

Time: 3 hour

Maximum Marks: 60

Note: Attempt all questions. Part(A) is compulsory. Attempt any four questions from Part B.

1. Give short answers of the following questions.

1. In Force-current analogy, write their equivalent terms:
Mass, Spring Constt., Frictional damping.
2. Write all the rules of block diagram reduction technique.
3. Define K_p , K_v , & K_a for a unity feedback system.
4. List various methods for finding absolute stability & Relative Stability.
5. Define Gain Crossover frequency & Phase Crossover frequency in a Bode plot.
6. Write the expressions for time response specifications of a second order system.
7. What are the major effects of adding a lead compensator to a control system.
8. Write down the state equation & output equation in state space model, naming all matrices.
9. Define Sensitivity. What is the effect of feedback on parameter sensitivity of a control system?
10. What is the difference between Type & Order of a system. What is the value of steady state error to a unit step input for a Type-1 system.

[2*10]

Part B

2. (a) The open loop transfer fn. is given by

$$G(s) = \frac{50}{(1 + 0.1s)(1 + 2s)}$$

Determine the steady state error for a unit step input, unit ramp input & acceleration input $\frac{t^2}{2}$

[5]

(b) The open loop transfer fn. of a unity feedback system is given by

$$G(s) = \frac{100}{s(s+5)(s+2)}$$

Determine the time response of the closed loop system for $r(t) = 1$. Also determine the percentage overshoot.

[5]

- a) The characteristic eqⁿ of feedback control system is

$$s^4 + 20s^3 + 15s^2 + 2s + k = 0$$

Determine the range of k for the system to be stable. what will be the frequency of oscillation if the system is marginally stable?

[5]

- (b) Define Gain Margin, Phase Margin, Gain Crossover frequency and Phase Crossover frequency in a polar plot.

[5]

4. (a) Show that the loci of constant phase angle of a closed loop system with unity feedback, is a family of circles whose centre is at

$$x_0 = -\frac{1}{2}, y_0 = \frac{1}{2N} \text{ \& radius is } \frac{(N^2+1)(\frac{1}{2})}{2N}$$

[5]

- (b) Obtain the unit step response of a unity feedback system whose open loop transfer fn. is :

$$G(s) = \frac{4}{(s+5)}$$

[5]

5. The open loop transfer function of a system is given by:

$$G(s)H(s) = \frac{K(s+4)}{(s+2)(s+3)}$$

Draw the complete Root Locus & comment on the stability of the closed loop system.

[10]

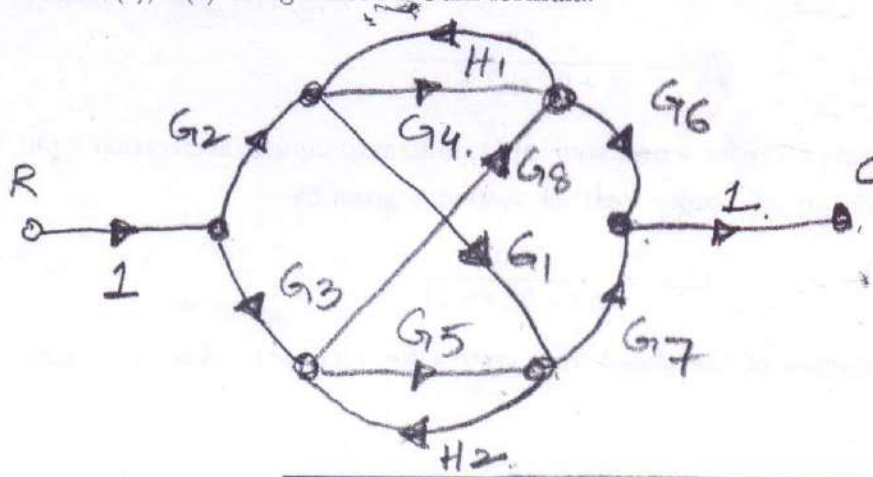
6. (a) What is a lead compensator? Draw its pol zero configuration on S-plane. Derive the expression of the attenuation in terms of maximum phase lead angle.

[5]

- (b) Draw the ckt. of an auto-transformer. Explain & show how copper is saved in an auto-transformer as compared to a two winding transformer.

[5]

7. Find C(s)/R(s) using Mason's Gain formula:



[10]