Exam Date & Time: 22-May-2023 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

IV Semester End Semester Examination
Engineering Mathematics IV (MAT 2256)

LINEAR CONTROL THEROY [AAE 2257]

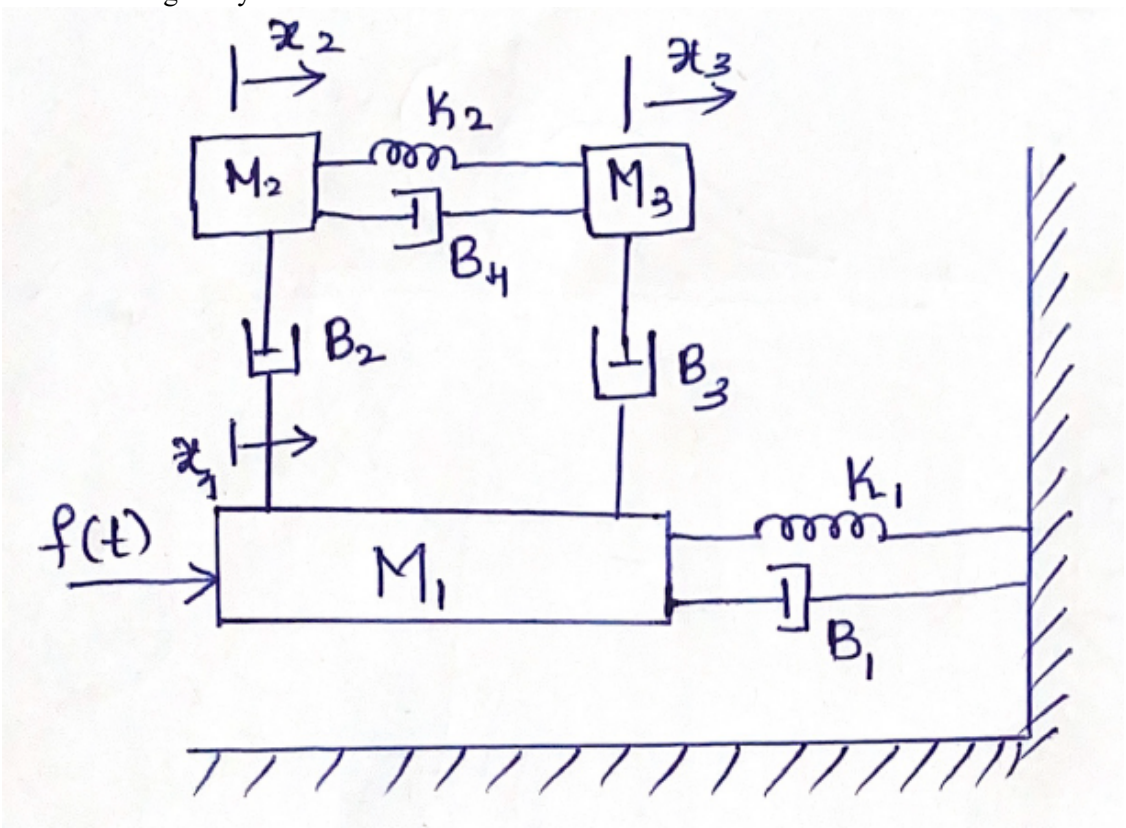
Marks: 50 **Duration: 180 mins.**

Descriptive Questions

Answer all the questions. Section Duration: 180 mins

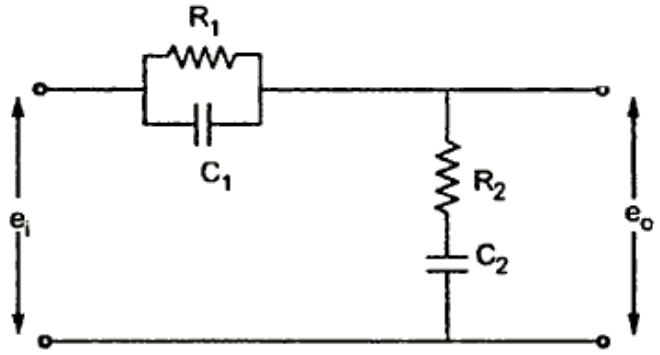
1) Write the differential equations governing the system and draw its Force-Voltage and Force-Current analogous systems.

A)



(5)

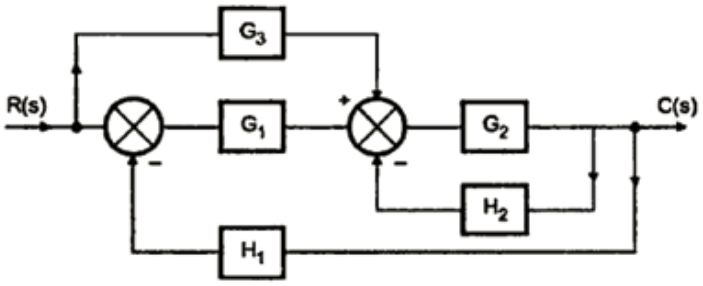
B) Find the Transfer Function $E_o(S)/E_i(S)$ of the given circuit.



(3)

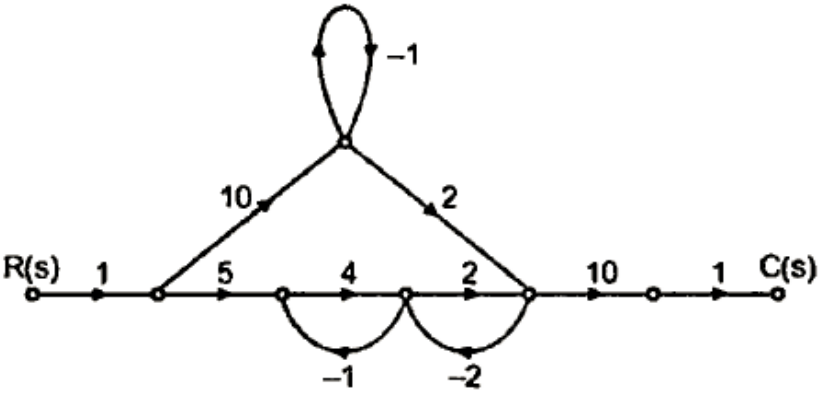
C) Distinguish between open and closed loop control systems with respect to traffic light control system with a generalized block diagram. (2)

2) Reduce the Block Diagram given below and obtain the Transfer Function C(s)/R(s).

A) 

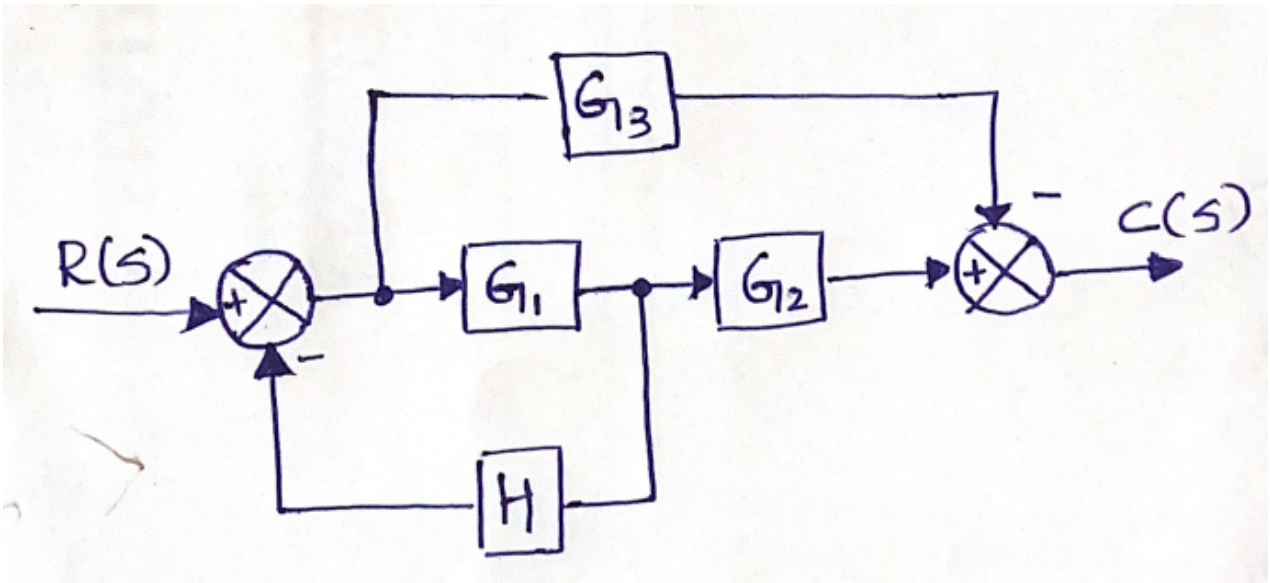
(5)

B) For the Signal Flow Graph shown in the below figure, obtain the Transfer Function C(S)/R(S)



(3)

C) Reduce the Block Diagram to a Signal Flow Graph and obtain the Transfer Function C(S)/R(S)



(2)

3) Compute the necessary values required to sketch **Root Locus Plot** for the Open Loop Transfer Function,

A) $G(S)H(S) = \dfrac{K}{S(S+5)(S+10)}$ (5)

B) Comment on stability for the characteristic equation $s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$ using (3)

Routh-Hurwitz criteria.

C) Sketch **Root Locus Plot** in graph sheet for the **Q. No (3A)** and comment on the stability (2)

4) Compute the necessary values required to draw **Bode Magnitude and Phase Plot** for the Open Loop Transfer Function

A) $G(S)= \frac{10(S+10)}{S(S+2)(S+5)}$ (5)

B) Plot the **Bode Magnitude and Phase plot** for the **Q. No. (4A)** in Semilog sheet and comment on the Stability. (3)

C) Draw the approximate **Nyquist Plot** for the Transfer Function

$G(S)= \frac{50}{(S+10)(S+20)}$ (2)

by observing the Type and Order of the system.

5) A closed loop servo is represented by the differential equation $\frac{d^2c}{dt^2} + 8\frac{dc}{dt} = 64e$

A) Where e=r-c
c=Displacement of the output shaft
r=Displacement of input shaft (5)

Find rise time, % overshoot, peak time, peak overshoot, settling time for a step input of 12 units.

B) Find the Transfer Function from the State Space Model.

$$\dot{X} = \begin{bmatrix} \dot{x_1} \\ \dot{x_2} \end{bmatrix} = \begin{bmatrix} -1 & -1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

$$Y = \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

(3)

C) Discuss in detail with the suitable Transfer Function and Circuit Diagram, how the Lag-Lead Compensators help to improve the steady state response of the system. (2)

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