ANALOG COMMUNICATION LAB

LABORATORY MANUAL

YEAR&SEM: II ECE-II SEM

REGULATION: R20

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENNG

HARDWARE

EXPERIMENTS

LIST OF EXPERIMENTS

S.NO	EXPERIMENT NAMES
	HARDWARE EXPERIMENTS
1	AMPLITUDE MODULATION & DEMODULATION
2	AM-DSBSC-MOD&DEMOD (BALANCEDMODULATOR)
3	DIODE DETECTOR CHARACTERISTICS
4	PRE-EMPHASIS ANDDE-EMPHASIS
5	FREQUENCY MODULATION & DEMODULATION
6	PULSE AMPLITUDE MODULATION & DEMODULATION
7	PULSE WIDTH MODULATION AND DEMODULATION
8	PULSE POSITION MODULATION AND DEMODULATION
9	PHASE LOCKED LOOP
10	RADIO FREQUENCY AMPLIFIER
	SOFTWARE EXPERIMENTS
1	AMPLITUDE MODULATION AND DEMODULATION
2	DSB-SCMODULATORANDDETECTOR
3	FREQUENCY MODULATION AND DEMODULATION
4	SSB-MODULATION ANDDETECTOR
5	PRE-EMPHASISANDDE-EMPHASIS
6	PULSE AMPLITUDE DEMODULATION AND DEMODULATION
7	SAMPLING THEOREM

1. AMPLITUDE MODULATION & DEMODULATION

AIM: To study the function of Amplitude Modulation & Demodulation (under modulation, perfect modulation & over modulation) and also to calculate the modulation index.

APPARATUS:

1. Amplitude Modulation &Demodulation trainer kit.
2. C.R.O(20MHz)
3. Connecting cords & probes.

THEORY:

Modulation is defined as the process of changing the characteristics (Amplitude, Frequency or Phase) of the carrier signal (high frequency signal) in accordance with the intensity of the message signal (modulating signal).

Amplitudemodulationisdefinedasasystemofmodulationinwhichtheamplitude   of   the carrier is varied in accordance with amplitude of the message signal (modulating signal).

The message signal is given by the expression.

$E_m(t) = E_m \cos W_m t$

Where Wm is ------>Angular frequency

E m ------- →Amplitude

Carrier voltage

$E_c(t) = E_c \cos W_c t \quad E(t) = E_c + K_a E_m \cos W_m t$

Ka E m Cos Wmt --→change in carrier amplitude

Ka---- →constant

The amplitude modulated voltage is given by

$E = E(t) \cos W_c t$

From above two equations

$E = (E_c + K_a E_m \cos W_m t) \cos W_c t$

$E = (1 + K_a E_m / E_c \cos W_m t) E_c \cos W_c t$

$E = E_c (1 + M_a \cos W_m t) \cos W_c t$

Where Ma ---- →depth of modulation/modulation index/modulation factor

$M_a = K_a E_m / E_c$

100*Ma gives the percentage of
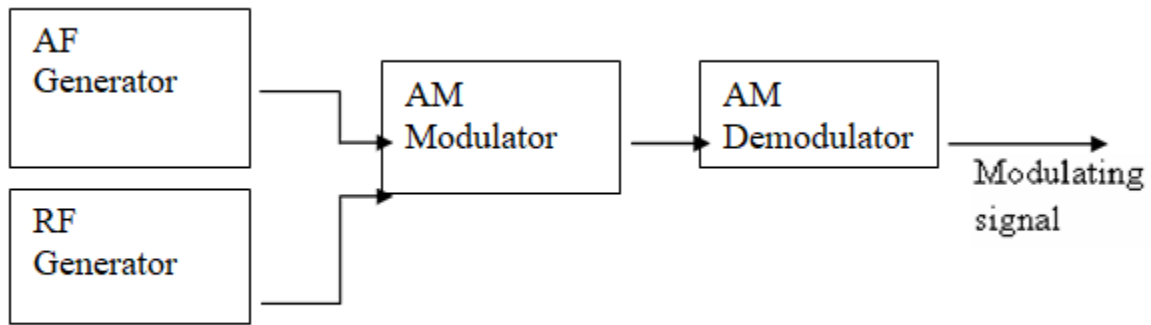
modulation

PROCEDURE:

1. Switch on the trainer kit and measure the internal carrier frequency and amplitude by using CRO. It will be around 100 KHz record this frequency as f_c.

2. Connect the built-in carrier to the carrier input of modulator circuit.

3. Connect around 3KHzto10KHzwith2V$_{p-p}$AF signal between AF inputterminal and ground terminals of the modulator circuit.

4. Vary the modulating signal frequency and amplitude and observe the input and output signals simultaneously on CRO.

5. Calculate the maximum and minimum points of modulated wave under CRO and calculate the depth of modulation

6. Repeat the above procedure for 60%, 80%and100% modulation index.

7. Connect the output of the modulator to the input of demodulator circuit and observe the output of demodulator and compare it with the modulating signal.
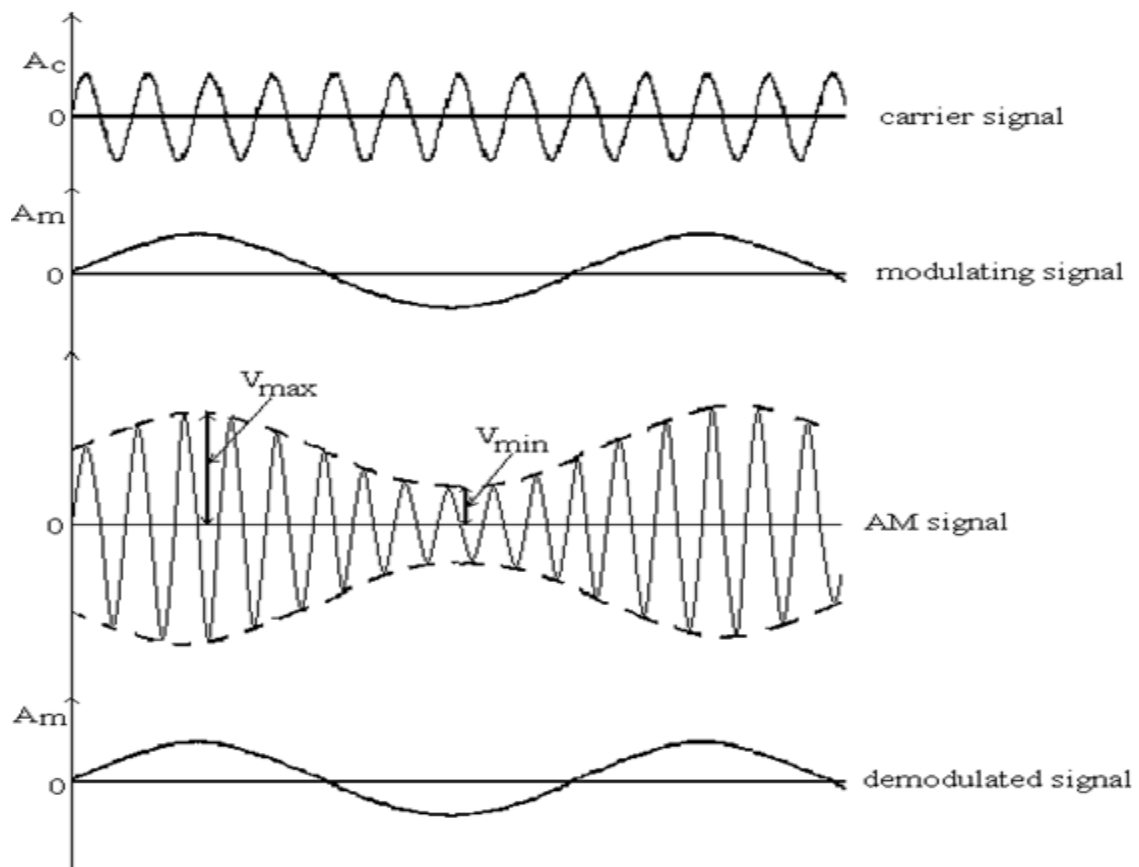
BLOCKDIAGRAM:

Modulation
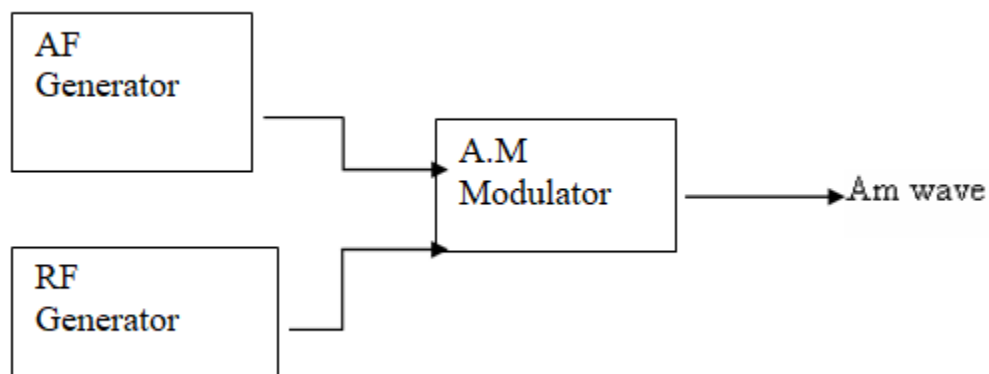
Demodulation

MODELGRAPH:

TABULARFORM:

S.No	V_{max}	V_{min}	$M=(V_{max}-V_{min})/(V_{max}+V_{min})$

RESULT:

VIVAQUESTIONS:

1. What is modulation and why modulation is needed?
2. Compare different AM techniques?
3. What is narrow banding?
4. What is frequency translation?
5. What is synchronous detection?

2 .AM-DSBSC-MOD&DEMOD (BALANCEDMODULATOR)

AIM: To study the process of balanced modulation and the corresponding waveform.

APPARATUS:

1. Balanced modulator Trainer Kit
2. CRO
3. Probes

THEORY:

Balanced modulator circuit is used to generate only the two side bands DSB-SC. The balanced modulation system is a system is a system of adding message to carrier wave frequency there by only the side bands are produced. It consists of two AM modulators arranged in a balanced configuration. The AM modulator is assumed to be identical. The carrier input to the two modulators is same.

If we eliminate or suppress the carrier then the system becomes suppressed carrier DSB-SC. In this we need reinsert the carrier is complicated and costly. Hence the suppressed carrier DSB system may be used in point to point communication system.

Generation of suppressed carrier amplitude modulated volt balanced modulator maybeof the following types.

1. Using transistors or FET.
2. Using Diodes

PROCEDURE:

1. Switch on the trainer kit and measure the internal carrier frequency and amplitude by using CRO.
2. Check the output of Audio Oscillator Which is nothing but Message signal.
3. Adjust the frequency and amplitude of message signal until we get the Shape of DSB-SC signal.
4. Adjust the frequency of the Carrier signal to get phase reversals at Zero crossings of Message signal.

Measure the frequency and Amplitudes of Message as well as the carrier signal, plot the wave forms

BLOCKDIAGRAM:

Modulation
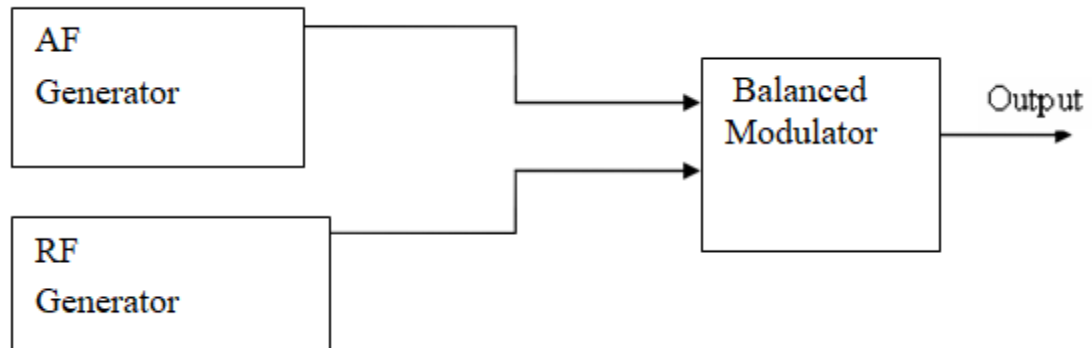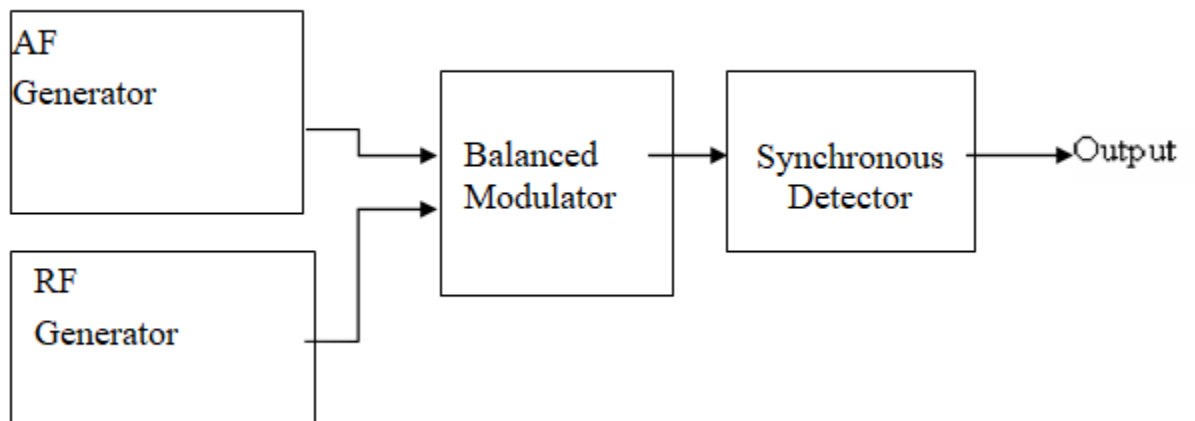
Demodulation

WAVEFORMS:
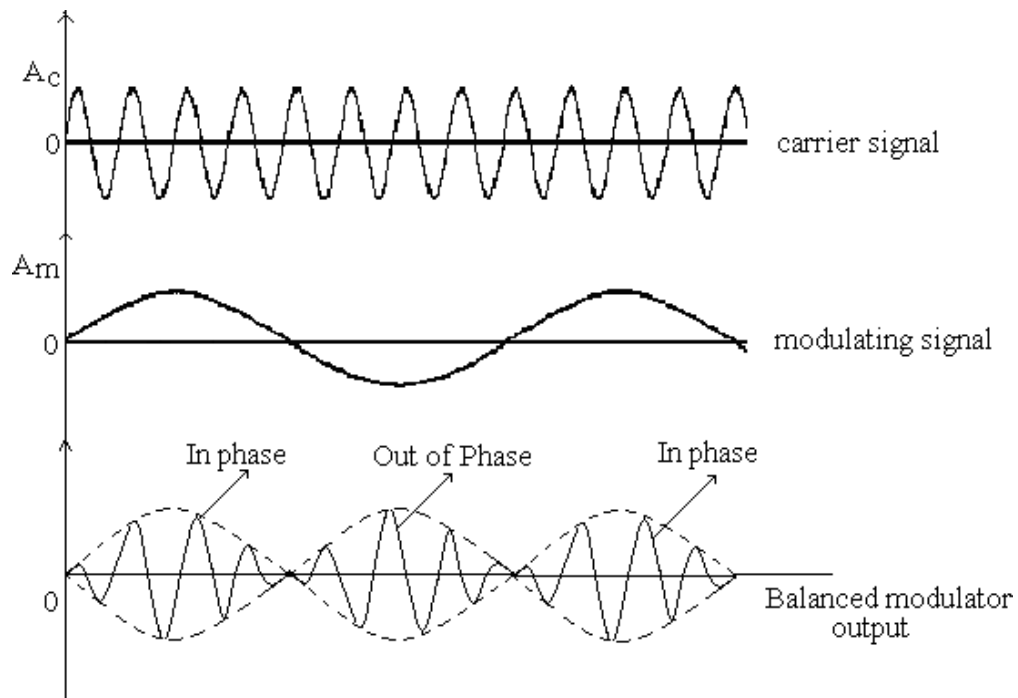
RESULT:

VIVA QUESTIONS:

1. What is balanced modulator?
2. Draw the spectrum of BM?
3. What is the output of BM?
4. Name different DSB-SC modulators?
5. Compare different AM techniques?
6. What is VSB? And its main application?

3. DIODE DETECTOR CHARACTERISTICS

AIM: To demodulate the modulated wave and to observe the characteristics of diode detector.

APPARATUS:

Name Of The Component/Equipment	Specifications/Range	Quantity
Diode(0A79)	Maxcurrent35ma	1
Resistor	10kΩ	1
Capacitor	0.1Uf	1
CRO	20MHz	1
AM Generator	0.1MHz-110MHz	1
Regulated Power Supply	0-30V,1A	1

CIRCUITDIAGRAM:

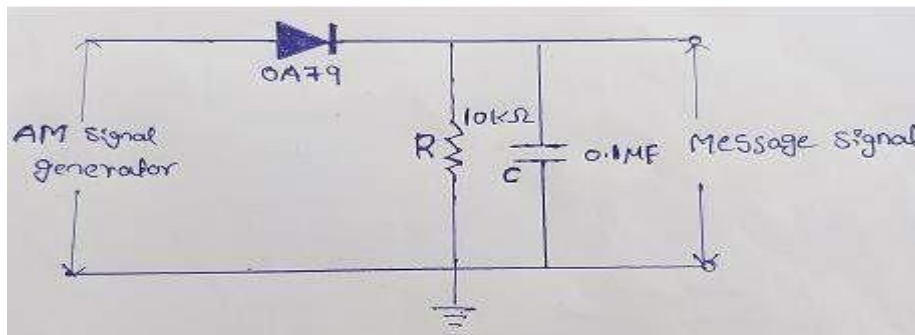Fig... Diode Detector

PROCEDURE:

1. Connectthecircuitdiagramasperfig.1.
2. Set the input amplitude modulate wave from AM generator.
3. Observe the modulating signal changes by varying the amplitudes of the AM signal.
4. Note down the Amplitude of the demodulated wave.
   Plot a graph between E_{max}Vs Detector wave amplitude as shown inFig.2.

SAMPLE READING:

TABLE1: Reading of Diode Detector

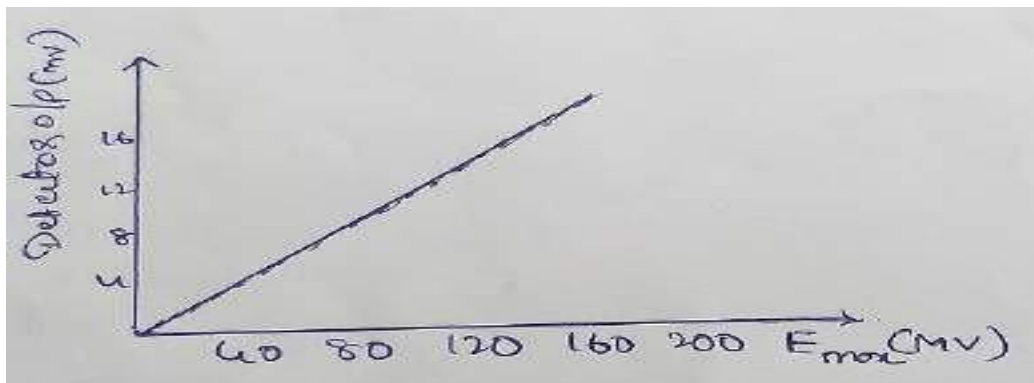| S. NO.	$E_{max}(mV)$	$E_{min}(mV)$	Detector O/P (mV)
3			
4			
5			

MODEL GRAPHS:

Fig.2.CharacteristicsofDiodeDetector

RESULT:

VIVA QUESTIONS:

1. Classify amplitude modulation detector or demodulators.
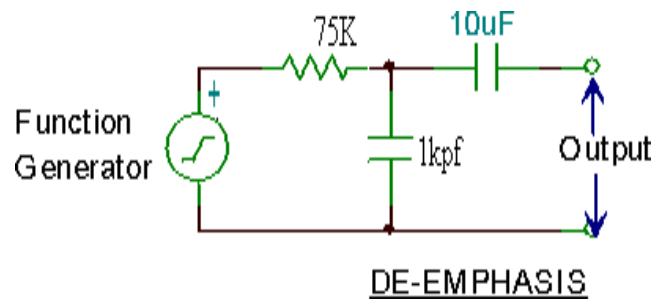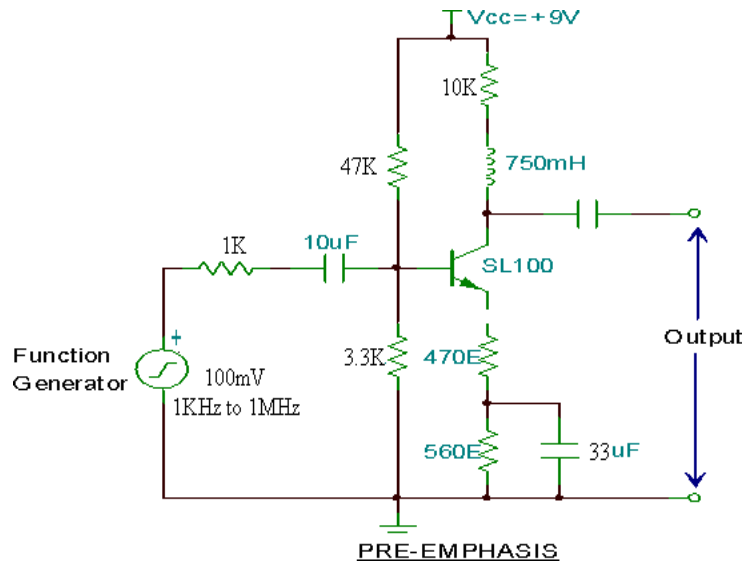2. Why envelope detector is most popular in commercial receiver circuits?

4. PRE-EMPHASIS ANDDE-EMPHASIS

AIM: To obtain the characteristics of pre-emphasis and de-emphasis.

APPARATUS:

1. Regulated power supply
2. CRO
3. Signal Generator
4. transistorSL100
5.resisters47K,3.3K,560Ω,22K,10K,470 Ω,75K,1K
6. capacitors10µf–2Nos, 33µf–1No, 1kpf–1no

CIRCUIT:

PRE-EMPHASIS

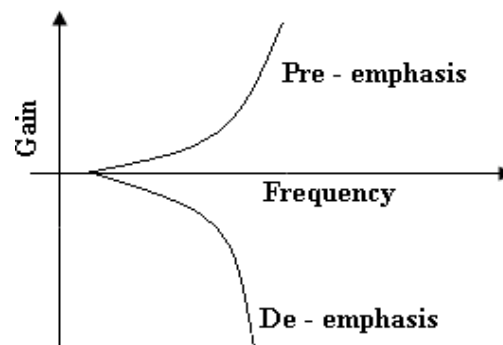DE-EMPHASIS

PROCEDURE:

Pre-emphasis:

1. Apply input signal, through the signal generator and set the amplitude of the input signal at 100mv (p-p).
2. Now vary the frequency of the in / p signal from100Hzto15KHz in steps and note down the output in each case.
3. Tabulate the above readings
4. Draw the graph frequency V_s gain in db on a semi log sheet.

De-Emphasis:

1. Adopt the same procedure 1to4asabove

TABULARFORM:

S. No	I/p signal frequeny(Hz)	o/p voltage	Gainindb20logV o/Vi

EXPECTEDWAVEFORMS:

RESULT:

VIVAQUESTIONS:

1. Draw the circuit of FM transmitter and receiver with

   Pre-emphasis and de-emphasis is network?

2. Draw the Pre-emphasis and
   De-emphasis curves corresponding to different and adds?

3. Compare FM discriminators?

4. What is hard limiter?

5. Define SNR?

6. What is pre-emphasis and de-emphasis?

5. FREQUENCY MODULATION & DEMODULATION

AIM: To generate frequency modulated waveform &demodulated waveform

APPARATUS:

1. Frequency Modulation and Demodulator Kit(SCIENTECH2203Techbook)

2. CRO

3. BNC Probes

4. Connecting Wires

PROCEDURE:

1. Turn on power to the Scientism 2203Tech Book.

2. Observe modulating signal at the output test point of AF Oscillator block. Set the modulating signal frequency(f_m)to3KHz

3. Select the desired modulator (reactance modulator, varactor modulator or ICXR2206 based FM modulator)using "Modulator Select" switch. Selected modulator is indicated by glowing LED 'sat its input and output.

4. The frequency of the FM carrier signal (f_c) should be approximately 455 KHzat the moment.

5. Now vary the amplitude of modulating signal using the amplitude potentiometer of the Audio oscillator block and observe the frequency modulated waveform at the output test point of Amplitude limiter block if reactance or varactor modulator is selected or at the output test point of Frequency Modulator (ICXR2206 based) if FM(ICXR2206) is selected.

6. Observe the demodulated output at the output test points of low pass filter/Amplifier block and compare it with the modulating signal. (Select the desired demodulator using detector selects witch(quadrature detector, detuned resonance detector ,Foster-Seeley/Ratio detector, PLL detector),when reactance or varactor modulator is selected in the modulator section))
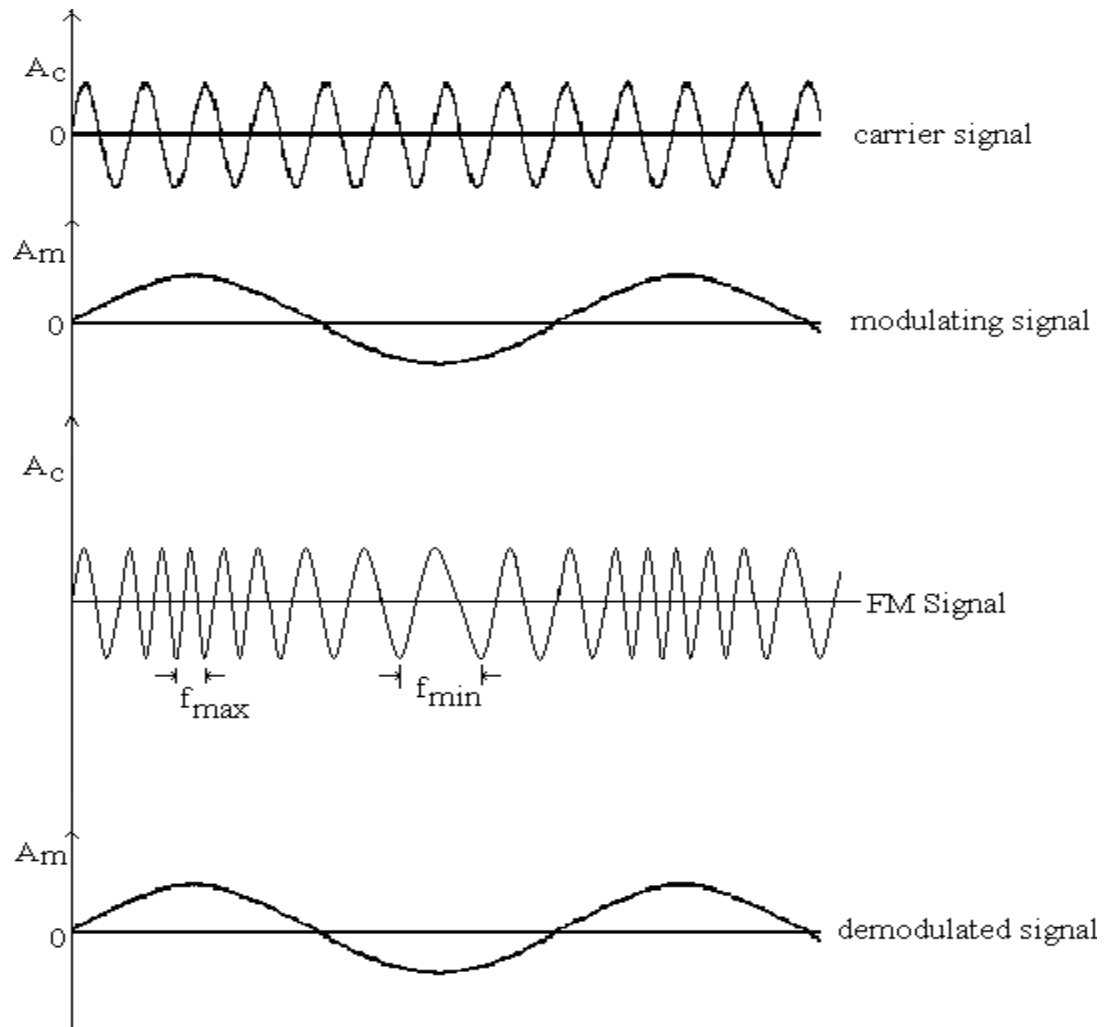
CALCULATIONS:

Carrier Frequency f_c=Modulating

Signal Frequency $f_m = f_{max} = f_{min} =$

$\delta f = f_{max} - f_c$

MODEL GRAPH:

RESULT:

VIVAQUESTIONS:

1. What is analog modulation?
2. What is angle modulation?
3. Compare AM with narrow band FM?
4. What is exponential Modulation?
5. What is linear modulation and non-linear modulation?

6. PULSE AMPLITUDE MODULATION & DEMODULATION

AIM: To Study Pulse Amplitude Modulation and demodulation using Sample Output, Sample & Hold Output & Flat Top Output.

APPARATUS:
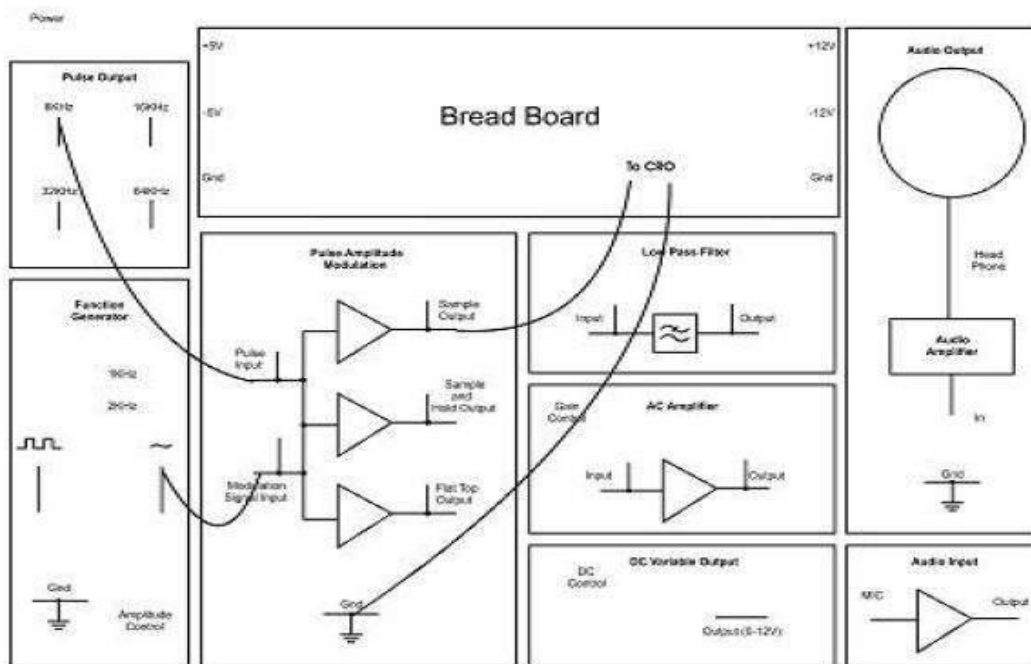
1. NV6575 Trainer

2. 2mmPatchCords

3. CRO with Test Probe

PROCEDURE:

PAM modulation:

1. Connect the circuit as shown in the figure.

- Connect patch cord between output of **Sine Wave**&"**Modulation Signal Input"** of **PAM** block.

- Keep the toggle switch at **1 KHz** position.
- Now connect"**8KHz" Pulse Output** to **Pulse Input** of **PAM** block.
- Set the **Amplitude Control** pot at fully clock wise direction.

2. Now connect the **SMPS Supply** between mains socket &NV6575Trainer.

3. Firstly switch **On** the SMPS supply &then trainer **Power** switch.

4. Now observe the output signals of **Sample Output**, **Sample and Hold Output**& **Flat Top Output on the CRO.**

5. Now varying the amplitude using **Amplitude Control** pot & Change the frequency through the position of toggles witch (2 KHz). Observe the effect on all the outputs.

6. Also, varying the frequency of pulse, by connecting the **Pulse Input** to the 4 frequencies available i.e. **8, 16, 32, 64 KHz** in Pulse output block. Observe the effect on all the outputs.
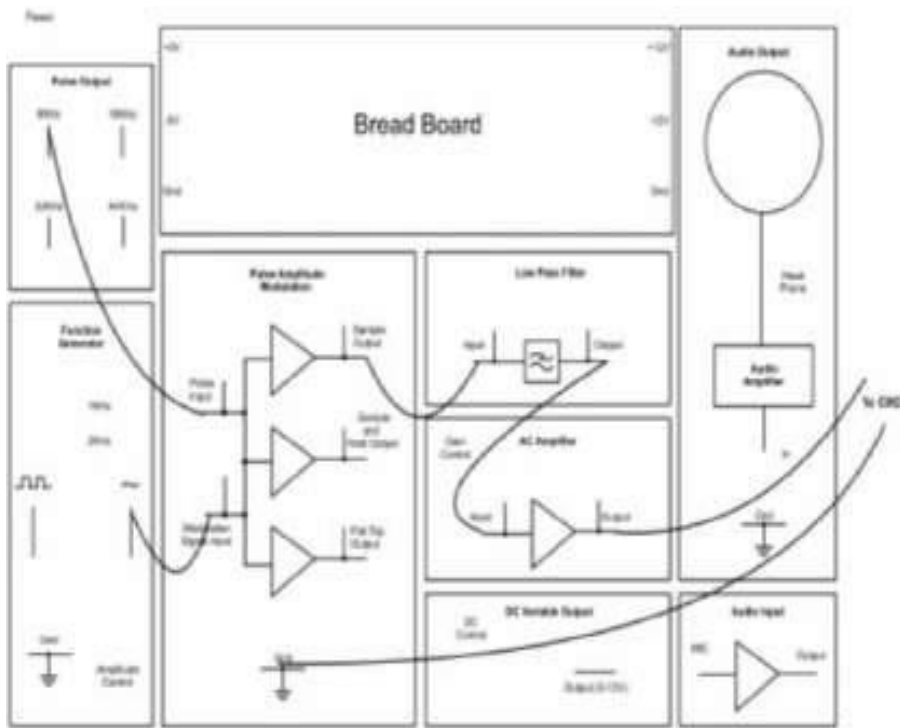
PAM demodulation:

1. Connect the "**Sample Output**" to "**Input**" of **Low Pass Filter** through the patch cord.

2. Connect patch cord between "**Output**" of **Low Pass Filter** and "**Input**" of **AC Amplifier**. Set the **Gain Control** pot in counter clock wise position.

3. Observethe"**Output**"of**ACAmplifier**ontheCRO.IfitisnotexactreplicaofInput then adjust the **Gain Control** pot & obtain pure sine wave similar to input.

4. Similarly connect the "**Sample & Hold Out put** " and "**Flat Top Output**" to **Low Pass Filter** and see the demodulated wave format the output of AC amplifier.

BLOCKDIAGRAM:

MODULATION:



NV6575 PAM Modulation and Demodulation Trainer
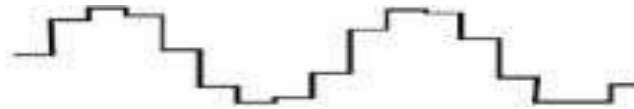
DEMODULATION:

NV6575 PAM Modulation and Demodulation Trainer

OBSERVATIONS:

S. No	Observation	Amplitude	Time
1.	Modulating signal		
2.	Sampling signal		
3.	Natural Sampling output		
4.	Sample and hold output		
5.	Flat top output		
6.	Demodulated output		

WAVEFORMS:

Modulating signal

Carrier Pulse train

Natural PAM

Flat-Top PAM
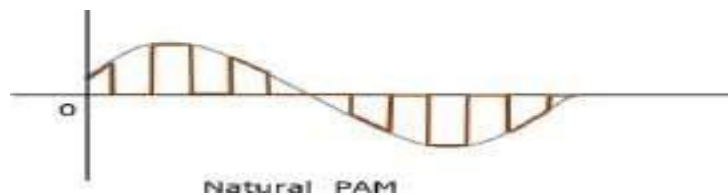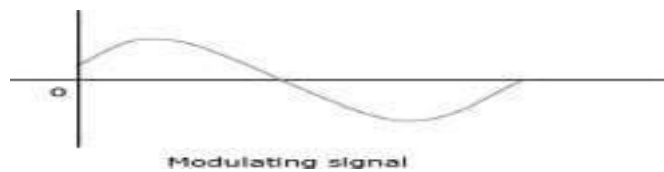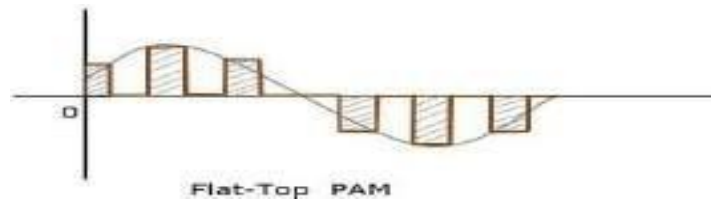
Sample and Hold signal

Demodulated Signal

RESULT:

Viva Questions:

1. Define Sampling theorem
2. What is nyquist rate?
3. How many types of samplings are there? Explain briefly
4. Define Pulse amplitude Modulation

5. Give few application of PAM
   Discuss the Bandwidth requirements of PAM

7. PULSE WIDTH MODULATION AND DEMODULATION

AIM: To Study pulse Width modulation and demodulation using different sampling   frequency

APPARATUS:

1. NV6576 Trainer

2. 2mmPatchCords

3. CRO with Test Probe/Recommended to use Digital Storage Oscilloscope (DSO) for better results

Procedure:

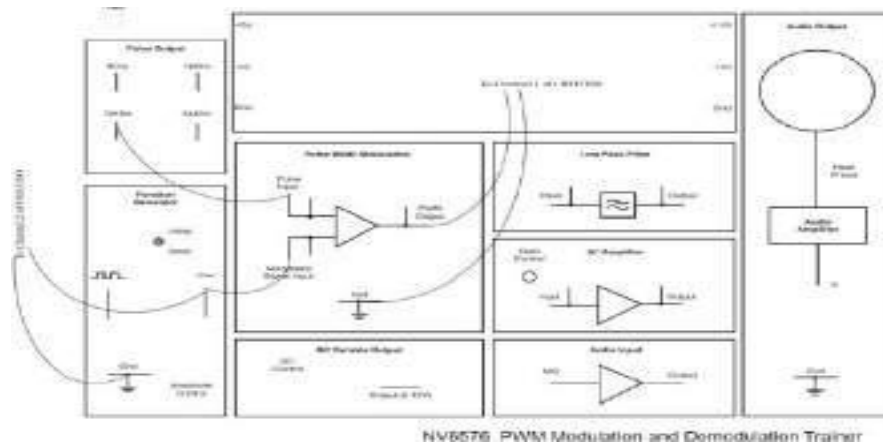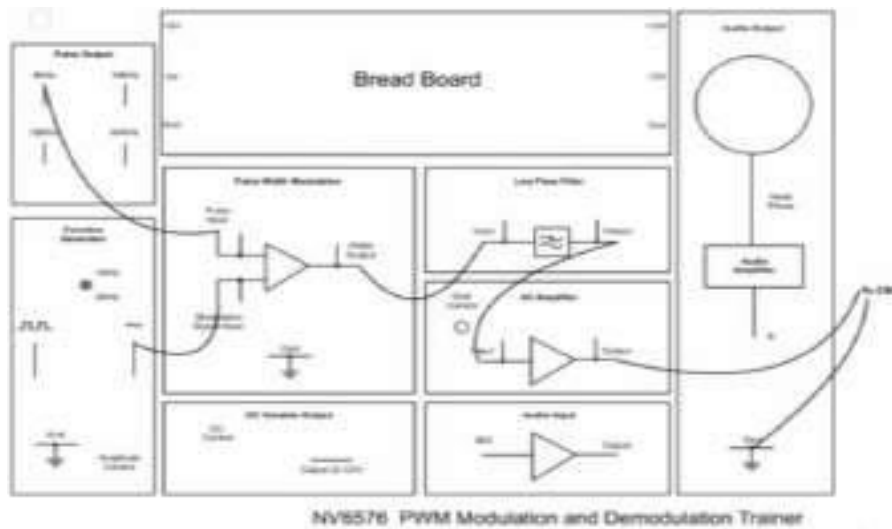### PWM modulation:

1. Connect the circuit as shown inFig

    - Connect patch cord between output of **Sine Wave** & "**Modulation Signal Input"** of **PWM** block.

    - Keep the toggle switch at **1KHz** position.

    - Now connect"**32 KHz" Pulse Output** to "**Pulse Input"** of **PWM** block.

    - Set the **Amplitude Control** pot at fully clock wise direction.

2. Connect the Channel 1 of CRO /DSO in between **PWM Output** & **ground** (Modulated Signal)

3. Connect the Channel 2 of CRO DSO in between **Sine Wave** & **ground** (Modulating Signal)

4. Now connect the **SMPS Supply** between mains socket & **NV6576** Trainer.

5.   First switch **On** the SMPS supply & then trainer **Power** switch.

6.   Now observe the "**PWM Output"** of Pulse Width Modulation on the CRO.

PWM demodulation:

1. Connect the "**PWM Output**" to "**Input**" of **Low Pass Filter** through the patch cord.

2. Connect patch cord between " **Output**" of **Low Pass Filter** and "**Input**" of **AC Amplifier**. Set the **Gain Control** pot in counter clock wise position.

Observe the "**Output**" of **AC Amplifier** on the CRO. If it is not exact replica of Input then adjust the **Gain Control** pot & obtain pure sine wave similar to input

Circuit Diagram:

PWM modulation:

NV6576 PWM Modulation and Demodulation Trainer

PWM Demodulation:

NV6576 PWM Modulation and Demodulation Trainer

Observations:

S. No	Observation	Amplitude	Time
1.	Modulating signal		
2.	Pulse signal		
3.	PWM output		
4.	Demodulated output		

WAVEFORMS:

Pulse signal

Modulating signal

PWM output

Demodulated

signal
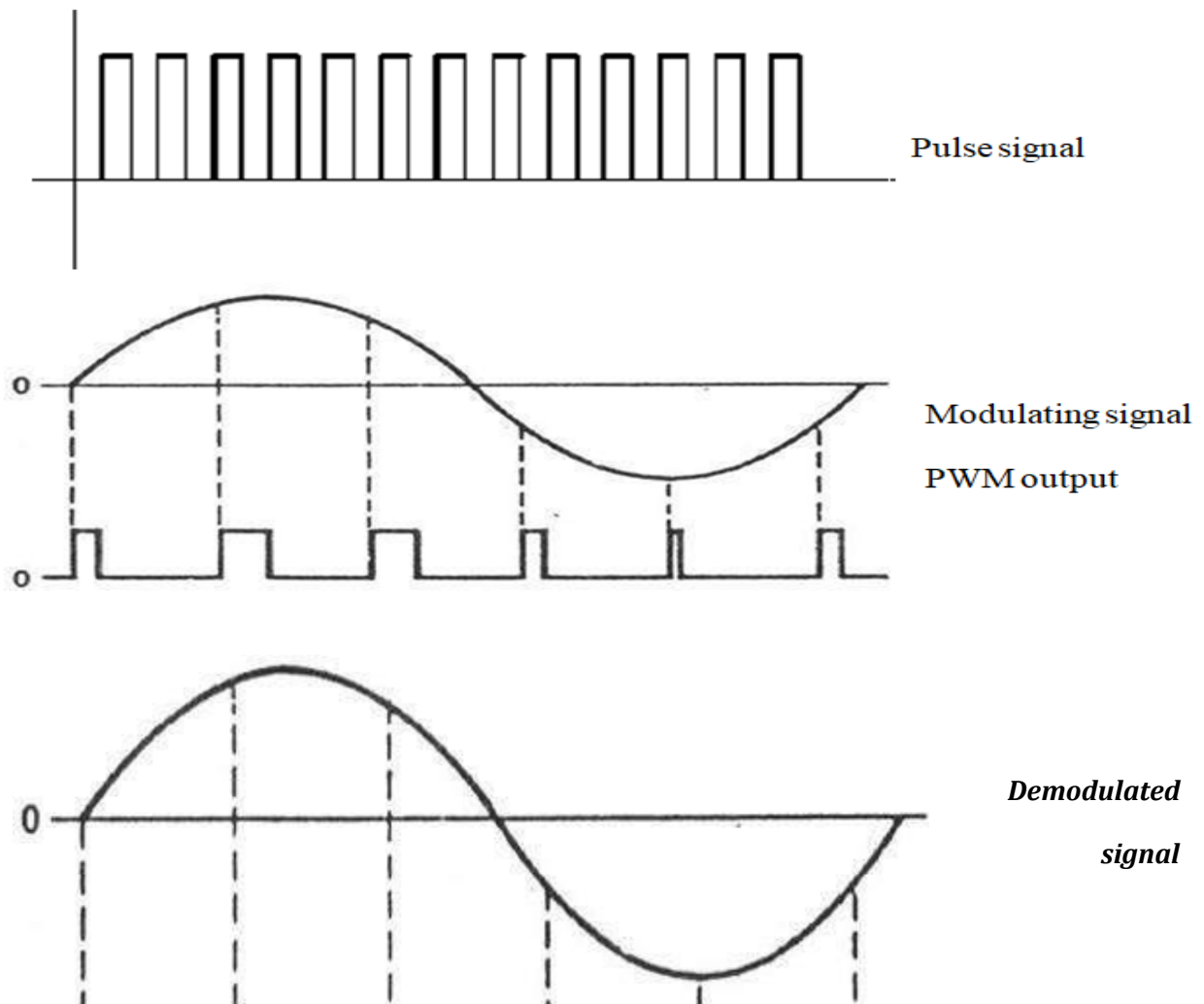
RESULT:

Viva Questions:

1. Define Pulse width Modulation
2. Give few applications of PWM.
3. Discuss the Bandwidth requirements of PWM.
4. What are the advantages of PWM over PAM?
5. What are the disadvantages of PWM

8. PULSE POSITION MODULATION AND DEMODULATION

AIM:

        To Study Pulse Position modulation and demodulation using Sine Wave input.

APPARATUS:

        1. NV6576 Trainer

        2. 2mmPatchCords

        3. CRO with Test Probe/Recommended to use Digital Storage
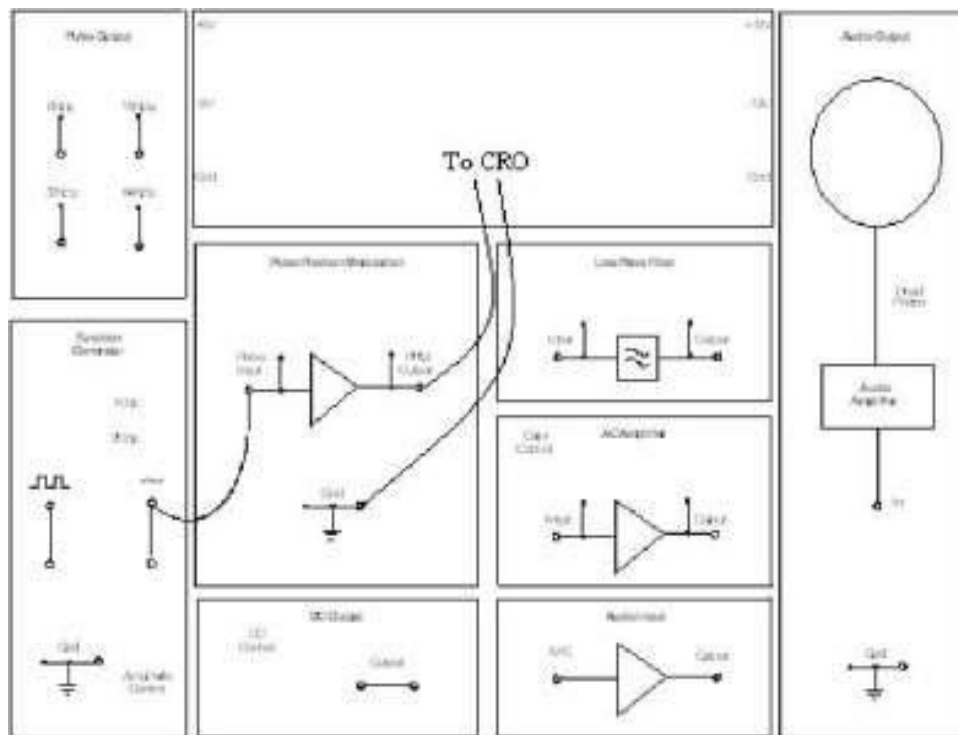Oscilloscope (DSO) for better results
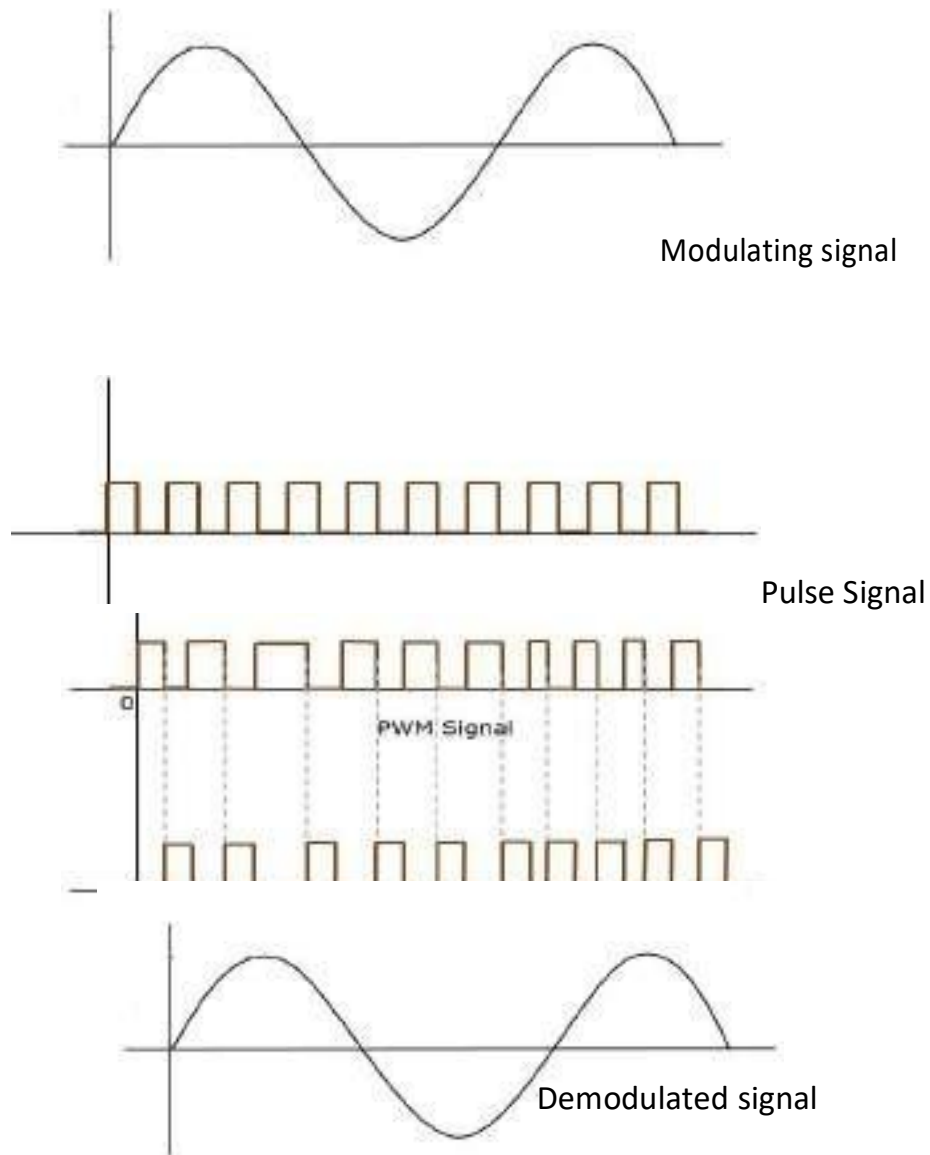
Procedure:

PPM Modulation:

PPM Modulation:

1. Connect the circuit as shown inFig.1

2. Connect patch cord between output of Sine Wave & "Input" of PPM block. 3. Keep the toggle switch at 1KHz position.

4. Set the Amplitude Control pot at fully clock wise direction.

5. Now connect the SMPS Supply between mains socket & NV6577 Trainer.

6. Firstly switch On the SMPS supply & then trainer Power switch.

7. Now observe the "PPM Output" of Pulse Position Modulation on the CRO.

8. Now varying the amplitude of sine wave using Amplitude Control pot & see its effect on PPM Output.

9. Change the frequency through the position of toggle switch (2 KHz) & observe the effect on PPM Output.

PPM Demodulation:

Connect the "PPM Output" to "Input" of Low Pass Filter through the patch cord. Connect patch cord between "Output" of Low Pass Filter and "Input" of AC Amplifier . Set the Gain Control pot in counter clock wise position .Observe the "Output" of AC Amplifier on the CRO. It is Demodulated wave form. If it is not exact replica of Input then adjust the Gain Control pot & obtain pure sine wave similar to input.

Circuit Diagram:

PWM modulation:

NV 6677 PPM Modulation and Demodulation Trainer

PPM Demodulation:

NV6577 PPM Modulation and Demodulation Trainer

Observations:

S. No	Observation	Amplitude	Time
1.	Modulating signal		
2.	Pulse signal		
3.	PPM output		
4.	Demodulated output		

Waveforms:

Modulating signal

Pulse Signal

PWM Signal

Demodulated signal

RESULT:

Viva Questions:

1. Explain the principle of PPM?
2. What are the Bandwidth requirements of PPM?
3. Write the advantages and disadvantages of Pulse position modulation?
4. Give few applications of PPM.

9. PHASE LOCKED LOOP

AIM: To find the lock range and capture range of a PLL.

APPARATUS:

1. ICLM565
2. Decade Resistance Box
3. Signal Generator
4. Multi meter--2Nos
5. Resistors--680Ω,670Ω,10KΩ
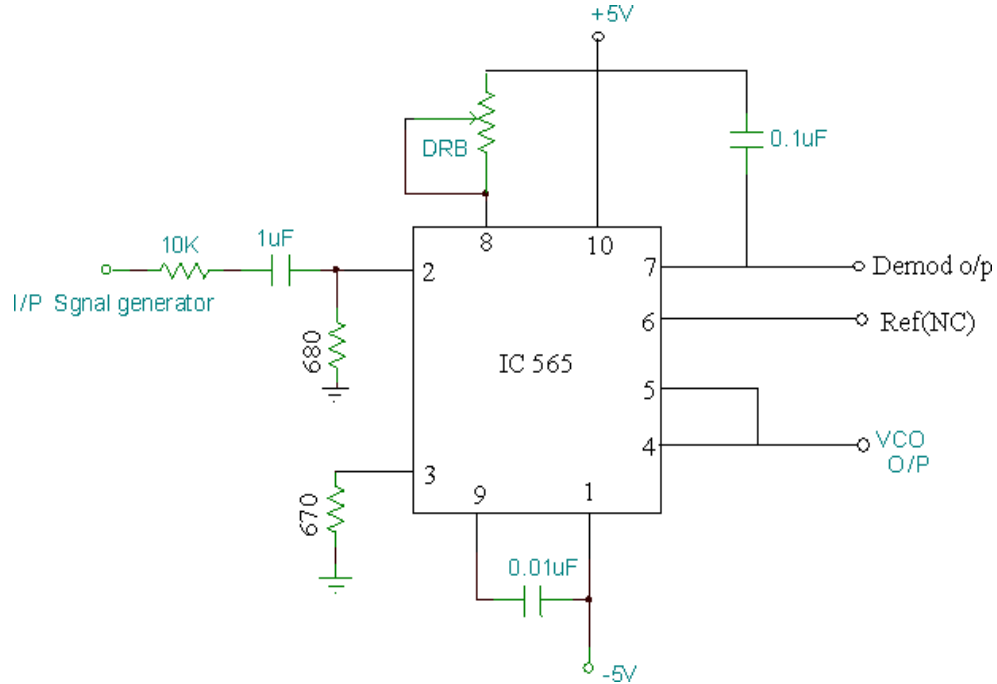6. Capacitors—1µF,0.1µF,0.01µF

PROCEDURE:

1. Connect the circuit as shown in the fig.
2. Check the VCO output at pin 4 of LM565
3. This is square wave form .The frequency of the wave form I f_o.
4. Short the IC pins 4 and 5 and give any signal of (1V p-p, 1KHz) and observe the VCO o/p.
5. When input and output frequencies are equal then note down it as f_1 and by increasing the I/P frequency slowly O/P frequency will also follow the I/P frequency This follow up will come up to f_2 and going on increasing I/P

    Frequency, the O/P frequency will back at f_o only.
6. Now decrease the I/P frequency slowly, at one point I/P and O/P frequencies will be equal that point of I/P frequency is noted as f_2.
7. by still decreasing I/P frequency, O/P frequency will also follow up once again, this follow up continuous up to f' further decreasing I/P frequency, O/P frequency will once again go back to f_o only.
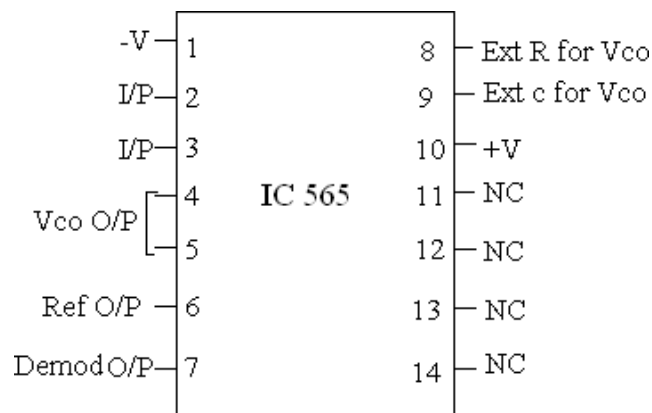
$$
\begin{array}{cccc}
f_0 & f_1 & f_2 & f_0 \\
\end{array}
$$

$$
\begin{array}{cccc}
f_0 & f_1' & f_2' & f_0 \\
\end{array}
$$
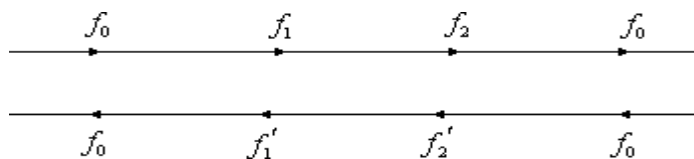
CIRCUIT:

Circuit of PLL:

PINofIC565:

RESULT:

VIVA QUESTIONS:

1. What type of feedback is used in PLL?
2. What is PLL?
3. What are main components in PLL?
4. Define the terms lock range; capture range and free running frequency?
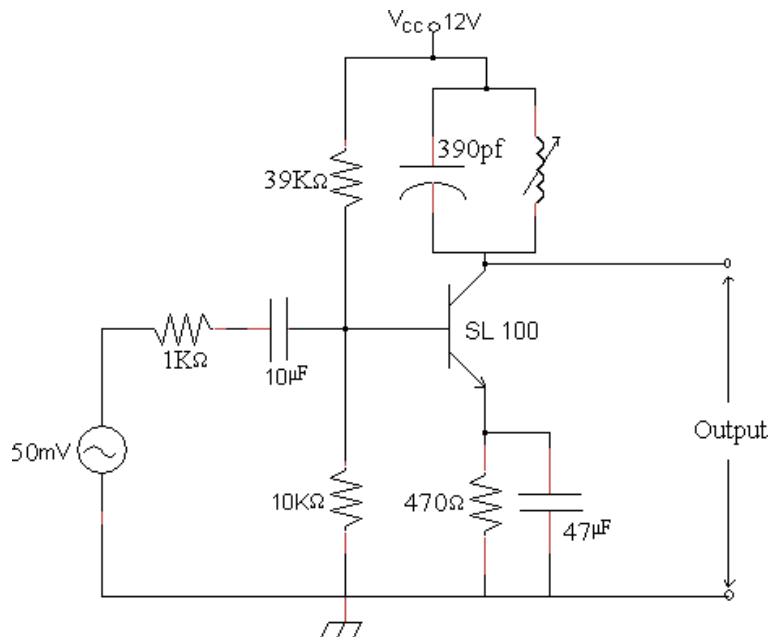5. What is loop filter?
6. What are main applications of PLL?

10 .RADIO FREQUENCY AMPLIFIER

AIM: To obtain the sensitivity and selectivity characteristics of an RF amplifier.

APPARATUS:

1. Regulator power supply
2. CRO
3. Signal generator
4. Transistor–SL100
5. Resistors–1KΩ,39KΩ,10 KΩ,470Ω
6. Capacitor–390pf,10µf,47µf

CIRCUIT:

THEORY:

Amplifiers are key building blocks in any communication system. In a receiver week incoming signal needs to be amplified to a sufficiently large value so that it can be detected. A radio frequency

amplifier, or RF amplifier, is a tuned amplifier that amplifies high-frequency signals used in radio communications. Since it is a tuned amplifier it selects the wanted frequency and rejects all unwanted frequencies. The frequency at which maximum gain occurs in an RF amplifier is made variable by changing the inductance or capacitance of the tuned circuit. An RF

Amplifier can tune over the desired range of input frequencies. The advantages of having an amplifier as a front end in receiver are as

Follows:

   I.   Better Sensitivity.

  II.   Better Selectivity.

 III.   Improved Signal-to-Noise ratio.

 IV.   Improved Image frequency rejection.

  V.   Better coupling of receiver to antenna.

Prevention of the re-radiation of the local oscillator signal through the antenna of the receiver

Sensitivity: Sensitivity is the ability of a RF receiver to amplify the week signals. It is often defined as the voltage that must be applied at the input of the receiver to give a standard output power. Sensitivity is often expressed in micro volts or in db's

Selectivity: The selectivity of a receiver is its ability to reject unwanted signals or selectivity is a measure of the performance of a radio receiver to respond only to the radio signal it is tuned to and reject other signals nearby in frequency. Selectivity is usually measured as a ratio in decibels (dB).

PROCEDURE:

    a) **Sensitivity:**

       1.   Connect the circuit as shown in the fig.

       2.   Switch on the power supply and function generator.

       3.   Apply 20mV, 100Hz signal as an input.

4. Now vary the input frequency from 100Hz to1MHz,
    keeping the input voltage constant and at each step
    noted own the output.

5. Tabulate the results.

6. Noted own the frequency at which the output voltage is
    maximum and it corresponds to the resonant
    frequency(f_o-practical) of RF amplifier

7. Draw the frequency response on semi log graph.

Selectivity:

1. Connect the circuit as shown in the fig.
2. Switch on the power supply and function generator
3. Apply 20mV input at the frequency output f_o (practical) and note down the t$V_{st.}$
4. Now vary the frequency from100Hz to 1MHz and vary the input voltage to get the V_{st} in each step.

5.   Calculate the attenuation in $dB = 20\log \dfrac{(V_{in} off\ resonance)}{(V_{in}\ at\ resonance)}$

6. Tabulate the results:

MODELGRAPH:
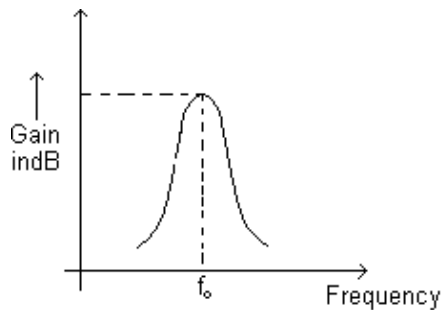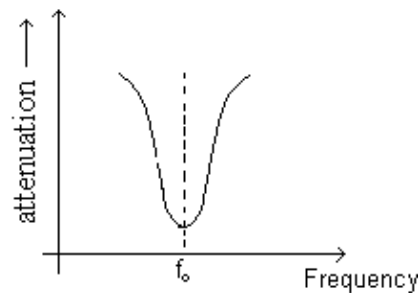
SENSITIVITY   SELECTIVITY

RESULT:

VIVA QUESTIONS:

1. What is selectivity?
2. What is sensitivity?
3. What is fidelity?
4. What is noise figure?
5. What are the advantages of using RF stage?
6. What is image frequency?
7. Draw backs of TRF receiver?
8. What is double spotting?
9. Why RF amplifier is needed in radio receivers?
10. What are the problems if there no RF amplifier?
11. Compare TRF and SH receivers?
12. Explain the characteristics of radio receivers?
13. RF frequency range?

SOFTWARE

EXPERIMENTS

INTRODUCTION TO MATLAB:

MATLAB is a high-level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numeric computation. Using the MATLAB product, you can solve technical computing problems faster than with traditional programming languages, such as C,C++and Fortran.

You can use MATLAB in a wide range of applications, including signal and image processing, communications, control design, test and measurement, financial modeling and analysis, and computational biology. Add-on tool boxes (collections of special-purpose MATLAB functions, available partly) extend the MATLAB environment to solve particular classes of problems in these application areas.

MATLAB provides a number of features for documenting and sharing your work. You can integrate your MATLAB code with other languages and applications, and distribute your MATLAB algorithms and applications. Features include:

- High-level language for technical computing
- Development environment form an aging code files, and data
- Interactive tools for iterative exploration, design, and problem solving
- Mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, and numerical integration
- 2-Dand3-Dgraphicsfunctionsforvisualizingdata
- Tools for building custom graphical user interfaces
- FunctionsforintegratingMATLABbasedalgorithmswithexterna lapplicationsandlanguages, such as C, C++,Fortran, JAVA^{TM}, COM and Microsoft Excel.

1. AMPLITUDE MODULATION AND DEMODULATION

AIM: To study the function of Amplitude Modulation & Demodulation (under modulation, perfect modulation & over modulation) using MATLAB.

APPARATUS:

1.Personal computer

2.MATLAB SOFTWARE

PROGRAMM:

```
F s=8000;

        F m=20;

      F c=500;

    Am=1;

       Ac=1;

   t= (0:0.1*F s)/ Fs;

 m=Am*Cos (2*pi*fm*t);

 c=Ac*Cos (2*pi*F c *t);

  Ka=0.5;

U=Ka*Am;

s1=Ac*(1+U* Cos (2*pi*fm*t)).*(Cos (2*pi*F c*t));

Subplot (4, 3, 1:3);

Plot (t, m);

Title ('modulating or message signal, (fm=20 Hz)');

Subplot (4, 3, 4:6);

Plot (t, c);

Title ('carrier signal (t c: 500 Hz)');

Subplot (4, 3, 7);

Plot (t, s1);
```

Title (' modulated signal (ka*Am=0.5)');

Am=2;

Ka=0.5;

u=Ka*Am;

s2=Ac*(1+4*Cos (2*pi*fm*t)).*(Cos (2*pi*F c*t));

Subplot (4, 3, 8);

Plot (t, s2);

Title ('exact modulated signal (Ka*Am=1)');

Am=5;

Ka=0.5;

U=Ka*Am;

s3=Ac*(1+U*Cos (2*pi*fm*t).*Cos (2*pi*F c*t));

Subplot (4, 3, 9);

Plot (t, s3);

Title ('over modulated signal (Ka: Am=2.5)');

r1=s1.*c;

[b , a]=butter (1, 0.01);

mr1=filter (b, a, r1);

Subplot (4, 3, 10);

Plot (t, mr1);

Title ('demodulated signal for (Ka*Am=0.5)');

r2=s2.*c;

[b ,a]=butter (1, 0.01);

mr2=filter (b, a, r2);

Subplot (4, 3, 11);

Plot (t, mr2);

Title ('demodulated signal for (Ka*Am=1)');

r3=s3.*c;

[b , a]=butter (1, 0. 01);
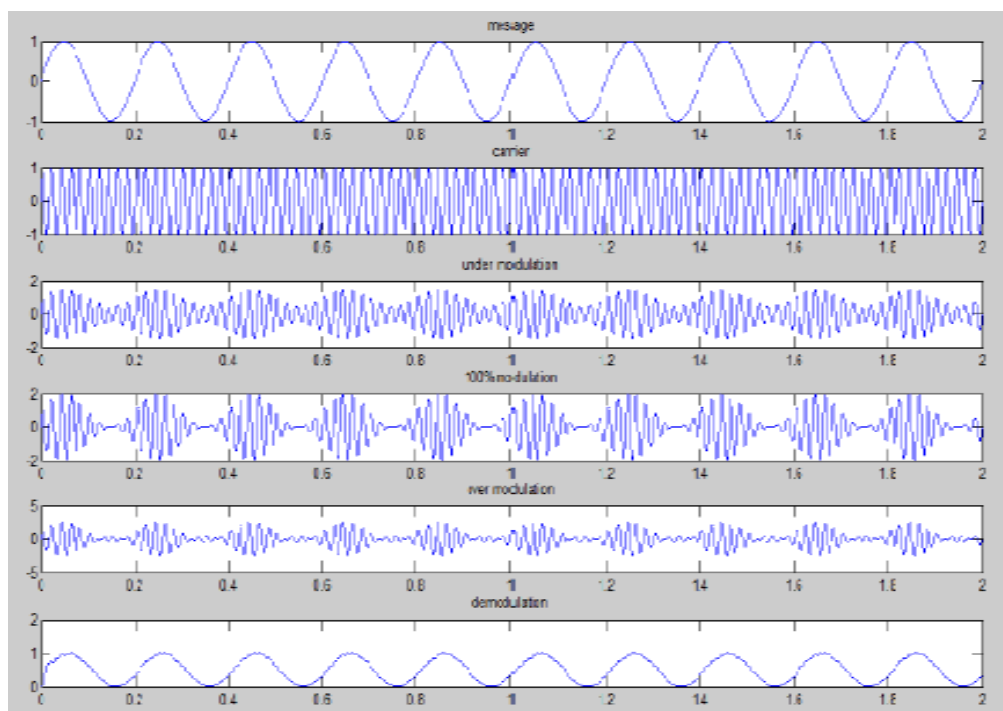
mr3=filter (b, a, r3);

Subplot (4, 3, 12);

Plot (t, mr3);

Title ('demodulated signal for (Ka*Am=2.5)');

SIMULATION RESULT:

RESULT:

2. DSB-SC MODULATOR AND DETECTOR

AIM: To study the function of DSB – SC Modulator and Detector using MATLAB.

APPARATUS:

  1.Personal computer

  2.MATLAB SOFTWARE

PROGRAMM:

```
t=0:0.000001:0.001;
    V M =1;

    VC = 1;

    Fm =2000;

    FC=50000;

  M _t=V m *sin (2*pi*fm*t);

   Subplot (4, 1, 1) plot (t, m _t) c _t=V c*sin (2*pi*F c *t);

    Subplot (4, 1, 2) plot (t, c _t) subplot(4,1,3)s _t=m _t.*c _t;

  Hold on;

   Plot (t, s _t) plot (t, m _t, 'r') plot (t, m _t,' r') hold off;

    r=s _t*c _t;

  [b a]=butter (1, 0.01);

   M r =filter (b, a, r);

  Subplot (4, 1, 4);

  Plot (t, m r);
```
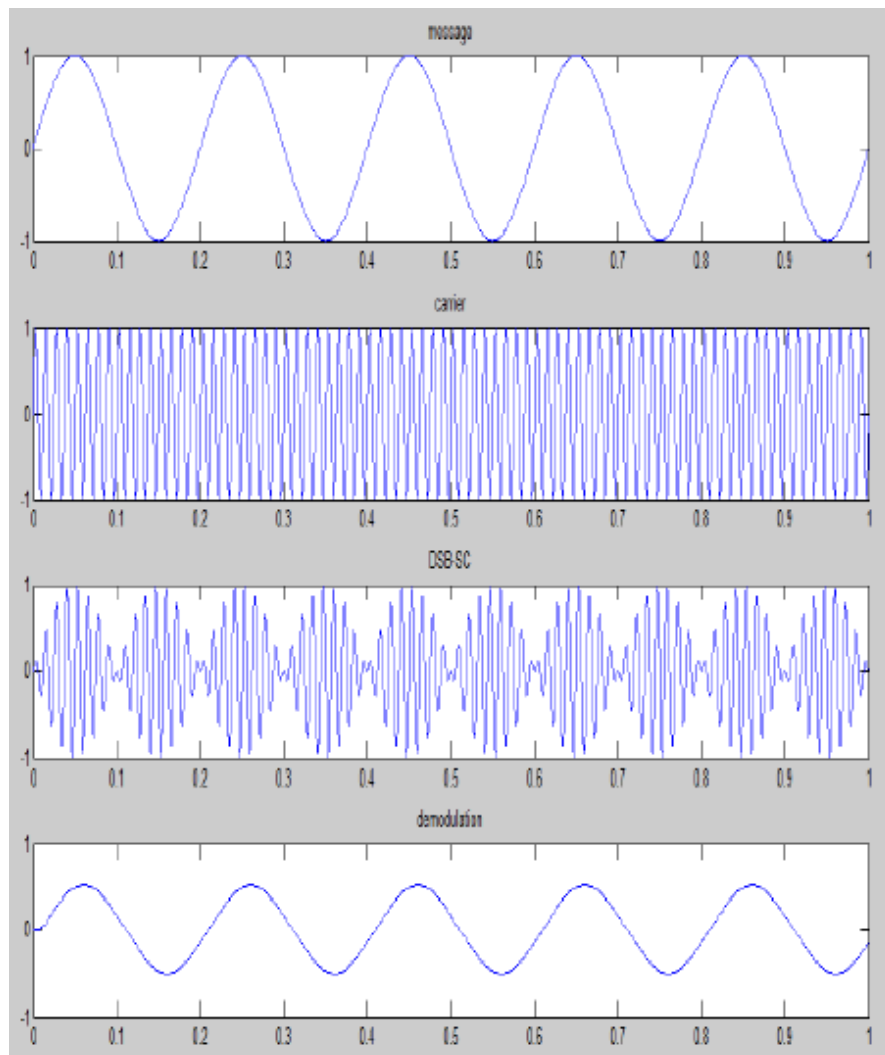
SIMULATION RESULT:

RESULT:

3 .FREQUENCY MODULATION AND DEMODULATION

AIM: To study the function of   Frequency Modulation and Demodulation using MATLAB.

APPARATUS:

1. Personal computer

2. MATLAB SOFTWARE

PROGRAMM:

```
Fs =10000;
Ac=1;

Am=1;

Fm=35;

F c=500;

b=10;

t= (0:0.1*F s)/Fs;

W c=2*pi*F c;

W m=2*pi*fm;

M t=am*Cos (wm*t);

Subplot (4, 1, 1);

Plot (t, m t);

Title ('modulating signal');

Ct=Ac*Cos (W c*t);

Subplot (4, 1, 2);

Plot (t, ct);

Title ('carrier signal');

S t=ac*Cos ((W c*t) +b*sin(wm*t));
```

Subplot (4, 1, 3);

Plot (t, st);

Title ('modulated signal');

d=de mod (s t, F c, Fs,'Fm');
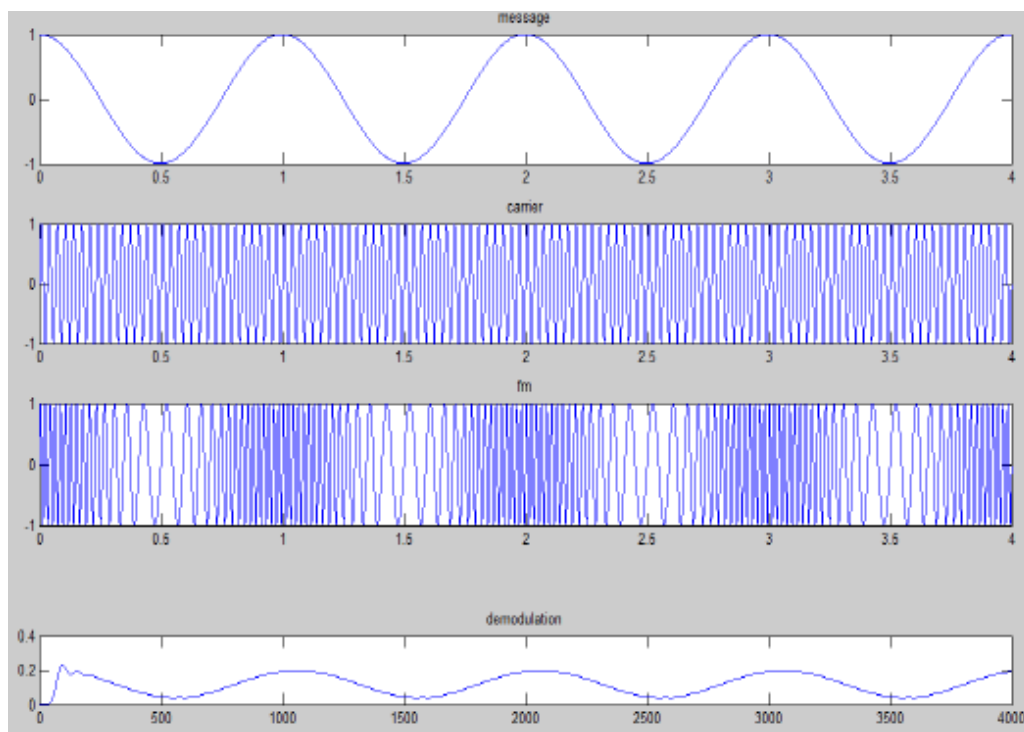
Subplot (4, 1, 4);

Plot (t, d);

Title ('demodulated signal');

SIMULATIONRESULT:

RESULT:

4.SSB-MODULATION AND DETECTOR

AIM: To study the function Of   SSB-Modulation and Detector using MATLAB.

APPARATUS:

1.   Personal computer

2.   MATLAB SOFTWARE

PROGRAMM:

```
F s=8000;
F m=20;

F c=50;

Am=1;

Ac=1;

t= {[0:0.1*F s]/F s;

Subplot (5, 1, 1);

m1 =am*Cos (2*pi*fm*t);

Plot (t, m1);

Title ('message signal');

m2=am*sin (2*pi*fm*t);

Subplot (5, 1, 2);

c1=ac*Cos (2*pi*F c*t);

Plot (t, c1);

Title ('carrier signal') l;

c2=ac*sin (2*pi*F c*t);

Subplot (5, 1, 3);

% subs=0.5*am*Cos (2*pi*fm*t).*ac*Cos (2*pi*F c*t)--0.5*am*sin (2*pi*fm*t).*ac*sin (2*pi*F c*t);
```
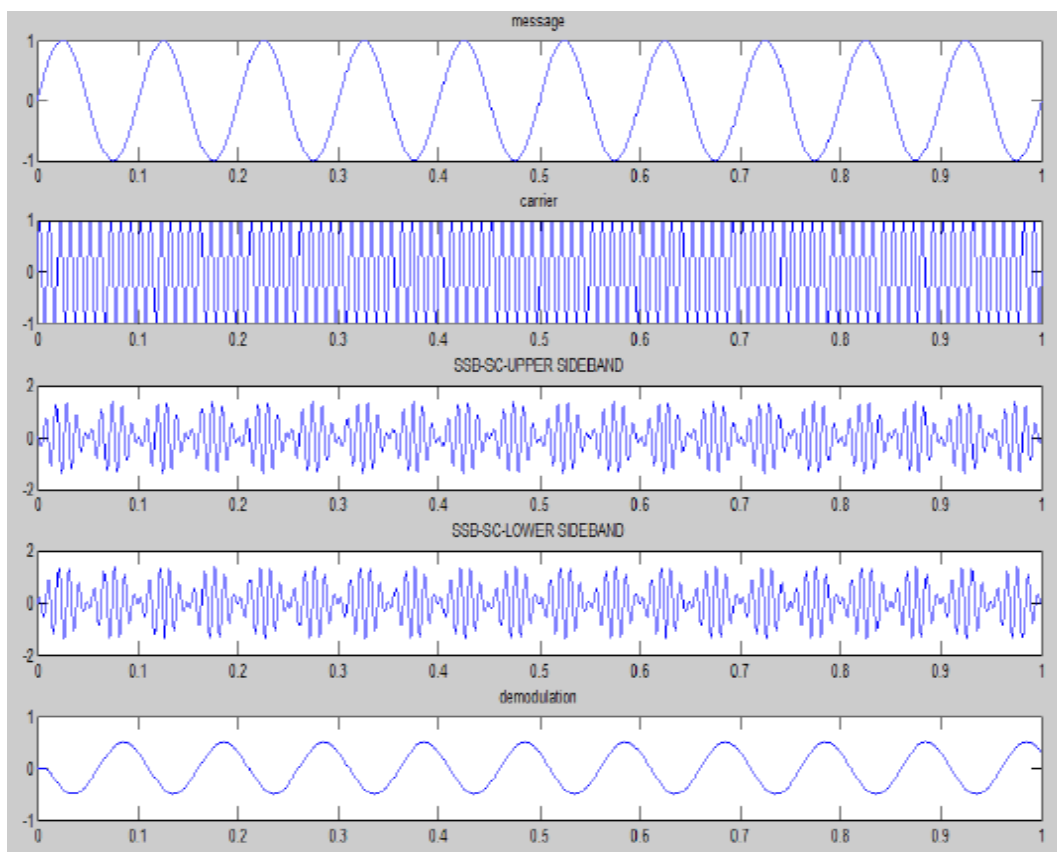
Subs=0.5*m1.*c1-0.5*m2.*c2;

Plot (t, subs);

Title ('SSB -sc signal with USB ');

Subplot (5, 1, 4);

Slab=0.5*m1.*c1+0.5*m2.*c2;

Plot (t, slab);

SIMULATIONRESULT:

RESULT:

5.PRE-EMPHASISANDDE-EMPHASIS

AIM : To study the function Pre-Emphasis and de-Emphasis using MATLAB.

APPARATUS:

1. Personal computer

2. MATLAB SOFTWARE

PROGRAMM:

Num _samples=2^13;

Fs =5000;

Ts =1/ Fs;

Fm1=20;

Fm2=30;

F c =200;

t= (o: num_samples-1)* t s;

f= (-num _samples /2:num_samples/2-1)* f s /num _samples;

M t =sin (2*pi*fm1*t);

Mf = f ft shift (abs (f f t (m t)));

F _cutoff _p e=15;

W n _p e=f _cut off _p e/ (f s/2);

[b _p e ,a _p e]=butter (1, w n _p e);

[h _p e, w]=freq z (a _p e, b _p e);

A _de=b _p e;

B _de=a _ p e;

[h _ d e, w]= frees (a _d e, b _de);

M t _p e=filter (a_ p e, b _p e, m t);

Mf _p e= f ft shift (abs (ff t (m t _p e)));

Figure (1) Subplot (2, 1, 1);

Plot (t, m t);

Axis ([0.6min (m t)-1max (m t) +1]) grid on;

Title ('modulating signal (time domain)');

Subplot (2, 1, 2);

Plot (f, m f);

Grid on;

Axis ([-50500max (mf) +100])title('modulating signal(frequency domain)');

Figure (2) Subplot (2, 1, 1);

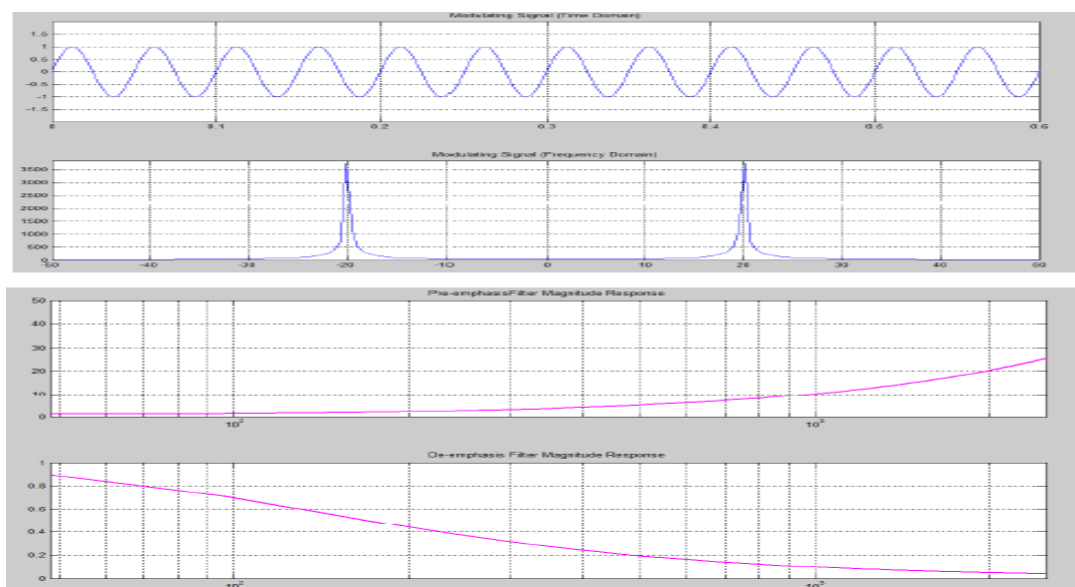Semi log x (w*pi*(Fs/2), abs (h _p e),'m','linewidth', 2) axis ([0fs/2050]) grid on;

Title ('pre-emphasis filter magnitude response');

Subplot (2, 1, 2);

Semi log x (w*pi*(f s/2),abs (h _de),'m','linewidth',2)axis([0fs/201]) grid on;

Title ('de-emphasis filter magnitude response');

SIMULATION RESULT:

RESULT:

6. PULSE AMPLITUDE DEMODULATION AND DEMODULATION

AIM: To study the function Pulse Amplitude Demodulation and Demodulation using MATLAB.

APPARATUS:

1. Personal computer

2. MATLAB SOFTWARE

PROGRAMM:

Fs =8000;

Fm=20;

F c =500;

Am=1Ac=1t= [0:0.1*f s] / f s;

m=Am*co s (2*pi*fm*t);

c=Ac*Cos (2*pi*F c*t);

Ka=0.5;

U=Ka*Am;

s1=Ac*(1+U*Cos (2*pi*fm*t)).*(Cos (2*pi*F c*t));

Subplot (4, 3, 1:3);

Plot (t, m);

Title ('modulating or message signal, (fm=20 Hz)');

Subplot (4, 3, 4:6);

Plot (t, c);

Title ('carrier signal (t c: 500 Hz)');

 Subplot (4, 3, 7);

Plot (t5, s 1);

Title (' modulated signal (ka*Am=0.5)');

```
Am=2;

Ka=0.5;

U=Ka*Am;

s2=Ac*(1+4*Cos (2*pi*fm*t)).*(Cos (2*pi*F c*t));

Subplot (4, 3, 8);

Plot (t, s2);

Title ('exact modulated signal (Ka*Am=1)');

Am=5;

Ka=0.5;

U=Ka*Am;

s3=Ac*(1+U*Cos (2*pi*fm*t).*Cos (2*pi*F c*t));

Subplot (4, 3, 9);

Plot (t, s3);

Title ('over modulated signal (Ka: Am=2.5)');

r1=s1.*c;

[b, a]=butter (1, 0.01);

mr1=filter (b, a, r1);

Subplot (4, 3, 10);

Plot (t, mr1);

Title ('demodulated signal for (Ka*Am=0.5)');

r2=s2.*c;

[b, a]=butter (1, 0.01);

mr2=filter (b, a, r2);

Subplot (4, 3, 11);

Plot (t, mr2);
```

Title ('demodulated signal for (Ka*Am=1)');
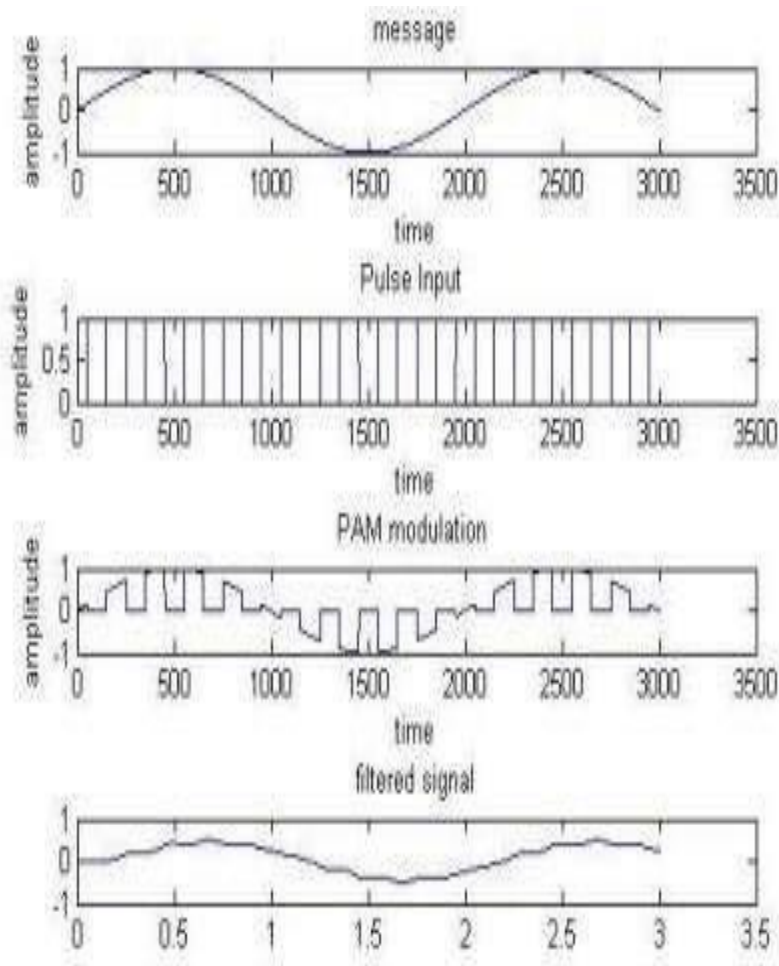
r3=s3.*c;

[b, a]=butter (1, 0.01);

mr3=filter (b, a, r3);

Subplot (4, 3, 12);

Plot (t, m r3);

Title ('demodulated signal for (Ka*Am=2.5)');

SIMULATION RESULT:

RESULT:

7. SAMPLING THEOREM

AIM: To study the function Sampling Theorem using MATLAB.

APPARATUS:

1. Personal computer

2. MATLAB SOFTWARE

PROGRAMM:

Clear all;

Close all;

C l c;

T final=0.05;

t=0:0.0005:t final;

Fm =input ('enter the analog frequency');

X t= Cos (2*pi*fm*t);

F s l=1.3*fm;

N l=0:2/f s l: t final;

X n=Cos (2*pi*n l*fm);

Sub plot (3, 1, 1);

Plot (t, x t, 'b', n l, x n,'r');

Title ('under sampling plot');

s2=2*fm;

n2=0:1/fs2: t final;

X n =Cos (2*pi*fm*n2);

Subplot (3, 1, 2);

Plot (t, x t,' b', n2, x n,' r');

Title ('n y quits plot');

fs3=5*fm;

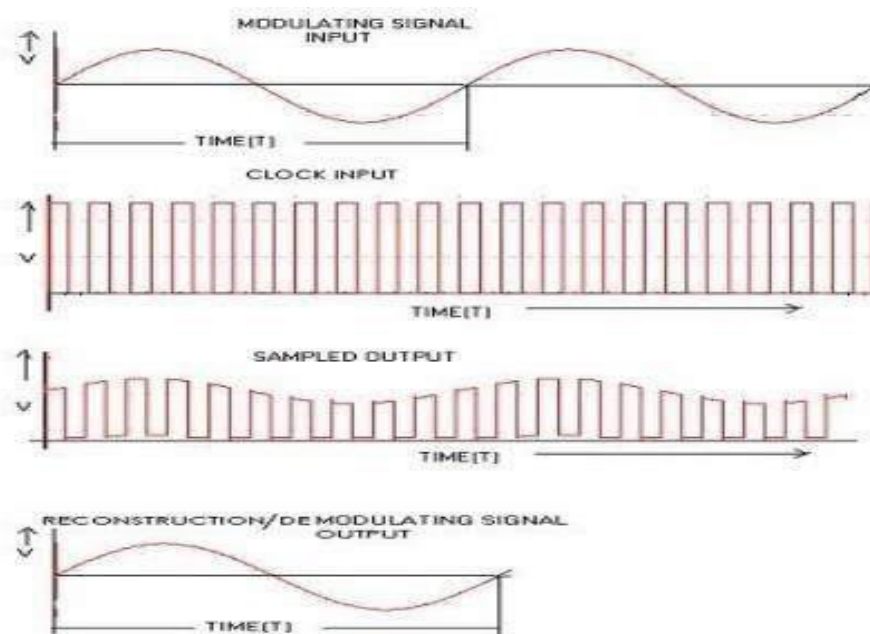n3=0:1/fs3: t final;

X n = Cos (2*pi*fm*n3);

Subplot (3, 1, 3);

Plot (t, x t, 'b', n3, x n, 'r');

Title ('over sampling plot');

X label ('time');

Y label ('amplitude');

SIMULATION RESULT:

RESULT: