CBCS SCHEME

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

15AE71

Seventh Semester B.E. Degree Examination, Feb./Mar. 2022
Control Engineering

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define control system. Compare open loop and closed loop systems with an example. **(10 Marks)**

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

OR

2 a. For the mechanical system shown in Fig Q2(a). Draw the mechanical equivalent and the differential equation of equilibrium. Also draw the analogous electrical network, using F-V analogy.

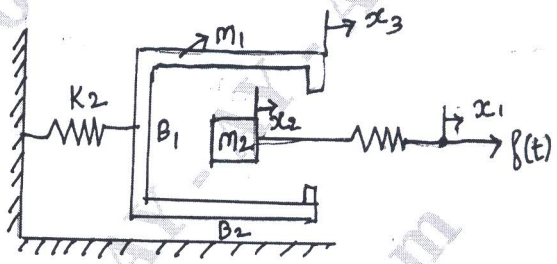

Fig Q2(a) **(10 Marks)**

b. Drive the transfer function for an armature controlled dc motor. **(06 Marks)**

Module-2

3 a. Determine the overall transfer function of a block diagram, shown in Fig Q3(a).

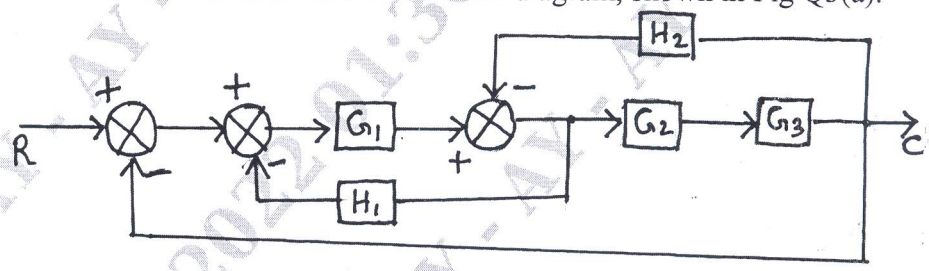

Fig Q3(a) **(08 Marks)**

b. Using signal flow graph and Mason's gain formula, obtain the overall transfer function of the system depicted in Fig Q3(b).

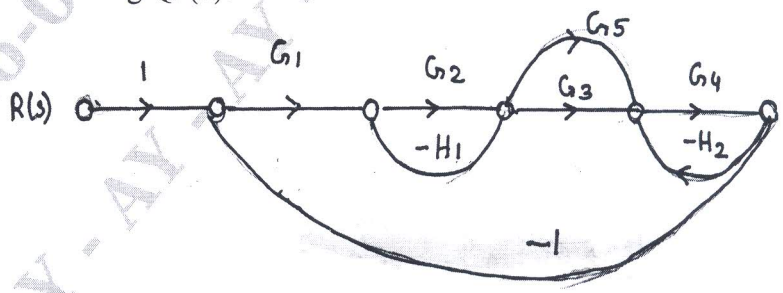

Fig Q3(b) **(08 Marks)**

OR

4 a. Explain RH criterion of stability of a control system and examine the stability of $s^4 + 2s^3 + 3s^2 + 8s + 2 = 0$, using same. **(08 Marks)**

b. A unity feedback system is characterized by an open loop transfer function. $G(s) = \dfrac{10}{s^2 + 2s + 6}$. Determine the following when the system is subjected to a unit step input, i) undamped natural frequency ii) Damping ratio iii) Peak overshoot iv) Peak time v) Setting time. **(08 Marks)**

Module-3

5 Sketch the root locus plot for a negative feedback control system having an open loop transfer function : $G(s)H(s) = \dfrac{K}{s(s^2 + 6s + 10)}$ **(16 Marks)**

OR

6 Sketch the Bode plot for $G(s)H(s) = \dfrac{2}{s(1+s)(1+0.2s)}$. Also obtain Gain Margin and phase Margin and cross over frequencies. **(16 Marks)**

Module-4

7 a. Sketch the polar plot for the system having open loop transfer function $G(s) = \dfrac{1}{s^2(1+s)}$. **(06 Marks)**

b. Comment on co-relation between time domain and frequency domain. **(10 Marks)**

OR

8 Obtain the Nyquist diagram for the open loop transfunction $G(s)H(s) = \dfrac{12}{s(s+1)(s+2)}$ and determine the nature of stability. **(16 Marks)**

Module-5

9 a. Discuss various methods of compensation in feedback control systems. **(06 Marks)**

b. Describe about the PI and PD controller with suitable diagram. **(10 Marks)**

OR

10 a. List the advantages and disadvantages of state variable representation of linear systems. **(06 Marks)**

b. State Kalman and Gilbert test of controllability. **(04 Marks)**

c. Determine the state controllability and observability of the system using Kalman test

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \\ \dot{X}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix}$$ **(06 Marks)**

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