Total No. of Questions—**8**] [Total No. of Printed Pages—**4+1**

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

# [4757]-1047

**S.E. (E & TC Electronics) (Second Semester)**

**EXAMINATION, 2015**

**CONTROL SYSTEMS**

**(2012 Pattern)**

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

***N.B.* :—** (*i*) Attempt 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*) Give the various terminology of electrical system and its analogous quantities based on force-current analogy. [6]

(*b*) Write the differential equations of system shown in Fig. 1. Also find $\dfrac{X_1(s)}{F(s)}$ [6]

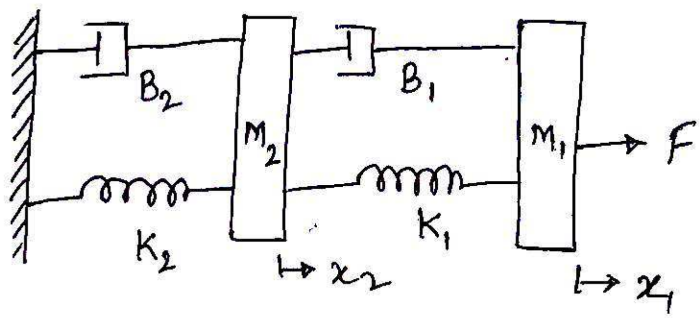


Fig. 1

*Or*

**2.** (*a*) Obtain transfer function of the system shown in Fig. 2 : [6]

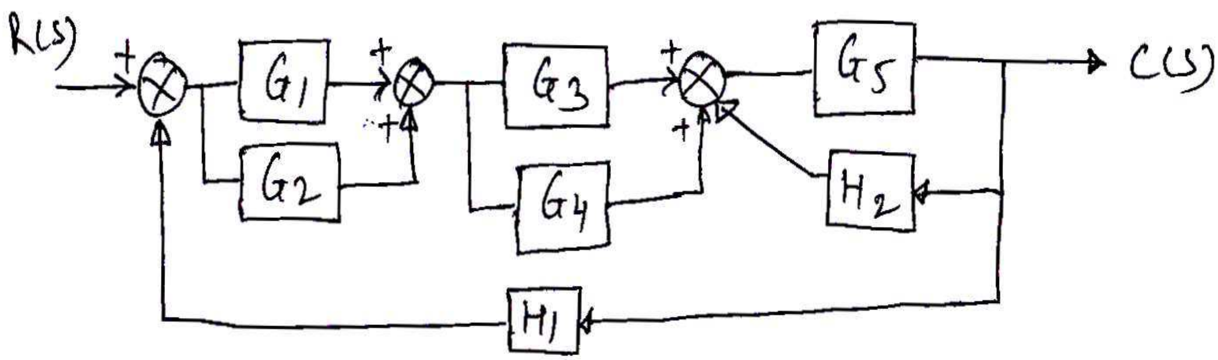


Fig. 2

(*b*) The open loop transfer function of unity feedback system is $G(s) = \frac{k_1}{s(\tau s + 1)}$ with $k$, $\tau > 0$ with a given value of $k_1$, the peak overshoot was found to be 80%. If the overshoot is decreased up to 20% by new gain $k_2$, find $k_2$ in terms of $k_1$. [6]

**3.** (*a*) Using Routh's criteria, comment on the stability if characteristic equation is : [4]

$$s^5 + 2s^4 + 3s^3 + 8s^2 + s + 1 = 0$$

(*b*) Draw the Bode plot and obtain gain margin, phase margin, gain crossover frequency and phase crossover frequency if : [8]

$$G(s) . H(s) = \frac{50{,}000 \ (s + 10)}{s(s + 1) \ (s + 500)}$$

*Or*

**4.** (*a*) If

$$G(s) H(s) = \frac{k}{s(s + 1) \ (s + 10)}$$

sketch the complete Root locus and comment on the stability. [8]

(*b*) If

$$G(s) H(s) = \frac{1}{s(s + 1)}.$$

Find Resonance peak and Resonance frequency. [4]

**5.** (*a*) Obtain transfer function of state model if : [6]

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}, \; B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, \; C = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix}, \; D = [0]$$

(*b*) Find controllability and observability of the state model : [7]

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

*Or*

**6.** (*a*) Obtain state transition matrix if : [6]

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -11 & -12 \end{bmatrix} x$$

using Laplace transformation.

(*b*) With the help of general equation, explain concept of controllable canonical and observable canonical form of state space. [7]

**7.** (*a*) Enlist various terms in PID controller with sketch of output of P, PI, PD and PID controller for step input. [6]

(*b*) Find pulse transfer function of Fig. 3. [7]

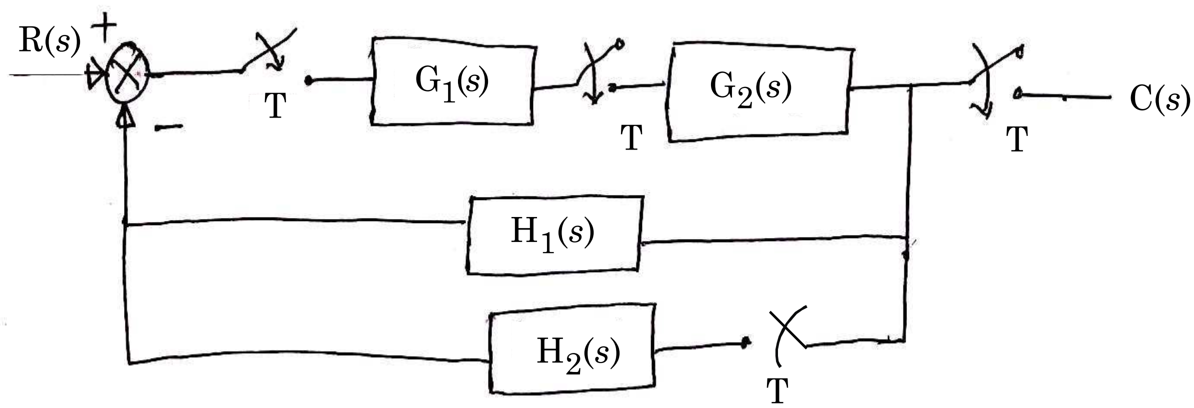


Fig. 3

*Or*

8. (*a*) Explain any *one* application of PLC with ladder diagram. [6]

(*b*) Obtain unit step response of the system shown in Fig. 4. [7]

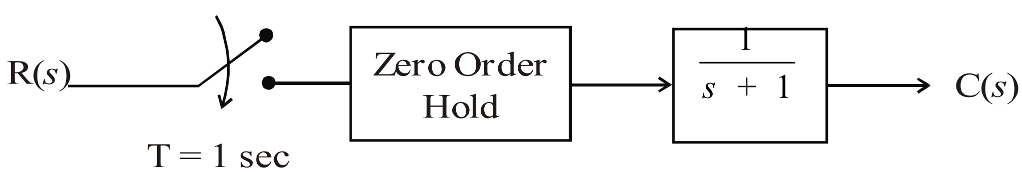


Fig. 4