(iii) With large deviation from the set point or smaller. Explain

(b) Determine the transfer function of a lead compensator that will provide a phase lead of 50° and gain of 8dB at $\omega = 5$ rad/sec. **5**

6. (a) Obtain the state space representation for the system described the equation : **10**

$$\frac{d^2y}{dt^3} + \frac{d^2y}{dt^2} + 6\frac{dy}{dt} = 6u(t)$$

(b) Check the controllability and observability of the system given in Q. 6 (a). **5**

7. (a) What are the most common non-linearity found in the system ? Explain any *five* of these in detail. **10**

(b) What is the difference between Regulator and Tracking Problem. **5**

020602

May 2024

B. Tech. (RAI) (Sixth Semester)

Robotics and Artificial Intelligence

Control Systems

(PCC-RAI-602/21)

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.

Part A

1. (a) What is the difference between a transfer function and a state-space representation of a system ? **1.5**

(b) Why positive feedback system is not advisable ? **1.5**

(c) What (positive or negative) should be Gain Margin for stable system ? What is the reason ? **1.5**

(d) Sketch the approximate polar plot for : **1.5**

$$G(s)H(s) = \frac{1}{s^4(s+p)}; p > 0 \mathbb{R}$$

(e) What is corner frequency in Bode Plot ? **1.5**

(f) Write the formula to evaluate *'Angle of Arrival'* in root locus ? **1.5**

(g) What is the relation existing between the standard test signals ? **1.5**

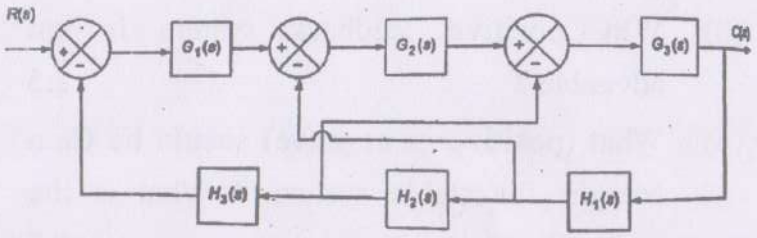
(h) What are the units of Position error constant (K_p), Velocity error constant (K_v) and Acceleration error constant (K_a) ? **1.5**

(i) Compare lead and lag-lead compensation. **1.5**

(j) What do you mean by homogeneous and non-homogeneous state equations. **1.5**

Part B

2. (a) Obtain the transfer function ($C(s)/R(s)$) of the system given below. **10**



(b) Describe the advantage of negative feedback control system on the basis of sensitivity analysis. **5**

3. (a) Sketch the root locus of the system whose loop transfer function is given by $G(s)H(s) = \frac{K}{s(s+1)(s+2)}$. Also determine the range of K for which the system is unstable. **10**

(b) The open loop transfer function of the system $G(s)$ for a unity feedback system is given by $G(s) = \frac{10(1+s)}{s^2(6+5s)}$. Determine the Steady-state error to an input $r(t) = 1 + 3t + 4t^2$ using the generalized error coefficients. **5**

4. The loop transfer function of a certain control system is given by $G(s)H(s) = \frac{k(s+1)^2}{s^3}$ Sketch the Nyquist plot and examine the stability of the system. **15**

5. (a) Integral control action makes a process :

(i) Faster or Slower **10**

(ii) More oscillatory or less