be completely controllable and completely observable. *5*

(b) The transfer function of an oscillator system is given by

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

Show that both controllability and observability are lost for $\omega T = n\pi$, where $n = 1, 2, \ldots$ and T is the sampling period. *5*

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

(a) Advantages and disadvantages of digital control system

(b) Simulation diagram for discrete version

(c) Routh Stability Criterion

(d) Pole Placement Design