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10ME82

Eighth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. Explain the concepts of openloop and closed loop control systems with two examples for each. **(10 Marks)**

b. What are the requirements of an ideal control systems? **(04 Marks)**

c. Explain the proportional Integral and Differential (PID) controller. **(06 Marks)**

2 a. Obtain the differential equations for the mechanical system shown in Fig.Q2 (a) and obtain the analogous electrical circuit based on the force voltage analogy. **(12 Marks)**

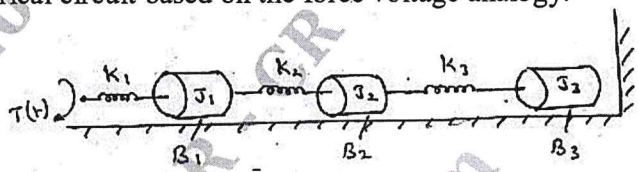

Fig. Q2 (a)

b. A thermometer is dipped in a vessel containing liquid at a constant temperature θ_i. The thermometer has a thermal capacitance for storing heat as C and thermal resistance to heat flow as R. If the temperature indicated by the thermometer is θ_o, obtain the transfer function of the system. **(08 Marks)**

3 a. Reduce the block diagram, shown in Fig. Q3 (a) and determine its transfer function. **(10 Marks)**

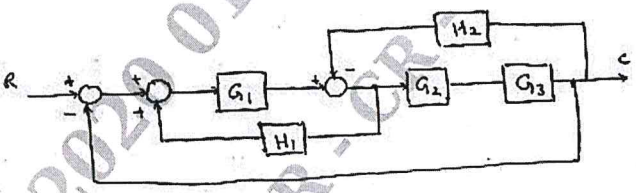

Fig. Q3 (a)

b. Find $\frac{C(s)}{R(s)}$ by Mason's gain formula for the system shown in Fig. Q3 (b). **(10 Marks)**

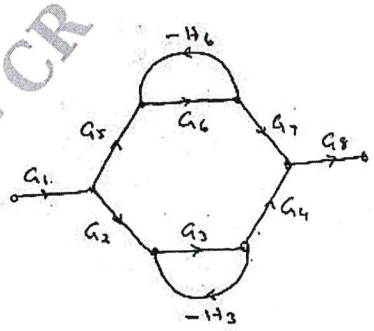

Fig. Q3 (b)

4 a. Derive an expression for the response of a first order system subjected to a unit step input. **(04 Marks)**

b. When the system shown in Fig. Q4 (a) is subjected to a unit step input, its response is as shown in Fig. Q4 (b). Determine the values of K and T from the response curve. **(08 Marks)**

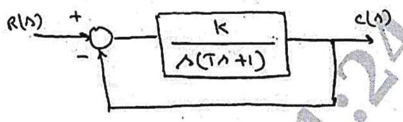

Fig. Q4 (a)

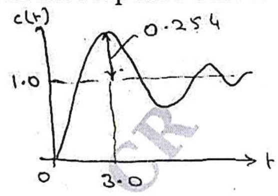

Fig. Q4 (b)

c. By applying Routh's criterion, discuss the stability of the closed loop system whose characteristic equation is $s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$. **(08 Marks)**

PART – B

5 a. Sketch the polar plot for $G(s)H(s) = \dfrac{1}{(1+5s)(1+10s)}$. **(05 Marks)**

b. Sketch the Nyquist plot for a system whose open loop transfer function is,

$G(s)H(s) = \dfrac{K}{s(s+2)(s+10)}$. Determine the range of K for which the system is stable.

(15 Marks)

6 A unity feedback system has $G(s) = \dfrac{K}{s(s+4)(s+10)}$. Sketch the Bode plot and find the value of K for which the system is marginally stable. **(20 Marks)**

7 Sketch the root locus for the system $G(s)H(s) = \dfrac{K}{s(s+4)(s^2+4s+20)}$. Discuss the stability of the system. **(20 Marks)**

8 a. Explain the need for system compensation. List the types of compensator used. **(05 Marks)**

b. Explain : (i) Lead compensator (ii) Lag compensator (iii) Lag-Lead compensator. **(15 Marks)**

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