(b) Construct the root locus of the system of

$$G(s)H(s) = \frac{k(s+2)}{s^2+2s+2} \qquad (8)$$

OR

(a) List the properties of root-loci. (6)

(b) Sketch the root locus plot for a unity feedback system with

$$G(s) = \frac{k}{s(s^2+4s+13)} \qquad (9)$$

(a) Draw the circuit and write the T.F of the phase-lag and phase lead compensation networks. (5)

(b) The open loop T.F. of an uncompensated system

$G(s) = \dfrac{k}{s(s+1)(s+4)}$. The system is to be compensated to meet the following specifications.

Damping ratio $\delta = 0.5$

Settling time $t_s = 10$ seconds

Velocity error constant $k_v \geq 5$

Design a suitable compensator. (10)

OR

(a) Derive the T.F. for phase-lag compensator. Sketch its Bode plot. (7)

(b) Explain the design procedure for lead compensator in frequency domain. (8)

***

BT IN - IV (S) - 04 - 027

B.Tech. Degree IV Semester (Special Supplementary) Examination in Instrumentation June 2004

IN 403 CONTROL ENGINEERING I

Time: 3 Hours Maximum Marks: 100

PART - A

(*Answer any five questions*)

(All questions carry ***equal*** marks)

(5 x 5 = 25)

I. (a) List the effects of feedback in a control system.

(b) State and explain Mason's gain formula for signal flow graph.

(c) What are the different static error constants and what are their values for a type I system?

(d) Sketch and explain the responses of the systems with variation in the location of roots of the characteristic equation in S-plane.

(e) What is a polar plot and how stability of control systems can be assessed by this plot?

(f) How will you determine angle of departure and angle of arrival of root locus?

(g) What is the need of compensation networks in control systems?

(Turn over)

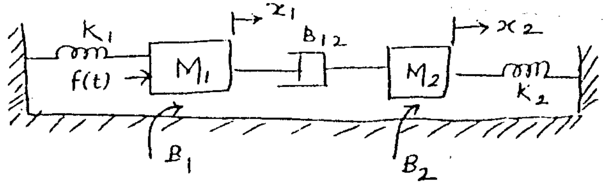
PART - B

(Answer *ALL* questions)

(All questions carry *EQUAL* marks) (15 x 5 = 75)

II. (a) Define transfer function of a system, what are their disadvantages? (5)

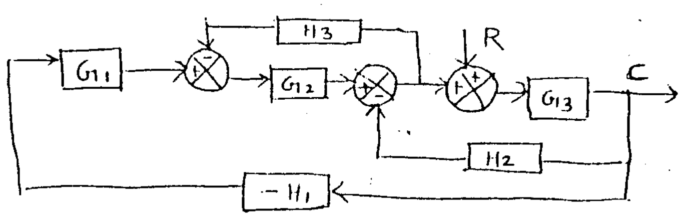
(b) Obtain the T.F $\frac{X_1(s)}{F(s)}$ and $\frac{X_2(s)}{F(s)}$ for the following system. (10)



OR

III. (a) Obtain the differential equations of a room heating system. (7)

(b) Obtain the T.F $\frac{R}{C}$ for the following network. (8)



IV. (a) Derive the expressions for the peak time (t_p) and peak overshoot (M_p) of a second order system when subjected to unit step input. (8)

(b) By means of Routh's stability criterion, determine the stability of the system represented by the characteristic equation $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. (7)

OR

V. (a) Briefly disucss the behaviour of a first order system when subjected to unit step, unit ramp and unit acceleration inputs. (7)

(b) For a unity feedback control system with open loop transfer function $\frac{20}{(s+1)(s+5)}$, obtain undamped natural frequency, damping factor, peak time, maximum overshoot. (8)

VI. (a) Explain Nyquist stability criterion. (5)

(b) By applying Nyquist stability criterion, determine value of 'k' for which system is just stable.

$$G(s) = \frac{k(s+2)}{(s+1)(s-1)} \quad , H(s) = 1$$ (10)

OR

VII. (a) Explain gain margin and phase margin. (5)

(b) Determine gain margin and phase margin of a unity feedback system having open loop T.F

$$G(s) = \frac{10}{jw(0.1jw+1)(0.05jw+1)}$$ using Bode Plot. (10)

VIII. (a) Explain the effects of adding poles and zeroes to the system on its stability and speed or response. (7)