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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)

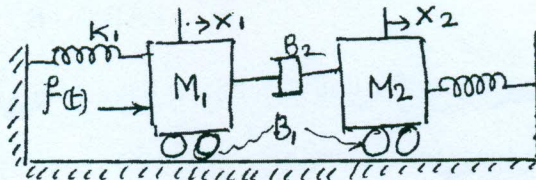


Fig. Q1(b)

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

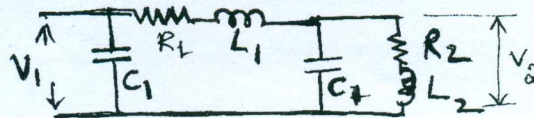


Fig. Q1(c)

- 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)

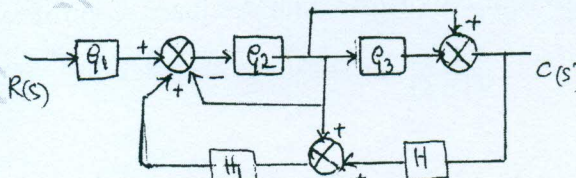


Fig. Q2(b)

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

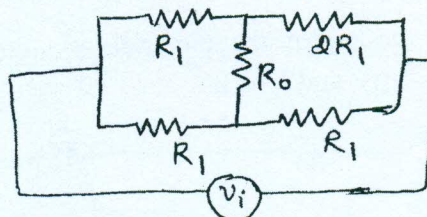


Fig. Q2(c)

- 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 $R = 1 \Omega$, $\alpha = 1H$ and $C = 1F$, find response for a step voltage of 10 V connected as input and output across R. (08 Marks)

Important Note : 1. On completing your answers, carefully draw diagonal cross lines on the remaining blank spaces.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.



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

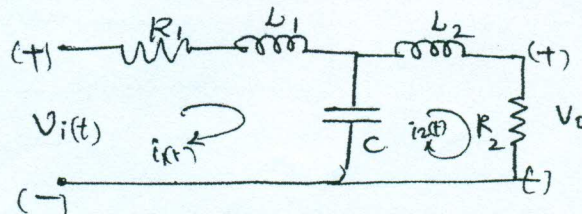


Fig. Q8(b)
