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10AE71

Seventh Semester B.E. Degree Examination, June/July 2017
Control Engineering

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Differentiate between open loop and close loop control system. **(05 Marks)**

b. What are the requirements of an ideal control system? **(05 Marks)**

c. Give the classification of controllers with block diagram and write their characteristics. **(10 Marks)**

2 a. Draw the mechanical equivalent network for the system shown in Fig. Q2 (a). Write the system equations and determine the transfer function relating displacements x_1 and x_2. **(10 Marks)**

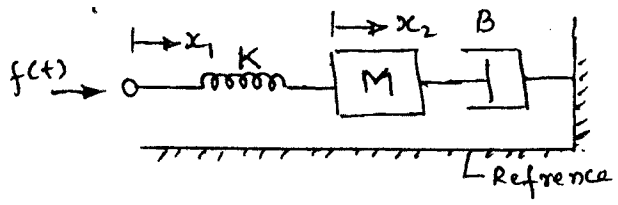

Fig. Q2 (a)

b. A thermometer has a time constant of 15.33 second. It is quickly taken from a temperature of 0°C to a water bath having a temperature of 100°C. What temperature will be indicated after 60 seconds? **(10 Marks)**

3 a. Reduce the block diagram shown in the Fig. Q3 (a) and obtain the transfer function of the system. **(10 Marks)**

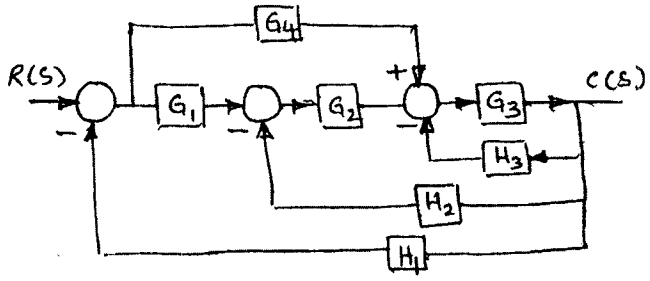

Fig. Q3 (a)

b. Obtain the transfer function $\frac{C(s)}{R(s)}$ of the signal flow graph shown in Fig. Q3 (b). **(10 Marks)**

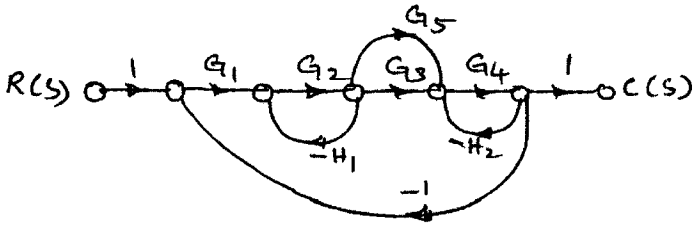

Fig. Q3 (b)

4 a. Obtain an expression for time of first order system subjected to unit step input. **(05 Marks)**

b. A system with a unity feed back has an open loop transfer function, $G(s) = \frac{5}{s(s+1)}$.

Determine : (i)Peak time (ii) Rise time (iii) Settling time (iv) Maximum peak overshoot. **(10 Marks)**

c. Check the stability of the system whose characteristic equation is,

$x^5 + 2x^4 + 6x^3 + 3x^2 + 2x + 1 = 0$ **(05 Marks)**

PART – B

5 a. Draw the polar plot for the transfer function, $G(s) = \frac{K}{s(1+sT_1)(1+sT_2)}$. Find the frequency and magnitude at which the polar plot cut the real axis. **(10 Marks)**

b. The open loop transfer function of a control system with unity feed back,

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

Sketch the Nyquist plot ascertain the stability. **(10 Marks)**

6 Construct the Bode plot for the open loop transfer function of a unity feed back system,

$$G(s) = \frac{20}{s(1+s)(1+0.01s)}$$

Find

(i) Phase cross over frequency.
(ii) Gain cross over frequency.
(iii) Gain margin.
(iv) Phase margin.

Is the system stable? **(20 Marks)**

7 Sketch the root locus for the system whose open loop transfer function is given by,

$$G(s)H(s) = \frac{K}{s(s^2+2s+5)}$$ **(20 Marks)**

8 a. Define the following:

(i) State (ii) State variable (iii) State vector (iv) State space **(08 Marks)**

b. What is compensation? How are comparators classified? **(06 Marks)**

c. For the following system test the controllability:

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} -2 & 1 & 2 \\ 4 & 0 & 3 \\ 1 & -1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 & 4 \\ -5 & 0 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$$ **(06 Marks)**

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