Roll No.: .....

National Institute of Technology, Delhi

Name of the Examination: B. Tech

Branch	**: ECE**	**Semester**	**: III**
Title of the Course	**: Control System**	**Course Code**	**: ECL 251**

Time: 2Hours **Maximum Marks: 25**

Note:

- **Questions are printed on BOTH sides. Answers should be CLEAR, TO THE POINT AND LEGIBLE.**
- **All parts of a single question must be answered together and in the same sequence as given in question paper. ELSE QUESTION SHALL NOT BE EVALUATED.**

Q. 1 Consider mechanical system is shown in fig. 1. Here, K_1, K_2 and K_3 are spring constants; f_{v1}, f_{v2} and f_{v3} are damping coefficients; M_1, M_2 are masses; and f(t) is the applied translational force. Find the electrical PARALLEL analog of the system. [4]

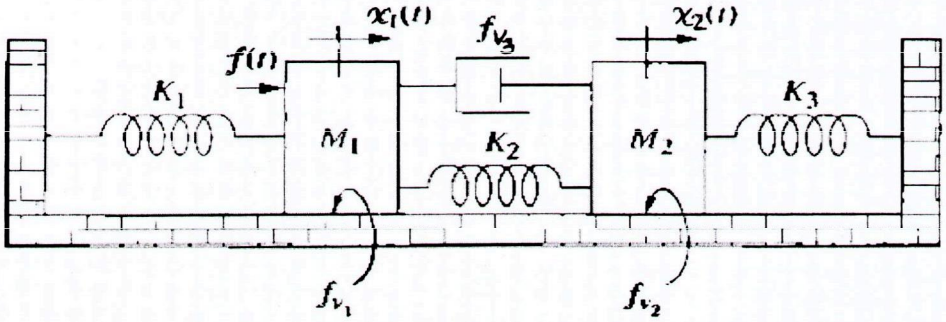


Figure 1

Q.2 A mechanical rotational system is shown in fig. 2. In the system, every gear experiences rotational friction which is reflected by damping coefficients D_1, D_2 and D_3. If the applied torque T(t) is 5 N-m, find the angular position $\theta_3(t)$ of J_3. (Assume the direction of T and θ_3 is same and anti clock-wise) [6]

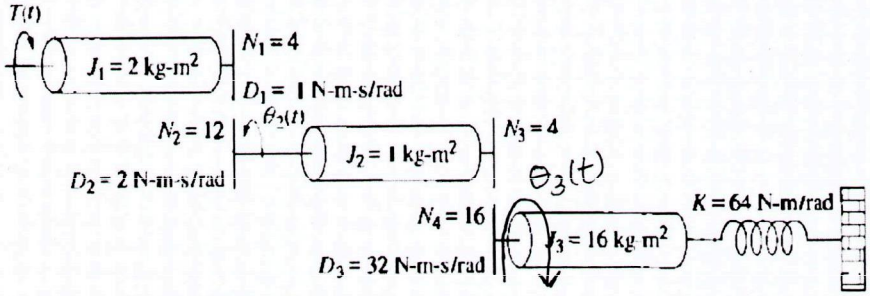


Figure 2

Q.3 A block diagram is shown in fig. 3. Find the transfer function C(s)/R(s) by block diagram reduction method. [5]

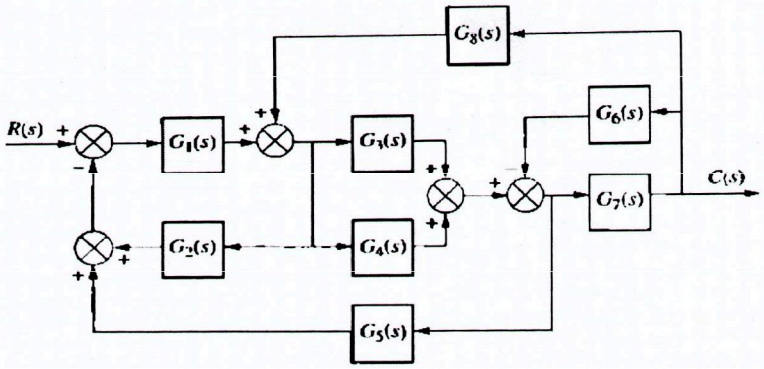
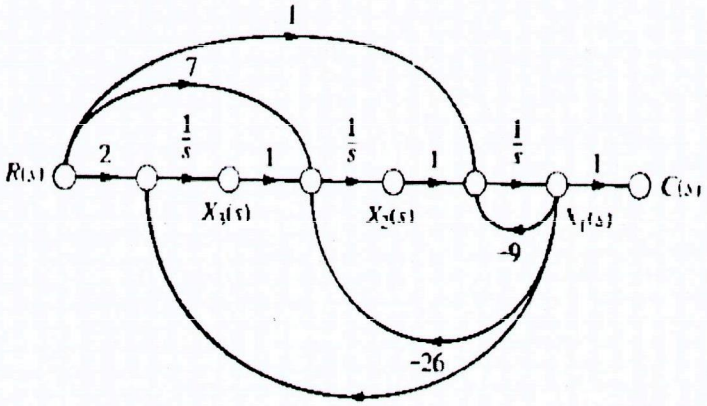


Figure 3

Q.4 A Signal Flow Graph is given in fig. 4. Find the transfer function by utilization of the Mason's Gain Formula. Clearly state all the forward paths and touching /non-touching loops with their path gain. [6]



Q.5 The depicted plot is the step response of a first order control system. Find the following:

(1) Time Constant T
(2) Rise Time T_r
(3) Settling Time T_s
(4) Exponential frequency. [4]