6E3109

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B.Tech. VI Sem. (Main & Back) Exam. May/June 2013

Electrical Engg.

6EE 1 Modern Control Theory

Time: 3 Hours **Maximum Marks: 80**

Min. Passing Marks: 24

Instructions to Candidates:

*Attempt any **five questions,** selecting **one question** from **each unit.** All questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.*

Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination.

1._____ 2._____

UNIT – I

Q.1. Define the following.

(i) Linearity [3]

(ii) Relaxedness [3]

(iii) Time Invariance [3]

(iv) Causality [3]

(v) Linear vector space linear Independence [4]

OR

Q.1. (a) Derive the solution of homogeneous state equation. [8]

(b) Consider the homogeneous equation.

$AX = 0$

Where $A = \begin{pmatrix} 0 & 1 & 1 & 2 & -1 \\ 1 & 2 & 3 & 4 & -1 \\ 2 & 0 & 2 & 0 & 2 \end{pmatrix}$

Find the linearly independent solution of this equation. [8]

UNIT – II

Q.2. (a) What are the advantages and disadvantages of state space analysis. [8]

(b) Draw the free body diagram and write the differential equation of the mechanical system shown in figure 1 [8]

Figure 1

OR

Q.2. (a) What are state variables? Give the advantages of modern control theory over conventional control theory. [8]

(b) For the system shown in figure 2, choose the state variable as v_1 (t) and v_2 (t) and write down the state equation.

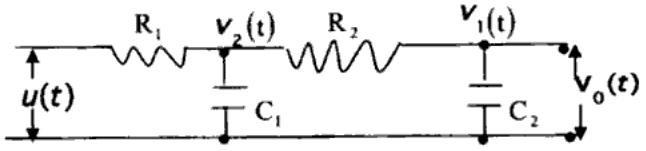

Figure 2 [8]

UNIT – III

Q.3. (a) Explain the procedure to convert a given state model into signal flow graph. [8]

(b) Obtain the transfer function if state model is given by.

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix} u$$

$$Y = \begin{bmatrix}1 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} \quad [8]$$

OR

Q.3. (a) Explain cascade and parallel decomposition in brief. [6]

(b) Construct the state model in Jordan's canonical form for a system whose transfer is given by

$$\frac{Y(s)}{x(s)} = \frac{10}{(s+1)^2(s+2)} \quad [10]$$

UNIT – IV

Q.4. (a) Define diagonalization ? Explain its importance in modern control theory. [8]

(b) Define the following:

(i) Eigen values (ii) Eigen vectors

(ii) State of a system (iv) State transition matrix [8]

OR

Q.4. (a) State the duality between controllability and Observability. [8]

(b) Consider the state equation.

$$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$

Obtain the state transition matrix. [8]

UNIT – V

Q.5. (a) What are the properties of z- transform? Find the relationship between z and s domain. [8]

(b) Find the z- transform of $\{u_n\}$ where

$$\{u_n\} = \begin{cases} 4^n & \text{if } n < 0 \\ 3^n & \text{if } n \geq 0 \end{cases}$$ [8]

OR

Q.5. (a) What is sampling process? Write short note on digital PID controller. [8]

(b) Find the z- transform of the following. [8]

(i) $\frac{a}{(s+a)^2}$ (ii) $e^{-at} \sin \omega t$

By using the property of z- transform.
