Total No. of Questions—8] [Total No. of Printed Pages—3

| Seat No. | |
|---|---|

**[5559]-139**

**S.E. (Electr./E&TC) (Second Semester) EXAMINATION, 2019**

**CONTROL SYSTEMS**

**(2015 PATTERN)**

**Time : 2 Hours** **Maximum Marks : 50**

***Instructions to the candidates:***

1) *Neat diagrams must be drawn wherever necessary.*
2) *Figures to the right side indicate full marks.*
3) *Use of logarithmic tables, slide rule, electronic pocket calculator and steam tables is allowed.*
4) *Assume suitable data if required.*



**Q 1) a)** Differentiate open loop and closed loop systems with suitable examples. **[6]**

**b)** For a system with closed loop transfer function: **[6]**

$$G(s)H(s) = \frac{10}{s^2 + 5s + 10}$$

Determine rise time, peak time, peak overshoot, and settling time with 2% criterion.

**Or**

**Q 2 a)** Determine the overall transfer function of the system shown in Fig. 1 using block diagram reduction rules. **[6]**

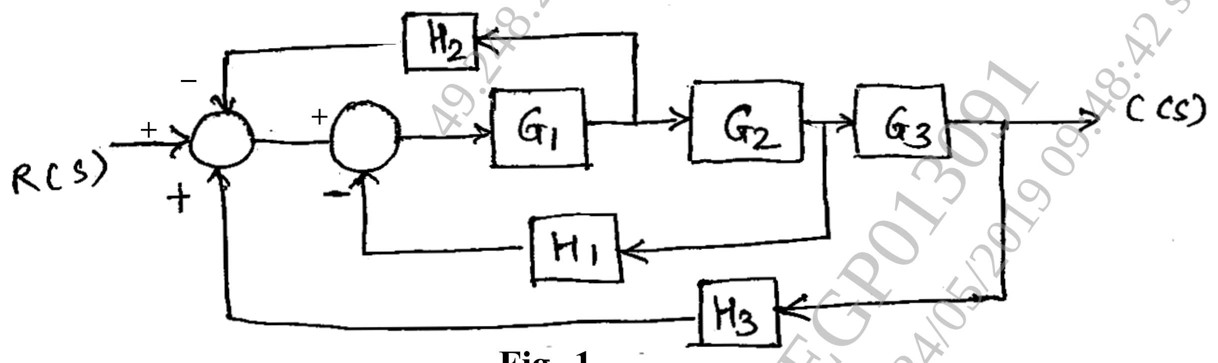


**Fig. 1**

**b)** For unity feedback system with open loop transfer function $G(s) = \frac{K}{s(s+10)}$.

Determine the gain K, peak overshoot, settling time and time to peak overshoot for unit step input, if damping factor is 0.5. **[6]**

P.T.O.

**Q 3 a)** Investigate the stability of the system with characteristic equation: $Q(s) = s^4 + 6s^3 + 11s^2 + 6s + 10 = 0$. Comment on stability. **[4]**

**b)** Draw Bode plot of the system with open loop transfer function:

$$G(s) = \frac{40}{s(s+2)(s+20)}$$

and determine gain crossover frequency, phase cross over frequency, gain margin, phase margin. Also comment on stability. **[8]**

**Or**

**Q 4 a)** For unity feedback system with open loop transfer function $G(s) = \frac{100}{s(s+9)}$. Determine damping factor, undamped natural frequency, resonant peak, resonant frequency. **[4]**

**b)** Sketch the root locus of unity feedback system with open loop transfer function: **[8]**

$$G(s) = \frac{K}{s(s^2 + 8s + 15)}$$

**Q 5 a)** For a system with transfer function: **[6]**

$$G(s) = \frac{s^2 + 3s + 3}{s^3 + 2s^2 + 3s + 1}$$

Determine state model in controllable canonical and observable canonical form.

**b)** Derive the expression for state transition matrix by Laplace transform method and state properties of state transition matrix. **[7]**

**Or**

**Q 6 a)** Obtain the state transition matrix for the following system. **[7]**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

**b)** Investigate for complete state controllability and observability of the system with state model: **[6]**

$$A = \begin{bmatrix} -2 & 1 \\ 1 & -2 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, \quad C = \begin{bmatrix} 1 & -1 \end{bmatrix}$$

Q 7 a) Draw and explain block diagram of Digital control system. [6]

b) Determine the pulse transfer function of the system shown in fig. Assume T= 1 sec. [7]

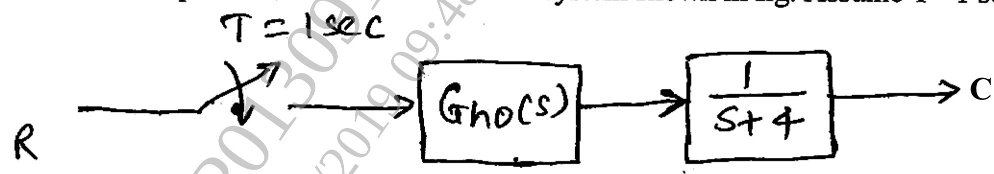


Fig. 2

Or

Q 8 a) Draw and explain block diagram of PLC. [6]

b) Find Pulse transfer function, impulse response of the system. [7]

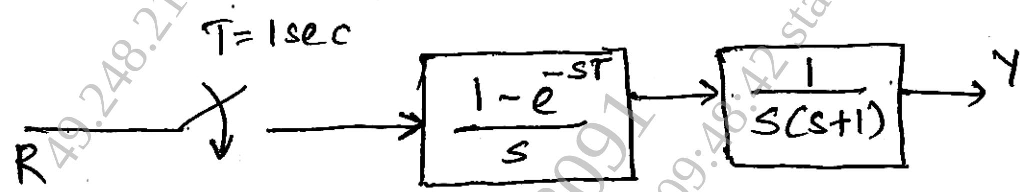


Fig. 3