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[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:

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- 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

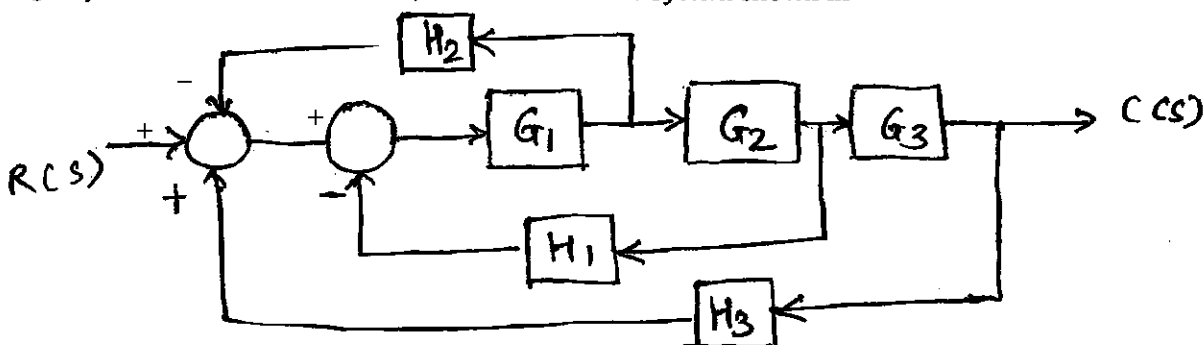


Fig. 1

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]

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,

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

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Q 3 a) Investigate the stability of the system with characteristic equation:

$$Q(s) = s^4 + 6s^3 + 11s^2 + 6s + 10 = 0. \text{ Comment on stability.}$$

[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:

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

[8]

Q 5 a) For a system with transfer function:

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

[6]

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]

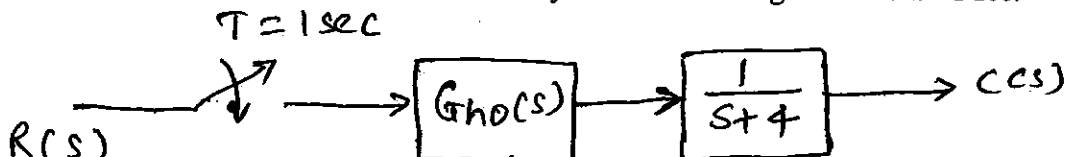
$$A = \begin{bmatrix} -2 & 1 \\ 1 & -2 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, \quad C = [1 \quad -1]$$

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]



Or

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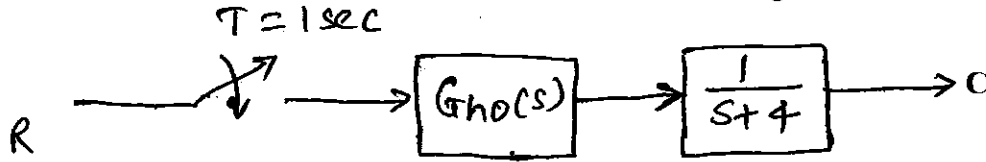


Fig. 2 Or

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

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

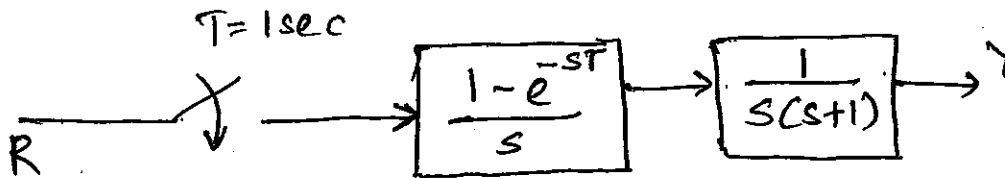


Fig. 3