CBCS SCHEME

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

17MT34

Third 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. Define a control system and explain the types of control system with suitable examples. **(10 Marks)**

b. Develop the mathematical equation and obtain transfer function $\frac{y_2(s)}{F(s)}$ of the system shown in Fig Q1(b)

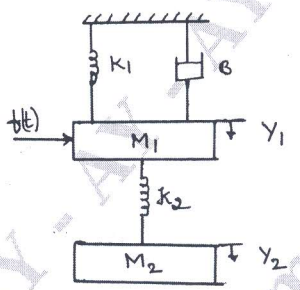

Fig Q1(b) **(10 Marks)**

OR

2 a. Obtain the differential equations and draw the electric network using force – voltage analogy for the given system. (Ref. Fig Q2(a)).

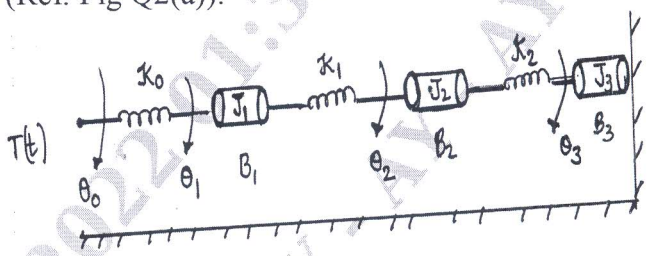

Fig Q2(a) **(10 Marks)**

b. Indentify the transfer function of the system show in Fig Q2(b), by block diagram reduction methods.

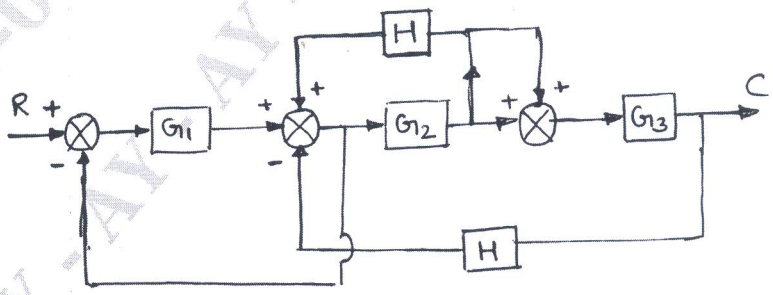

Fig Q2(b) **(10 Marks)**

Module-2

3 a. Using Mason's gain formula, find the gain of the following system in Fig Q3(a).

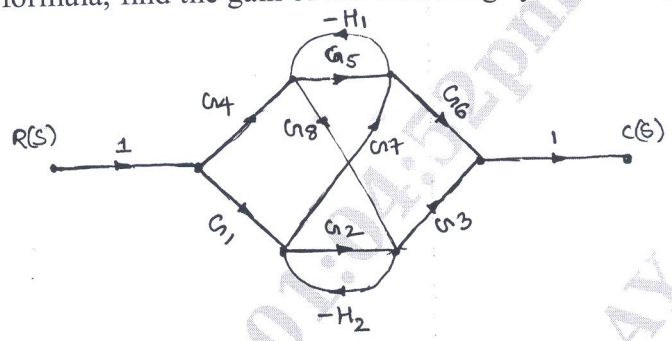

Fig Q3(a) **(10 Marks)**

b. Construct the signal flow graph for the following set of system equations.

$Y_2 = G_1Y_1 + G_3Y_3$

$Y_3 = G_4Y_1 + G_2Y_2 + G_5Y_3$

$Y_4 = G_6Y_2 + G_7Y_3$

where Y_4 is output, Find transfer function $\frac{Y_4}{Y_1}$. **(10 Marks)**

OR

4 a. Discuss the various standard input test signal used in the control system analysis. **(07 Marks)**

b. Determine the response of a first order system with transfer function $\frac{C(s)}{R(s)} = \frac{1}{1+Ts}$ by subjected unit step input and sketch the system response. **(13 Marks)**

Module-3

5 a. For a system with characteristics equation $s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$, examine stability by means of Routh criterion. **(10 Marks)**

b. Determine the stability of the systems represented by the characteristics equation $s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$ by means of the Routh Criterion. Determine the number of roots lying in right half of s-plane. **(10 Marks)**

OR

6 The open loop transfer of a unity feedback system is $G(s) = \frac{1}{s(s+3)(s+5)}$. Determine closed loop dominant poles, damped natural frequency and gain K for the damping ratio 0.6. **(20 Marks)**

Module-4

7 The open loop transfer function of an unity feedback system is $G(s) = \frac{K}{s(1+0.1s)(1+s)}$. Determine the value of K so that gain margin is + 30dB and phase margin is 30°. **(20 Marks)**

OR

8 Apply Nyquist stability criterion to the system with open loop transfer function $G(s)H(s) = \frac{40}{(s+4)(s^2+2s+2)}$ and ascertain its stability. **(20 Marks)**

Module-5

9 a. Obtain the appropriate state model for a system represented by an electric circuit in Fig Q9(a)

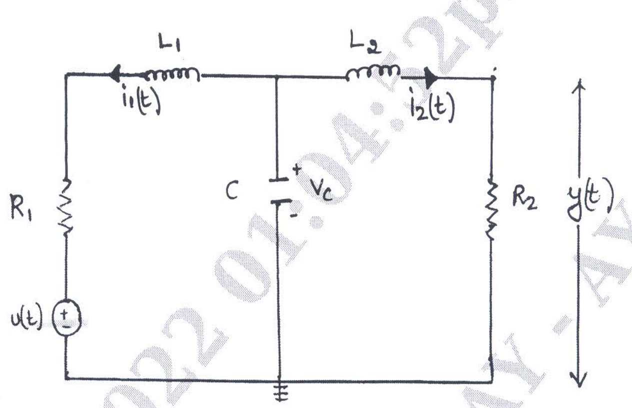

Fig Q9(a) **(10 Marks)**

b. Obtain the state transition matrix for the following system

$$\begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} -1 & -0.5 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 0.5 \\ 0 \end{bmatrix} U$$

(10 Marks)

OR

10 a. Explain the derivation of transfer function from the state model and mention the advantages of phase variable. **(10 Marks)**

b. Find the transfer function for a system having state model as given below :

$$X = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X + \begin{bmatrix} 1 \\ 0 \end{bmatrix} U$$

$$Y = \begin{bmatrix} 1 & 0 \end{bmatrix} X$$

(10 Marks)

* * * * *