Code No: **RT42021**

R13

Set No. 1

IV B.Tech II Semester Supplementary Examinations, September - 2020

DIGITAL CONTROL SYSTEMS

(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any THREE questions from Part-B

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PART–A ***(22 Marks)***

1. a) States the sampling theorem. [3]
   b) Obtain the z-transform for ramp function. [3]
   c) States the controllability in digital control system. [4]
   d) Obtain the relationship between z- and s-domain. [4]
   e) Derive the transfer function of lead compensator. [4]
   f) Obtain the Ackermann's formula for state feedback gain matrix 'K'. [4]

PART–B ***(3x16 = 48 Marks)***

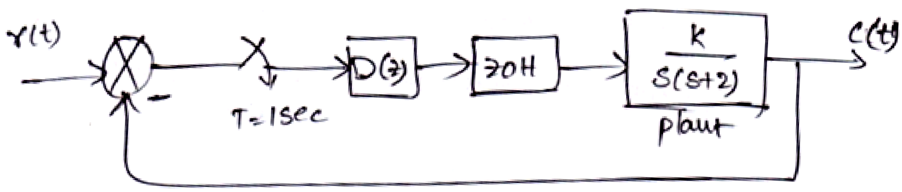
2. a) Explain the implementation problems in digital control. [8]
   b) Describe the zero order hold with necessary diagrams and equations. [8]

3. a) Determine the Z-transform for the following [9]
   i). $F(s)=\frac{8(S+1)}{S(S+2)}$ ii). $F(s)=\frac{1}{S^2(S+2)}$ and iii). $f(t)=t\sin\omega t$
   b) Determine the inverse Z-transform of $\frac{4Z^2-Z}{Z^3-3Z^2+7Z-1}$ [7]

4. Obtain the state model of the following difference equation. Also determine its state transition matrix [16]
   y(k+2)+2y(k+1)+3y(k)=u(k+1)+4u(k)
   Assuming initial conditions are zero.

5. a) Explain the mapping between S-plane and Z-plane with necessary diagrams and equations. [8]
   b) Test the stability conditions of the digital systems that are represented by the characteristic equation $Z^4-4Z^3+Z^2-3Z+2=0$ [8]

6. Design a lag compensator D(z) in ω-plane for the following system to meet the given specifications [16]
Damping ratio is 0.5
Settling time is 1.3 sec
Velocity error constant is 3.0 sec^{-1}



7. Consider the state equation of the system is given by [16]

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

$$where\ \ A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 1 & 0 \\ -1 & -2 & -3 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$$

Compute **k** so that the control law $u = -kx.$ place the closed loop poles at $-1 \pm j2, -3.$ Given the state variable model of the closed loop system.