6E3109

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6E3109

B.Tech. VIth Semester (Main/Back) Examination, June - 2010

Electrical Engineering

6 EE1 Modern Control Theory (Common for EE & EX)

Time : 3 Hours

Maximum Marks : 80

Min. Passing Marks : 24

Instructions to Candidates:

Attempt overall ***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. Calculator.

Unit-I

1. a) Define linear, independence of vectors. What information do they give about the controllability of the system. Define

   i) Bases

   ii) Domain

   iii) Range of a vector space. **(8)**

   b) How is Linearity defined in reference of a control system. Can a nonlinear system be linearised? Which techniques do you know? **(8)**

OR

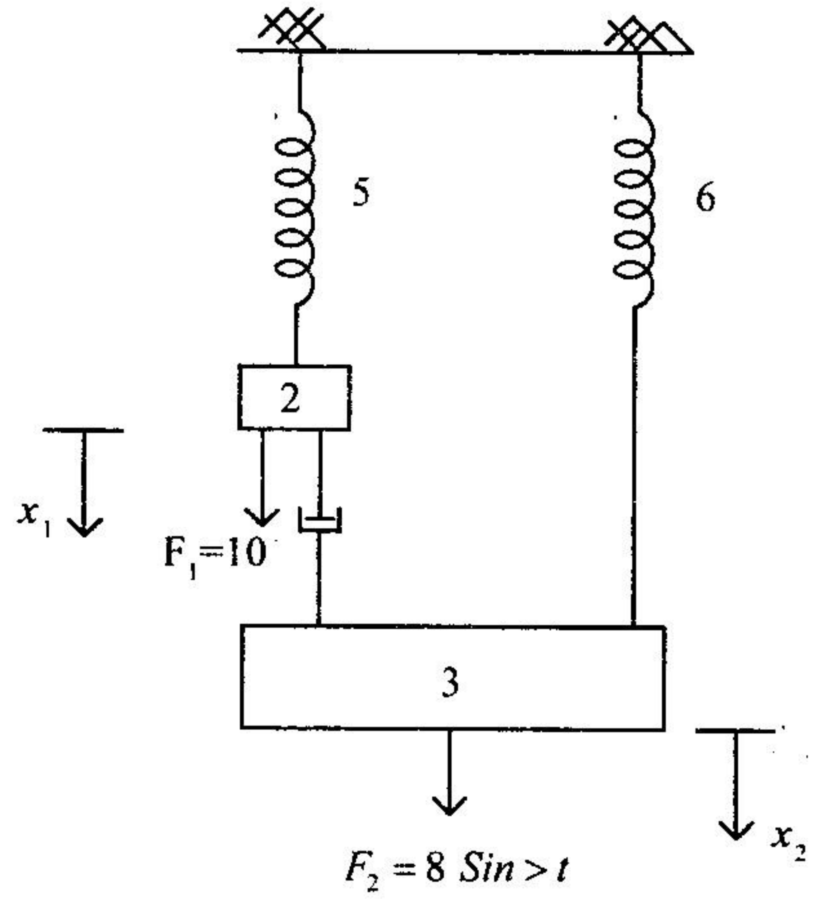
   a) Differentiate between Modern and conventional control system. **(8)**

   b) i) What is meant by causal and non-causal systems.

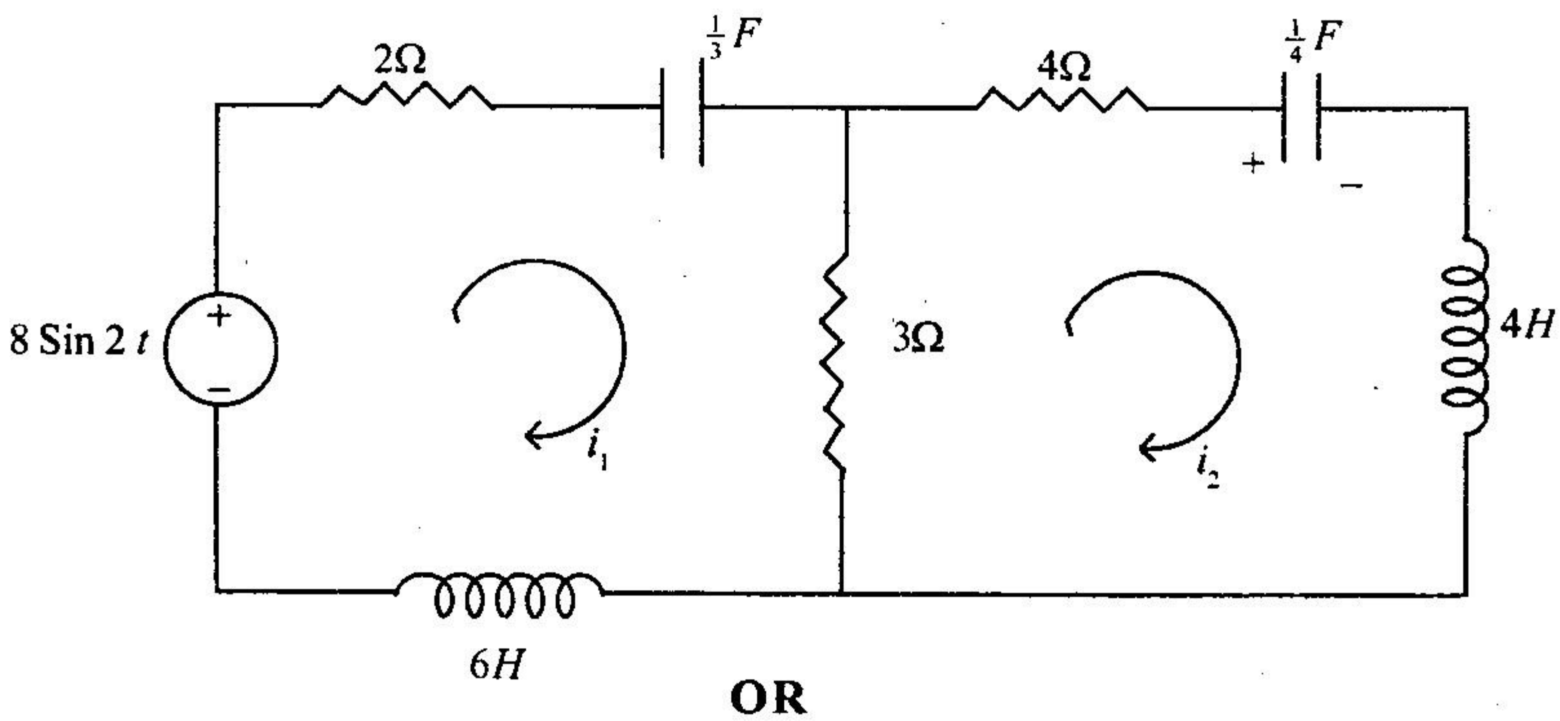
   ii) Define state, state space and state space equations. **(8)**

Unit-II

2. a) Obtain the state space representation for the following mechanical system.**(8)**



b) Write differential equations governing the following electrical circuit and hence develope transfer function for it. **(8)**

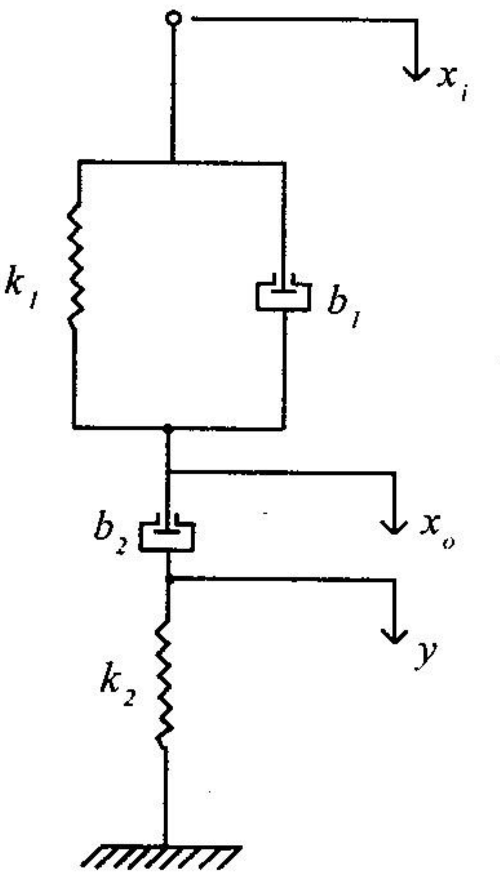


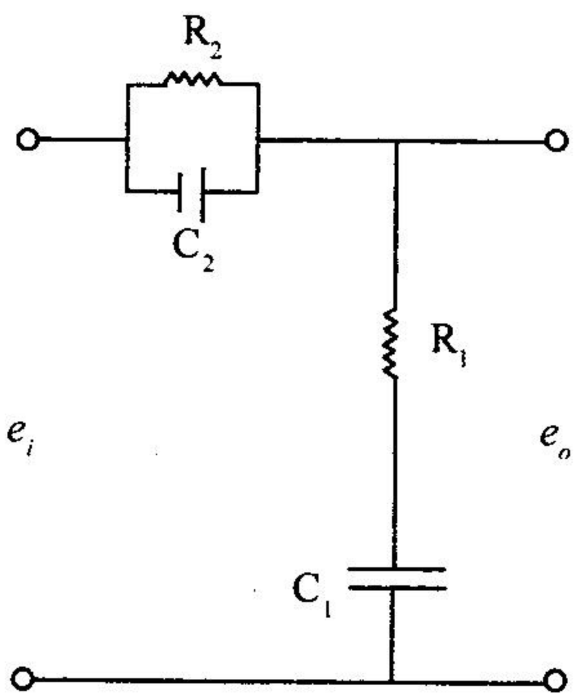
OR

a) A system is described by following differential equation. Derive the state model for it.

$$\frac{d^3y}{dt^3}+6\frac{d^2y}{dt^2}+2\frac{dy}{dt}+4y=-5\frac{d^2u}{dt^2}+8\frac{du}{dt}.$$ **(6)**

b) Show that systems shown in figures below are analogous systems. Find the transfer functions of both.





(10)

Unit-III

3. a) A control system is described by following transfer function. $\frac{Y(s)}{U(s)} = \frac{s+12}{s^2+7s+12}$ obtain the state space representation of this system in

i) Controllable phase variable form.

ii) Observable phase variable form. **(8)**

b) Consider the system

$\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X \cdot \quad X(0) = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ Find the free response of the system. **(8)**

OR

a) Consider the system

$$\dot{X} = \begin{bmatrix} -3 & 1 \\ -2 & 0 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} Y$$

$$Y = \begin{bmatrix} 1 & 0 \end{bmatrix} X.$$

Find the transfer function $\frac{C(s)}{R(s)}$ of the above system. **(8)**

b) Consider the same system given in the above equation. Transform the system by similarity transformation defined by $X = P\overline{X} = \begin{bmatrix} 2 & -1 \\ -1 & 1 \end{bmatrix} \overline{X}$. **(8)**

Unit-IV

4. a) For the system matrix

$$A=\begin{bmatrix}-4 & 1 & 0\\ 0 & -3 & 1\\ 0 & 0 & -2\end{bmatrix}$$ Find the eigenvalues and eigenvectors. **(8)**

b) Write short notes on : **(any two)**

i) State transition matrix

ii) Caley - Hamilton Theorem

iii) Kalman's method of controllability and observability. **(4 each)**

OR

a) The transfer function $G(s)$ of a system is given by $G(s)=\dfrac{s+3}{(s+2)^2(s+5)}$.

Transform the system in Jordan cannonical form. **(8)**

b) Write short notes on : **(any two)**

i) Pole - placement Design

ii) Eigenvalues & Eigenvectors

iii) Solution of state equation. **(4each)**

Unit-V

5. a) Consider the system $\dot{X}=AX+BY$ and $Y=CX$ with

$$A=\begin{bmatrix}0 & 1\\ 0 & 0\end{bmatrix}\quad b=\begin{bmatrix}0\\ 1\end{bmatrix}\text{ and }\quad c=\begin{bmatrix}1 & 0\end{bmatrix}$$

Design a feedback control law to place the closed loop poles at $s=-4\pm j4$. **(8)**

b) How are digital control systems different from continuous time control systems. How are they analysed and what stability tests are available to check their stability. **(8)**

OR

Write short notes on : **(any two)**

i) Ackerman's Formula.

ii) Sampled data control systems.

iii) Digital PID controller. **(8each)**