Code No: R2022044 **R20** **SET - 1**

II B. Tech II Semester Supplementary Examinations, December- 2022

LINEAR CONTROL SYSTEMS

(Common to ECE & EIE)

Time: 3 hours **Max. Marks: 70**

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks

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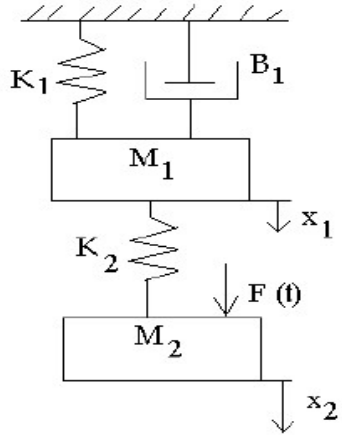
UNIT-I

1 a) With necessary equations give the basic elements of a linear mechanical system. [7M]

b) Write the dynamic equation in respect of the mechanical system given in Fig. Then using force-voltage analogy, obtain the equivalent electrical network. [7M]



Or

2 a) Explain the difference between open loop, closed loop system and write the advantages and features of transfer function. [7M]

b) Explain about Traffic control systems with a neat sketch. [7M]

UNIT-II

3 a) Draw the transient response of a second order system and define all the specifications for under damped case. [7M]

b) A unity feedback system is characterized by an open-loop transfer function G(s) = K/s(s+5). Determine the gain K so that the system will have a damping ratio of 0.5. For this value of K, determine settling time, peak overshoot and times to peak overshoot for a unit-step input. [7M]

Or

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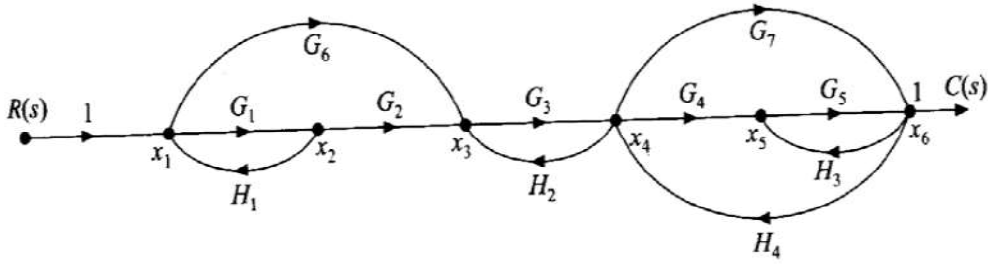
4 a) Derive the expressions for rise time, peak overshoot, settling time of 2nd order system of unit step input. [7M]

b) What are differences between block diagram reduction and signal flow graph reduction. [7M]
Obtain transfer function through massion gain formula for the following Fig.



UNIT-III

5 a) A unity feedback control system has an open loop transfer function [7M]

$$G(s) = \frac{K}{s(s^2 + 4s + 13)}$$

Sketch the root locus.

b) Construct Routh array and determine the stability of the system represented by the characteristics equation $s^7 + 9s^6 + 24s^4 + 24s^3 + 24s^2 + 23s + 15 = 0$ [7M]

Or

6 a) Explain about the procedure of construction of Rootlocus. [7M]

b) Sketch the root locus of the system whose open loop transfer function is $G(s) = \frac{K}{s(s+2)(s+4)}$. Find the value of K so that the damping ratio of the closed loop system is 0.5. [7M]

UNIT-IV

7 a) Plot the Bode diagram for the following transfer function and obtain the gain and phase cross over frequencies. [7M]

$$G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}.$$

Determine the value of K for a gain cross over frequency of 20 rad/sec.

b) A certain unity negative feedback system has the G(s) =$1/s^2+4$. By applying Nyquist stability criterion, determine the stability of the closed loop system. [7M]

Or

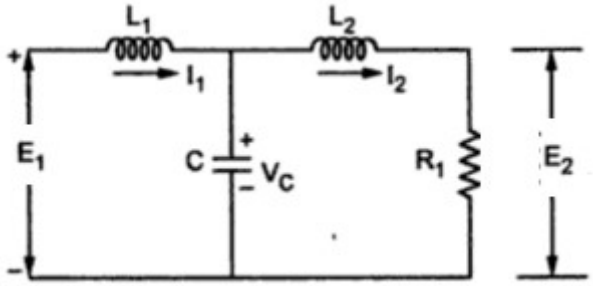
8 a) Explain the effect of addition of a zero to the transfer function of using polar plot of a given system. [7M]

b) Sketch the Bode plot and hence find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin. [7M]

$$G(s) = \frac{0.75(1 + 0.2s)}{s(1 + 0.5s)(1 + 0.1s)}$$

UNIT-V

9 a) Obtain the state equation and output equation of the electric network as shown in Fig. [7M]



b) Write a short note on concepts of controllability and observability. [7M]

Or

10 a) A second order linear system is described by [7M]

$$\dot{x}_1 = -3x_1 + x_2 + u$$

$$\dot{x}_2 = -x_1 - x_2 + u$$

and $y = x_1 + x_2$.

Determine the transfer function and also calculate the zero input response of $x_1(0) = 1$ and $x_2(0) = -1$

b) Explain the procedure for designing the lead compensator. [7M]