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FIRST SEMESTER | M.Tech [C&I]

Supp. EXAMINATION Feb 2019

EE-562 Discrete Data System & Digital Control

Time: 3:00 Hours | *Max. Marks :100*

Note: Attempt any five questions. Assume suitable missing data, if any.

Q1 [a] Obtain the state space (State Model) representation for the armature controlled DC motor. (10)

1[b] A system is described by the following differential equation. Represent the system in phase variable form: (10)

$$\frac{d^3x(t)}{dt^3} + 3\frac{d^2x(t)}{dt^2} + 4\frac{dx(t)}{dt} + 4x(t) = u_1(t) + 4u_2(t) + 6u_3(t)$$

Outputs are

$$y_1(t) = 4\frac{dx(t)}{dt} + 3u_1(t)$$

$$y_2(t) = \frac{d^2x(t)}{dt^2} + 4u_2(t) + u_3(t)$$

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Q.2 [a] Solve the difference equation (10)

$$c(k+2) + 3c(k+1) + 2c(k) = u(k);\ c(0) = 1$$
$$c(k) = 0\ for\ k < 0.$$

2 [b] Determine the inverse Z-transform f(k) for the function (10)

$$F(z) = \frac{-10(11z^2 - 15z + 6)}{z^3 - 4z^2 + 5z - 2}\ ;\ for\ all\ k \geq 0.$$

Q.3 [a] Find c(k) for the sampled data control system shown in figure 1. (10)

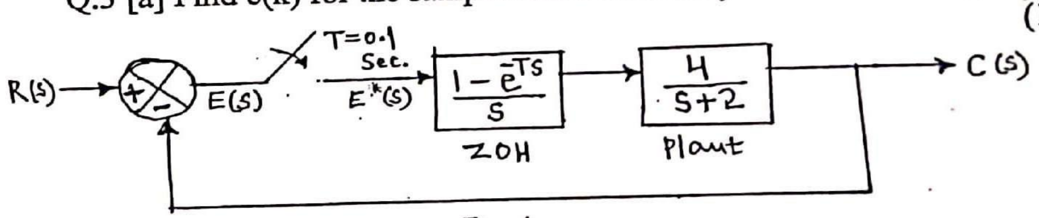

Fig.1

3 [b] For a system represented by the state equation (10)

$\dot{X}(t)=AX(t)$

the response of

$X(t)=\begin{bmatrix} e^{-2t} \\ -2e^{-2t} \end{bmatrix}$ when $X(0)=\begin{bmatrix} 1 \\ -2 \end{bmatrix}$

And

$X(t)=\begin{bmatrix} e^{-t} \\ -e^{-t} \end{bmatrix}$ when $X(0)=\begin{bmatrix} 1 \\ -1 \end{bmatrix}$

Determine the system matrix A and state transition matrix.

Q.4 [a] Discuss the need of sampler and zero order hold devices. Also discuss the sampled data control system with the help of neat diagrams. (10)

4[b]. Determine the stability of the following characteristic equation using Bilinear Transformation. (10)

$$Z^3-0.2Z^2-0.25Z+0.05=0$$

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Q.5 Consider the dynamics of a non-homogeneous system as

$$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$

where u(t) is the unit step function occurring at t =0.

$$y(t) = [1\ 0]X(t)$$

And the initial condition $X(0) = [1\ 0]^T$ (5+10+5)

(a) Determine the STM using the Laplace inverse transform technique.
(b) Determine the solution of state equation
(c) Find the output y(t) at t = 1 sec.

Q.6 A discrete time system is described by state equation (5×4)

$$y(k+2) + 5y(k+1) + 6y(k) = u(k)$$
$$y(0) = y(1) = 0; T = 1\ sec.$$

(a) Determine the state model in canonical form
(b) Find state transition matrix
(c) Determine the state model in phase variable form
(d) For input u(k)=1 for k≥0, find output y(k).

Q.7 Discuss and derive the relationship between the following pl

(a) r plane and s plane
(b) z plane and s plane
(c) s plane and z plane

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