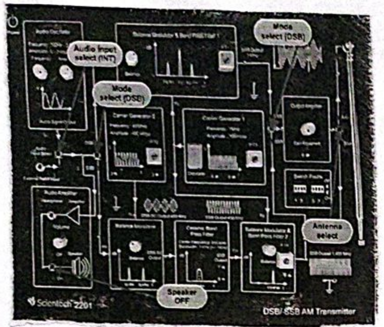
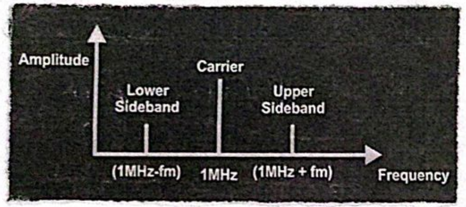
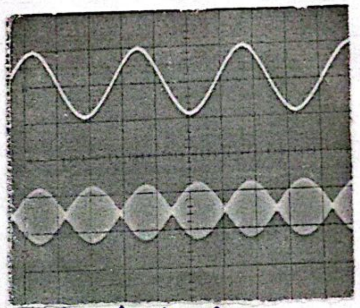


DSB/SSB Transmitter



Amp-Freq Graph



Carrier Signal
under modulated signal

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Page No. 1

EXPERIMENT-1

Objective - To study the function of Amplitude modulation & Demodulation & also calculate modulation index efficiency.

Equipment- Scientech 2201 module, CRO, function generator, connecting cords.

Procedure: This experiment investigates generation of double sideband amplitude modulated (Am) waveforms using scientech 2201 module. By removing carrier from such Am waveforms, generation of double sideband supressed carrier (DSSC) Am is also investigated.

Ensure that following initial conditions exist on board.
Audio i/p select switch should be in INT position to select onboard generated audio signal as modulating signal.
Mode switch in DSB position to connect DSB signal to o/p amplifier section.
o/p amplifiers gain potentiometer in full clockwise position for max amplification.
Speakers switch in off position.

Turn on power to scientech.

Observe o/p of 'Audio Oscilator' block at 'Audio Signal o/p' test point on oscilloscope. Amplitude & frequence of this audio signal can be varied using respective

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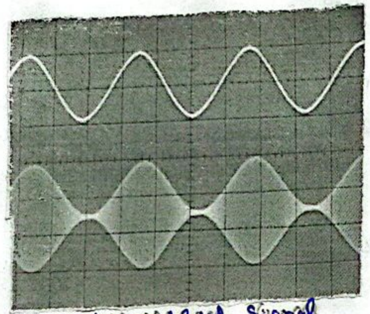
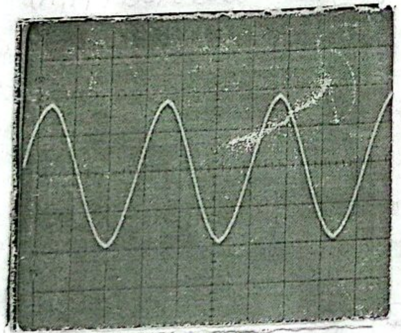
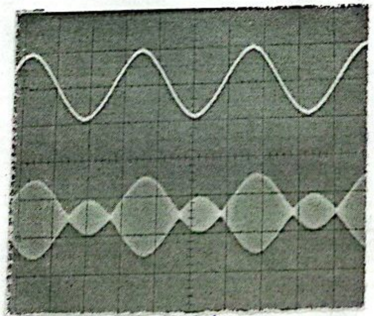


Under modulated Signal
Critical Signal



Message Signal



Over - modulated Signal

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amplitude & frequency control pots. The amplitude varies from 0-2vpp approx & frequency varies from 300 Hz - 3kHz.

) 1MHz crystal oscillator block generates sine wave of 1MHz frequency & 120 mv pp amplitude appox. which is used as carrier i/p to balance modulator & band pass filter circuit. Observe carrier waveform at o/p test point on oscilloscope.

Balanced modulator & band pass filter circuit 1 use to perform 'Double side band Amplitude modulation'. Balance pot is used to vary depth of modulation AM waveform. Initially turn pot to its max position & observe DSB AM o/p on oscilloscope together with modulating audio signal o/p 1 at trigger the oscilloscope on audio signal o/p.

o/p from balanced modulator & band pass filter circuit block is double sideband.

Percentage modulation $= \frac{V_{max} - V_{min}}{V_{max} + V_{min}} \times 100\%$.

Modulation factor $\Rightarrow m = \frac{V_{max} - V_{min}}{V_{max} + V_{min}}$

Efficiency, $\eta = \frac{m^2}{2 + m^2}$

Teacher's Signature ______

Observation Table

Type of Modulation	Vmax	Vmin
under	8 V	2.5 V
Critical	6 V	0 V
Over	30 V	- 50 V

① for under modulation: $m = \frac{V_m}{V_c} = \frac{E_{max} - E_{min}}{E_{max} + E_{min}} = \frac{8 - 2.5}{8 + 2.5}$

$m = 0.52$

$\eta = \frac{m^2}{2+m^2} = \frac{0.2704}{2.2704} = 0.119$

② for critical modulation: $m = 6/6 = 1$

$\eta = \frac{m^2}{m^2+2} = \frac{1}{3} = 0.333$

③ for over modulation: $m = \frac{E_{max} - E_{min}}{E_{max} + E_{min}} = \frac{300 - (-50)}{300 + (-50)}$

$m = 1.4$

$\eta = \frac{m^2}{2+m^2} = \frac{1.96}{3.96} = 0.494$

Result - In under modulation, the modulation index is 0.52 and efficiency is 0.119

for critical modulation, the modulation index is 1 & efficiency is 0.333.

for over modulation, the modulation index is 1.36 and efficiency is 0.474.

Applications - Tele Communication
TV transmitters.

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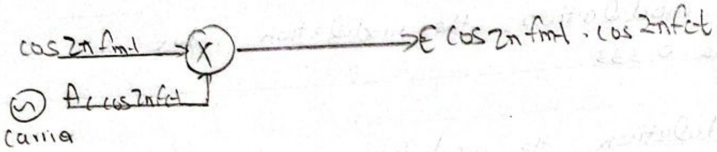
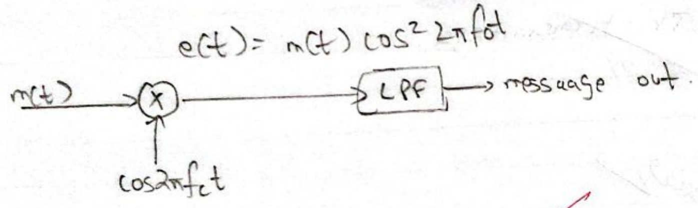
DSB-SC modulation:



DSB-SC Demodulation:



EXPERIMENT - 2

Aim - To demonstrate DSB-SC modulation and demodulation.

Apparatus Required - Modulation & demodulation trainer kit, CRO, function generator, connecting cords.

Theory - DSB-SC modulation stands for double sideband suppressed carrier modulation. It is a type of modulation where the carrier signal is suppressed and only side bands containing the information are transmitted. The modulated signal is represented as $s(t) = m(t) \cdot \cos(2\pi f_c t)$

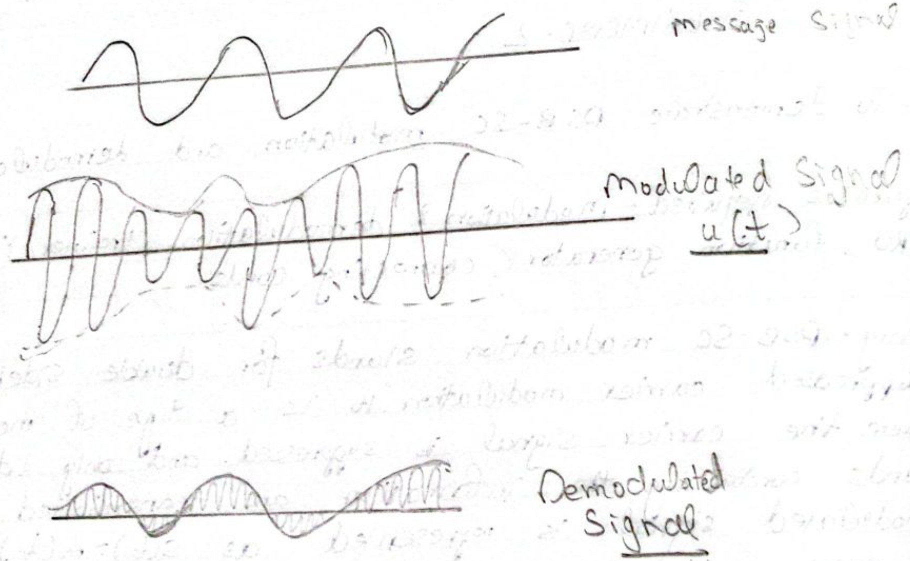
where $m(t) \rightarrow$ message signal

$f_c \rightarrow$ carrier frequency.

The demodulation process involves multiplying received signal with a carrier signal of same frequency & phase as used in modulation. The demodulated output is filtered using low pass filter to recover original signal.

Procedure -

- Connect the signal generator to DSB-SC modulator
- Connect the output of modulator to osilloscope to get signal.
- Set signal generator to produce a carrier signal with desired frequency.
- Generate sinusoidal message signal, m(t) with lower frequency than the carrier signal.



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5. Observe the output of modulator on oscilloscope to confirm presence of DSB-SC modulated waveform with supressed carrier.
6. Connect modulated output to DSB-SC demodulator circuit.
7. Apply same carrier frequency, f_c to demodulator for coherent detection.
8. Pass demodulated signal through low pass filter to recover the message signal.
9. Observe & compare signal with the original message signal.

Result - We have succesfully demonstrated the process of DSB-SC modulation & demodulation.

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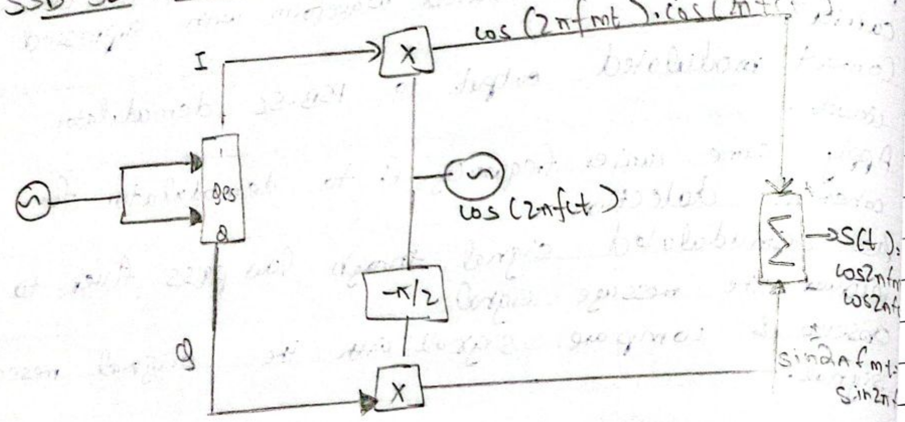
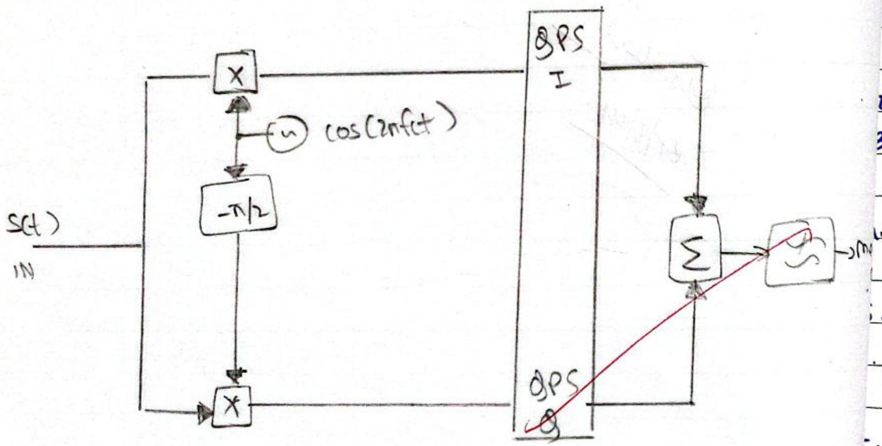
SSB-SC Modulation:



SSB-SC demodulation:



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Experiment 3

Aim - To demonstrate SSB-SC modulation and demodulation

Apparatus Required - Modulation & demodulation trainer kit, CRO, function generator, connecting cords.

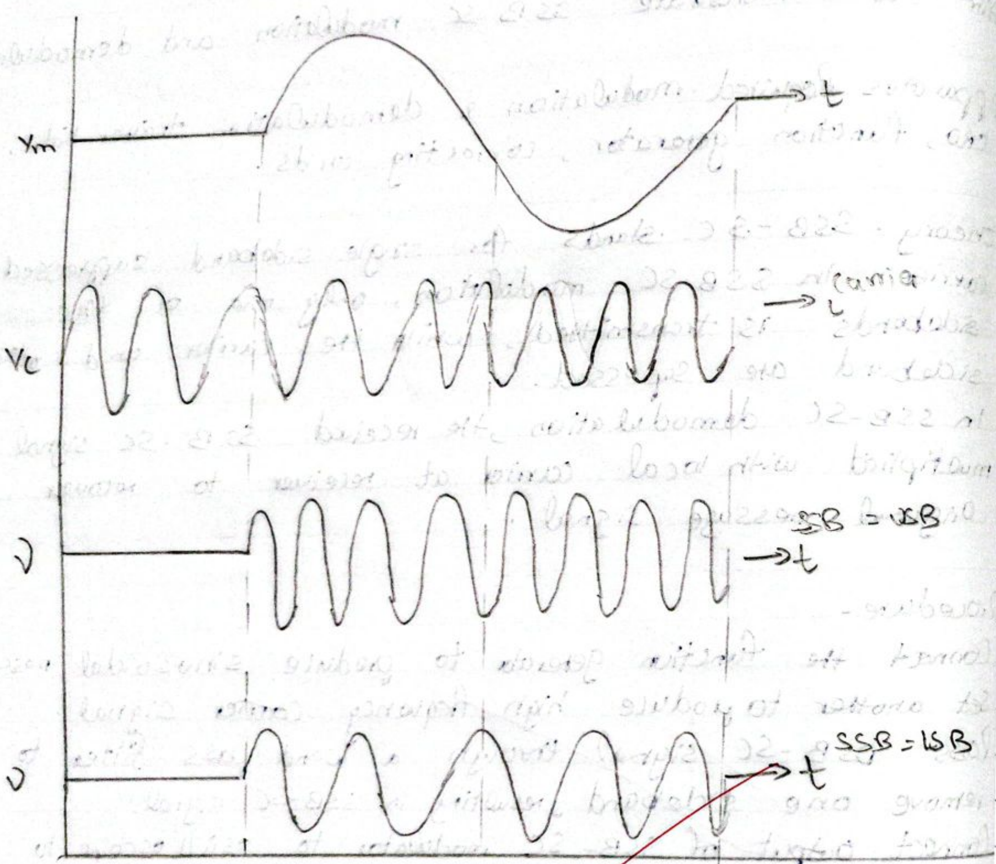
Theory - SSB-SC stands for single sideband suppressed carrier. In SSB-SC modulation, only one of the sidebands is transmitted, while the carrier and other sideband are supressed.
In SSB-SC demodulation, the received SSB-SC signal is multiplied with local carrier at receiver to recover original message signal.

Procedure -

1. Connect the function generator to produce sinusoidal message.
2. Set another to produce high frequency carrier signal.
3. Pass DSB-SC signal through a band pass filter to remove one sideband, resulting in SSB-SC signal.
4. Connect output of SSB-SC modulator to osilloscope to observe modulated waveform.
5. Connect SSB-SC signal output to demodulator circuit.
6. Ensure synchronization of local oscillator with carrier frequency.
7. Adjust carrier frequency & ensure proper synchronization for a clear modulated signal.
8. Record characteristics of modulated & demodulated signals.

Teacher's Signature ____________

* SSB-SC Graph

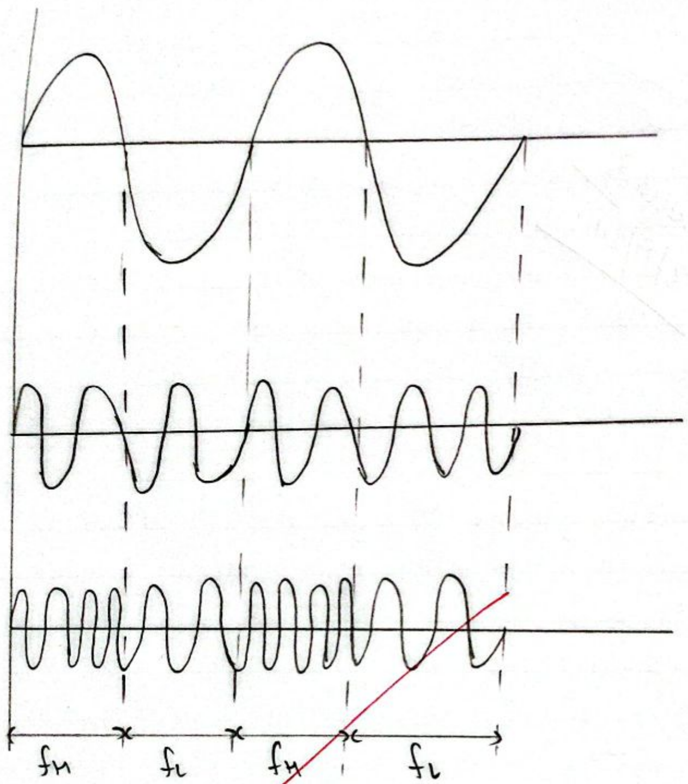


Result - we have succesfully learned to demonstrate the process of SSB-SC modulation & demodulation.

Applications - Telecommunications systems, two-way radios, high frequency, voice and data transmissions etc.

3/9/24.

Frequency Modulation:



modulation Index: $\beta = \frac{\Delta f}{\Delta m}$

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EXPERIMENT-4

Aim- To study frequency modulation and demodulation and calculate modulation index

Equipments Required- Scientech oscilloscope with connecting probes.

Theory- Frequency modulation is a method of encoding information in a carrier wave by varying its frequency. The amplitude remains constant, while frequency changes according to instantaneous amplitude of modulating signal.

The modulation index in FM is defined as the ratio of the frequency deviation (Δf) to the frequency of modulating signal (f_m)

$$\beta = \frac{\Delta f}{f_m}$$

Procedure.

1. Generate carrier signal using signal generator at fixed frequency f_c.
2. Obtain modulating signal $m(t)$, which is information signal that is transmitted.
3. Use frequency modulator signal circuit to combine modulating signal with carrier signal $c(t)$.
4. Measure maximum frequency deviation Δf using frequency counter.
5. Measure frequency of modulating signal f_m.
6. Use formula $\rightarrow \beta = \frac{\Delta f}{f_m}$.

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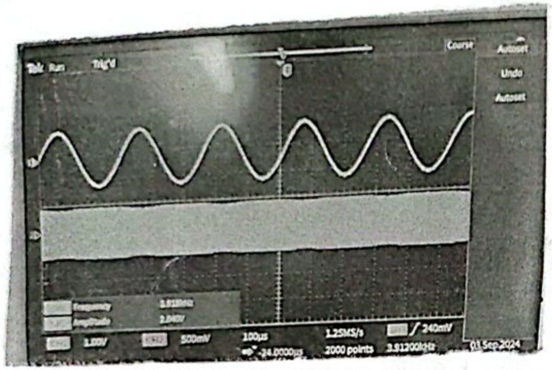

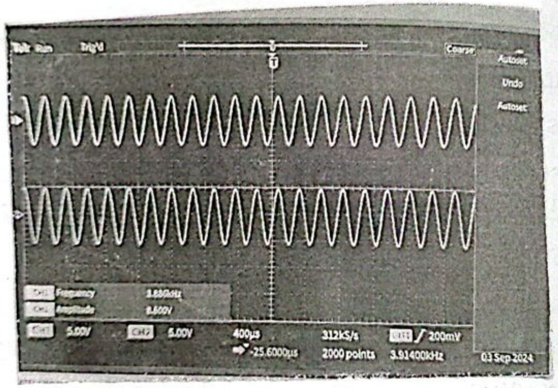

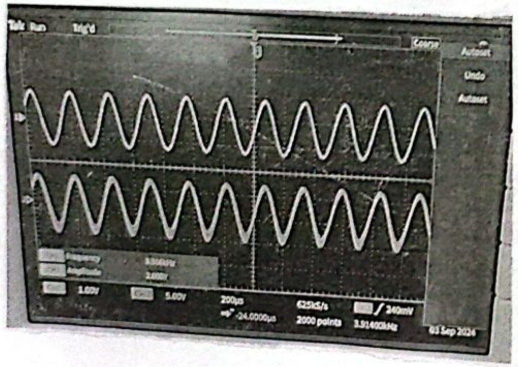

Expt. No. ______ Date ______

7. For demodulation, pass frequency signal through demodulator circuit.
8. The demodulator extracts original modulating signal m(t) from frequency-modulated signal.
9. Obser signal on oscilloscope to confirm it matches original signal.

Result - Succesfully learned how to study frequency modulation and demodulation. The modulation index is 5.

Applications - Radio broadcasting, television sound transmission, wireless microphones, telemetry systems.

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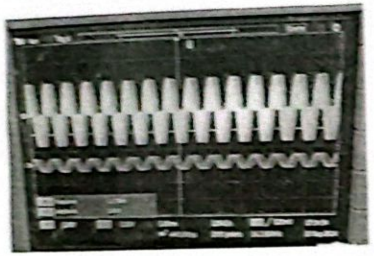
Teacher's Signature ______

Sample output / low pass filter second order



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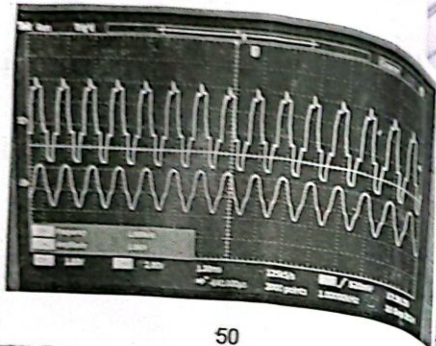

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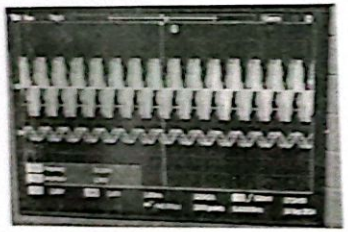

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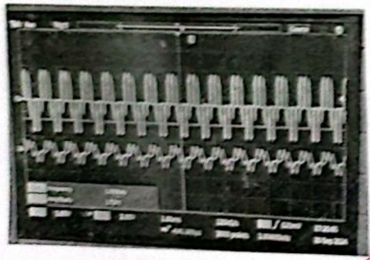

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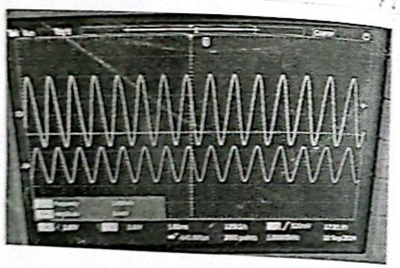
Sample hold output / low pass filter second order



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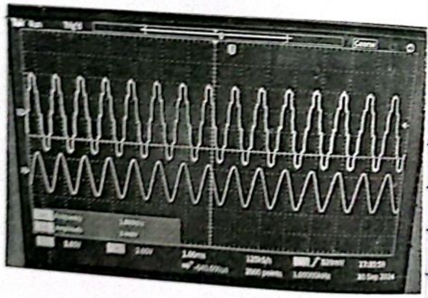

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Topic.........

Date 10/9/24

EXPERIMENT NO. - 5

AIM - Study of sampling process and signal reconstruction by familiarisation with oscilloscope and function generator.

EQUIPMENT REQUIRED - ST 2151 techbook with power cords, CRO with oscilloscope probe, connecting cords.

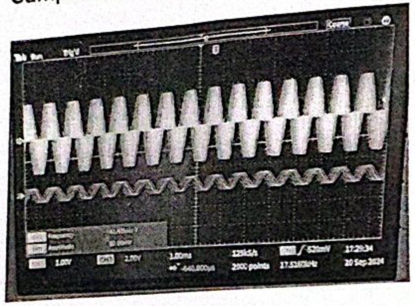
THEORY - Sampling is the process of converting a continous time signal into a discrete time signal by taking samples at uniform intervals. According to Nyquist Shannon sampling theorm, to accurately represent a signal, the sampling rate must be atleast twice the highest frequency component of the signal. i.e Nyquist Rate : $\omega_s \geq 2\omega_m$.

Reconstruction is the process of converting the discrete samples back into continous signal. This is done using low-pass filter, known as recontruction filter, to remove high frequency components introduced by sampling.

PROCEDURE -

1. Connect the power cord to the techbook. Keep the power switch in 'OFF' position.
2. Connect 1 KHz sine wave to signal input.
3. Connect BNC connector to the CRO and techbooks output port.
4. Connect sample output to forth order low pass filter input and sample and hold output to second order low pass filter input and observe the output.

Sample output / low pass filter 4th order



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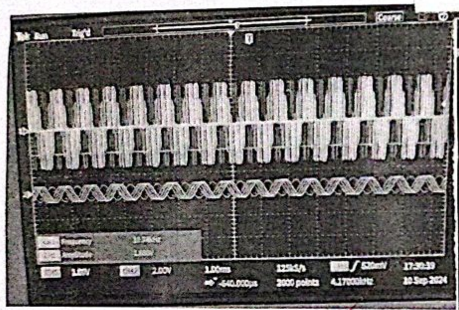

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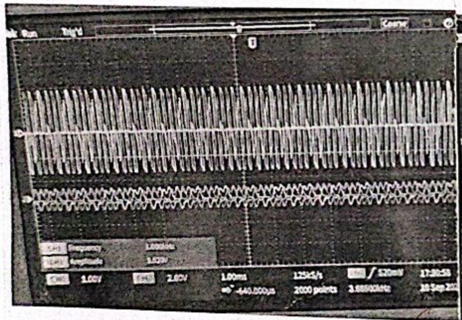

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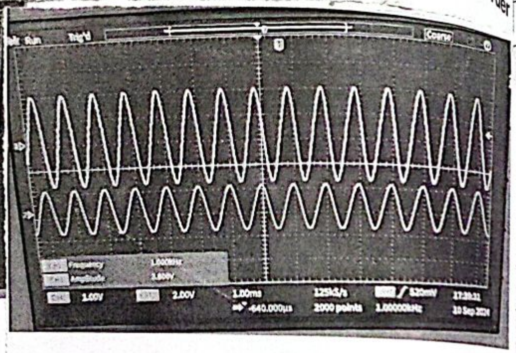
Sample hold output / low pass filter 4th order



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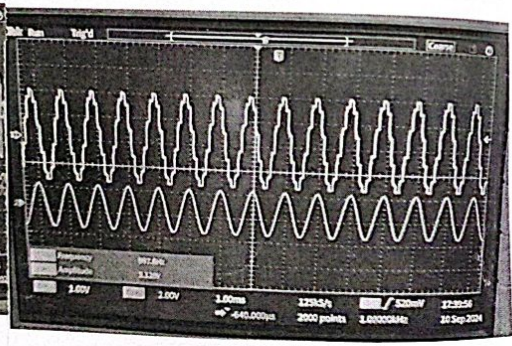

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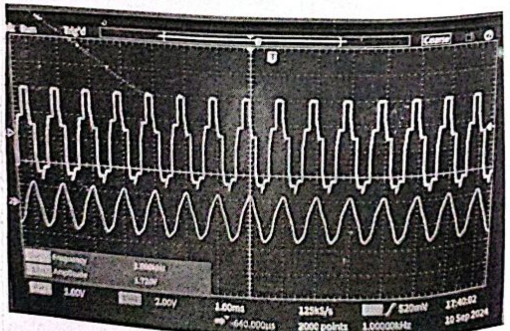

Topic...

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5. By pressing sampling frequency selector switch, change the sampling frequency from 400 kHz, 200 kHz, 100 kHz upto 20 kHz. Observe the sample output and hold output changes in each case.

6. Also observe output of second order low pass filter and fourth order low pass filter.

Result :

The lower sampling frequencies introduce distortion into the filter output waveform. This is due to fact that filter does not alternate the unwanted next frequency component.

Applications :

Digital Audio, Image sampling, Analog to Digital conversions (ADC), Error Detection and correction etc.

5/11/24.

Topic...Date. 7

EXPERIMENT - 6

Aim - Study the analog to digital conversion of sinusoidal signal to analog signal.

Equipments Required - ST 2601 with power supply chord & connecting cords.

Theory - Analog to digital conversion is the process of converting continous analog signals into discrete signals that can be processed by digital systems, such as computer or micro-controllers. Digital to analog conversion is the reverse process, where the digital signal is converted back into a continous analog signal.

Procedure -

1. Connect power supply to techbook.
2. Make connections in which connect DC supply to Vi of converter.
3. Keep DC potentiometer in counter clockwise position.
4. ~~Ke~~ Switch on power supply.
5. Keep DC potentiometer at mid-position.
6. To start the conversion, place the switch in cont position. The LEDs lit according to binary sequence when signal from D/A goes over input, the counter stops & LEDs show binary conversion.
7. Vary the DC potentiometer & observe corresponding digital output.
8. Without resetting the converter in upward stream because, counter is configured as UP counter only, but to observe the converted output when input is

Teacher's Sign ....

Observations -

Binary Inputs	Analog to Digital Output	Digital to Analog
0001	114.5	-2.491
0010	0.466	-1.254
0011	0.819	-3.754
0100	1.128	-0.623
0101	1.452	-3.122
0110	1.786	-1.885
1000	2.187	-0.438
1001	2.528	-308.8
1010	2.907	-2.807
1011	3.23	-1.575
1100	3.70	-0.406
1101	3.952	-0.993
1110	4.38	-03.432
1111	4.70	-2.202
	5.06	-0.409

being decreases.

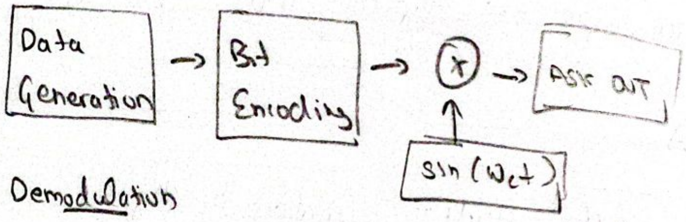
7 Observe oscilloscope the typical steps signal at D/A output.

8 Repeat test.

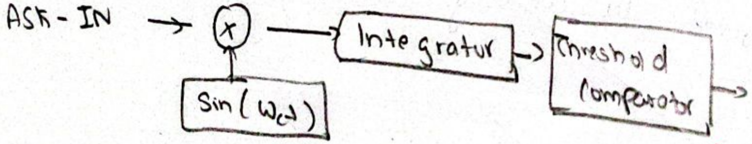
Result - Succesfully studies analog to digital and digital to analog conversion of sinusoidal signal.

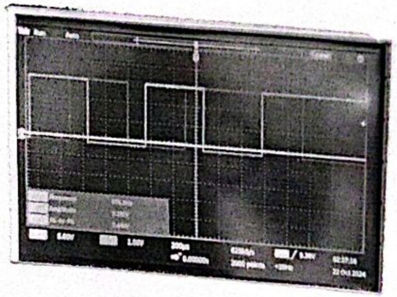
8/11/24

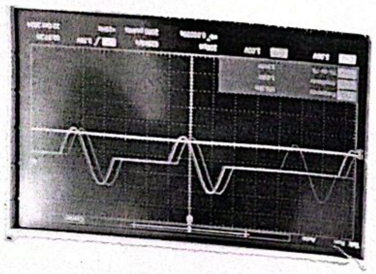
ASK Modulation

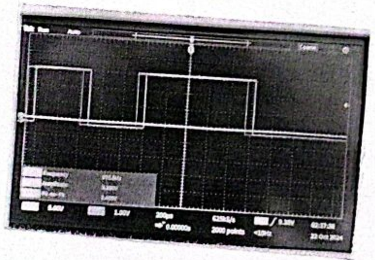


ASK Demodulation









Topic...Date...........................

EXPERIMENT No.-7

Aim- To study the generation & detection (modulation and demodulation) of Amplitude Shift Keying (ASK)

Equipment Required:
- ASK modulation and demodulator kit
- Digital storage oscilloscope
- Connecting wires

Theory:

The binary ASK system was one of the earliest form of digital modulation used in wireless telegraphy.
In a binary ASK system binary symbol 1 is represented by transmitting a sinusoid carrier wave of fixed amplitude. AC & fixed frequency for the bit duration T_b whereas binary symbol 0 is represented by switching of the carrier for T_b sec. This signal can be generated simply by turning the carrier of oscillator ON & OFF.

Procedure:

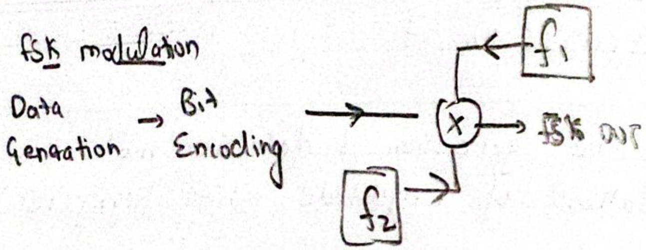
1. The connections are given as per the block diagram.
2. Connect the power supply in proper polarity.
3. Set the amplitude & frequency of the carrier wave.
4. Set the message data bit.
5. Observe the waveform at message data, carrier signal, ASK modulator o/p & ASK demodulator o/p.
6. Plot on graph paper.

Result: Binary ASK modulation & demodulation are verified in the hardware kit and its waveforms are studied.

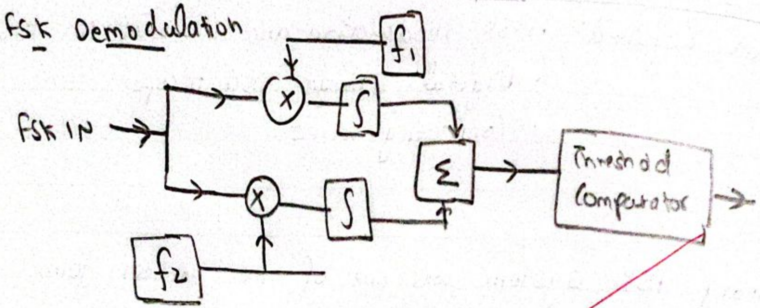
7/11/24

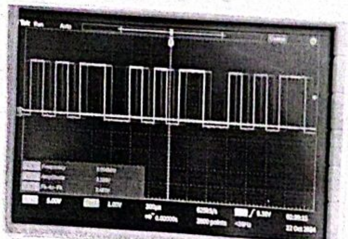
Teacher's Sign ....

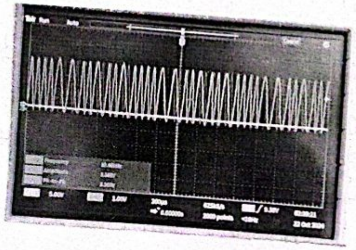
fsk modulation

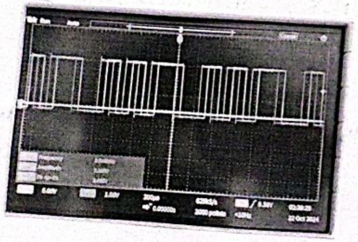


fsk Demodulation









EXPERIMENT NO. 8

Aim - To study the modulation & demodulation of frequency shift key (fsk)

Equipment Required - • fsk modulation & demodulation kit
• Digital Storage oscilloscope
• Connecting wires

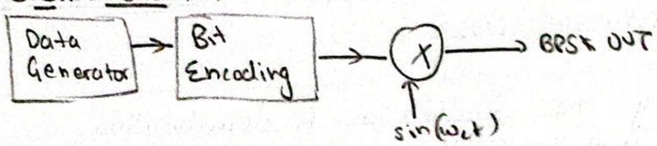
Theory - fsk signalling schemes find a wide range of applications in low speed digital data transmission system. fsk schemes are not as efficient as psk schemes in terms of power & bandwidth. In binary fsk signalling the waveforms are used to convey binary digits 0 & 1 resp. The binary fsk waveform is a continous, phase constant envelope fm waveform.

Procedure -
1. The connections are given as per block diagram.
2. Connect the power supply in proper polarity to the kit
3. Set the amplitude of sine wave as desired
4. Observe the waveforms at clock, sin1 & 2, modulation o/p, fsk o/p.
5. Plot it.

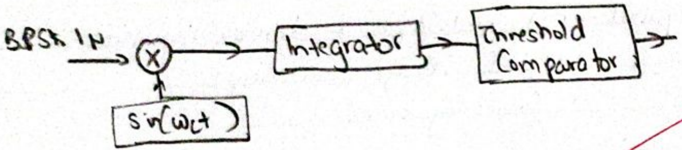
Result - Bfsk (Binary frequency shift keying) modulation & demodulation are verified in hardware kit and its waveform are studied.

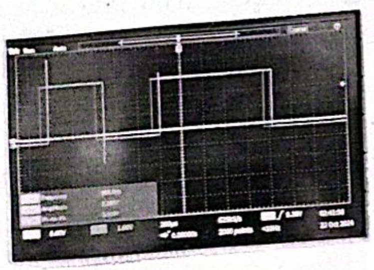
8/11/24.

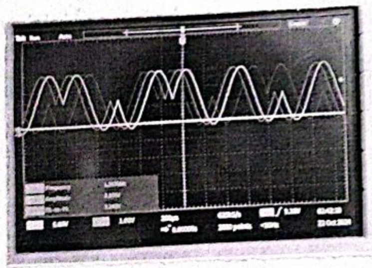
BPSK Modulation

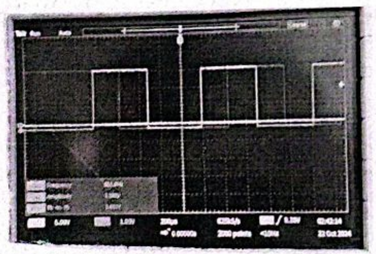


BPSK Demodulation









EXPERIMENT NO. 09(a)

AIM. To study modulation & demodulation of Binary Phase Shift Keying

Equipment.-
- BPSK modulator & demodulator
- oscilloscope
- Connecting wire

Theory.

BPSK is a digital modulation technique that represent binary data using two distinct phase states of a carrier signal.
Binary '0' is represented by 0° phase shift.
Binary '1' is represented by 180° phase shift.

This modulation approach provides a robust method of communication as the phase shifts are easily distinguishable even in the presence of noise.
The demodulation process involves extracting the original binary data from modulation signal by determining the phase changes.

Procedure.

→ Modulation - 1. Use the signal generator to produce a sinusoidal carrier signal.
2. Generate binary data to represent the digital information to be transmitted.
3. Feed both carrier signal and binary data into BPSK transmittor.
4. Connect the o/p of the BPSK modulator to the oscilloscope to visualize the BPSK signal.

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→ Demodulator:- 1. feed the modulated BPSK signal into the BPSK demodulator
2. The demodulator compares the incoming BPSK signal with the recovered carrier signal.
3. Use the oscilloscope to verify that the demodulated signal matches the original binary data i/p.

Result- A BPSK modulated signal on the oscilloscope with clear phase shift and a demodulated signal that matches the original binary data confirming succesfull modulation & demodulation.

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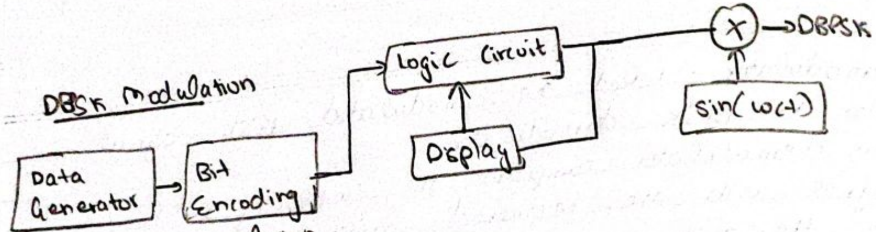
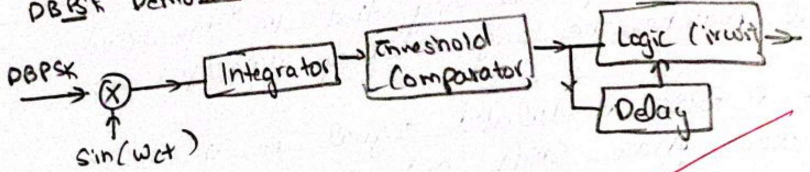
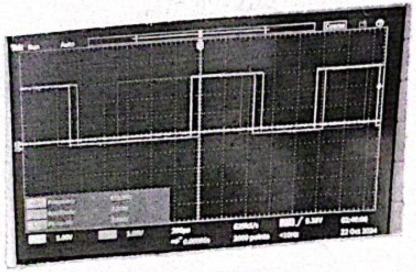
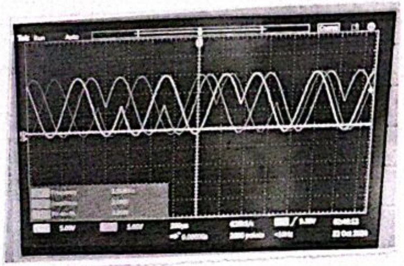
DBPSK Modulation

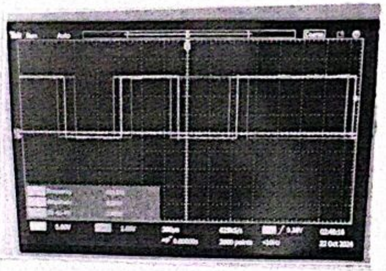


DBPSK Demodulation









EXPERIMENT 9(b)

AIM- To study the modulation & demodulation of Differential Binary Phase Shift Keying (DBPSK)

Equipment Required- • DBPSK Modulator/Demodulator
• Oscilloscope
• Cables & Connector

Theory- DBPSK is a type of phase shift keying where information is represented by phase shift changes relative to the previous symbol. unlike standard binary phase shift, DBPSK does not require a unique reference carrier phase at the receiver making it more robust.

In modulation process this method makes the signal less sensitive to phase noise & enables simpler demodulation since no phase reference is needed at receiver. In demodulation, this eliminates the need for precise synchronization of carrier phase.

Procedure-

→ Modulation- 1) Set up the signal generator to output a binary data stream.
2) Feed this data into DBPSK modulator.
3) Observe the modulated signal on the oscilloscope.

→ Demodulation- 1) Connect the DBPSK modulated signal to the demodulator input.
2) The demodulator will interpret phase shift and produce the binary output stream.

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3. Use the oscilloscope to compare the demodulated output with original binary data.

Result -

On the oscilloscope the modulated DBPSK waveform should exhibit phase changes corresponding to the input data. In demodulation the output binary data should match the input data stream.

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