

B.E. Electrical VII CBGS

C.S. -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)

$$\dot{x} = Ax + Bu$$

$$y = Cx$$

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

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

(10)

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)

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

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)

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

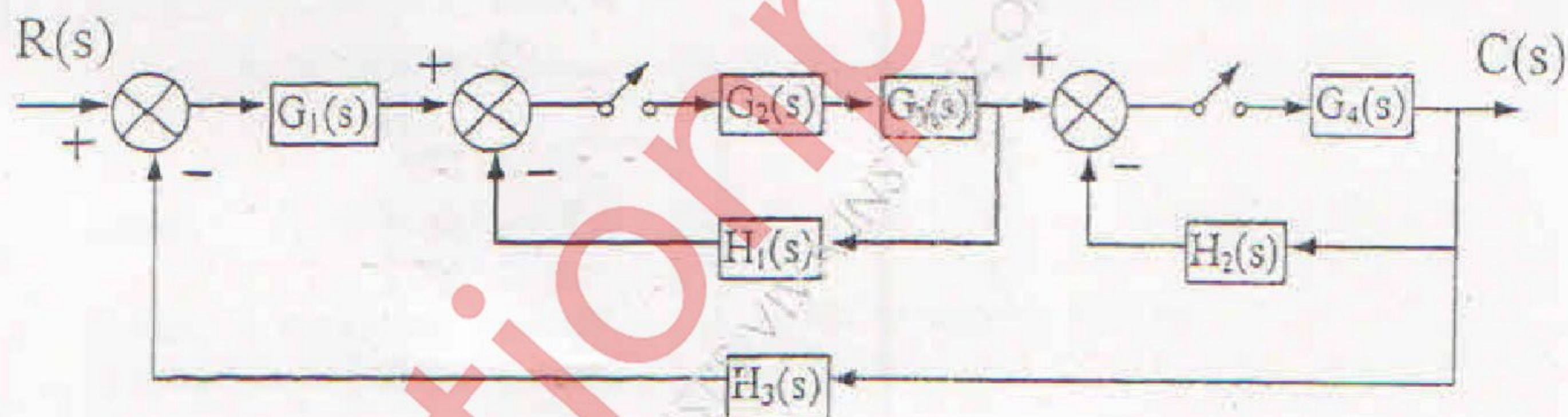
to yield a step response with 10% overshoot, a peak time of 2 seconds and zero steady state error.

- 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. (10)  
 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.

- 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)