Question Paper

Exam Date & Time: 09-May-2024 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

FOURTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, MAY 2024

LINEAR CONTROL THEORY [AAE 2223]

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

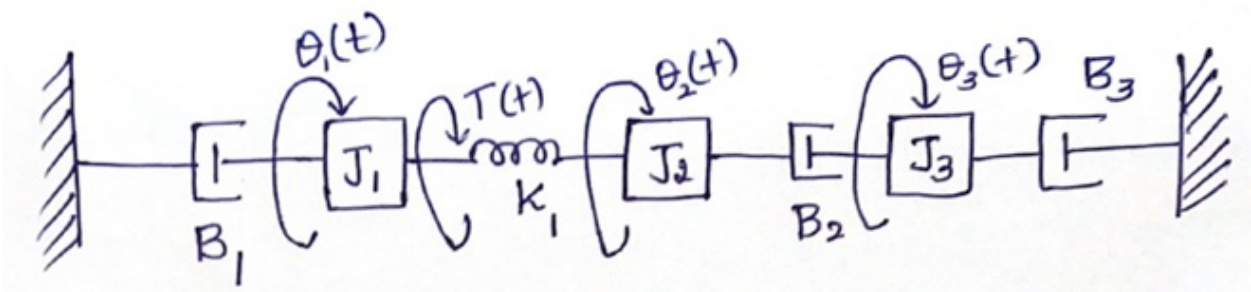
A

Answer all the questions.

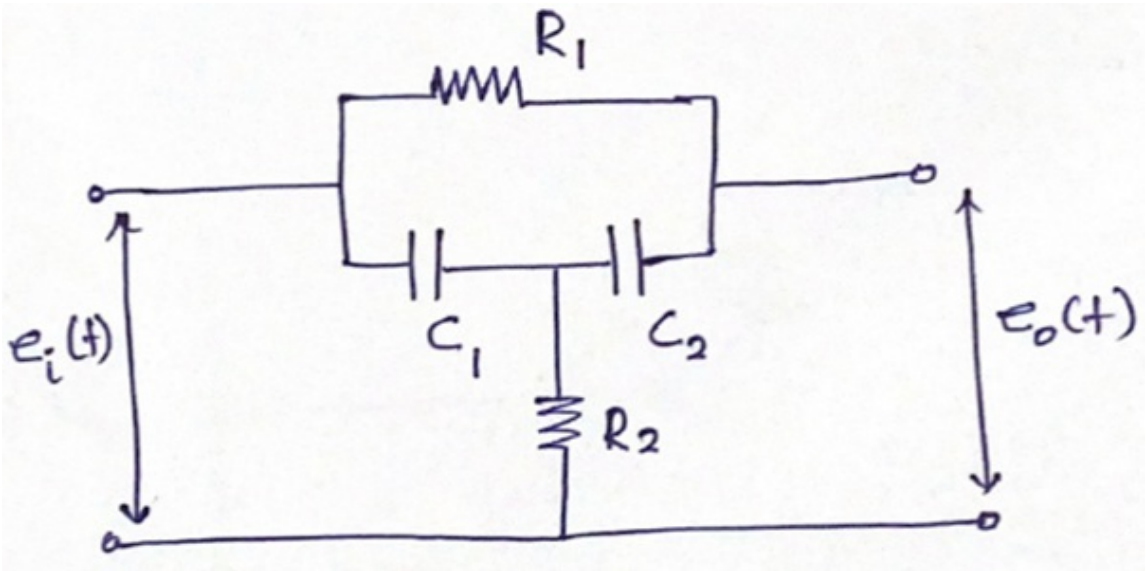
Instructions to Candidates:
1) Answer ALL the questions.
2) Missing data may be suitably assumed.

1) Write the differential equations governing the system and draw its **Torque-Voltage and Torque-Current analogous systems**. (5)

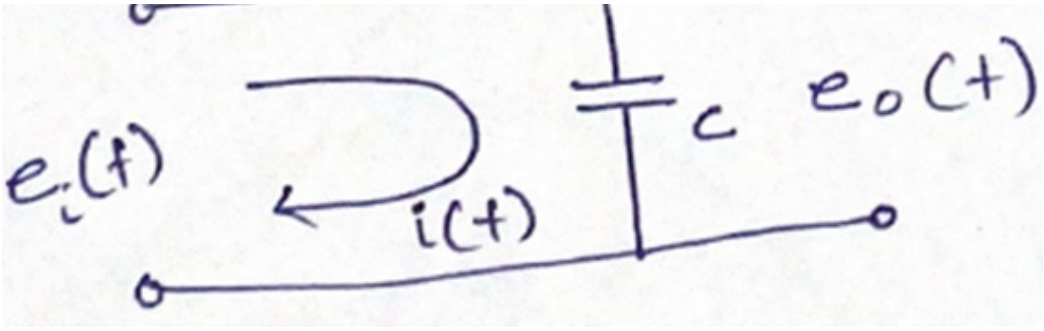
A)



B) Find the **Transfer Function Eo(S)/Ei(S)** of the given circuit. (3)

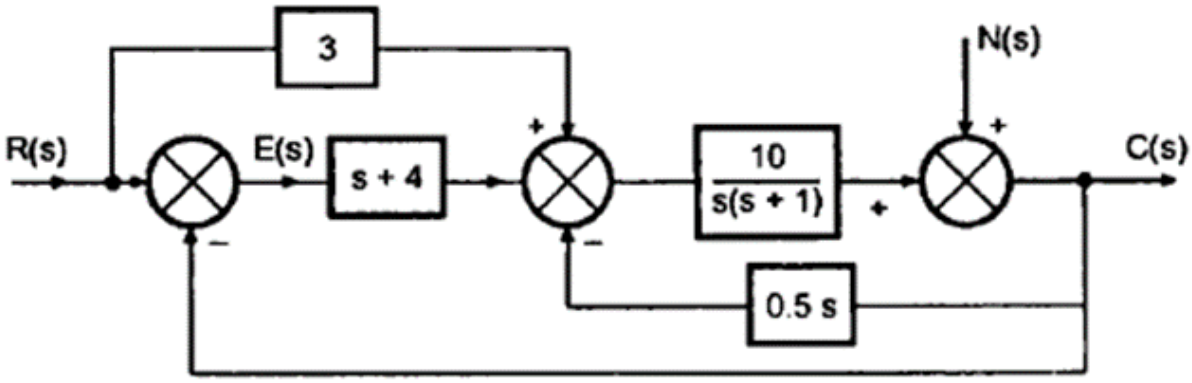


C) Draw the **Block Diagram for the electrical network** shown below and obtain the **Transfer Function Eo(S)/Ei(S).** (2)

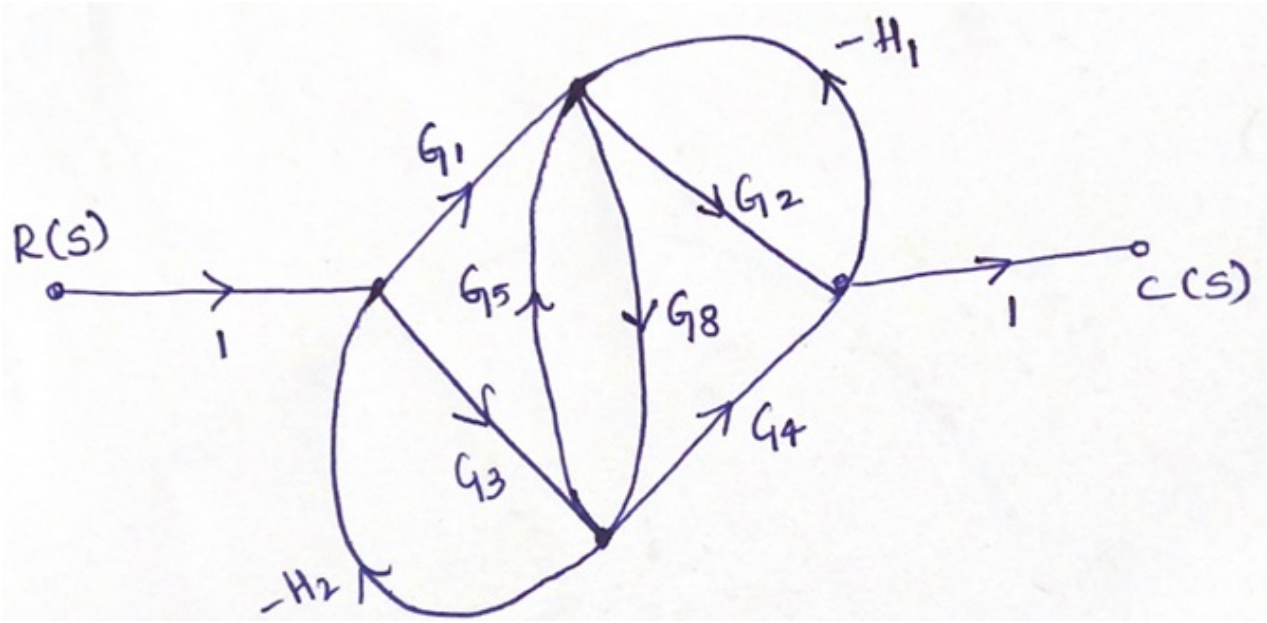


2) Reduce the Block Diagram given below and obtain the **Transfer Function C(s)/R(s) if N(s)=0**. (4)

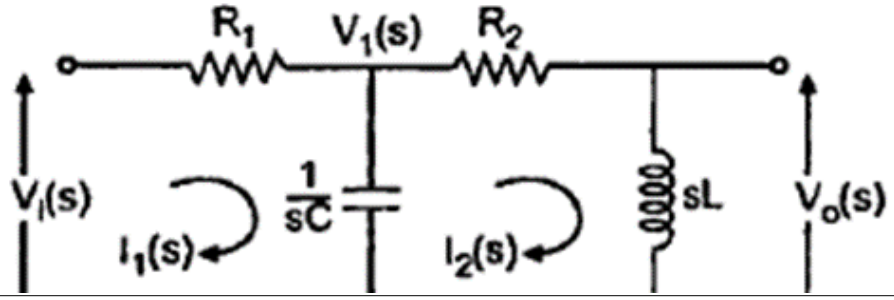
A)



B) For the Signal Flow Graph shown in the below figure, obtain the **Transfer Function C(S)/R(S) using Mason's Gain Formula**, (4)



C) Draw the **suitable Signal Flow Graph** for the electrical network shown in the below figure, (2)



3) Compute the necessary values required to sketch **Root Locus Plot** for the Open Loop Transfer Function, (5)

A) $G(s)\,H(s)\dfrac{K}{s(s+3)(s^2+2s+2)}$

B) **Sketch Root Locus Plot in graph sheet** for the **Q. No (3A)** and analyse its stability. (Write the graph sheet number) (2)

C) Comment on stability for the characteristic equation, $s^6+4s^5+3s^4-16s^2-64s-48$. Using (3)

Routh-Hurwitz criteria.

4) Compute the necessary values required to draw **Bode Magnitude and Phase Plot** for the Open Loop Transfer Function, (5)

A) $G(s)=\dfrac{20(s+20)}{s(s+5)(s+10)}$

B) **Plot the Bode Magnitude Plot and Phase plot for the Q. No. (4A)** in Semilog sheet and analyse the Stability (Write the graph sheet number). (3)

C) Draw the approximate **Polar Plot and Nyquist Plot** for the Transfer Function $G(s)=\dfrac{1}{s(s+1)(s+20)}$ (2)

by observing the **Type and Order of the system.**

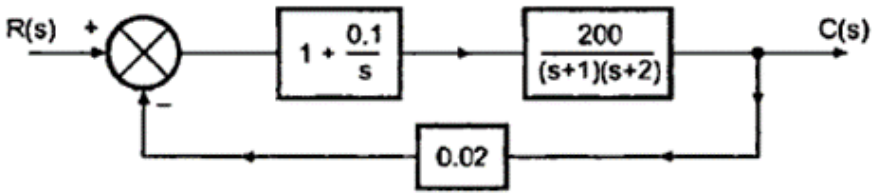
5) A system has 30% overshoot and settling time for 5 seconds, for a unit step input. Determine the **transfer function**. Also calculate **peak time and output response**. Assume e_{ss} (steady state error) as 2% (4)

A)

B) If a system is represented by the following differential equation, (4)

$\dfrac{d^3y(t)}{dt^3}+\dfrac{d^2y(t)}{dt^2}+6\dfrac{dy(t)}{dt}+7y(t)=2u(t)$, Obtain the **State Space Model**.

C) The control system is shown below. If the input to the system is Unit step, find the **e_{ss} (steady state error)** (2)



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