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FIFTH SEMESTER

B.Tech.[EE/EL]

SUPPL. EXAMINATION

Feb *2019*

EE/EL315 DIGITAL CONTROL & STATE VARIABLE ANALYSIS

Time: 3:00 Hours

Max. Marks :50

Note: Attempt any five questions. All questions carry equal marks.
Assume suitable missing data, if any.

1 [a] Obtain the state space (State Model) representation for armature controlled DC motor. (5)

1 [b] A system is described by the following differential equation. Represent the system in phase variable form: (5)

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

Outputs are

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

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

2 [a] Solve the difference equation (5)

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

$$c(k) = 0\ for\ k < 0.$$

2 [b] Discuss the need of sampler and zero order hold devices. Also discuss the sampled data control system with the help of neat diagrams. (5)

3 [a] For a system represented by the state equation (5)

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

the response of

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

3[b] Find the transfer function from the data given below for continuous system. (5)

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

4 [a] Check the stability of the following characteristic equation using Jury's stability test. (5)

$$Z^4 - 1.7Z^3 + 1.04Z^2 - 0.268Z + 0.024 = 0$$

[b] Discuss the advantages of state variable theory over the classical control theory. (5)

5 [a]. Obtain the STM of the following system

$$\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix}$$ (5)

5[b]. Determine the stability of the following characteristic equation using Bilinear Transformation. (5)

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

6 A discrete time system is described by state equation (2.5×4)

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

(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).

7 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 $X(0) = [1\ 0]^T$ (2.5+5+2.5)

(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.

END