(64)

BE - sem - VII - CBGS - Electrical

CS - II

10/12/15

QP Code **5982**

Time :3 Hrs. Max. Marks:80

NOTE:

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.

Q1 Solve any **Four**

a. Compare lag and lead compensators along with electrical equivalent circuit and pole-zero plot in s-plane. (5)

b. Explain in brief different forms of industrial PID controllers. (5)

c. Write a short note on modeling of the sampler in digital control system. (5)

d. Explain start/stop interlocking circuit in PLC programming with the help of suitable example. (5)

e. Explain the scan cycle of execution in PLC. (5)

f. Consider the system defined by (5)

$$\dot{x} = Ax + Bu \qquad y = Cx$$

where, $A = \begin{bmatrix} -1 & 0 & 1 \\ 1 & -2 & 0 \\ 0 & 0 & -3 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ $C = [1\ 1\ 0]$

Transform the system equation into (i) controller canonical form and (ii) observer canonical form.

Q2 a. Given a unity feedback system with (10)

$$G(s) = \frac{1}{s(s+1)(0.5s+1)}$$

Use frequency response method to design lead compensator to yield (i) Steady state error to a unit ramp input is less than 0.05 (ii) Phase margin more than 45 degree.

Q2 b. Design a state variable feedback controller to yield a 20.8% overshoot and a settling time of 4 second for a plant (10)

$$\dot{x} = Ax + Bu \qquad y = Cx + Du$$

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

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Q3 a. Write a short note on Proportional Band (PB) in case of PID controller. (05)

b. Explain the stability criterion of Digital control system. (05)

c. Consider a linear system described by the differential equation (10)

$$\ddot{y} + 2\dot{y} + y = \dot{u} + u$$

with $x_1 = y$, $x_2 = \dot{y} - u$

Determine whether this system is observable or not?

Q4 a. Design an integral controller for the plant (10)

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -7 & -9 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u \qquad y = [4 \;\; 1]\, x$$

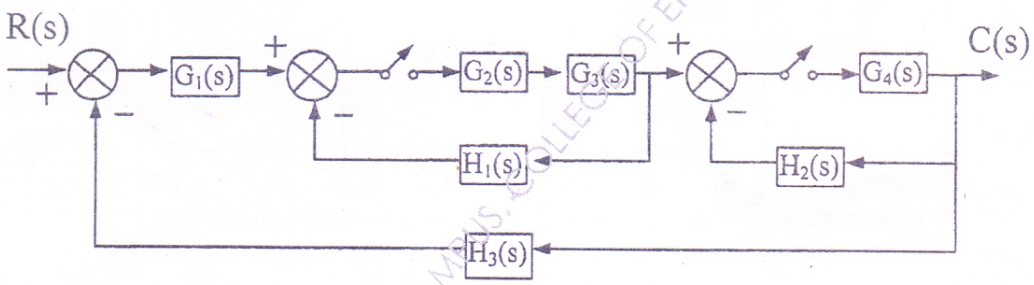
to yield a step response with 10% overshoot, a peak time of 2 seconds and zero steady state error.

b. Given a Z.O.H. in cascade with (10)

$$G_1(s) = \frac{s+2}{s+1}$$

Find the sampled data transfer function, G (z) if a sampling time T is 0.5 second.

Q5 a. Find T(z) = C(z) / R(z) for the given block diagram if T = 0.3 sec. (10)



b. Draw and explain the PLC ladder diagram for manufacturing of 5mH and 10mH inductor coils. When 5 mH inductor is produced, the machine makes 400 revolutions to wind the coil. If the inductor is produced 10 mH, the machine makes 800 revolutions before stopping. (10)

Q6 a. Explain relay logic instructions in PLC (05)

b. Write a short note on PLC processor unit. (10)

c. Explain AC input module of PLC (05)