Code No: **R42021** **R10** **Set No. 1**

IV B.Tech II Semester Supplementary Examinations, April - 2018

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) Sketch the signal $x(t) = e^{-t}$ for an interval $0 \le t \le 2$. Sample the signal with a sample period T=0.2 sec and sketch the discrete time signal. [4]
   b) Define with neat sketch (i) Periodic signal (ii) Nondeterministic signals. [4]
   c) Whether the following signals are periodic or not.
   (i) $3\cos(17\pi t + \pi/3) + 2\sin(19\pi t - \pi/3)$
   (ii) $u(t) - u(t-10)$
   (iii) $Cos(1/3\,t) + \sin(1/4\,t)$ [7]

2. a) What is z-transform and its limitations? Explain the initial and final value theorems. [7]
   b) Find the inverse z-transforms of the following functions.
   (a) $\frac{3z^2+2z+1}{z^2-3z+2}$ (b) $\frac{z-4}{(z-1)(z-2)^2}$ [8]

3. a) State and prove the sampling theorem. [7]
   b) What do you mean by D/A conversion? Explain any one method with neat sketch. [8]

4. a) The input-output of a sampled data system is described by the difference equation $y(k+2) + 3y(k+1) + 4y(k) = r(k+1) - r(k)$. Determine the pulse transfer function. [8]
   b) For a homogenous system given by
   $$X(k+1) = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X(k)$$
   Obtain state transition matrix $\psi(k)$. [7]

5. Consider the system defined by,
   $$\begin{pmatrix} x_1(k+1) \\ x_2(k+1) \end{pmatrix} = \begin{pmatrix} a & b \\ c & d \end{pmatrix} \begin{pmatrix} x_1(k) \\ x_2(k) \end{pmatrix} + \begin{pmatrix} 1 \\ 1 \end{pmatrix} u(k);\ y(k) = (1 \quad 0) \begin{pmatrix} x_1(k) \\ x_2(k) \end{pmatrix}$$
   Determine the condition on a, b, c and d for complete state controllability and complete observability. [15]

6. a) Write the necessary and sufficient conditions for jury stability test and draw the jury table. [7]
   b) Examine the stability of the following characteristic equation.
   $(i)\ P(z) = z^4 - 1.2z^3 + 0.07z^2 + 0.3z - 0.08 = 0$
   $(ii)\ P(z) = z^3 - 1.1z^2 - 0.1z + 0.2 = 0$ [8]

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7. A block diagram of a digital control system is shown in the figure.1 Design a compensation D(z) to meet the following specifications.
   i) Velocity error constant, $K_v \geq 3\text{sec}^{-1}$
   ii) Phase Margin $\geq 50^0$
   iii) Band Width = $1.1 rad/\text{sec}$

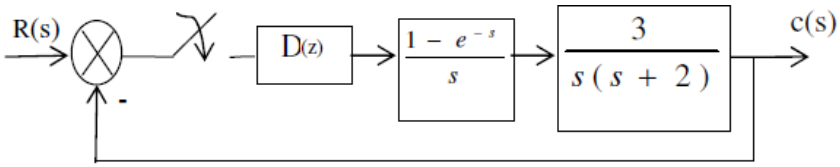

Figure.1 [15]

8. a) Prove Ackermann's formula for the determination of the state feedback gain matrix K. [7]
   b) Consider the system $x(k+1) = Gx(k) + Hu(k)$

$$G = \begin{bmatrix} 0 & 1 \\ -0.16 & -1 \end{bmatrix}, H = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

Determine a suitable state feedback gain matrix 'k' such that the system will have the closed loop poles at $z = 0.5 \pm j0.5$. [8]