CBCS SCHEME

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21EE52

Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Control Systems

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. What are the properties of a good control system? **(04 Marks)**

b. Write the comparison between open loop control system and closed loop control system. **(08 Marks)**

c. For the mechanical system shown in Fig Q1(c), write the differential equations of performance. Find write loop equations based on Force – Voltage analogy and write electrical analogous circuit.

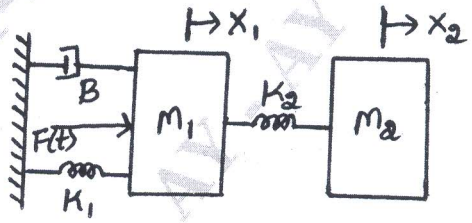

Fig Q1(c) **(08 Marks)**

OR

2 a. Obtain the transfer function of an armature controlled DC servomotor. **(08 Marks)**

b. Write the differential equations governing the mechanical system shown in Fig Q2(b). Draw the torque – current electrical analogous circuit.

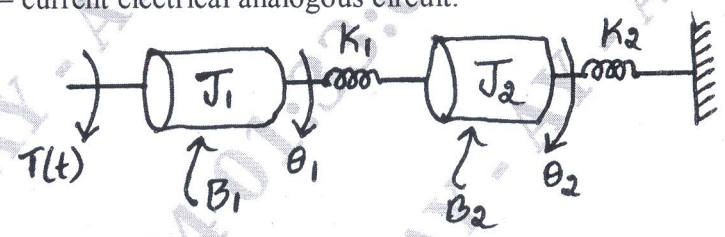

Fig Q2(b) **(08 Marks)**

c. Explain translational motion of mechanical system. **(04 Marks)**

Module-2

3 a. Define the following terms : i) Source node ii) Sink node iii) Forward path iv) Self loop. **(04 Marks)**

b. What is Block diagram? List the properties of Block diagram. **(08 Marks)**

c. Obtain the transfer function for the block diagram, shown in Fig Q3(c), using block diagram reduction technique.

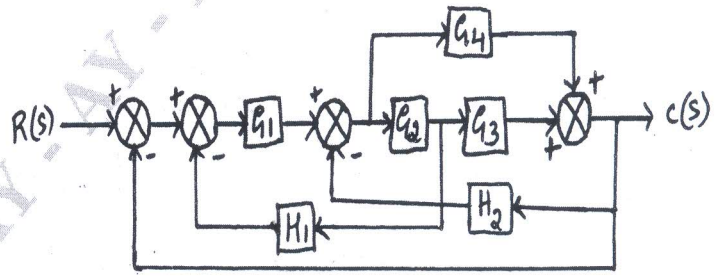

Fig Q3(c) **(08 Marks)**

OR

4 a. Explain the procedure of Block diagram reduction technique. **(06 Marks)**

b. Construct the signal flow graph and determine the transfer function using Mason's gain formula for Fig Q4(b).

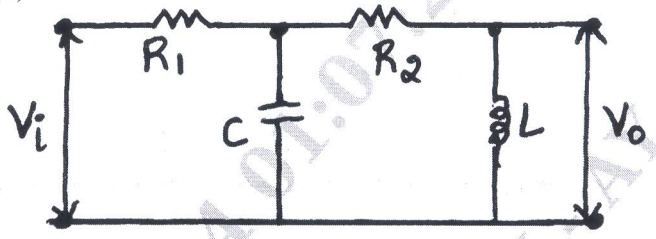

Fig Q4(b) **(07 Marks)**

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

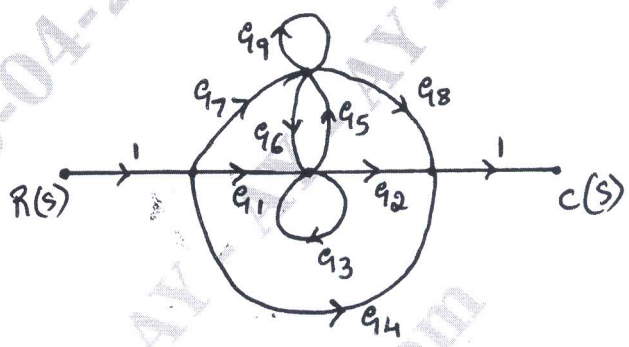

Fig Q4(c) **(07 Marks)**

Module-3

5 a. Define and derive the expression for i) Rise time ii) Peak overshoot of an underdamped second order control system subjected to step input. **(07 Marks)**

b. Determine the stability of the following characteristic equations of the system

$s^4 + 6s^3 + 26s^2 + 56s + 80 = 0$

$s^4 + 2s^3 + 4s^2 + 6s + 8 = 0$ **(06 Marks)**

c. A second order system is given $\frac{C(s)}{R(s)} = \frac{25}{s^2 + 6s + 2s}$. Find the rise time, peak time, setting time and peak overshoot if subjected to unit step input. Also obtain the expression for its output response. **(07 Marks)**

OR

6 a. Explain Routh-Huruity criterion for determining the stability of the system and mention its limitations. **(06 Marks)**

b. The open loop transfer function of a unity feedback control system is given by the characteristic equation. Determine the range of values of K for the system stability. What is the value of K which given sustained oscillations? What is the oscillation frequency?

$$G(s) = \frac{K}{(s+2)(s+4)(s^2+6s+2s)}$$ **(07 Marks)**

c. A unity feedback system is characterized by an open loop transfer function $G(s) = \frac{K}{s(s+10)}$. Determine the gain 'K', so that system will have a damping ratio of 0.5. For the value of K determine the settling time, peak overshoot, peak time for a unit step input. **(07 Marks)**

Module-4

7 a. Define the following terms : i) Angle of asymptotes ii) Asymptote iii) Breakaway points **(06 Marks)**

b. Draw the appropriate root locus diagram for a closed loop system whose loop transfer function is given by $\frac{G(s)}{H(s)} = \frac{K}{s(s+1)(s+2)}$. Comment on the stability. **(14 Marks)**

OR

8 a. Define the following terms :
i) Gain margin ii) Phase margin iii) Gain crossover frequency **(06 Marks)**

b. A unity feedback control system has $G(s) = \frac{80}{s(s+2)(s+20)}$. **(14 Marks)**

Module-5

9 a. The open loop transfer function of a control system is $G(s)H(s) = \frac{K}{s(s+2)(s+10)}$.
Sketch the Nyquist plot and calculate the value of K. **(14 Marks)**

b. Write short notes on PID controller. **(06 Marks)**

OR

10 a. What is controller? Explain the effect of P, I, PI and PID controller of a second order system. **(12 Marks)**

b. Explain the steps to solve problems by Nyquist criterion. **(08 Marks)**

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