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10ES43

Fourth Semester B.E. Degree Examination, June/July 2013
Control Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Compare open loop and closed loop control systems and give one practical example of each. **(06 Marks)**

b. For the system shown in Fig.Q.1(b) write mechanical network and obtain its mathematical model. **(06 Marks)**

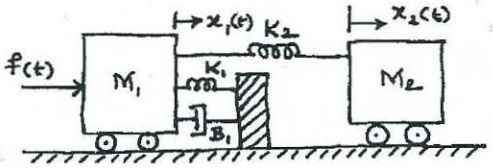


Fig.Q.1(b)

c. For the system shown in Fig.Q.1(c) write its mechanical network and obtain mathematical model and electrical analogue based on force-current analogy. **(08 Marks)**

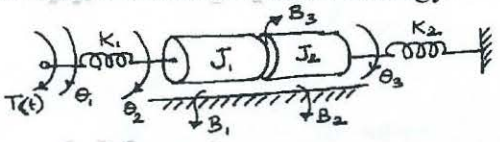


Fig.Q.1(c)

2 a. Define transfer function and what are its properties. **(05 Marks)**

b. Obtain the transfer function for the block diagram shown in Fig.Q.2(b) using block diagram reduction method. **(07 Marks)**

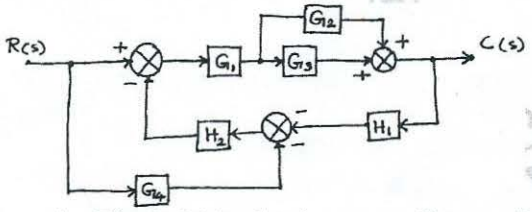


Fig.Q.2(b)

c. For the block diagram, given in Fig.Q.2(c) obtain over all transfer function using Mason's gain formula. **(08 Marks)**

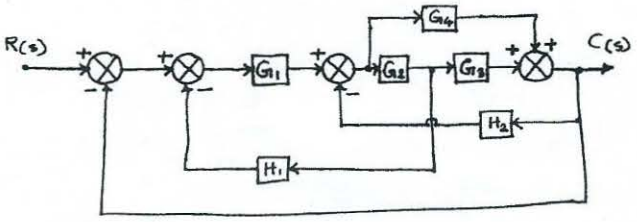


Fig.Q.2(c)

c. The open loop transfer function of a servo system with unity feedback is given by

$$G(s) = \frac{10}{s(0.1s+1)}.$$

Find out static error constants and obtain steady state error when subjected to an i/p of

$$r(t) = A_0 + A_1 t + \frac{A_2}{2} t^2.$$ **(08 Marks)**

4 a. Explain RH stability criterion used for finding of stability of control systems. **(06 Marks)**

b. Find the range of K for the system to be stable using RH criterion.

$$G(s)H(s) = \frac{k(1-s)}{s(s^2+5s+9)}.$$ **(06 Marks)**

c. Investigate the stability of the system give by characteristic equation
$S^6 + 2S^5 + 8S^4 + 12S^3 + 20S^2 + 16S + 16 = 0$. **(08 Marks)**

PART – B

5 A feedback control system has an open loop transfer function

$$G(s)H(s) = \frac{K}{s(s+3)(s^2+2s+2)}.$$

Draw the root locus as K varies from 0 – to - ∞. **(20 Marks)**

6 a. Define the following terms:
i) Resonant peak
ii) Resonant frequency
iii) Band width
iv) Cut off frequency. **(04 Marks)**

b. Sketch the bode plot for the transfer function

$$\frac{300(s^2+2s+4)}{s(s+10)(s+20)}.$$ **(13 Marks)**

c. Write a note about gain margin in brief. **(03 Marks)**

7 a. Plot the polar plot for the transfer function given $G(s) = \frac{1}{s(Ts+1)}$. **(06 Marks)**

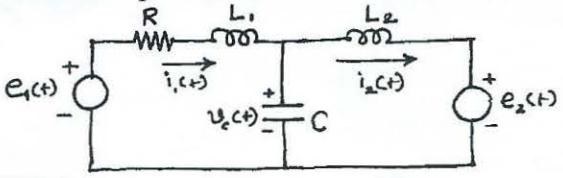
b. State Nyquist stability criterion. **(02 Marks)**

c. Using Nyquist stability criterion verify stability of the system described below:

$$G(s)H(s) = \frac{5}{s(1-s)}.$$ **(12 Marks)**

8 a. Obtain the state model for the electrical system given in Fig.Q.8(a). Take $e_1(t)$, $e_2(t)$ as i/p variables and voltage across R as o/p variables. **(08 Marks)**

Fig.Q.8(a)



b. List out the properties of STM. **(05 Marks)**

c. Obtain the state transition matrix for a system matrix given by $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$. **(07 Marks)**

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