USN | | | | | | | | | | | **10ES43**

Fourth Semester B.E. Degree Examination, June/July 2018
Control Systems

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define control system. Explain linear and nonlinear control system. **(06 Marks)**

b. Derive transfer function for a lag-lead network, shown in Fig.Q.1(b). **(06 Marks)**

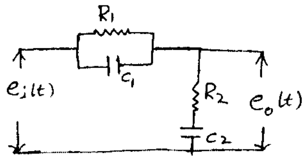


Fig.Q.1(b)

c. For the mechanical system shown in Fig.Q.1(c) i) Draw the mechanical network; ii) Write differential equations; iii) Draw force-to-voltage [F-V] analogous electric network.

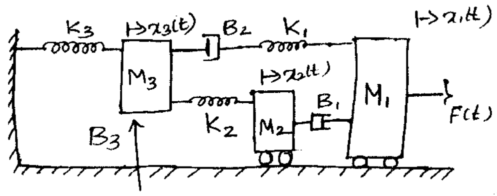


Fig.Q.1(c) **(08 Marks)**

2 a. Illustrate how to perform the following in connection with block diagram reduction techniques:
   i) Moving a summing point before the block.
   ii) Removing minor feedback loop.
   iii) Shifting take off point after summing point. **(06 Marks)**

b. Obtain $\frac{C_1(S)}{R_2(S)}$ and $\frac{C_2(S)}{R_1(S)}$ for the given multiple input and multiple output system shown in Fig.Q.2(b). **(06 Marks)**

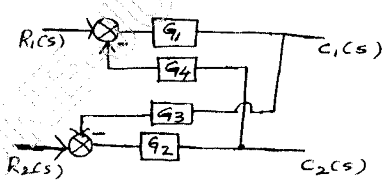


Fig.Q.2(b)

c. Draw the signal flow graph and determine the overall transfer function of the block diagram shown in Fig.Q.2(c) using Mason's gain formula. **(08 Marks)**

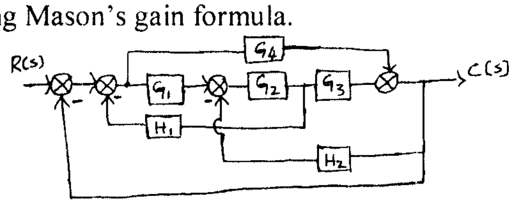


Fig.Q.2(c)

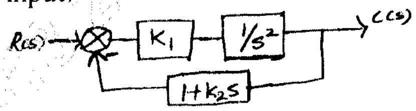
3 a. State various standard test signals commonly used in control system. Sketch their typical plots and obtain their Laplace transform. (06 Marks)

b. A unity feedback system has $G(S) = \dfrac{10(S+2)(S+3)}{S(S+1)(S+5)(S+4)}$. Determine:

i) Type of the system
ii) All error coefficients and
iii) Steady state error where input is $r(t) = 3 + t + t^2$. (06 Marks)

c. For control system shown in Fig.Q.3(c) find the values of K_1 and K_2 so that $M_P = 25\%$ and $T_P = 4$ sec. Assume unit step input. (08 Marks)

Fig.Q.3(c)



4 a. Define the following terms related to a control system:
i) Stable system ii) Marginally stable system iii) Relatively more stable system. (06 Marks)

b. For unity feedback system, $G(S) = \dfrac{K}{S(1+0.4S)(1+0.25S)}$, find range of values of K, marginal value of K and frequency of sustained oscillations. (06 Marks)

c. Using RH criterion determine the stability of the system having the characteristic equation $S^6 + 2S^5 + 5S^4 + 8S^3 + 8S^2 + 8S + 4 = 0$. Examine the stability. (08 Marks)

PART – B

5 a. Find valid break away points and inter section of root locus with imaginary axis for $G(S)H(S) = \dfrac{K(S+1)}{S(S-1)(S^2+5S+20)}$. (08 Marks)

b. Sketch the rough nature of the root locus of a certain control system whose characteristic equation is given as $S^3 + 9S^2 + KS + K = 0$. Comment on stability. (12 Marks)

6 a. Explain the correlation between time domain and frequency domain systems. (06 Marks)

b. For a unity feedback system $G(S) = \dfrac{242(S+5)}{S(S+1)(S^2+5S+121)}$. Sketch the bode plot, find W_{gc}, W_{pc}, GM and PM. Comment on stability. (14 Marks)

7 a. Draw a polar plot for a –VE feedback control system having an open loop transfer function $G(S)H(S) = \dfrac{100}{(S+2)(S+4)(S+8)}$. (06 Marks)

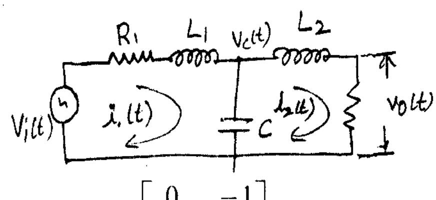
b. List the advantages of Nyquist plot. (04 Marks)

c. Investigate the stability of a negative feedback control system whose open loop transfer function is given by $G(S)H(S) = \dfrac{100}{(S+1)(S+2)(S+3)}$, using Nyquist stability criterion. (10 Marks)

8 a. Define state variables. List the properties of state transition matrix. (06 Marks)

b. Obtain the state and output equation for the electrical network shown in Fig.Q.8(b). (06 Marks)

Fig.Q.8(b)



c. Find the state transition matrix for $A = \begin{bmatrix} 0 & -1 \\ +2 & -3 \end{bmatrix}$. (08 Marks)

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