EXERCISE 7

FREQUENCY RESPONSE AND COMPENSATION OF LAG PROCESS

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

LAB PREREQUISITES:

Exercise 1 to 6

PREREQUISITE KNOWLEDGE:

Fundamentals of control system and electronic equipments.

OBJECTIVES:

To study and analyze frequency response of the second order lag process .

To study and compensate the lag process using lead lag compensator.

THEORY:

Phase Lead Compensation

A system which has one pole and one dominating zero (the zero which is closer to the origin than all over zeros is known as dominating zero.) is known as lead network. If we want to add a dominating zero for compensation in control system then we have to select lead compensation network. The basic requirement of the phase lead network is that all poles and zeros of the transfer function of the network must lie on (-)ve real axis interlacing each other with a zero located at the origin of nearest origin.

Effect of Phase Lead Compensation

1. The velocity constant Kv increases.
2. The slope of the magnitude plot reduces at the gain crossover frequency so that relative stability improves and error decrease due to error is directly proportional to the slope.
3. Phase margin increases.
4. Response becomes faster.

Advantages of Phase Lead Compensation

1. Due to the presence of phase 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 lead compensation maximum overshoot of the system decreases.

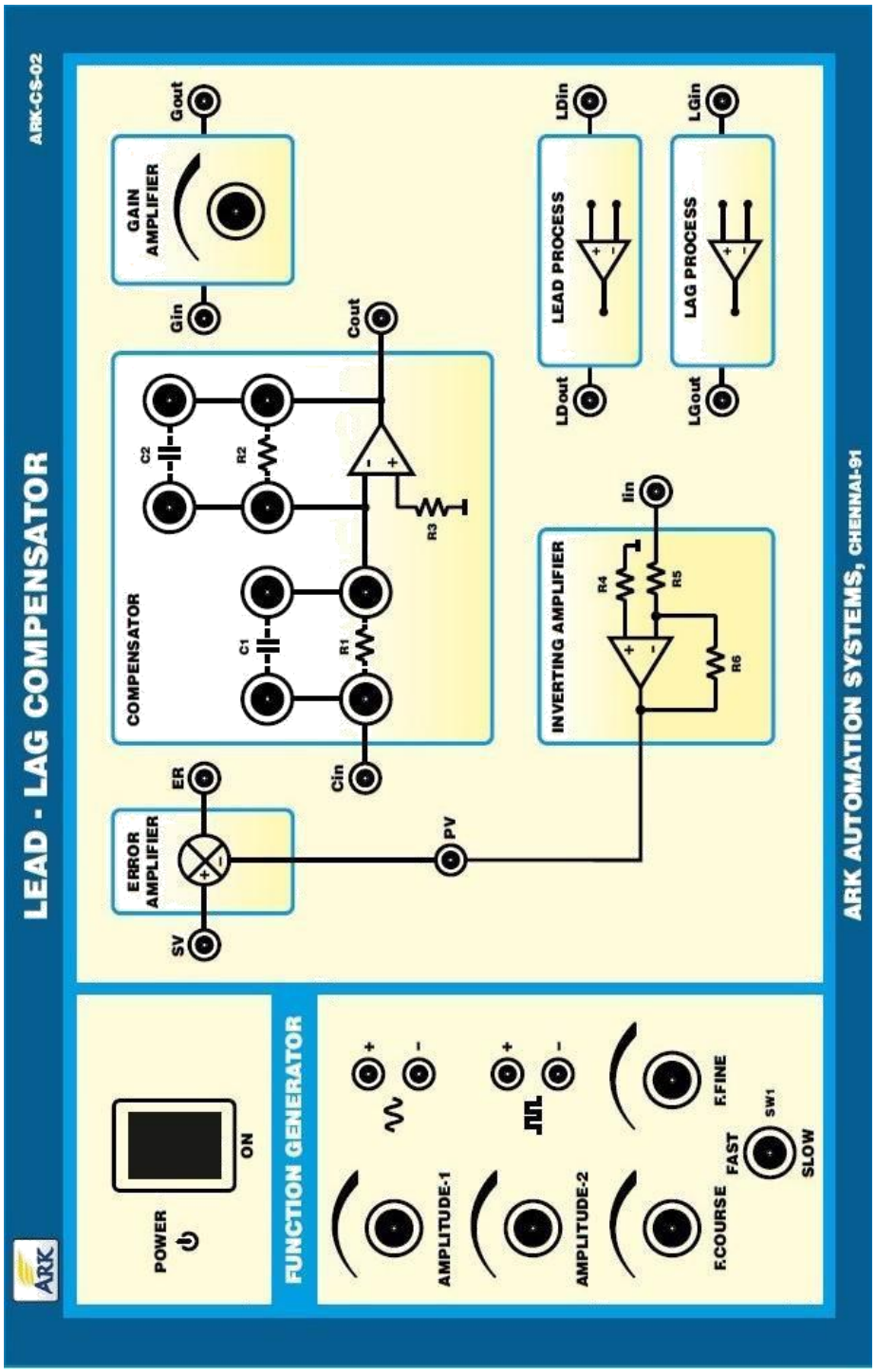
Disadvantages of Phase Lead Compensation

Steady state error is not improved.

Advantages of Phase Lag Lead Compensation

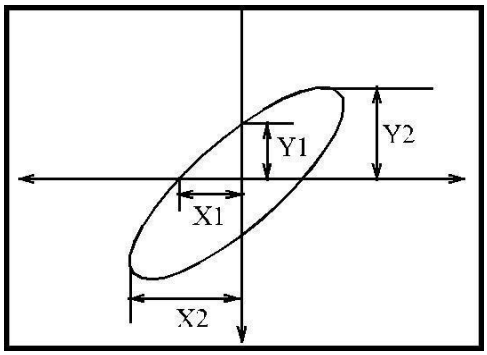
1. Due to the presence of phase lag-lead network the speed of the system increases because it shifts gain crossover frequency to a higher value.
2. Due to the presence of phase lag-lead network accuracy is improved.

FRONT PANEL DIAGRAM



PROCEDURE:

1. Using patch card connect the input to LGin of Lag network as well as CRO(Ch-1)
2. Connect the LGout of Lag 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 (below 100Hz) 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 lag process



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

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

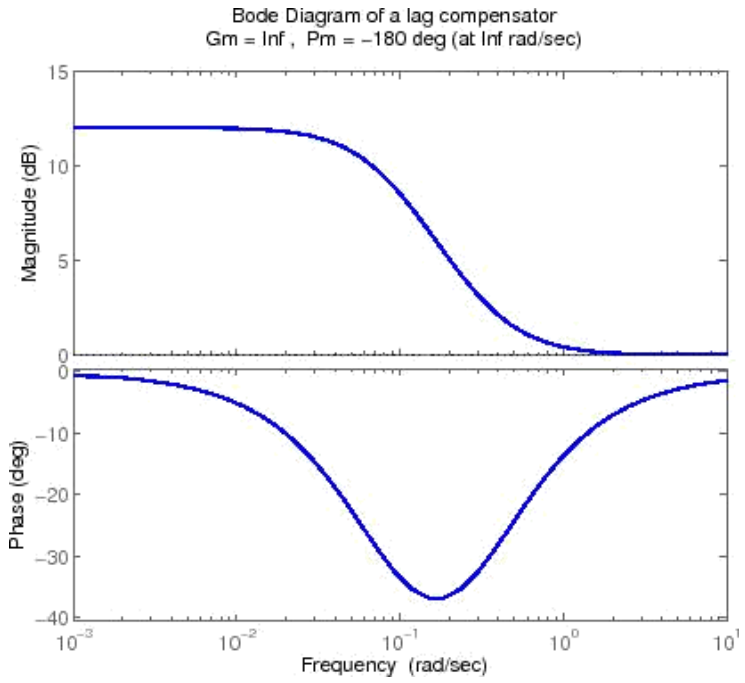
9. Consider the case of a particular frequency, phase and begin to perform calculation to compensate lag network.
10. Assume different values of Resistance, Capacitance (R1, C1, C2) and connect suitable components values on the compensator network. Connect a pot of 10kΩ as resistor R2.
11. Using patch cards Connect LGout to Cin 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 R2.

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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