

**[5354]-623**  
**B.E. (Electrical)**  
**CONTROL SYSTEM - II**  
**(2012 Pattern)**

*Time : 2½ Hours]**[Max. Marks : 70**Instructions to the candidates:*

- 1) *Neat diagrams must be drawn wherever necessary.*
- 2) *Figures to the right indicate full marks.*
- 3) *Assume suitable data, if necessary.*

**Q1) a)** Explain in detail design procedure of lead compensator. **[8]**

b) A system is represented by the state model. **[6]**

$$\dot{X} = \begin{bmatrix} -2 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -3 \end{bmatrix} X + \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} u, \quad Y = [1 \ 0 \ 0] X$$

Determine controllability & observability of above using Kalman's test.

c) Define the terms : **[6]**

- i) State variable
- ii) State vector
- iii) State space
- iv) State trajectory.

OR

**Q2) a)** A system is represented by a state model

$$\dot{X} = \begin{bmatrix} 0 & 1 \\ -1 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 2 \end{bmatrix} u, \quad Y = [1 \ 0] X$$

It is required to place the poles of the system at  $S = -3 \pm j4$ . Design a suitable state feedback gain matrix 'K' using transformation matrix method. **[8]**

*P.T.O.*

- b) Solve the homogeneous state equation, given that

$$\dot{X} = \begin{bmatrix} -4 & 1 \\ -3 & 0 \end{bmatrix} X \quad Y = [1 \ 0]X \quad X_0 = [1 \ 1]^T \quad [8]$$

- c) What is lag compensator? Explain with the help of pole-zero plot, TF & circuit diagram. [4]

**Q3)** a) Define the terms phase trajectory and phase portrait and explain the procedure of construction of phase trajectory using delta method. [10]

- b) With suitable sketches write a short note on stability Analysis of a non linear system using describing function method. [8]

OR

**Q4)** a) In a unity feedback system, an ideal relay with output  $\pm 2$  units is connected in cascade with  $G(s) = \frac{10}{s(s+3)(s+4)}$ . Determine the amplitude & frequency of limit cycle, if it exists, by describing function method. [10]

- b) With suitable sketches show various types of singular points. Also mention the location of closed loop poles in each case. [8]

**Q5)** a) What is ZOH? Derive its transfer function. [8]

- b) Obtain Z transform of following sequences. [8]

i)  $f(k) = \{2, 4, \underset{\uparrow}{5}, 7, 3\}$

ii)  $f(k) = \left(\frac{1}{2}\right)^k u(k)$

Also state ROC in both cases.

OR

**Q6) a)** Explain with neat diagram process of analog to digital conversion of a signal. [8]

b) Solve following difference equation. [8]

$$x(k+2) - 3x(k+1) + 2x(k) = u(k)$$

given that  $x(0) = 0$  and  $x(1) = 1$

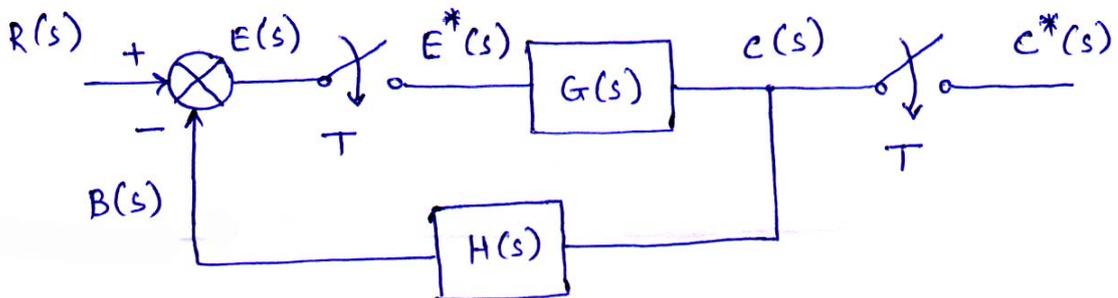
**Q7) a)** What is pulse transfer function? Write general procedure to obtain pulse transfer function. [8]

b) Obtain the cascade realization of the system described by - [8]

$$D(z) = \frac{z^3 + 3z^2 + 7z + 5}{z^3 + 3z^2 + 9z + 14}$$

OR

**Q8) a)** Obtain the pulse transfer function of following closed loop system. [8]



b) Obtain parallel realization of the system described by

$$D(z) = \frac{z^2 + 11z + 15}{z^2 + 7z + 12} \quad [8]$$

