Date 12/2/2024

Expt. No. 2

Page No. 4

Study of Lissajous Figures

Aim: To study lissajous patterns while varying the phase difference of the waves. and observing their interference on DSO

Apparatus: ~~Arb~~ Function generator with two inputs, DSO (Digital Storage Oscilloscope), BNC cable.

Theory:

1> Function Generator → Electronic test equipment used to generate various waveforms over wide frequency range

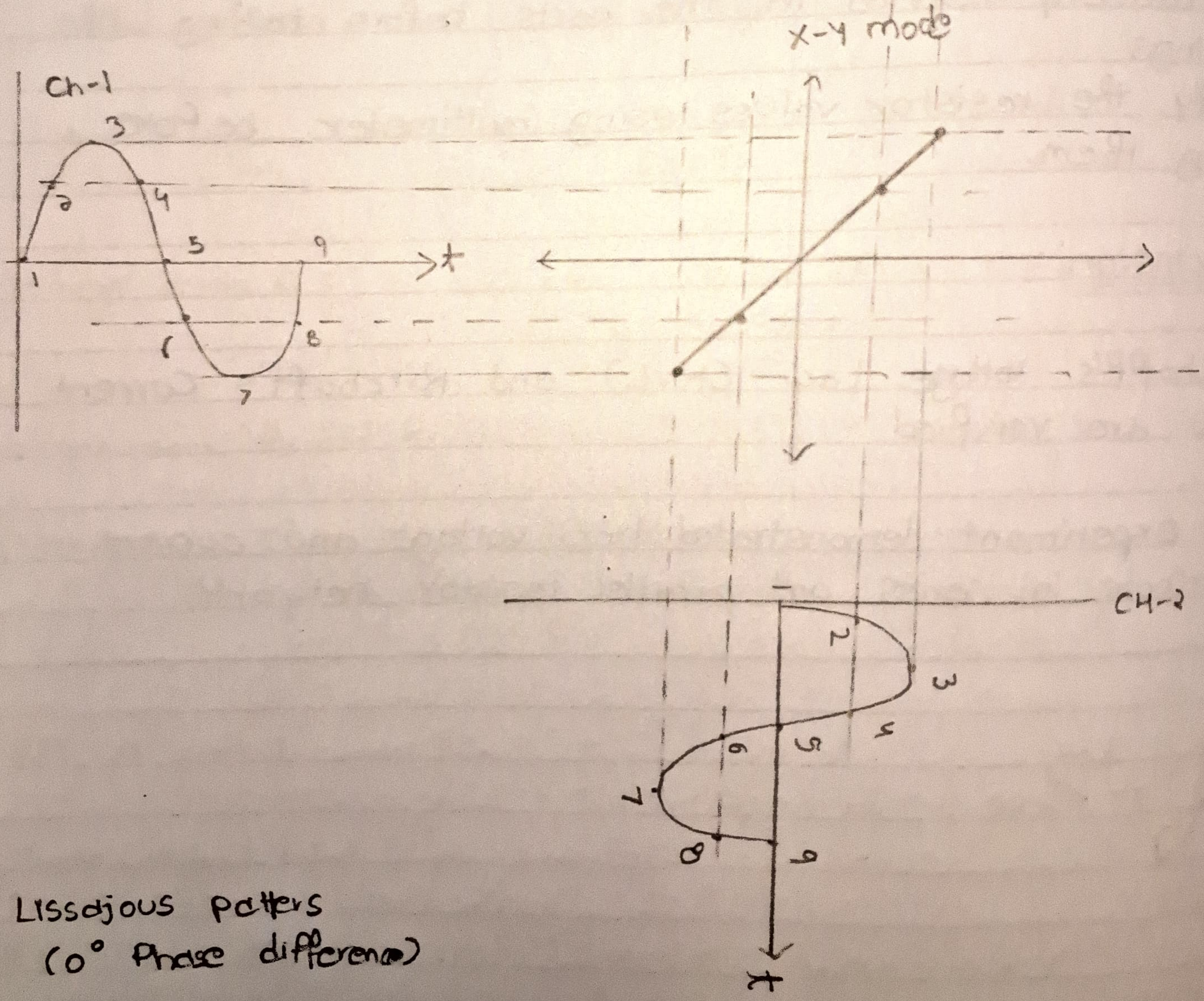
2> Oscilloscope → Used to visualise output signals as they vary over time. There are three types → CRO, DSO and MSO. We are using DSO.

3> BNC (Bayonet Neill - Concelman) Cable → Used to transfer generated function ~~g~~ from function generator to the oscilloscope

Teacher's Signature :

Aim :- To study lissajous patterns while varying the phase difference of the waves and observing their interference on DSO

Apparatus :- Function generator with two outputs, DSO (Digital Storage Oscilloscope), BNC cable



Lissajous patters
(0° Phase difference)

Lissajous Patterns → Lissajous patterns are the figures displayed on Oscilloscope in X - Y made when two perpendicular sinosoidal signals interact. These patterns depend on the frequency ratio and phase difference between signals

$X = A \sin(at + \delta)$
$Y = B \sin(bt)$

→ The a/b ratios decides the appearance of the Lissajous figures

→ The δ determines the rotation angle of the figure

→ The amplitudes determine the slope of figure

Determine frequency : - Draw tangent in x and y dir^n
· Count the no. of cuts

$\frac{f_v}{f_h} =$ $\frac{\text{no. of horizontal tangents}}{\text{no. of vertical tangents}}$

Observation :

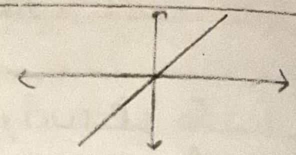
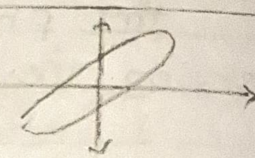
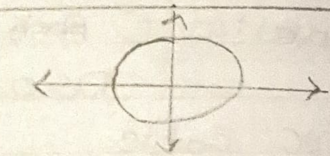
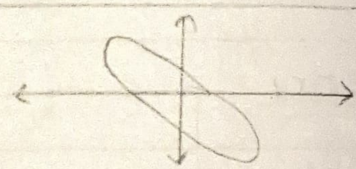
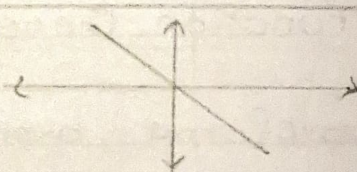
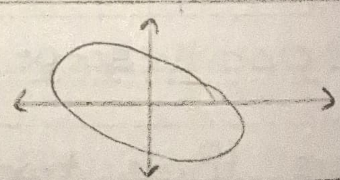
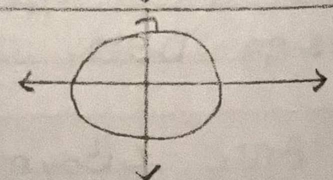
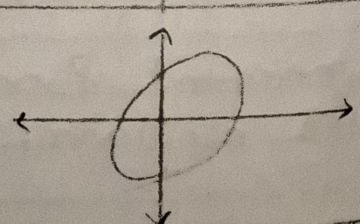
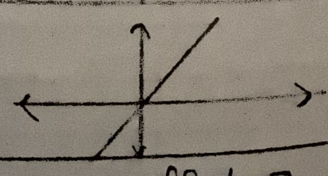
Angle in wave-1	Angle in wave-2	Figure
0°	0°	
45°	0°	
90°	0°	
135°	0°	
180°	0°	
225°	0°	
370°	0°	
315°	0°	
360°	0°	

Table -1 [Phase variation , f → 1:1 (1kHz) , A = 2Vpp , offset = 0

Applications of Lissajous Figures →

i) Phase difference measurement b/w two signals
ii) Frequency determination of one of the source
iii) Signal Testing

Procedure →

1) Connect respective channels of function generator to DSO with BNC cables
2) In the function generator, we will generate 2 sine waves keeping their frequency, phase, amplitude and offset same initially. By this, we will see a straight-line in DSO at 45° to x-axis
3) Now keeping all quantities same, we will vary phase of one channel w.r.t other and how the patterns change in DSO
4) Now vary frequency and observe how the pattern changes. We will vary frequency to different ratios, such as 1:1, 2:1, 3:1 etc

Conclusion →

1) Upon changing frequency ratio and phases, we observe changing patterns.

2) If $x = A \sin(at + \delta)$ and $y = B \sin(bt)$, then ratio a/b gives aspect ratio

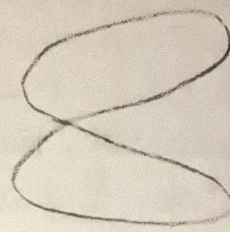
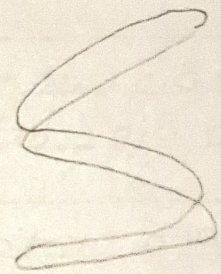
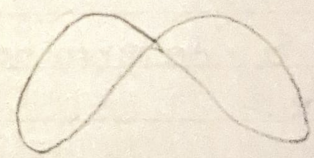
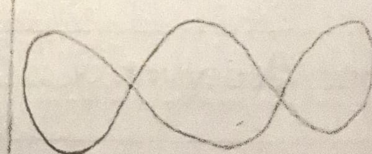
Frequency (wave-1)	Frequency (wave-2)	Figure
2KHz	1KHz	
3KHz	1KHz	
1KHz	2KHz	
1KHz	3KHz	

Table-2

Frequency variation (Phase difference = 0, A = 2Vpp offset = 0 for both waves)

Eg If $(a/b) = 5/4$ → no. of horizontal lobes → 4
no. of vertical lobes → 5

3) Phase shift produces change in shape
Amplitude produces change in slope

Calculations

→ Suppose equations are → $x = A \sin(\omega t + 90^\circ) = A \cos(\omega t)$
$y = A \sin(\omega t)$

Same amplitude and frequency, phase difference of 90°

$\frac{x^2}{A^2} + \frac{y^2}{B^2} = 1$ (using $\sin^2(\omega t) + \cos^2(\omega t) = 1$)

→ $x = A \sin(\omega t)$
$y = A \sin(\omega t)$

→ Same amplitude and frequence
→ No phase difference

$y = x$

Precautions.

1) Ensure proper connectivity of cables

2) Control the offset of the waves