6E3109

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6E3109
B. Tech. VI Sem. (Main & Back) Exam., May/June-2014
Electrical Engineering
6EE 1 Modern Control Theory
Common for EX, EE

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 may suitably be assumed and stated clearly.*

Units of quantities used/ calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1.____________ 2.____________

UNIT-I

Q.1 (a) Explain the concept of linear vector space linear Independence. [6]

(b) Are the following sets linearly independent in the field of real numbers? [10]

(i) $\begin{bmatrix} 4 \\ -9 \\ 11 \end{bmatrix}, \begin{bmatrix} 2 \\ 13 \\ 10 \end{bmatrix}, \begin{bmatrix} 2 \\ -4 \\ 1 \end{bmatrix}$

(ii) $\begin{bmatrix} 1+i \\ 2+3i \end{bmatrix}, \begin{bmatrix} 10+2i \\ 4-i \end{bmatrix}, \begin{bmatrix} -i \\ 3 \end{bmatrix}$

OR

Q.1 (a) Consider the following matrix with coefficients in R.

$$L = A = \begin{bmatrix} 3 & 2 & -1 \\ -2 & 1 & 0 \\ 4 & 3 & 1 \end{bmatrix} \qquad b = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

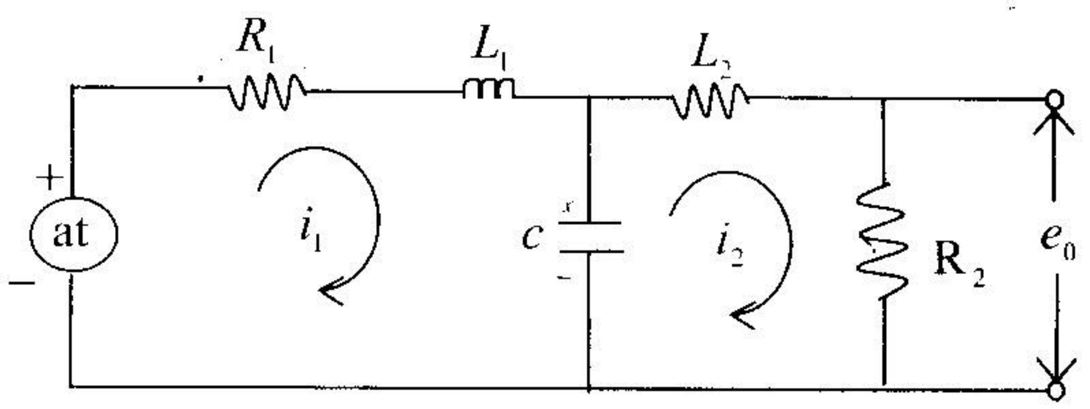
Find the Representation of A with respect to the basis $\{b, Ab, A^2b\}$ [10]

(b) Explain the concept of Linearity & Causality. [6]

UNIT-II

Q.2 (a) Explain the difference between Modern Control theory and Conventional Control theory. [6]

(b) Write state equations for the networks shown below: [10]



OR

Q.2 (a) Construct the state model for a system characterized by the differential equation.

$$\frac{d^3y}{dt^3} + \frac{6d^2y}{dt^2} + \frac{11dy}{dt} + 6y = U$$ [10]

(b) Explain the following terms:

(i) State variables. [3]

(ii) State vector [3]

UNIT-III

Q.3 (a) Derive the transfer function from state-model. [8]

(b) Find out the transfer function:

$$\begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 2 \\ 5 \end{bmatrix} U$$

$$y = [1 \quad 2] \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$$ [8]

OR

Q.3 (a) A feed back system is characterized by the closed loop transfer function-

$$T(s) = \frac{S^2 + 3S + 3}{S^3 + 2s^2 + 3s + 1}$$

Draw a suitable signal flow graph and therefore construct a state model of the systems. [10]

(b) Derive State - Space representation using canonical variable's equation. [6]

UNIT-IV

Q.4 (a) Obtain the state transition matrix $\phi(t)$ for the matrix $A = \begin{bmatrix} 0 & -2 \\ 1 & -3 \end{bmatrix}$ [8]

(b) Obtain the time response of the system-

$$\dot{x} = Ax$$

$$A = \begin{bmatrix} 0 & 1 \\ -2 & 0 \end{bmatrix} \quad X(0) = [1 \quad 1]'$$ [8]

OR

Q.4 (a) Define the concept of Controllability & Observability. [6]

(b) Consider the system with state equation -

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \\ \dot{X}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} U$$

Check the above system whether controllable or not. [6]

(b) Mention the Ackerman's Formula. [4]

UNIT-V

Q.5 (a) Find the relation between S and Z domain and comment on mappings. [8]

(b) Define the initial & final value theorem for Z transform. [8]

OR

Q.5 (a) Write short note on digital P I D Controller and sampled data Control System

[4+4]

(b) Find the Z transform -

(i) $G(s) = \dfrac{10}{s(s+1)(s+3)}$ [3]

(ii) $G(s) = \dfrac{10}{s^2+2s+2}$ [3]

(iii) $f(t) = t^2$ [2]
