Total No. of Questions—**8**] [Total No. of Printed Pages—**4**

Seat No.	

[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]

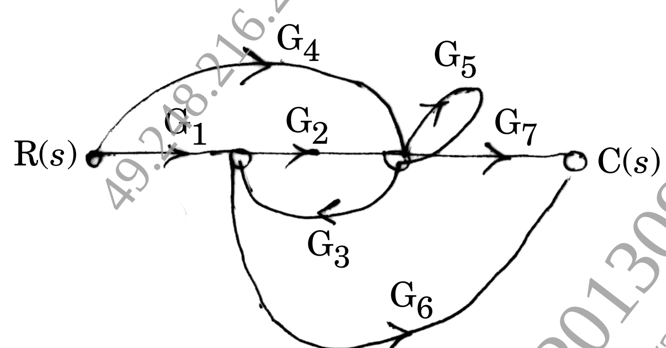

Fig. 1

(*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]

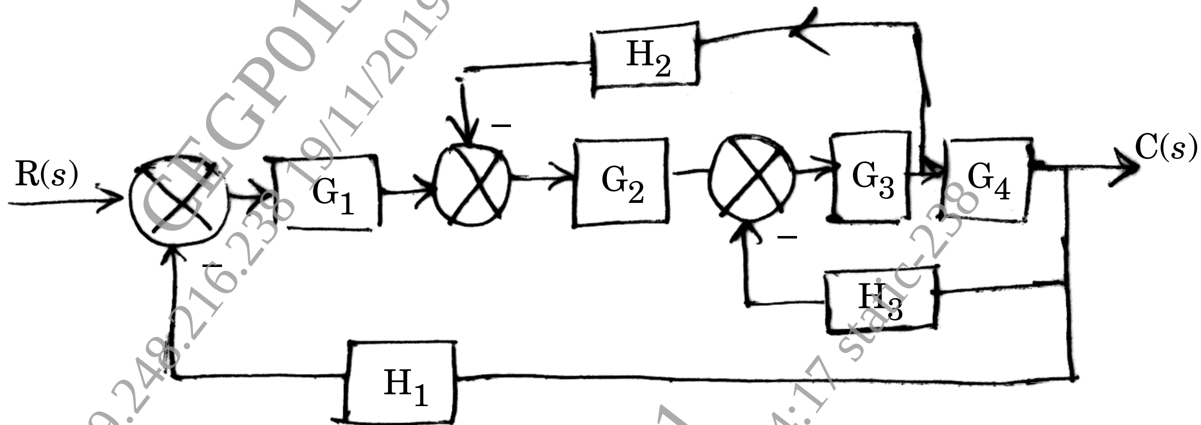

Fig. 2

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

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

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 w_{gc}, w_{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]

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

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

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

using Laplace transformation.

Or

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

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

$$Y = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix} X$$

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

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

and $Y = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$ 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]

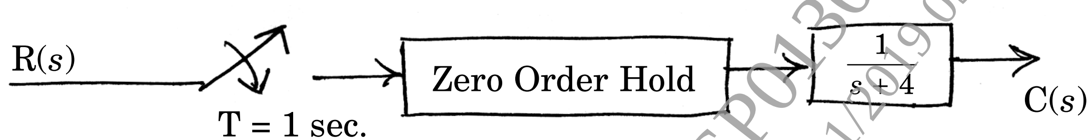

Fig. 3

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