

(3 Hours)

[Total Marks – 80]

NB

1. Question No.1 is compulsory.
2. Attempt any three questions from remaining.
3. Use semi log paper where necessary.
4. Assume suitable data wherever necessary.

Q.1 Attempt any four questions.

- a. Compare lead and lag compensator on the basis of pole zero plot and Electrical circuit? [5]
- b. What do you mean by “Tustin Transformation” why it is used? [5]
- c. Explain issues in implementation of industrial PID controller. [5]
- d. Explain start and stop interlocking circuit in PLC programming with the help of example. [5]
- e. Explain Phase variable, CCF and OCF with example? [5]
- f. How many words are occupied by counter instruction in the counter file? [5]

Q.2

- a. Design a lag compensator for a unity feedback system for transfer function given by  $G(s) = \frac{K}{s(s+1)(0.5s+1)}$  to meet following requirement:  
 $GM = 10\text{db}$ ,  $\phi_m = 40^\circ$ ,  $K_v = 5/\text{sec}$  [15]
- b. Explain Proportional band in case of PID controller. [5]

Q.3

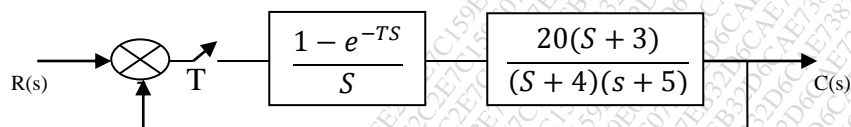
- a. Design a state feedback controller to yield a 20.8% overshoot and settling time of 4 second for a plant  $\dot{X} = Ax + Bu$  And  $Y = Cx$

Where  $A = \begin{bmatrix} 0 & 1 & 1 \\ 0 & 0 & 1 \\ -1 & -5 & -6 \end{bmatrix}$   $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$   $C = [10 \quad 1 \quad 0]$  &  $D = [0]$  [10]

- b. Prove that the transform of sampled output is the product of the transform of the sampled input and pulse transfer function of the system and thus derive transfer function of the system. [10]

Q.4

- Explain the relationship between numbers assigned to data files in memory and numbers used by input and output modules in PLC with example. [10]
- For step and ramp input find the steady state error for unity feedback system shown in figure with sampling time interval "T=0.1 seconds". [10]



Q.5

- Find  $G(Z)$ , for  $G_1(s) = \frac{(s+2)}{s(s+1)}$  in cascade with zero order sample and hold. The sampling period is  $T=0.5$  sec. [10]
- What is PB and integral Kick in case of PID controller? [10]

Q.6

- Explain Memory unit of PLC. [10]
- Explain Jump and label operations in PLC [10]