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10AE71

Seventh Semester B.E. Degree Examination, May 2017
Control Engineering

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Define control system. Compare open loop and closed loop control system with an example. **(06 Marks)**

b. What are the requirements of an ideal control system? **(06 Marks)**

c. Explain proportional plus integral and proportional plus derivative controller with the help of block diagram. **(08 Marks)**

2 a. Obtain the transfer function $\frac{X_1(S)}{F(S)}$ for the mechanical system shown in Fig.Q2(a). **(10 Marks)**

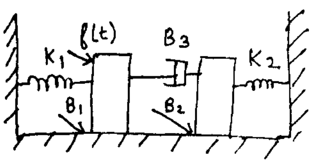

Fig.Q2(a)

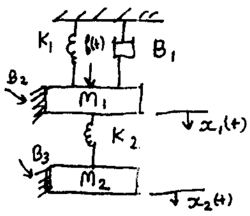

Fig.Q2(b)

b. Draw the equivalent mechanical system for a given system shown in Fig.Q2(b). Write the set of equilibrium equations and obtain analogous circuits using F-V analogy. **(10 Marks)**

3 a. Find the transfer function using block diagram reduction technique for the system shown in Fig.Q3(a). **(10 Marks)**

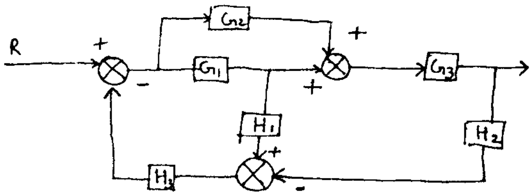

Fig.Q3(a)

b. Using Mason's gain formula determine the overall transfer function of the system shown in Fig.Q3(b). **(10 Marks)**

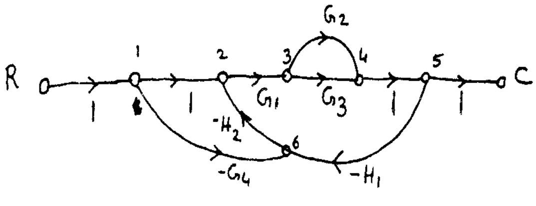

Fig.Q3(b)

4 a. Derive an expression for the response of the first order system subjected to unit step input. **(06 Marks)**

b. A unity feedback system is characterized by an open loop transfer function

$$G(s) = \frac{10}{s^2 + 2s + 6}$$

Determine Damping ratio, peak overshoot undamped natural frequency, peak time, settling time when the system is subjected to a unit step input. **(10 Marks)**

c. The characteristic equation of a system is given by $s^4 + 6s^3 + 23s^2 + 40s + 50 = 0$. Determine the stability using R-H criterion. **(04 Marks)**

PART – B

5 a. Consider a type 0 system with open loop transfer function

$G(s)H(s) = \frac{1}{1+Ts}$, where T is constant. Obtain its polar plot. **(06 Marks)**

b. The open loop transfer function of a unity feedback system is given by

$G(s) = \frac{20(1-s)}{(s+2)(s+3)}$. Draw the Nyquist plot and hence find out whether the system is stable or not. **(14 Marks)**

6 a. Define : (i) Cut off frequency (ii) Bandwidth (iii) Gain crossover frequency (iv) Phase crossover frequency. **(04 Marks)**

b. Construct the Bode plot for a unity feedback system whose open loop transfer function is given by $G(s)H(s) = \frac{10}{s(1+s)(1+0.02s)}$

From the Bode plot determine Gain and Phase crossover frequencies. **(16 Marks)**

7 Sketch the root locus plot of a negative feedback system with an open loop transfer function

$$G(s) = \frac{K}{(s-1)(s+2)(s+3)}$$ **(20 Marks)**

8 a. Discuss various methods of compensation in feedback control system. **(09 Marks)**

b. Obtain the state model of the system shown in Fig.Q8(b). **(05 Marks)**

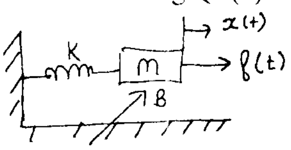

Fig.Q8(b)

c. Evaluate the observability of the system with

$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$, $C = [3 \quad 4 \quad 1]$, using Gilbert test. **(06 Marks)**

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