CBCS SCHEME

USN | | | | | | | | | | |

15EC43

Fourth Semester B.E. Degree Examination, July/August 2021
Control Systems

Time: 3 hrs. Max. Marks:80

Note: ***Answer any FIVE full questions.***

1 a. List the merits and demerits of open loop and closed loop control systems. Give at least one example each? **(05 Marks)**

b. Explain the block diagram rule regarding :
i) Combining blocks in cascade
ii) Moving a summing point after a block
iii) Moving a take-off point beyond a block. **(05 Marks)**

c. For the electrical circuit shown in Fig.Q1(c) construct the block diagram.

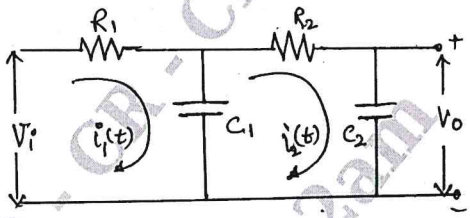

Fig.Q1(c) **(06 Marks)**

2 a. For the two port network shown in Fig.Q2(a), obtain transfer function of $V_1(s)/I_1(s)$.

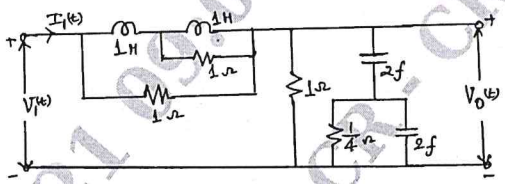

Fig.Q2(a) **(05 Marks)**

b. For the system shown in Fig.Q2(b), i) Write the differential equation describing the system ii) Draw Force – voltage analogous electrical circuit.

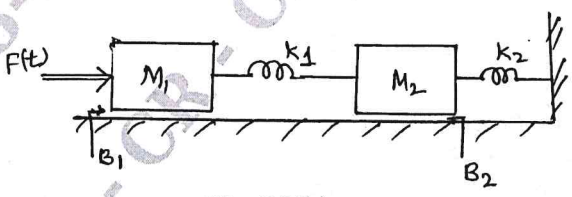

Fig.Q2(b) **(05 Marks)**

c. For the signal graph shown in Fig.Q2(c), find the transfer function, using Masoris gain formula.

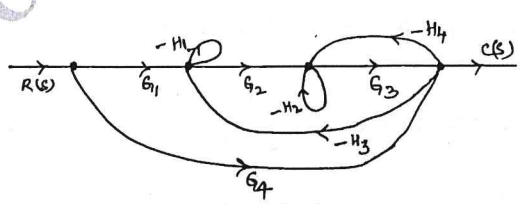

Fig.Q2(c) **(06 Marks)**

3 a. Derive the time response of second order system for the underdamped case, subjected to unit step input. **(10 Marks)**

b. For the unity feedback system $G(s)=\frac{s(s+1)}{s^2(s+3)(s+10)}$. Determine the type of the system, error co-efficients and steady state error for input $r(t)=1+3t+\frac{t^2}{2}$. **(06 Marks)**

4 a. Explain the following time domain specifications of a second order system :
i) Rise time ii) Peak time iii) Maximum over shoot iv) Settling time. **(04 Marks)**

b. The open loop transfer function of a unity feedback control system is given as $G(S)=\frac{k}{S(TS+1)}$. By what factor the system gain K has to be multiplied to decrease overshoot from 75% to 25%. **(06 Marks)**

c. For the system shown in Fig.Q4(c), determine the value of 'a' which gives damping factor 0.7. What is the steady state error to unit ramp input for valve of 'a'.

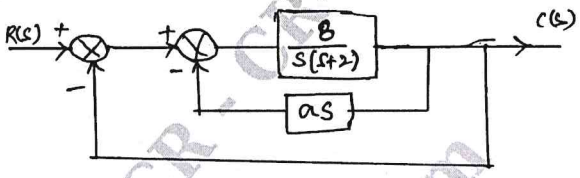

Fig.Q4(c) **(06 Marks)**

5 a. Explain the terms 'Relative stability' and 'Conditional Stability'. **(04 Marks)**

b. State and explain Routh-Hurwitz criterion. **(04 Marks)**

c. Sketch the root loci to determine the stability of the system $G(s)=\frac{k}{s(s+1)(s+3)}$. **(08 Marks)**

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

b. The open loop transfer function of a unity feedback system is given by $G(s)=\frac{k}{s(s+3)(s^2+s+1)}$.
Find the value of K, that will cause sustained oscillation and hence find the oscillation frequency. **(08 Marks)**

7 a. Define the following with reference to Bode plots :
i) Gain margin
ii) Phase margin
iii) Gain cross over frequency
iv) Phase cross over frequency. **(06 Marks)**

b. Construct the bode plot for a unity feedback control system with $G(s)=\frac{10(s+10)}{s(s+2)(s+5)}$. Find its gain margin and phase margin. Comment on the stability. **(10 Marks)**

8 a. Sketch the polar plot of $G(s)=\frac{1}{s+2}$. Show all the steps involved. **(06 Marks)**

b. Sketch the Nyquist plot for the open – loop transfer function $G(s)H(s)=\frac{10}{(s+2)(s+4)}$.
Determine the stability of the closed loop system by Nyquist criterion. **(10 Marks)**

9 a. List the properties of state transition matrix. **(06 Marks)**

b. What is sampled data control system? **(02 Marks)**

c. Obtain the state model for the electric network shown in Fig.9(c). Select i_L and V_c as state variables.

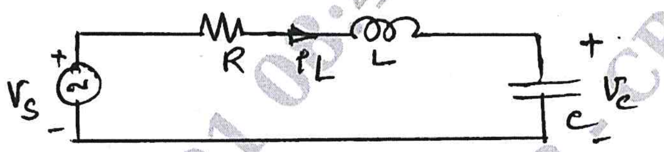

Fig.Q9(c) **(08 Marks)**

10 a. What is signal reconstruction? Explain it with sample and hold circuit. **(08 Marks)**

b. Obtain the state transition matrix Q(t) of the following system.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Also obtain the inverse of the state transition matrix $\phi'(t)$. **(08 Marks)**

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