(11)

B.E. Electrical VII - CBGS
Control Syster - II

31.5.16

QP Code : 31374

(3 Hours) [Total Marks: 80]

Note:
- Question No. 1 is compulsory.
- Answer any **three** from the remaining five questions.
- Assume suitable data if necessary and justify the same.
- Figures to the right indicate the marks.

1 Each question carry five marks 20

a Given a point on the z-plane, how can one determine the associated settling time and peak time?

b Under what conditions would you use an observer in your state space design? Which plant representation lends itself to easier design of an observer? Why?

c Draw the bode plot of a typical lag compensator. Why it is called as a lag compensator?

d Explain the scan cycle of PLC.

2 a Use frequency response methods to design a lead compensator for a unity feedback system where $G(s) = \frac{K(s+7)}{s(s+5)(s+15)}$ and the following specifications are to be met: percent overshoot=15%, Settling time=0.1sec, and Kv=1000. 10

b Explain the memory unit of PLC. 10

3 a Consider the following transfer function: $G(s) = \frac{(s+6)}{(s+3)(s+8)(s+10)}$. If the system is represented in parallel form design a controller to yield a closed loop response of 10% overshoot with a settling time of 1 sec. Design the controller by first transforming the plant to phase variables. Draw the plant representation in parallel form with the controller gains. 15

b Draw the implementation for the digital compensator defined by $Gc(z) = \frac{(z+0.5)}{z^2-0.5z+0.7}$ 05

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4 a Design an integral controller to yield a 10% overshoot, 0.5 sec. settling time and zero steady state error for a step input for the following plant. 10

$$\dot{x} = \begin{bmatrix} -2 & 1 \\ 0 & -5 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u; \qquad y = [1 \quad 1]\, x$$

b Compare Timer ON, Timer OFF and Retentive Timer instructions of PLC with timing diagrams. Explain the significance of cascade timer with an example. 10

5 a Given $T(z) = \frac{N(z)}{D(z)}$ where $D(z) = z^4 + z^3 - 2z + 0.5$, use the Routh- Hurwitz criterion to find the number of z-plane poles of T(z) inside, outside and on the unit circle. Is the system stable? 10

b What is meant by Integral wind-up? How it will affect the performance of the system? Explain a simple anti wind up circuit with block diagrams to mitigate the wind-up effect. 10

6 a Explain four types of arithmetic functions performed by PLC. 10

b Explain Input/Output addressing formats in PLC. Also explain the relationship between the number assigned to the data files in memory and the number used by the I/O terminal using suitable diagrams. 10