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10ES43

Fourth Semester B.E. Degree Examination, June/July 2016
Control Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. What are the properties of good control system? **(04 Marks)**

b. Construct mathematical model for the mechanical system shown in Fig. Q1(b). Then draw electrical equivalent circuit based on F–V analogy. **(08 Marks)**

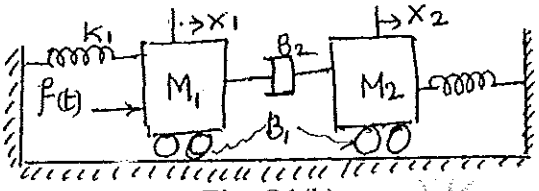

Fig. Q1(b)

c. For electrical system shown in Fig. Q1(C), obtain transfer function $V_2(s)/V_1(s)$. **(08 Marks)**

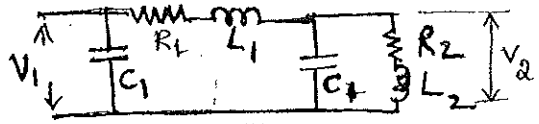

Fig. Q1(c)

2 a. List the features of transfer function. **(04 Marks)**

b. Obtain the transfer function for the block diagram shown in Fig. Q2(b), using block diagram reduction method. **(08 Marks)**

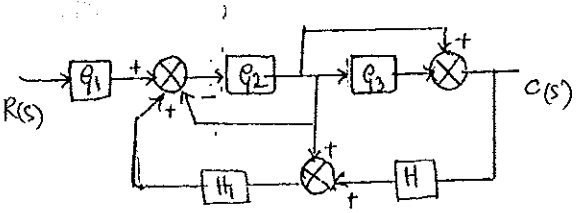

Fig. Q2(b)

c. For the electrical circuit shown in Fig. Q2(c), obtain over all transfer function using Mason's gain formula. **(08 Marks)**

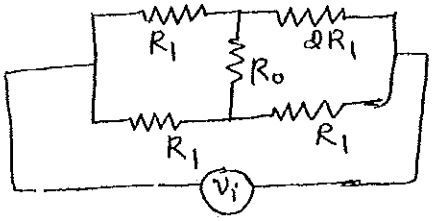

Fig. Q2(c)

3 a. What are static error coefficients? Derive expression for the same. **(06 Marks)**

b. An unity feedback system has $G(s) = \frac{20(1+s)}{s^2(2+s)(4+s)}$, calculate its steady state error co-efficients when the applied input $r(t) = 40 + 2t + 5t^2$. **(06 Marks)**

c. A R–L–C series circuit is an example of second order function. If R = 1 Ω, α = 1H and C = 1F, find response for a step voltage of 10 V connected as input and output across R. **(08 Marks)**

4 a. List the advantages and disadvantages of Routh's criterion (R–H–criterion). **(04 Marks)**

b. A unity feedback control system has $G(s) = \frac{k(s+13)}{s(s+3)(s+7)}$. Using Routh's criterion calculates the range of k for which the system is i) stable ii) has closed loop poles more negative than–1. **(10 Marks)**

c. Find the range of k for which the system, whose characteristic equation is given below is stable. $F(s) = s^3 + (k + 0.5)\, s^2 + 4ks + 50$. **(06 Marks)**

PART – B

5 a. Sketch the root locus for unity feedback having $G(s) = \frac{k(s+1)}{s(s+2)(s^2+2s+2)}$. Determine the range of k for the system stability. **(16 Marks)**

b. Explain how to determine angle of arrival from poles and zeros to complex zeros **(04 Marks)**

6 a. What are the limitations of frequency response methods? **(04 Marks)**

b. A control system having $G(s) = \frac{k(1+0.5s)}{s(1+2s)\left(1+\frac{s}{20}+\frac{s^2}{8}\right)}$ draw bode plot, with k = 4 and find gain margin and phase margin. **(16 Marks)**

7 a. What is polar plot? Explain procedure to sketch polar plot for type 0 and type 1 systems. **(08 Marks)**

b. Sketch the Nyquist plot of a unit feedback control system having the open loop transfer function $G(s) = \frac{5}{s(1-s)}$. Determine the stability of the system using Nyquist stability criterion. **(12 Marks)**

8 a. Find the transfer function for a system having state model as given below :

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u \quad y = [1 \quad 0]x.$$ **(08 Marks)**

b. Obtain the state model for the electrical system given in Fig. Q8(b) choosing the state variables as $i_1(t)$, $i_2(t)$ and $V_C(t)$. **(12 Marks)**

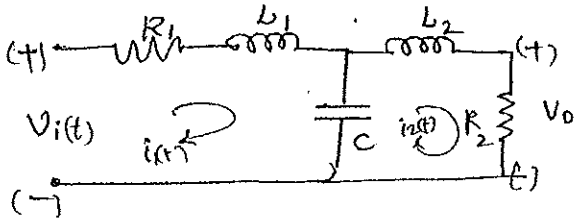

Fig. Q8(b)

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