CBCS SCHEME

USN 4VP20EC082 **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.

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)**

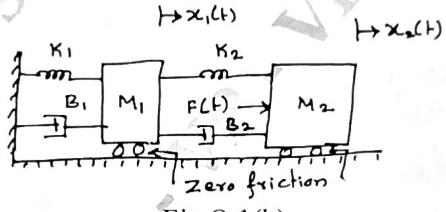

Fig.Q.1(b)

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)**

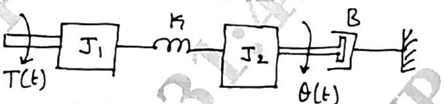

Fig.Q.2(a)

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

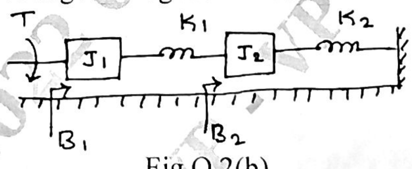

Fig.Q.2(b)

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)**

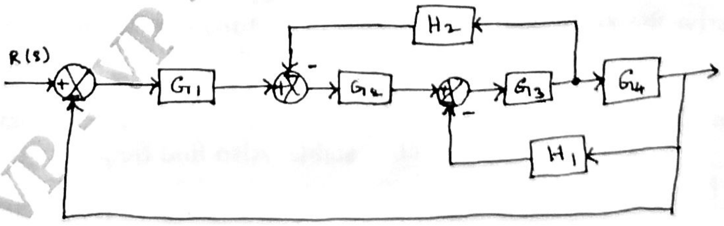

Fig.Q.3(a)

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

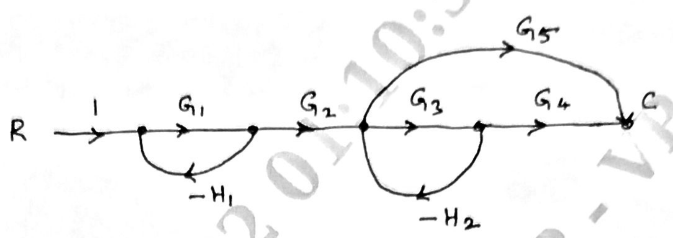

Fig.Q.3(b)

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)

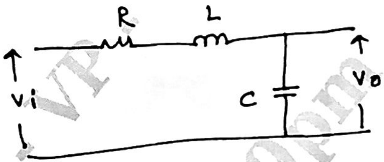

Fig.Q.4(b)

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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