5. (a) Draw the pole zero configuration of a lag compensator on S-plane. Compare lag and lead compensators. **5**

(b) Draw Bode plot of the transfer fn. $G(s) = 75(1 + 0.2s)/s\ (s^2 + 16s + 100)$. Find gain crossover and phase crossover frequency and comment on its stability. **10**

6. (a) Construct the state model of the system characterized by the differential equation. Give a block diagram representation of the state space model : **10**

$$\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 6y = 0$$

(b) Write and prove properties of State transition matrix. **5**

7. Write short notes on any *two* of the following : **15**

(a) Optimal Control

(b) Controllability and Observability

(c) M and N Circles.

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008606

May 2024

B. Tech. (ECE) (Sixth Semester)

Control System (EC-601)

Time : 3 Hours] [*Maximum Marks : 75*

Note : It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other. Semi-logarithmic graph paper will be requird.

Part A

1. (a) Write the rule of moving the summing point ahead of the block. **1.5**

(b) What is feedback ? Which type of feedback is employed in control system ? **1.5**

(c) List the time domain specifications. **1.5**

(d) What is the effect of PI controller on the system performance ? **1.5**

(e) What is phase and gain crossover frequency ? **1.5**

(f) The damping ratio and natural frequency of oscillation of a second order system is 0.5 and 8 rad/sec respectively. Calculate resonant peak and resonant frequency. **1.5**

(g) Define BIBO stability. **1.5**

(h) What is centroid ? How is it calculated ? **1.5**

(i) What is State Space ? **1.5**

(j) Draw the Bode plot of a lead compensator. **1.5**

Part B

2. (a) A unity feedback system has an open loop transfer function : **10**

$G(s) = K/s(s^2 + 8s + 32)$. Sketch the Root Locus and determine the dominant closed loop poles with $\zeta = 0.5$

(b) The characteristic equation for a feedback control system is given as : **5**

$s^5 + 2s^4 + 24s^3 + 48s^2 - 25s - 50 = 0$

Determine the location of roots and comment on the stability of the system.

3. (a) For a unity feedback system having open loop transfer fn. as : **5**

$G(s) = K(s + 2)/s^2(s^2 + 7s + 12)$. Determine :

(i) Type of the system

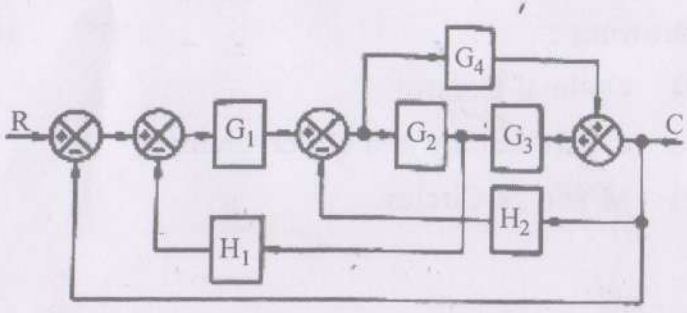
(ii) Error constants K_p, K_v, K_a

(iii) Steady state error for parabolic input.

(b) The open loop transfer fn. of a unity feedback system is given by : **10**

$G(s) = 1/s(1 + s)(1 + 2s)$. Sketch the polar plot and determine gain margin and phase margin.

4. (a) Find $C(s)/R(s)$ of the system : **10**



(b) What is signal flow graph ? Explain Mason's gain formula. **5**