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18EC43

Fourth Semester B.E. Degree Examination, July/August 2022
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. What is Control System? Distinguish between open loop and closed loop system. Give one example for each. **(08 Marks)**

b. Write the differential equations governing the mechanical system shown in Fig.Q.1(b). Draw the force-voltage and force-current electrical analogous circuits. **(12 Marks)**

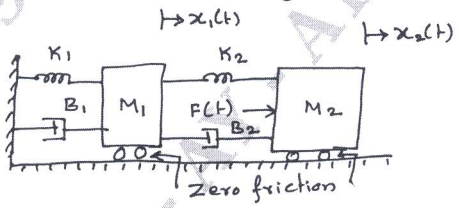

Fig.Q.1(b)

OR

2 a. Write the differential equations governing the mechanical rotational system shown in Fig.Q.2(a). Obtain the transfer function of the system. **(10 Marks)**

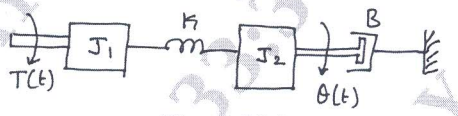

Fig.Q.2(a)

b. Write the differential equations governing the mechanical rotational system shown in Fig.Q.2(b). Draw the torque-voltage analogous circuit. **(10 Marks)**

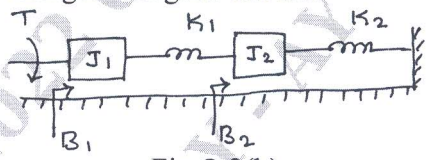

Fig.Q.2(b)

Module-2

3 a. Determine the overall transfer function $\frac{C(S)}{R(S)}$ for the system shown in Fig.Q.3(a) using block diagram reduction technique. **(10 Marks)**

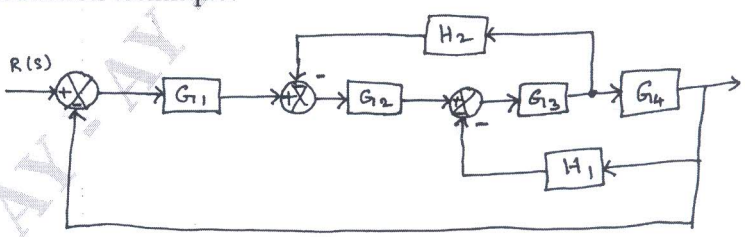

Fig.Q.3(a)

b. Find the overall T.F by Mason's gain formula for the SFG given in the Fig.Q.3(b). **(10 Marks)**

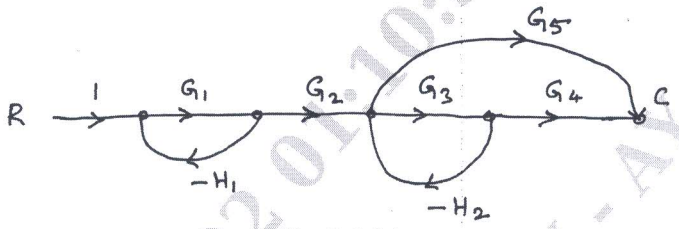

Fig.Q.3(b)

OR

4 a. Draw the SFG and obtain the FF transfer function for a system which is described by the set of following algebraic equations.

$y_2 = a_{12}y_1 + a_{32}y_3$

$y_3 = a_{23}y_2 + a_{43}y_4$

$y_4 = a_{24}y_2 + a_{34}y_3 + a_{44}y_4$

$y_5 = a_{25}y_2 + a_{45}y_4$ **(10 Marks)**

b. Find out the transfer function shown in Fig.Q.4(b) using Mason's gain formula. **(10 Marks)**

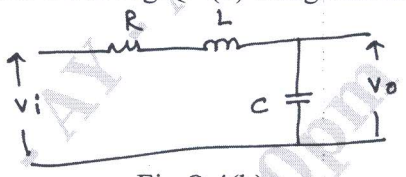

Fig.Q.4(b)

Module-3

5 a. Derive the expression of response of first order system for unit step input. **(10 Marks)**

b. With neat graph explain the time domain specifications of second order system. **(10 Marks)**

OR

6 a. Obtain the response of unity feed back system whose open loop transfer function $G(S) = \frac{4}{S(S+5)}$ and when input is unit step. **(10 Marks)**

b. A unity feed back system with $G(S) = \frac{100}{S^2(S+1)(S+2)}$

i) What is the type of system?

ii) Find static error coefficients.

iii) Find steady state error if the input is $r(t) = 2t^2 + 5t + 1$. **(10 Marks)**

Module-4

7 a. Derive the expression for condition of stability of control system. **(05 Marks)**

b. Explain Routh-Hurwitz criterion for stability of the system and what are its limitations. **(05 Marks)**

c. Find the range of K so that the system with characteristic equation as: $s^4 + 25s^3 + 15s^2 + 20s + k = 0$ is stable. Also find frequency of oscillation at marginal value of K. **(10 Marks)**

OR

8 a. Sketch the root Locus plot for all values of K ranging from o to ∞ for a negative feed back control system characterized by $GH(S)=\frac{K(S+6)}{S(S+1)(S+2)}$. **(10 Marks)**

b. Plot the Bode diagram for open loop transfer function

$G(S)=\frac{10}{S(1+0.4s)(1+0.1s)}$ and obtain the gain and phase cross over frequencies. **(10 Marks)**

Module-5

9 a. Using Nyquist stability criterion, investigate the stability of a closed loop system whose OLTF is given by

$G(S)H(S)=\frac{K}{(S+1)(S+2)}$. **(10 Marks)**

b. Distinguish between classical method and state space approach. **(10 Marks)**

OR

10 a. A negative feed back control system is characterized by an open loop transfer function.

$GH(S)=\frac{5}{S(S+1)}$

Investigate the closed loop stability of the system using Nyquist stability criterion. **(10 Marks)**

b. Write a state model for differential equation

$$4\frac{d^3}{dt^3}y+8\frac{d^2}{dt^2}y+24\frac{dy}{dt}+4y=32\,U(t)$$

Using phase variable canonical form. **(10 Marks)**

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