EE5T1

Reg. No.

Fifth Semester B.E. Degree Examination, July/August 2002

Electrical & Electronics Engineering

Linear Control Systems

Time: 3 hrs.] [Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. Assume reasonable missing data, if any.

1. (a) Differentiate between open loop and closed loop control systems. (5 Marks)

(b) From basic principle, derive an expression for the transfer function between velocity and armature voltage of armature controlled DC servomotor. (7 Marks)

(c) Draw the signal flow graph for Q.No. 1(b) and obtain the transfer function between velocity and armature voltage using Mason's gain formula. (8 Marks)

2. (a) What are analogous systems ? Using force - current analogy obtain the equivalent electrical network of the mechanical system shown in fig. 1. .

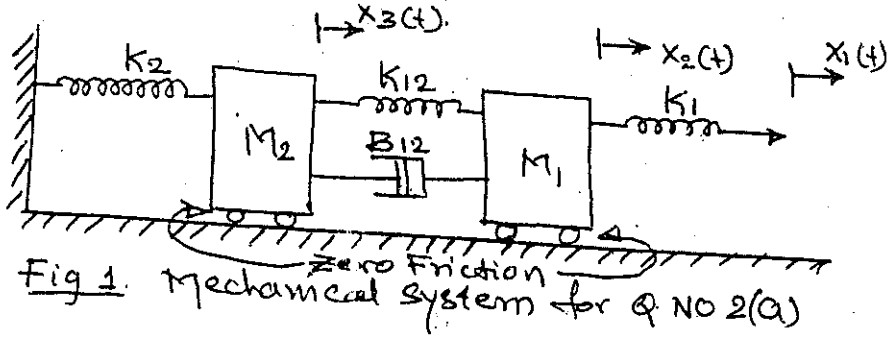

Fig 1. Mechanical System for Q NO 2(a)

(10 Marks)

(b) The closed loop transfer function of a second order system is $\frac{C(s)}{R(s)} = \frac{25}{s^2+6s+25}$ find rise time, peak time, maximum overshoot and setting time, if the system is subjected to unit step input. Assume allowable steady state error as 2%. Find also its output response. (10 Marks)

3. (a) The heat treating oven, operating in unity feedback system has an openloop transfer function

$$G(S) = \frac{20,000}{(S+1)(1+0.1S)(1+0.005S)}$$

The desired (reference temp) temperature is 1000^0C. Find the steady state temperature. (8 Marks)

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(b) For the system shown determine the tachometer constant K_t so as to have the damping ratio as 0.5. Calculate the corresponding peak time maximum overshoot, and damped natural frequency.

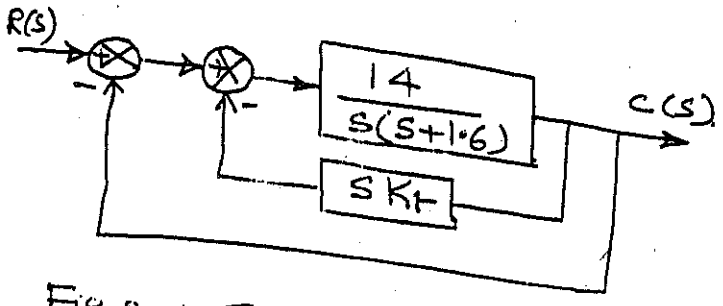

Fig 2 : System for Q.No 3b.

(12 Marks)

4. (a) What is RH criterion? What are the difficulties that arise in finding the stability of the system using R-H criterion? Explain in brief their remedies. (12 Marks)

(b) Find the range of value of K, so that the system with characteristics equation $F(S) = S(S^2 + S + 1)(S + 4) + k = 0$, is stable. (8 Marks)

5. (a) Sketch the Nyquist plot for a system having loop transfer function as

$$G(S)H(S) = \frac{10}{S(S+1)(S+2)}$$

From the plot calculate the gain margin and comment on its stability. (8 Marks)

(b) Construct the Bode's plot for a system having loop transfer function as

$$G(S)H(S) = \frac{80}{S(S+2)(S+20)}$$

From plot calculate gain margin, phase margin, gain cross over frequency and phase cross over frequency. Comment on its stability. (12 Marks)

6. (a) Define the term "Root locus diagram". Mention the rules to draw the locus. Draw the complete Root Locus diagram of a system having loop transfer function as

$$G(S)H(S) = \frac{K}{S(S^2 + 2S + 2)}$$

From the diagram discuss the stability of the system. (2+10+8 Marks)

7. (a) Define the terms: State, variables, state vector and state space. (5 Marks)

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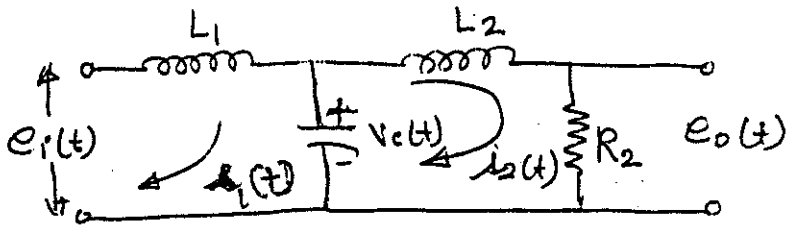
(b) Obtain the state model and output model of the electrical networks shown in fig. Choose $i_1(t), i_2(t)$ *and* $V_C(t)$ as state variables. .



(10 Marks)

(c) Obtain the transfer function of a system whose state model and output model are known. **(5 Marks)**

8. (a) Obtain the solution of system whose state model is given by $\dot{X}(t) = A \times (t) + Bu(t) : x(0) = X_0$ and hence define state transition matrix. **(10 Marks)**

(b) A system is described by

$$\dot{X}(t) = \begin{bmatrix} 1 & -2 \\ 1 & -4 \end{bmatrix} X(t); \quad X(0) = \begin{bmatrix} 0.5 \\ 1 \end{bmatrix}$$

Obtain the solution of the systems. **(10 Marks)**

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