

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 =  $35^\circ$
- 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]**

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

$$y = [20 \quad 30 \quad 10]x$$

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

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

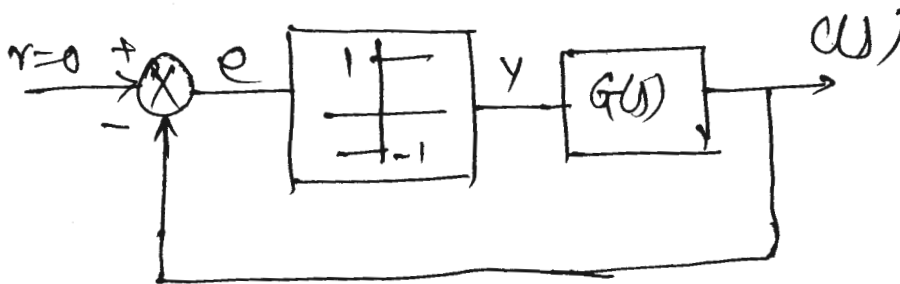
c) Obtain the state model using Phase variables if a system is described by the differential equation. **[6]**

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

### UNIT IV

**Q3) a)** Classify basic types of Non-linearities. Explain the common types of non-linearities 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]**

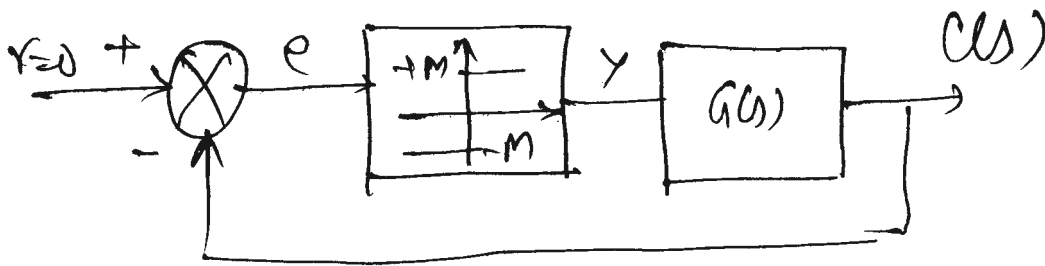


The transfer function of the plant is  $G(s) = \frac{10}{s(1+5s)(1+10s)}$

- 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]

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

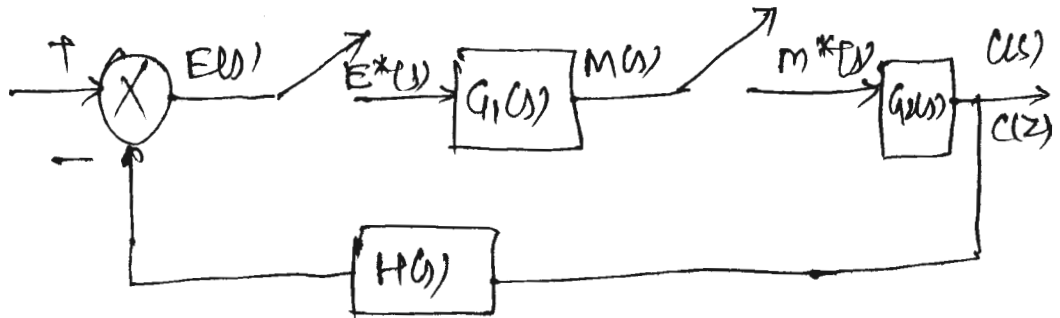
Where a is a constant and T is the sampling period, determine the inverse z transform  $x(kT)$  by use of the partial-fraction-expansion method.

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.

