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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)

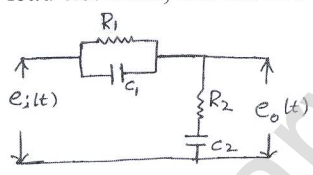


Fig.Q.1(b)

- 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.

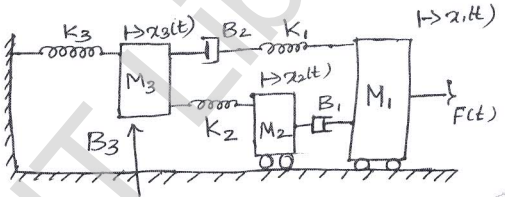


Fig.Q.1(c)

(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)

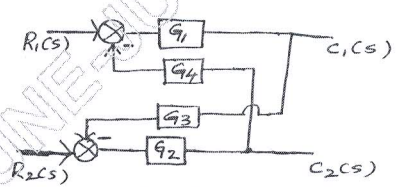


Fig.Q.2(b)

- 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)

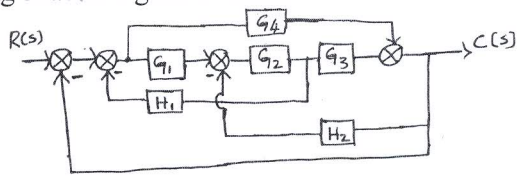
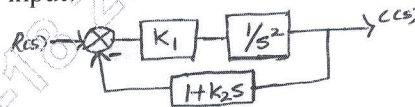


Fig.Q.2(c)

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

- 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  $G(S) = \frac{10(S+2)(S+3)}{S(S+1)(S+5)(S+4)}$ . 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)

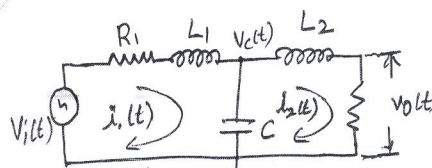


- 4 a. Define the following terms related to a control system:  
 i) Stable system ii) Marginally stable system iii) Relatively more stable system. (06 Marks)
- b. For unity feedback system,  $G(S) = \frac{K}{S(1+0.4S)(1+0.25S)}$ , find range of values of K, marginal value of K and frequency of sustained 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  $G(S)H(S) = \frac{K(S+1)}{S(S-1)(S^2+5S+20)}$ . (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  $G(S) = \frac{242(S+5)}{S(S+1)(S^2+5S+121)}$ . 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 -VC feedback control system having an open loop transfer function.  $G(S)H(S) = \frac{100}{(S+2)(S+4)(S+8)}$ . (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  $G(S)H(S) = \frac{100}{(S+1)(S+2)(S+3)}$ , 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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