Code No: 157BE **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech IV Year I Semester Examinations, July/August - 2022
DIGITAL CONTROL SYSTEMS
(Electrical and Electronics Engineering)

Time: 3 Hours **Max.Marks:75**

Answer any five questions
All questions carry equal marks
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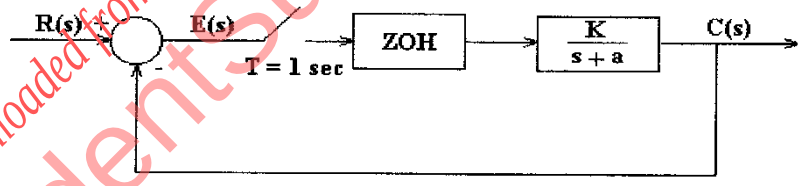
1.a) With neat sketches, explain the principle of sample and hold circuit.
b) Find ZOH equivalent transfer function of 10/ (5s+1) obtained with the sampling period of T_s = 0.5 sec. [7+8]

2. What is sampling? Discuss various types of sampling operations. [15]

3.a) Determine the z-transform of the following:
i) $F(s) = \frac{5}{s(s+3)^2}$ ii) $f(t) = e^{-2t}\cos 4t$
b) Obtain the relation between s-plane and z-plane. [10 +5]

4.a) State and explain Jury stability test.
b) Obtain the closed loop pulse transfer function of the following system shown in figure below. [6+9]



5.a) Determine the controllability of a discrete time control system given below.

$$X(k+1)\,T = \begin{bmatrix} \cos\omega T & \sin\omega T \\ -\sin\omega T & \cos\omega T \end{bmatrix} X(kT) + \begin{bmatrix} 1-\cos\omega T \\ \sin\omega T \end{bmatrix} u(kT) \text{ and}$$

$$Y(kT) = [1 \quad 0]\, X(kT)$$

b) Explain the controllability and observability applied to discrete time control systems. Can you say that duality exists between them? [8+7]

6.a) State and explain Lyapunov stability applied in stability analysis of discrete time control systems.
b) Investigate the controllability and observability of the following system

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

$$\begin{bmatrix} y_1(k) \\ y_2(k) \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix}$$

[7+8]

7. Consider the system: $X(k+1) = F\,X(k) + G\,u(k)$ and $y(k) = C\,X(k)$, where

$$F = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -3 & -2 & -1 \end{bmatrix};\ G = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix};\ C = [1 \quad 0 \quad 0]$$

Determine a suitable state feedback gain matrix K such that the system will have the closed loop poles at $Z = (0.5 \pm j\,0.3)$ and $Z = 0.8$. [15]

8. Explain the design procedure of Fast Output Sampling (FOS) and periodic output feedback controller for discrete time systems. [15]

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