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

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**[5252]-537**

**S.E. (Ele./E&TC Engg.) (Second Semester) EXAMINATION, 2017**

**CONTROL SYSTEMS**

**(2015 PATTERN)**

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

***N.B.* :—** (*i*) Neat diagrams must be drawn wherever necessary.

(*ii*) Figures to the right indicate full 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) Obtain the transfer function of system represented by the signal flow graph shown in Figure 1. [6]

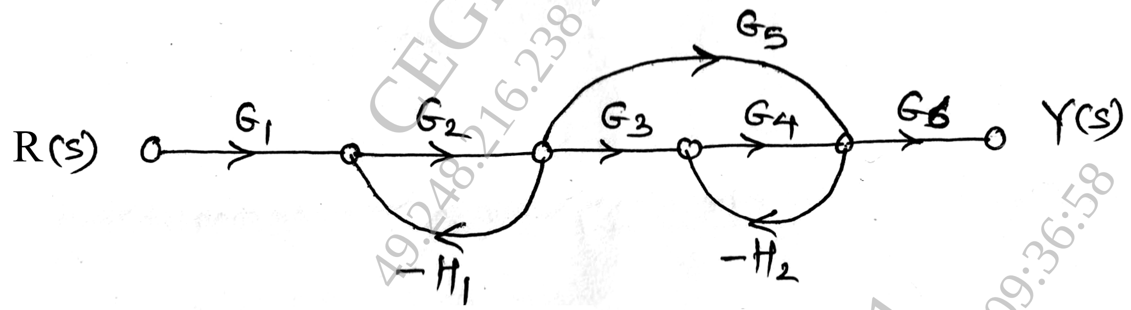


Fig. 1

(B) For the system with closed loop transfer function

$$G(s) = \frac{9}{s^2 + 4s + 9}$$

determine damping factor, undamped natural frequency, rise time, peak time, peak overshoot and settling time with 2% tolerance band. [6]

P.T.O.

*Or*

**2.** (A) Obtain the transfer function $\frac{V_0(s)}{V_{in}(s)}$ for the system shown in Figure 2. [6]

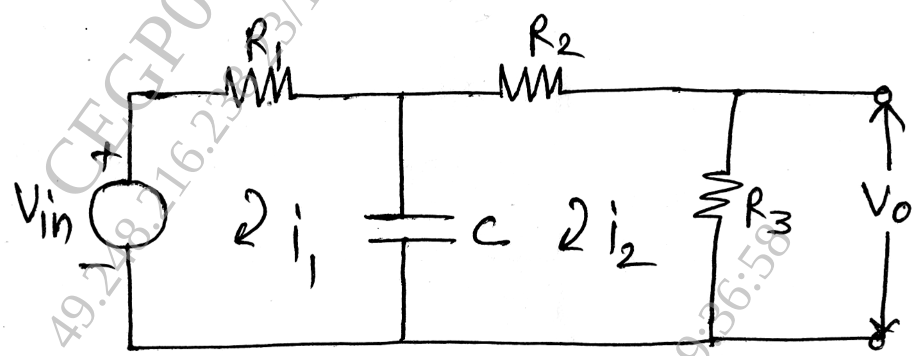


Fig. 2

(B) For the unity feedback system with open loop transfer function $G(s) = \frac{50\,(s+5)}{s(s^2+5s+50)}$, determine static error constants and steady state error if input is $r(t) = 1 + 5t$. [6]

**3.** (A) Investigate the stability of a system having closed loop characteristic equation :

$$Q(s) = s^4 + 5s^3 + 7s^2 + 3s + 2$$

using Routh stability criterion. Also find number of closed loop poles in the right half of $s$-plane. [4]

(B) For the unity feedback system with open loop transfer function

$$G(s) = \frac{50}{s(s+2)(s+10)},$$ sketch Bode plot.

Determine gain crossover frequency, phase crossover frequency, gain margin and phase margin. Also investigate the stability. [8]

*Or*

**4.** (A) Determine damping factor, undamped natural frequency, resonant peak and resonant frequency for the system with closed loop transfer function [4]

$$G(s) = \frac{36}{s^2 + 6s + 36}$$

(B) Sketch root locus of a system with open loop transfer function

$$G(s)H(s) = \frac{k}{s(s+2)(s+8)}.$$ [8]

**5.** (A) Obtain controllable canonical and observable canonical state models for the system with transfer function [6]

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

(B) Investigate for complete state controllability and state observability of system with state space model matrices [7]

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -4 & -5 & -7 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, C = [1 \quad 2 \quad 1]$$

*Or*

**6.** (A) Determine the state transition matrix of system with state equation [7]

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -8 & -6 \end{bmatrix} x$$

(B) Derive the formula for obtaining transfer function from state model and use it to find transfer function of a system with state model.

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

$y = [2 \quad 3]x.$ [6]

**7.** (A) Determine pulse transfer function of a system shown in figure 3, using first principle (Starred Laplace transform). [7]

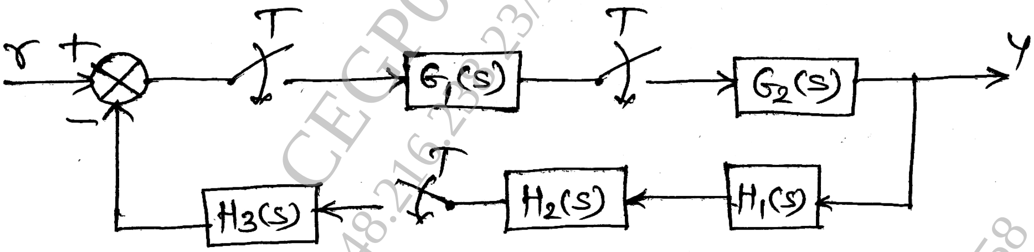


Fig. 3

(B) Write a short note on PID controller. [6]

*Or*

**8.** (A) Determine pulse transfer function, impulse response and step response of a system shown in figure. 4 [7]

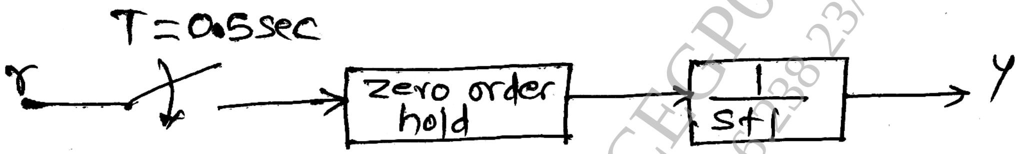


Fig. 4

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