CBCS SCHEME

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15EC43

Fourth Semester B.E. Degree Examination, Feb./Mar. 2022
Control Systems

Time: 3 hrs. Max. Marks: 80

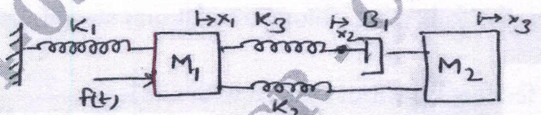
Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Distinguish between Open loop and Closed loop system with suitable examples. **(04 Marks)**

b. Write the differential equations for mechanical system shown in Fig. Q1(b) and write FV Analogous Electrical circuit. **(06 Marks)**

Fig. Q1(b)



c. For the signal flow graph, shown in Fig. Q1(c), determine the Transfer function $\frac{C(s)}{R(s)}$, using Mason's Gain formula. **(06 Marks)**

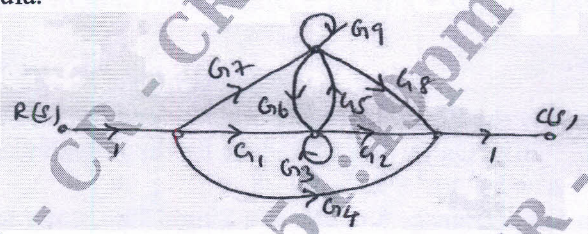


Fig. Q1(c)

OR

2 a. Draw the Mechanical network. Write differential equations of performance and also draw the Torque Current Analogous circuit for Fig. Q2(a). **(06 Marks)**

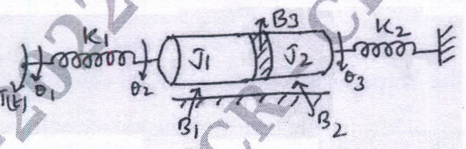


Fig. Q2(a)

b. Obtain $\frac{C(s)}{R(s)}$ of the system shown in Fig. Q2(b) by using block diagram Reduction method.

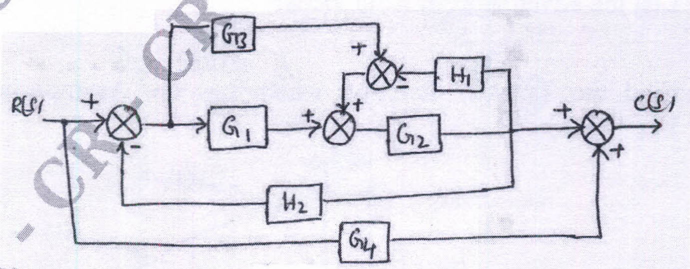


Fig. Q2(b)

(06 Marks)

c. Illustrate how to perform the following connection with block diagram Reduction technique.
i) Shifting a Takeoff point after a block ii) Shifting a Summing point after a block. **(04 Marks)**

Module-2

3 a. A negative feedback system is characterized by an Open loop system $G(s)\,H(s) = \dfrac{10}{s(s+2)}$. If the system is subjected to a step input of IV. Find the following time domain specifications : i) Delay time ii) Rise time iii) Peak time iv) Peak overshoot. **(08 Marks)**

b. For a system $G(s)\,H(s) = \dfrac{K}{s^2(s+2)(s+3)}$. Find the value of K to limit steady state error to 10 when input to system is $1 + 10t + \dfrac{40}{2}t^2$. **(08 Marks)**

OR

4 a. Comment on the following statement : An increase in damping ratio increases the rise time. **(04 Marks)**

b. For a unity feedback control system with $G(s) = \dfrac{64}{s(s+9.6)}$. Write the output response to a unit step input. Determine i) The response at t= 0.1sec. ii) Maximum value of the response and time at which it occurs. **(08 Marks)**

c. Explain Proportional + Integral + Differential controller and their effect on Stability. **(04 Marks)**

Module-3

5 a. Explain briefly the Routh - Hurwitz criterion and use it to determine the roots i) in RHS ii) LHS iii) On jw axis of S plane for the Polynomial. $P(s) = s^6 + s^5 + 5s^4 + s^3 + 2s^2 - 2s - 8$. **(08 Marks)**

b. The Open Loop Transfer function of a Single loop, unity feedback control system is given by $G(s) = \dfrac{K(s+13)}{s(s+3)(s+7)}$.

i) Find the value of K for which the Closed loop system is stable.

ii) Find the value of K for which the Closed loop poles are more negative then -1. **(08 Marks)**

OR

6 a. Following all the steps, draw the root locus diagram for the Transfer function $G(s)\,H(s) = \dfrac{K}{s(s^2+8s+17)}$. From the diagram evaluate the value of K for a system damping ratio of 0.5. **(14 Marks)**

b. List the advantages of Root locus. **(02 Marks)**

Module-4

7 a. Find the Transfer function which has the Asymptotic Bade magnitude plot shown in Fig. Q.7(a). **(08 Marks)**

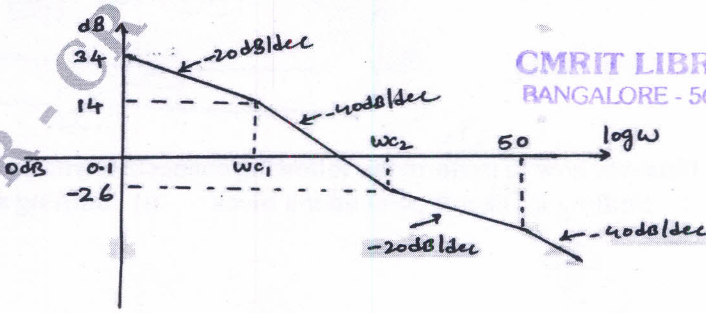


Fig. Q7(a)

b. A –Ve Feedback control system is characterized by an Open Loop Transfer function $G(s)\,H(s) = \dfrac{10}{(s+1)(s+2)}$ investigate the closed loop stability of the system using Nyquist stability criterion. **(08 Marks)**

OR

8 a. The Open Loop Transfer function of unity feedback system is $G(s) = \dfrac{K}{s(1+0.02s)(1+0.05s)}$. Draw the Asymptotic Bode plot and hence find the value of K for which gain margin is 10dB, what is corresponding phase margin. **(12 Marks)**

b. State and explain "Nyquist Stability Criterion". **(04 Marks)**

Module-5

9 a. Explain Signal reconstruction scheme using sample and hold circuit. **(04 Marks)**

b. Obtain state model for system represented by differential equation.

$$\frac{d^3y}{dt^3} + 3\frac{d^2y}{dt^2} + 6\frac{dy}{dt} + 7y(t) = 2u(t).$$ **(06 Marks)**

c. Obtain Transfer function of system having state model.

$$\dot{X}(t) = \begin{vmatrix} -5 & -1 \\ 3 & -1 \end{vmatrix} X(t) + \begin{vmatrix} 2 \\ 5 \end{vmatrix} U(t).$$

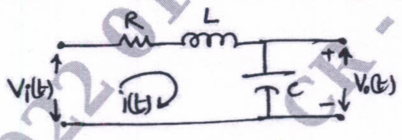
$$Y(t) = [1\ 2]\ X(t).$$ **(06 Marks)**

OR

10 a. Discuss the advantages and limitations of State Variable approach. **(03 Marks)**

b. Find the State space representation of circuit shown in Fig. Q10(b). **(06 Marks)**

Fig. Q10(b)



c. Find State transition matrix for $A = \begin{vmatrix} 0 & -1 \\ +2 & -3 \end{vmatrix}$. **(07 Marks)**

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