Sem VIII / Digital Control System / INST (DCS) 26-05-15

QP Code : 8164

(3 Hours) **[Total Marks : 100**

N.B.

1. Q.1 is compulsory. Attempt any four from the remaining questions.
2. All questions carry equal marks.
3. Figures to the Right indicate full marks.
3. Assume suitable data if necessary

Q.1 Attempt any four — 20

a. Explain digital control system with neat block diagram.

b. State sampling theorem. What are the undesirable characteristics that may be exhibited in response if sampling theorem is not satisfied?

c. Specify the region in *z plane* that corresponds to the shaded region in *s plane* as shown in Fig. 1.

d. Explain controllability and observability of the system.

f Explain sampler as an impulse modulator.

e. Explain various types of continuous and discrete time signals.

Q.2 A. Obtain the pulse transfer function with sampling rate $T_s = 1sec.$ for the system shown in Fig.2. — 10

B. Determine the stability of the system having characteristic equation — 10

$$P(z) = z^3 - z^2 - 0.19z + 0.28 = 0$$

using Routh's Stability criterion.

Q.3 A. Derive the transfer function for the ZOH. — 10

B. Determine controllability and observability for the following system — 10

$$x(k+1) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0.24 & -1.28 & 2.1 \end{bmatrix} x(k) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(k)$$

$$y(k) = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} x(k)$$

Q.4 A. Obtain the pulse transfer function for the digital control system described by — 10

$$x(k+1) = Gx(k) + Hu(k)$$
$$y(k) = Cx(k) + Du(k)$$

B. Represent the following system into the observable canonical form. — 10

$$G(z) = \frac{z^2 - 1.2z + 0.35}{z^3 - 0.7z^2 + 0.14z - 0.008}$$

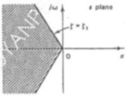

Fig. 1

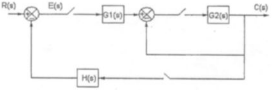

Fig. 2

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Q.5 A. Obtain the solution to the system of equation $x(k+1) = \begin{bmatrix} 0.5 & 0 \\ 0 & -0.1 \end{bmatrix} x(k)$. Assume initial condition $x(0) = (1, 0)'$ and sampling time $1sec$. 10

B. Prove using similarity transformation that state space representation is not unique. Also prove the invariance of eigenvalues under the similarity transformation. 10

Q.6 A. Design the state feedback control for the following system to place the poles at 0.5 and 0.2. 10

$$\Phi(k+1) = \begin{bmatrix} 0 & 1 \\ -0.88 & -1.9 \end{bmatrix} \Phi(k) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} \Gamma(k)$$

B. Determine the stability of the system using Lyapunov equation. 10

$$x(k+1) = \begin{bmatrix} 0 & 1 \\ -1.5 & 2.5 \end{bmatrix} x(k)$$

Q.7 A. Derive the state transition matrix via recursion for the system 10

$$x(k+1) = Gx(k)$$

B. Explain pole placement method using ackermann's formula 10

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