

6E3109

Roll No. _____

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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.

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

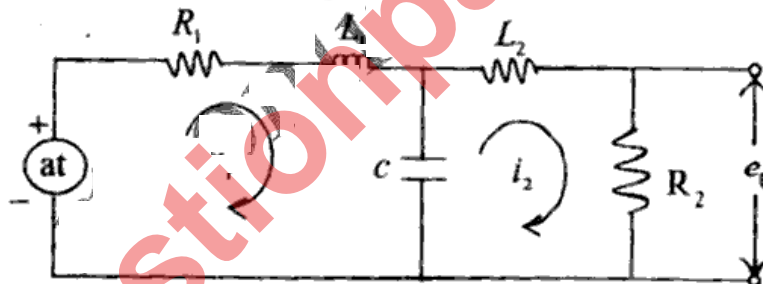
Find the Representation of A with respect to the basis $\{b, Ab, A^2b\}$ [10]

(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.

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

(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:

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 2 \\ 5 \end{bmatrix} U$$

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

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-

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

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 PID Controller and sampled data Control System [4+4]

(b) Find the Z transform -

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

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

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