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[5668]-139

S.E. (Elect. E&TC) (Second Semester) EXAMINATION, 2019

CONTROL SYSTEMS

(2015 PATTERN)

Time : Two Hours

Maximum Marks : 50

- N.B. :-**
- (i) Neat diagram must be drawn wherever necessary.
  - (ii) Figures to the right indicate full marks.
  - (iii) Assume suitable data, if necessary.

1. (a) Determine the overall transfer function  $C(s)/R(s)$  for the signal flowgraph shown in Fig. 1. [6]

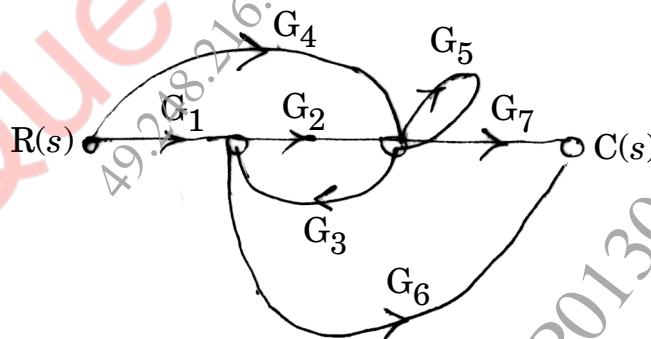


Fig. 1

- (b) Explain open loop and closed loop systems with suitable examples. [6]

P.T.O.

Or

2. (a) Reduce the following block diagram using block diagram reduction rules and obtain  $\frac{C(s)}{R(s)}$ . [6]

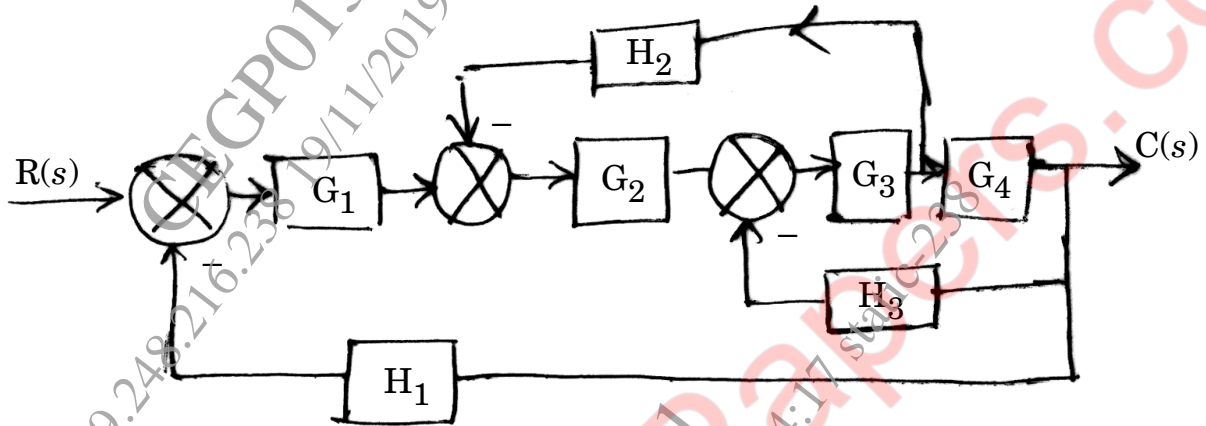


Fig. 2

- (b) For a unity feedback system having open loop transfer function : [6]

$$G(s) = \frac{k(s+2)}{s(s^3 + 7s^2 + 12s)}$$

Find :

- (i) Type of system
  - (ii) Error coefficients  $k_p$ ,  $k_v$ ,  $k_a$
  - (iii) Steady state error when input to the system is  $\frac{R}{2}t^2$ .
3. (a) Investigate the stability of system with characteristic equation : [4]

$$s^4 + 2s^3 + 4s^2 + 6s + 8 = 0.$$

How many poles of systems lie in right half of s-plane ?

- (b) Draw Bode plot of the system with open loop transfer function : [8]

$$G(s) = \frac{50}{s(s+5)(s+10)}$$

Determine  $\omega_{gc}$ ,  $\omega_{pc}$ , gain margin and phase margin.

Or

4. (a) For the system with closed loop transfer function : [4]

$$G(s) = \frac{25}{s^2 + 6s + 25}$$

Determine resonant peak, resonant frequency, damping factor and natural frequency.

- (b) Sketch root locus of the system with open loop transfer function : [8]

$$G(s) = \frac{k}{s(s+3)(s+5)} \quad H(s) = 1.$$

5. (a) Find controllability and observability of the state model : [7]

$$A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}, \quad B = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}, \quad C = [1 \quad 1 \quad 1], \quad D = [0]$$

- (b) Obtain the state transition matrix for the system with state equation : [6]

$$[\dot{X}] = \begin{bmatrix} 0 & 1 \\ -8 & -9 \end{bmatrix} [X]$$

using Laplace transformation.

Or

6. (a) Investigate the complete state controllability and observability of the system with state model : [7]

$$\dot{X} = \begin{bmatrix} 0 & 0 & -3 \\ 1 & 0 & -4 \\ 0 & 0 & -1 \end{bmatrix} X + \begin{bmatrix} 1 \\ 2 \\ 0 \end{bmatrix} u$$

$$Y = [0 \quad 0 \quad 1] X$$

- (b) Obtain transfer function for system having state model : [6]

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} -2 & -3 \\ 4 & 2 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 3 \\ 5 \end{bmatrix} U$$

$$\text{and } Y = [1 \quad 1] \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} \text{ with } D = 0.$$

7. (a) Draw and explain block diagram of digital control system. [7]  
(b) Write a note on PID controller. [6]

Or

8. (a) Determine pulse transfer function and impulse response of the system shown in Fig. 3. [7]

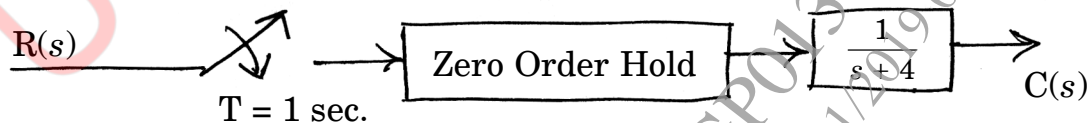


Fig. 3

- (b) Draw and explain block diagram of PLC. [6]