CBCS SCHEME

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

18AE732

Seventh Semester B.E. Degree Examination, June/July 2023
Control Engineering

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define control system. Distinguish between open loop and closed loop control system with examples. **(06 Marks)**

b. What are the requirements of an ideal control system? **(06 Marks)**

c. Explain the concept of feedback control system with basic structure. List its effects on control system. **(08 Marks)**

OR

2 a. For the mechanical system shown in Fig.Q.2(a).

i) Obtain the differential equation.

ii) Draw the equivalent mechanical system.

iii) Draw the analogous electrical network based on Force-voltage and Force-current analogy.

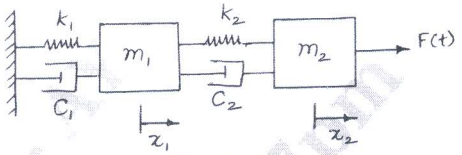

Fig.Q.2(a)

(10 Marks)

b. Derive the transfer function of an armature controlled DC motor. **(10 Marks)**

Module-2

3 a. Obtain the over all transfer function of the block diagram show in Fig.Q.3(a) by reducing technique. **(10 Marks)**

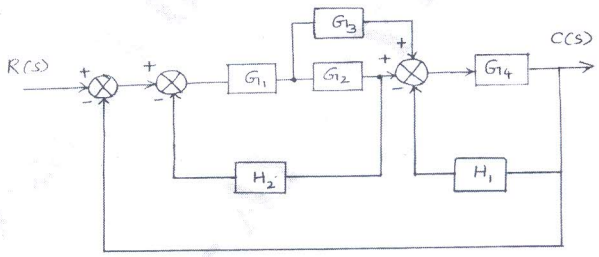

Fig.Q.3(a)

b. Using signal flow graph and Masoni gain formula, obtain the overall transfer function of the system depicted in Fig.Q.3(b).

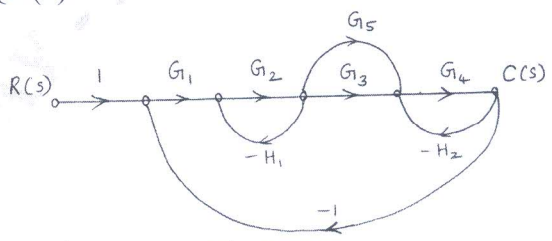

Fig.Q.3(b)

(10 Marks)

OR

4 a. A unity feedback control system is characterized by an open-loop transfer function $G(S)H(S) = \frac{K}{S(S+10)}$. Determine the system gain K, so that the system will have a damping ratio of 0.5. For this value of K, find the rise time, peak time, settling time and peak overshoot for a unit step input. **(10 Marks)**

b. Derive the response of a first order system, subjected to unit step and unit impulse input. **(10 Marks)**

Module-3

5 a. State and explain Routh Hurwitz's stability criterion. **(08 Marks)**

b. Sketch the root locus plot for $G(S)H(S) = \frac{K}{S(S+2)(S+4)}$. Comment on stability. Also determine the frequency of oscillation. **(12 Marks)**

OR

6 Sketch the Bode plot for $G(S)H(S) = \frac{2}{S(1+S)(1+0.2S)}$. Also obtain gain margin, phase margin and cross over frequencies. **(20 Marks)**

Module-4

7 a. Define: Gain Margin (GM), Phase Margin (PM), Phase cross-over frequency (W_{pc}) and Gain Cross-over frequency (W_{gc}). **(08 Marks)**

b. Sketch the polar plot for the transfer function $G(S) = \frac{10}{S(S+1)(S+2)}$ **(12 Marks)**

OR

8 a. Sketch the Nyquist plot for the open loop transfer function $G(S)H(S) = \frac{12}{S(S+1)(S+2)}$ and determine the nature of stability. **(12 Marks)**

b. What are M and N-circles? Sketch them. **(08 Marks)**

Module-5

9 a. What is a controller? Briefly explain with the block diagram proportional plus integral plus derivative (PID) controller and state its characteristics. **(10 Marks)**

b. What is system compensation? Explain the lead compensator and lag compensator. **(10 Marks)**

OR

10 a. Define: State variables, state vector, state space and state model. **(08 Marks)**

b. The general state model of a system is given by

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = \begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + \begin{bmatrix}0\\ 0\\ 2\end{bmatrix}u \quad \text{and} \quad y = \begin{bmatrix}1 & 0 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$$

Using Gilbert's test state the controllability and observability of the system. **(12 Marks)**

* * * * *