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| Exp. No.9  Date: | **Design of Lag, Lead Compensators and Evaluation of**  **Closed Loop Performance** |

# Aim

# The design lag lead compensator and evaluate the closed loop performance.

# Introduction

Lag and lead compensators play a crucial role in control systems, addressing challenges in system response, transient behavior, and steady-state performance. This topic explores the nuanced design and evaluation of these compensators, aiming to minimize system error and optimize functionality. Through parameter tuning and rigorous assessment of closed-loop performance, valuable insights into control system design principles are gained, applicable across various engineering contexts.

# Procedure

Step 1: Analyze the dynamic characteristics of the given system and derive its transfer function.

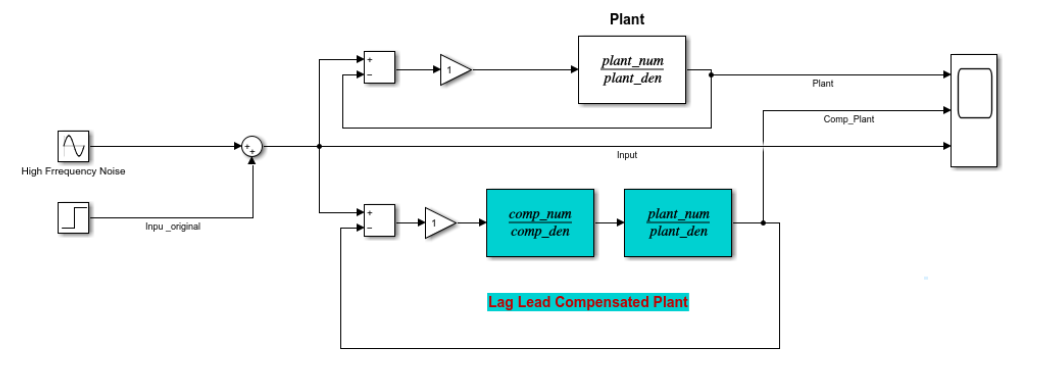
Step 2: Design the lag compensator by selecting appropriate parameters like time constant and gain.

Step 3: Design the lead compensator by choosing suitable parameters such as time constant and gain.

Step 4: Implement the designed lag and lead compensators in MATLAB using the Control System Toolbox.

Step 5: Analyze the closed-loop response, evaluating transient behavior, steady-state error, and overall stability.

**MATLAB Circuit**

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**MATLAB Code :** Lag Compensator

clc;

close all;

clearvars;

% Lag Compensator Design

plant\_num = [5];

plant\_den = [2 1 0];

plant\_tf = tf(plant\_num,plant\_den);

comp\_num = [20 1];

comp\_den = [200 1];

comp\_tf = tf(comp\_num,comp\_den);

% Plotting Gain and Phase margin for plant

figure;

margin(plant\_tf);

grid on;

% Compensated System

lag\_comp\_sys = plant\_tf\*comp\_tf;

disp(lag\_comp\_sys);

hold on;

margin(lag\_comp\_sys);

legend ('plant', 'comp\_plant');

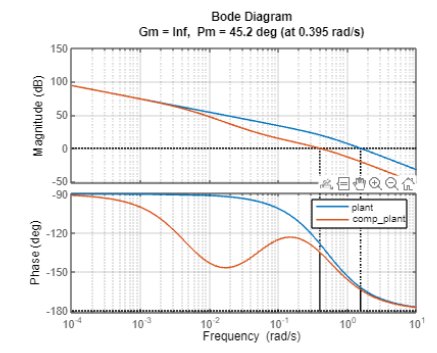
% Plotting Gain and Phase margin for compensator

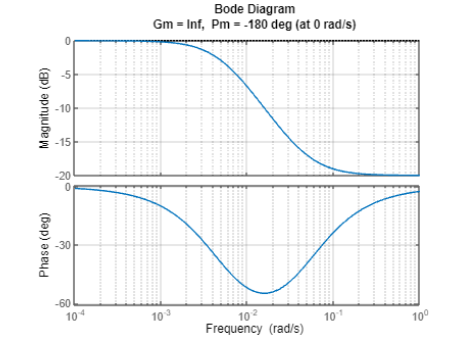
figure;

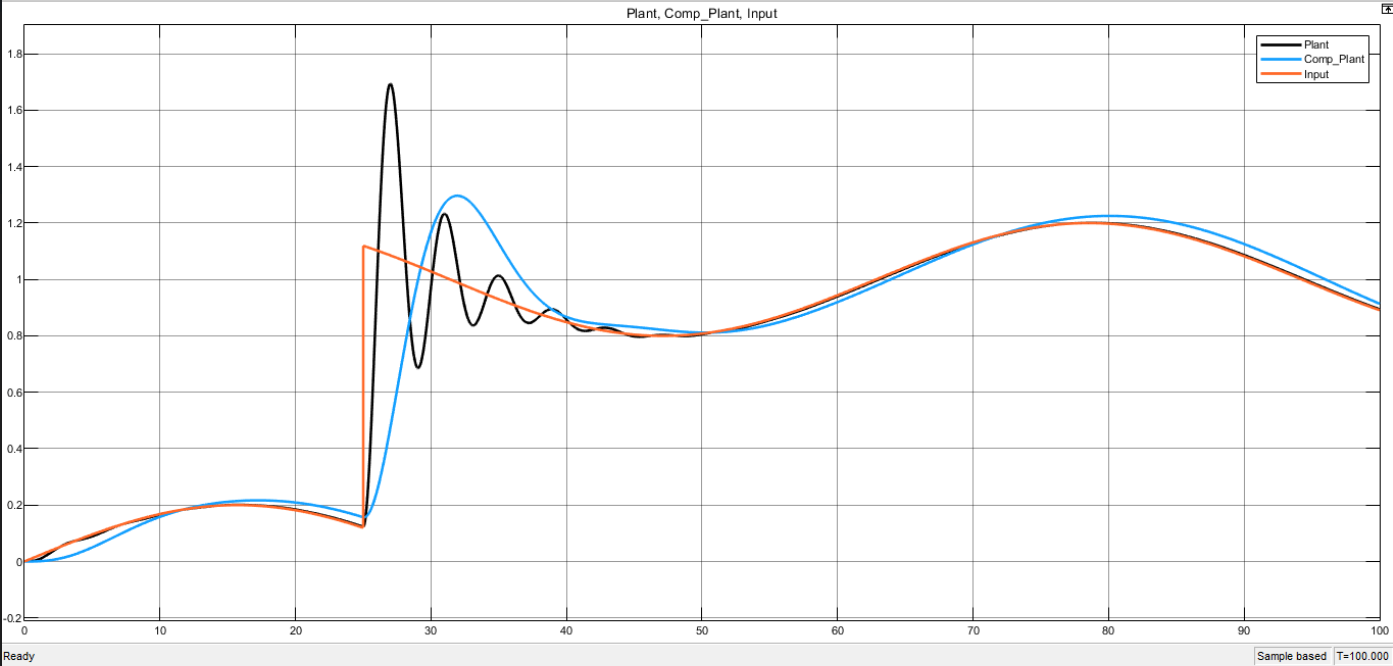
margin(comp\_tf);

grid on;

**Output Waveform**

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**MATLAB Code:** Lead Compensator

clc;

close all;

clearvars;

% Lead Compensator Design

plant\_num = [15];

plant\_den = [1 1 0];

plant\_tf = tf(plant\_num,plant\_den);

comp\_num = [0.36 1];

comp\_den = [0.09 1];

comp\_tf = tf(comp\_num,comp\_den);

% Plotting Gain and Phase margin for plant

figure;

margin(plant\_tf);

grid on;

hold on;

% Compensated System

lead\_comp\_sys = plant\_tf\*comp\_tf;

disp(lead\_comp\_sys);

margin(lead\_comp\_sys);

hold off;

legend ('plant', 'comp\_plant');

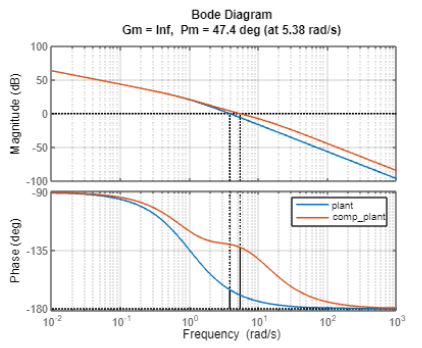
% Plotting Gain and Phase margin for compensator

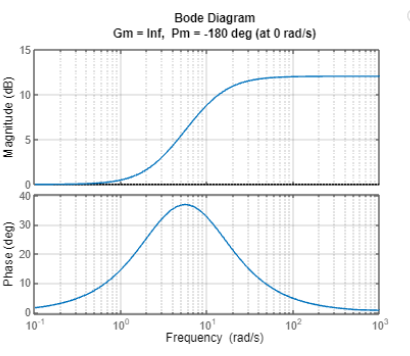
figure;

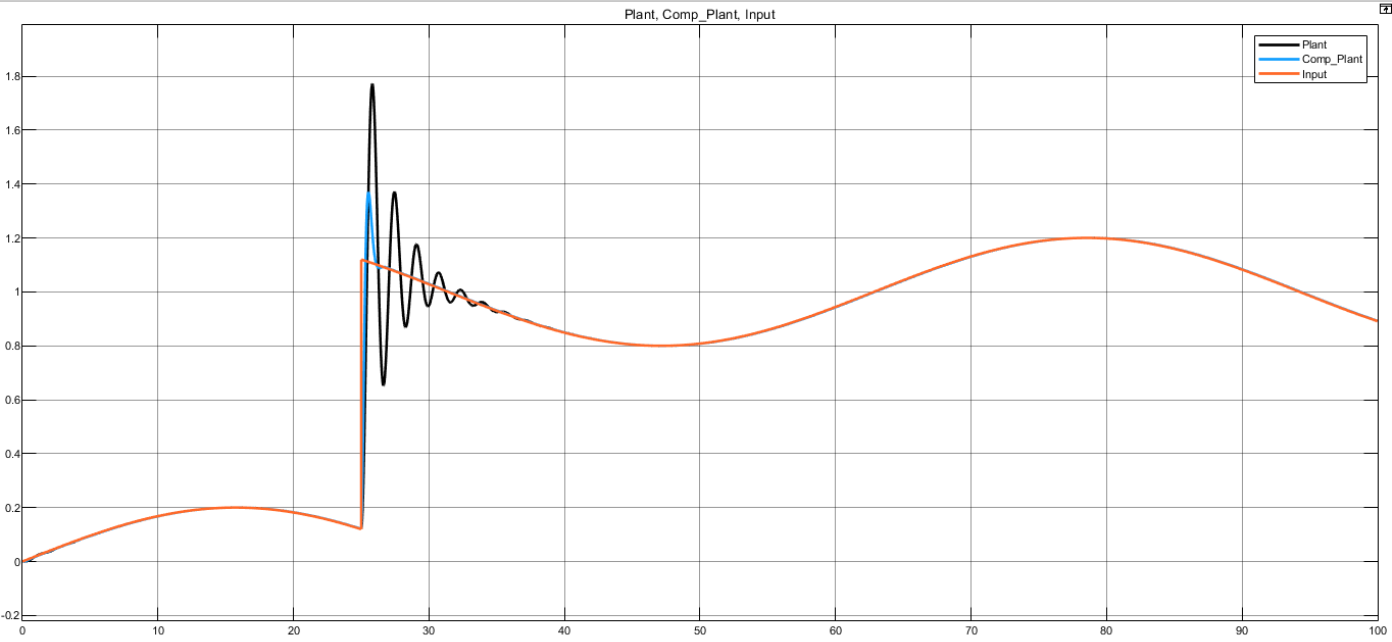
margin(comp\_tf);

grid on;

**Output Waveform**

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**Inference**

# Result

Thus, the lag, lead compensator has been simulated and the output waveform has been analyzed.