CBCS SCHEME

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

15MT34

Third Semester B.E. Degree Examination, July/August 2022
Control System

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Explain with an example and block diagram, a closed loop control system. **(06 Marks)**

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

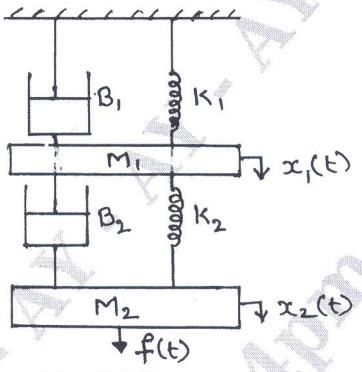

Fig.Q.1(b) **(10 Marks)**

OR

2 a. For the given system shown in Fig.Q.2(a), write the differential equations in force voltage and force-current analogy.

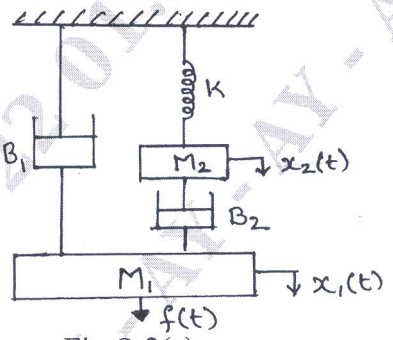

Fig.Q.2(a) **(06 Marks)**

b. Reduce the block diagram shown in Fig.Q.2(b) by reduction technique and find C(s)/R(s).

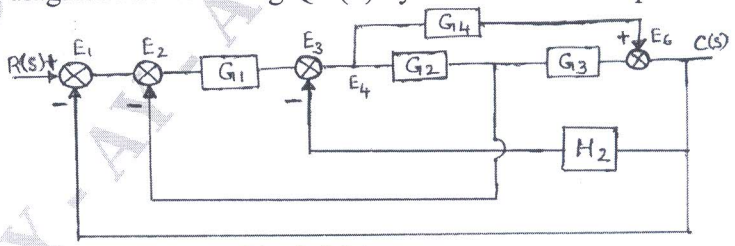

Fig.Q.2(b) **(10 Marks)**

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)**

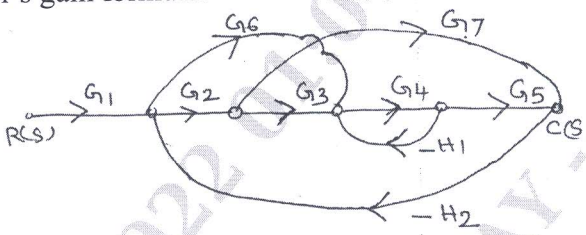

Fig.Q3(b)

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 $G(S) = \frac{K}{s(s+10)}$.

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 $G(S) = \frac{40(S+2)}{S(S+1)(S+4)}$. Determine all static error coefficients **(04 Marks)**

Module-3

5 a. Using Routh criteria determine stability of following systems:

(i) Its loop transfer function has poles at S = 0, S = −1, S = −3 and zero at S = −5, gain of K of forward path is 10.

(ii) It is a type one system with an error constant of 10 sec^{-1} and poles at S = −3 and S = −6 **(10 Marks)**

b. Determine the stability of the system having the characteristic equation using R-H criterion.

$s^6 + 2s^5 + 5s^4 + 8s^3 + 8s^2 + 8s + 4 = 0$ **(06 Marks)**

OR

6 Draw the root locus diagram for the loop transfer function, $G(s)H(s) = \frac{K}{s(s^2+8s+17)}$.

Evaluate the value of K for a system having damping ratio of 0.5 from the diagram. **(16 Marks)**

Module-4

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

b. For a control system having $G(S) = \frac{K(1+0.55)}{S(1+2S)(1+0.05S+0.125S^2)}$ 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 $G(S)H(S) = \frac{10}{S^2(1+0.25S)(1+0.5S)}$ **(12 Marks)**

Module-5

9 a. Define state variable and state transition matrix. List the properties of the state transition matrix. **(08 Marks)**

b. Obtain the state model for the electrical system shown in Fig. Q9 (b) choosing the state variables as $i_1(t)$, $i_2(t)$ and $V_c(t)$ **(08 Marks)**

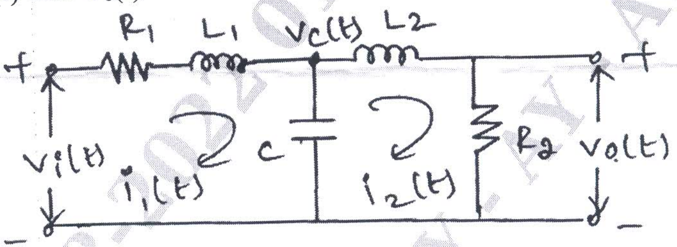

Fig. Q9 (b)

OR

10 a. Obtain the state transition matrix for $A = \begin{bmatrix} 0 & -1 \\ 2 & -3 \end{bmatrix}$. **(08 Marks)**

b. Obtain the solution of the homogeneous state equation, $\dot{X} = AX$ where $A = \begin{bmatrix} 1 & -2 \\ 1 & -4 \end{bmatrix}$ and $X(0) = \begin{bmatrix} 0.5 \\ 1 \end{bmatrix}$. **(08 Marks)**

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