Aug 19, 2020

[U19CS012]

EXPERIMENT No: 01

SPECTRUM ANALYSER AND OBSERVE SPECTRUM

(*) **AIM:** To study Spectrum Analyzer and observe the spectrum of sinusoidal signal and square wave.

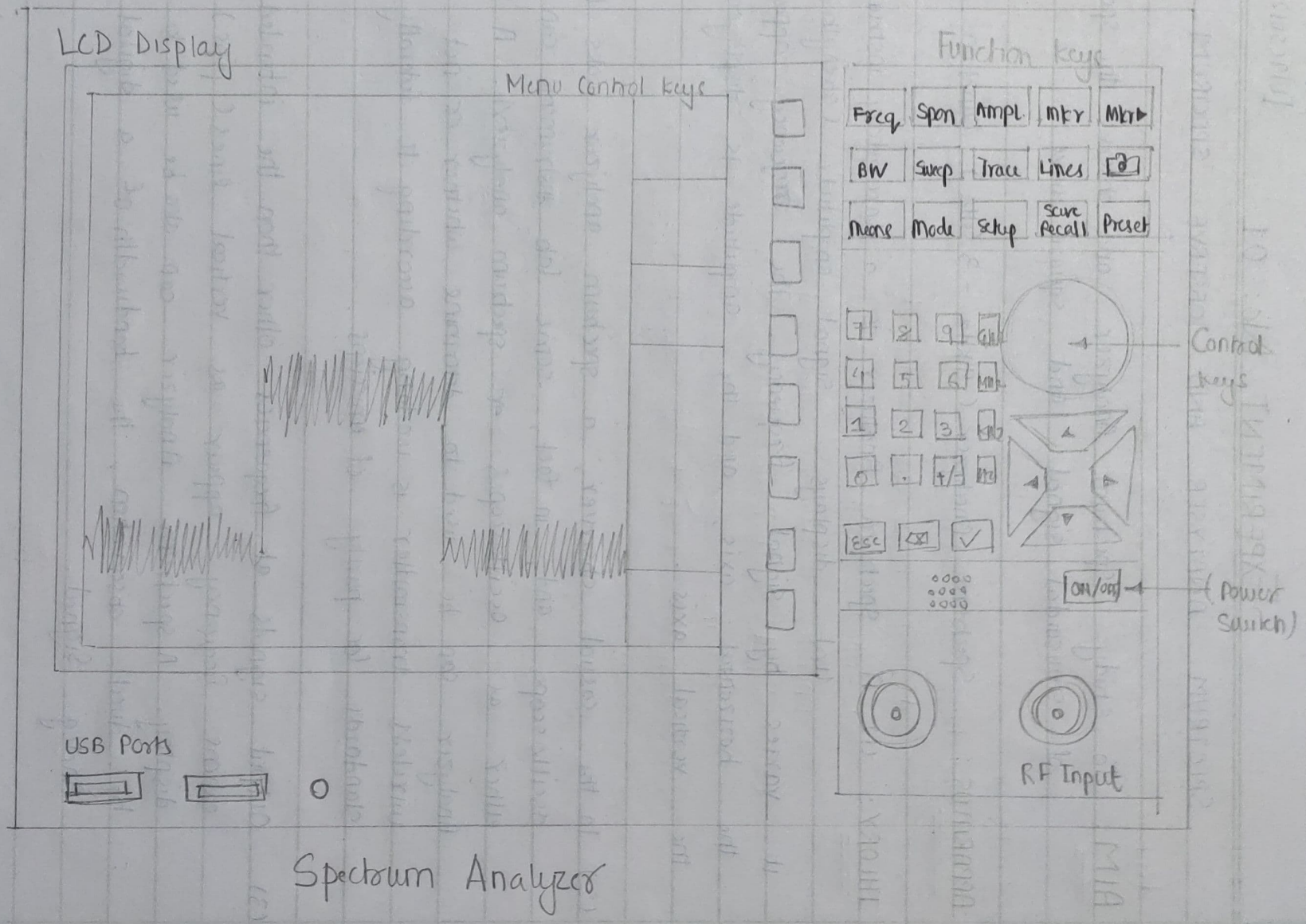
(*) **APPARATUS:** Spectrum Analyzer (9kHz - 3 GHz) Function Generator

(*) **THEORY:** (1) A Spectrum Analyzer is a laboratory instrument that displays signal amplitude (strength) as it varies by signal frequency. The frequency appears on the horizontal axis, and the amplitude is displayed on the vertical axis.

(2) To the casual observer, a spectrum analyzer looks like an oscilloscope and, in fact, some lab instruments can function either as oscilloscopes or spectrum analyzers. A Spectrum Analyzer can be used to determine whether or not a wireless transmitter is working according to federally defined standards for purity of emissions

(3) Output signals at frequencies other than the intended communications frequency appear as vertical lines (pips) on the display. A spectrum Analyzer can also be used to determine, by direct observation, the bandwidth of a digital or Analog Signal.

(4) A spectrum Analyzer interface is a device that can be connected to a wireless receiver or a personal computer to allow visual detection and analysis of electromagnetic signals over a defined band of frequencies.



Spectrum Analyzer

FEATURES OF LAB INSTRUMENT GSP-830 (GWINSTEK):

- ✓ 5 markers with delta marker & peak functions
- ✓ 3 traces
- ✓ Split windows with separate settings
- ✓ 6.4" TFT color LCD, 640 x 480 resolution
- ✓ AC/DC/ battery - multi-mode power operator
- ✓ Autoset
- ✓ 9 kHz - 3 Ghz frequency range

FREQUENCY SELECTION AND THEIR SELECTION METHODS

(1) FREQUENCY:

Frequency/ Span : The frequency key, toghether with span key sets the frequency scale.

View Signal (Center & Span): Center and span method defines the center frequency & the left/ right bandwidth (span) to locate the signal.

Setting Frequency adjustment Step: Frequency adjustment step defines the arrow keys resolution for center, start and stop frequency

Panel Operation:

- ✓ Press frequency key
- ✓ Press F4 (step)
- ✓ Enter the value using numerical and unit keys, arrow keys & scroll nobe.

(2) RANGE: 9 KHz to 3 GHz

(3) Set Center Frequency:

Panel Operation:

- ✓ Press frequency key
- ✓ press F1 (center)
- ✓ Enter the value using numerical and unit keys, arrow keys and scroll nobe.

(4) Set Frequency Span:

Panel operation:

- ✓ Press span key
- ✓ press F1 (span)
- ✓ Enter the value using numerical and unit keys, arrow keys and scroll nobe.

(5) View Signal (Start & Stop)

- ✓ Start and stop method defines the beginning and end of the frequency range.
- ✓ Arrow keys and scroll knobe resolution: 1/10 of span.

(6) Set start frequency

Panel Operation:

- ✓ Press frequency key
- ✓ Press F2 (start)
- ✓ Enter the value using numerical and unit keys, arrow keys and scroll nobe.

(7) Set Stop Frequency:

Panel operation:

- ✓ Press Frequency key
- ✓ press F3 (Stop)
- ✓ Enter the value using numerical and unit keys, arrow keys and scroll nope.

(8) Full or Zero span:

Full or zero span setting set the spans to extreme values : 3 GHz (full) or 0 kHz (zero) - they provide faster ways to view signals in certain signals such as in time domains (0 span) for viewing modulation or in full span for viewing signals with unknown frequencies.

(9) Display full frequency span

Panel operation

- ✓ Press the span key
- ✓ Press F2 (full span)
- ✓ Range : 3 GHz (fixed)
- ✓ Full span also sets these parameters to fixed values
- ✓ Center frequency : 1.5 GHz
- ✓ Start frequency : 0 kHz
- ✓ Stop frequency : 3 GHz

(10) Zero Span Display Panel operations

- ✓ Zero span display can be obtained by pressing F3 Key
- ✓ Start frequency & Stop frequency remains Same as center frequency
- ✓ Note: Last span setting can be recalled by F4 key

AMPLITUDE SELECTION AND SETTING Methods

(1) AMPLITUDE

Amplitude key sets vertical attribute of the display, including the upper limit (reference level), vertical range (amplitude scale) vertical unit and compensation for external gain or loss (external offset)

(2) Set Vertical Scale

Vertical display scale is defined by reference amplitude, amplitude range, measurment unit and external gain/loss.

(3) Set reference amplitude

✓ The reference level defines the amplitude at the top of the displayed range.

Panel operations:

✓ Press amplitude key
✓ Press F1 (reference level)
✓ Enter the value using numerical and unit keys, arrow keys and scroll knob.

Arrow keys, and scroll knob, scroll knob resolution: vertical scale.

Range:

dBm: -110 to +20 dBm, 0.1 dBm resolution
dBmV: -63.1 to 66.99 dBmV, 0.01 dB resolution
dBμV: -3.01 to 126.99 dBμV, 0.01 dB resolution.

(4) Select amplitude Scale

> Panel operation:

Press Amplitude key
Press F2 (Scale dB/DIV)
Repeatedly to select the scale

> Range: 10, 5, 2, 1 dB/DIV

> Panel operation:

Press Amplitude key
Press F3 (Units)
Select and press the unit from F1 (dBm), F2 (dBmV) and F3 (dBμV)
Press F6 (return) to go back to previous menu.
dBm = -110 to +20 dBm, 0.1 dBm resolution
dBmV = -63.1 to 66.99 dBmV, 0.01 dB resolution
dBμV = -3.01 to 126.99 dBμV, 0.01 dB resolution
Set external offset level

(5) Background

External offset compensates the amplitude gain or loss caused by an external network or devices.

Panel operations:

1. Press Amplitude key
2. Press F4 (external gain)
3. Enter the value using numerical and unit keys, arrow keys and scroll knob.

Range:

-20 dB to +20 dB, 0.1 dB resolution

ICON:

-> The amplitude icon appears at the bottom of the display when the external offset changes.
-> To check whether Spectrum analyzer working properly
-> Generate Auxilary signal: Press system key, press auxilary signal, select an option from side given menu, following signal will generate. It generate 10 MHz signal with 10 dB amplitude.

Observation Table: Next Pages →

Spectrum Diagrams (waveforms)

(*) Conclusion: Hence, we have successfully verified and analysed the spectrum of sinusoidal signal and square wave for different frequency and amplitude.

Observation Table

Waveform : SINE

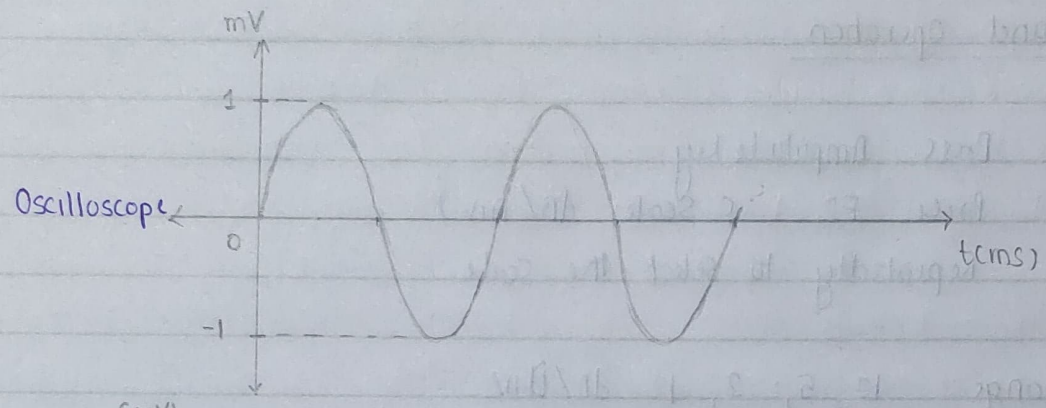
Sr. No.	Frequency (KHz)	Amplitude (mV)
1	10	1
2	15	1
3	15	2
4	12.5	2
5	12.5	0.5

Waveform : SQUARE

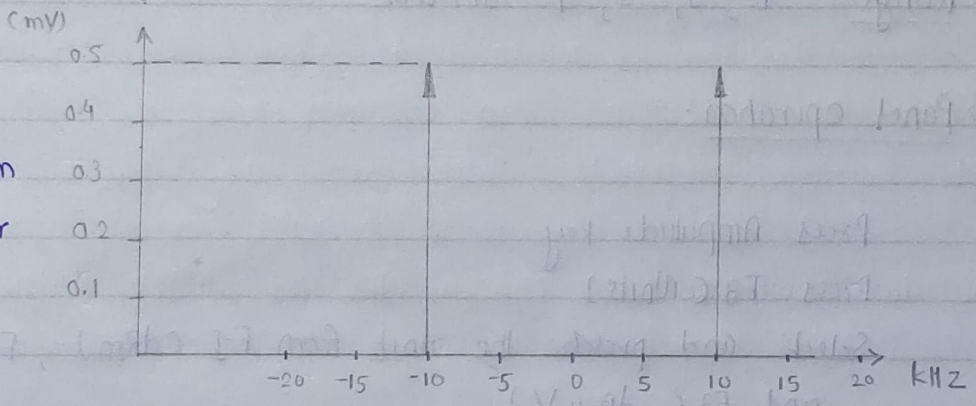
Sr. No.	Frequency (KHz)	Amplitude (mV)
1.	10	1
2.	5	1
3	10	2
4	12.5	1
5	12.5	2

SINE WAVE

1.> A = 1 mV f = 10 KHz

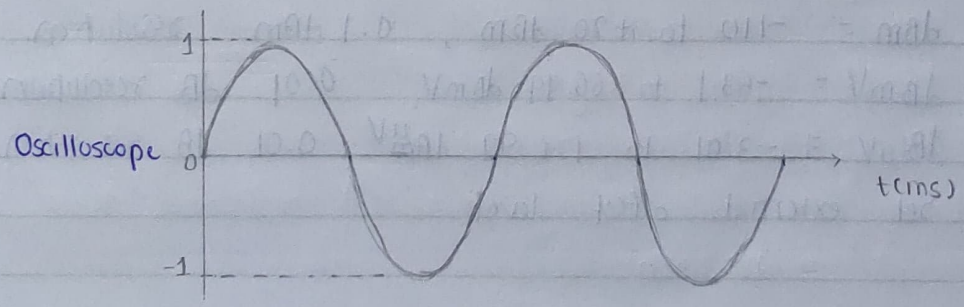


Oscilloscope

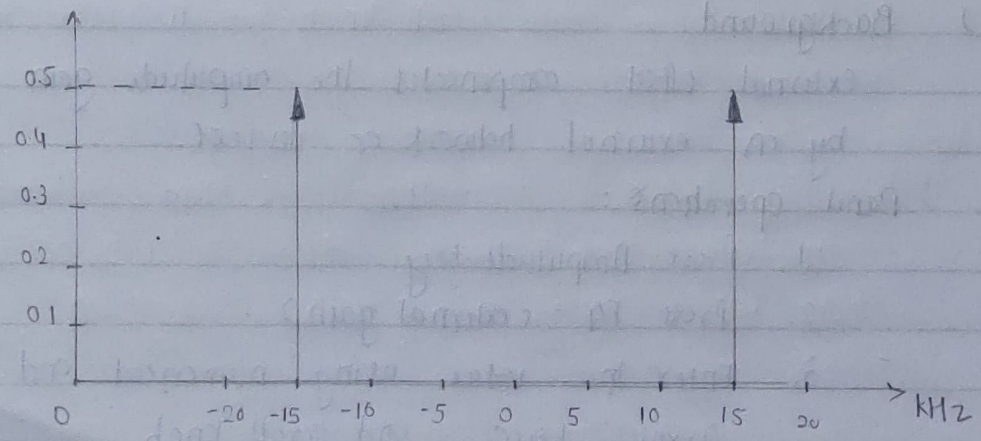


Spectrum Analyzer

2.> A = 1 mV f = 15 KHz

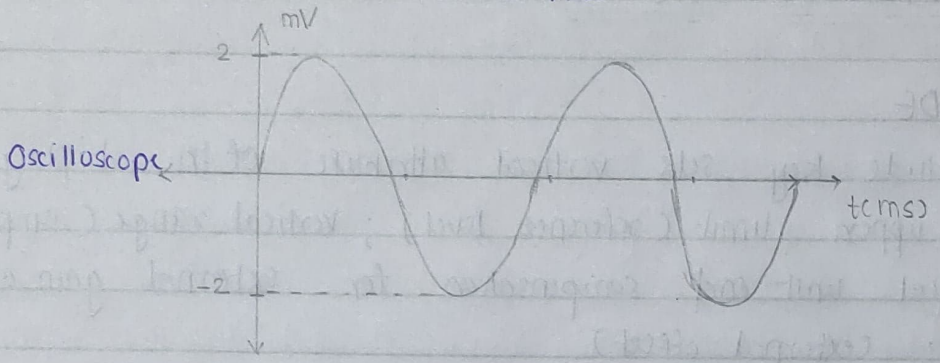


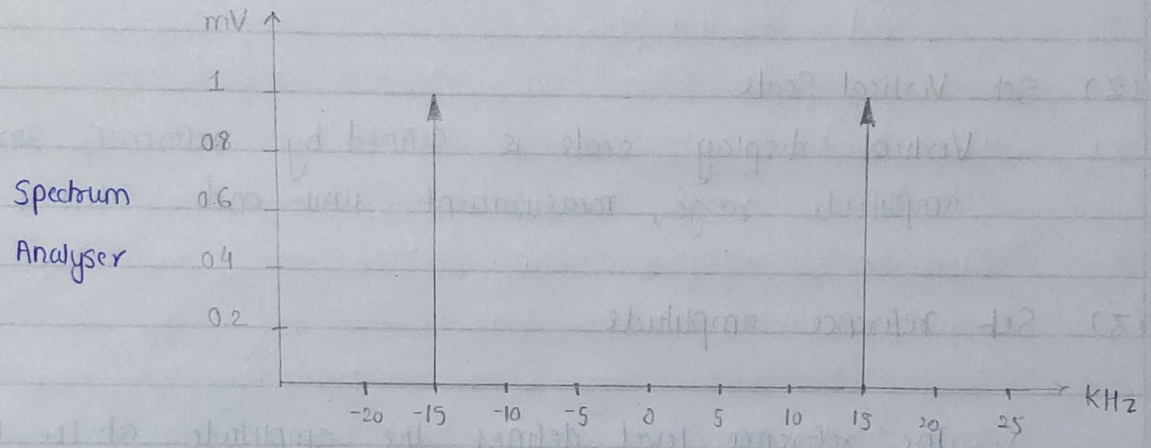
Oscilloscope



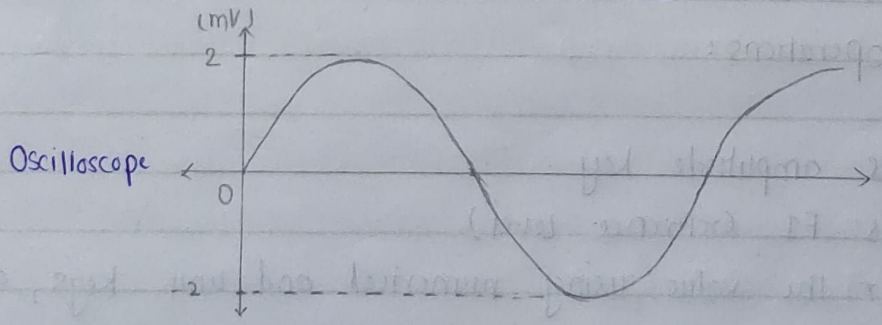
Spectrum Analyser

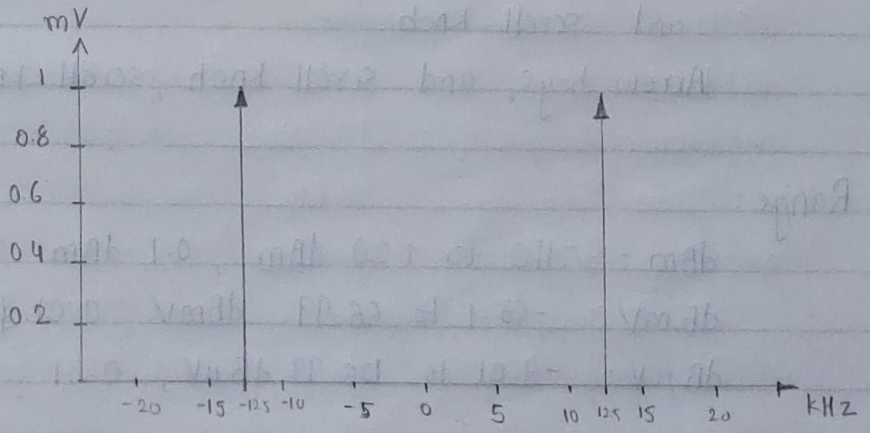
3.> A = 2 mV f = 15 KHz





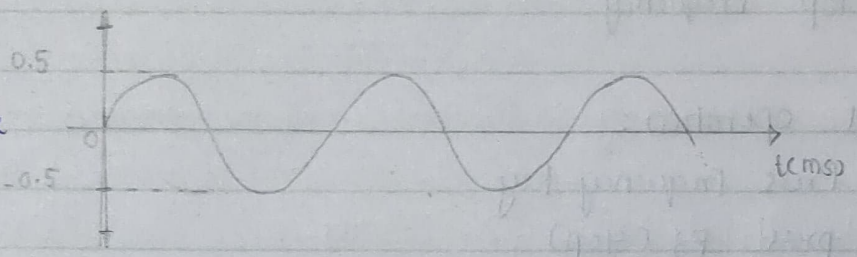
4.> A = 2 mV f = 12.5 KHz



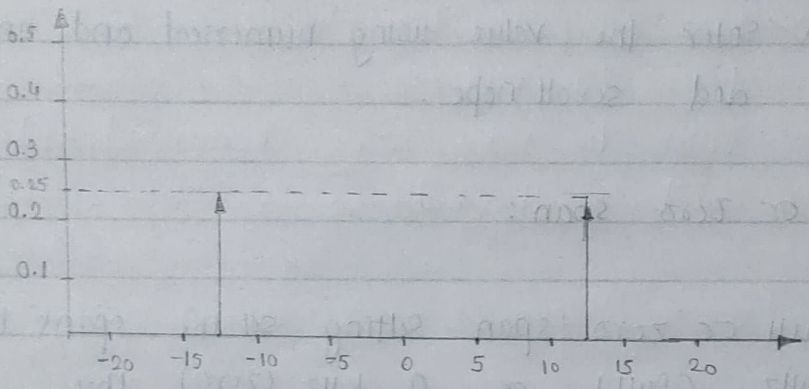


5.) A = 0.5 mV f = 12.5 kHz

Oscilloscope

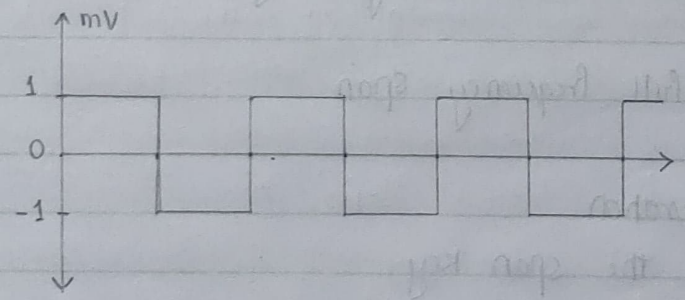


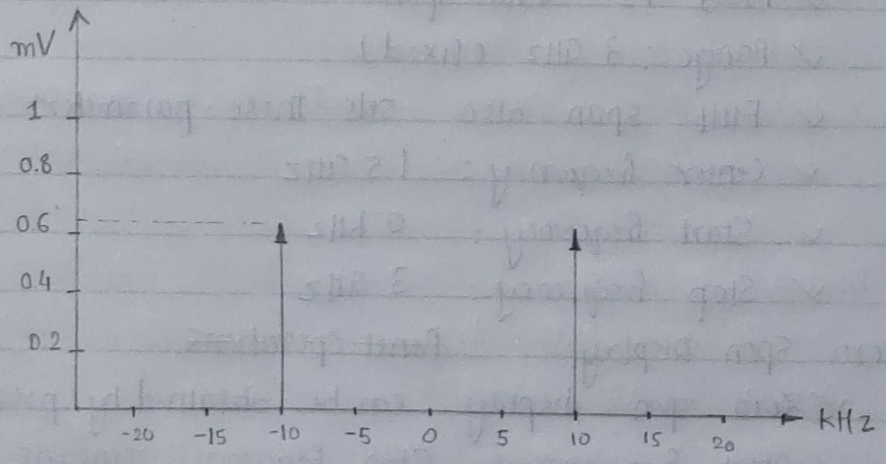
Spectrum Analyser



SQUARE WAVE

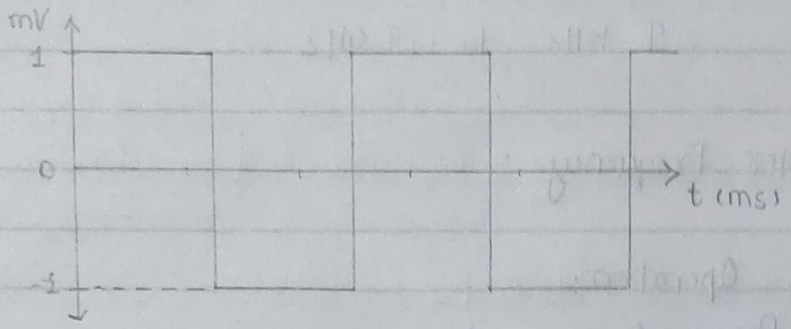
1.) A = 1 mV f = 10 kHz



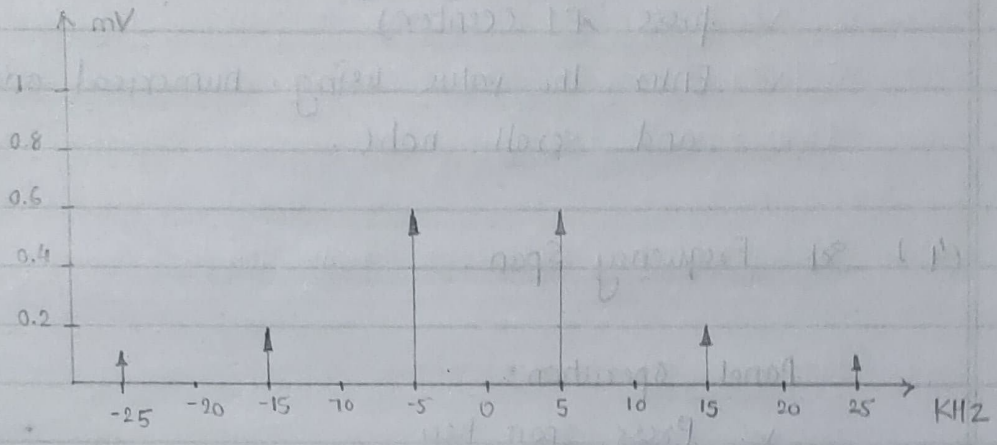


2.) A = 1 mV f = 5 kHz

Oscilloscope

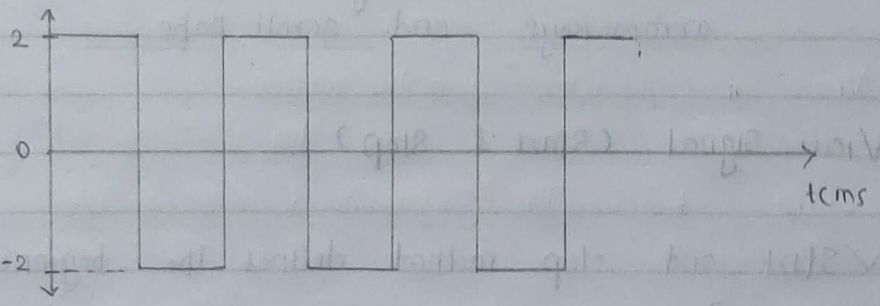


Spectrum Analyser

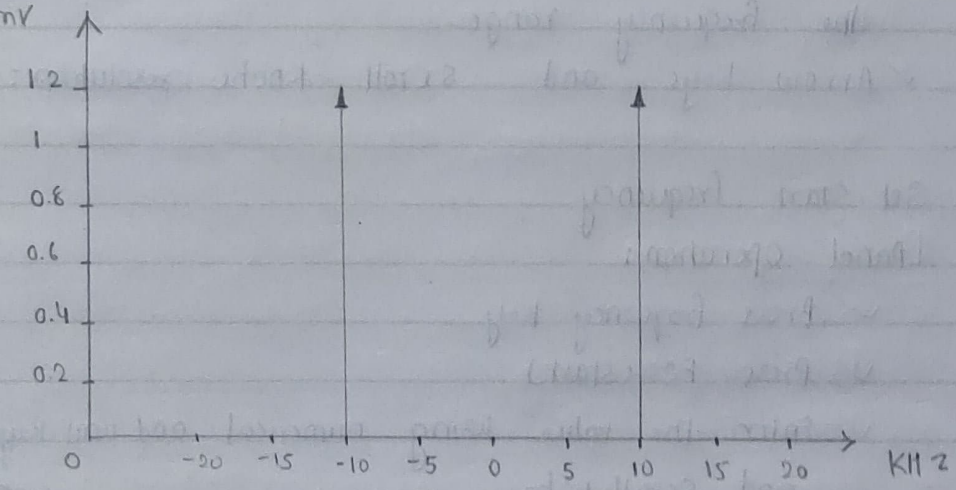


3.) A = 2 mV f = 10 kHz

Oscilloscope



Spectrum Analyser



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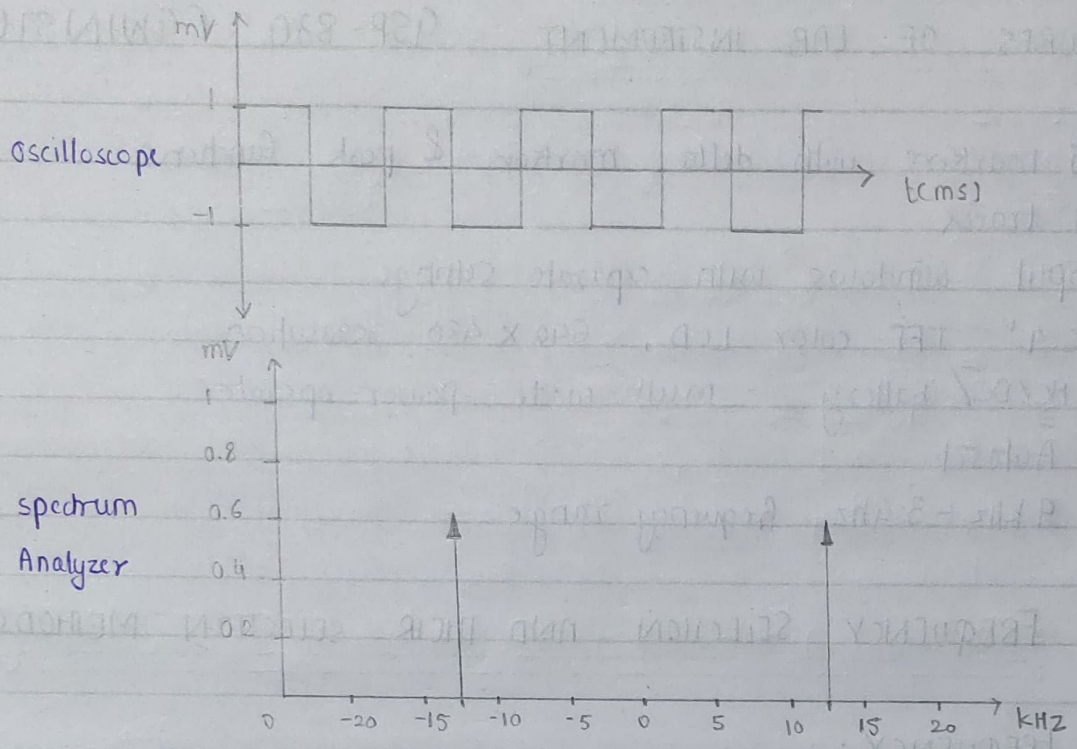
4.) A = 1mV f = 12.5 kHz



5.) A = 2mV f = 12.5 kHz