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CBCS SCHEME

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18EC43

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

Time: 3 hrs. Max. Marks: 100

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

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-1

1 a. Define control system and explain with an example. **(04 Marks)**

b. Compare open loop and closed loop control system. **(06 Marks)**

c. Find the transfer function of the electromechanical system shown in Fig.Q1(c).

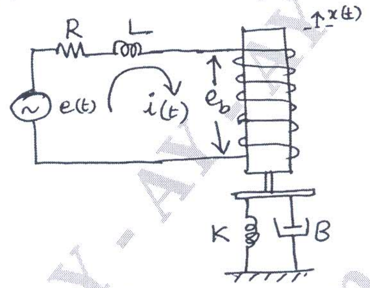

Fig.Q1(c) **(10 Marks)**

OR

2 a. What are the effects of feedback in a control system? **(06 Marks)**

b. Write the differential equation for the given mechanical system shown in Fig.Q2(b). Find the analogous electrical circuit based on Force-Voltage analogy.

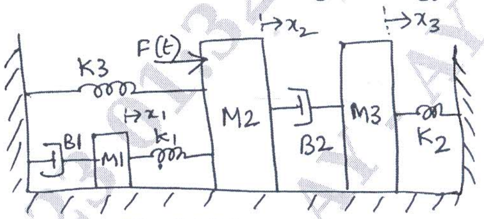

Fig.Q2(b) **(10 Marks)**

c. Find the Torque - Voltage Analogous circuit for the Fig.Q2(c) shown.

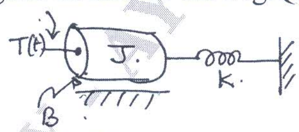

Fig.Q2(c) **(04 Marks)**

Module-2

3 a. Find the overall transfer function $\frac{C(s)}{R(s)}$ for the block diagram shown in Fig.Q3(a).

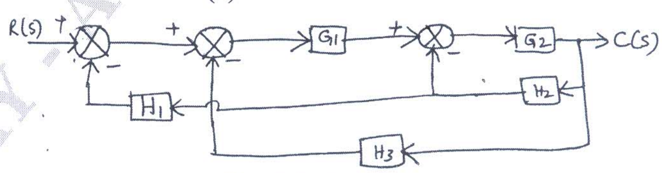

Fig.Q3(a) **(10 Marks)**

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b. Find the transfer function by constructing a block diagram for the circuit shown in Fig.Q3(b)

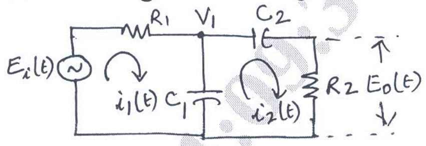

Fig.Q3(b) **(10 Marks)**

OR

4 a. Find $\frac{C(s)}{R(s)}$ when $N(s) = 0$ for the diagram shown in Fig.Q4(a).

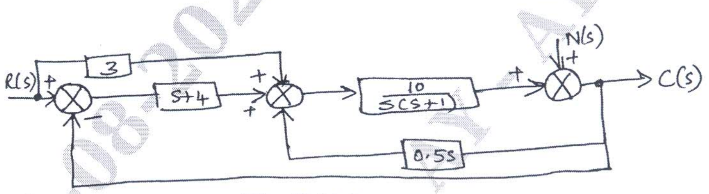

Fig.Q4(a) **(10 Marks)**

b. Find $\frac{C}{R}$ using Mason's Gain formula for the signal flow graph shown in Fig.Q4(b).

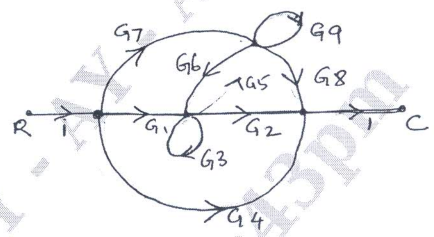

Fig.Q4(b) **(10 Marks)**

Module-3

5 a. A unity feedback system is characterized by an open loop transfer function

$$G(s) = \frac{K}{s(s+10)}$$

Find the value of K so that the system will have a damping ratio of 0.6, for this value of K find M_p, T_p and T_s for a unit step input. **(08 Marks)**

b. Find the error constants k_p, k_v and k_a for the unity feedback control system whose open loop transfer function

$$G(s) = \frac{100}{s^2(s+2)(s+5)}$$

Find the steady state error when the input $r(t) = 1 + t + 2t^2$. What is the type and order of the system? **(08 Marks)**

c. With the neat diagram write a note on PID controller. **(04 Marks)**

OR

6 a. Starting from output equation C(t), derive the expression for peak time, peak overshoot, settling time of an under damped second order system subjected to unit step input. **(10 Marks)**

b. Obtain rise time, peak time, % peak overshoot, settling time for the unit step response of a closed loop system given by

$$\frac{C(s)}{R(s)} = \frac{25}{s^2 + 6s + 25}$$

Also find the expression for the output. **(10 Marks)**

Module-4

7 a. For a unity feedback system whose open loop transfer function is $G(s) = \frac{k(s+4)}{s(s+1)(s+2)}$

Find the range of k that keeps the system stable using R-H criteria. **(08 Marks)**

b. Sketch the Root Locus diagram for the unity feedback control system with

$G(s) = \frac{k}{s(s^2+8s+17)}$. Determine the value of k for a damping ratio of 0.5. **(12 Marks)**

OR

8 a. For a system having open loop transfer function given by $G(s) = \frac{10(1+0.125s)}{s(1+0.5s)(1+0.25s)}$

Draw the Bode magnitude and phase plot. Determine the Phase margin and Gain margin. Comment on the stability. **(10 Marks)**

b. Find the transfer function of the system whose Bode diagram is shown in Fig.Q8(b).

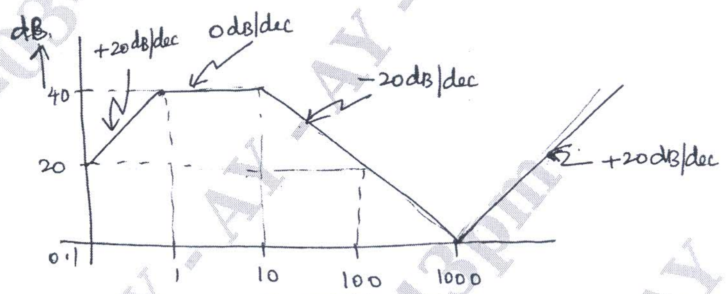

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. The open loop transfer function of a unity negative feedback control system is given by

$$G(s) = \frac{k(s+3)}{s(s^2+2s+2)}$$

using Nyquist criteria find the value of k for which the closed loop system is stable. **(10 Marks)**

b. Explain lead-lag compensating network. **(04 Marks)**

c. Represent the differential equation given below in state model

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

OR

10 a. Mention the properties of State Transition Matrix. **(04 Marks)**

b. Obtain the state model of the given network shown in Fig.Q10(b) in standard form.

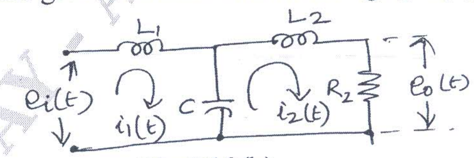

Fig.Q10(b) **(08 Marks)**

c. Find the state transition matrix for the state equation given below.

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}1\\ 1\end{bmatrix}u(t)$$ **(08 Marks)**

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