Total No. of Questions—8] [Total No. of Printed Pages—5

Seat No.	

[5459]-139

S.E. (Electronics/E&TC Engineering) (II Sem.) EXAMINATION, 2018

CONTROL SYSTEMS

(2015 PATTERN)

Time : Two Hours **Maximum Marks : 50**

***N.B.* :—** (*i*) Answer Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6**, Q. No. **7** *or* Q. No. **8**.

(*ii*) Neat diagrams must be drawn wherever necessary.

(*iii*) Figures to the right indicate full marks.

(*iv*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*v*) Assume suitable data, if necessary.

1. (A) Determine the overall transfer function Y(*s*)/R(*s*) for the signal flow graph shown in Fig. 1. [6]

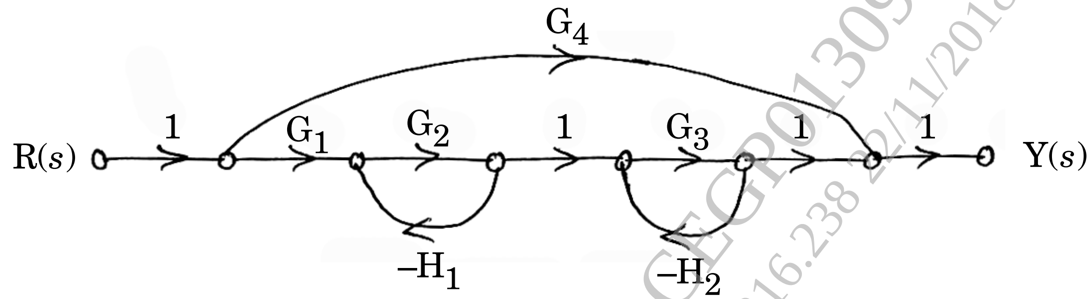

Fig. 1

P.T.O.

(B) For the system with open loop transfer function :

$$G(s) = \frac{k_2}{s(s + k_1)}, \quad H(s) = 1$$

with unity feedback, determine the values of k_1 and k_2 if the damping factor is 0.6 and peak time is 1 second. Also determine peak overshoot, natural frequency, rise time and settling time. [6]

Or

2. (A) Determine the overall transfer function Y(s)/R(s) for the block diagram shown in Fig. 2 using block diagram reduction rules. [6]

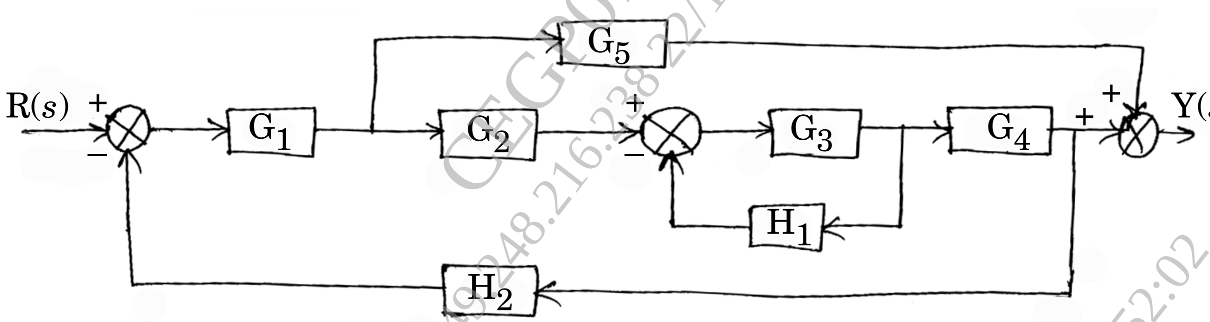

Fig. 2

(B) Determine static error constant (k_p, k_v, k_a) and steady error for step input if the unity feedback system has open loop transfer function :

$$G(s) = \frac{k}{s(s+2)(s+4)+10}, \quad k = 20.$$

Also find k if steady state error for step input is 0.8. [6]

3. (A) Investigate the stability of system with characteristic equation :

$$Q(s) = s^4 + 9s^3 + 7s^2 + 4s + 3 = 0$$

using Routh stability test. Also determine the number of poles in the right half of s-plane. [4]

(B) Draw Bode plot of the system with open loop transfer function :

$$G(s) = \frac{20(s+5)}{s(s+10)}$$

and determine gain margin, phase margin. Also comment on stability. [8]

Or

4. (A) Determine resonant peak (M_r) and resonant frequency (W_r) for the unity feedback system with open loop transfer function : [4]

$$G(s) = \frac{9}{s(s+4)}.$$

(B) Sketch the root locus of the system with : [8]

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

5. (A) Obtain controllable canonical and observable canonical state model of the system with transfer function : [6]

$$G(s) = \frac{s^2 + 7s + 9}{s^3 + 6s^2 + 4s + 3}.$$

(B) For the system with state model : [7]

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

$$y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} x$$

investigate the state controllability and state observability.

Or

6. (A) Determine the transfer function of system with state model : [6]

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -3 & -4 & -7 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 2 & 1 \end{bmatrix} x$$

(B) Determine state transition matrix of the system with a state equation : [7]

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ 0 & -4 \end{bmatrix} x$$

Also determine solution of state equation if :

$$x(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}.$$

7. (A) Determine the pulse transfer function of system shown in Fig. 3 using first principle (starred Laplace and z-transform method). [7]

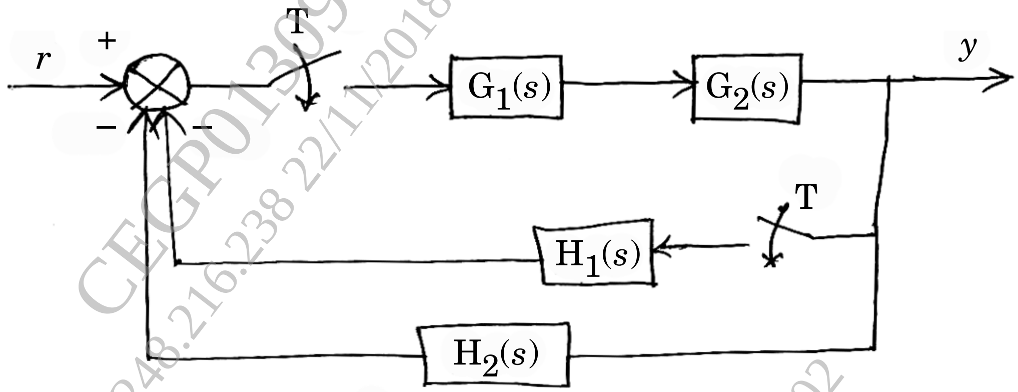

Fig. 3

(B) Obtain the ladder diagrams for the following Boolean expressions without minimizing them : [6]

(i) $Y = A\bar{B}\bar{C} + \bar{A}BC$

(ii) $Y = AB + \bar{A}\bar{B}\bar{C} + A\bar{B}D$.

Or

8. (A) Obtain the pulse transfer function of the system shown in Fig. 4 and determine its step response. [7]

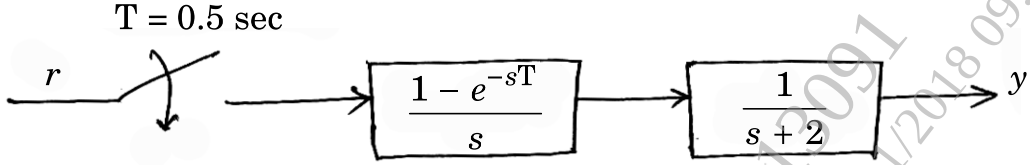

Fig. 4

(B) Write controller equations, transfer functions and draw block diagrams of PI and PD controllers. [6]