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

Seat No.	

[5152]-137

S.E. (Electronics/E&TC) (II Sem.) EXAMINATION, 2017

CONTROL SYSTEM

(2012 PATTERN)

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

***N.B.* :—** (*i*) Figures to the right indicate full marks.

(*ii*) *All* questions carry equal marks.

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

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

1. (*a*) State any *six* rules of block diagram reduction. [6]

(*b*) For unity feedback system with open loop transfer function $G(s) = \frac{25}{s(s+k)}$ determine damping factor, k, peak overshoot, peak time if settling time with 2% criterion is 2 seconds. [6]

P.T.O.

Or

2. (*a*) Determine the transfer function $\frac{X_2(s)}{F(s)}$ for the system shown in Fig. 1 : [6]

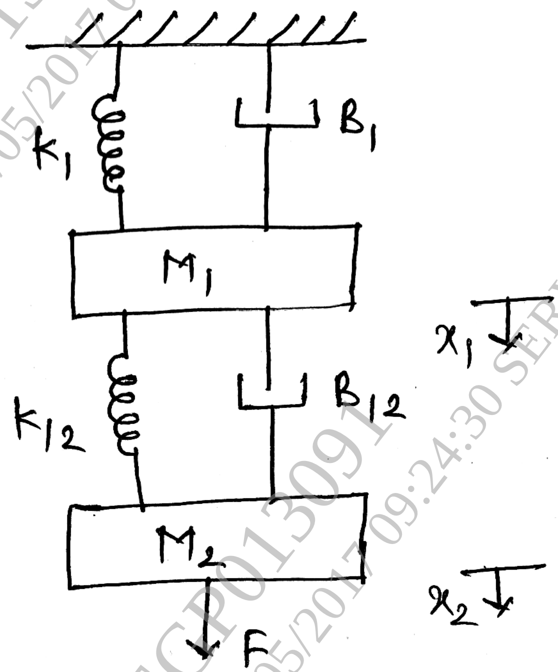

Fig. 1

(*b*) For the system with closed loop transfer function :

$$G(s) = \frac{16}{s^2 + 4s + 16}$$

determine rise time, peak time, peak overshoot, settling time with 2% criterion. [6]

3. (*a*) Determine the range of k for the closed loop stability of unity feedback system with open loop transfer function :

$$G(s) = \frac{k}{s(s+1)(s+4)}$$

Also determine the frequency of oscillations when the system is marginally stable. [4]

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

$$G(s) = \frac{8}{s(s+2)(s+4)}.$$

Determine stability margins (gain and phase) and the corresponding frequencies. Comment on stability. [8]

Or

4. (*a*) Determine the value of k if damping factor is $\xi = 0.5$ for the unity feedback system with open loop transfer function $G(s) = \frac{k}{s(s+4)}$. Also determine resonant peak and resonant frequency. [4]

(*b*) Sketch the root locus of the system with open loop transfer function $G(s) = \frac{k}{s(s+3)(s+5)}$. [8]

5. (*a*) Determine state transition matrix of : [6]

$$A = \begin{bmatrix} 0 & 1 \\ -3 & -4 \end{bmatrix}.$$

(*b*) Derive the formula to determine transfer function from state model $\dot{x} = Ax + Bu$, $y = Cx + Du$ and determine transfer function if : [7]

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

Or

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

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

(*b*) For the system with transfer function :

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

obtain the state space representation in controllable canonical form and observable canonical form. [6]

7. (*a*) Explain the process of bottle filling plant with neat diagram and draw a ladder diagram for this application. Assume that all switches/relays are operated based for sensor signals and the operation is not timer based. [6]

(*b*) Obtain pulse transfer function and impulse response of the system shown in Fig. 2 : [7]

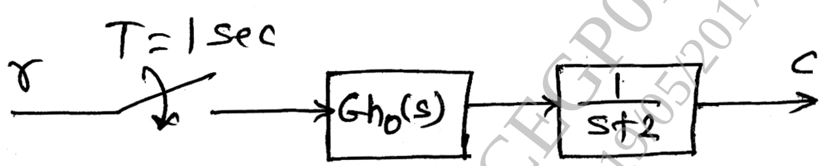

Fig. 2

Or

8. (*a*) Write equation of PID controller and sketch the response of P, PI and PID controller to unit step input. [6]

(*b*) Obtain pulse transfer function C(*z*)/R(*z*) for the system shown in Fig. 3 using first principle (starred Laplace transform method) : [7]

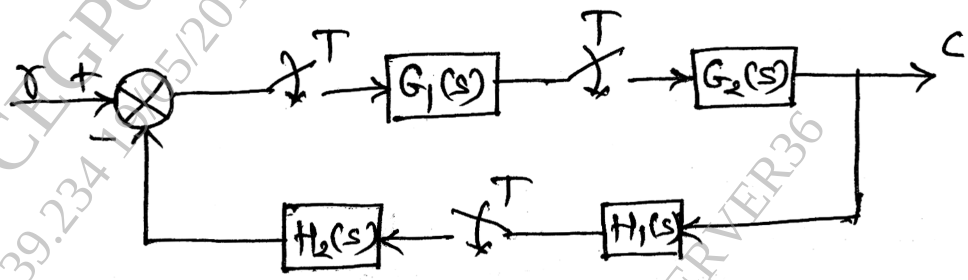

Fig. 3