MEL H010
3

CBCS SCHEME

USN

15MT34

Third Semester B.E. Degree Examination, June/July 2019
Control Systems

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Distinguish between open loop and closed loop control systems and given one practical example of each. **(06 Marks)**

b. For the system shown in Fig.Q1(b).
  i) Draw the mechanical network
  ii) Write the differential equations
  iii) Draw torque-voltage analogous electric network. **(10 Marks)**

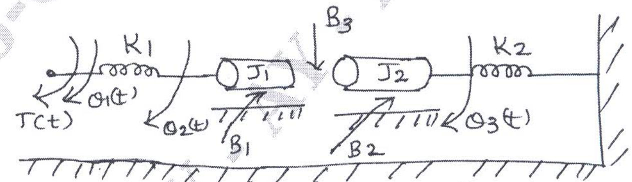

Fig.Q1(b)

OR

2 a. Define transfer function and what are its properties. **(06 Marks)**

b. Obtain the transfer function for the block diagram shown in Fig.Q2(b). Using block diagram reduction method. **(10 Marks)**

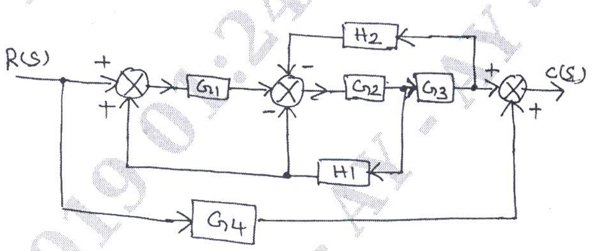

Fig.Q2(b)

Module-2

3 a. What is signal–flow graph representation? Briefly explain the properties of signal flow graph. **(06 Marks)**

b. Obtain the closed loop transfer function $\frac{C(s)}{R(s)}$ for the signal flow graph of a system show in Fig.Q3(b) using Mason's gain formula. **(10 Marks)**

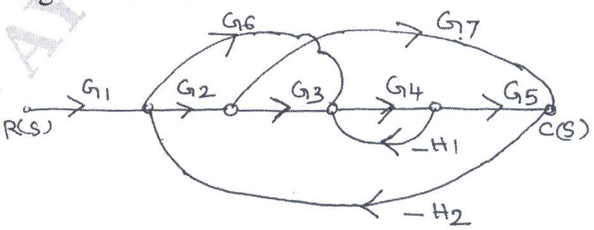

Fig.Q3(b)

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.

OR

4 a. Derive expressions for peak time t_p and peak over shoot M_p of an under damped second order control system subjected to step input. **(06 Marks)**

b. A unity feedback system is characterized by an open loop transfer function $G(S) = \dfrac{K}{s(s+10)}$.
Determine the gain K so that the system will have a damping ratio of 0.5. For this value of K determine the peak time and peak overshoot for a unit step input. **(06 Marks)**

c. For a unity feedback control system with $G(S) = \dfrac{40(S+2)}{S(S+1)(S+4)}$. Determine all static error coefficients **(04 Marks)**

Module-3

5 a. Explain Routh –Hurwitz's criterion for determining the stability of a system. **(04 Marks)**

b. The open loop transfer function of a unity feedback system is given by $G(S) = \dfrac{K}{S(S+3)(S^2+S+1)}$. Determine the value of that will cause sustained oscillations in the closed loop system and also find the frequency of oscillations. **(06 Marks)**

c. Determine the range of K such that the characteristics equation $S^4 + 6S^3 + 30S^2 + 60S + K = 0$ has roots more negative than – 1. **(06 Marks)**

OR

6 a. Consider the system with $G(S)H(S) = \dfrac{K}{S(S+2)(S+4)}$, find whether S = –0.75 and S = –1 +j4 is ON the root Locus or not using angle condition. **(04 Marks)**

b. Sketch the root locus plot for a unity feedback control system with open loop transfer function $G(S) = \dfrac{K}{S(S+2)(S+6)}$ comment ON the stability of the system. **(12 Marks)**

Module-4

7 a. List the advantage and limitations of frequency domain approach. **(04 Marks)**

b. For a control system having $G(S) = \dfrac{K(1+0.55)}{S(1+2S)(1+0.05S+0.125S^2)}$ draw Bode plot, with K = 4 and find gain margin and phase margin. **(12 Marks)**

OR

8 a. State and explain Nyquist stability criterion. **(04 Marks)**

b. For the given system $G(S)H(S) = \dfrac{10}{S^2(1+0.25S)(1+0.5S)}$ **(12 Marks)**

Module-5

9 a. List the advantages of state variable analysis. **(05 Marks)**

b. Define : i) State ii) state variables as applied to state variable analysis. **(04 Marks)**

c. Obtain the transfer function : if $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 2 \\ 5 \end{bmatrix} u \quad y = \begin{bmatrix} 1 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$. **(07 Marks)**

OR

10 a. List the properties of state transition matrix. **(06 Marks)**

b. Obtain the state transion matrix for $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$ **(10 Marks)**