Total No. of Questions : 8]

SEAT No. :

**P3591**

[Total No. of Pages : 4

# [4959]-1063

## B.E. (Electrical)

## CONTROL SYSTEMS - II

## (2012 Pattern)

*Time : 2½ Hours]* *[Max. Marks : 70*

***Instructions to the candidates:***

1) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.*
2) *Neat diagrams must be drawn wherever necessary.*
3) *Figures to the right indicate full marks.*
4) *Assume suitable data if necessary.*

**UNIT I, II & III**

***Q1)*** a) Design a suitable compensator for a unity feedback system with open loop transfer function $G(s) = K/s^2\,(0.2s+1)$ to satisfy the following specifications. **[10]**

i) Acceleration error constant $k_a=10$;

ii) P.M = 35°

b) State the advantages of state space analysis over transfer function model analysis. **[4]**

c) Ascertain the condition for controllability & observability for a LTI system described by the state equation. **[6]**

$$\dot{x} = \begin{bmatrix} 3 & 1 & 0 & 0 \\ 0 & 3 & 1 & 0 \\ 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 4 \end{bmatrix} x(t) + \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \\ b_{31} & b_{32} \\ b_{41} & b_{42} \end{bmatrix} u(t)$$

OR

*P.T.O.*

*Q2)* a) For the system, defined by **[10]**

$$\dot{x} = \begin{bmatrix} 1 & 1 & -1 \\ 4 & 3 & 0 \\ -2 & 1 & 10 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 20 & 30 & 10 \end{bmatrix} x$$

By using state feedback control u = -K$x$, it is desired to have the closed loop poles at s = -2±j2 & s = -5. Determine the state feedback gain matrix K by using similarity transformation method.

b) Realize the lead-lag compensator with active electrical network. **[4]**

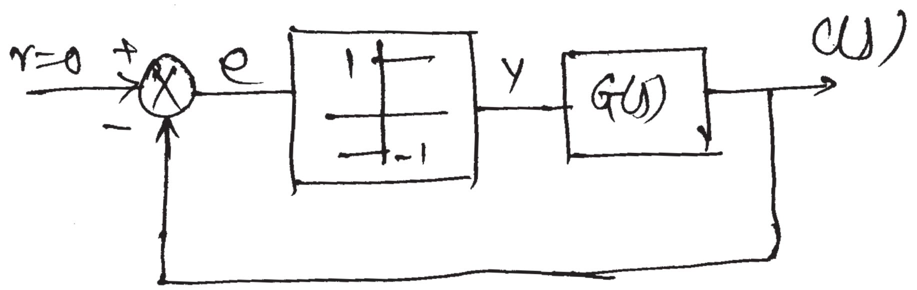
c) Obtain the state model using Phase variables if a system is described by the differential equation. **[6]**

$$\frac{d^3 y(t)}{dt^3} + 8\frac{d^2 y(t)}{dt^2} + 14\frac{dy(t)}{dt} + 4y(t) = 10u(t)$$

## UNIT IV

*Q3)* a) Classify basic types of Non-linarites. Explain the common types of non-linarites observed in physical systems. **[6]**

b) A non-linear control system shown below, has Relay as a non linearity with describing function $N(X) = 4/\pi X$. **[10]**




The transfer function of the plant is $G(s) = \dfrac{10}{s(1+5s)(1+10s)}$

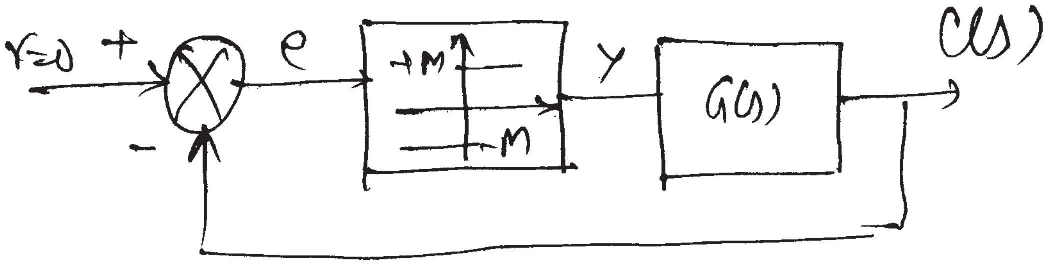
i) Determine whether limit cycle exist or not.

ii) If exist then determine frequency & amplitude. Analyze the system using Describing function method.

OR

*Q4)* a) Explain Jump Resonance phenomenon observed in non-linear control systems. **[6]**

b) A non linear control system shown below is applied with unit step input. Assuming system is initially at rest & M = 1. Draw the phase trajectory using method of isocline. $G(s)=\frac{4}{s(1+s)}$. Comment on the system's stability. **[10]**




## UNIT V

*Q5)* a) Draw the block diagram of digital control system & explain the function of each block in short. **[6]**

b) Given the *z* transform **[8]**

$$X(z)=\frac{(1-e^{-aT})z}{(z-1)(z-e^{-aT})}.$$

Where a is a constant and T is the sampling period, determine the inverse z transform x(kT) by use of the partial-fraction-expansion method.

OR

*Q6)* a) What is Zero order hold (ZOH)? Derive its transfer function. **[6]**

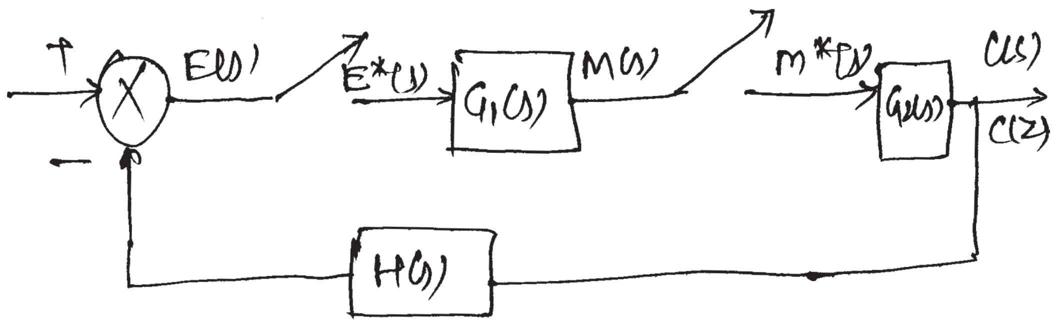
b) Solve the following difference equation by use of the z transform method.

$x(k+2) + 3x(k+1) + 2x(k) = 0.$ $x(0) = 0,$ $x(1) = 1$ **[8]**

## UNIT VI

***Q7)*** a) Define Pulse transfer function. State General procedure for obtaining Pulse-transfer function. **[8]**

b) Obtain the closed loop pulse transfer function C(z)/R(z) for the system. **[12]**




OR

***Q8)*** a) Explain the role of the characteristic equation in determining the stability of the discrete-time control systems. **[8]**

b) A digital filter is defined by **[12]**



$$G(z) = \frac{Y(z)}{X(z)} = \frac{4(z-1)(z^2+1.2z+1)}{(z+0.1)(z^2-0.3z+0.8)}$$

Obtain the series & parallel block diagram realization.

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