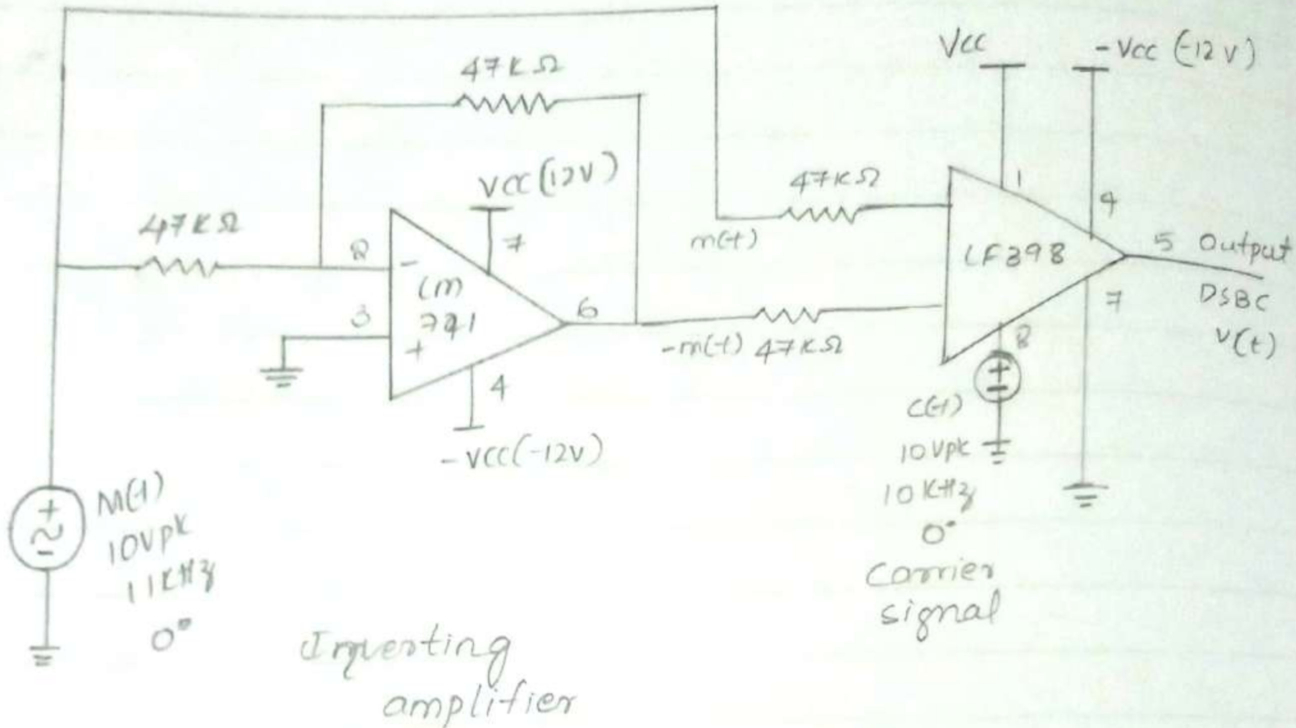
CIRCUIT DIAGRAM

1) MODULATOR.



Design

$$\text{Gain } A_V = \frac{R_f}{R_1} = \frac{47K}{47K} = 1$$

$$R_F = R_1 = 47K\Omega$$

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Date: 21/4/22

Expt. No.: 01 Page No.: 01

Generation and detection of DSBSC and Standard Amplitude modulation (DSBFC) using IC398 and LM741

AIM:- To generate DSBSC and AM signal using IC LF398 modulation for carrier frequency = 10KHz and message frequency = 1KHz. Also plot the variations of modulating signal amplitude versus modulation index.

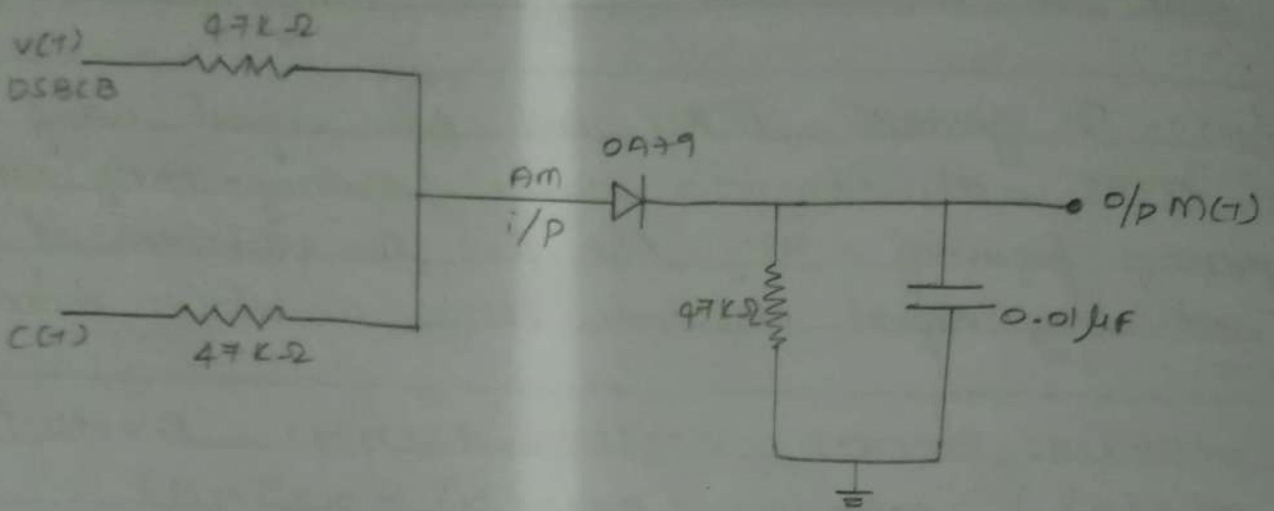
COMPONENTS REQUIRED:- IC398 and LM741, Resistors(4.70KΩ(1) 10KΩ(9)), capacitors (0.01μF(1), 0.001μF(1))

THEORY:- Amplitude Modulation is a technique in which amplitude of the carrier is varied in accordance with the instantaneous value of message.

Transformer less DSB-SC generation: is An alternative method of generating the DSBSC. Consider the block diagram of fig 2 which has the analog inverter, 2 channel switch and band pass filter. The first block, analogue inverter takes an input signal and provides signal with 180° phase shift at its output. The inverter can be realized using either a transformer or using an operational amplifier as an inverter. The second block, the two channel analogue switch has two input signals ('A' and 'B') and a select signal input. The output of the switch ~~can~~ at any instant is either 'A' or 'B' depending on the amplitude of selected input being high or low. The two channel switch can be realized using 2 transistors (n-p-n & p-n-p) or using standard 2-channel switch available as linear integrated circuit. Third block a BPF, tuned to the

Teacher's Signature

DEMODULATION



Design.

$$\frac{1}{f_c} << RC << \frac{1}{f_m}$$

$$\frac{1}{10K} << RC << \frac{1}{1K}$$

$$100\mu s << RC << 1ms$$

Assume $RC = 500\mu s$

let $C = 0.01\mu F$

then $R = 50k\Omega$

Assume $R = 47k\Omega$.

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carrier frequency and can be either active (or) passive filter, and is the only block similar to that fig1 since transformer less ckt are preferred this combination is an alternative method of generating DSB SC.

The demodulation ckt is a simple envelope detector. The output of this detector is the envelope of the input. As the envelope of the AM is the modulating signal m(t), the demodulation can be carried out by this ckt.

Modulation is defined as process by which some characteristic of carrier signal in accordance with the modulating signal. Base band signal is modulating signal and output of modulation process is modulation signal.

Amplitude modulation is the process of varying the amplitude of the carrier wave is varied about a means values linearly with the base band signal. The envelope of the modulating wave has the same shape as the base band signal provided the following two requirements are satisfied. The carrier frequency fc must be much greater than the highest frequency component of message signal i.e $f_c >> f_m$

Modulation index must be less than unity, if it is more than unity, the carrier wave becomes over modulated.

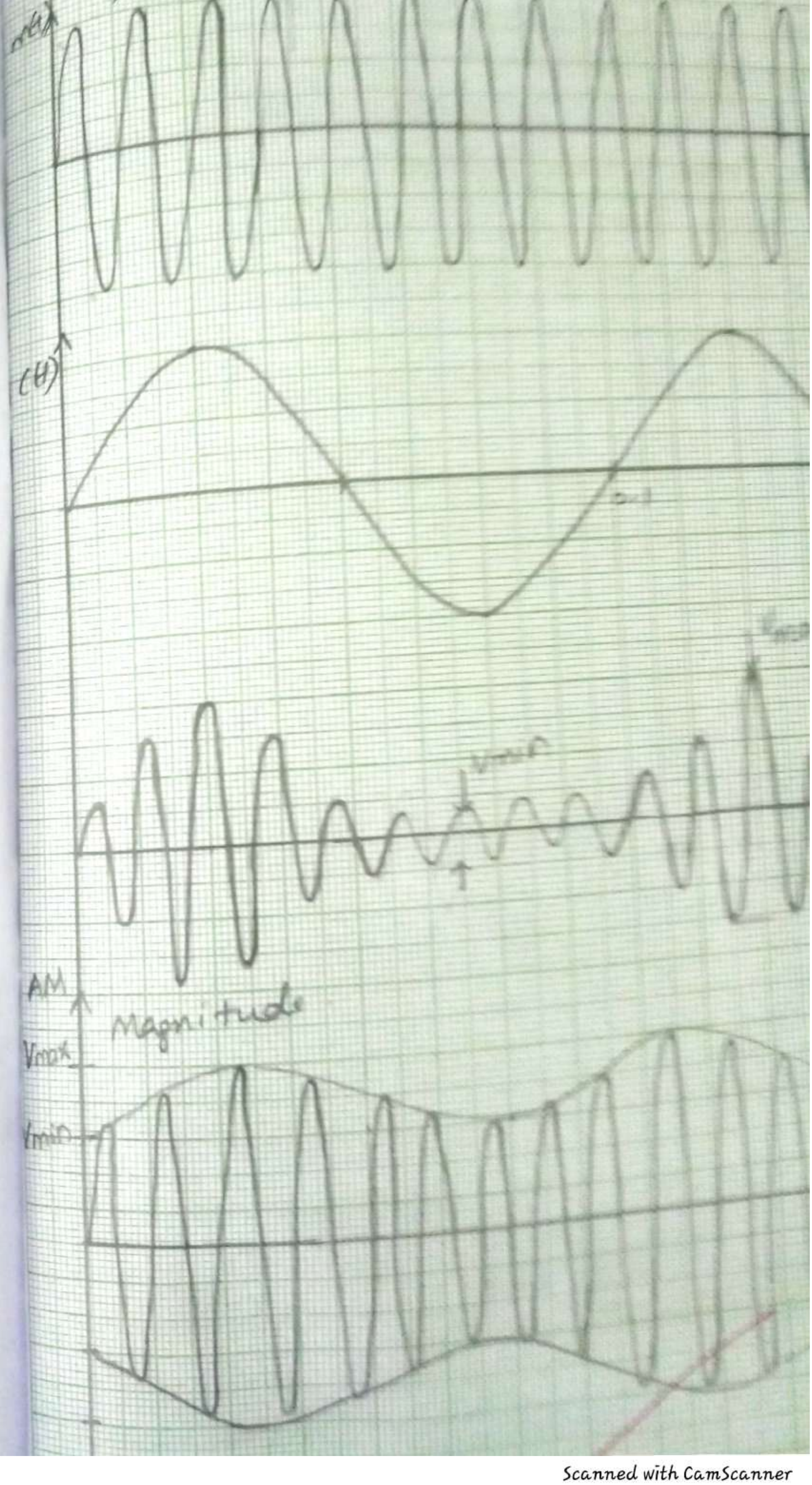
Amplitude Modulation :-

For the Experimental verification of the alternate method of DSBSC Generation, we need an analogue inverter and an anlogue switch. The analogue inverter and switch can be realized using varied

Expt. No.: 01

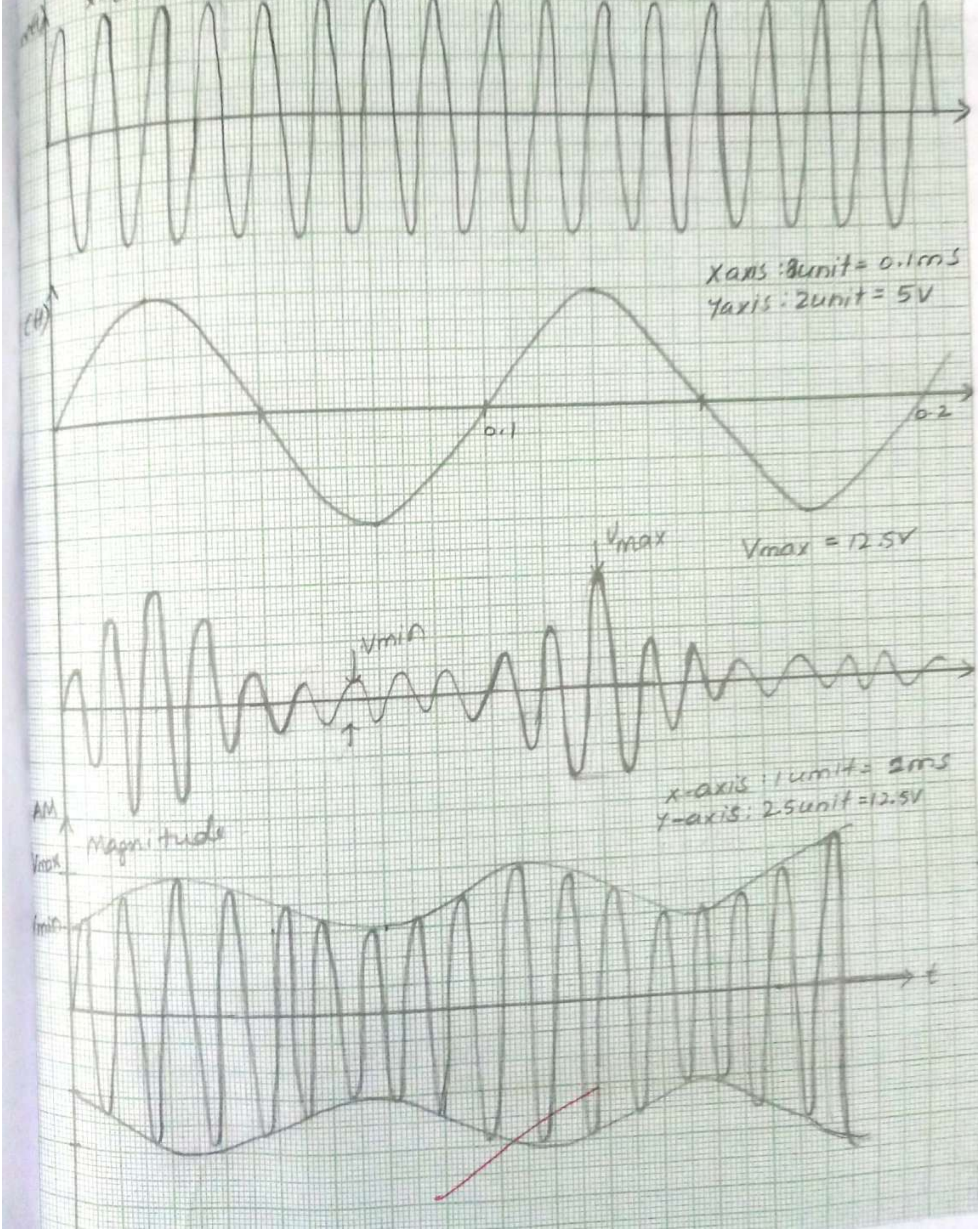
AMPLITUDE MODULATION

x-axis 1unit = 1ms, y axis: 2unit = 5V



AMPLITUDE MODULATION (AM)

x-axis 1unit = 1ms , Y axis : 2unit = 5V



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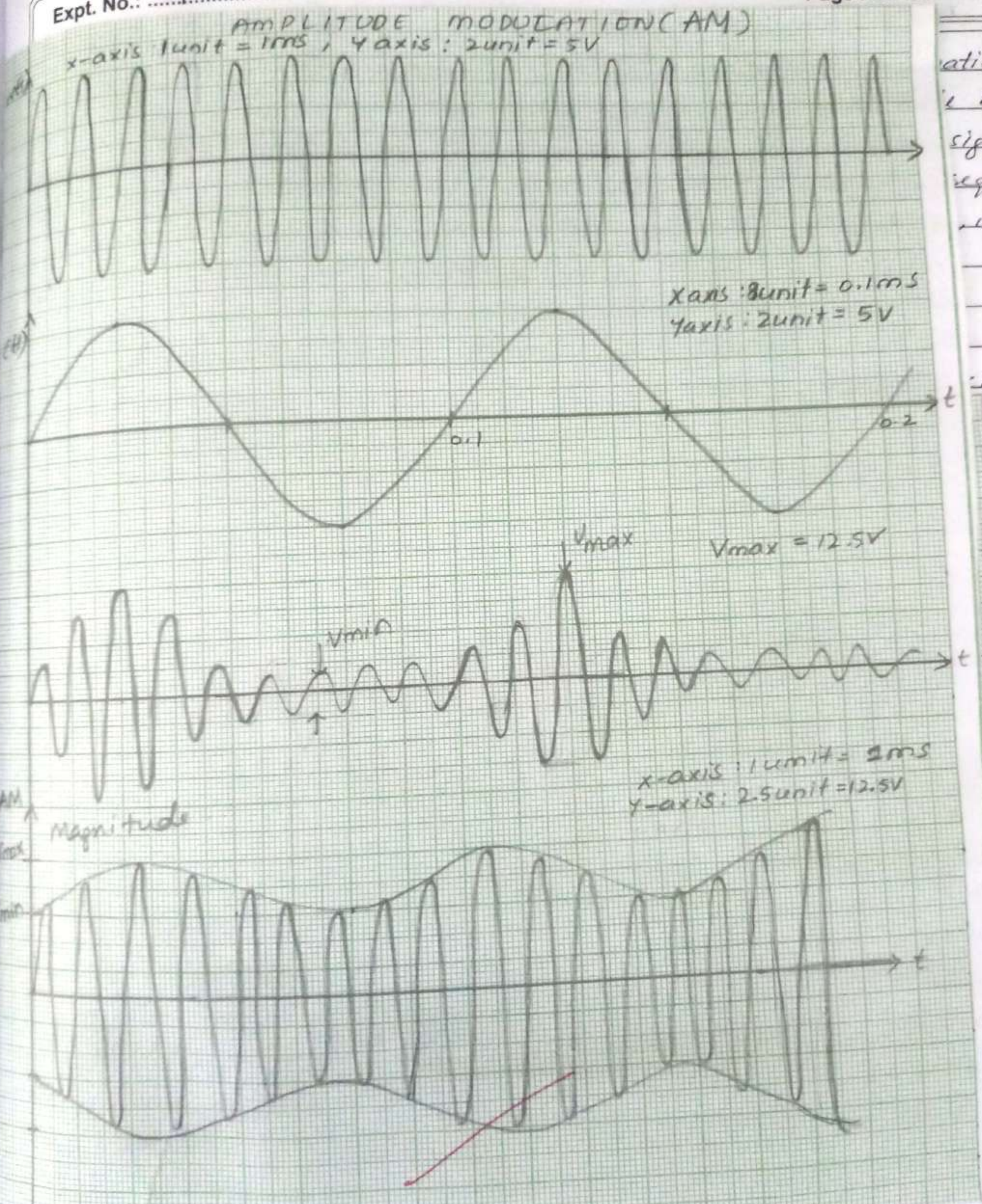

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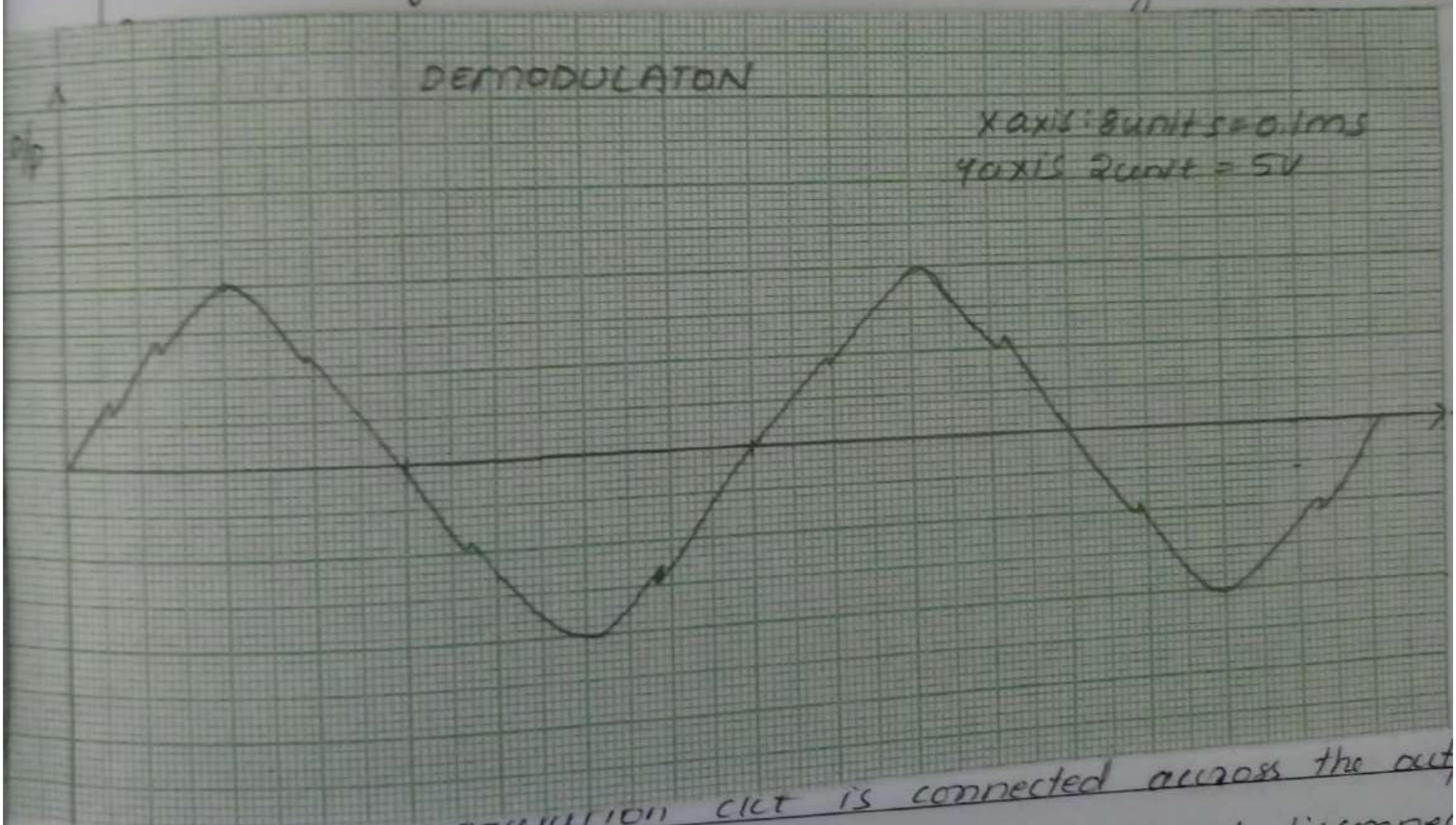
number of IC's (or) even transistor, resistor combinati
the individual circuit are given in figure There
connected as in fig 2, produces the DSBSC sig
at the output of BPF tuned to carrier freq
In both cases, square wave carrier is ≥10 KHz, a
the sinosoidal message of 1KHz

PROCEDURE:- DSBSC Modulation = Analog Inverter
(1) Initially wire the ckt for analog inverter ck



(.) Now demodulation ckt is connected across the out
DSBSC modulator circuit. By connecting and disconnec
the 'c'. Observe demodulated signal.
(9) By varying the modulating voltage in DSBSC mo
ckt, observe the demodulated signal. Similarly, b
modulating frequency in modulation circuit observe d

number of IC's (or) even transistor, resistor combination the individual circuit are given in figure. These blocks connected as in fig 2, produces the DSBSC signal at the output of BPF tuned to carrier frequency. In both cases, square wave carrier is ≥10 KHz, while the sinosoidal message of 1KHz

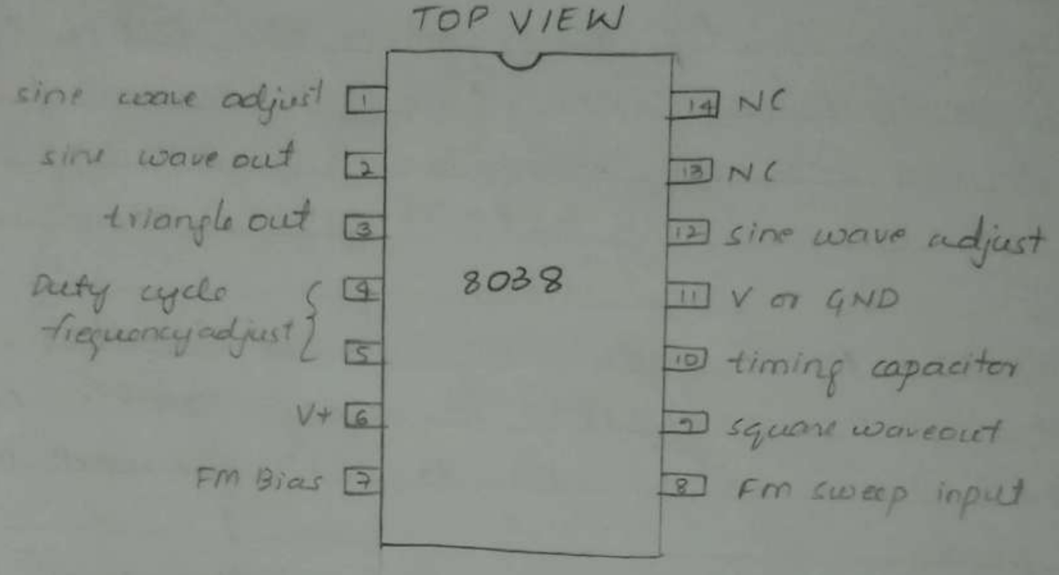
PROCEDURE:- DSBSC Modulation = Analog Inverter
(1) Initially wire the ckt for analog inverter ckt.
(2) Set audio signal generator to 1KHz sine wave with 1V peak.
(3) Now observe the o/p wave form at the o/p of analog inverter. This waveform should be inversion of i/p sine wave
(4) Now wire the analog multiplier circuit
(5) A square wave of 10KHz with 10Vpp is connected to pin No. 8 of LF398
(6) Observe o/p at pin 5 of LF398
(7) Now slightly increase and decrease modulating signal and note how DSBSC modulation changes.
Demodulation
(8) Now demodulation ckt is connected across the output of DSBSC modulator circuit. By connecting and disconnecting the 'c', observe demodulated signal.
(9) By varying the modulating voltage in DSBSC modulation ckt, observe the demodulated signal. Similarly, by varying modulating frequency in modulation circuit observe demodulated signal.

Result:- Amplitude modulation and demodulation was conducted, and output waveforms were observed.

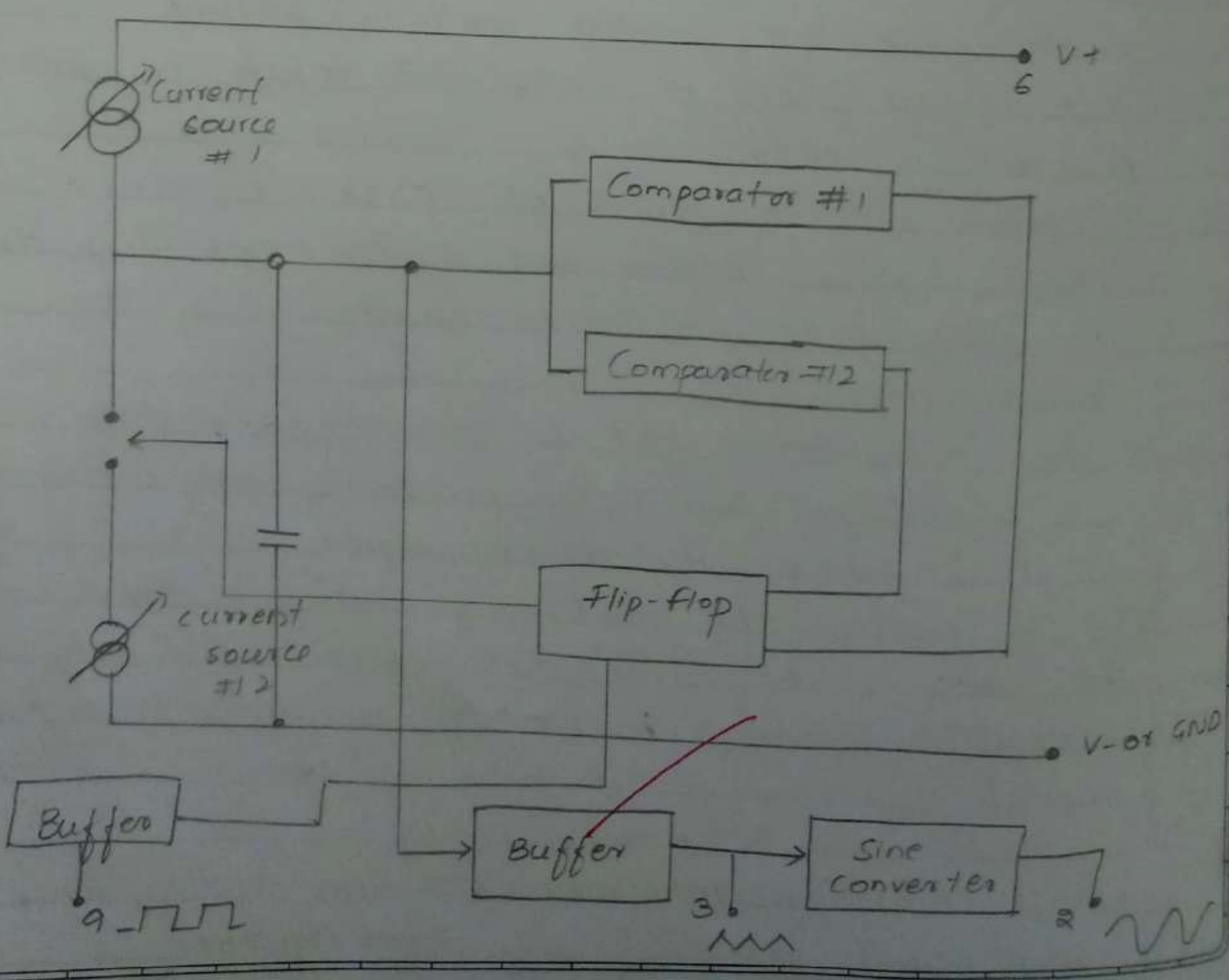
Teacher's Signature

ICL 8038 pinout and functional Diagram.

Pinout



Functional Diagram.



Frequency Modulation using IC 8038 and demodulation using IC565

AIM:- To design and conduct an experiment to generate an FM wave using IC 8038 and demodulation using IC565

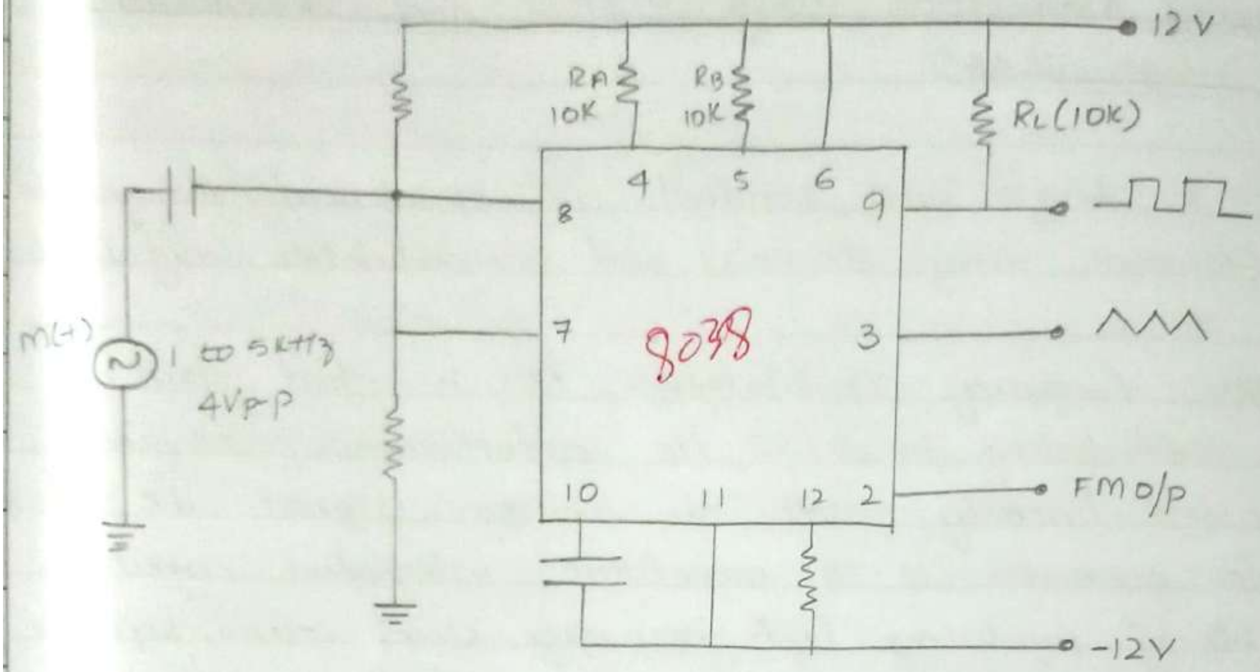
THEORY:- Frequency Modulation : FM is that form of angle modulation in which the instantaneous frequency is varied linearly with the message signal. IC 8038 waveform generator is a monolithic integrated circuit capable of producing high accuracy sine, cosine, square triangular, saw tooth and pulse waveform with a minimum number of External components. Fig 1 shows pin diagram of IC 8038. It is a precision waveform generator / voltage contrived oscillator. It is a monolithic IC capable of producing high frequency sine, square, triangular, sawtooth and pulse wave.

Applications:-

* Sine wave output Buffer Amplifier
* Burst generator
* Variable Audio oscillator (20hz to 20kHz)
* Linear voltage controlled oscillator.

Basic principle of IC 8038: In fig1 of functional block diagram of IC 8038, an external capacitor C is charged and discharged by two current source. Current source #2 is switched on and off by a flip-flop, while the current source #1 is on continuously

Frequency Modulation application circuit from ICL8038



Design

Let $R = R_a = R_b = 10K\Omega$

Let $f = 33KHz$

$$f = \frac{0.33}{RC}$$

Substituting for R and f in above Equation we get

$C = 0.001\mu F$

Calculations.

$$f_{max} = \frac{1}{25\mu} = 40KHz$$

$$f_{min} = \frac{1}{50\mu} = 20KHz$$

1) $\Delta f = \frac{20KHz}{2} = 10KHz$ (frequency deviation $= \frac{f_{max} - f_{min}}{2}$)

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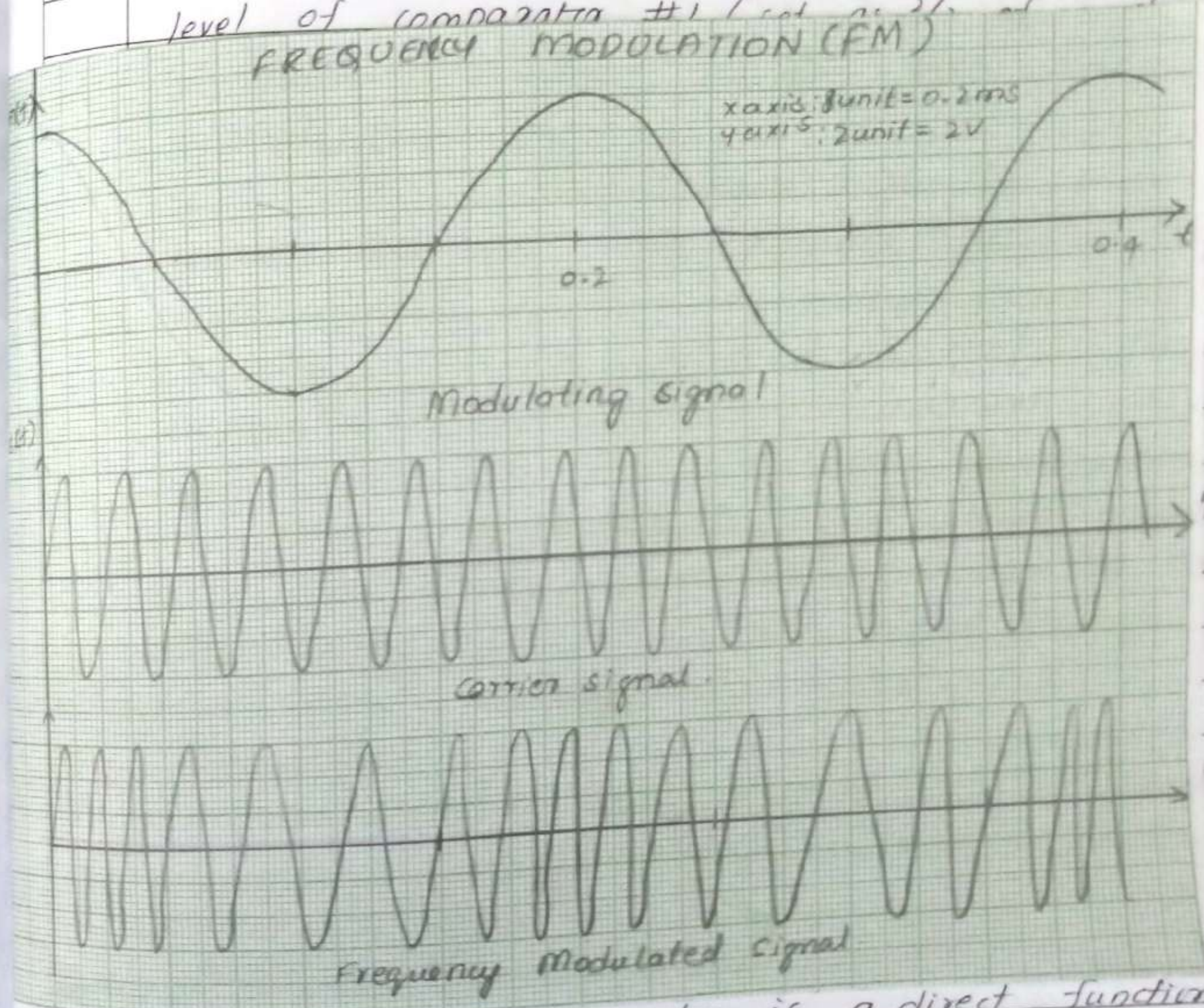
Expt. No.: 02 Page No.: 05

Assuming that the flipflop is in a state such that current source #2 is off, and capacitor is charged with a current i_c the voltage across the capacitor rises linearly with time When this voltage reaches level of comparator #1 (set at 2/3 of ... voltage)



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of wave form generator is a direct function of DC voltage at terminal '8' by altering this voltage. is performed The frequency deviations can be archived varying the voltage at pin No. 8

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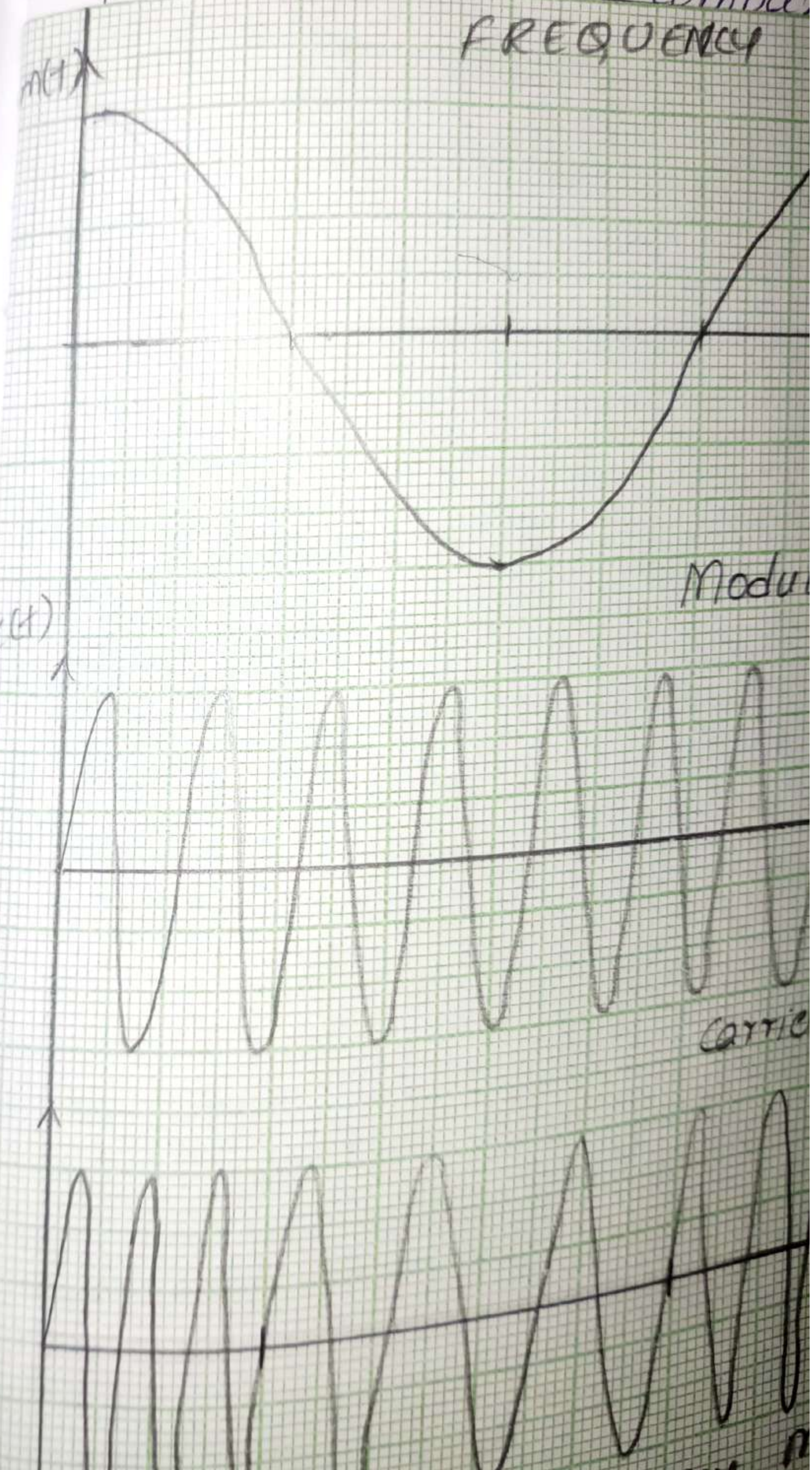
FREQUENCY



Assuming that the flipflop is in a state such that current source #2 is off, and capacitor is charged with a current ic the voltage across the capacitor rises linearly with time. When this voltage reaches the level of comparator #1 (set as 2/3 of supply voltage), flip-flop is triggered, changes states, and releases current source #2.

This current source normally carries a current 2I, thus the capacitor is discharged with a net-current I and the voltage across it drops linearly with time. When it has reached the level of comparator #2, the flipflop is triggered into its original state and the cycle starts again. Four waveforms are readily obtainable from this basic generator circuit. with the current source set at I and 2I respectively. The triangular wave is then passed through the on-chip wave shapes to generate sinewave

Part-2

The objective is to generate single and multitone FM signals using a voltage controlled oscillator and observe the waveforms.

Frequency Modulation and sweeping:- The frequency of wave form generator is a direct function of DC voltage at terminal '8' by altering this voltage, FM is performed. The frequency deviations can be archived by varying the voltage at pin No. 8

Implement the frequency Modulator circuit shown in the datasheet. The o/p of the VCO when no modulation is applied, the carrier frequency is

2) $\beta \rightarrow$ Modulation index $= \frac{\Delta f}{f_m} = \frac{10K}{3.5K} = 2.8$

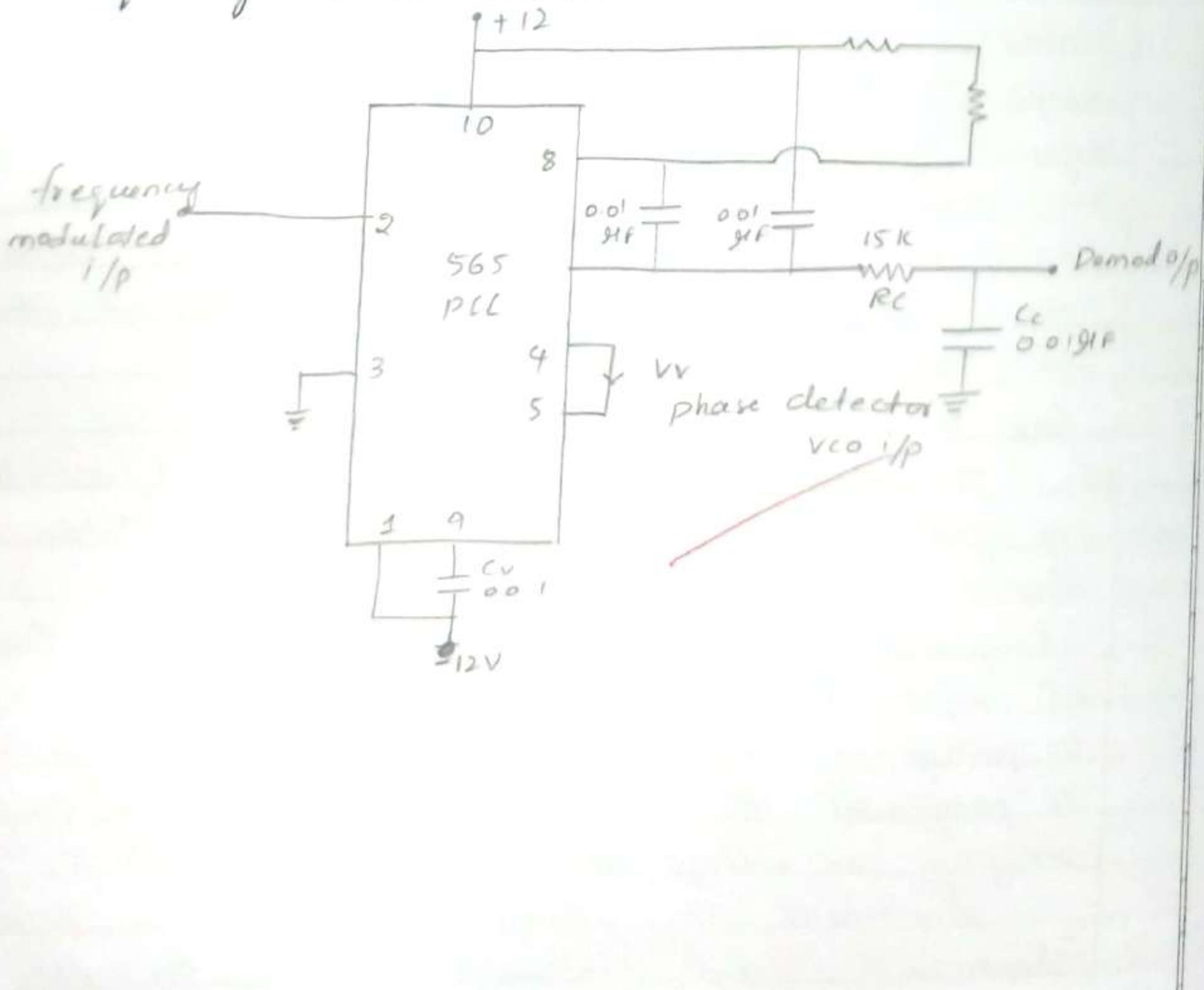
3) frequency sensitivity. $K_f = \frac{\Delta f}{A_m} = \frac{10K}{2} = 5K$

4) Bandwidth $= 2(\Delta f + f_m)$ Hz

$= 2(10K + 3.5K)$

$= 27$ KHz.

frequency demodulation.

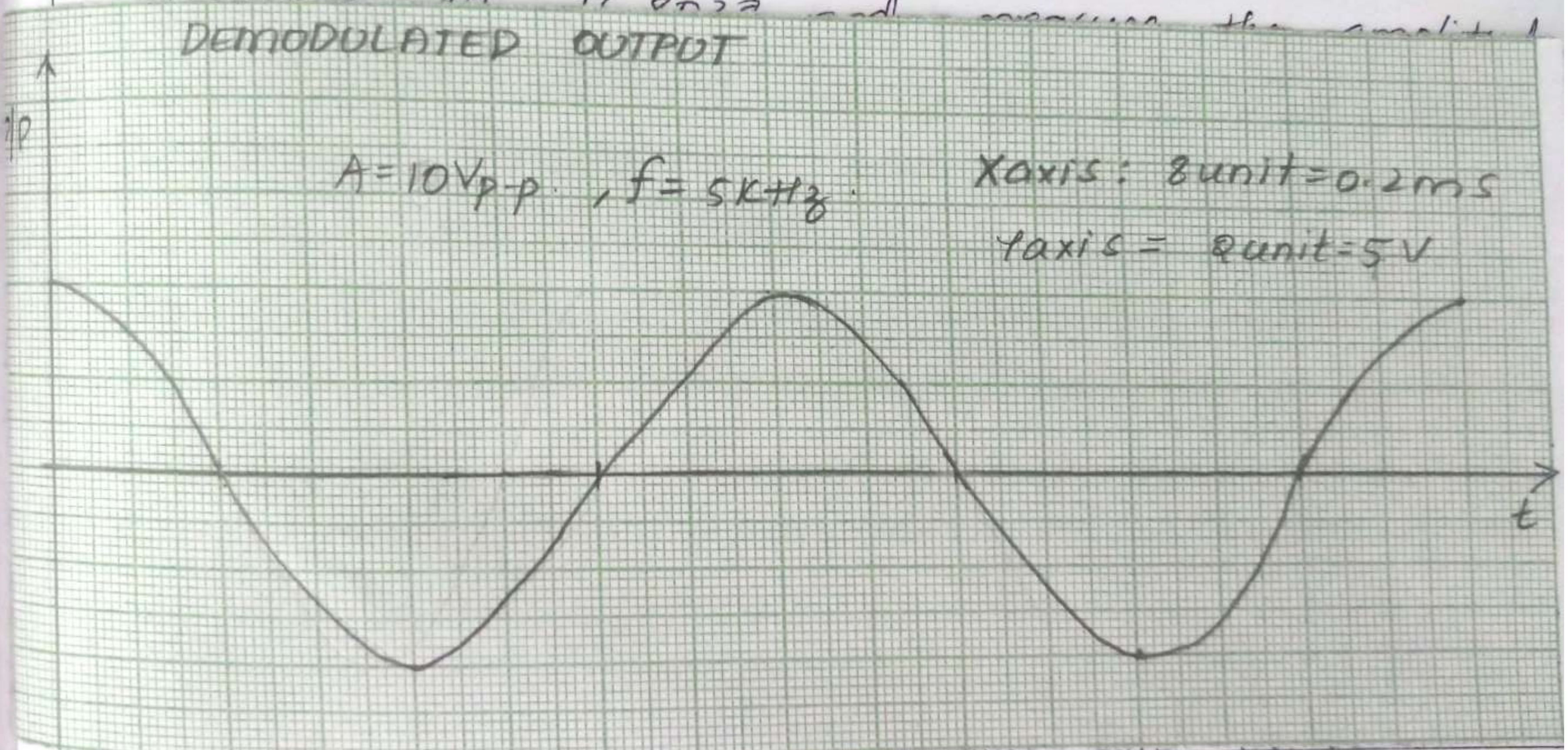


the oscilloscope. ... the wave f...

PROCEDURE:

1) Rig up the circuit.

2) Observe the unmodulated sinusoidal carrier



conducted and waveforms were observed.

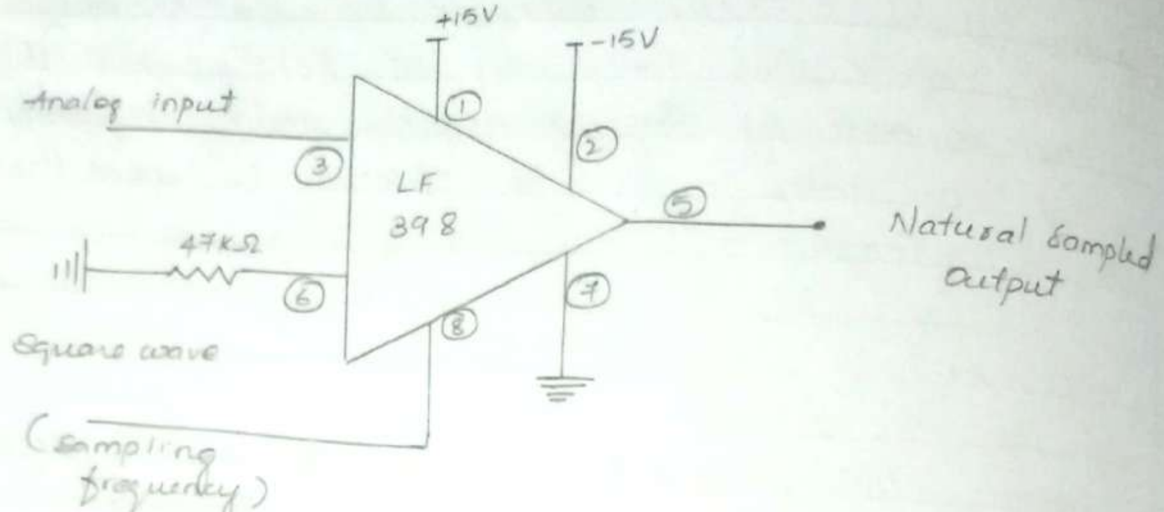
given by $f = 0.33/RC$ where $R = R_A = R_B = R_C$ design the circuit for carrier frequency of 33KHz. Test the system response by feeding a 1-Hz audio frequency tone to the FM sweep input pin. Observe the wave forms on the oscilloscope

PROCEDURE:

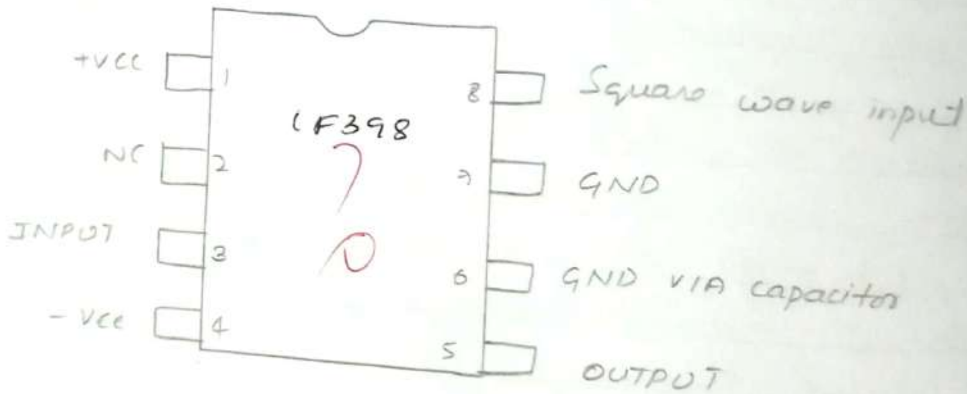
1) Rig up the circuit.
2) Observe the unmodulated sinusoidal carrier signal at pin 2 of IC 8038 and measure the amplitude and frequency without applying modulating signal.
3) Apply modulating signal with amplitude 4V peak and frequency of 1KHz
4) Observe the frequency modulated output at pin 2
5) Note down maximum and minimum frequencies corresponding to two-peaks of modulating signal
6) Compute the parameters of the FM signal and tabulate them.

Result :- Frequency Modulation and demodulation was conducted and waveforms were observed.

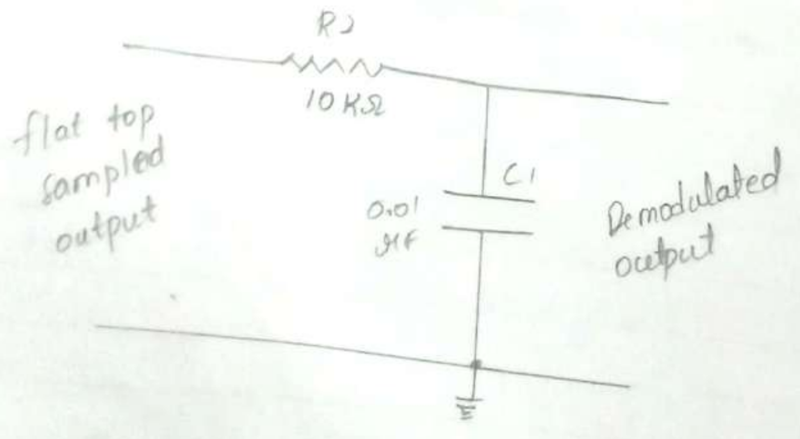
PAM Signal Generation.



PIN DIAGRAM.

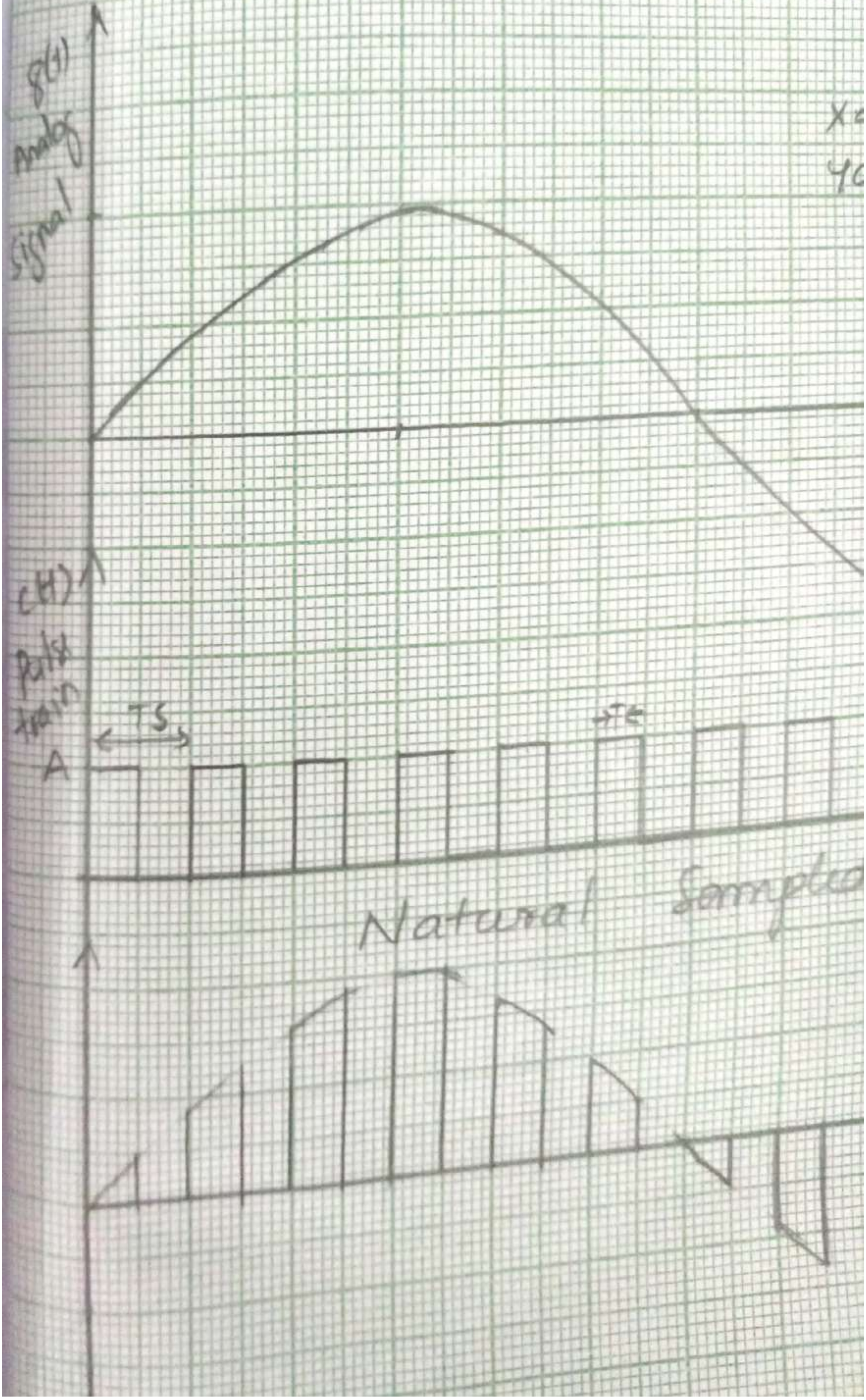


Demodulation Circuit.



APPARATUS REQUIRED

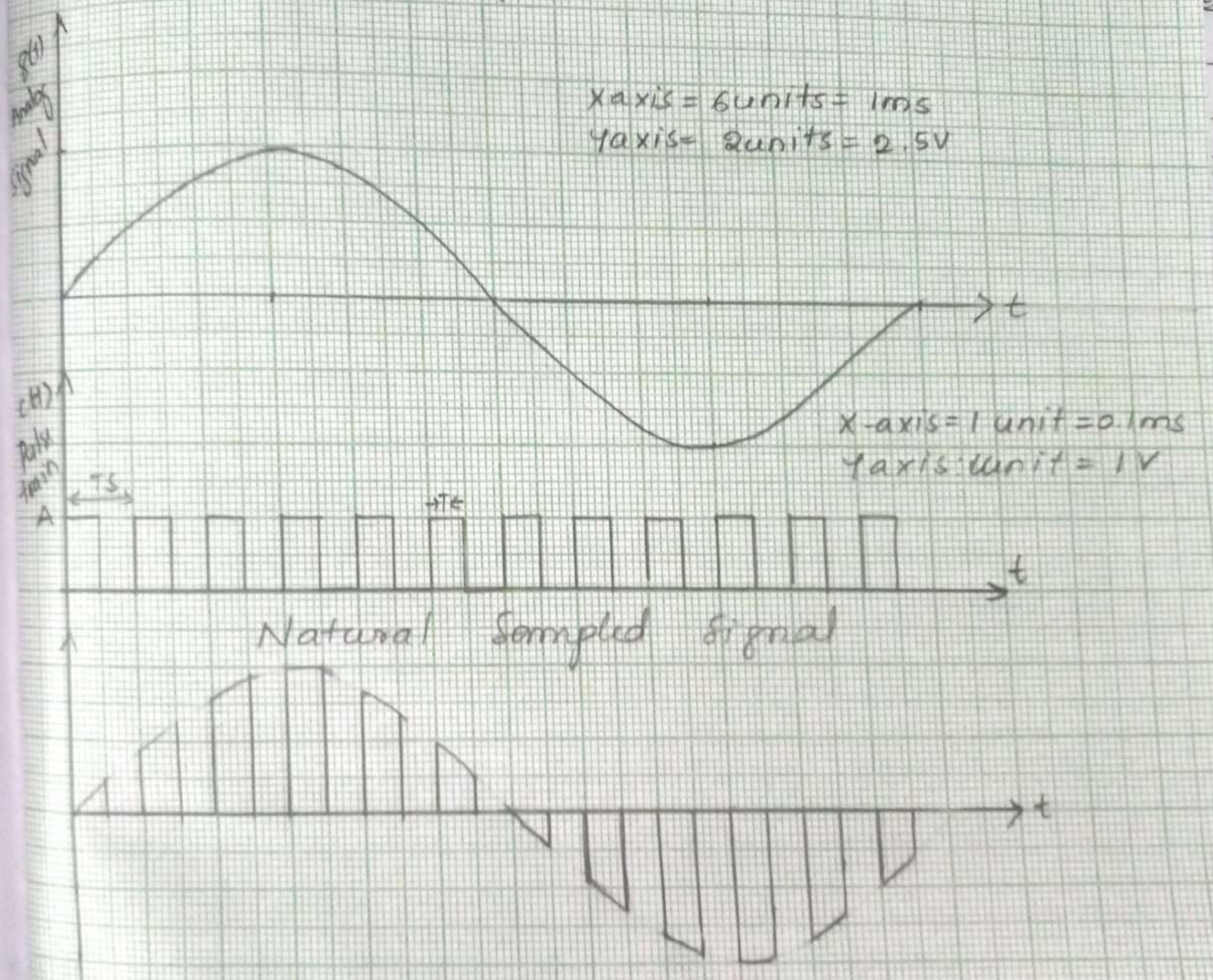
PULSE SAMPLING



...observe the waveforms.

APPARATUS REQUIRED :- Transistor BC 107/2N2222, Resist...

PULSE SAMPLING



Circuit Diagram : Pulse Sampling.

Pulse Sampling, Flat Top Sampling and Reconstruction

Pulse Amplitude Modulation:

AIM: To conduct pulse sampling, flat top sampling and Reconstruction and observe the waveforms

APPARATUS REQUIRED :- Transistor BC 107/2N2222, Resistor 10kΩ 2nos, 22kΩ, capacitor 1.99μF, signal general, CRO

THEORY:- Pulse Amplitude Modulation is defined as the variation of amplitude of the pulse in accordance with the message signal. The output is a series of pulses, the amplitude of which vary in proportion with the message signal. Sampling rate exceeds twice the maximum signal frequency, than the original signal can be reconstructed in the receiver with minimal distortion. The most popular sampling method is the sample and hold method in which flat top samples are created. The top of the samples remains a constant and is Equal to the instantaneous value of the baseband signal at the start of sampling. A flat top pulse has constant amplitude established by sample value of signal at beginning of pulse interval and each sample is extended to have duration of T-seconds.

Circuit Diagram: Pulse Sampling.

The transistor conducts during the positive half cycle of c(t) and transistor doesnot conduct during negative half cycle of c(t). For demodulating sampled signal, a simple, RC low-pass filter is used. The analog

Pulse Sampling, Flat Top Sampling and Reconstruction

Pulse Amplitude Modulation:

AIM:- To conduct pulse sampling, flat top sampling and Reconstruction and observe the waveforms.

APPARATUS REQUIRED :- Transistor BC 107/2N2222, Resistor 10kΩ · 2nos, 22 kΩ, capacitor 1.7μF, signal general, CRO

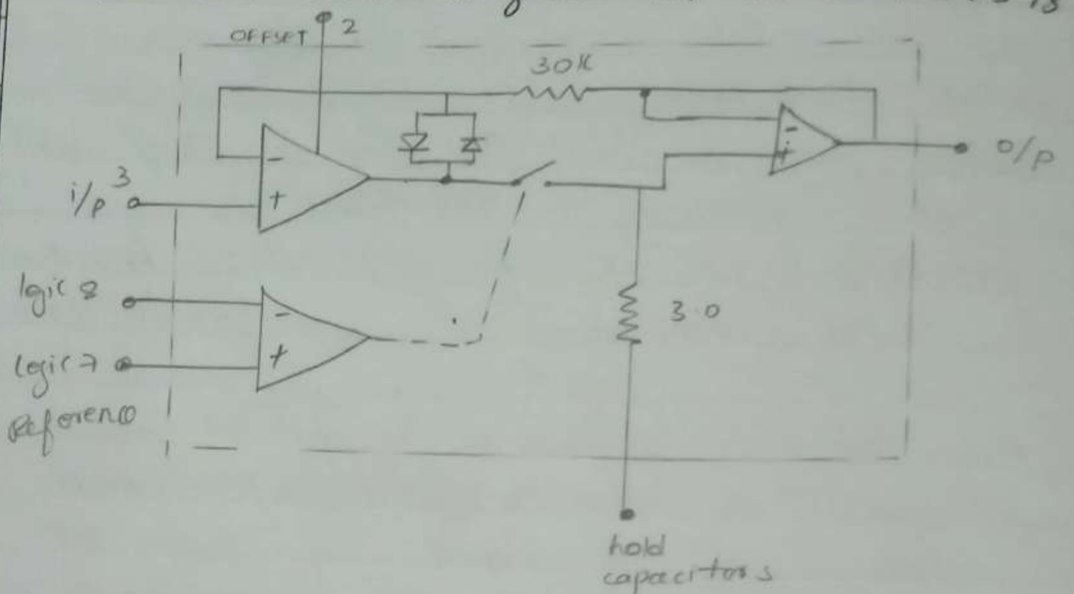
THEORY:- Pulse Amplitude modulation is defined as the variation of amplitude of the pulse in accordance with the message signal. The output is a series of pulses, the amplitude of which vary in proportion with the message signal. Sampling rate exceeds twice the maximum signal frequency, than the original signal can be reconstructed in the receiver with minimal distortion. The most popular sampling method is the sample and hold method in which flat top samples are created. The top of the samples remains a constant and is Equal to the instantaneous value of the baseband signal at the start of sampling. A flat top pulse has constant amplitude established by sample value of signal at beginning of pulse interval and each sample is extended to have duration of T- seconds.

Circuit Diagram: Pulse Sampling.

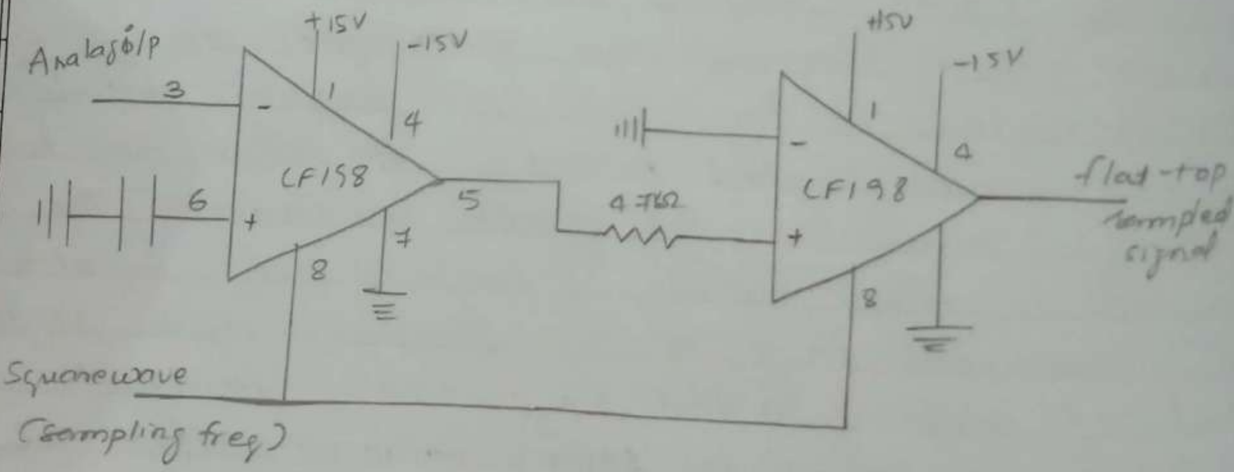
The transistor conducts during the positive half cycle of c(t) and transistor doesnot conduct during negative half cycle of c(t). For demodulating sampled signal, a simple RC low-pass filter is used. The analog

Flat top Signalling

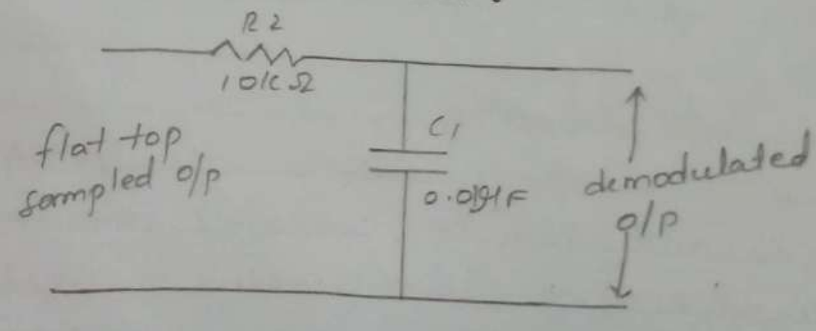
function block diagram of IC LF198/398



Circuit diagram:



Demodulation Circuit



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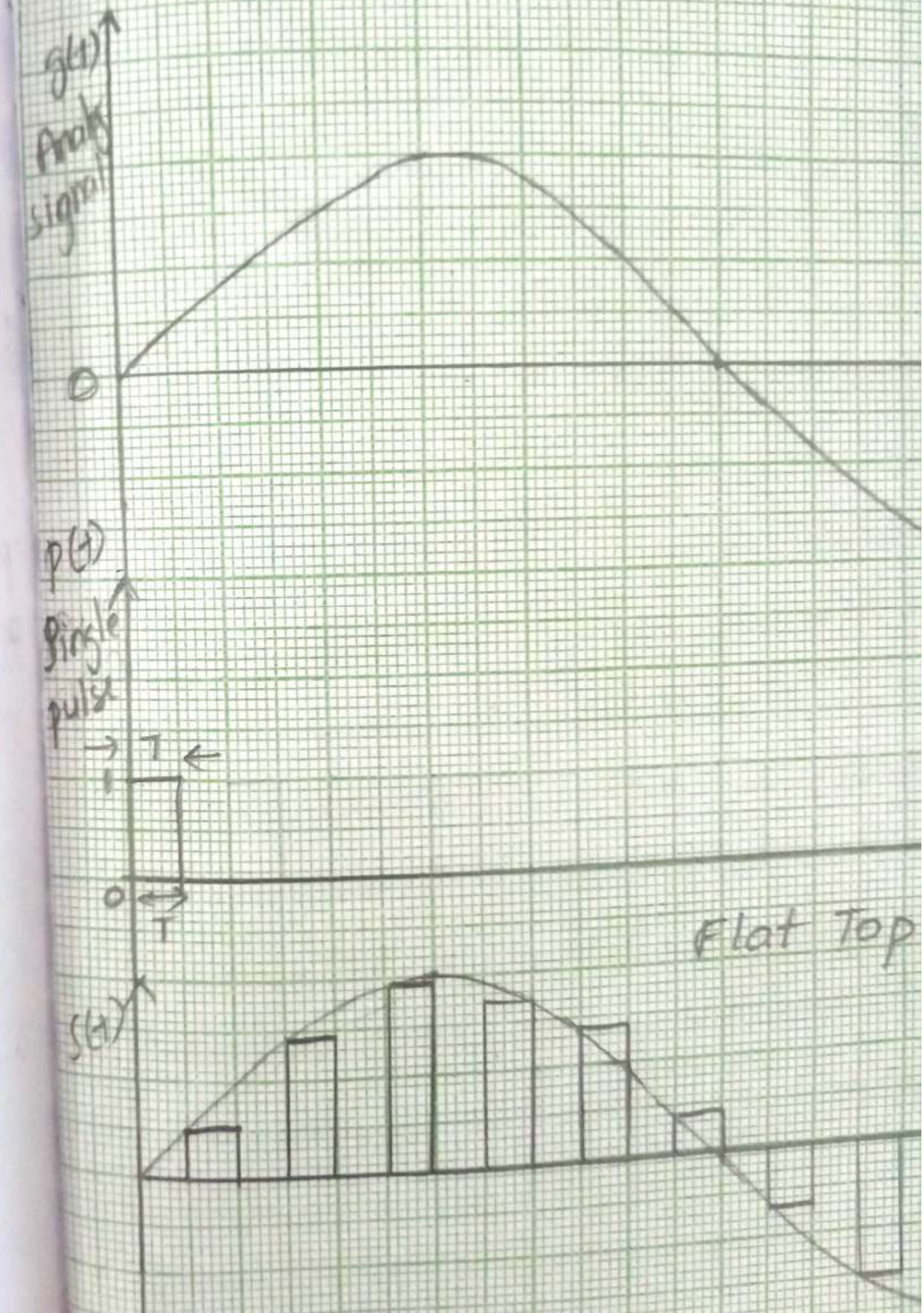
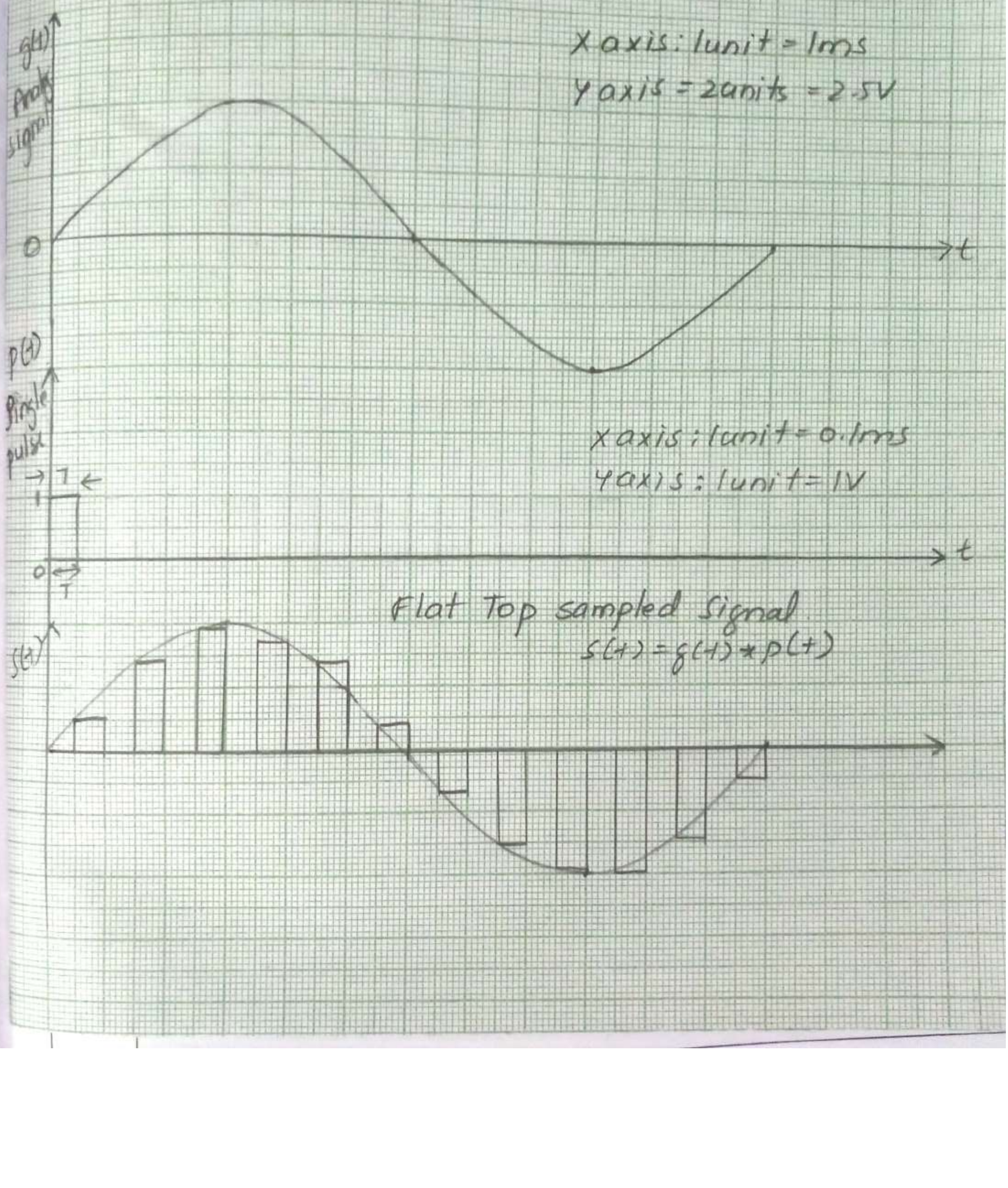
FLAT TOP SAMPLING



FLAT TOP SAMPLING



signal can be exactly recovered from sampling provided the pulse repetition frequency of pulses is greater than twice analog frequency according to sampling theorem. The ckt and output waveform is as shown in fig 1 & 2.

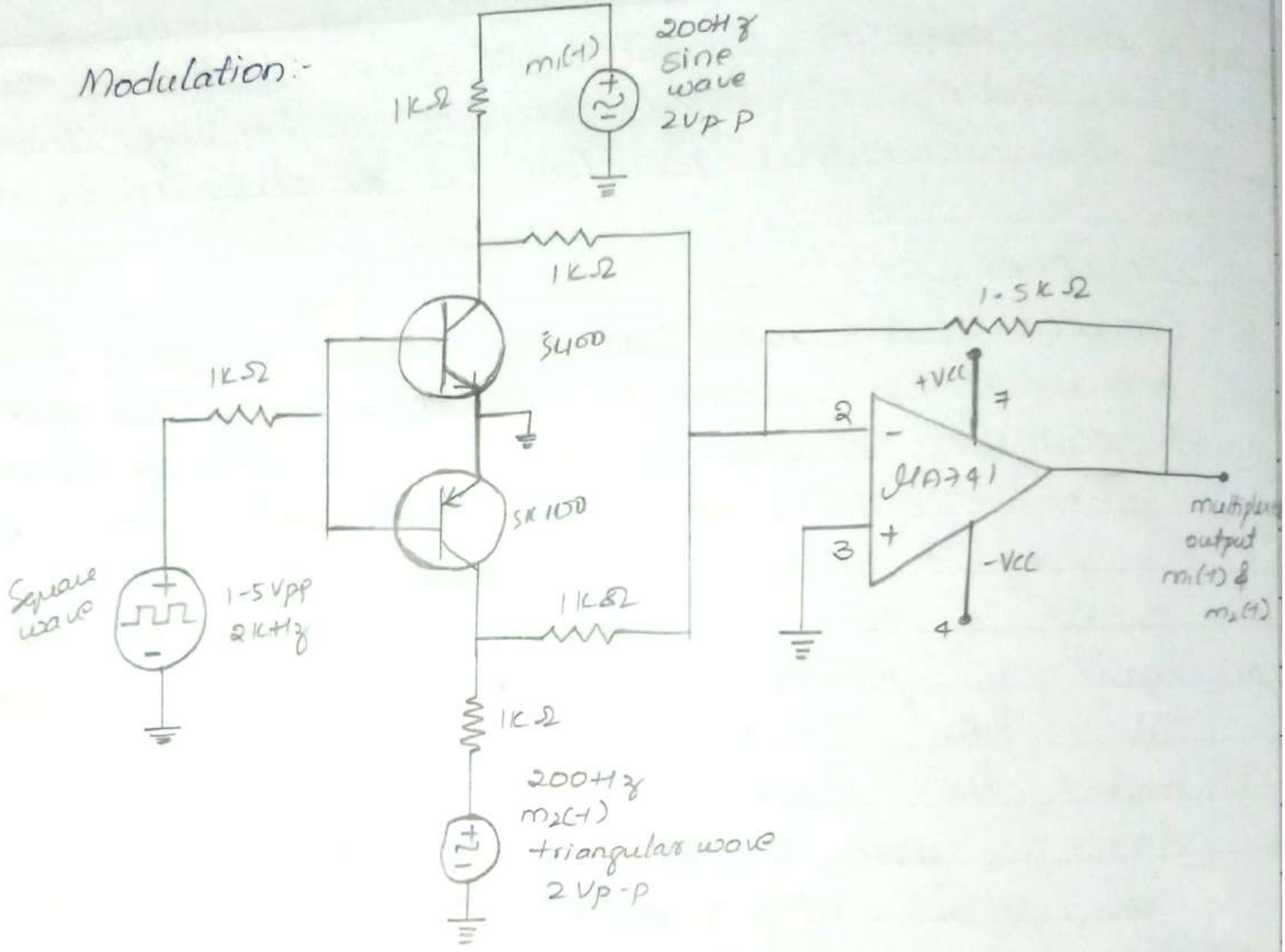
PROCEDURE:

(1) Connections are made as per circuit diagram
(2) Sine wave input signal of 5V, 1KHz and square wave of 5V, 10KHz is given as input to ckt. message signal is given to collector and carrier signal of high frequency is given to base of transistor
(3) Output is taken at emitter and observed across the CRO
(4) Repeat the procedure for different conditions of sampling i.e $fs=2fm$, $fs>2fm$, $fs<2fm$.
(5) connect the demodulator circuit and the modulated output is given to the demodulator to obtain the message signal obtain output for different conditions.
(6) Plot the waveforms.

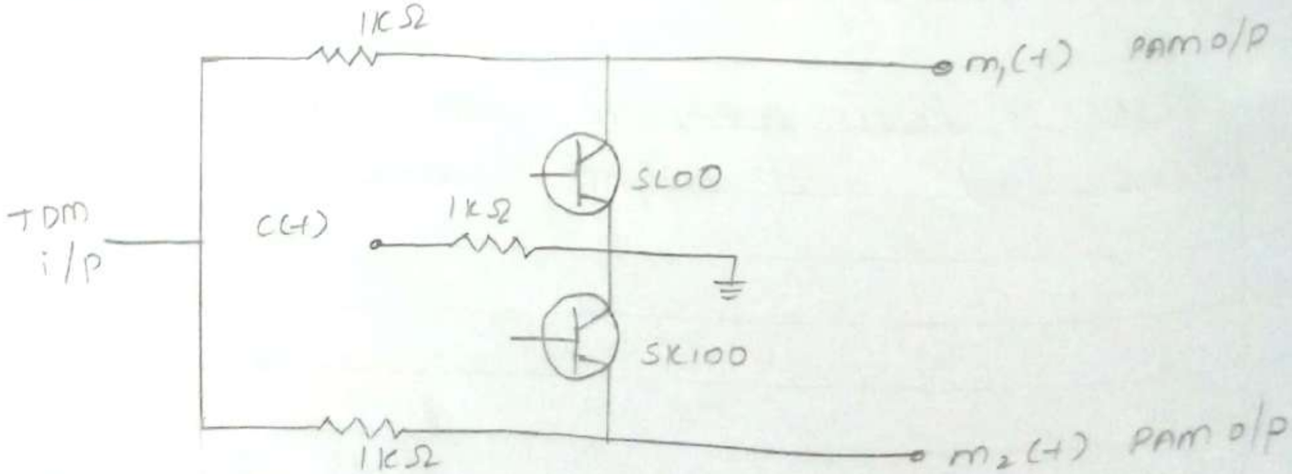
RESULT:- Pulse sampling and flat top sampling was conducted and output waveform were observed

CIRCUIT DIAGRAM

Modulation:-



Demodulation:-



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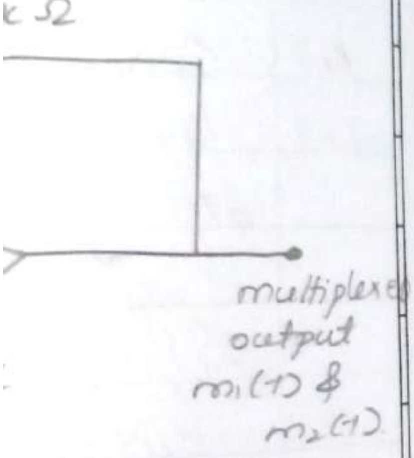
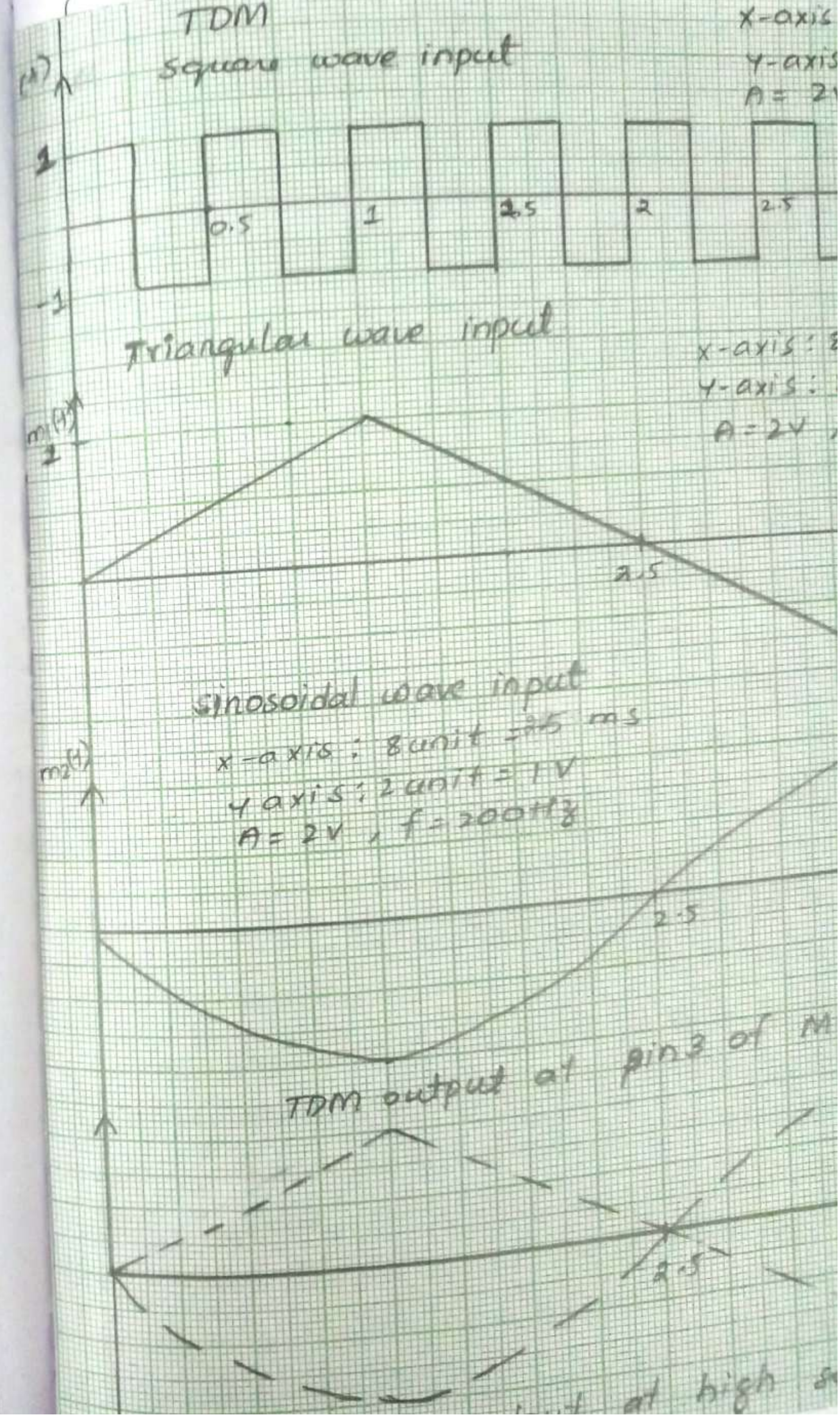

k Ω
multiplexed output
$m_1(t)$ & $m_2(t)$
(t) PAM o/P


TDM
square wave input
X-axis
Y-axis
A = 2
1
0.5
1
1.5
2
2.5
-1
Triangular wave input
X-axis :
Y-axis :
A = 2V
$m_1(t)$
1
2.5
Sinosoidal wave input
X-axis : 8 unit = 2.5 ms
Y axis : 2 unit = 1 V
A = 2V , f = 200Hz
$m_2(t)$
2.5
TDM output at pin 3 of M
2.5
at high

Date: 13/5/22

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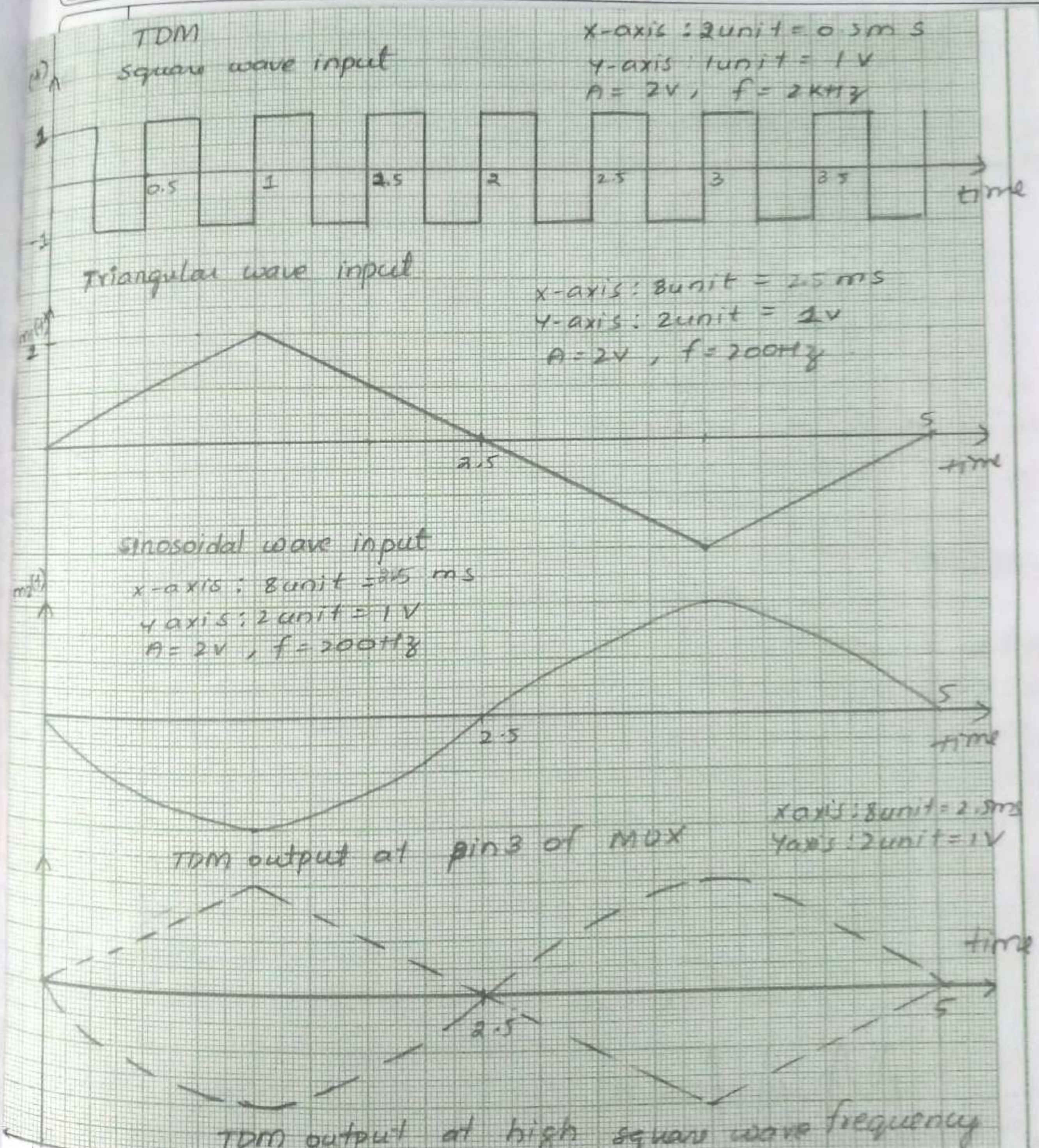

(ii) practical it is to combine a set of low bit rat[e]

streams, each with ...

Date: 13/5/22

Expt. No.: 4

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TDM of Two Band Limited signals

AIM:- To design and demodulation the working of TDM and recovery of two-band limited PAM signal.

COMPONENTS REQUIRED:

* Transistor SL100, SK100, op-amp, μA741
Resistor 1KΩ 8nos, 1.5KΩ 1no
* Function generator, Regulated DC power supply, Spring board, CRO.

THEORY:- More efficient communication system can be obtained if a station transmits more than one message on the same carrier and on the same channel (or) number of transmitters is transmitting simultaneously on the same channel. This process is known as multiplexing and has been used for many years in long distance telephony, multiplex transmissions have been used since a long time for broadcasting. Remote data transmissions (telemetry) would not be practicable were it not for multiplexing.

There are 2 types of multiplexing:

1) Time division multiplexing (TDM)
2) Frequency division multiplexing (FDM)

In practical it is to combine a set of low bit rate streams, each with a fixed and pre-defined bit rate into a single high-speed bit stream that can be

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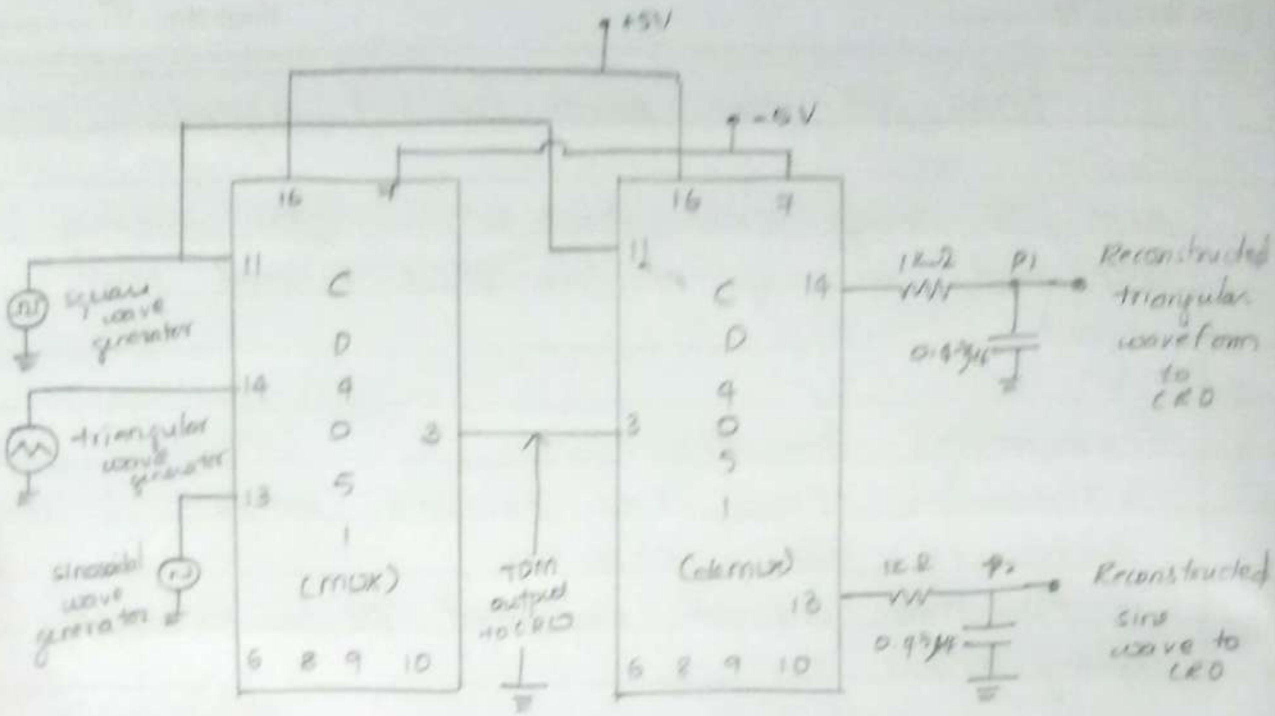

Multiplexing and Demultiplexing of two different Signals.

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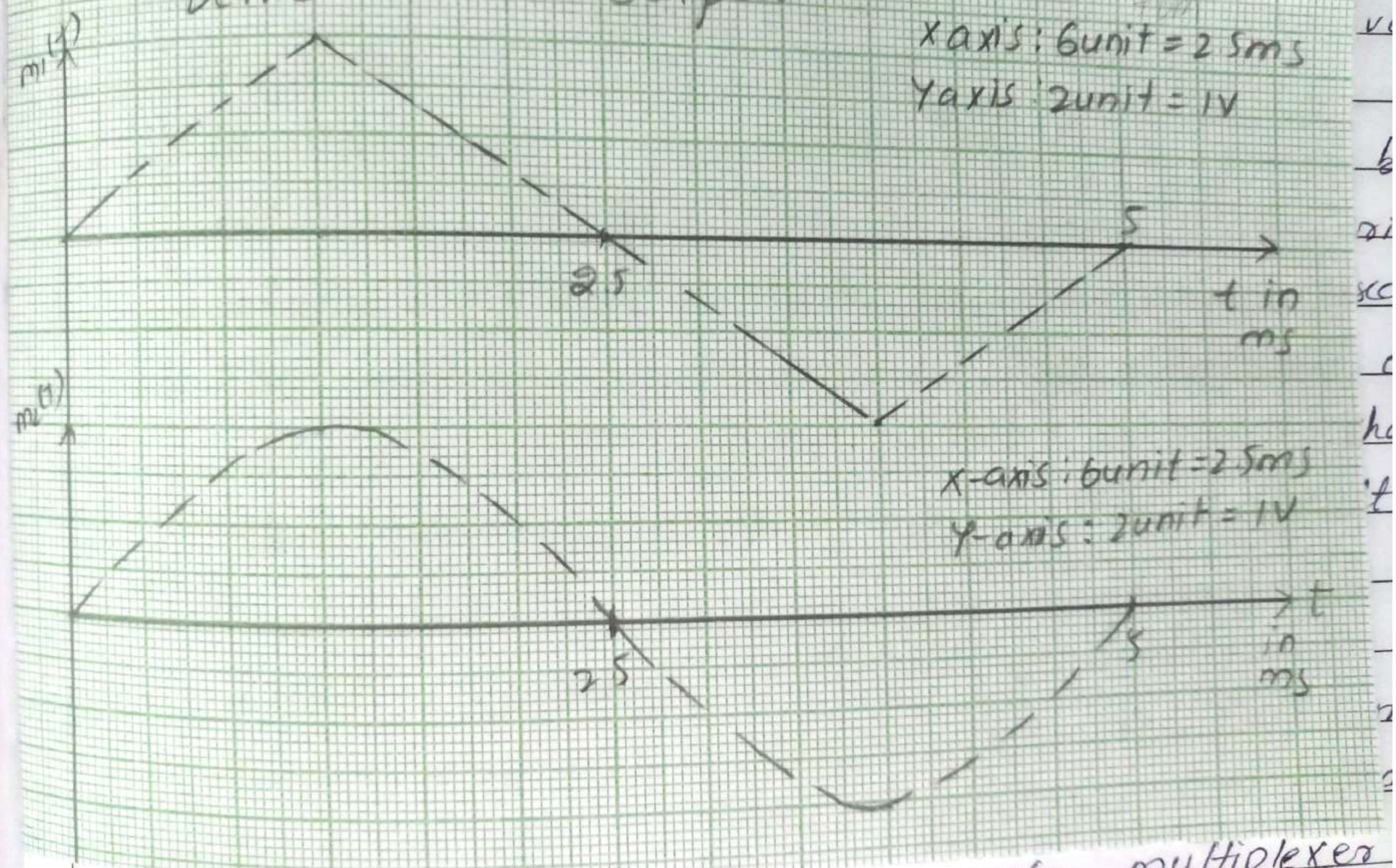
physical channel, that extented over a long d
Consider for instance, a channel capable of
192 kbit/sec from chicago to Newyork. Suppo

Demodulated output



multiplexer
small then the

transmitted over a singnal channel. This technique is called TDM and has many applications, including wireline telephone systems. The main reasons to use TDM is to take advantage of Existing transmission lines. It would be very expencive if each low bit rate stream were assigned a costly physical channel, that extended over a long distance.

Consider for instance, a channel capable of transmitting 192 kbit/sec from chicago to Newyork. Suppose that three sources, all located in chicago (each have 64 bit/sec of data that they want to transmit to individual users in New-york. As shown in figure given below, high bit rate channel can be divided int a series of time slots and slots can be alternatively used by 3 sources. The three sources are thus capable of transmitting all of their data across a single, shared chharel. This reverse process is called demultiplexing.

Time Division Multiplexing (TDM)

choosing the proper size for the time slots involves a trade off between efficiency and delay. If the time slots are 2 small, then the multiplexer must be fast enough and powerful enough to be constantly switching between sources and the demultiplexers must be fast enough and powerful enough to be constantly switching between the user. If the time slots are larger than one-bit, data from each source must to stored while other sources are using the channel. This storage will produce delay. If the time slots are too large, then a significant delay will be introduced between each sources and its user. Source applications, such as teleconferencing and videoconferencing cannot be tolerate long delays.

As shown in example, the sources that are multiplexed may have different bit rates, when this occurs each source is assigned a number of time slots in proportion to its transmission rate

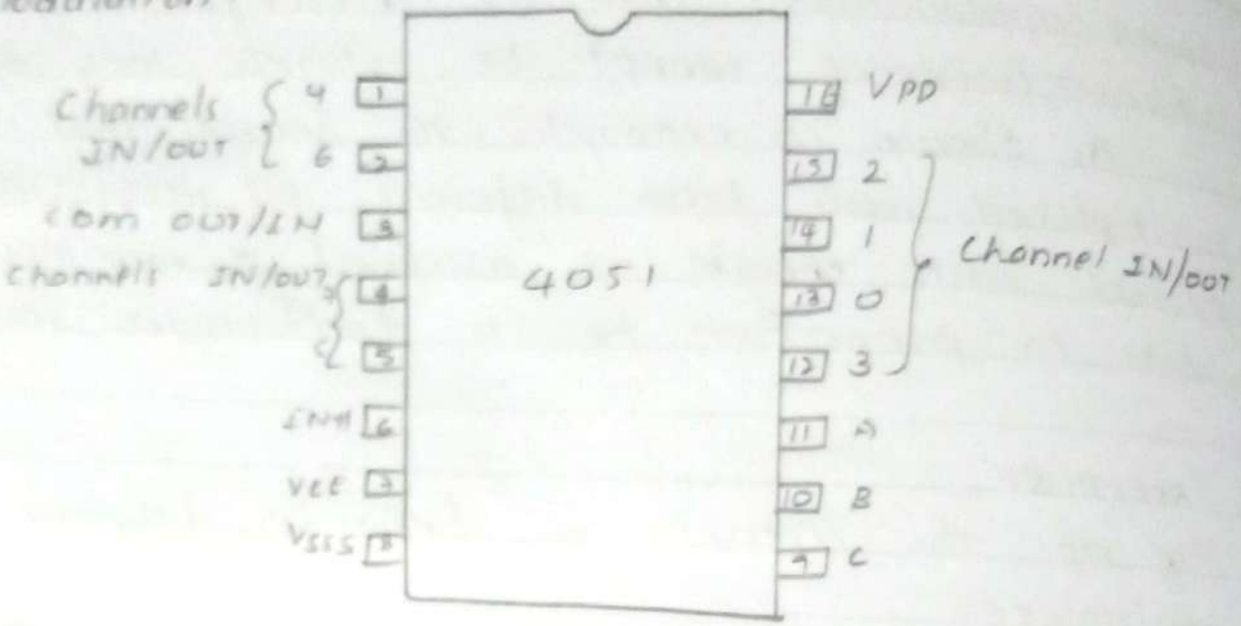
PROCEDURE:

1) Rig up the circuit as shown in diagram for multiplexer
2) feed the input message signal m_1 & m_2 of 2 Vp-p at 200Hz
3) feed the high frequency carrier signal of 2Vp-p at 2kHz
4) Observe the multiplexed output
5) Rig up the demodulator ckt as shown in the circuit diagram for demultiplexer
6) observe the demultiplexer output in the CRO.

Result :- Time Division multiplexing and demultiplexing was conducted and waveforms were observed.

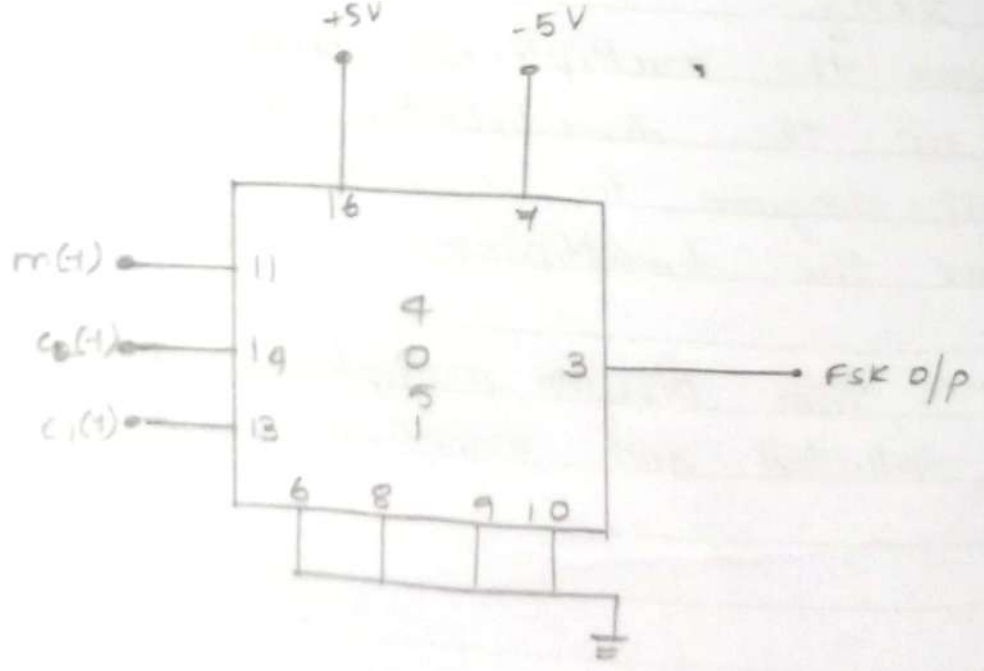
Circuit Diagram

Modulation:



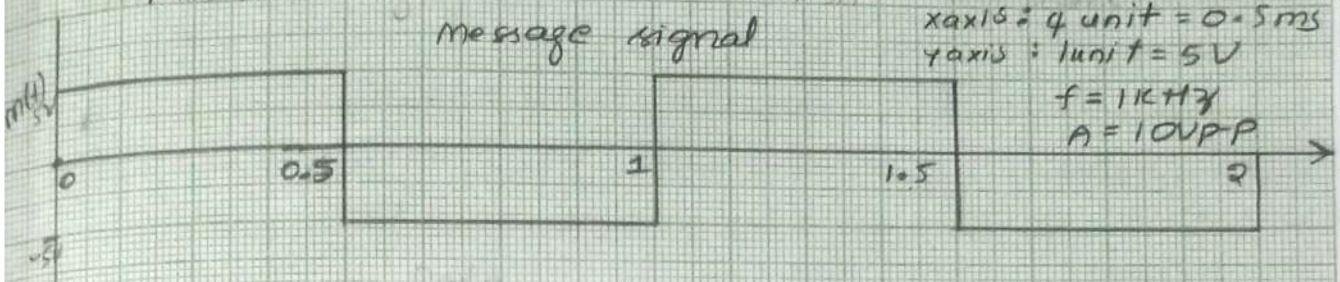
Circuit Diagram

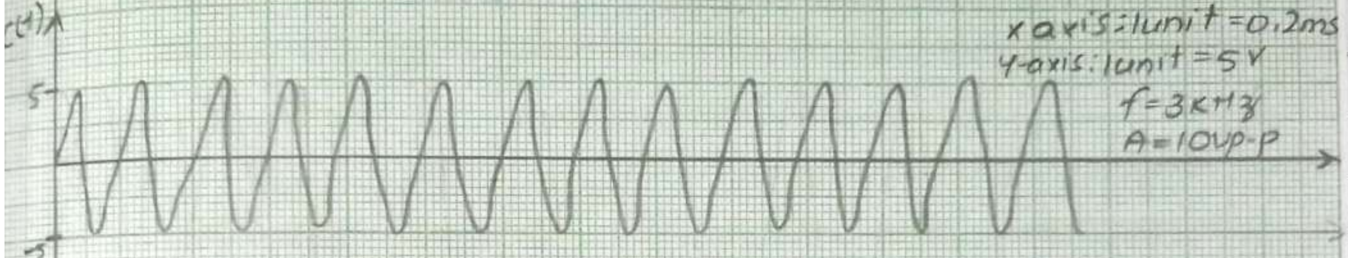
Modulator.

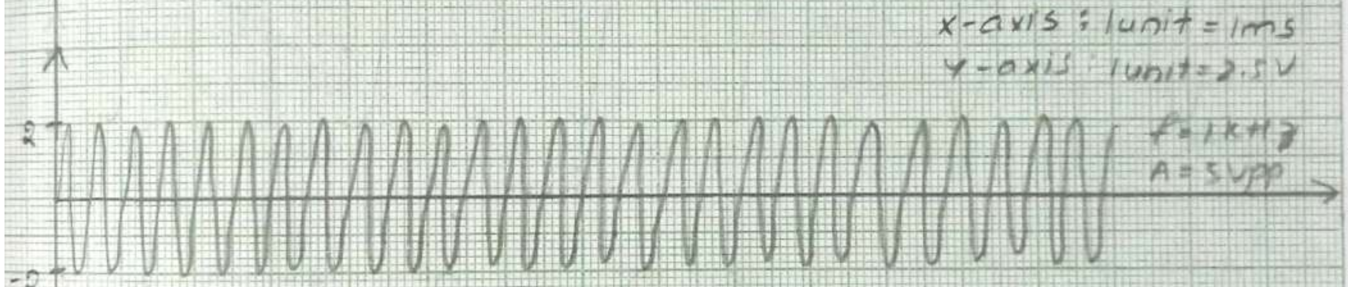


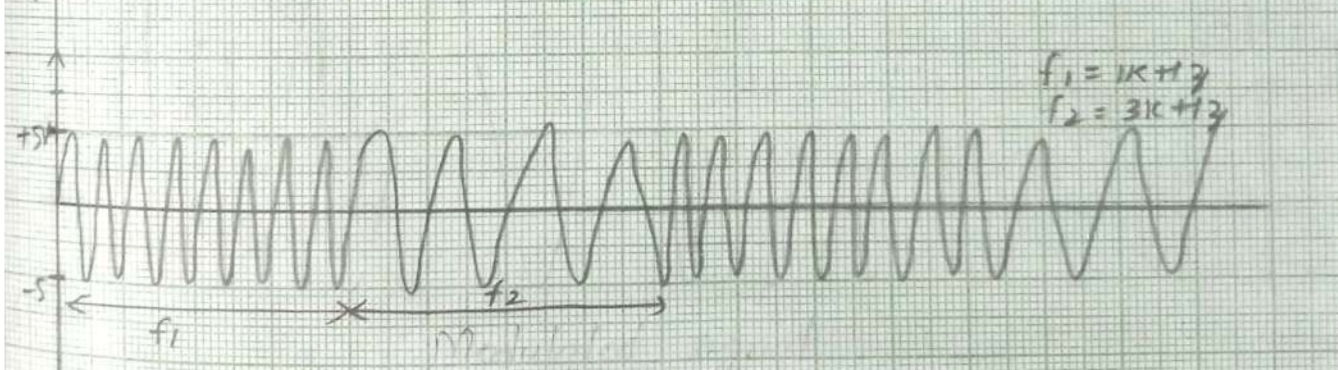
FREQUENCY SHIFT KEYING

Message signal









Demodulated waveforms

PD

Channel IN/OUT

→ FSK O/P

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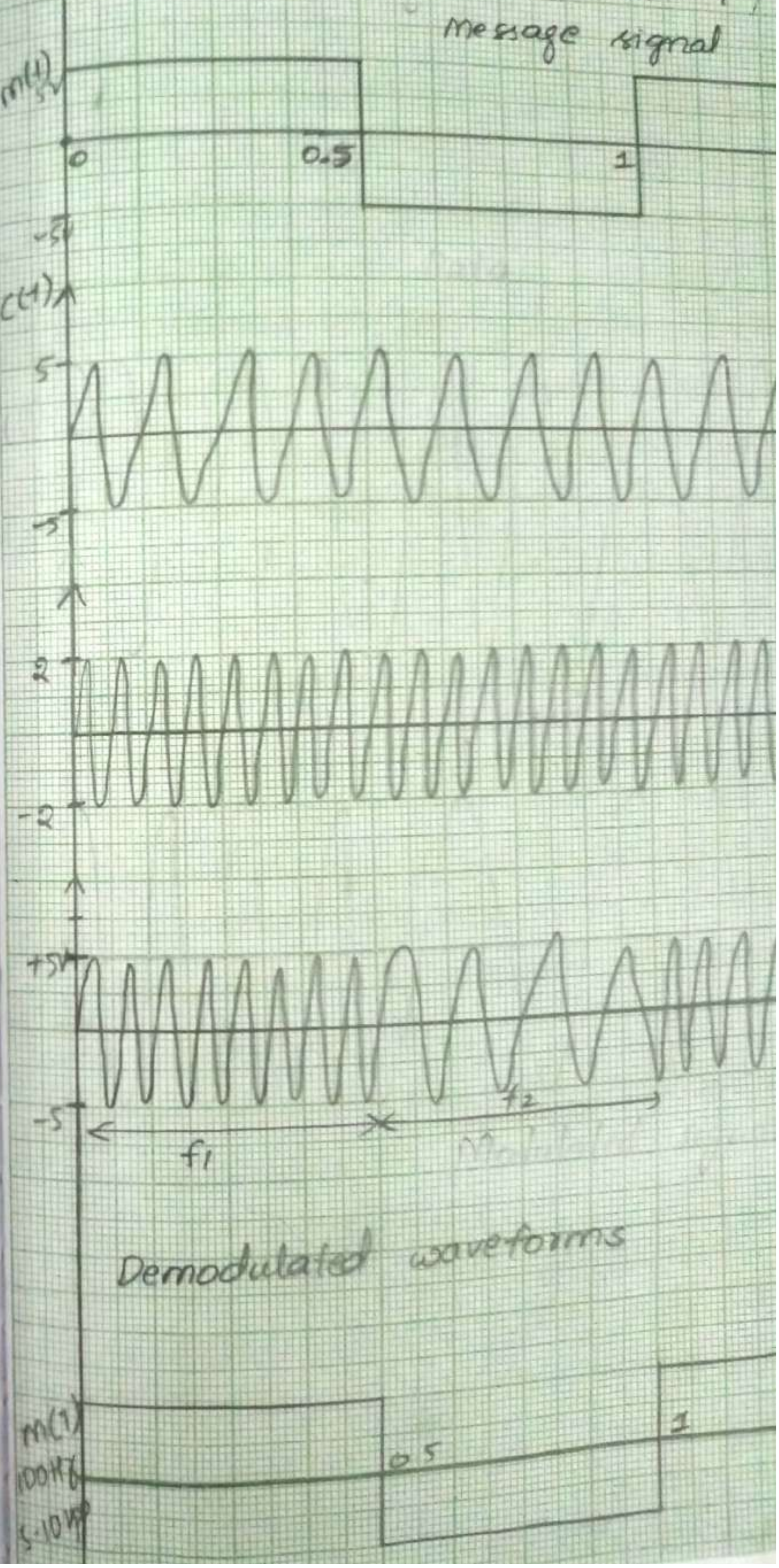
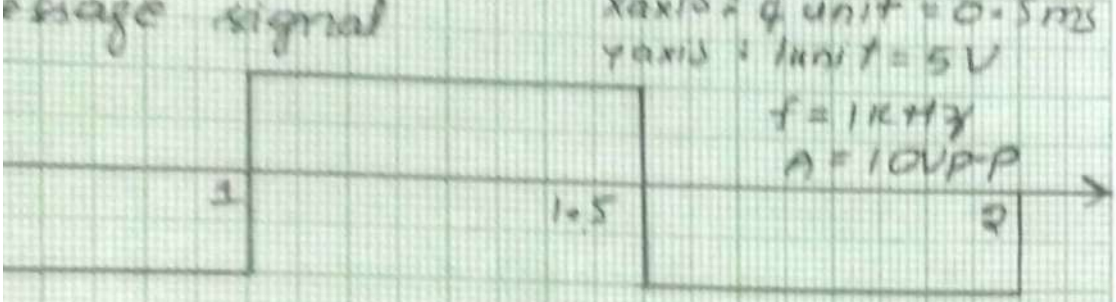
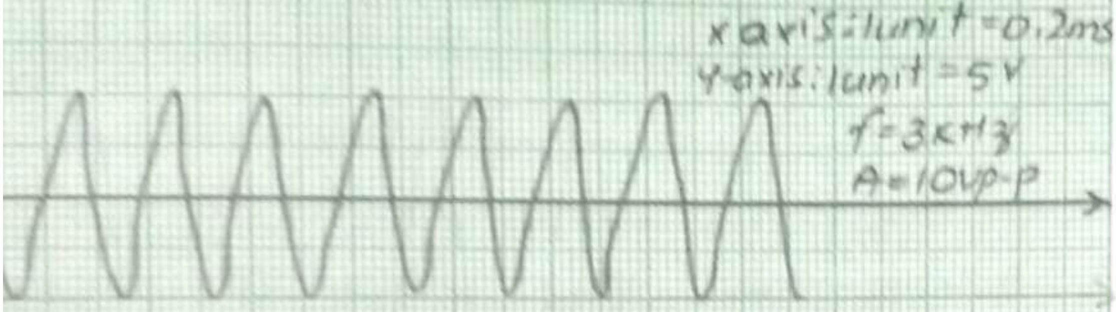
FREQUENCY SHIFT KEYING

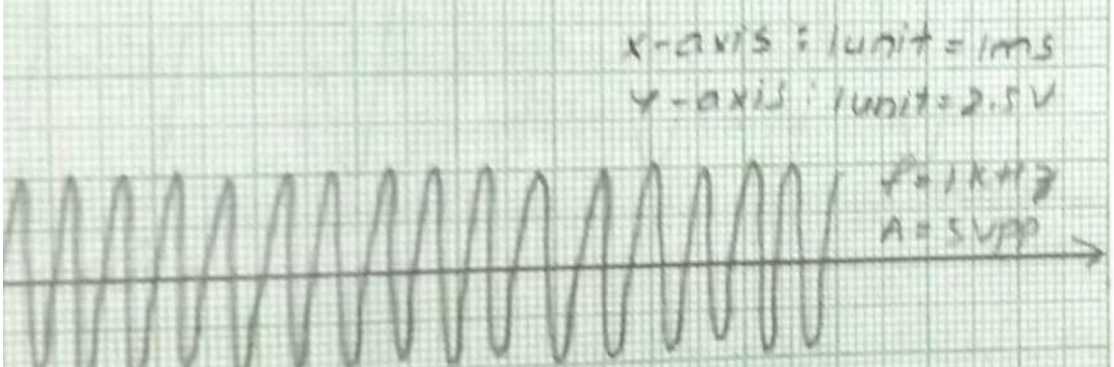


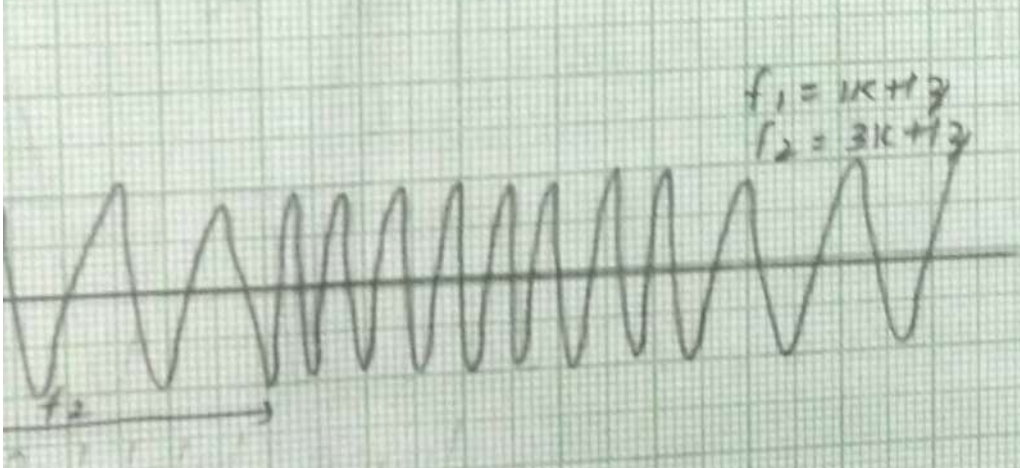
HIFT KEYING

essage signal

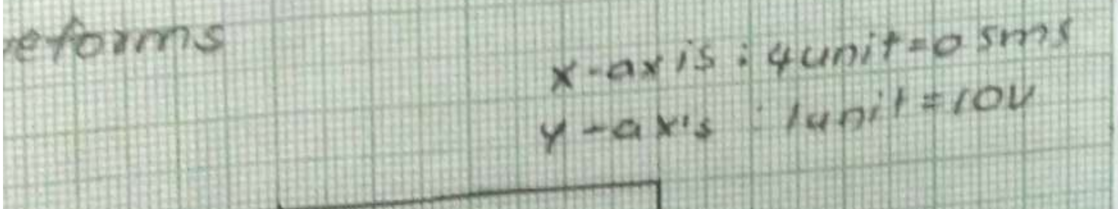








eforms



(Binary)

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with

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4no.s,
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FSK and PSK Generation and Detection (Binary)

a) FSK Generation and Detection

Aim:- Design and demonstrate the working of FSK with suitable circuit for carrier signals of , determine the frequency deviation and modulation index. Demodulate above signal with the help of suitable circuit.

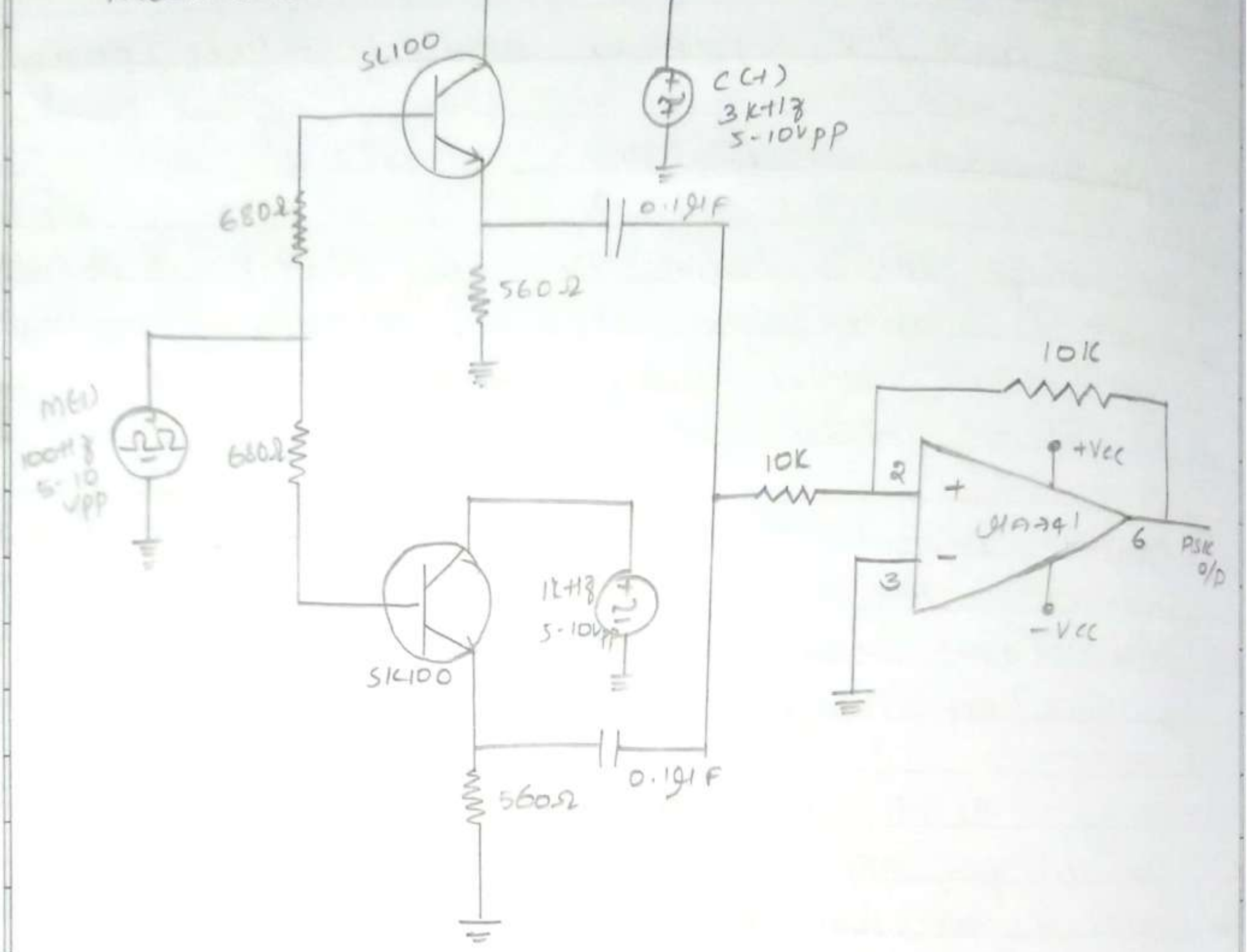
Apparatus Required: Transistors SL100, SK100, op-amp, μA741 2no.s Diode OA79, Resistors 680 Ω 2nos, 500 Ω 2no.s, 10K Ω 4no.s, 1K Ω, 10k Ω pot, capacitors 0.1 mF 3no.s, 0.22mF, function generator, Regulated DC power supply, spring board, CRO.

Theory:- As its name suggests, a frequency shift keyed transmitter has its frequency shifted by the message. Although there could be more than 2 frequencies involved in an FSK signal, in this experiment the message will be a binary bit stream and so only 2 frequencies will be involved. The word keyed suggests that the message is of the on-off (mark space) variety, such as one (historically) generated by a morse key or more likely in the present context, a binary sequence.

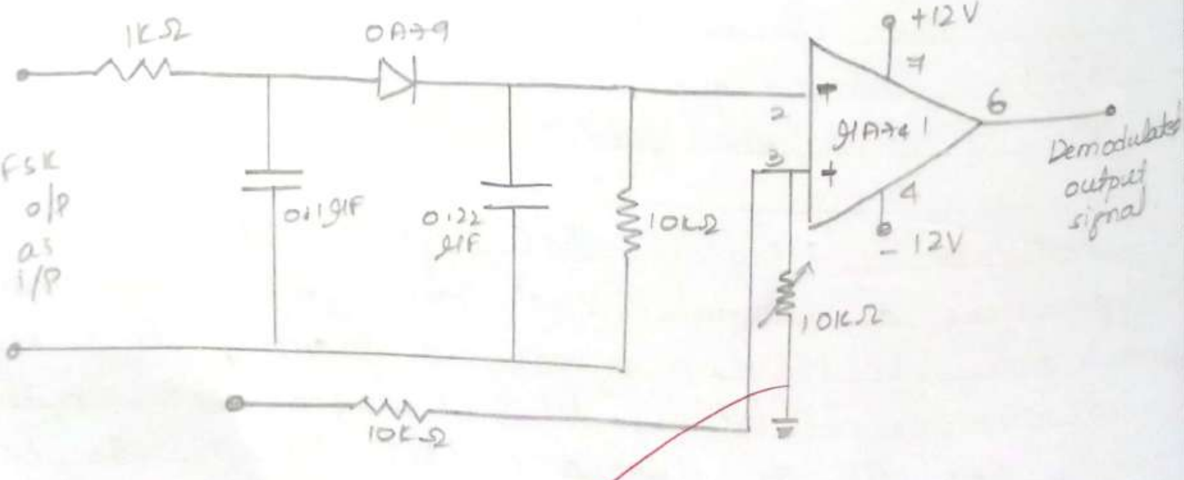
Modulation:- Frequency shift keying is the process of generating a modulated signal from a digital data input. If incoming bi is 1, a signal with frequency f_1 is sent for a duration of bit. If bit is 0, signal with frequency f_2 is sent for the duration of bit. This is the basic principle behind the FSK modulation. Two transistors are used

Teacher's Signature ______

Modulation



Demodulation



in switching configuration to obtain FSK signal. When the input bit is 1, NPN transistor is ON and corresponding carrier signal is output. If input bit is 0, PNP transistor is ON, and the corresponding carrier is output. In demodulator circuit the FSK modulated signal is applied to a low pass filter. Thus ASK is obtained and then demodulated using envelope detector and comparator

Demodulation:- There are different methods of demodulating FSK. A natural classification is into synchronous (coherent) (or) asynchronous (non-coherent)

Representative demodulator of these two types are the following

Asynchronous Demodulator:

A close look at waveform of fig. 1 reveals that it is the sum of 2 amplitude shift keyed (ASK) signals. The receiver of fig 3 takes advantages of this. The FSK signal has been separated into 2 parts by band pass filters (BPF) tuned to the MARK and SPACE frequencies.

The output from each BPF looks like an amplitude shift keyed signal. There can be demodulated asynchronously, using the envelope

The decision circuit, to which the outputs of the envelope detectors are presented, selects the output which is the most likely one of the 2 inputs. It also re-shape the waveform from a band limited to a rectangular form. This is in effect a 2 channel receiver. The bandwidth of each is dependent on message bit rate. There will be minimum frequency separation required of 2 tones

Design

Modulation

$I_{csat} = 2mA$, $h_{fe} = 30$, $V_{BE}\,sat = 0.7V$; $V_{CE}sat = 0.2V$

We know that $I_B = I_C / h_{fe}$

$= 2mA / 0.3$

$I_B = 0.0667mA$

choose $I_B = 6.67mA$ (To make quick-point be very much in saturation region)

Also $R_E = V_E / I_E$

$$= \frac{V_C - V_{CE}}{I_E} = \frac{5 - 0.2}{8.667mA} = 553.82\Omega$$

$$= \underline{\underline{560\Omega}}$$

Also $R_B = (V_m - V_{BE} - V_E) / I_B$

$= (10 - 0.7 - 4.8) / I_B = 675\Omega \approx \underline{680\Omega}$

Demodulation

For LPF :- To convert FSK signal to ASK, the LPF must allow 1KHz signal but reject 3KHz signal (or) vice-versa here, the LPF is designed to pass 1KHz, the design equation can be written as

$1KHz \quad I = 1/2\pi RC$

$f_{cLPF} < 3KHz$

Choose $\Rightarrow f_c = 1.5KHz$

let $C = 0.1mF$, then

$$R = \frac{1}{2pi\, f_{cLPF}\, C} = 1.06K\Omega$$

choose $R = 1K\Omega$

~~let $C = 0.1mF$ then~~

~~$R = \frac{1}{2pi}$~~

for Envelope detector

$$\frac{1}{f_c} < R \times C < \frac{1}{f_m}$$

$f_{max} = 3Hz$

$$\frac{1}{3KHz} < R \times C < \frac{1}{100}$$

$R \times C = 2.2ms$ &

let $= 0.22\mu F$, $R = 10K\Omega$

very much in saturation region)

$\frac{2}{\ldots 7mA} = 553.82\Omega$

$= \underline{560\Omega}$

$(V_{BE} - V_E) / I_B$

$\ldots .7 - 0 - 4.8) / I_B = 675\Omega \approx \underline{680\Omega}$

...t FSK signal to ASK, the LPF

...d but reject 3KHz signal (or) vice-versa

designed to pass 1KHz, the design

...itten as

...C

...z

$= 1.5KHz$

...F, then

$= 1.06K\Omega$

...fcLPF C

$1K\Omega$

let $C = 0.1\mu F$ then

$R = \frac{1}{2pi}$

for Envelope detector

$\frac{1}{fc} < R \times C < \frac{1}{fm}$

$f_{max} = 3Hz$

$\frac{1}{3KHz} < R \times C < \frac{1}{100}$

$R \times C = 2.2001$ &

$\ldots = 0.22 \mu F, R = 10K\Omega$

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Demodulation

For LPF :- To convert FSK signal to ASK, the LPF must allow 1KHz signal but reject 3KHz signal (or) vice-versa here, the LPF is designed to pass 1KHz, the design equation can be written as

$1\,KHz \quad f = 1/2\pi RC$

$f_{C,LPF} < 3KHz$

Choose $\Rightarrow f_c = 1.5KHz$

let $C = 0.1mF$, then

$$R = \frac{1}{2pi\, f_{C,LPF}\, C} = 1.06K\Omega$$

Choose $R = 1K\Omega$

let $C = 0.1mF$ then

$R = \frac{1}{2pi}$

for Envelope detector

$\frac{1}{f_c} < R \times C < \frac{1}{f_m}$

$f_{max} = 3Hz$

$\frac{1}{3KHz} < R \times C < \frac{1}{100}$

$R \times C = 2.2ms$ &

let $= 0.22\mu F$, $R = 10K\Omega$

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Synchronous Demodulator:

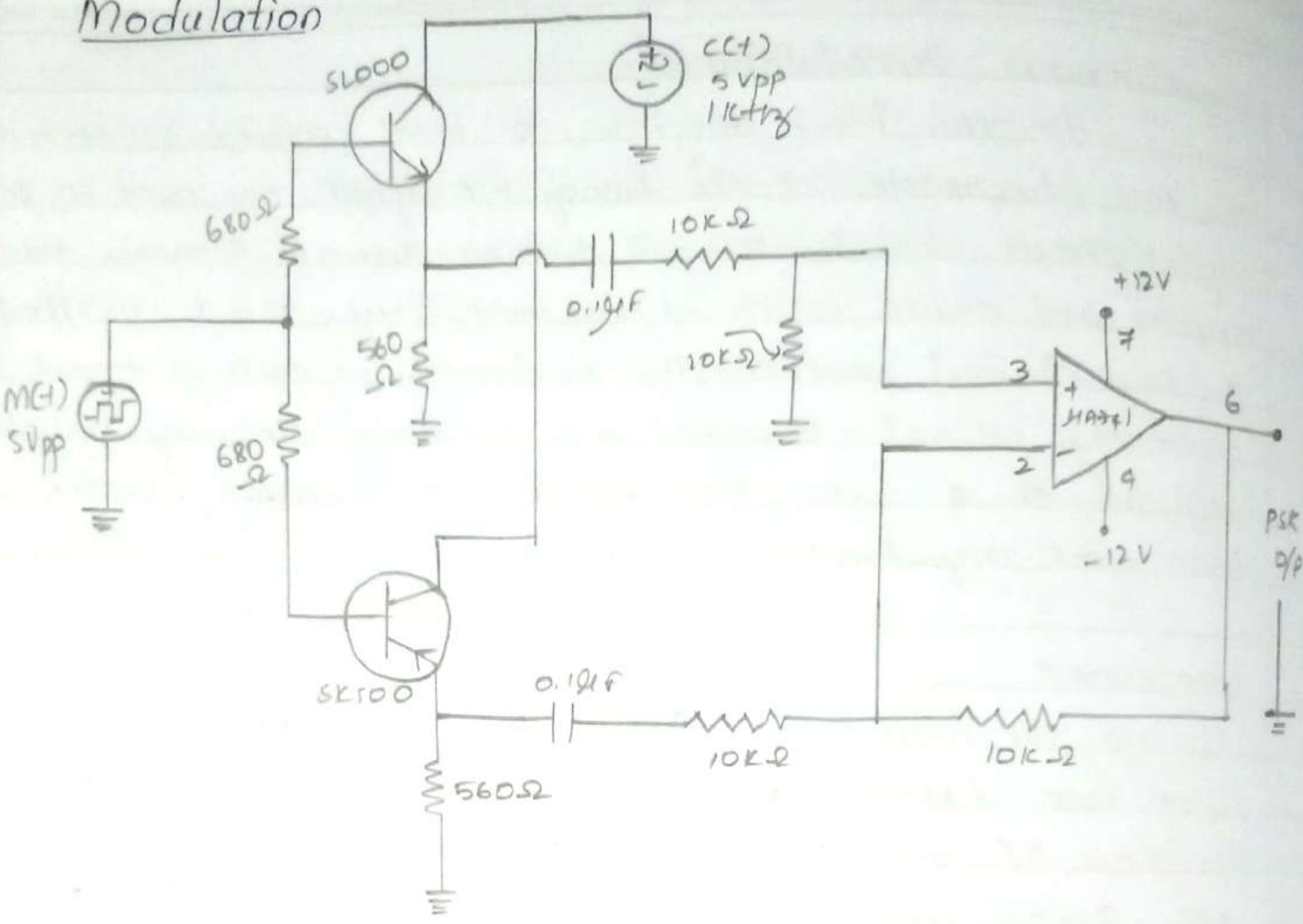
In the block diagram, 2 local carrier on each of the two frequencies of the binary FSK signal, are used in 2 synchronous demodulators. A decision circuit examines two outputs and decides which is the most likey. This is, in effect a two channel receiver. The bandwidth of each is dependent on message bit rate. There will be a minimum frequency separation required of 2 tones. This demodulator is more complex than most asynchronous demodulators

PROCEDURE

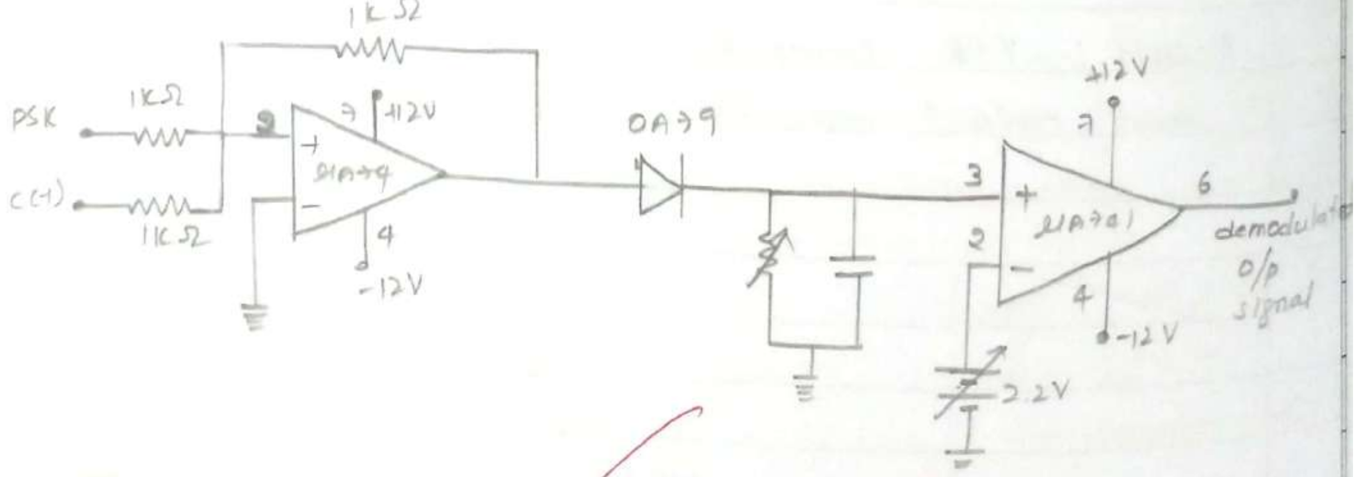
1) Rig up the circuit as shown in circuit diagram.
2) Give two different frequencies for carrier and message to the base of NPN and PNP transistor
3) FSK signals are obtained at the inverting amplifier terminal
4) For demodulation, convert FSK to ASK then demodulate the message signal by envelope detector and comparator.

Result :- FSK Generation and detection was conducted and output waveforms are observed.

Modulation



Demodulation



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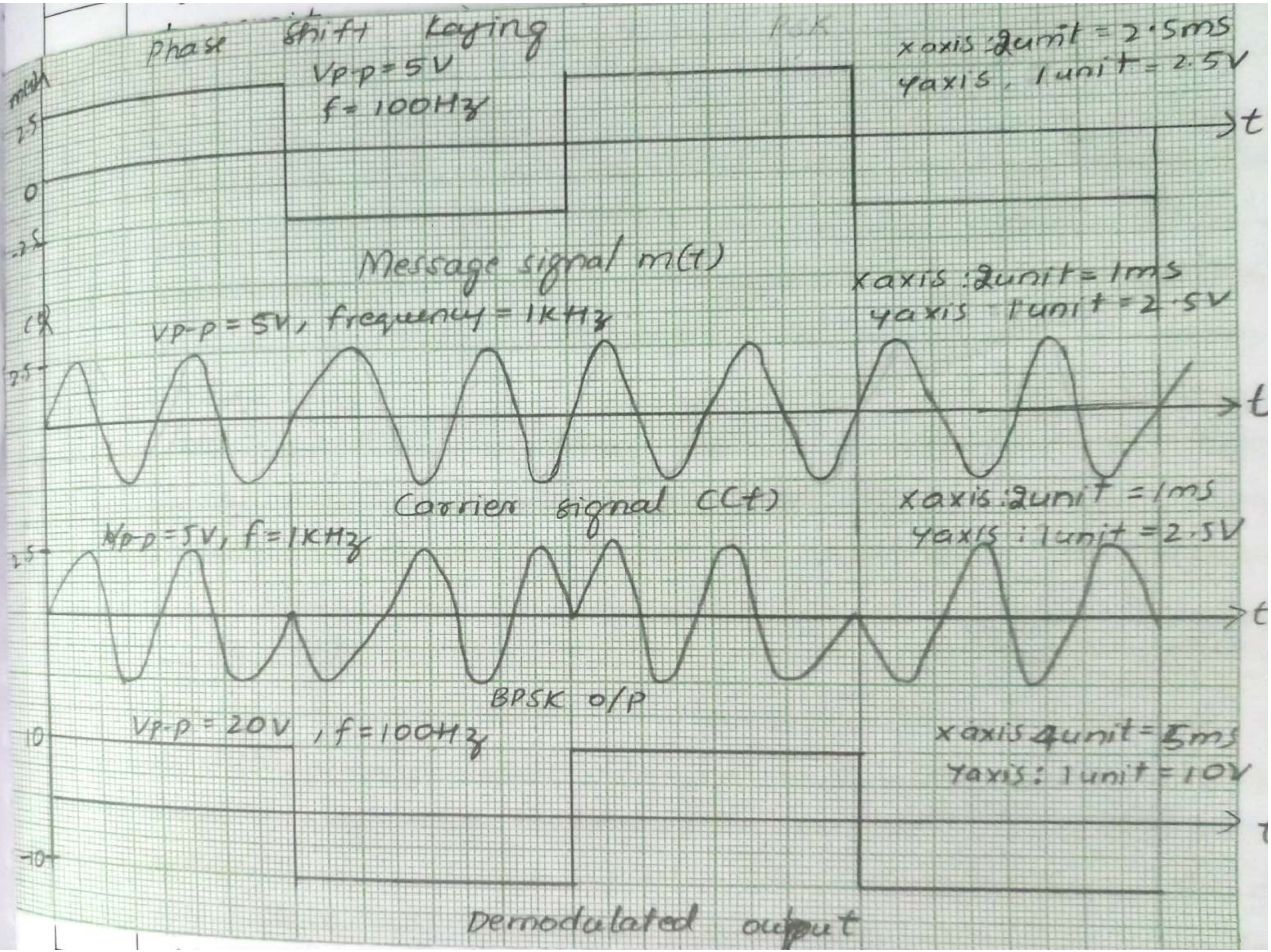
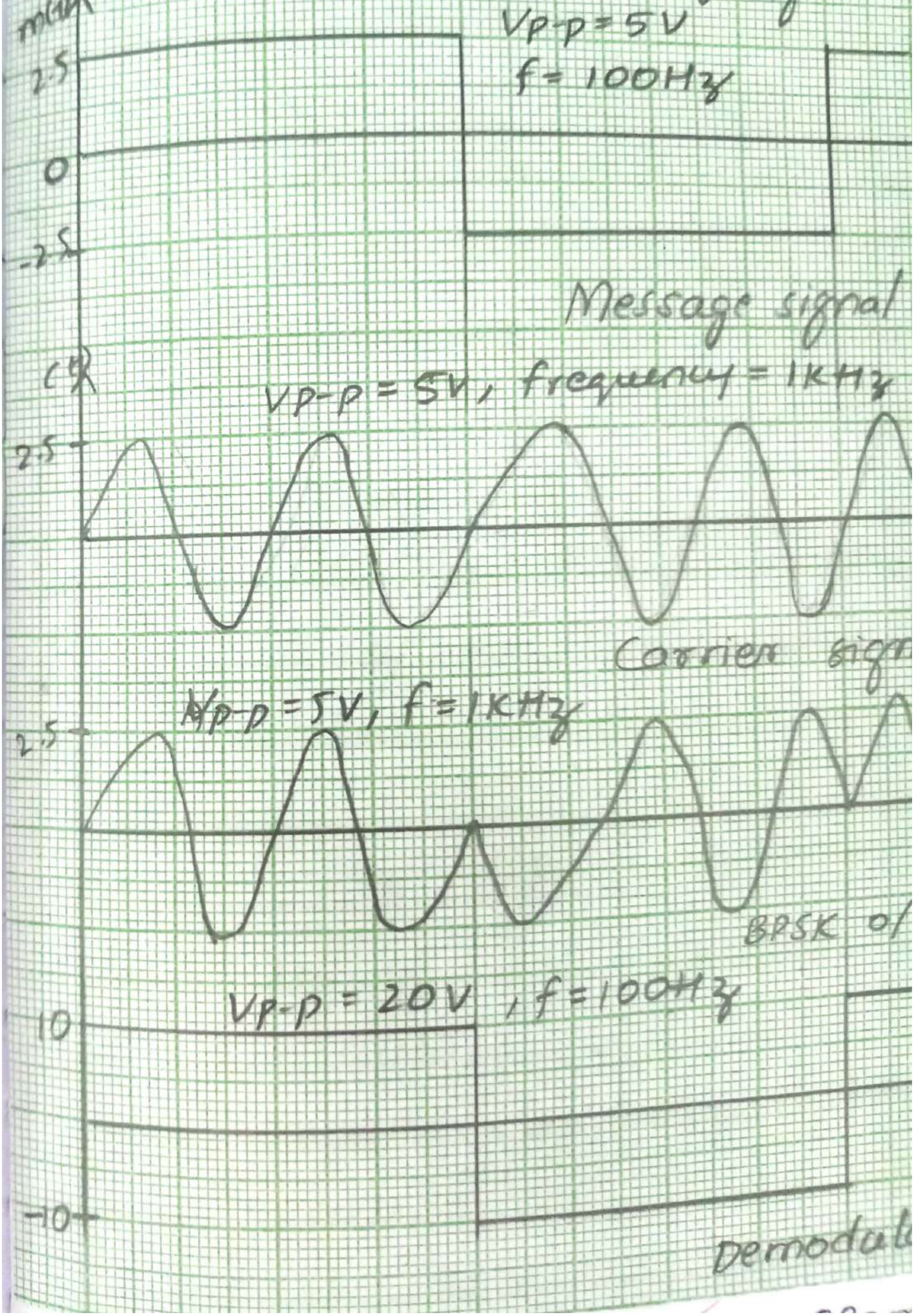
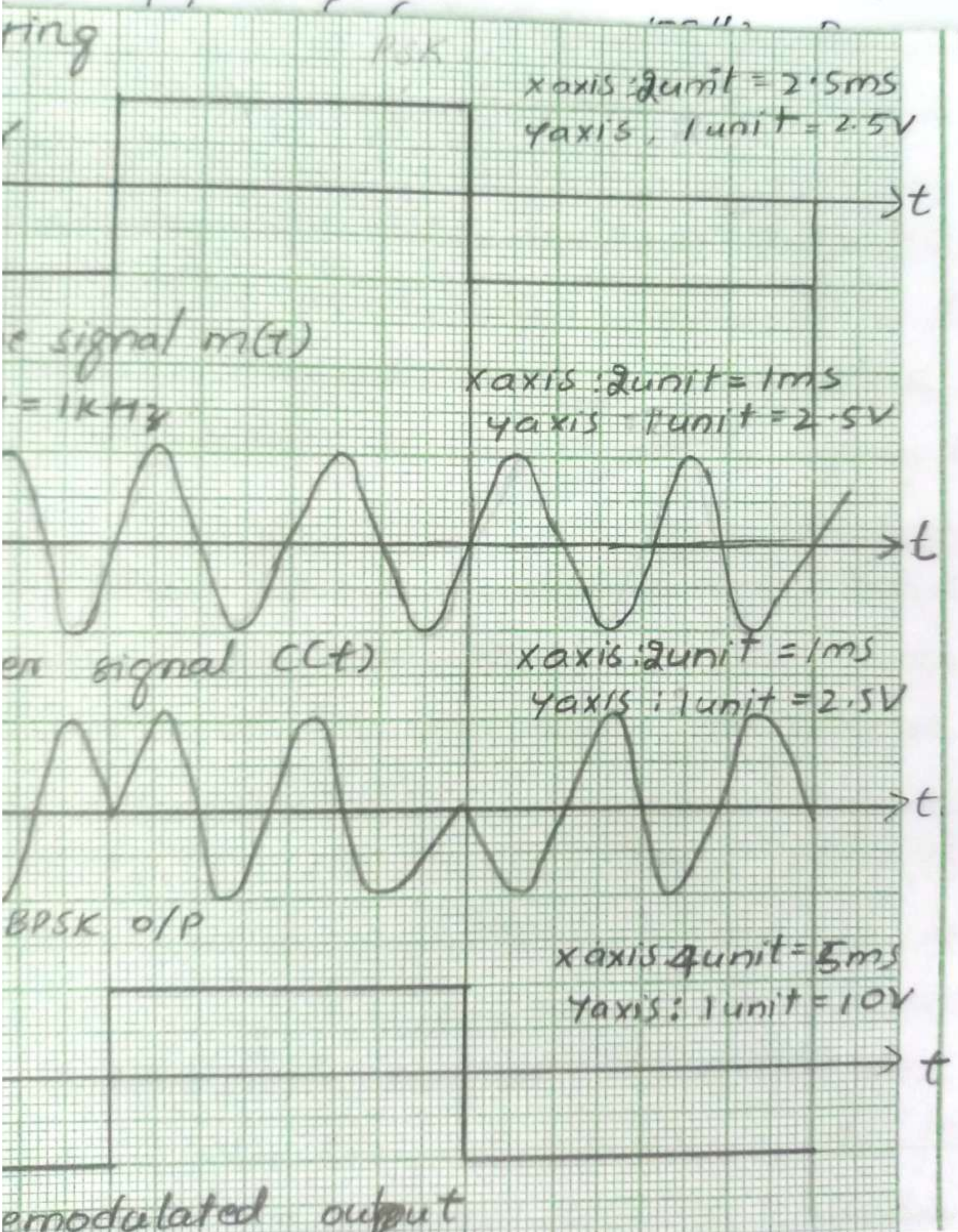

Phase shift keying
Vp-p = 5V
f = 100Hz
x axis : 2unit = 2.5ms
y axis , 1unit = 2.5V
m(t)
2.5
0
-2.5
t
Message signal m(t)
x axis : 2unit = 1ms
y axis 1unit = 2.5V
c(t)
Vp-p = 5V, frequency = 1KHz
Carrier signal c(t)
x axis : 2unit = 1ms
y axis : 1unit = 2.5V
Vp-p = 5V, f = 1KHz
BPSK o/p
Vp-p = 20V , f = 100Hz
x axis 2unit = 5ms
Y axis : 1unit = 10V
10
-10
Demodulated output

Phase Shift Keying



ion and Detection

and demonstrate the working of BPSK modulated
given carrier signal of frequency 1KHz to



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b) PSK Generation and Detection

AIM:- Design and demonstrate the working of BPSK modulated signals for a given carrier signal of frequency 1KHz to transmit a given data of frequency 100Hz. Demonstrate the BPSK signal to recover the digital data

APPARATUS REQUIRED:- Transistor SL100, CK100, op-amp, μA741, 3nos Diode OA79, Resistors 560Ω 2no.s, 680Ω 2no's, 10kΩ 6no.s, capacitors 0.1μF 2no.s, 0.22mF, potentiometer 10kΩ 2no.s, function generator, Regulated DC power supply, Spring board, CRO.

THEORY: Phase shift keying is a digital modulation technique, A cosinusoidal carrier of a fixed amplitude and frequency is taken. The digital data of 1's and 0's is converted to

$s(t) = A\cos(2\pi f_c t)$

$s(t) = A_c\cos(2\pi f_c t + p)$ respectively. Here, phase shift keying is obtained using a switch followed by op-amp circuitary. If incoming bit is 0, the output is same as the carrier. If it is zero, the output of 180° phase shifted version of carrier signal. For demodulation the PSK signal is converted to ASK signal using opamp circuit and then ASK signal using opamp circuit and then ASK signal is demodulated using an envelope detector and comparator.

Design

a) Modulation:

$I_{C\,sat} = 2mA$, $h_{fe} = 30$, $V_{BEsat} = 0.7V$, $V_{CEsat} = 0.2V$

W.K.T $I_B > I_C / h_{fe}$

$> 2mA/30$

$I_B > 0.0667mA$, So choose $I_B = 6.67mA$. Also

$R_E = V_E / I_E = (V_C - V_{CE}) / I_E$

$= (5 - 0.2) / 8.667mA = 553.82\Omega \approx 560\Omega$

Also $R_B = (V_m - V_{BE} - V_E) / I_B$

$= (10 - 0.7 - 4.8) / I_B = 675\Omega \approx 680\Omega$

b) Demodulation

$1/f_c < RC < 1/f_m$

here $f_{max} = 1KHz$

$1/1KHz < RC < 1/100$

$1ms < RC < 10ms$

$RC = 2.2ms$ and let $C = 0.22mF$

then $R = 10k\Omega$ (pot).

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PROCEDURE

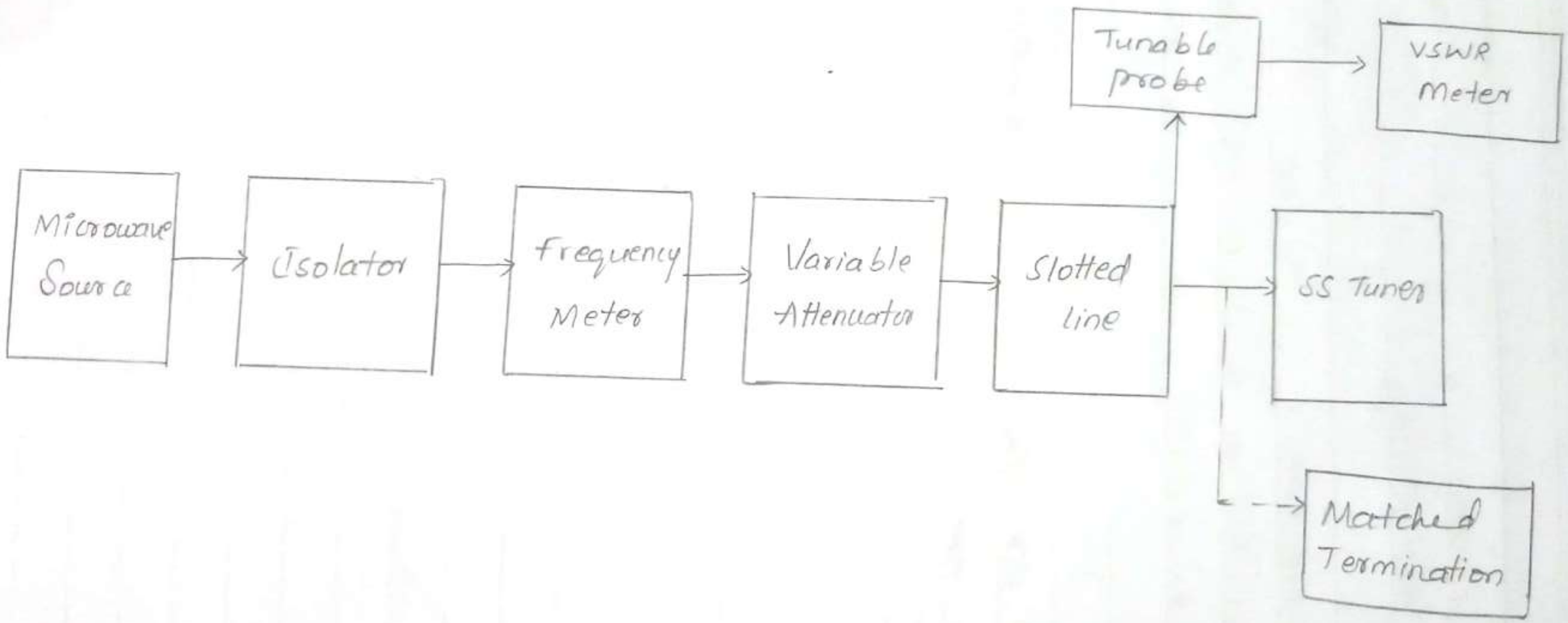
1) Rig up the circuit as shown in circuit diagram
2) Carrier wave and message is given as input of switching circuit
3) Observe the PSK output on the CRO
4) PSK output is fed as input to the demodulated circuit
5) Observe the demodulated output on the CRO.

RESULT :- PSK Generation and detection has been done. and waveforms were observed.

Teacher's Signature

(A) Measurement of frequency and Guide wave length

Block Diagram:



Measurement of frequency, Guide wavelength, power, VSWR and attenuation in a microwave Test Bench

AIM :- To measure the frequency, guide wavelength, power, VSWR and attenuation in a microwave test bench.

APPARATUS :- Microwave Test bench and accessories

THEORY :- A microwave test bench consists of a microwave source (modulation option also exists), isolator (to protect the source from reflected power), variable attenuator and a frequency meter, a slotted line, slide screw tuner, a tunable probe along with a crystal detector and VSWR meter to measure power on VSWR values for a given load value.

The VSWR value can be used to further calculate the magnitude of the reflection co-efficient of a load. The phase shift w.r.t to a reference plane can be measured by moving the tunable probe along the slotted section of the waveguide and the phase of the reflection co-efficient can also be calculated. In practice if unknown load impedance has to be measured, we can find out of the load impedance value using the reflection coefficient measurements.

A VSWR meter is sensitive high gain, high Q, low noise voltage amplifier tuned normally at a fixed frequency of 1kHz at which the microwave signal is modulated. The output of the tunable probe is connected to a crystal detector. The output of

OBSERVATIONS

Range: 8.54 to 8.56

$d_1 = MSR + CVD(LC) = 10.2 + 3(0.01)$

$MSR = 10.2$ $\qquad d_1 = 10.23cm$

$CVD = 3$

$LC = 0.01$

$d_2 = 7.6 + 3(0.01) = 7.631cm$

$$\frac{\lambda g}{2} = d_1 \sim d_2$$

$$\lambda g = 2[d_1 \sim d_2]$$

$$\lambda g = 2(10.23 - 7.631)$$

$$\lambda g = 5.198cm$$

$$\lambda c = 2a = 2 \times 2.3 = 4.6cm$$

$$\frac{1}{\lambda_0^2} = \frac{1}{\lambda g^2} + \frac{1}{\lambda c^2}$$

$$\frac{1}{\lambda_0^2} = \frac{1}{(5.198)^2} + \frac{1}{(4.6)^2}$$

$$\frac{1}{\lambda_0^2} = 0.08426$$

$$\lambda_0 = 3.44500368$$

$$f_0 = \frac{c}{\lambda_0}$$

$$= \frac{3 \times 10^8}{3.44500368}$$

$$f_0 = 8.70 \simeq 8.54 GHz$$

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the tunable probe is connected to the crystal detector. The output of this detector is amplified and gives as input to the VSWR meter. The detector works in square law region. The meter directly gives the VSWR reading Vmax/Vmin for an input of Vmin, after the meter is adjusted to unity VSWR for an input corresponding to Vmax.

PROCEDURE:-

1) Set up the components and Equipments as shown in the block diagram above. First use a matched termination and disconnect the SS tuner.
2) set up variable attenuator at minimum attenuation position
3) Keep the control knobs of VSWR meter as below
Range - 50dB
input switch - Crystal low impedance
Meter switch - Normal position
Gain (coarse and fine) - Mid position.
4) Keep the control knobs of klystron power supply as below
Beam voltage - off
Mod - switch - AM
Beam voltage knob - fully anticlockwise
Reflector voltage - fully clockwise
AM - Amplitude knob - Around fully clockwise
AM - frequency knob - Around mid position.
5) Switch 'ON' the klystron power supply, VSWR meter/CRO.
6) Switch 'ON' the beam voltage switch and set beam voltage at 250V with the help of beam voltage knob.

Teacher's Signature ____________

VSWR

$$VSWR : \frac{V_{max}}{V_{min}}$$

$$V_{max} = 48m \quad V_{min} = 20m$$

$$VSWR = \frac{48m}{20m} = 2.4$$

7. Adjust the reflector voltage to get some deflection in VSWR meter.
8. Maximize the deflection with AM amplitude and frequency control knob of power supply. The following controls can also control the deflection in VSWR meter.
9. Tune the frequency meter knob to get a dip on the VSWR scale and note down the frequency directly from frequency meter.
10. Now, replace the matched termination, with movable short, and detune the frequency meters.
11. Move the probe along the slotted line the deflection VSWR meter will vary. Move the prob to be maximum deflection position, to get accurate reading. If necessary increase the VSWR meter range dB switch to be higher position. Note and record the probe position. These position can also be noted with the help of a CRO instead of VSWR meter.
12. Move the probe to next minimum position and record the probe position again.
13. Calculate the guide wavelength as twice the distance between two successive minima positions, obtained from above. These calculations can also be done using successive maxima positions. Tabulate the results of this positions as shown in the table and below
14. Measure the wavelength inner broad diminesions 'a' which will be around 22.86mm for X-band
15. Calculate the frequency by using equations given after the table.

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B) Measurement of VSWR and power

Using the set up shown in the block diagram previously, first move the probe along the slotted line to get maximum deflection in VSWR meter.

(1) Adjust VSWR meter gain control knob (or) variable attenuator untill the meter indicates 1.0 on normal VSWR scale.

(2) keep the entire control knob, as it is, move the probe to the next minimum position measurement is being performed. Read the VSWR on scale and power in dB from the VSWR meter.

(3) Repeat the above step for change of SS tuner probe death and record and the corresponding VSWR

(4) If the VSWR is between 3.2 and 10, change of S.S tuner prob depth and record the corresponding VSWR the range dB switch to next higher position and real the VSWR on second VSWR scale of 3 to 10

(C) Measure of Attenuation.

(1) Fix a particular attenuation value in the attenuator. Then move the probe along the slotted line to get maximum deflection in VSWR meter. Adjust the control knob of VSWR meter. Adjust the gain control knob of VSWR meter if necessary. Note the power value(P_1) in dB as seen from the VSWR meter.

(2) Vary the variable attenuator knob by X-dB without disturbing any settings on the VSWR meter, not the power value for this reading on the attenuator (P_2)

Teacher's Signature

(3) Compute $P_2 - P_1$. This must be equal to X-dB which is the attenuation of the attenuator

(4) The above experiment can be done to calculate the attenuation of a given unknown attenuator. ~~An~~

D) Measurement of Relative and Absolute Power.

(1) In the above measurement of attenuation, if P_1 is made as a reference power level, the power output P_2 is the relative power output level due to the device AUT (or) due to the extra X-dB setting in the variable attenuator. If by some other method (ex: using power meter etc...), we known the exact power level for the case of P_1 then P_2 can be mapped to its absolute value and the absolute power measurement can be done.

Result:- Frequency measured in microwave testbench is $f_0 = 8.54$ GHz and VSWR = 2.4

Teacher's Signature

OBSERVATIONS:

DIPOLE ANTENNA: E-PLANE S=7cm.

CLOCKWISE			ANTICLOCKWISE		
ANGLE	POWER (dB)	Normalization	ANGLE	POWER(dB)	Normalization
0	-32.2	0	0	-32	0
10	-32	-0.2	10	-34.5	-2.5
20	-34.5	-2.3	20	-39	-7
30	-39.5	-7.3	30	-45	-13
40	-44.5	-12.3	40	-52	-20
50	-50	-17.8	50	-55	-23
60	-54.5	-22.3	60	-56	-24
70	-55.5	-23.3			
80	-55.5	-23.3			

DIPOLE ANTENNA: H PLANE

CLOCKWISE			ANTICLOCKWISE		
ANGLE	Power (dB)	N.P	ANGLE	Power (dB)	N.P
0	-34.5	0	0	-34.5	0
10	-35	-0.5	10	-35.8	-1.3
20	-36	-1	20	-36.8	-2.3
30	-38	-3.5	30	-40.2	-5.7
40	-40.2	-5.2	40	-43	-8.8
50	-43	-8.5	50	-45.6	-11.1
60	-46	-11.5	60	-47.5	-13
70	~~-48~~ -50	-15.5	70	-52.2	-17.7
80	-55.5	-21	80	-62.2	-27.7

Measurement of Directivity and Gain of Microstrip patch Antenna, Dipole and Yagi antenna.

Aim:- To measure the directivity and gain of antenna standard dipole, microstrip patch antenna and Yagi antenna

COMPONENTS REQUIRED:- Power supply, Microwave source different type transmitting and receiving antenna, frequency meter, Active filter, VSWR

THEORY:- If a transmission line propagating energy is left open at one end, there will be radiation from this end. The radiation pattern of an antenna is a diagram of field strength (or) more often the power intensity as a function of aspect angle at a constant distance from the radiating antenna. An antenna pattern is of course three dimensional but for practical reasons it is normally presented as a two dimensional pattern is one (or) several planes. An antenna pattern consists of several lobes, main lobe, side lobes and back lobe. The major power is concentrated in main lobe and it is required to keep the power in side lobes and back lobe as low as possibile The power intensity at maximum of the main lobe compared to power intensity achieved from an imaginary omni-directional antenna with the same power fed to the antenna is defined as gain of the antenna.

As we known that the 3dB beamwidth is the angle between the two points on a main lobe where the power intensity is half the maximum power intensity. When measuring an antenna platform, it is normally most interesting to plot the

Teacher's Signature

$$D = \frac{42000}{\theta_E \times \theta_H} = \frac{42000}{32 \times 50} = 2625$$

$$G = \frac{4\pi S}{\lambda_0} \sqrt{\frac{P_r}{P_t}}$$

$$= \frac{4\pi \times 7 \times 10^{-2}}{12.5 \times 10^{-2}} \sqrt{\frac{0.0245}{0.0562}}$$

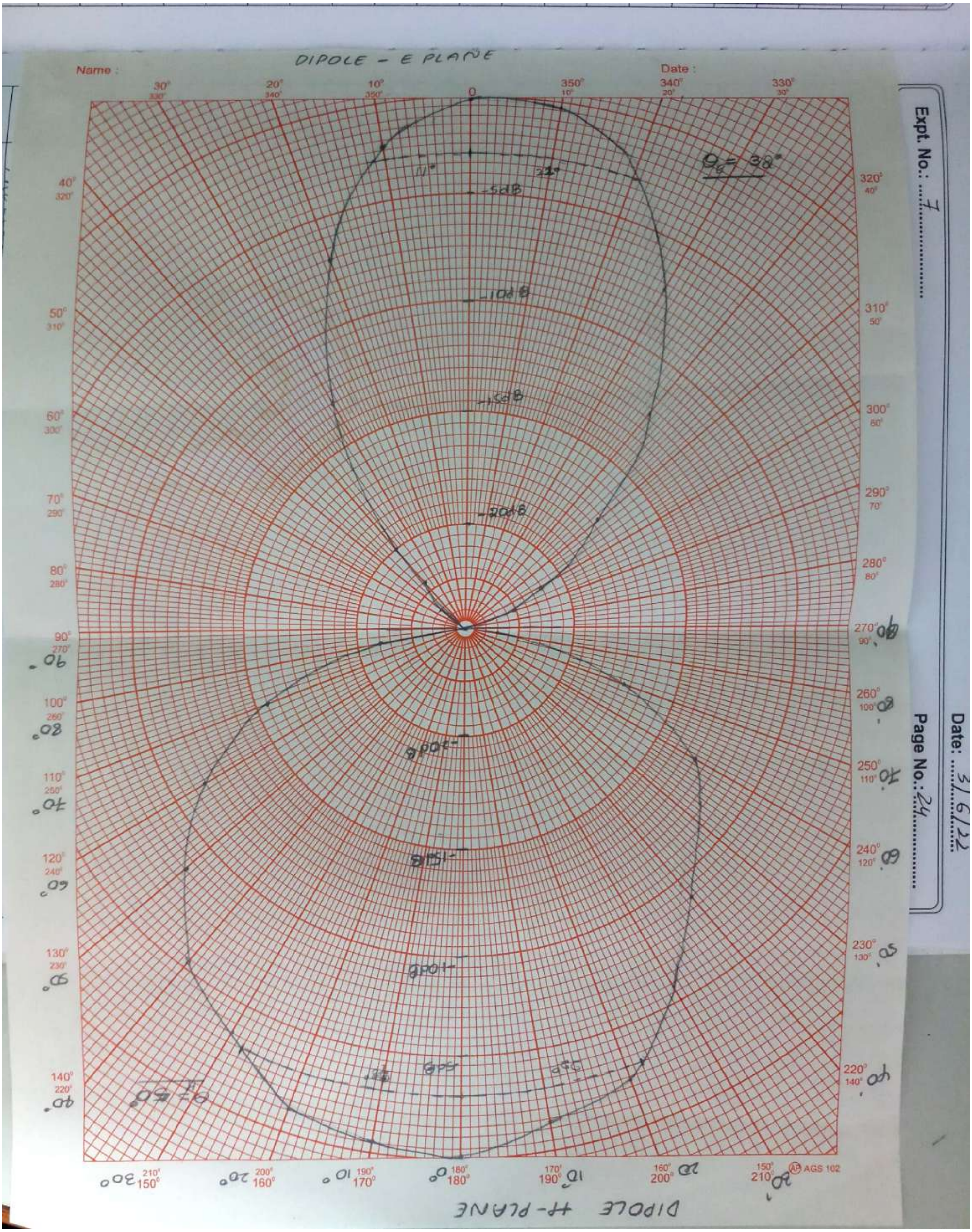
$$G = 4.644.$$

$P_r = -32.2\,dB$

$20 \log \cancel{P_r}\, x = -32.2\,dB$

$P_r = 0.0245$

$P_t = -25\,dB = 0.0562$



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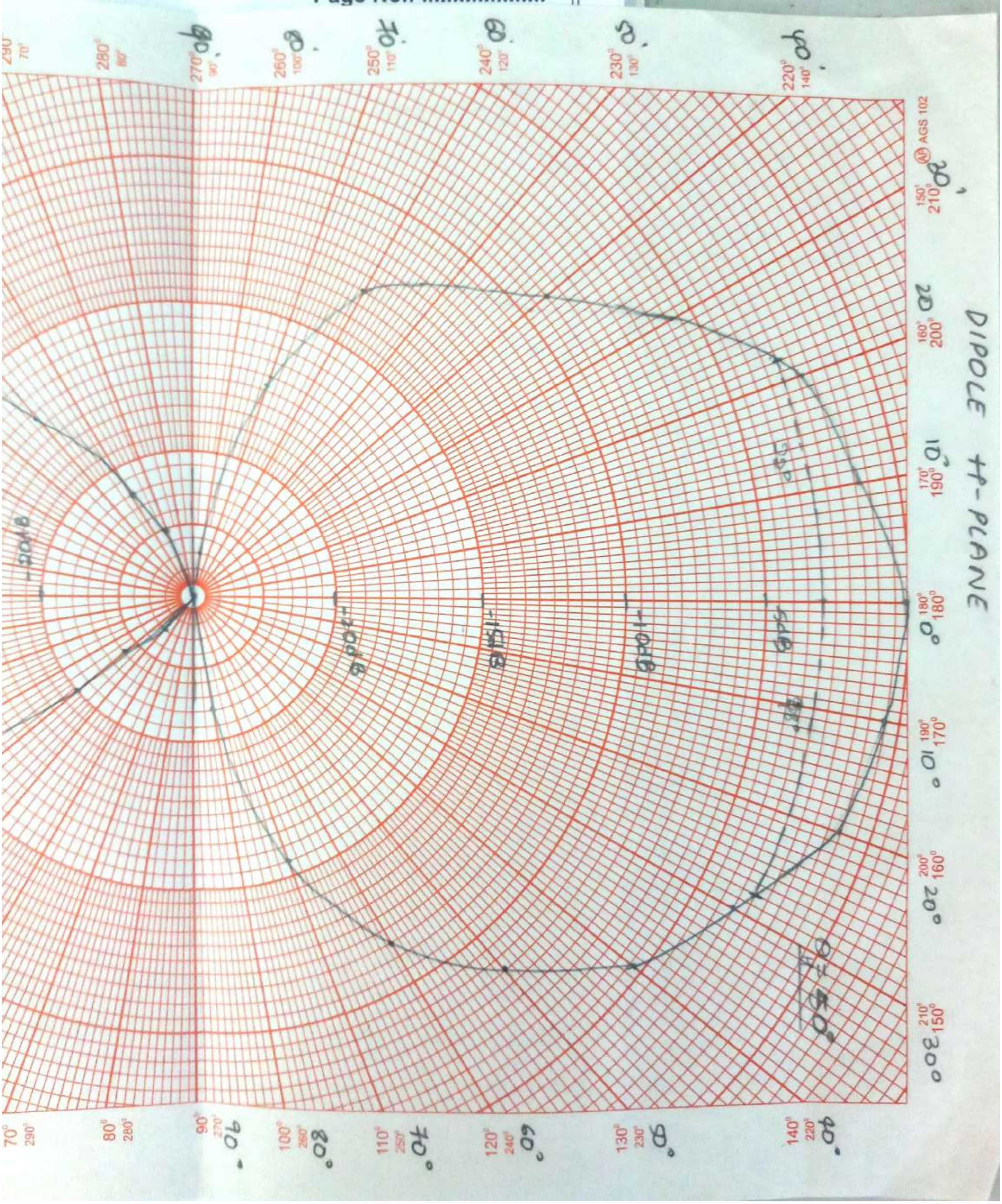


pattern far from the antenna. It is also very important to avoid disturbing reflection antenna measurements are normaly made at anechoic chambers. One method is to compare the unknown antenna with a standard gain antenna with known gain. Another method is to use two identical antennas, as transmitter and other as receivers from following formula, gain can be calculated

wher pt is transmitted power

P_r is received power

G_1, G_2 - gain of transmitting and receiving antenna

S - radial distance between two antennas

ω - is free space wavelength

If both, transmitting and receiving antenna are identical having gain G then above equation becomes

$$P_r = \frac{P_t * \lambda_0^2 G^2}{(4\pi S)^2}$$

$$G = \frac{4\pi S}{\lambda_0}\sqrt{\frac{P_r}{P_t}}$$

In above Equation P_t, P_r, S and λ_0 can be measured and gain can be computed. As is evident from the above equation, it is not necessary to know the absolute value of P_t and P_r only ratio is required which can be measured by SWR meter.

PROCEDURE:

Directivity Measurement:

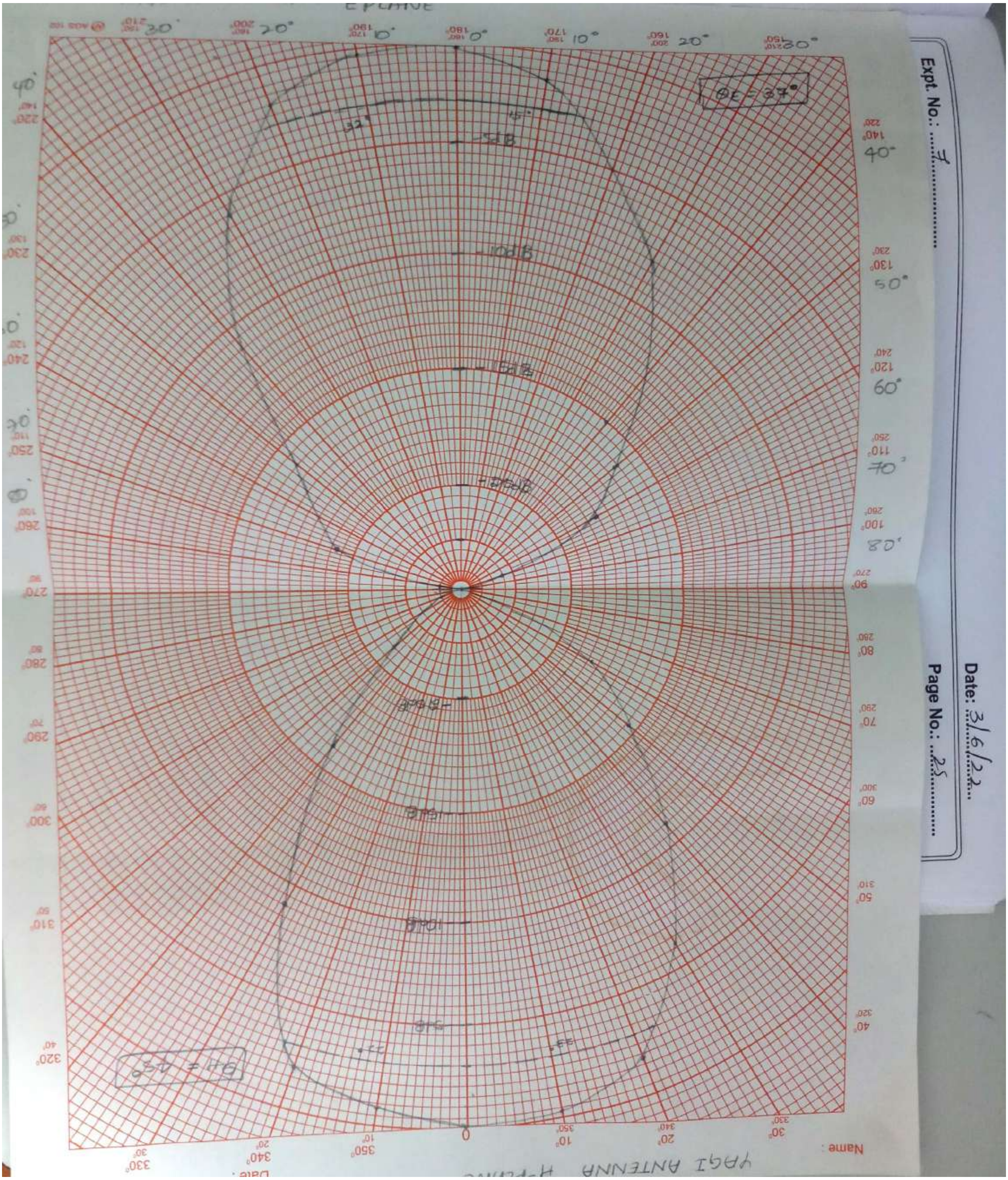
(1) Connect a mains cord to the microwave Generator and SWR meter.

YAGI ANTENNA : H-PLANE   S=11.5 cm

CLOCKWISE			ANTICLOCKWISE		
ANGLE	POWER	NP	ANGLE	POWER	NP
0	-34	0	0	-34	0
10	-34.9	-0.9	10	-34.3	-0.3
20	-35.6	-1.6	20	-35.5	-1.7
30	-43	-9	30	-40.2	-6.2
40	-50.2	-16.2	40	-45	-11
50	-55	-21	50	-49.4	-15.4
60	-62	-28	60	-52.4	-18.4

YAGI ANTENNA - E PLANE

CLOCKWISE			ANTICLOCKWISE		
ANGLE	POWER	NP	ANGLE	POWER	NP
0	-33	0	0	-33	0
10	-34.5	-1.5	10	-33.2	-0.2
20	-38	-5	20	-35	-2
30	-41	-8	30	-39	-6
40	-48	-15	40	-44	-11
50	-49	-16	50	-49	-16
60	-51	-18	60	-52.4	-19.4
70	-57	-24	70	-58	-25


E PLANE
θE = 37°
-3dB
-10dB
-15dB
-20dB
θH = 42°
YAGI ANTENNA H-PLANE
Expt. No.: 7
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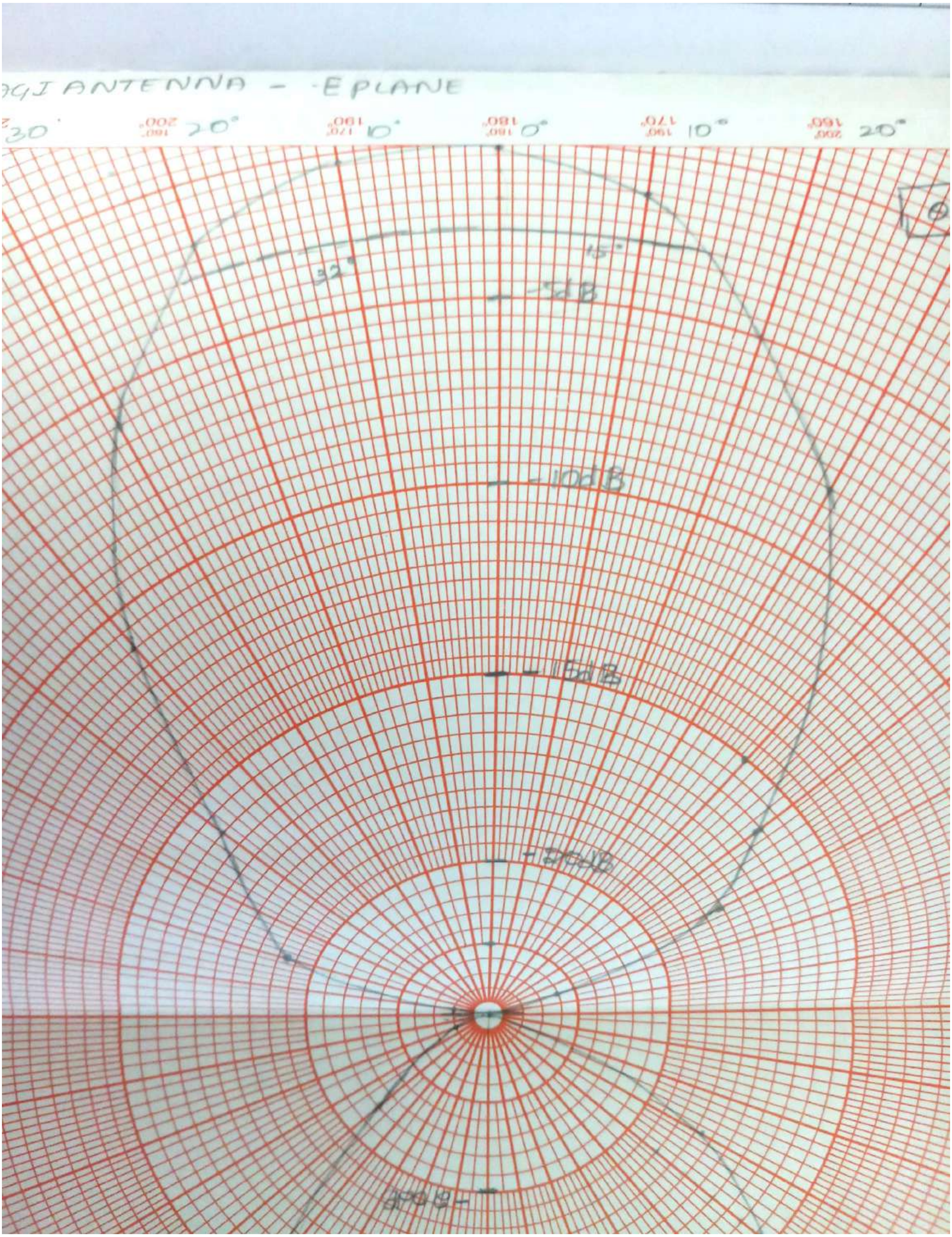
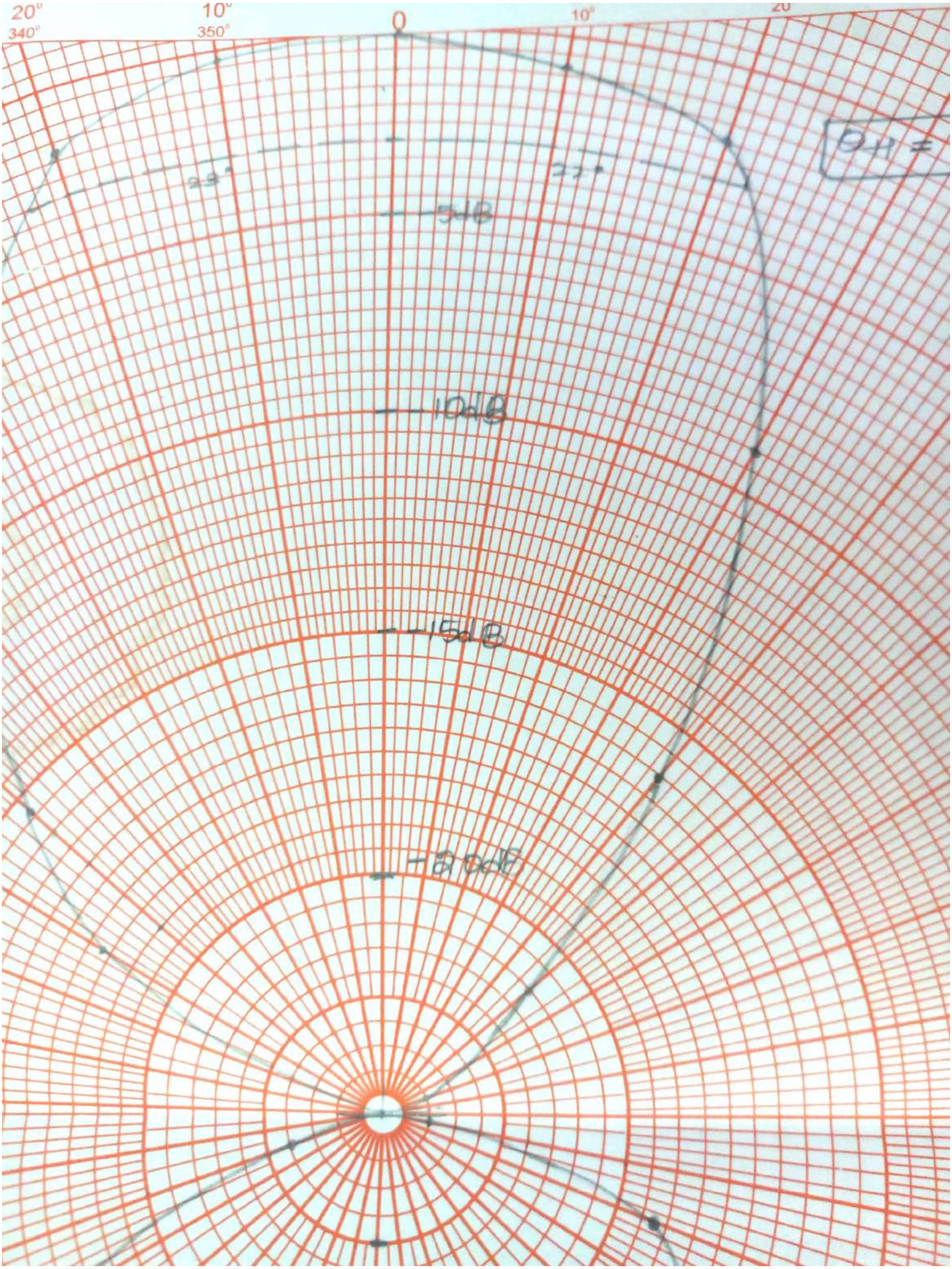
Name :


AGI ANTENNA - EPLANE
30°
20°
10°
0°
10°
20°
32°
15°
-5dB
-10dB
-15dB
-20dB


20°
340°
10°
350°
0
10°
5dB
10dB
15dB
-20dB
θH =

(2) Now connect a Yagi antenna in horizontal plane to the transmitter mast and connect it to the RF. Output of microwave generator using a cable (SMA to SMA)

(3) Set both the potentiometer at fully clockwise position

(4) Now take another Yagi antenna and RF amplifier from the given suitcase.

(5) Connect the input terminal of Amplifier to the antenna in horizantal plane using an SMA (male) to SMA (female) L connector.

(6) Now connect the output of the Amplifier to the input of detector and mount the detector at the Receiving mast.

(7) Connect one end of the cable (BNC to BNC) to the bottom side of receiving mast and another end to the input of SWR meter.

(8) Now set the between Transmitter and the Receiver at half meter.

(9) Select the transmitter of internal AM Mode and press the switch on "RF on".

(10) Select the range switch at SWR meter at 40-dB position with normal mode.

(11) Set both the gain potentiometers at fully clockwise position and input select switch should to at 200 ohms position. In case if reading is not available at - and B range then press 200K ohm to get high gains reading.

(12) Now set any value of received gain at 40dB position with the help of

* frequency of the microwave Generator
* Modulation frequency adjustment
* Adjusting the distance between transmitter and Receiver

$D = \cancel{4}1200$

$$D = \frac{32400}{\Theta_{Hp}\,\Theta_{HE}} = \frac{32400}{37 \times 45} = 19.4594$$

$$G = \frac{4\pi S}{\lambda_0}\sqrt{\frac{P_r}{P_t}} = \frac{4\pi * 11.5 \times 10^{-2}}{12.5 \times 10^{-2}}\sqrt{\frac{0.01995}{0.0562}} = 6.885$$

$P_r = -34dB = 0.01995$

$P_t = -25dB = 0.0562$.

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(13) With these adjustments you can increase (or) decrease the gain.

(14) mark the obtained reading on the radiation pattern plot at zero degree position.

(15) Now slowly move the receiver antenna in the steps of 10 degree and plot the corresponding readings.

(16) This will given the radiation pattern of the antenna under test

(17) ~~B~~ This will given the radiation pattern of the antenna under test

(18) Directivity of antenna is the measures of power density an actual antenna radiates in the direction of its strongest emission. ~~so~~

(19) In the same way you can measure the directivity of dipole antenna

Gain Measurement

(1) Connect a power cable to the microwave generator and SWR meter.

(2) Connect a Yagi antenna in horizontal plane to the transmitter mast and connect it to the RF output of microwave generator using a cable (SMA to SMA)

(3) Set both the potentiometer at fully clockwise position.

(4) Now take another Yagi antenna from the given surface

(5) Connect this antenna to the detector with a help of SMA (male) to SMA (female) connector

(6) Connect detector to the receiving mast.

(7) Connect one end of the cable to bottom side of receiving mast and another end to input of skip meter.

Teacher's Signature ____________

(8). Now set the distance between transmitter (feed point) and receiver at half meter.

(9) Now set the receiving antenna at zero degree and switch on the power from both generator and SWR meter.

(10) Select the transmitter for internal AM mode and press the switch "RFON"

(11) Select the range switch at SWR meter at 40-dB position with normal mode.

(12) Set both the gain potentiometers at fully clockwise position and input select switch shld be at 200 ohm position

(13) Now set the maximum gain in the meter.

(14) Measure and record the received power in dB. P_r = ____

(15) Now remove the detector from the receiving End and also remove the transmitting Yagi antenna from RF output.

16. Observe the output of detector on SWR meter that will be the transmitting power P_t = ____ dB

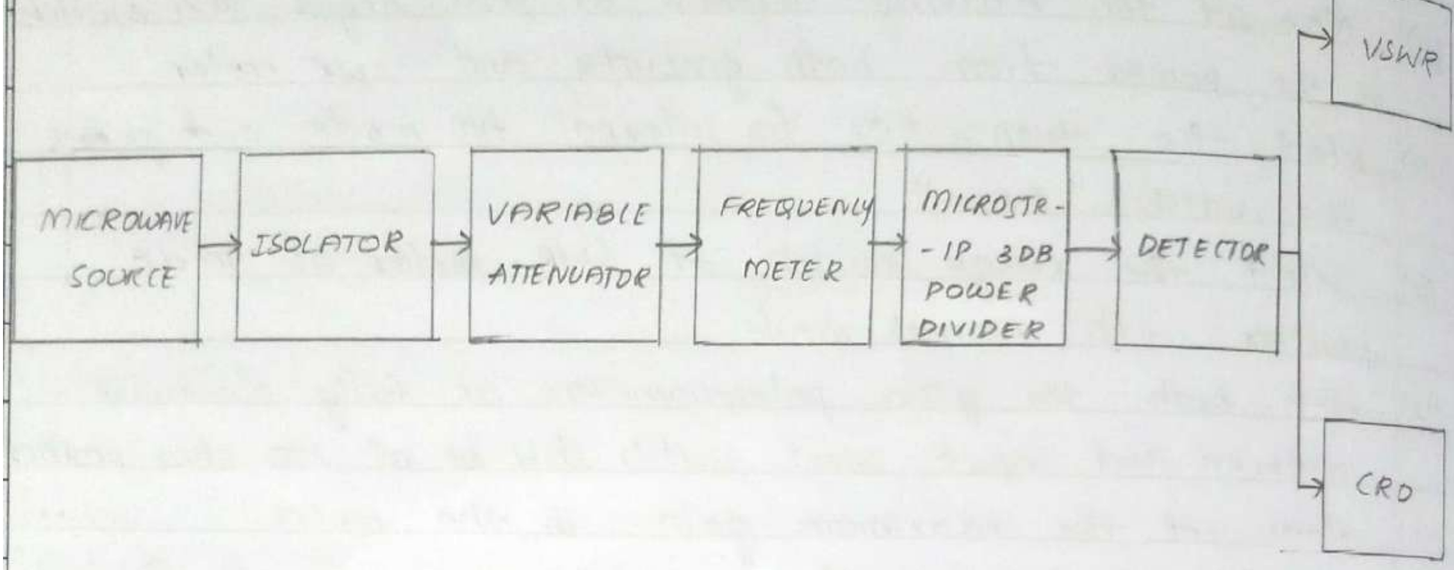
17. Calculate the difference in dB between the power measured in steps 14 and 15 which be the power ratio P_t/P_r

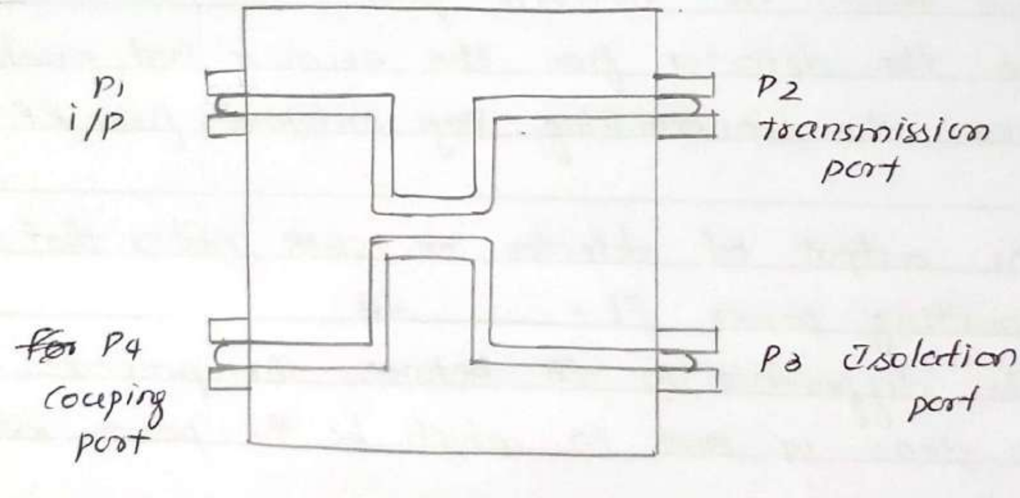
18. Gain of antenna is $G = \frac{4\pi S}{\lambda_0}\sqrt{\frac{P_r}{P_t}}$

19. Gain can be measured with the help of absolute power meter also. For these detector will not be used and directly the power sensor can be connected to both the ends as described earlier.

Result:- Directivity and gain of dipole and Yagi antenna has been measured

Circuit Diagram.





8a) Determination of Coupling and Isolation characteristic of microstrip directional coupler.

AIM:- To determine coupling and isolation characteristic of microstrip directional coupler

COMPONENTS: Power supply, microwave source, 50 ohm transmission line, Branch line coupler, frequency meter Active filter, VSWR

THEORY: A directional coupler is a four port device, where in port-1 called input port is given input power. The output port is in the main line, which gets more of the input port. The coupler takes very small amount of input power and serves as a reference measurement in many application. The isolated power should not receive any power ideally. The port is isolated from the input port. Directional coupler is used after the antenna in a receiver circuit. This helps in monitoring reflected power. In a transmit circuit, antenna is connected after the directional coupler, this helps in monitoring incident and reflected power to the antenna and from the antenna.

PROCEDURE:

(1) Set up the system as shown in figure
(2) Keeping the voltage at minimum, switch on power supply
(3) Insert a 50Ω transmission line and check for the output also the end of the system.

Tabular Column.

f (GHz)	P1 (dB)	P2 (dB)	P3 (dB)	$S_{21} = P_2 - P_1$	$S_{31} = P_3 - P_1$
2.3	23	25	25.5	2	2.5
2.4	24	24	24.4	2	0.4
2.5	28	33.6	34	5.6	6
2.6	29	33.4	33.8	4.4	4.8
2.7	31	34.3	34	3.3	3
2.8	30	34.5	34.2	4.5	4.2

$\boxed{f = 2.7\,GHz}$

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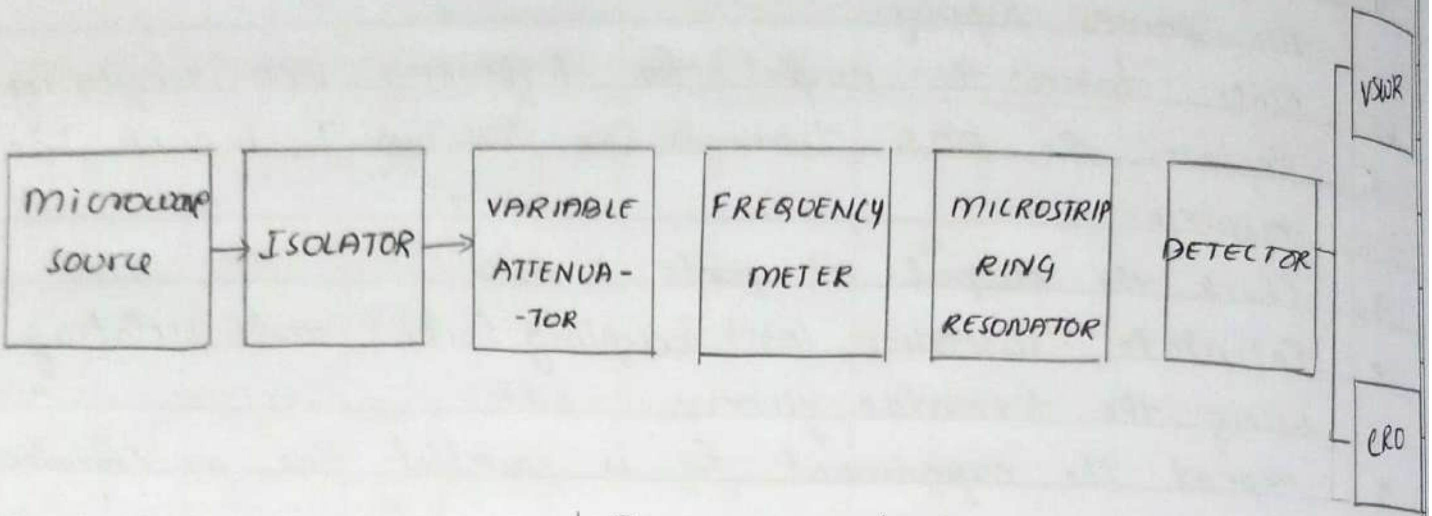
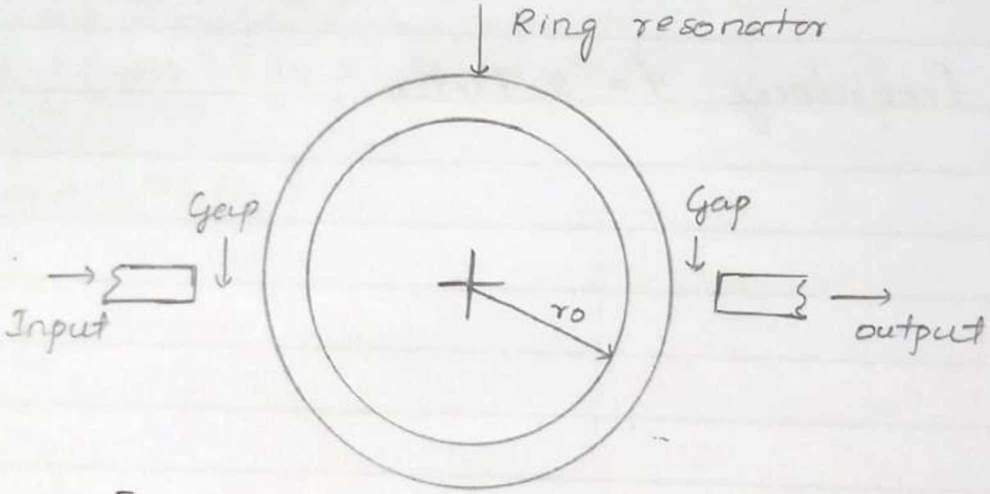
4. Vary the power supply voltage at minimum switch on the power supply.
5. Note down the output for different VCO frequency
6. Replace the 50Ω transmission line with branch line coupler.
7. Check the output at ports 2, 3, 4
8. Calculate insertion loss, coupling factor, and isolating using the formulae given
9. Repeat the experiment for a parallel line in complex.

Output :- frequency f = 2.7 GHz.

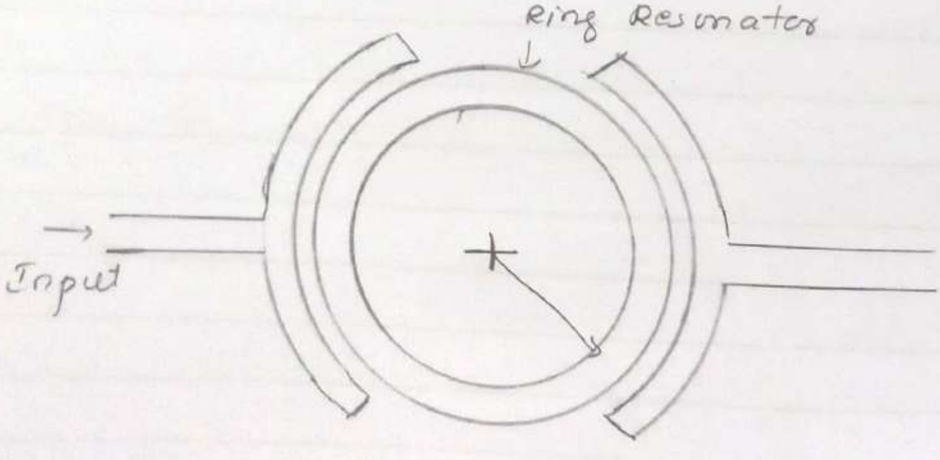
Teacher's Signature ______

Circuit Diagram





Input of a micro strip ring resonator with input and output lines.



Layout with curved input and output feed lines.

8b) Measurement of Resonance characteristics of Microstrip Ring Resonator.

AIM:- To measure the resonant characteristic of a microstrip ring resonator and output.

COMPONENTS REQUIRED:- Power supply, Microwave source, frequency meter, variable Attenuator, microstrip ring resonator co-axial wave guide.

THEORY: This is a simple printed planar resonance at microwave frequencies using microstrip technology. It is used in making filters (Band pass or Band stop) to some extent as an antenna element. It is a two port that resonates the transmission characteristics of this two port network show that is resonants at a centre frequency where it has zero loss. But for other frequencies this loss increases.

The open-end effect encountered in a rectangular resonator at the feeding gasps can be minimized by forming the resonator as a closed loop. Such a resonator is called ring resonator. As explained in the case of the rectangular resonator, the coupling can be loose or tight depending on gap width. Resonance is established when the mean circumference of the ring is Equal to integral multiples of guide wavelength

$$2pro = nl = \frac{n n_0}{f_0 \sqrt{\epsilon_{ef}}}$$

Tabular column

f(GHz)	P_1 (dB) (without Ring resonator/ with detector only)	P_2 (dB) with using resonator.
2.3	-23	30.8
2.4	-24	31.4
2.5	-28	41.2
2.6	-29	54.2
2.7	-31	59.5
2.8	-30	58.00

$f_r = 2.3 GHz$

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ro is the mean radius of ring, n is mode number. The ring has lowest order resonance for n=1. For this mode, field maxima occur at the two couping gaps and nulls occur at 90° locations from the coupling gaps

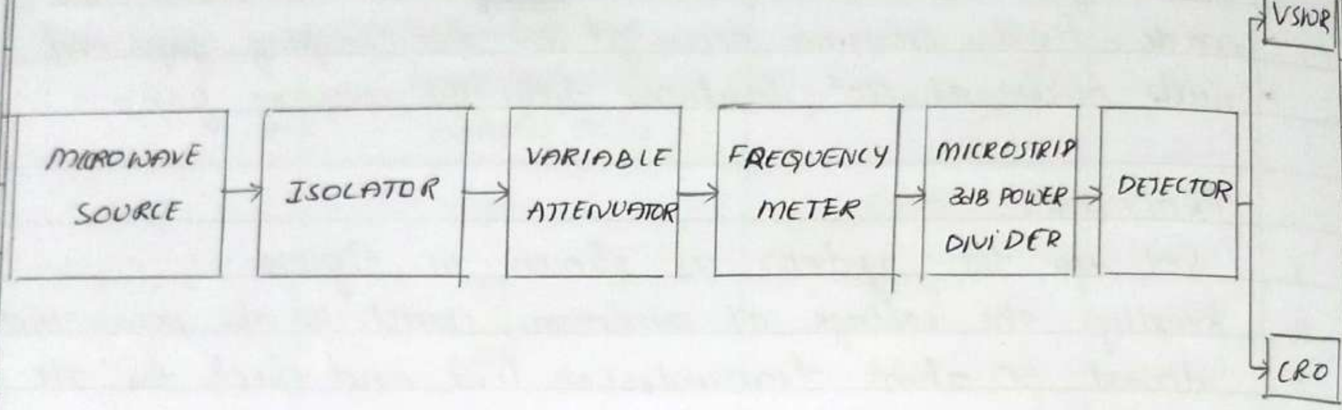
PROCEDURE

1. Set up the system as shown in figure
2. Keeping the voltage at minimum, switch on the power supply
3. Insert 50 ohm transmission line and check for the output at the end of the system using VSWR
4. Vary the power supply and check the output for different VCO frequency
5. Replace the 50 ohm transmission line with ring resonator
6. Vary the supply voltage, tabulate VCO frequency vs output.
7. Plot the graph frequency vs output & find resonant frequency.

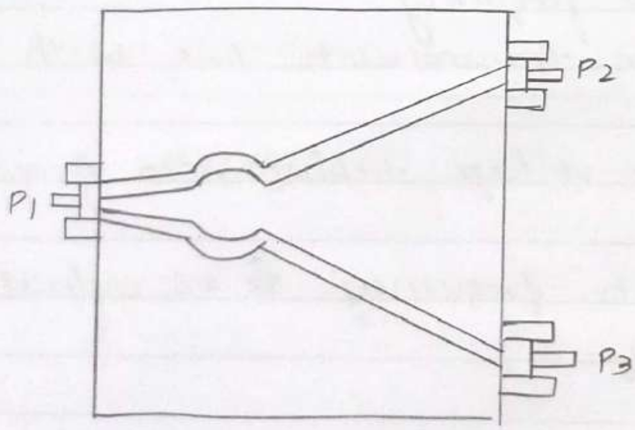
RESULT: The Resonant frequency $f_0 = 2.3 GHz$

Teacher's Signature

Block diagram:



MICROSTRIP 3-dB POWER DIVIDER.



8(c) Measurement of Power Division and Isolation characteristics of Microstrip 3dB Power divider.

Aim:- To measure power divider and Isolation characteristics of microstrip 3dB power divider.

COMPONENTS REQUIRED: Power supply, Microwave source, Frequency meter, variable Attenuator, microstrip 3dB power divider, Co-axial wave guide Adaptor, VSWR, CRO, Co-axial cable, cooling fan

BLOCK DIAGRAM:

THEORY:- A power divider is 3 port network. Input port is given power. This power is then divided into 2 parts and each of these power is output to the output ports. So output power in any port is less than the input port. If the power divider is ideal two output powers sum is equal to the input power. A power divider can also act as a power combiner. If 2 power inputs are given to output ports of power divider, the sum power is emitted from the input port of power divider. In communication often, we need power division, either in receiver circuit or transmitter circuit. This device is used. A 3dB power divider divides input into two equal values.

PROCEDURE.

1. Set up the system as shown in figure.
2. Keeping the voltage at minimum, switch on the power supply.

Tabular column.

f (GHz)	P_1 (dB)	P_2 (dB)	P_3 (dB)	$S_{21} = P_2 - P_1$	$S_{31} = P_3 - P_1$
2.3	23	26	26	3	3
2.4	24	26	26	2	2
2.5	26	36	38	8	10
2.6	28	38	40	9	11
2.7	29	36	41	5	10
2.8	30	35	39	5	9

f = 2.3 GHz

3. Insert a 50 ohm transmission line and check for output at the end of system using VSWR.
4. Vary the power supply voltage and check the output for different VCO frequency.
5. Keep the VCO frequency constant note down the output. This value can be taken as the input to the power divider.
6. Replace the 50 ohm transmission line with the Wilkinson power divider.
7. Tabulate the output at ports 2 and 3.
8. Calculate insertion loss and coupling factor in each coupled arm.

RESULT : with VSWR meter : Isolation
frequency f = 2.3 GHz.

SIMULATION EXPERIMENTS

General Procedure:

1. Open simulink. Select Blank Model
2. In the model page, go to library Browser. Type in the name of the block required in search field. Drag and drop the block the model page
3. Once all the blocks have been placed, rig up the connections by drawing wires. To do so just click on the open ends of each block and drag the wire to the required block.
4. To change the properties of any block, double click on the block to get the parameters window.
5. Save the design by going to file -> save
6. Go to simulation -> Run (or) click on the play button
7. Double click on the CROS (or) constellation diagram to view the waveforms.
8. The properties of CRO (or) constellation diagrams can be altered in the settings option after opening them
9. To view the proper number of waveform on the CRO, go to view -> layout and adjust accordingly
10. Note the same waveform in this manual can be different from the obtained, due to random number.

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Expt. No.: ....

SIMULATION EXPERIMENTS

General Procedure:

1. Open simulink. Selecl Blank Model
2. In the model page, go to library Browser. Type in the name of the block required in search field. Drag and drop the block the model page
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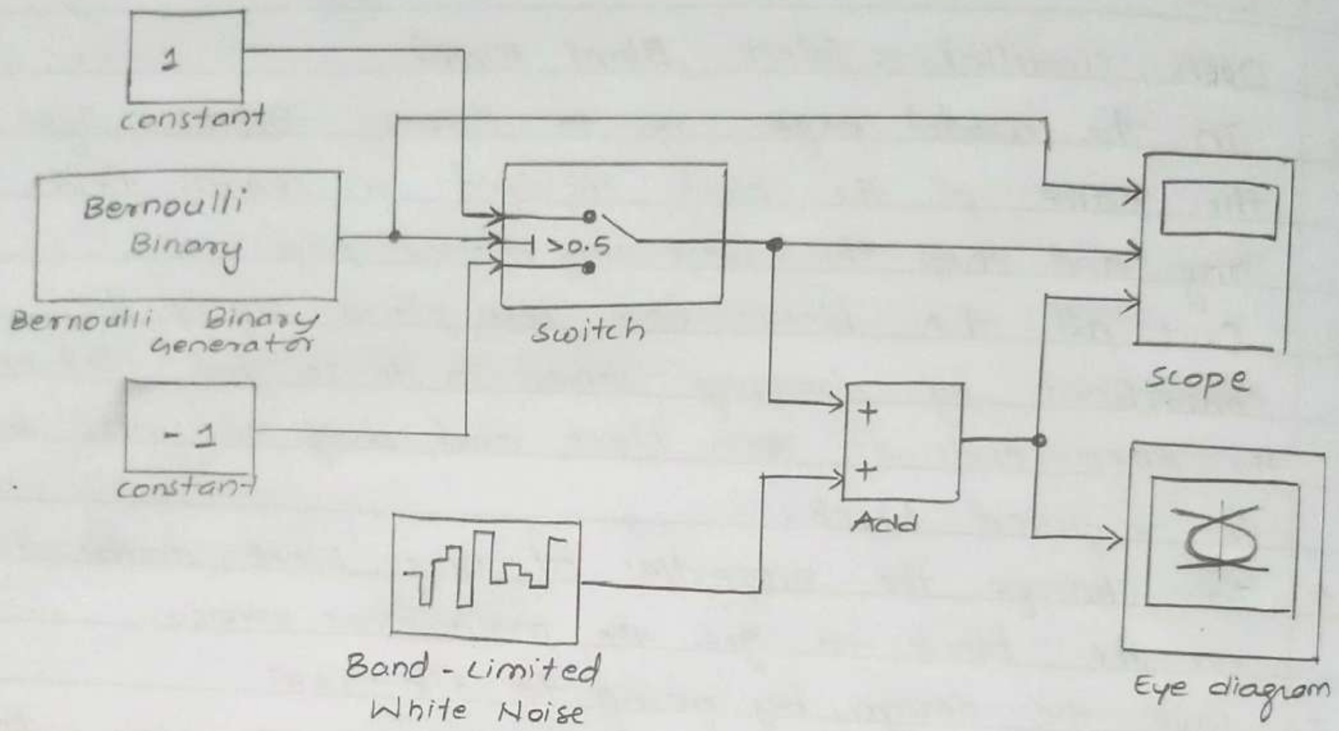
9. To view the proper number of waveform on the CRO, go to view -> layout and adjust accordingly
10. Note the some waveform in this manual can be different from the obtained, due to random number.

Teacher's Signature ______

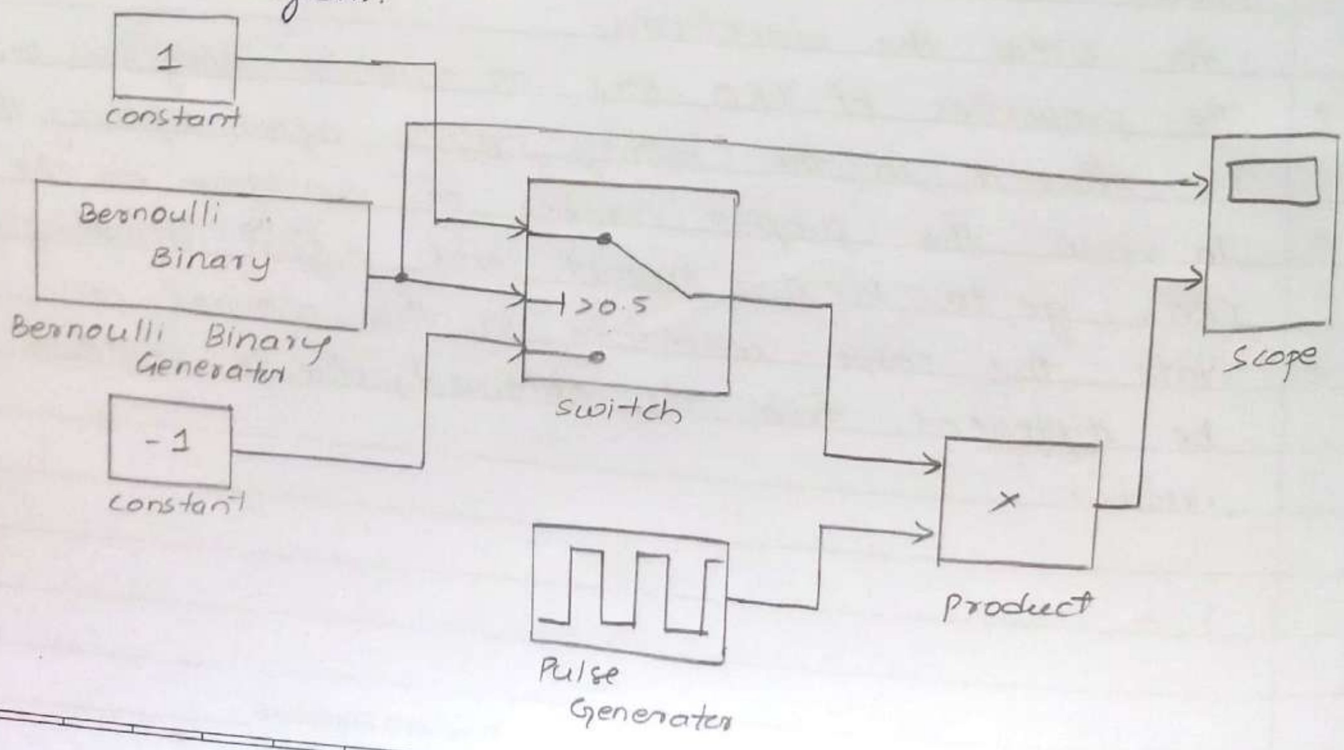
a) NRZ signalling (with Eye diagram for bipolar signalling)

Circuit diagram.



b) RZ signalling

Circuit diagram.



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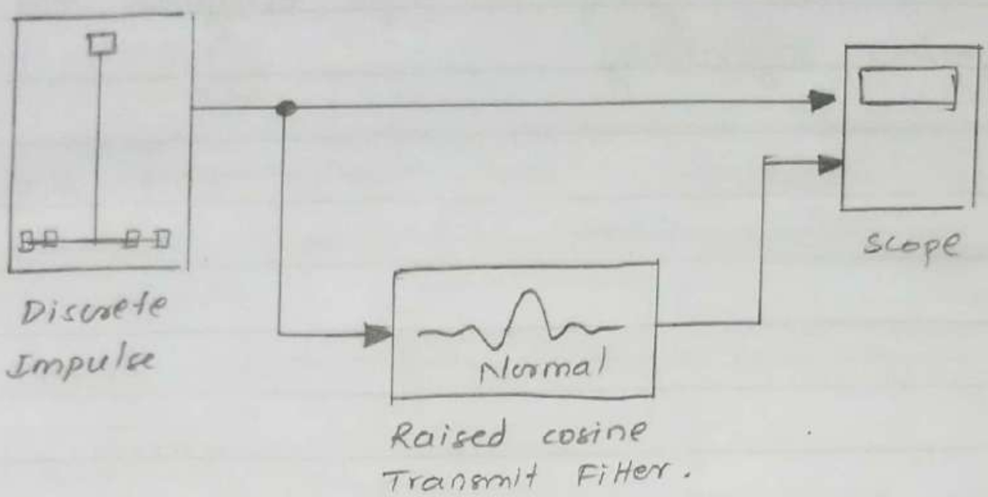
Simulate NRZ, RZ, Half sinosoidal and raised cosine pulses and generate eye diagram for binary polar signalling

Signature

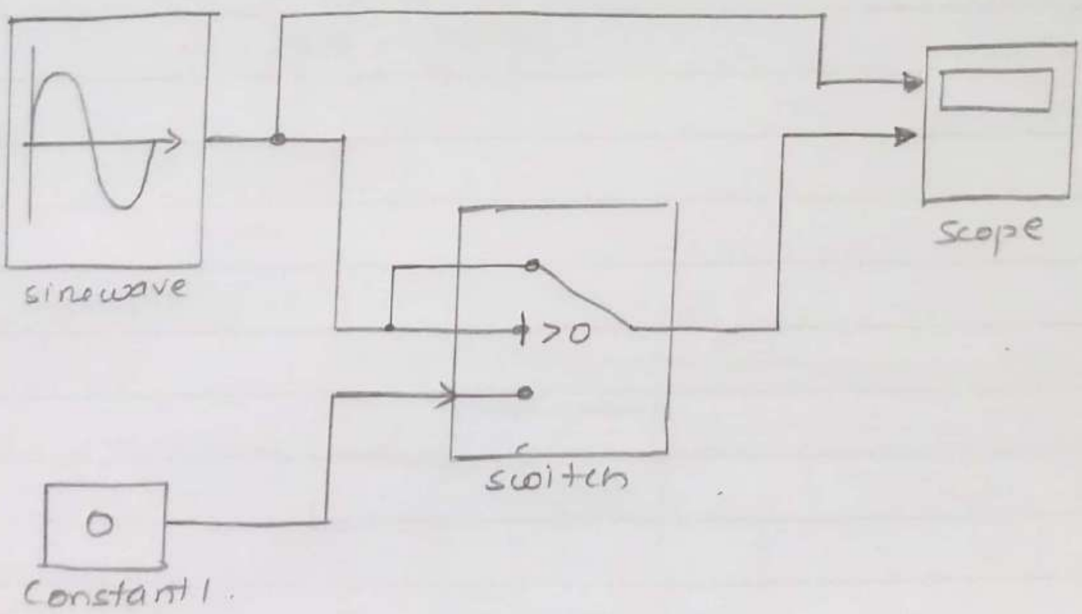
c) Raised Cosine Pulse.

Circuit



d) Half sinusoidal:

Circuit:



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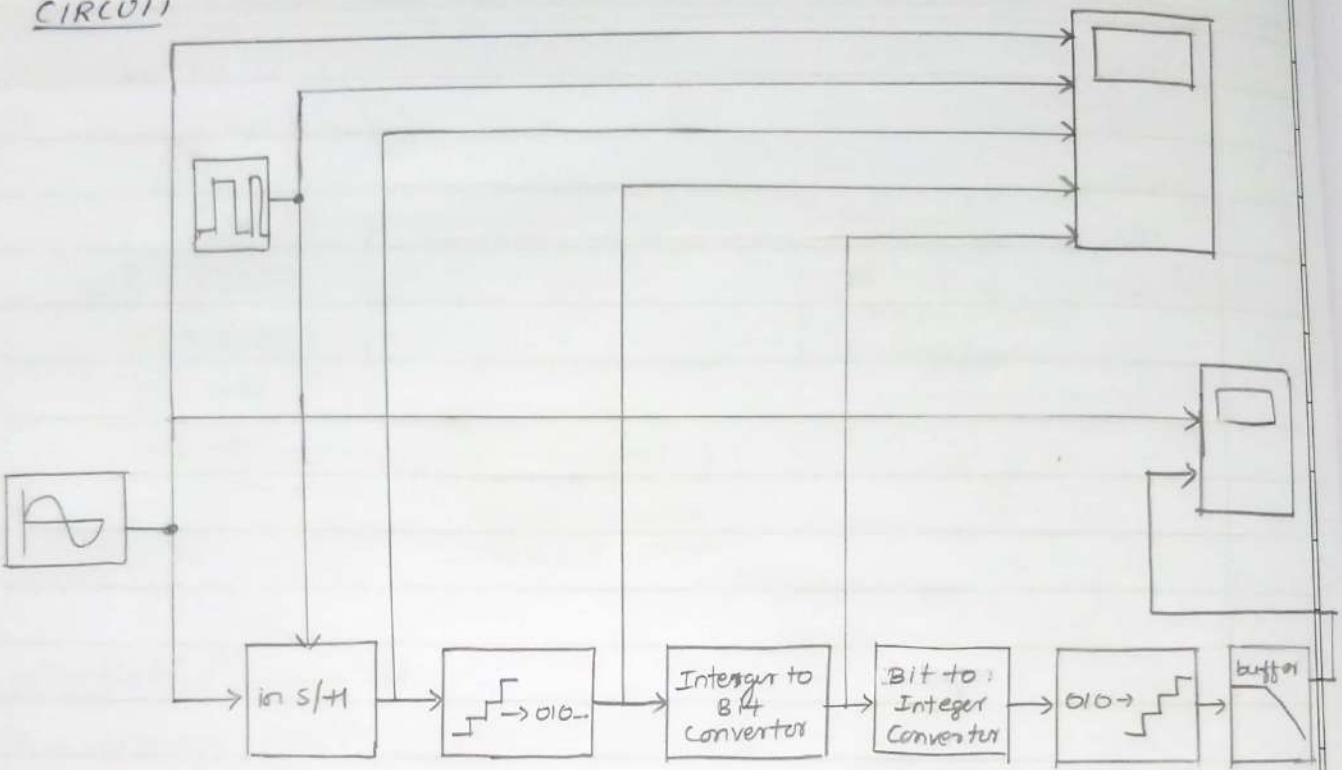
CIRCUIT



in S/H
010..
Integer to Bit Converter
Bit to Integer Converter
010→
buffer

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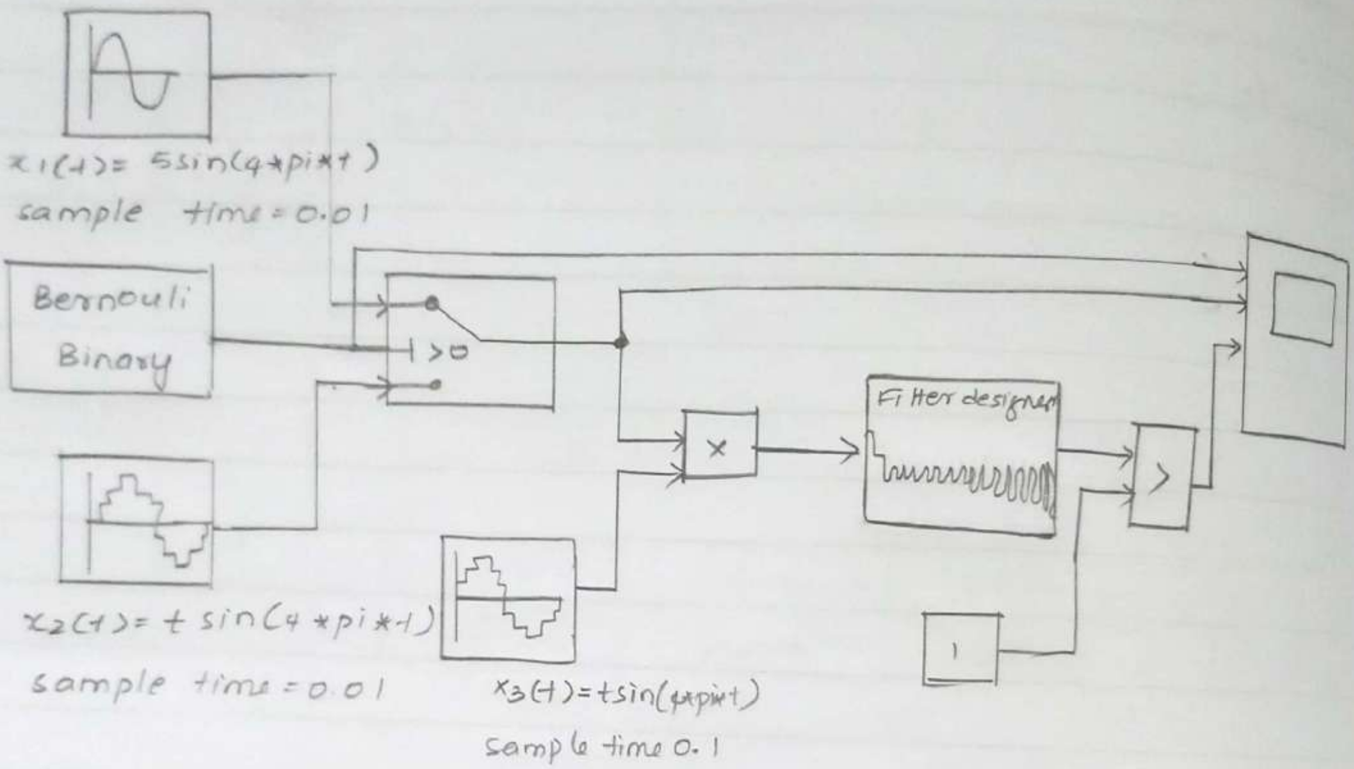
Simulate and pulse code modulation and demodulation system and display the waveforms

A.

Teacher's Signature

AMPLITUDE SHIFT KEYING.

BLOCK DIAGRAM:



Computations of the probability of bit Error for coherent binary ASK, FSK and PSK for an AWGN channel and compare with their performance curves

% A script to compare to BER of BASK, BFSK, BPSK from simulation and theory.

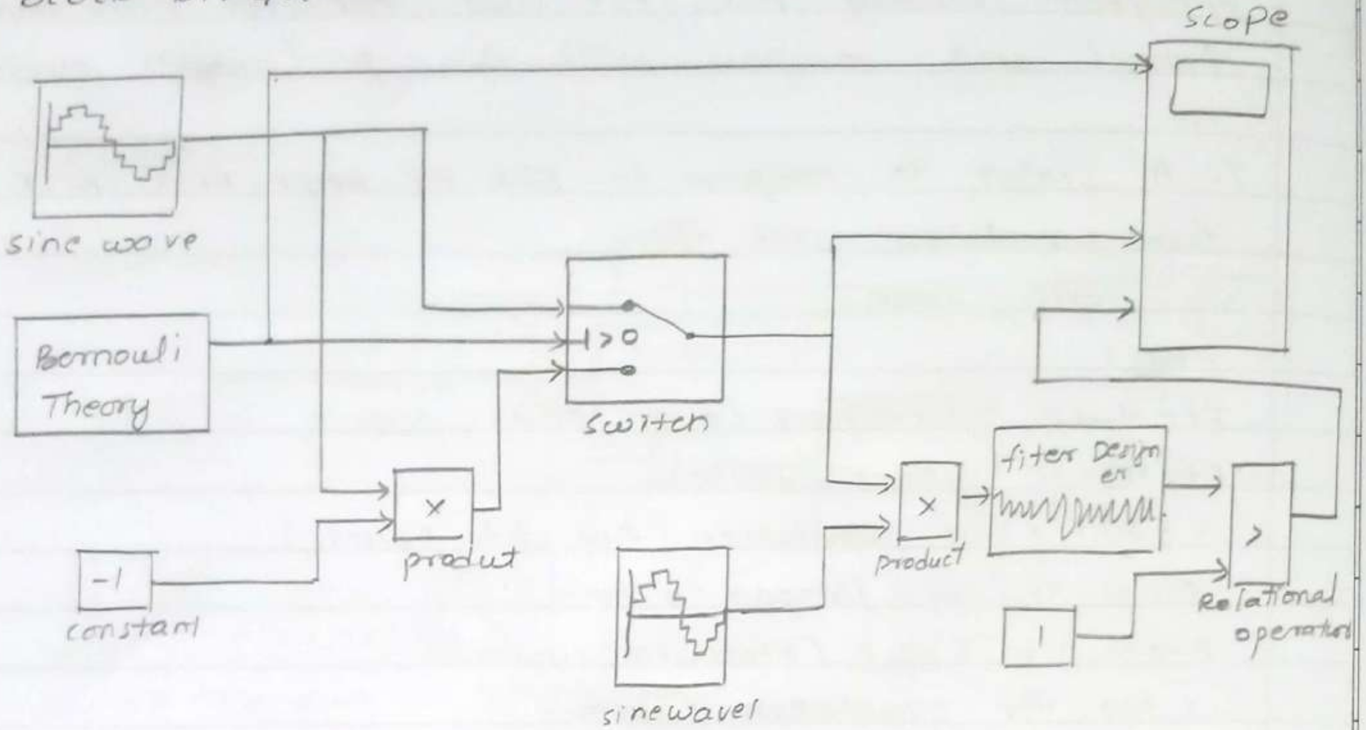
```
Sig_length = 2000;
Eb=1;
EtoN_dB = linespace (0,20,100);
EtoN= 10^(EtoN_dB/10);
% Eb/No of simulation (five data points)
EtoN_dB_sim = linspace (0,20,5);
EtoN_sim = 10.^(EtoN_dB_sim/10);
% No. for simulation purposes
No = Eb./EtoN_sim;
% Theoretical BER calculations
BER_BASK_te = (1/2) * erfc (sqrt (EtoN/4));
BER_BFSK_te= (1/2)* erfc (sqrt (EtoN/2));
BER_BPSK_te= (1/2) * erfc( sqrt (EtoN));

for iter=1: length (EtoN_sim)
% Initialize error as 0
E_BASK = 0;
E_BFSK = 0;
E_BPSK = 0;

% Generate random string of bits with the length
specified above
```

PHASE SHIFT KEYING

BLOCK DIAGRAM



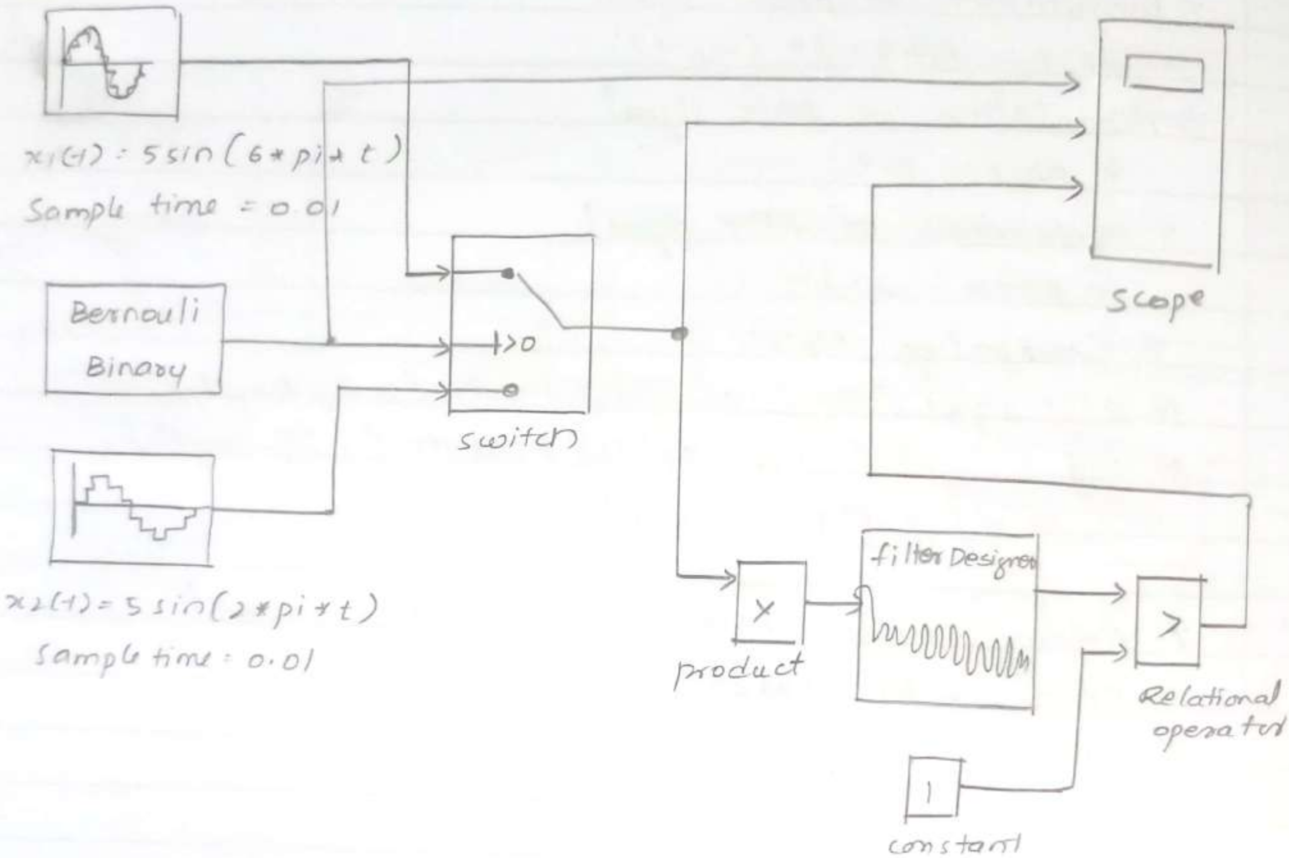
```
bit = randi([0 1], 1, sig-length);
% Modulation of BFSK signal
  x_BFSK = bit + 1j * (~bit);
% Modulation of BASK signal
    x_BASK = bit;
  % modulation of BPSK signal
    x-BPSK = 2 * bit - 1;
  % Generating Noise
 N-ril = sqrt (No (iter)/(2) * randn(1, sig-length);
 N-imj = sqrt (No (iter)/2) * randn (1, sig-length);
 N = N_ril + 1j * (N_imj);

 % Adding AWGN noise to modulated signal
 y-BASK = x-BASK+N;
 y_BFSK = x_BFSK + N;
 y-BPSK = x-BPSK+N;

for iter2 = 1: sig-length
% BASK detector
z-BASK (iter2) = (y-BASK (iter2));
% Decision circuit BASK
  if (z_BASK (iter2) >0.5 && bit (iter2)==0)||(z-BASK(iter2)<0.5
   && bit (iter2)==1);
     E-BASK = E-BASK+1;
      end
 % BFSK detector
   z_BFSK (iter2) real (y_BFSK (iter2)) - imag (y- BFSK (iter2)));
  if (z-BPSK (iter2)>0 && bit (iter2)==0)||(z_BPSK(iter2)<0
        && bit (iter2) == 1);
```

FREQUENCY SHIFT KEY

BLOCK DIAGRAM



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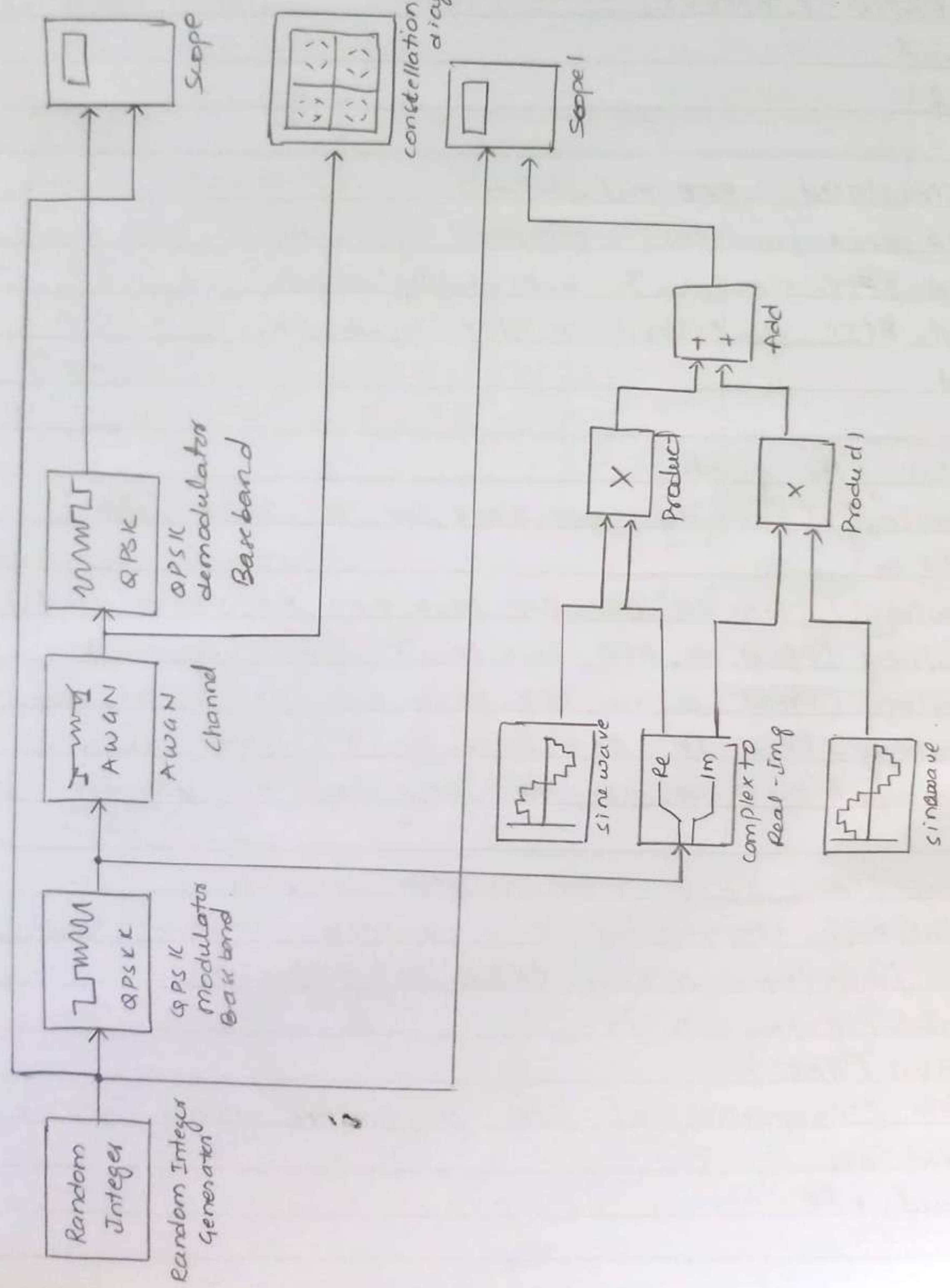
```
E.BPSK = E_BPSK+1;
  end
end

% Simulated BER calculations
BER_BASK_sim(iter) = E_BASK/ Sig_length;
BER_BFSK_sim (iter)= E_BFSK/Sig_length;
BER_BPSK_sim(iter)= E_BPSK/ Sig_length;
End

% Making the graph
semilogy (EtoN_dB , BER_BASK_te, 'k', 'color', 'red');
hold on
semilogy (EtoN_dB_sim, BER_BASK_sim, 'k*', 'color', 'red');
semilogy (EtoN_dB, BER_BFSK_te, 'k', 'color', 'green');
semilogy (EtoN_dB_sim, BER_BFSK_sim, 'k*', 'color', 'green');
semilogy (EtoN_dB, BER_BPSK_te, 'k', 'color', 'blue');
semilogy ( EtoN_dB_sim, BER_BPSK_sim, 'k*', 'color', 'blue');

legend ('BASK theory', 'BASK simulation', 'BFSK theory', 'BFSK
simulation', 'BPSK theory', 'BPSK simulation, 'location', 'best');
axis [min (EtoN_dB) max (EtoN_dB) 10^(-6) 1];
xlabel ('Eb/No (dB)');
ylabel ('BER');
title ('Comparison of BER performance curves (BER vs. Eb/No)');
grid on;
hold off
```

Teacher's Signature

1) DPSK Transmitter and receiver



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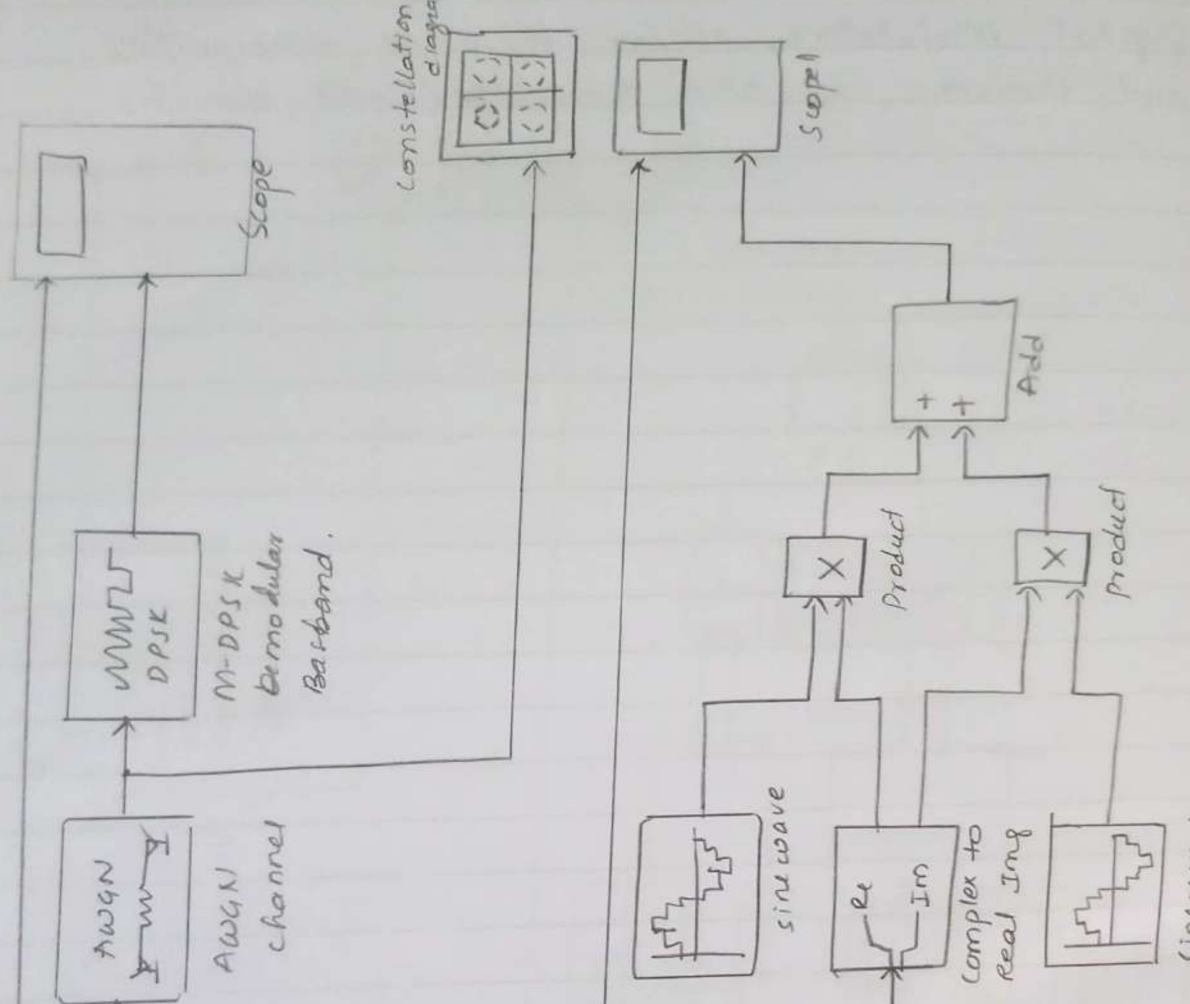
Digital Modulation schemes (i) DPSK transmitter and Receiver ; ii) QPSK transmitter and Receiver

QPSK Transmitter and Receiver.



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