CBCS SCHEME

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

18MT34

Third Semester B.E. Degree Examination, Dec.2024/Jan.2025
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. Explain open loop control system and closed loop control system with an example. State its advantages and limitations. **(12 Marks)**

b. Obtain the transfer function for the following mechanical system shown below in Fig.Q.1(b). **(08 Marks)**

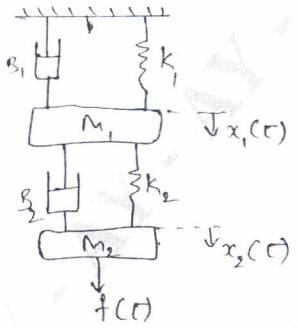

Fig.Q.1(b)

OR

2 a. For the given system shown in Fig.Q.2(a) below, write the differential equations in force voltage, and force current analogy. Make nodal representation of this model. **(10 Marks)**

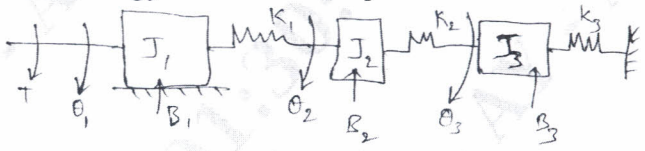

Fig.Q.2(a)

b. The performance equations of a controlled system are given by the following set of linear algebraic equations. Draw the block diagram and determine $\frac{C(s)}{R(s)}$ by reducing the block diagram in steps.

$E_1(s) = R(s) - H_3(s).C(s)$; $E_2(s) = E_1(s) - H_1(s)E_4(s)$; $E_3(s) = G_1(s).E_2(s) - H_2(s).C(s)$;

$E_4(s) = G_2(s).E_3(s)$; $C(s) = G_3(s).E_4(s)$ **(10 Marks)**

Module-2

3 a. Define the following terms related to signal flow graph :

(i) Source node (ii) Sink node (iii) Forward path and its gain

(iv) Feed back loop and its gain (v) Non-touching loops. **(10 Marks)**

b. A unity feedback system is characterized by 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 0.5. For this value of K, determine the settling time, peak over shoot and time to peak overshoot for unit step input. **(10 Marks)**

OR

4 a. Find $\frac{C}{R}$ for the graph shown in Fig.Q4(a) using Mason's gain formula: **(10 Marks)**

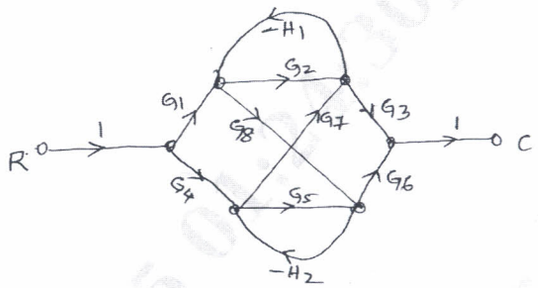

Fig. Q4 (a)

b. Obtain an expression for the time response of second order system for underdamped condition. **(10 Marks)**

Module-3

5 a. Define the following : i) Absolute stability ii) Relative stability iii) Conditionally stable iv) Marginally stable. **(04 Marks)**

b. For unity feedback system $G(s) = \frac{k}{s(1+0.4s)(1+0.25s)}$ find the range of values of k, marginal value k and frequency of oscillation (w). **(08 Marks)**

c. For a system with C.E – characteristics equation $F(s) = s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$. Examine stability. **(08 Marks)**

OR

6 a. State the advantages and limitation of frequency domain approach. **(08 Marks)**

b. Explicitly discuss the correlation between time and frequency response of a second order system. Obtain the expression for resonant peak. **(12 Marks)**

Module-4

7 A feedback control system has an open loop transfer function $G(s).H(s) = \frac{K}{s(s+3)(s^2+2s+2)}$. Draw the root locus as 'K' varies from 0 to ∞. **(20 Marks)**

OR

8 a. Define the following:

i) Gain crossover frequency
ii) Phase crossover frequency
iii) Resonant peak
iv) Resonant frequency. **(06 Marks)**

b. Sketch the Bode plot for the transfer function:

$\frac{300(s^2+2s+4)}{s(s+10)(s+20)}$. **(14 Marks)**

Module-5

9 a. Develop the state equations for the network shown in Fig. Q9(a). **(10 Marks)**

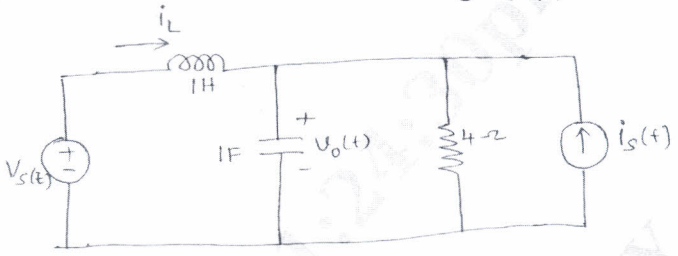

Fig. Q9(a)

b. Find the state transition matrix for a system whose system matrix is given by, $A = \begin{bmatrix} 0 & 1 \\ -2 & -2 \end{bmatrix}$. **(10 Marks)**

OR

10 a. Obtain the time-response for the following system:

$$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$

where u(t) is the unit step function. **(10 Marks)**

b. Represent the differential equation given below in a state model.

$$\frac{d^3y}{dt^3} + 3\frac{d^2y}{dt^2} + 6\frac{dy}{dt} + 7y(t) = 2u(t).$$ **(10 Marks)**

* * * * *