EXERCISE 8

FREQUENCY RESPONSE AND COMPENSATION OF LEAD PROCESS

Date: ***Reg. No. :***

LAB PREREQUISITES:

Exercise 1 to 7

PREREQUISITE KNOWLEDGE:

Fundamentals of control system and electronic equipments.

OBJECTIVES:

- To study and analyze frequency response of the second order lead process .
- To study and compensate the lead process using lead lag compensator.

THEORY:

Phase Lag Compensation

A system which has one zero and one dominating pole (the pole which is closer to origin that all other poles is known as dominating pole) is known as lag network. If we want to add a dominating pole for compensation in control system then, we have to select a lag compensation network.

The basic requirement of the phase lag network is that all poles and zeros of the transfer function of the network must lie in (-) ve real axis interlacing each other with a pole located or on the nearest to the origin.

Effect of Phase Lag Compensation

1. Gain crossover frequency increases.
2. Bandwidth decreases.
3. Phase margin will be increase.
4. Response will be slower before due to decreasing bandwidth, the rise time and the settling time become larger.

Advantages of Phase Lag Compensation

1. Phase lag network allows low frequencies and high frequencies are attenuated.
2. Due to the presence of phase lag compensation the steady state accuracy increases.

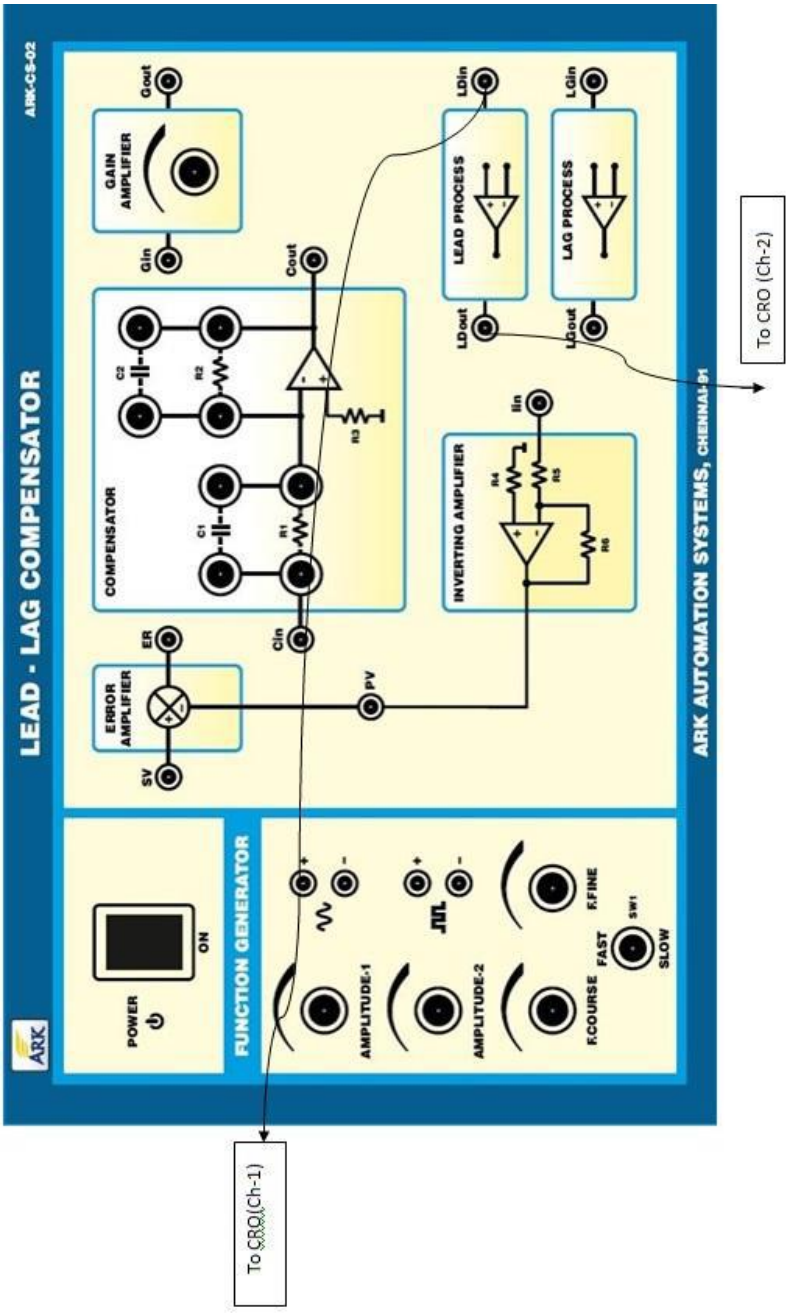
Disadvantages of Phase Lag Compensation

Due to the presence of phase lag compensation the speed of the system decreases.

Advantages of Phase Lag Lead Compensation

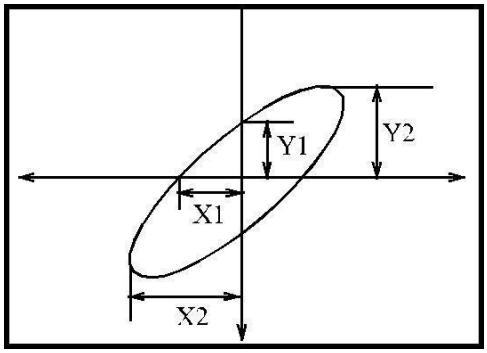
1. Due to the presence of phase lag-lead network the speed of the system increases because it shifts gain crossover frequency to a higher value.
2. Due to the presence of phase lag-lead network accuracy is improved.

FRONT PANEL DIAGRAM



PROCEDURE:

1. Using patch card connect the input to LDin of Lead network as well as CRO(Ch-1)
2. Connect the LDout of Lead network to CRO (Ch-2).
3. Switch ON the power supply of unit
4. Set sine wave as input and note down the amplitude and frequency of the input signal
5. View the Lissajous pattern by using CRO, by means of keeping the CRO button in X-Y mode and estimate the phase shift ( ) of the output signal compared to input due to the lag process response
6. Vary the frequency from low to high (above100Hz) and conduct the experiment and note down the readings and tabulate it.
7. The phase angle ( ) is measured from Lissajous pattern as shown in figure
8. Plot the gain plot (Gain Vs Frequency) and phase plot(Phase Vs Frequency) in semilog graph sheet and conclude the behavior of lead process



$$\sin \phi = \frac{x_1}{x_2} = \frac{y_1}{y_2}$$

$$\phi = \sin^{-1}\left(\frac{x_1}{x_2}\right) = \sin^{-1}\left(\frac{y_1}{y_2}\right)$$

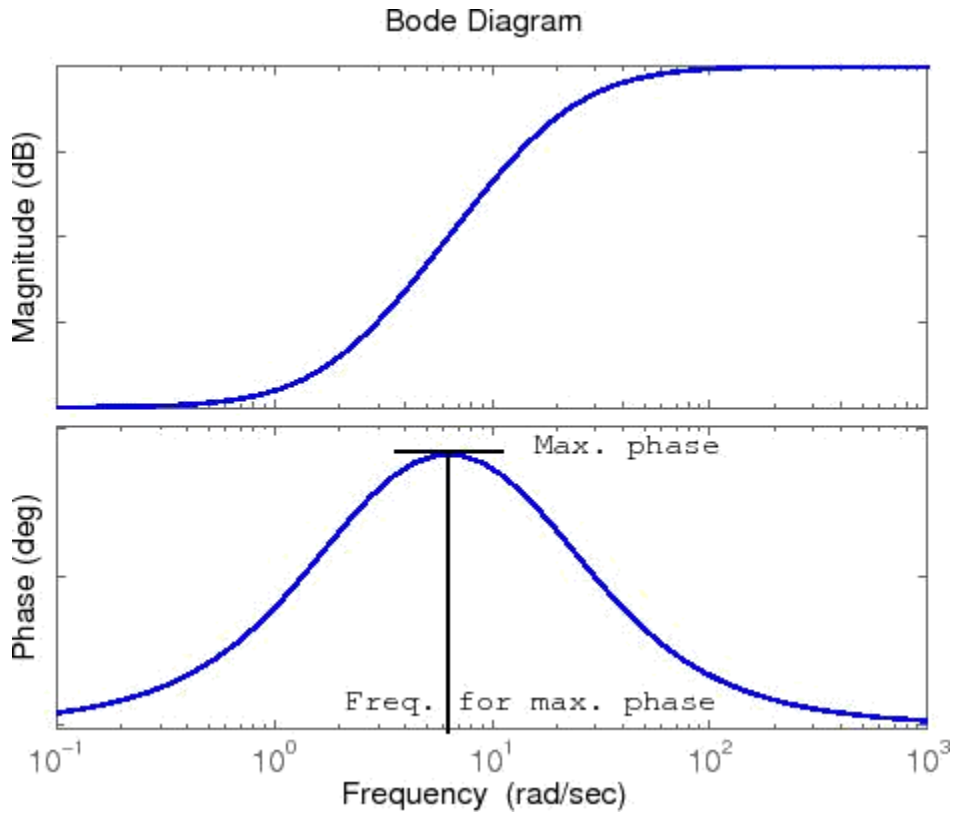
9. Note down the frequency, phase and begin to perform calculation to compensate lead network.
10. Assume different values of Resistance, Capacitance (R2, C1, C2) and connect suitable components values on the compensator network. Connect a pot of 10kΩ as resistor R1.
11. Using patch cards Connect LDout toCin and connect Cout to Gain amplifier.
12. Connect the gain amplifier output to CRO (Ch-2).
13. Tune the potentiometer to null the phase shift and measure the value of the potentiometer R 1.

TABULATION

Input Voltage V_i(V) = ……. V

Freq	Freq	Y1	Y2	Phase (Φ)	O/P Voltage Vo	Gain 20logVo/Vi
(Hz)	(rad/sec)			(deg)	(V)	(dB)

MODEL GRAPH



RESULTS & INFERENCES:

Evaluation Component	Maximum Marks	Marks Obtained
Pre-lab Tasks	10	
In-Lab Tasks	20	
Post-lab Tasks	10	
Bonus Tasks	10	
Signature of Faculty with Date		

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