[06 – 4123]

IV/IV B.E. DEGREE EXAMINATION.

First Semester

Electrical and Electronics Engineering

DIGITAL CONTROL SYSTEMS

(Common with Dual Degree Programme in EEE)

(Effective from the admitted batch of 2006–2007)

Time : Three hours Maximum : 70 marks

First question is compulsory.

Answer any FOUR from the remaining questions.

All questions carry equal marks.

1. (a) Differentiate between zero-order hold and first-order hold circuits with suitable examples.

(b) Illustrate the role of ZT in digital control systems.

(c) Evaluate the final value of the function.

$$X(z)=\frac{2-4z}{z-0.5}.$$

7. (a) Find the eigen values, eigen vector and Jordan- form representations for the matrix :

$$\begin{bmatrix} 4 & 1 & -2 \\ 1 & 0 & 2 \\ 1 & -1 & 3 \end{bmatrix}.$$

(b) State and explain the conditions to be satisfied for state controllability and observability.

8. Write short notes on the following :

(a) Fractional hold device.

(b) Solution of non-homogeneous state equations.

(c) Observability and its testing.

(d) Prove that it is possible to map the left half S-plane into the region within a unit circle in the Z-plane.

(e) What is bilinear transformation?

(f) Define State Transition Matrix.

(g) Give the state diagram for the differential equation $\frac{d^2x}{dt^2} + 3\frac{dx}{dt} + 2x = r$.

2. (a) State and explain Sampling theorem.

(b) Derive the transfer function of zero-order hold and first-order hold. Draw input and output characteristics. Describe their features.

3. (a) Find the Z-transform of the following functions.

(i) $e^{-5t}.Sin4t$

(ii) $\frac{a^2}{s^2(s+a)^2}$.

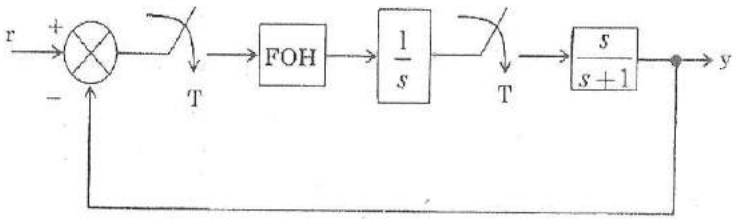
(b) Determine the inverse Z-transform of the following function

$$X(z) = \frac{3z^2 + z + 1}{z^2 - 3z + 2}.$$

(c) State the convolution property of Z-transform.

4. (a) A system has $G(z)=\frac{z-1}{z+1}$. Draw the closed loop configuration.

(b) Find the transfer functions of the following closed loop digital control system.



5. (a) Describe briefly the stability tests of a digital system.

(b) Check if all the roots of the following characteristic equations lie within the unit circle.

(i) $z^3 - 0.2z^2 - 0.25z + 0.05 = 0$

(ii) $z^4 - 1.7z^3 + 1.04z^2 - 0.268z + 0.024 = 0$.

6. (a) Explain Bilinear Transformation method of converting an analog system to a digital system. Derive the mapping formula.

(b) In the mapping $Z = e^{TS}$, prove that a stable analog system results in a stable digital system.