National Institute of Technology, Delhi

Name of the Examination: B.Tech.

Mid Semester Examination (Spring, March-2023)

Branch	: ECE	**Semester**	: IVth
Title of the Course	: Control Theory	**Course Code**	: ECB 352 *(ECL 251)*

Time: 1 Hour 30 Minutes **Maximum Marks: 25**

Note: *All questions are compulsory.*

| COURSE OUTCOMES		COGNITIVE LEVELS
CO1	To understand the basic concept of control system and identify a set of algebraic equation to represent and model complicated system into more simplified form.	Remembering (Level I)
CO2	Interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis.	Understanding (Level II)
CO3	To build different types of controllers and compensator to ascertain the required dynamic response from the system and solve control system related problems.	Applying (Level III)
CO4	To test the stability of the control system using time domain and frequency domain analysis	Evaluating (Level V)

Course Outcomes(CO's)	CO1	CO2	CO3	CO4
Questions No.	Q1, Q3, Q4	Q2, Q6	Q5	Q7

Answer the following questions.

Q1. Define the closed loop control system with block diagram. Also outline the basic definitions of the notations used in the block diagram. **[2 Marks]**

Q2. Convert the given mechanical system based on the force current analogy into equivalent analogy electrical system. **[2 Marks]**
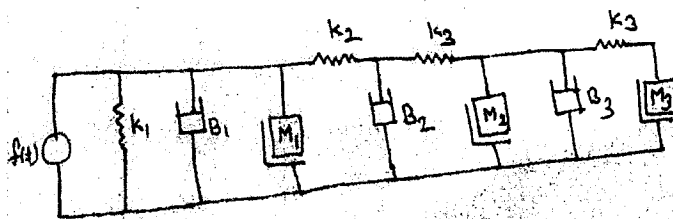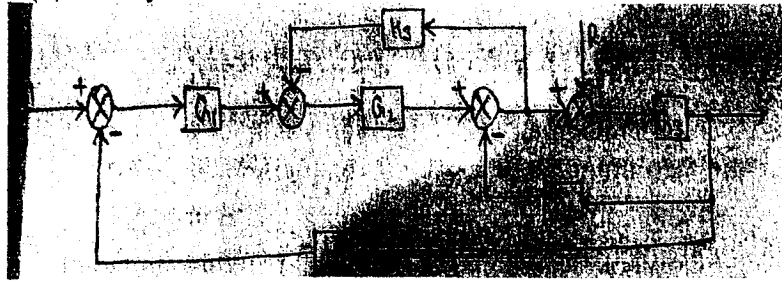

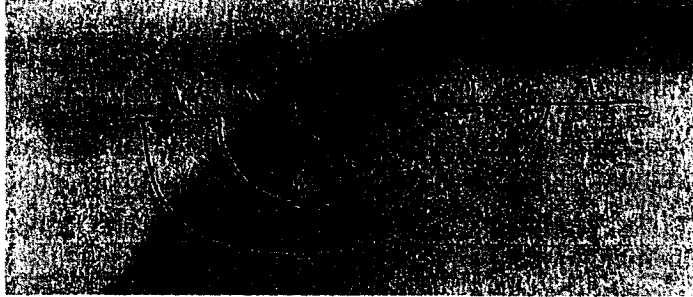**Q3.** Draw the mechanical circuit for the system shown in figure and write the system equations. **[3 Marks]**
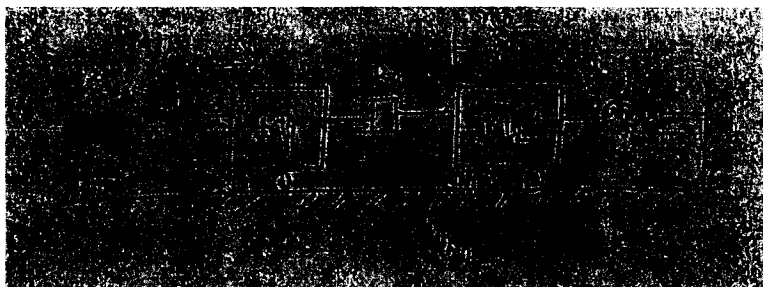
Q4   Write the output (C) of the system if $R_1 = 0$.   **[5 Marks]**

Q5.   Calculate the transfer function of the signal flow graph using Manson's Gain formula.   **[5 Marks]**

Q6.   The open loop transfer function of unity feedback system $G(s) = k/s(s+10)$. Estimate the value of k so that the system has damping ratio equals to 0.5. For this value of k, find the value of settling time, rise time, delay time, percentage peak overshoot and time for first overshoot and second overshoot.   **[4 Marks]**

Q7.   Test the stability of the system using RH criteria.   **[4 Marks]**

$$S^6 + 2S^5 + 8S^4 + 12S^3 + 20S^2 + 16S + 16$$