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Control systems lab
Experiment (4)
Effects of positive and negative damping

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Objective:

* To understand the definition of damping factor in the second order differential equation.

* Study the effect of the damping factor on the transient response and natural oscillation

Part I:

ω_n	Amplitude	Periodic time
10	4V	0.6 sec
5	4V	1.5 sec

Table 4.1

Q4.1) What value of natural frequency do you measure under this condition (ω_n=10)?

F= ωn/2pi=10/2pi=1.6 Hz

Q4.2) What is the effect of alternating (increasing) the two ω_n potentiometers together?

When we increase the value of ωn the frequency will increase(and the time will decrease)

Part II:

ζ	Amplitude for the first sine	Frequency for the first sine	Type of damping
0	2*2=4V	t=1.5sec f=1\t=0.67Hz	undamped
0< ζ<1 (0.3)	1.5*2=3V	t=1.5 sec f=1\t=0.67Hz	Underdamping
ζ =1	1*2=2V	t=2*0.5=1 sec	Critical damping
ζ >1 (2)	1*2=2V	t=3.5*0.5=1.75 sec	Over damping
ζ <0 (part III)	2.5*2=5V	t=1.5sec f=1\t=0.67Hz	Negative damping

Q4.3) What happened to the oscillation as ζ increased?

The oscillation decrease by increasing the value of ζ

Q4.4) For what value of the damping factor ζ there no any oscillation?

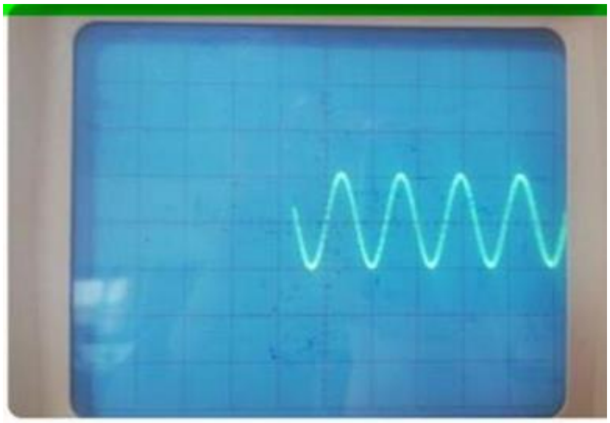
$\zeta \geq 1$ >>>> critical and over damping

Part III:

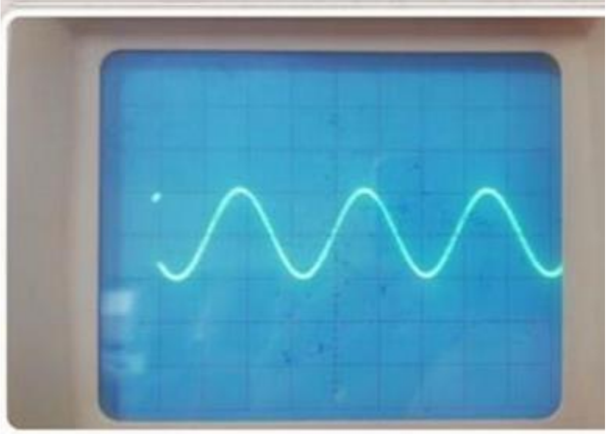
Q4.5) Describe the waveform obtained for positive damping and negative damping, noting the similarities and the differences between them.

In the case of positive damping the signal damped over the time, while in the case of negative damping the signal increases over the time … In the case of underdamping oscillation occurs ,and it is the same with negative damping also

Undamped signals



Wn=10 Z=0 ch1=2v 0.5 s

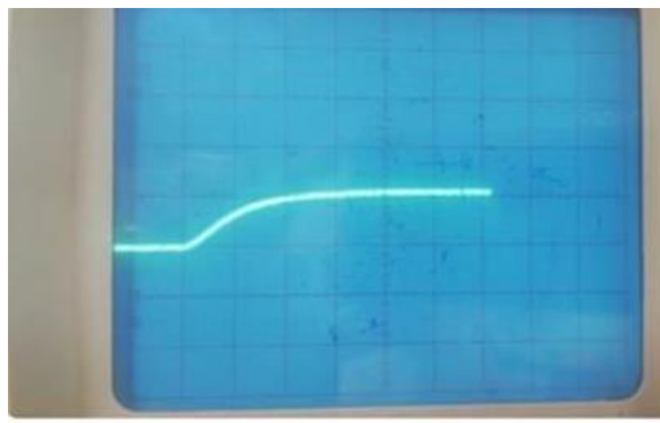


Wn =5 Z=0 ch1 = 2v 0.5 s

Underdamped signal

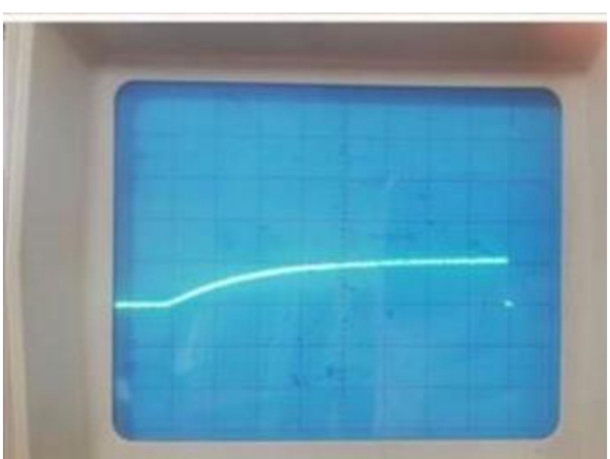
Z=0.3 Wn=10

critical damped signal



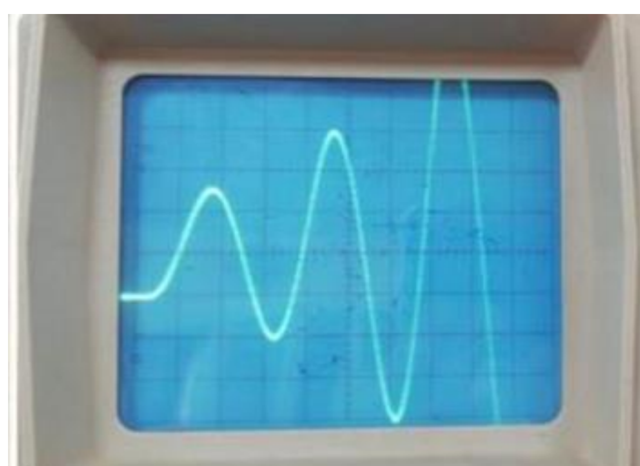
Z=1 Wn=10

overdamped signal



Z=2 Wn=10

Negative damped signal



Z=-0.1 Wn =10

conclusion:

The results of this experiment shows the effect of changing damping factor   in the signals.

Positive damping divided into three types(depend on the value of the damping factor): underdamping ,critical damping , and over damping.

In first the signal will oscillate forever because there is no damping factor =0((undamped)) .

In the second case the signal damped over time ,damping factor=0.3((underdamped))..

In the third case the signal reaches its equilibrium position in the shortest possible time ,damping factor=1((critical damped))… no oscillation

In the 4th case the signal its equilibrium without oscillate (takes time more than the critical factor=2((over damped))… no oscillation

In the 5th case the signal's amplitude increase over the time factor=-0.1((negative damped))… there is oscillation