

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer any one question from each pair of questions : Q.1 & Q.2, Q.3 & Q.4, Q.5 & Q.6, Q.7 & Q.8.
- 2) Figures to the right indicate full marks.

**Q1)** a) Draw electrical circuit & derive transfer function of Lead compensation network. [6]

b) A unity feedback system has an open loop transfer function,  

$$G(s) = \frac{4}{s(s+2)}$$
 . Design a suitable Lead compensator so that phase margin is 50° and  $K_v = 20/\text{sec}$ . [10]

c) Explain the effect of pole zero cancellation on the controllability of system. [4]

OR

**Q2)** a) Explain the steps to design lag network by Bode plot approach. [6]

b) Determine the STM for the system is given by : [10]

$$\dot{X}(t) = \begin{bmatrix} -2 & 3 \\ 0 & -3 \end{bmatrix} X(t)$$

by Inverse transform method.

c) Evaluate the controllability and observability of the following system. [4]

$$A = \begin{bmatrix} -2 & 1 \\ 1 & -2 \end{bmatrix}; B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}; C = [1 \quad -1]$$

**Q3)** a) Derive the describing function for Ideal Relay. [8]

b) Explain asynchronous quenching and frequency entrainment of linear system. [8]

OR

**Q4) a)** A system with  $G(s) = \frac{50}{s(s+1)(s+2)}$  includes ideal relay with output equal to  $\mp 1$  unit. Determine the amplitude and frequency of limit cycle by describing function method. [6]

**b)** Determine the kind of Singularity, find the characteristic equation and draw phase portrait for the following differential equation  $\ddot{x} + 3\dot{x} + 3x = 0$ . [10]

**Q5) a)** Compare Digital Control System with Continuous Control System. [8]

**b)** Determine Inverse Z-transform of the following : [8]

i)  $X(z) = \frac{z-4}{(z-1)(z-2)^2}$  by partial fraction expansion

ii)  $X(z) = \frac{4z}{(z+0.5)^2}$  for  $|z| > 0.5$

OR

**Q6) a)** Explain the effect of sampling period on the transient response and on the stability of digital control system. [8]

**b)** What is Zero Order Hold (ZOH)? Derive its transfer function. [8]

**Q7) a)** Obtain direct & cascade realization from given transfer function. [10]

**b)** Describe general procedure to obtain pulse transfer function. [8]

OR

**Q8) a)** Explain various methods of digital programming. [10]

**b)** Obtain the pulse transfer function of two systems in cascade with sampler in between. [8]

