CBCS SCHEME

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

15EC43

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)**

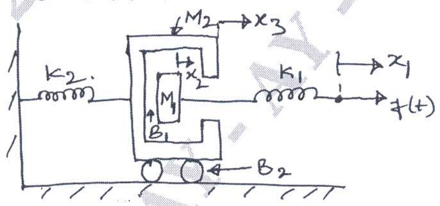


Fig. Q1(b)

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

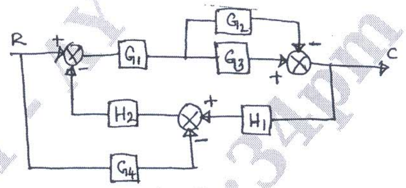


Fig. Q1(c)

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)**

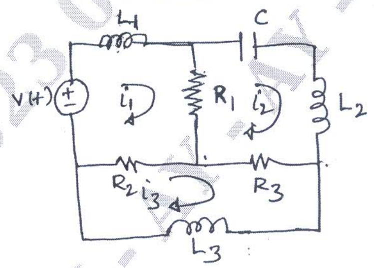


Fig. Q2(a)

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

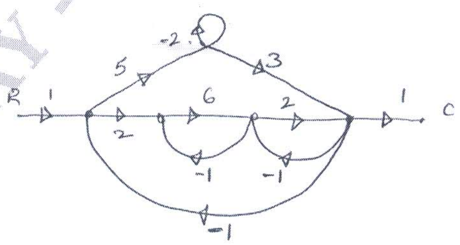


Fig. Q2(b)

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

$G(s) = \dfrac{20(1+s)}{s^2(2+s)(4+s)}$. 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 (Tp) and Maximum overshoot (Mp). **(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 $\dfrac{d^2y}{d+2} + 4\dfrac{dy}{dt} + 8y = 8x$, 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

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

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)**

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 $G(s)H(s) = \dfrac{K(s+1)}{s(s-1)}$. Also show that root locus forms a circle. **(08 Marks)**

Module-4

7 a. Draw the Bode plot of a system having

$G(s) = \dfrac{K(1+0.2s)(1+0.025s)}{s^3(1+0.001s)(1+0.005s)}$.

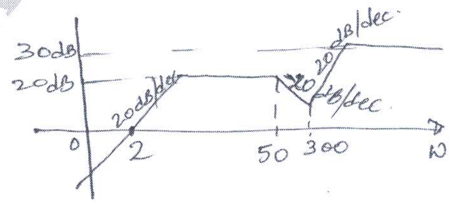
Show that the system is conditionally stable. Find the range of 'K' for which the system is stable. **(10 Marks)**

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 $G(s) = \dfrac{K(s+3)}{s(s^2+2s+2)}$ 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)**

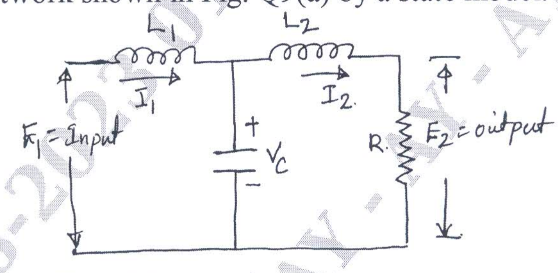


Fig. Q9(a)

b. Mention the properties of State Transition matrix. **(05 Marks)**

c. Explain Analysis of sampling process in digital control system. **(06 Marks)**

OR

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)**

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