USN | | | | | | | | | | 06ES43

Fourth Semester B.E. Degree Examination, Dec. 2013/Jan. 2014
Control Systems

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer FIVE full questions, selecting atleast TWO questions from each part.***
2. Missing data, if any, may be suitable assumed.

PART – A

1 a. Define a control system. Explain with examples, open loop and closed loop control systems. List the merits and demerits of open loop and closed loop control systems. **(10 Marks)**

b. For the mechanical system shown in Fig. Q1(b),
i) Draw the mechanical network
ii) Write the differential equations describing the system
iii) Draw the F – V analogous electrical circuit after writing the corresponding electrical equations. **(10 Marks)**

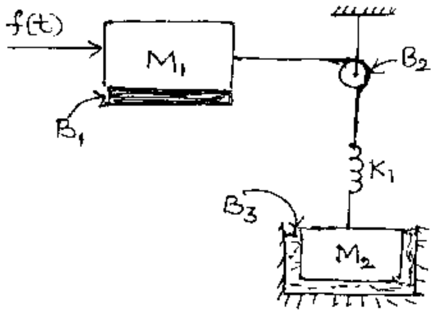

Fig. Q1(b)

2 a. For the circuit shown in Fig. Q2(a). Draw the block diagram and determine the transfer function $\frac{V_0(S)}{V_i(S)}$, using block diagram rules. **(10 Marks)**

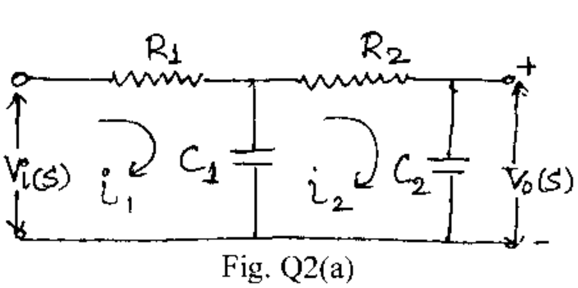

Fig. Q2(a)

b. For the system represented by the following equations, find the transfer function $\frac{X(S)}{U(S)}$ by signal flow graph, technique

$$x = x_1 + \alpha_3 U$$

$$\dot{x}_1 = -\beta_1 x_1 + x_2 + \alpha_2 U$$

$$\dot{x}_2 = -\beta_2 x_1 + \alpha_1 U.$$ **(10 Marks)**

3 a. Explain the following time domain specifications of a second order systems, with neat sketch i) Peak time ii) Delay time iii) Rise time iv) maximum over shoot v) Settling time. **(06 Marks)**

b. A system described by $\frac{d^2y}{dt^2}+\frac{8dy}{dt}+25y(t)=50x(t)$,

Evaluate the response and maximum output for a step of 2.5 units. **(08 Marks)**

c. In the block shown in Fig. Q3(c) $G(s) = A/S^2$ and $H(S) = (ms + n)$. For A = 10, determine the values of m and n for a step input with a time constant 0.1 sec ; which give a peak over shoot of 30%. **(06 Marks)**

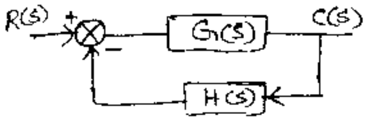

Fig. Q3(c)

4 a. What are the difficulties encountered while assessing Routh – Hurwitz criteria and how do you eliminate these difficulties. explain with examples. **(06 Marks)**

b. The open loop transfer function of a feedback control system is given by

$$G(S)H(S)=\frac{K}{S(s+4)(s^2-2s+2)}$$

i) Using R- H cretarian determine the range of "K" for which the system will be stable

ii) If a zero at S = –4 is added to the forward transfer function, how is the stability affected? **(08 Marks)**

c. Using R – H cretarian, find the stability of a unity feedback system having closed loop transfer function $G(S)=\frac{e^{-ST}}{S(s+2)}$. **(06 Marks)**

PART – B

5 a. State the different rules for the construction of root locus. **(08 Marks)**

b. A feedback control system has open loop transfer function :

$$G(S)H(S)=\frac{K}{S(s+4)(s^2+4s+20)}$$

Plot the root locus for K = 0 to ∞ indicate all points on it. **(12 Marks)**

6 a. Explain co-relation between time domain and frequency domain for second order systems. **(06 Marks)**

b. The open loop transfer function of unity feedback control system is given by

$$G(S)H(S)=\frac{K}{S(1+0.001s)(1+0.25s)(1+0.1s)}$$

Determine the value of K, so that the system will have a phase margin of 40°, what will be the gain margin. Use code plot. **(14 Marks)**

7 a. State and explain Nyquist stability cretarian. **(06 Marks)**

b. Using Nyquist stability cretarian, find the range of K for closed – loop stability

$$G(S)H(S)=\frac{K}{S(s^2+2s+2)} \quad K>0.$$ **(14 Marks)**

8 a. Explain properties and significance of state transition matrix. **(10 Marks)**

b. A linear time invariant system is characterized by the homogeneous state equation :

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

Compute the solution of homogeneous equation assume the initial state vector. **(10 Marks)**

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