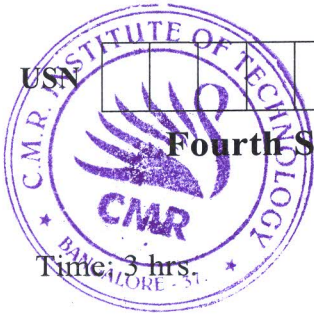


CBCS SCHEME

15EC43



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Fourth Semester B.E. Degree Examination, June/July 2023

Control Systems

Time: 3 hrs.

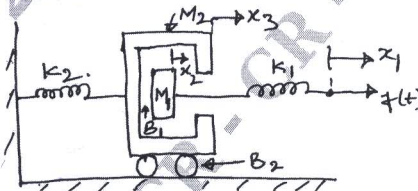
Max. Marks: 80

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

Module-1

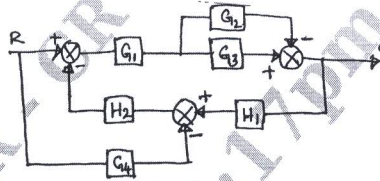
- 1 a. Explain Open Loop and Closed Loop Control System, with an example. (05 Marks)
- b. Draw Electrical Analogous system using Force – Voltage and Force – Current Analogy for Mechanical system, shown in Fig. Q1(b). (06 Marks)

Fig. Q1(b)



- c. Obtain C/R ratio for block diagram shown in Fig. Q1(c), using block diagram reduction technique. (05 Marks)

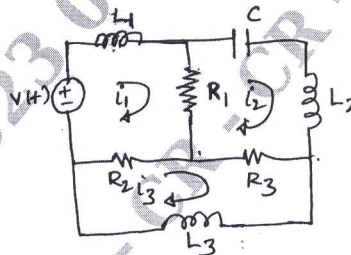
Fig. Q1(c)



OR

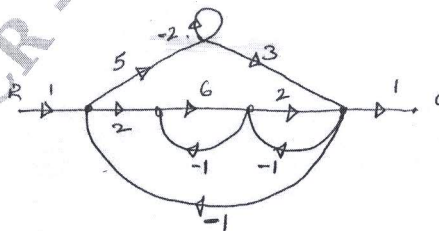
- 2 a. Obtain Mechanical system from Force Voltage Electrical network shown in Fig. Q2(a). Also write relevant equations for both the networks. (08 Marks)

Fig. Q2(a)



- b. Use Mason's gain formula to find $\frac{C}{R}$ ratio for the signal flow graph shown in Fig. Q2(b). (08 Marks)

Fig. Q2(b)



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.

Module-2

- 3 a. What are different Input test signals? Write Laplace transform of these signals. (05 Marks)
 b. A unity feedback system has

$$G(s) = \frac{20(1+s)}{s^2(2+s)(4+s)}$$
 Calculate its steady state error co-efficients and steady state error when the applied input is $r(t) = 40 + 2t + 5t^2$. (05 Marks)
 c. Obtain the expression for peak time (T_p) and Maximum overshoot (M_p). (06 Marks)

OR

- 4 a. Derive expression for time response of Second order system for unit step input. (08 Marks)
 b. A system is given by the differential equation $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 8y = 8x$, where 'y' is the output and 'x' is the input. Determine peak time, delay time and maximum overshoot for unit step input. (04 Marks)
 c. Define PD, PI and PID controllers. (04 Marks)

Module-3

- 5 a. Explain Routh's Stability Criterion. (06 Marks)
 b. Sketch the root locus for the system represented by the open loop transfer function

$$G(s) = \frac{K}{s(s^2 + 8s + 17)}$$

- i) What is the value of K for a damping factor of 0.5?
 ii) What is the corresponding closed loop transfer function? (10 Marks)

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OR

- 6 a. Determine the range of K such that the characteristic equation $s^3 + 3(k+1)s^2 + (7k+5)s + (4k+7) = 0$ has roots more -ve than $s = -1$. (08 Marks)
 b. Draw the root locus for the open loop transfer function $G(s)H(s) = \frac{K(s+1)}{s(s-1)}$. Also show that root locus forms a circle. (08 Marks)

Module-4

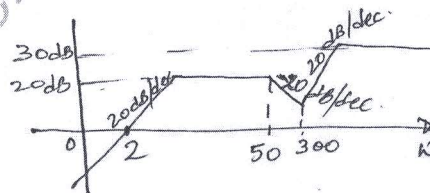
- 7 a. Draw the Bode plot of a system having

$$G(s) = \frac{K(1+0.2s)(1+0.025s)}{s^3(1+0.001s)(1+0.005s)}$$
 Show that the system is conditionally stable. Find the range of 'K' for which the system is stable. (10 Marks)
 b. Explain how to determine gain crossover frequency, phase crossover frequency, gain margin and phase margin using polar plots. (06 Marks)

OR

- 8 a. Estimate the transfer function from the Bode plot shown in Fig. Q8(a). (06 Marks)

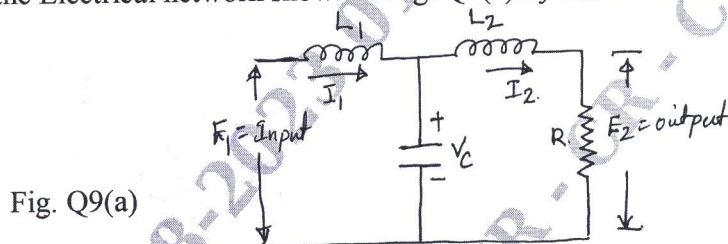
Fig. Q8(a)



- b. The Open loop transfer function of a unity feedback system is given by $G(s) = \frac{K(s+3)}{s(s^2+2s+2)}$ using the Nyquist criteria, find the value of 'K' for which the closed loop system is just stable. (10 Marks)

Module-5

- 9 a. Represent the Electrical network shown in Fig. Q9(a) by a state model. (05 Marks)



- b. Mention the properties of State Transition matrix. (05 Marks)
 c. Explain Analysis of sampling process in digital control system. (06 Marks)

- 10 a. For a certain system when $x(0) = \begin{bmatrix} 1 \\ -3 \end{bmatrix}$ then $x(t) = \begin{bmatrix} e^{-3t} \\ -3t^{-3t} \end{bmatrix}$ while $x(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ the $x(t) = \begin{bmatrix} e^t \\ e^t \end{bmatrix}$. Determine the system matrix A. Also find State transition matrix. (10 Marks)
- b. Mention the advantages of Digital Control system. (06 Marks)
