

ANALOG COMMUNICATIONS LAB
LABORATORY MANUAL

R 16

III/ IV B.E (ECE)

II–Semester



**DEPT. OF ELECTRONICS AND COMMUNICATION
ENGINEERING**

SIR C.R.REDDY COLLEGE OF ENGINEERING

ELURU-534007

Vision Of The Institution

To emerge as a premier institution in the field of technical education and research in the state and as a home for holistic development of students and contribute to the advancement of society and the region.



Mission Of The Institution

To provide high quality technical education through a creative balance of academic and industry oriented learning; to create an inspiring environment of scholarship and research; to instill high levels of academic and professional discipline; and to establish standards that inculcate ethical and moral values that contribute to growth in career and development of society in general.

Vision Of The department

To be a premier department in the region that nurtures individuals for acquisition of knowledge and skills with research orientation which suits the local and global needs of industry and society in the field of Electronics and Communication Engineering.



Mission Of The Department

To impart quality education and encourage research with an emphasis on application and innovation; to cater the emerging societal needs through all-round development of students; to enable individuals face the global competition; to inculcate the importance of ethical and moral values in students.

Program Outcomes

Engineering Graduates will be able to:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, society, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in society and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives

PEO 1: Develop a solid foundation in mathematics and sciences to solve electronics and communication engineering problems.

PEO 2: Apply core engineering concepts to develop novel products and solutions demanded by modern industry

PEO 3: Pursue higher studies, research & development in science & technology and keep abreast of latest technological developments.

PEO 4: Inculcate professional and ethical attitude, effective communication skills, Team spirit & leadership qualities

PEO 5: Contribute to the needs of the society in solving technical problems using electronics communications engineering principles, tools and practices

Program Specific Outcomes

A graduate of the Electronics and Communication Engineering Program will be able to:

PSO1: Apply domain specific knowledge for the design and analysis of VLSI and Communication System applications

PSO2: Demonstrate technical competency by developing hardware and software applications in the fields of IOT, Embedded and related systems

Course Outcomes

At the end of this course the student will be able to

1. Verify the working of different modulation techniques and spectrum analyzer.
2. Analyze the operation of different modulation techniques for given input data.
3. Design the different communication circuits and verify the working of the circuits.

CO-PO & PSOs Mapping:

C.O U.No.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C327.1	3								3	3	2		2	
C327.2		3							3	3	2		2	
C327.3		2	3						3	1	2		2	

ANALOG COMMUNICATIONS LAB

LABORATORY MANUAL

R 16

LIST OF EXPERMENTS

S. No	Name Of The Experiment	Pg.No.
<i>Part - A: Hardware</i>		
1	Amplitude Modulation- Mod & Demod.	1
2	Am- Dsb Sc- Mod & Demod.	5
3	Spectrum Analysis Of Modulated Signal Using Spectrum Analyzer	8
4	Diode Detector	11
5	Pre- Emphasis &De- Emphasis	13
6	Frequency Modulation- Mod. & Demod.	16
7	Pluse Amplitude Modulation – Mod. & Demod.	19
8	Pluse Width Modulation – Mod. & Demod.	22
9	Pluse Position Modulation – Mod. & Demod.	27
10	Phase Locked Loop	31
11	Radio Receiver Characteristics	35
12	Study On Radio Receiver/TV Receiver Demo Kits	38
<i>Part – B: Simulation</i>		
1	Amplitude Modulation- Mod & Demod.	42
2	AM- DSB SC- Mod & Demod.	45
3	Frequency Modulation- Mod. & Demod.	47
4	SSB - Mod & Demod	49
5	Pre- Emphasis &De- Emphasis	51
6	Pluse Amplitude Modulation – Mod. & Demod.	53
7	Pluse Width Modulation – Mod. & Demod.	56
8	Pluse Position Modulation – Mod. & Demod	58
9	Phase Locked Loop	60

10	Spectrum Analysis Of Modulated Signal Using Spectrum Analyzer.	63
11	Sampling Theorem	65
<i>Add On Experiments</i>		
1	Frequency Response Of Band Pass Filter	68
2	Frequency Response Of Low Pass Filter	72
3	Harmonic Generator	76

II Year - II Semester

L	T	P	C
0	0	3	2

ANALOG COMMUNICATIONS LAB

List of Experiments (Twelve experiments to be done- The students have to calculate the relevant parameters)-

(a. Hardware, b. MATLAB Simulink, c. MATLAB Communication tool box)

- A. Amplitude Modulation - Mod. & Demod.
- B. AM - DSB SC - Mod. & Demod.
- C. Spectrum Analysis of Modulated signal using Spectrum Analyser
- D. Diode Detector
- E. Pre-emphasis & De-emphasis
- F. Frequency Modulation - Mod. & Demod.
- G. AGC Circuits
- H. Sampling Theorem
- I. Pulse Amplitude Modulation - Mod. & Demod.
- J. PWM , PPM - Mod. & Demod.
- K. PLL
- L. Radio receiver characteristics

Equipments & Software required:

Software :

- i.) Computer Systems with latest specifications
- ii) Connected in Lan (Optional)
- iii) Operating system (Windows XP)
- iv) Simulations software (Simulink & MATLAB)

Equipment:

1. RPS - 0 – 30 V
2. CRO - 0 – 20 M Hz
3. Function Generators - 0 – 1 M Hz
4. Components
5. Multimeters
6. Spectrum Analyser

Exp no:

Date:

1. AMPLITUDE MODULATION & DEMODULATION

AIM: To generate the amplitude modulated waveform with modulation indices, and demodulate the same.

APPARATUS:

1. PHYSITECH'S Amplitude Modulation and Demodulator Trainer
2. Function Generator
3. CRO
4. BNC Probes
5. Connecting Wires

PROCEDURE:

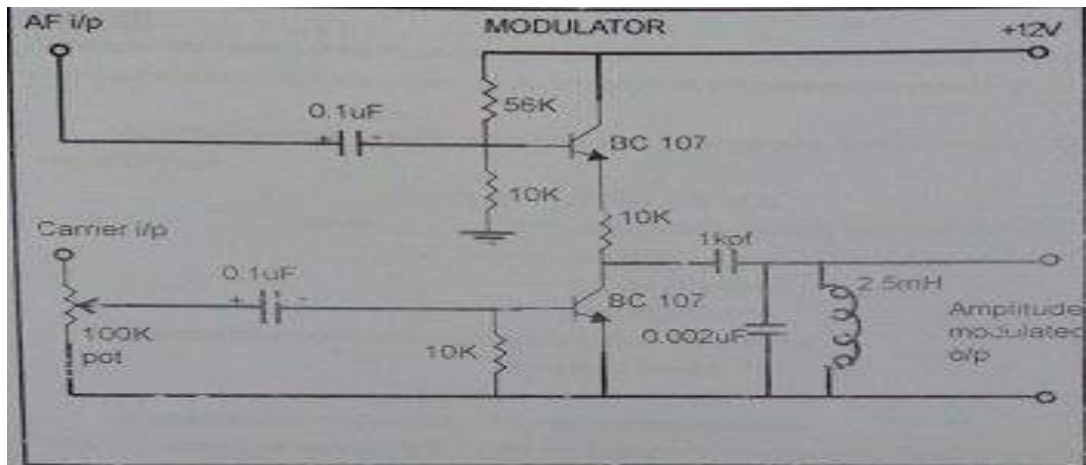
1. Switch on the trainer kit and measure the internal carrier frequency and amplitude by using CRO. It will be around 100 KHz record this frequency as f_c .
2. Connect the built in carrier to the carrier input of modulator circuit.
3. Connect around 3 KHz to 10 KHz with $2V_{p-p}$ AF signal between AF input terminal 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

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

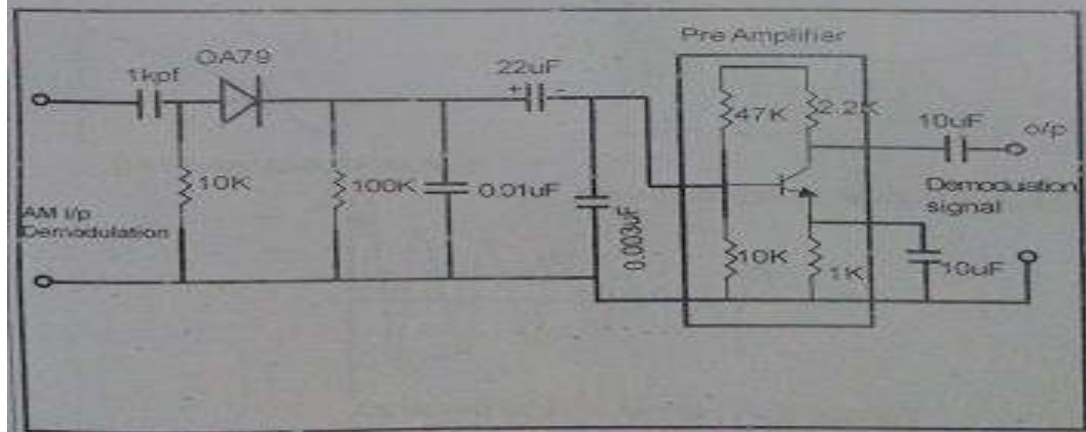
6. Compare the theoretical value given by $m = \frac{V_m}{V_c}$ where V_m is the modulating signal amplitude and V_c is the carrier signal amplitude.
7. Repeat the above procedure for 60%, 80% and 100% modulation index.
8. Connect the output of the modulator to the input of demodulator circuit and observe the output of demodulator and compare it with the modulating signal.

CIRCUIT:

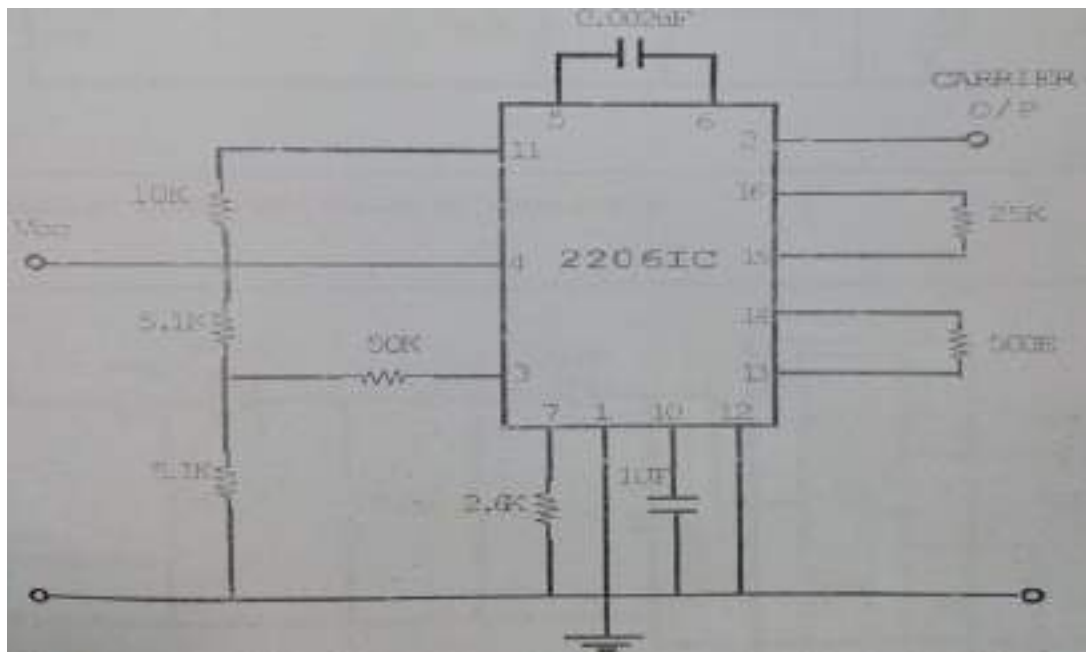
Modulator and Demodulator:

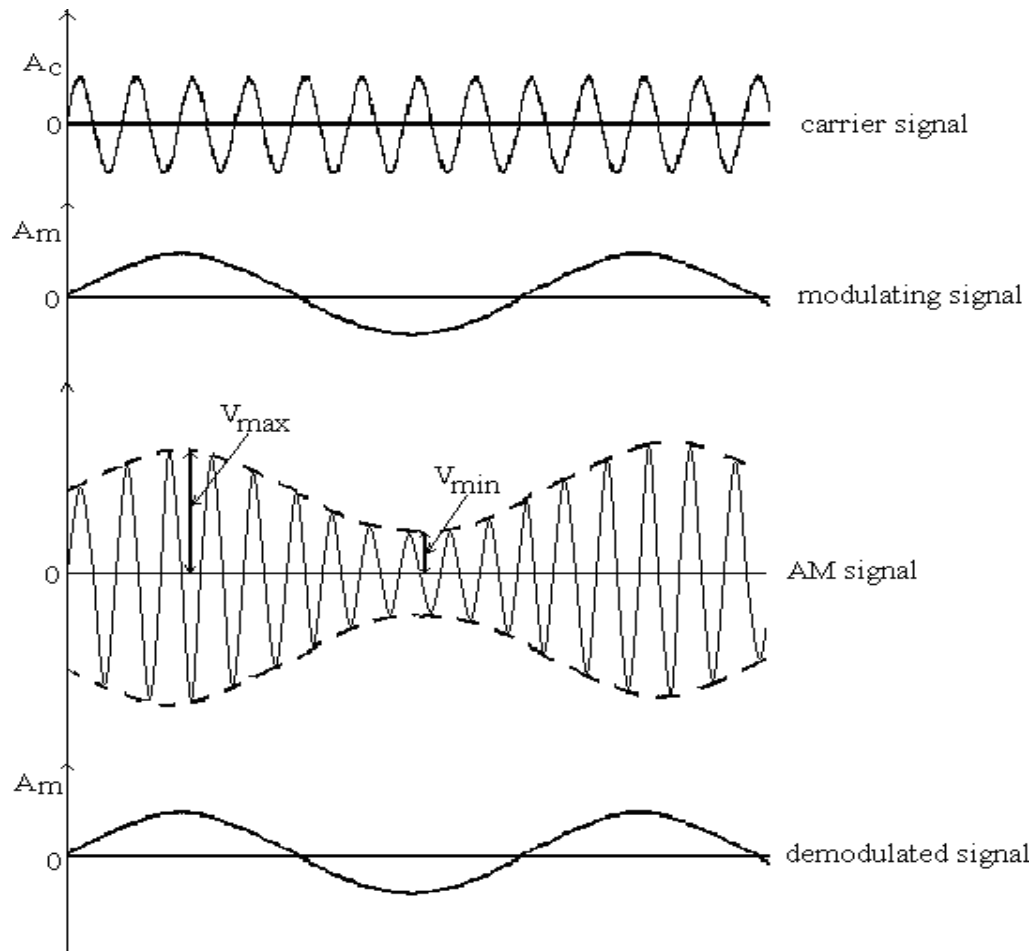


CIRCUIT FOR AMPLITUDE MODULATION



Carrier Generator:



MODEL GRAPH:**Theoretical Calculations:****TABULAR FORM:**

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

RESULT:**VIVA QUESTIONS:**

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?

Exp no:

Date:

2. AM-DSB SC-MOD&DEMOD (BALANCED MODULATOR)

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

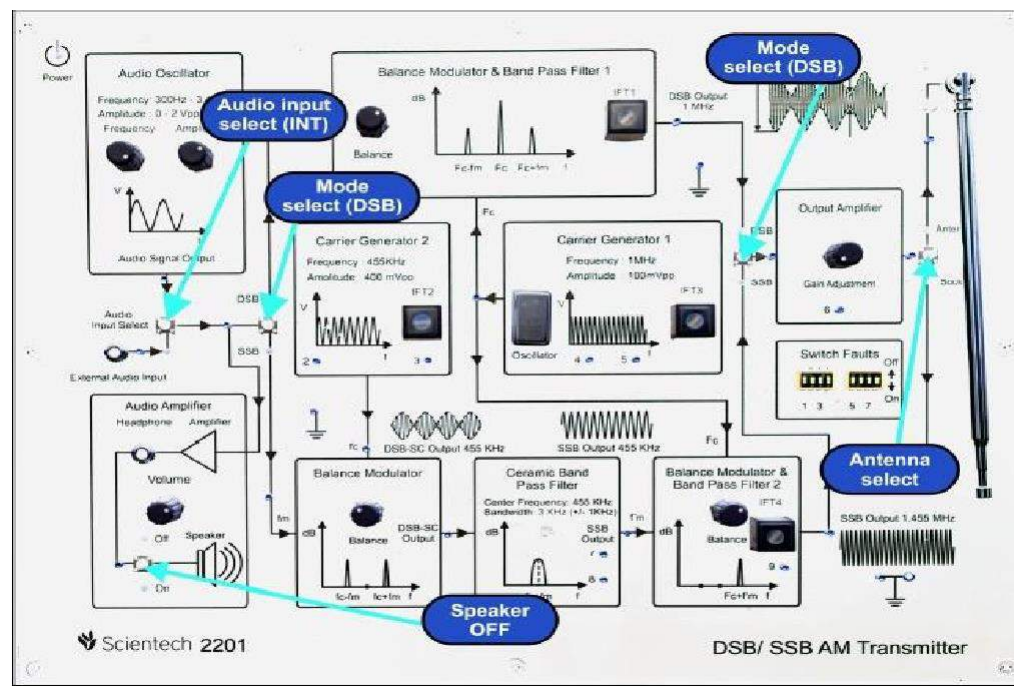
APPARATUS:

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

PROCEDURE:

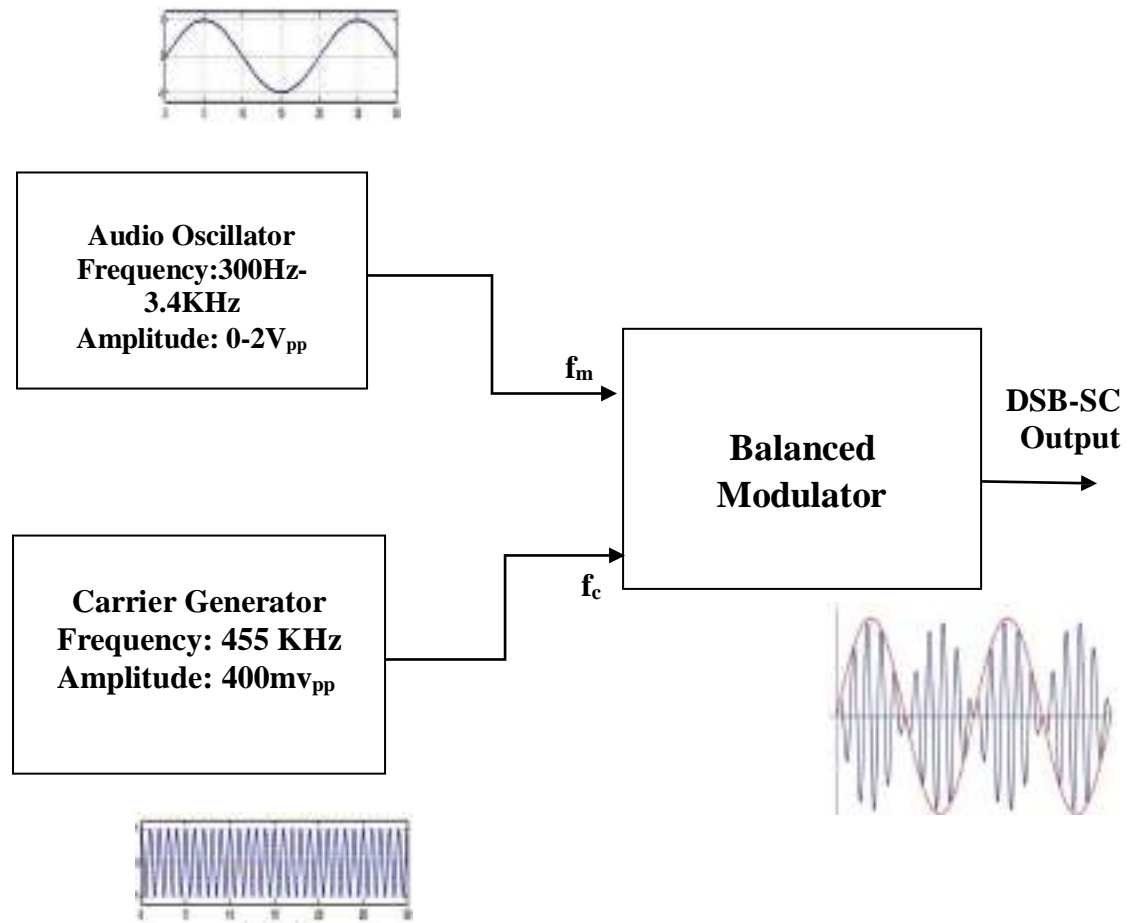
1. Switch on the trainer kit and measure the internal carrier frequency and amplitude by using CRO.
2. Check the output of Audio Oscillator Which is nothing but Message signal.
3. Adjust the frequency and amplitude of message signal until we get the Shape of DSB-SC signal.
4. Adjust the frequency of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

KIT:

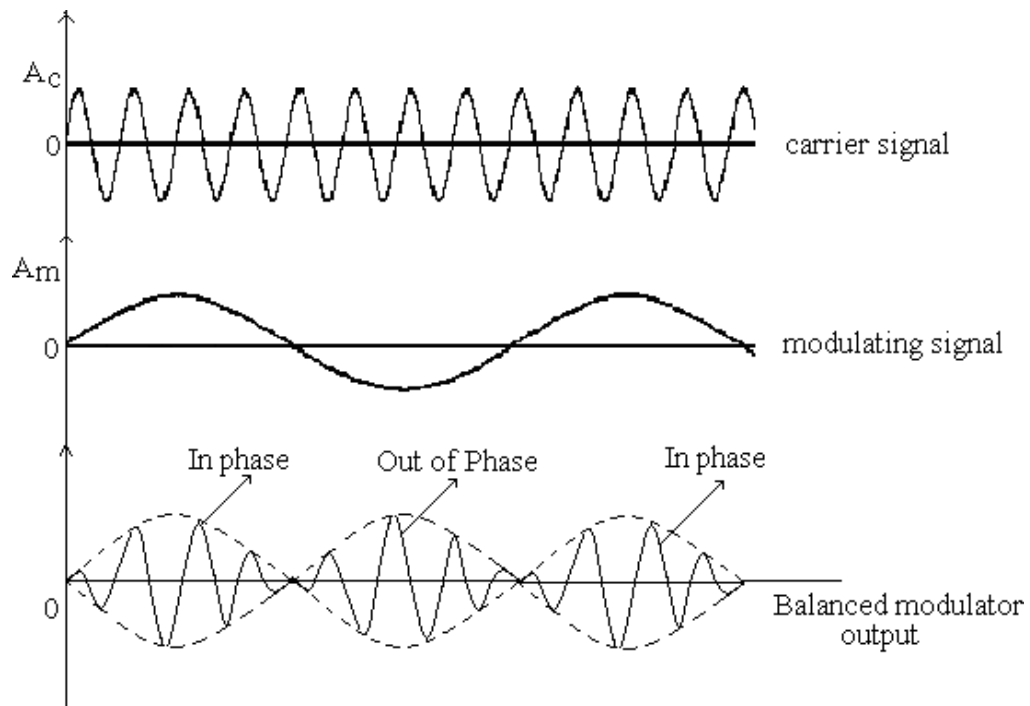


DSB-SC Transmitter trainers kit

BLOCK DIAGRAM:



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?

Exp no:

Date:

3. SPECTRUM ANALYZER: HARMONICS OF SINE WAVE & SQUARE WAVE

AIM:

1. To measure Harmonics of Sine wave by using Spectrum Analyzer.
2. To measure Harmonics of Square wave by using Spectrum Analyzer.

EQUIPMENT USED:

1. Spectrum Analyzer
2. Signal source
3. BNC – BNC cable

PROCEDURE:

1. Switch on the Spectrum Analyzer and check if the instrument is meeting the Calibrated requirements else refer to the manual supplied along with the Instrument

2. Switch on the signal source and set as given below

FUNCTION KNOBE :	SINEWAVE/SQUAREWAVE
FREQUENCY KNOBE:	1 M HZ
FREQ. VARIABLE KNOB:	MAX
LEVEL KNOB:	MIN
ATTENUATION P.B SWITCHES:	BOTH PRESSED

3. Set the Spectrum Analyzer as given below

CENTER FREQUENCY:	000.01
ATTENUATION:	ALL DEPRESSED
SCAN WIDTH	2MHZ / div

4. Connect Spectrum Analyzer and AMW signal generator via, BNC – BNC cable
Typical spectrum analyzer display, showing power vs. frequency/wavelength a spectrum analyzer or spectral analyzer is a device used to examine the spectral components. fig 1.2
5. On connecting both the instruments you shall observe a spectral lines other than the
Zero frequency line as shown in fig 1.2

6. Now switch on the MARKEB PUSH button. MK is lit and the display shows the Marker frequency. The marker is shown on the screen as a vertical needle. Now adjust the marker knob so as to align the needle with the highest spectral line. The Reading as obtained on the display in the fundamental frequency.
7. Now move on the marker to the adjacent spectral lines on RHS and note down the Display readings. These readings correspond to the harmonic frequencies.
8. Also note down the levels of each spectral line on the CRT display.
9. Repeat (7) and (8) till you can observe spectral lines and note down the readings
10. Repeat the same experiment by selecting the function of square wave in function generator.

PRECAUTIONS:

Never exceed the input to the Spectrum Analyzer beyond 10m Vrms with no attenuation and 1 Vrms with all attenuation switches pressed

OBSERVATIONS: SINE WAVE

Fundamental frequency	Frequency on display	Level in dBm
1 MHz	1 st harmonic : 2 nd harmonic: 3 rd harmonic:	
2MHz	1 st harmonic : 2 nd harmonic: 3 rd harmonic:	
3MHz	1 st harmonic : 2 nd harmonic: 3 rd harmonic:	

RESULT:

VIVA QUESTIONS:

1. What is a spectrum analyzer?
2. What are harmonics?

Exp no:

Date:

4. 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)	Max current 35ma	1
Resistor	10k Ω	1
Capacitor	0.1Uf	1
CRO	20MHz	1
AM Generator	0.1MHz-110MHz	1
Regulated Power Supply	0-30V, 1A	1

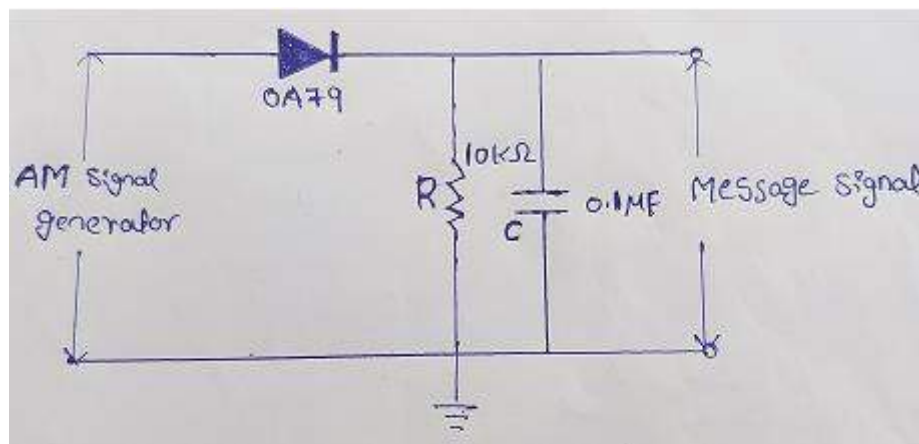
CIRCUIT DIAGRAM:

Fig.1. Diode Detector

PROCEDURE:

1. Connect the circuit diagram as per fig.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.
5. Plot a graph between E_{max} Vs Detector wave amplitude as shown in Fig.2.

SAMPLE READING:

TABLE 1: Reading of Diode Detector

S. NO.	$E_{max}(mV)$	$E_{min}(mV)$	Detector O/P (mV)
1			
2			
3			
4			
5			

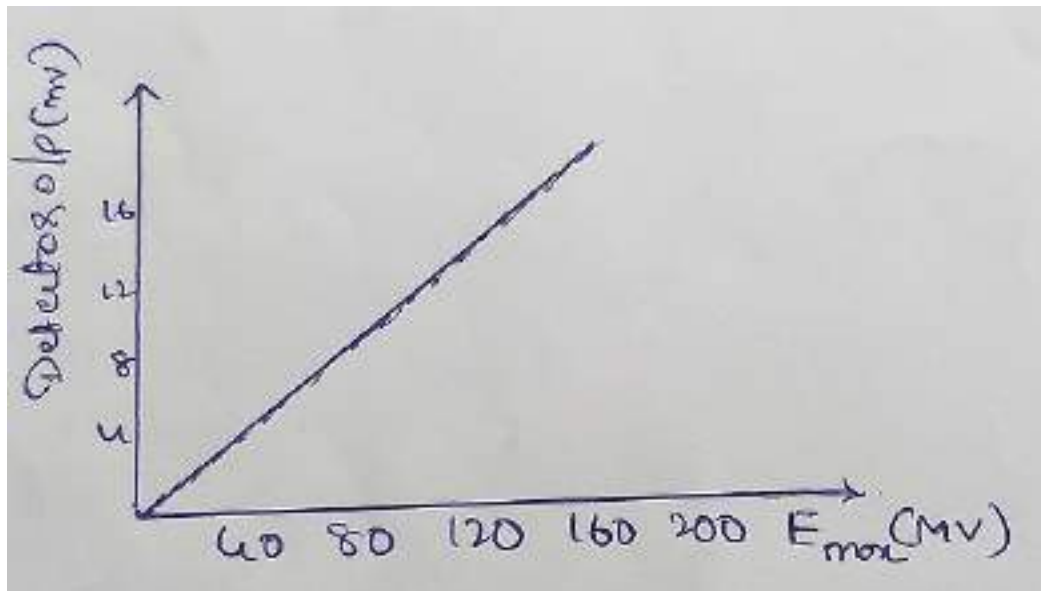
MODEL GRAPHS:

Fig.2. Characteristics of Diode Detector

RESULT:**VIVA QUESTIONS:**

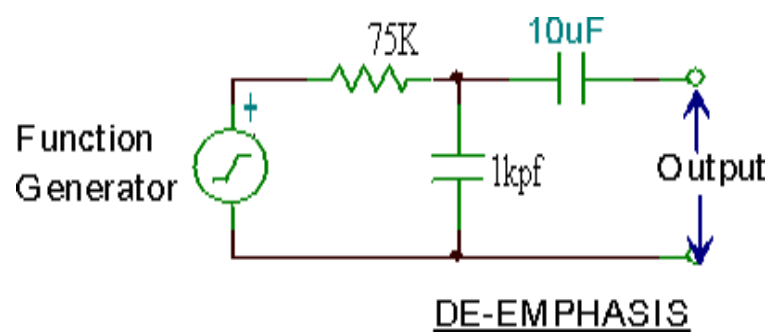
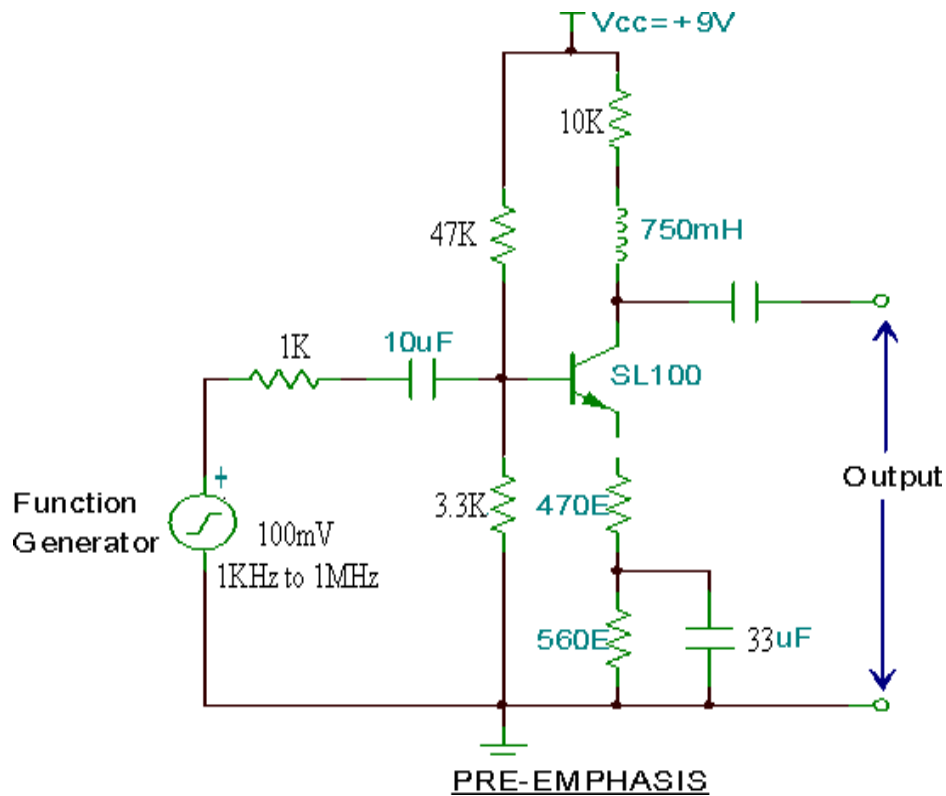
1. Classify amplitude modulation detector or demodulators.
2. Why envelope detector is most popular in commercial receiver circuits?

Exp no:

Date:

5. PRE-EMPHASIS AND DE-EMPHASIS**AIM:** To obtain the characteristics of pre-emphasis and de-emphasis.**APPARATUS:**

1. Regulated power supply
2. CRO
3. Signal Generator
4. transistor SL100
5. resistors 47K, 3.3K, 560Ω, 22K, 10K, 470 Ω, 75K, 1K
6. capacitors 10μf – 2Nos, 33 μf – 1No, 1kpf – 1no

CIRCUIT:

PROCEDURE:**Pre-emphasis:**

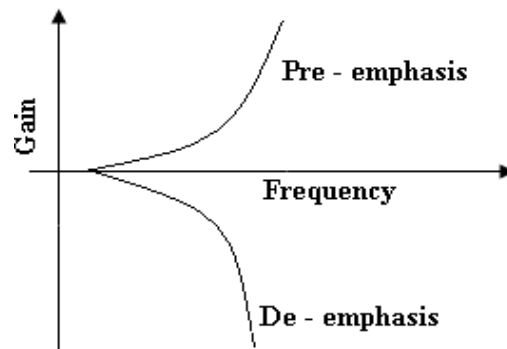
1. Apply input signal, through the signal generator and set the amplitude of the input signal at 100mv (p-p).
2. Now vary the frequency of the i/p signal from 100Hz to 15 KHz in steps and note down the output in each case.
3. Tabulate the above readings.
4. Draw the graph frequency V_s gain in db on a semi log sheet.

De-Emphasis:

1. Adopt the same procedure 1 to 4 as above

TABULAR FORM:

S. No	I/p signal frequency (Hz)	o/p voltage	Gain in db $20 \log V_0/V_i$

EXPECTED WAVEFORMS:**RESULT:****VIVA QUESTIONS:**

1. Draw the circuit of FM transmitter and receiver with pre-emphasis and de-emphasis network?
2. Draw the pre-emphasis and de-emphasis curves corresponding to different standards?
3. Compare FM discriminators?
4. What is hard limiter?
5. Define SNR?
6. What is pre-emphasis and de-emphasis?

Exp no:

Date:

6. FREQUENCY MODULATION & DEMODULATION**AIM:** To generate frequency modulated waveform & demodulated waveform**APPARATUS:**

6. Frequency Modulation and Demodulator Kit (SCIENTECH 2203 Techbook)
7. CRO
8. BNC Probes
9. Connecting Wires

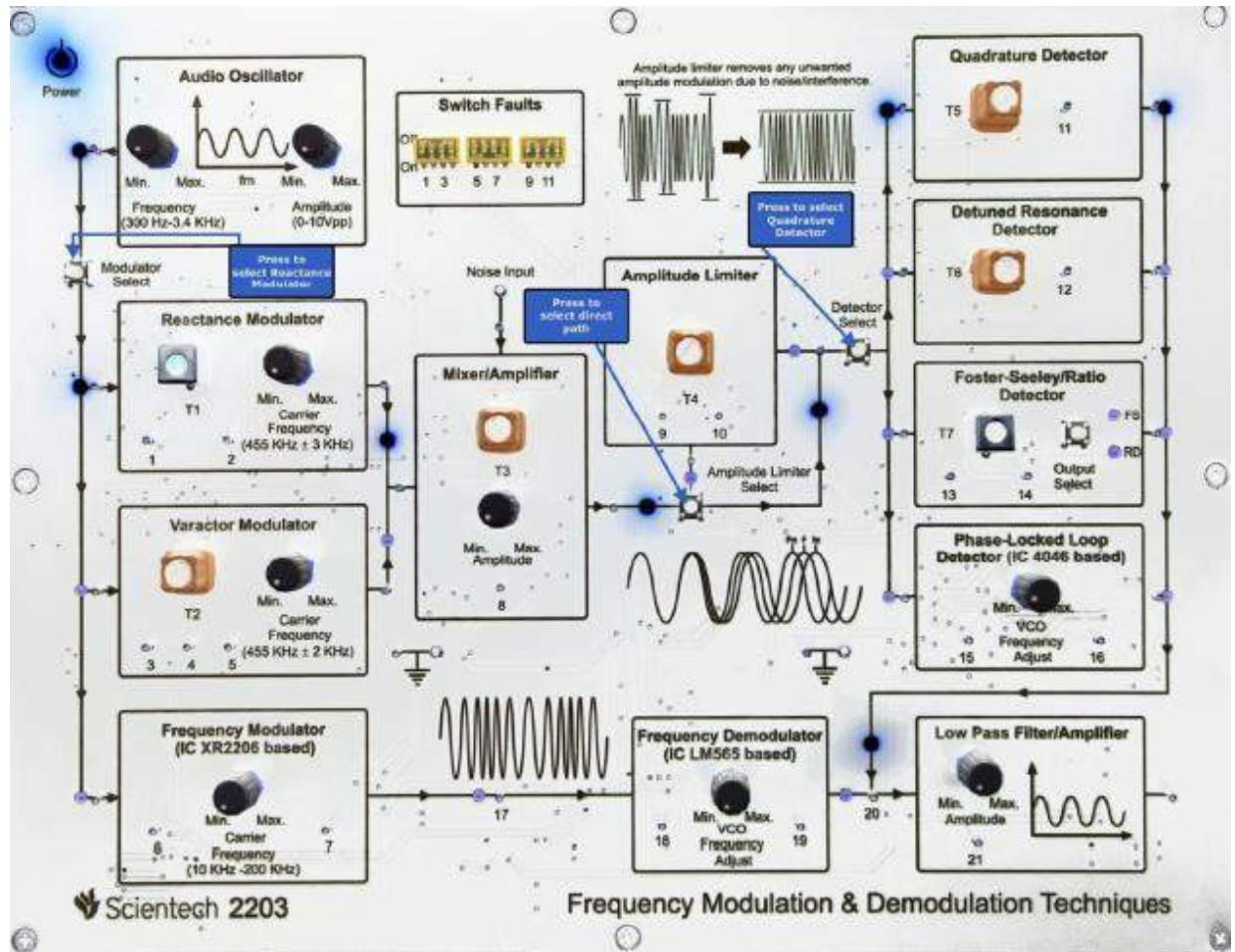
INITIAL SETTINGS:

1. All Switch Faults : OFF condition
2. Amplitude pot of Audio Oscillator block : Minimum position
3. Frequency pot of Audio Oscillator block : Maximum position
4. Carrier Frequency pot of Reactance Modulator : Centre position
5. Carrier Frequency pot of Varactor Modulator : Centre position
6. Amplitude pot of LPF : Centre position
7. VCO Frequency adjust pot of PLL : Minimum position
8. Carrier Frequency pot of FM (IC XR2206based) : Minimum position
9. VCO Frequency pot of Frequency Demodulator : Minimum position
10. Amplitude pot of Mixer/Amplifier block : Maximum position

PROCEDURE:

1. Turn on power to the Scientech 2203 TechBook.
2. Observe modulating signal at the output test point of AF Oscillator block. Set the modulating signal frequency(f_m) to 3KHz
3. Select the desired modulator (reactance modulator, varactor modulator or IC XR2206 based FM modulator) using “Modulator Select” switch. Selected modulator is indicated by glowing LED’s at its input and output.
4. The frequency of the FM carrier signal (f_c) should be approximately 455 KHz at 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 (IC XR2206 based) if FM (IC XR2206) 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 select switch (quadrature detector, detuned resonance detector, Foster- Seeley/ Ratio detector, PLL detector), when reactance or varactor modulator is selected in the modulator section))

KU:



CALCULATIONS:

Carrier Frequency $f_c =$

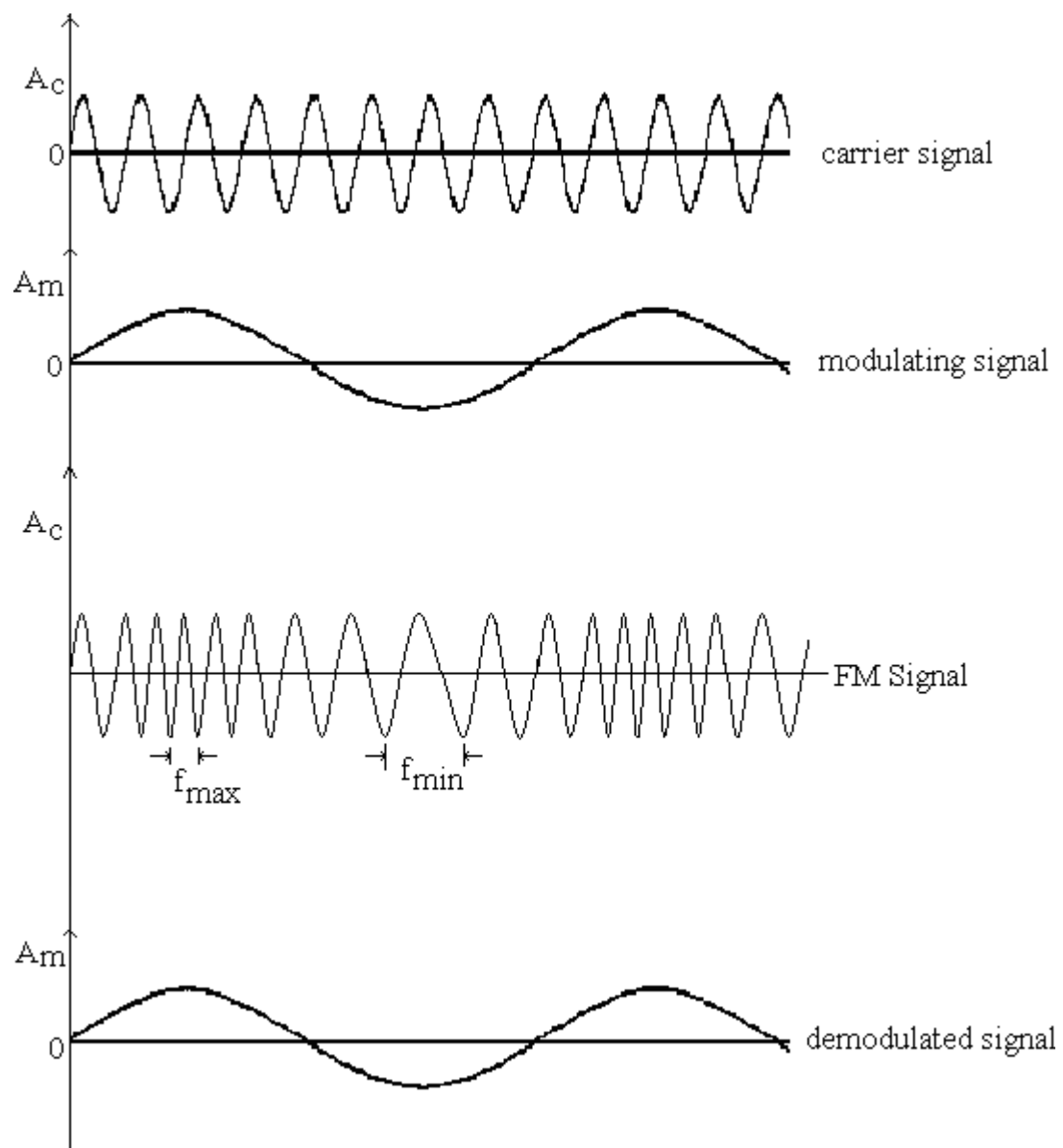
Modulating Signal Frequency $f_m =$

$f_{max} =$

$f_{min} =$

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

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

MODEL GRAPH:**RESULT:****VIVA QUESTIONS:**

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?

Exp no:

Date:

7. PULSE AMPLITUDE MODULATION & DEMODULATION

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

EQUIPMENT NEEDED:

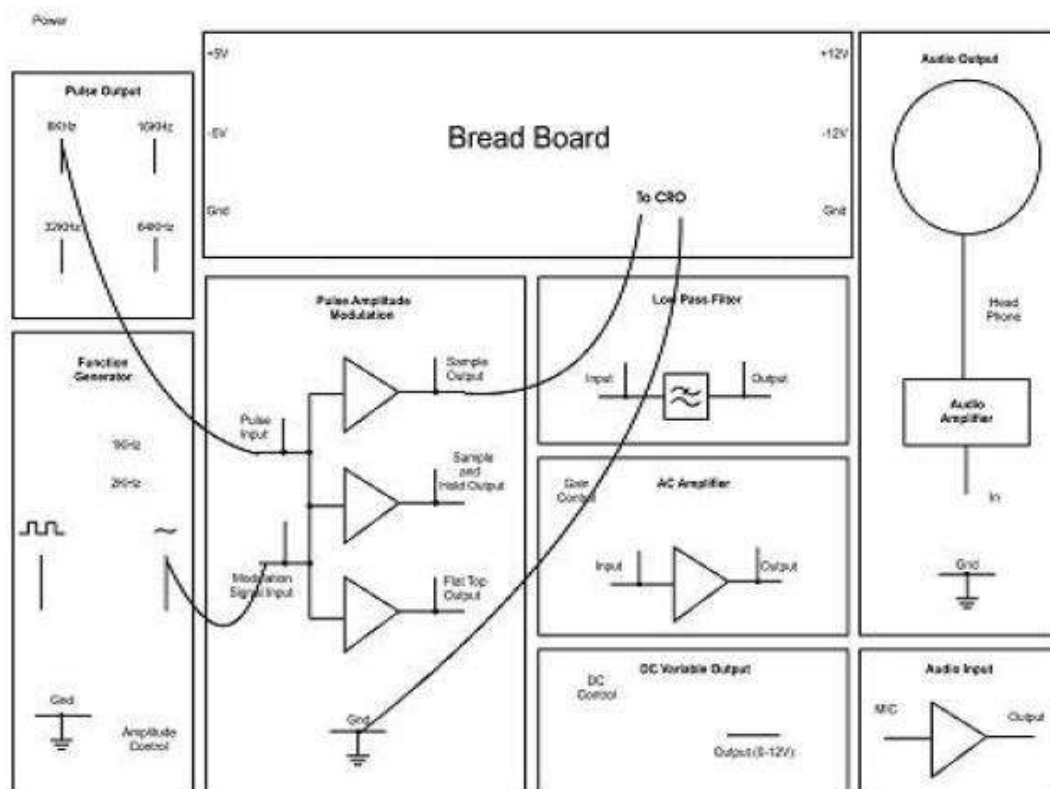
1. NV6575 Trainer
2. 2mm Patch Cords
3. CRO with Test Probe

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 “**8 KHz**” **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 & NV6575 Trainer.
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 toggle switch (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.

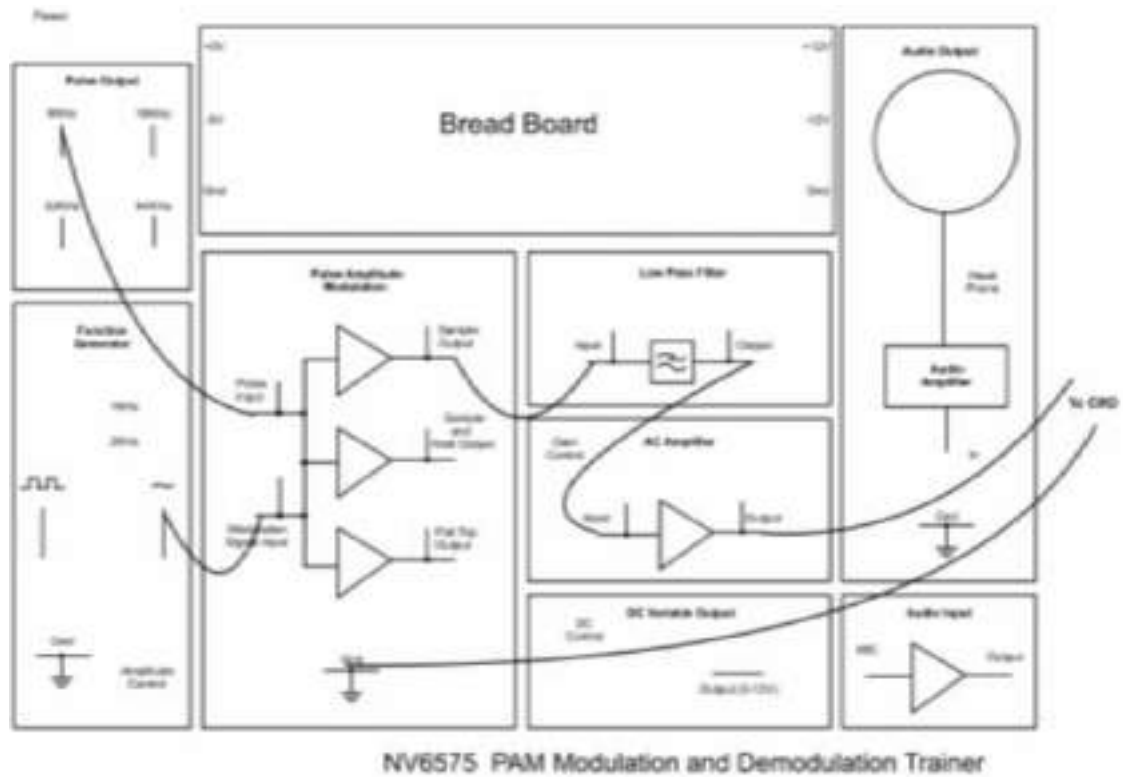
PAM demodulation:

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 clockwise position.
3. 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.
4. Similarly connect the “Sample & Hold Output” and “Flat Top Output” to Low Pass Filter and see the demodulated waveform at the output of AC amplifier.

BLOCK DIAGRAM:**MODULATION:**

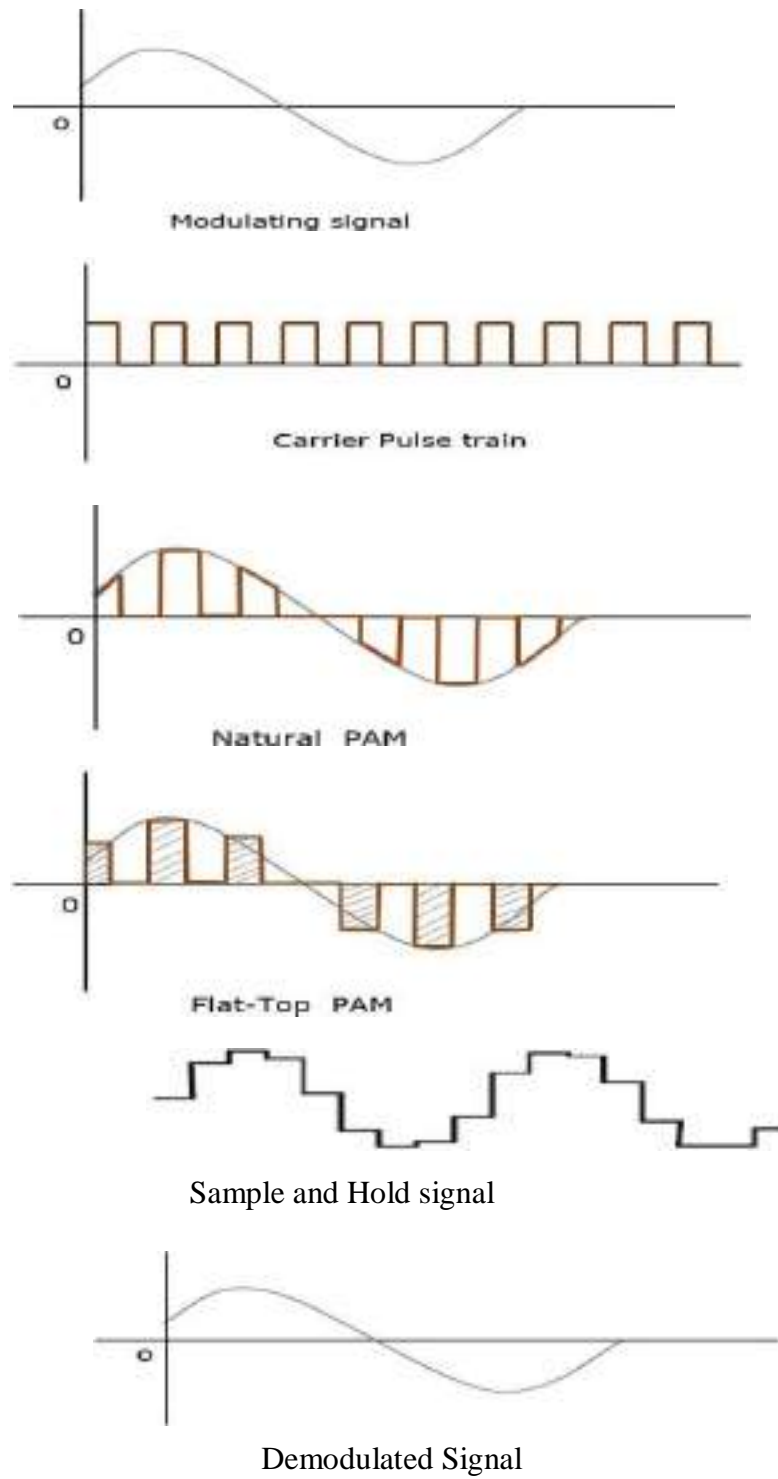
NV6575 PAM Modulation and Demodulation Trainer

DEMODULATION:



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:**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
6. Discuss the Bandwidth requirements of PAM.

Exp no:

Date:

8. PULSE WIDTH MODULATION AND DEMODULATION

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

Equipment Needed :

1. NV6576 Trainer
2. 2mm Patch Cords
3. CRO with Test Probe/Recommended to use Digital Storage Oscilloscope (DSO) for better results

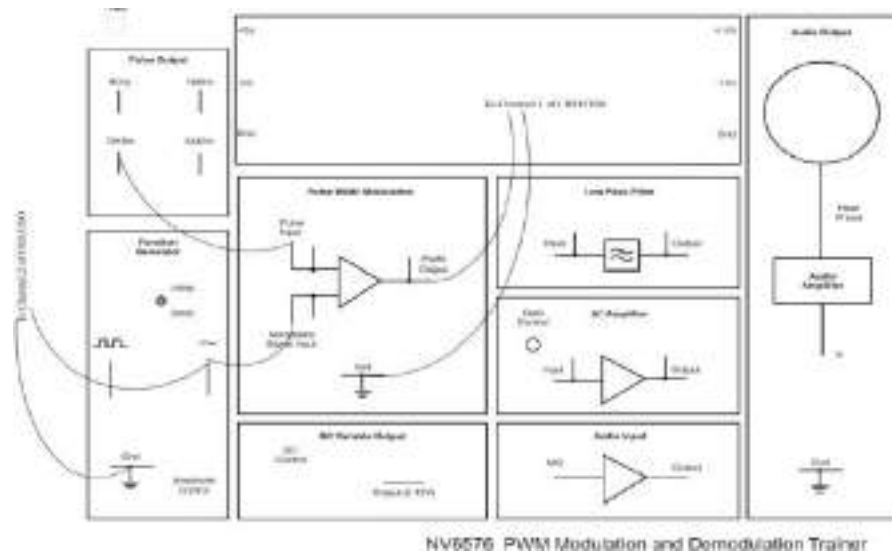
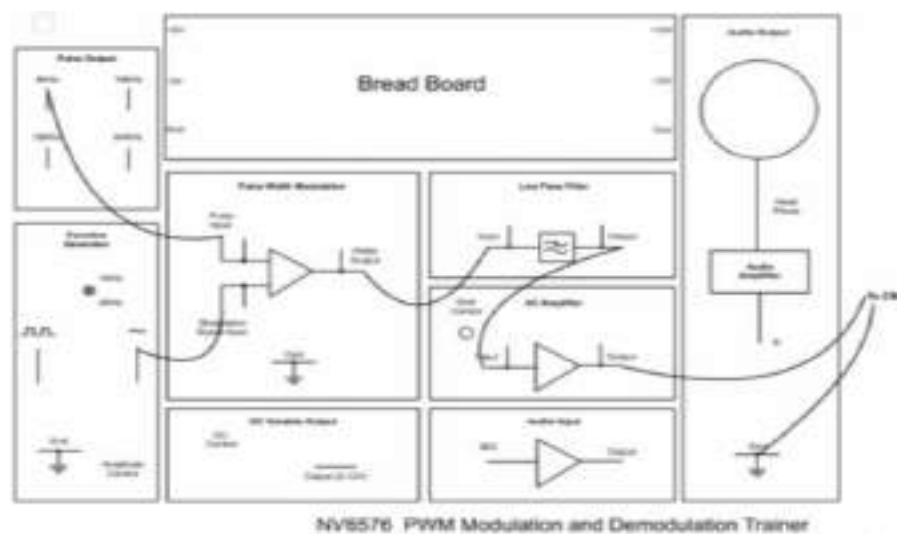
Procedure:

PWM modulation:

1. Connect the circuit as shown in Fig
 - Connect patch cord between output of **Sine Wave** & “**Modulation Signal Input**” of **PWM** block.
 - Keep the toggle switch at **1 KHz** 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** & **Gnd** (Modulated Signal)
3. Connect the Channel 2 of CRO/DSO in between **Sine Wave** & **Gnd** (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.

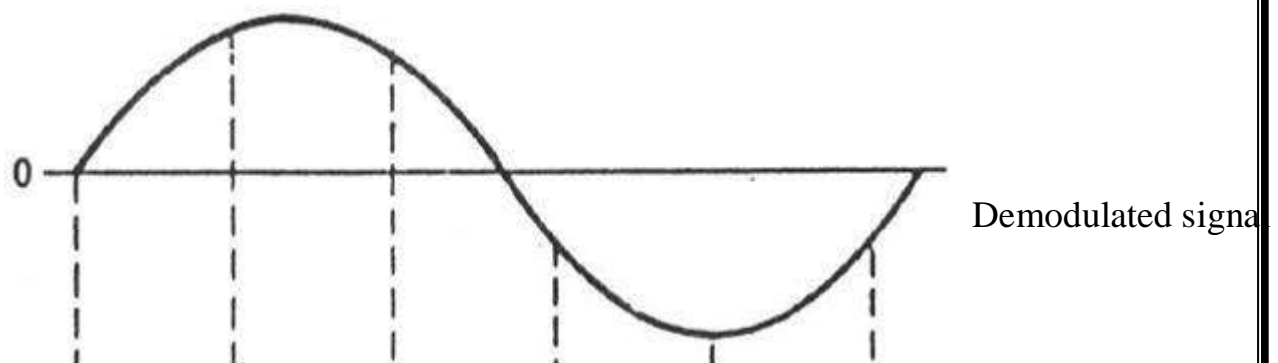
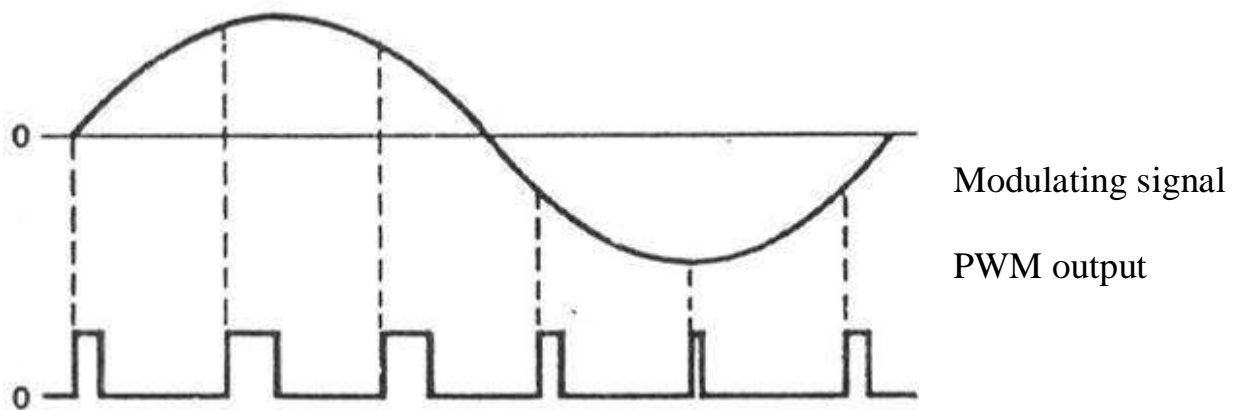
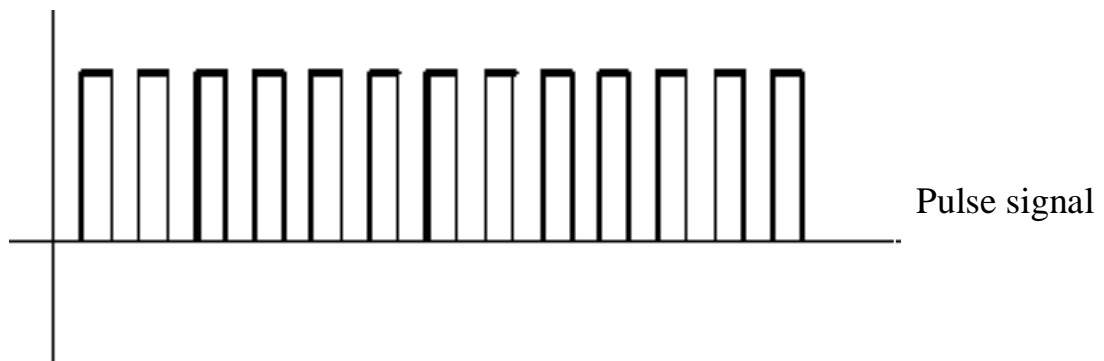
PWM demodulation:

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 clockwise position.
3. 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:****PWM Demodulation:**

Observations:

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

WAVEFORMS:

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

Exp no:

Date:

9. PULSE POSITION MODULATION AND DEMODULATION

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

Equipment Needed :

1. NV6576 Trainer
2. 2mm Patch Cords
3. CRO with Test Probe/Recommended to use Digital Storage Oscilloscope (DSO) for better results

Procedure:

PPM Modulation:

Connect the circuit as shown in Fig.1

Connect patch cord between output of Sine Wave & “Input” of PPM block.

Keep the toggle switch at 1 KHz position.

Set the Amplitude Control pot at fully clock wise direction.

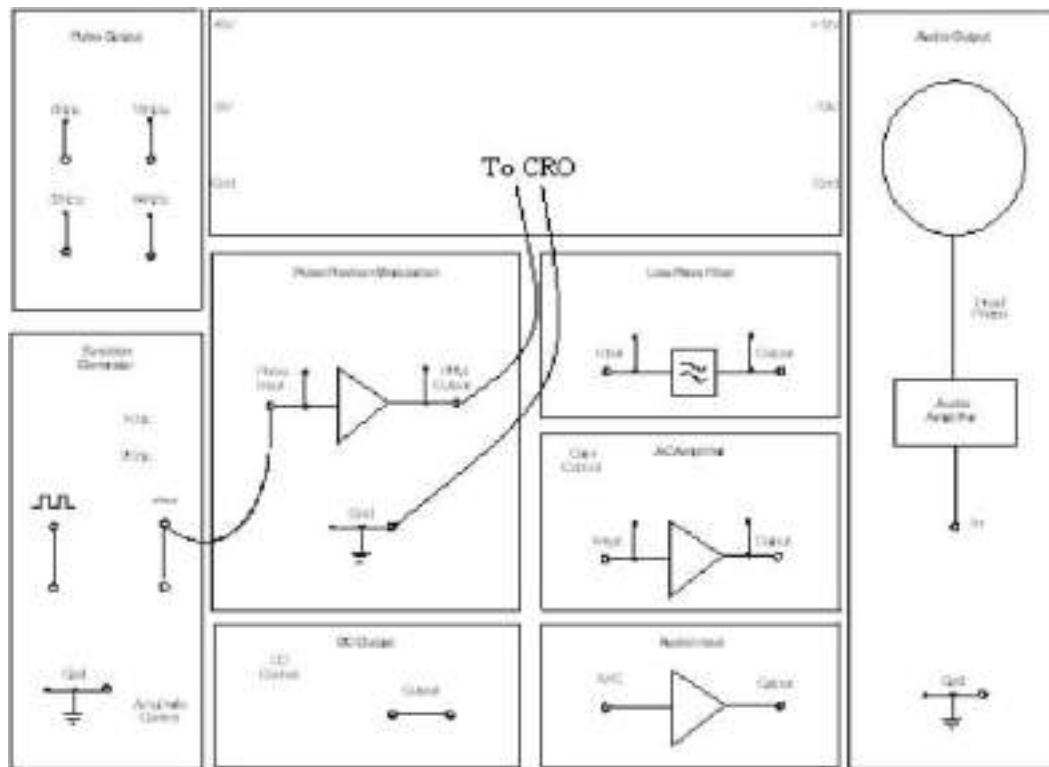
2. Now connect the SMPS Supply between mains socket & NV6577 Trainer.
3. Firstly switch On the SMPS supply & then trainer Power switch.
4. Now observe the “PPM Output” of Pulse Position Modulation on the CRO.
5. Now varying the amplitude of sine wave using Amplitude Control pot & see its effect on PPM Output.
6. 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 clockwise 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.

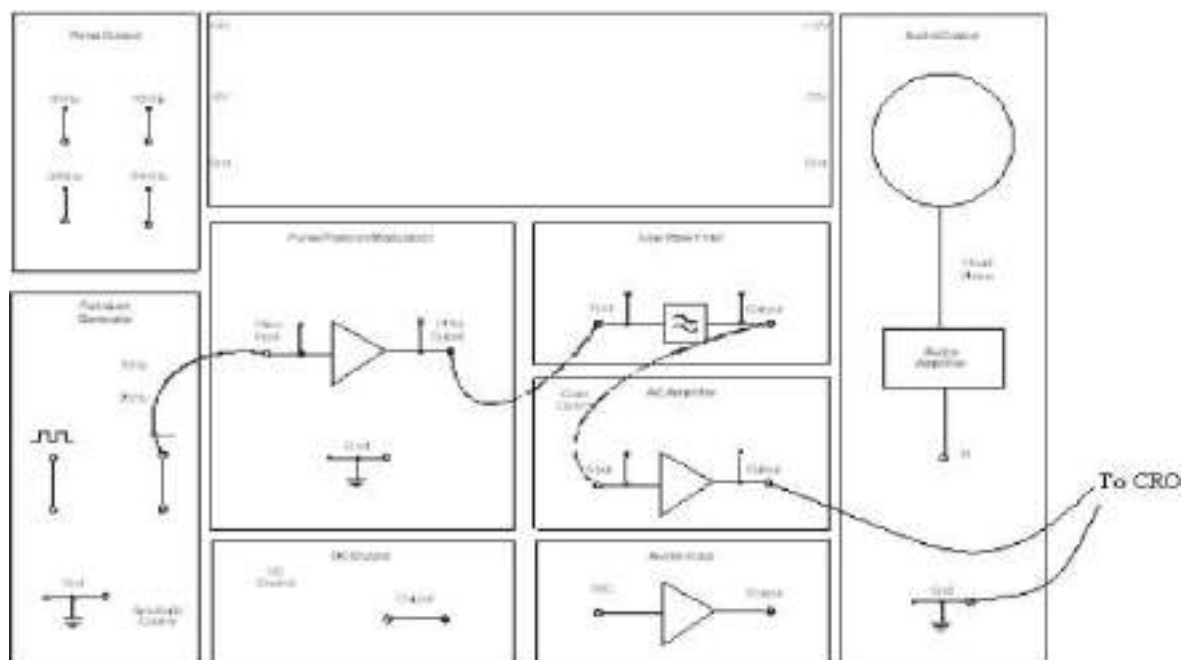
Circuit Diagram:

PWM modulation:



NV6577 PPM Modulation and Demodulation Trainer

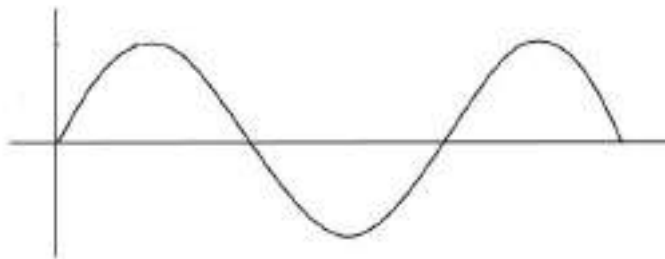
PPM Demodulation:



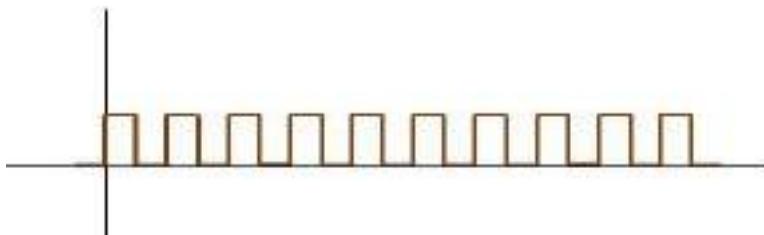
NV6577 PPM Modulation and Demodulation Trainer

Observations:

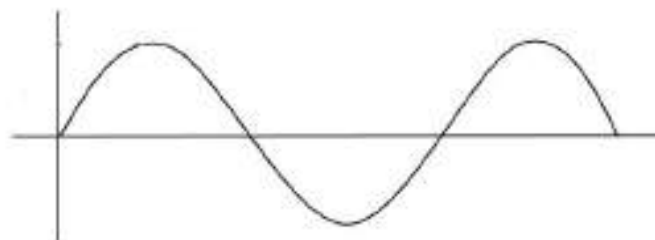
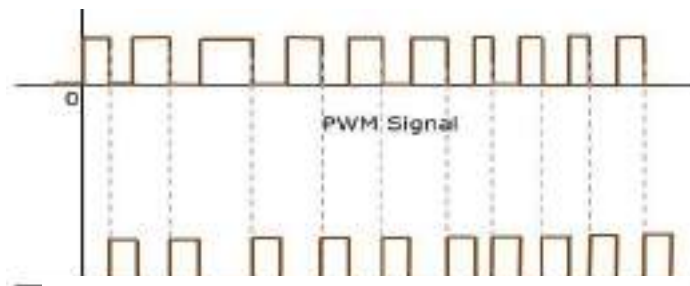
S.No	Observation	Amplitude	Time
1.	Modulating signal		
2.	Pulse signal		
3.	PPM output		
4.	Demodulated output		

Waveforms:

Modulating signal



Pulse Signal



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.

Exp no:

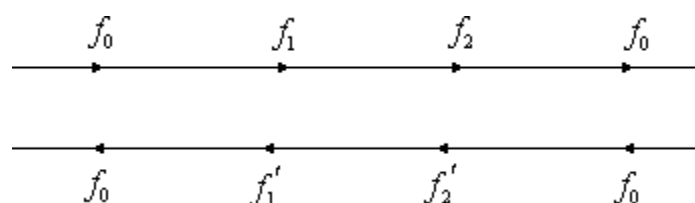
Date:

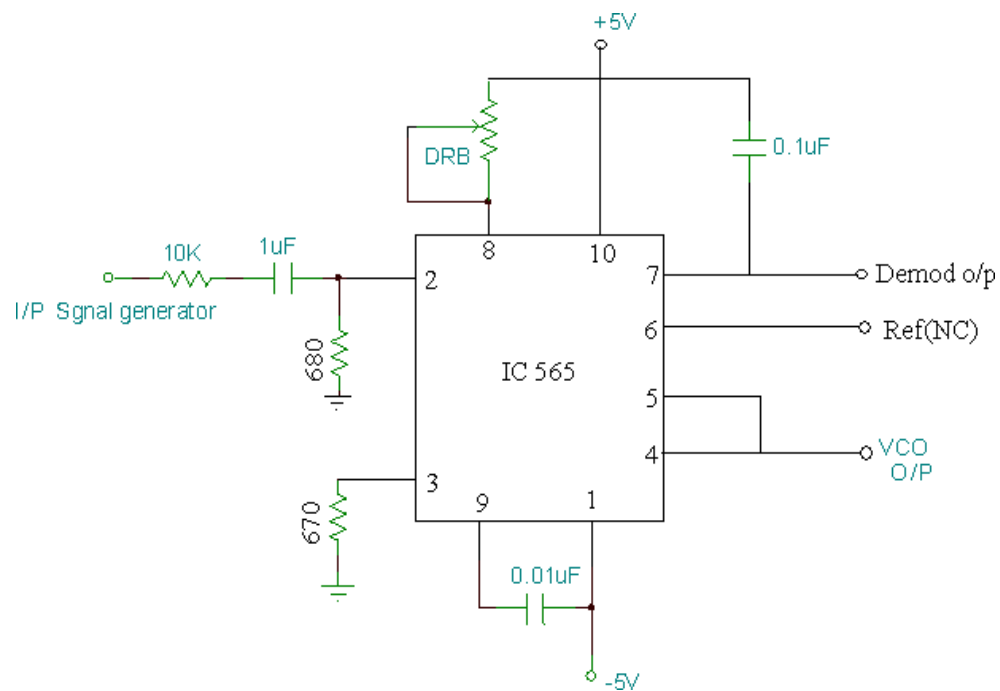
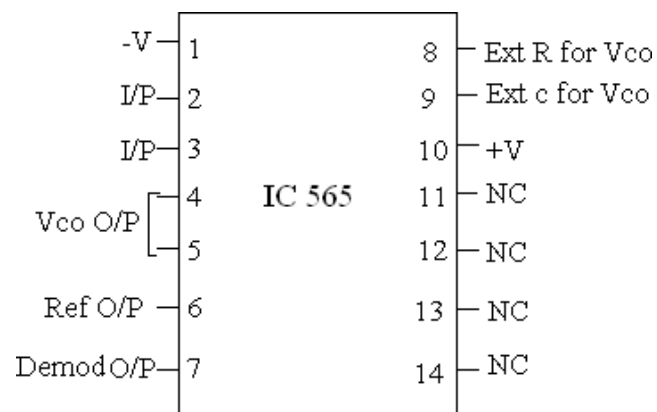
10. PHASE LOCKED LOOP**AIM:** To find the lock range and capture range of a PLL.**APPARATUS:**

1. IC LM565
2. Decade Resistance Box
3. Signal Generator
4. Multimeter -- 2 Nos
5. Resistors-- 680Ω , 670Ω , $10K\Omega$
6. Capacitors— $1\mu\text{F}$, $0.1\mu\text{F}$, $0.01\mu\text{F}$

PROCEDURE:

1. Connect the circuit as shown in the fig.
2. Check the VCO output at pin 4 of LM 565
3. This is square wave form. The frequency of the wave form is 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_1' further decreasing I/P frequency, O/P frequency will once again go back to f_o only.



CIRCUIT:**Circuit of PLL:****PIN of IC 565:****THEORETICAL CALCULATIONS:**

$$f_o = \frac{1.2}{4R_0C_0},$$

$$\text{Capture range } f_c = 2\sqrt{\frac{f_1}{2\pi \times 3.6 \times 10^3 C_2}},$$

$$\text{Lock range } f_L = 1.39f_0$$

PRACTICAL CALCULATIONS:

$$f_0 = 10\text{KHz},$$

$$\text{Lock range } f_L = f_2 - f_1'$$

$$\text{Capture range } f_c = f_2' - f_1$$

RESULT:**VIVA QUESTIONS:**

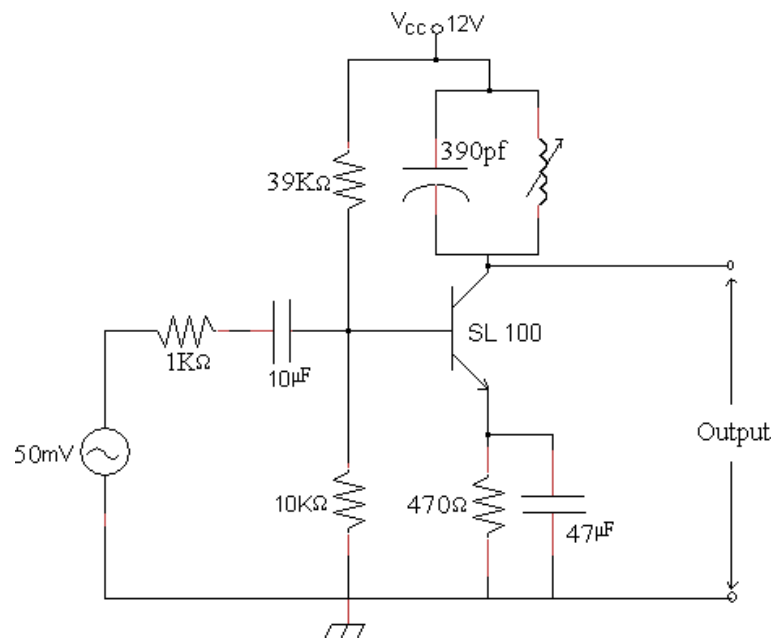
1. What type of feedback is used in PLL?
2. What is PLL?
3. What are main components in PLL?
4. Define the terms lock range; capture range and free running frequency?
5. What is loop filter?
6. What are main applications of PLL?

Exp no:

Date:

11. 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 – $1\text{K}\Omega$, $39\text{K}\Omega$, $10\text{K}\Omega$, 470Ω
6. Capacitor – 390pf , $10\mu\text{f}$, $47\mu\text{f}$

CIRCUIT:**THEORY:**

Amplifiers are key building blocks in any communication system. In a receiver weak 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.
- VI. Prevention of the reradiation of the local oscillator signal through the antenna of the receiver.

Sensitivity: Sensitivity is the ability of a RF receiver to amplify the weak 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:

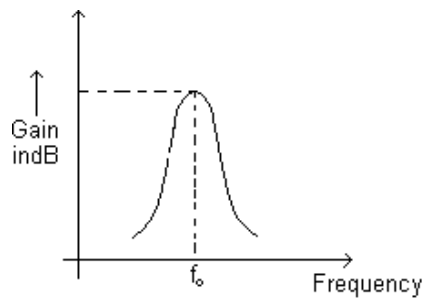
1. Connect the circuit as shown in the fig.
2. Switch on the power supply and function generator.
3. Apply 20mV, 100Hz signal as an input.
4. Now vary the input frequency from 100Hz to 1MHz, keeping the input voltage constant and at each step note down the output.
5. Tabulate the results.
6. Note down 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.

b) Selectivity:

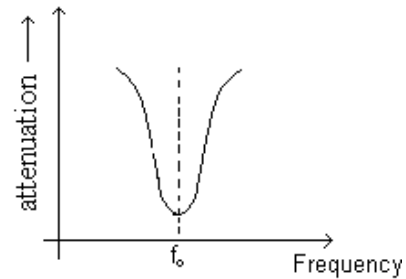
1. Connect the circuit as shown in the fig.
2. Switch on the power supply and function generator.
3. Apply 20mV input at the frequency f_o (practical) and note down the output V_{st} .

4. Now vary the frequency from 100Hz to 1MHz and vary the input voltage to get the V_{st} in each step.
5. Calculate the attenuation in $dB = 20 \log \left(\frac{V_{in\ offresonance}}{V_{in\ atresoance}} \right)$
6. Tabulate the results:

MODEL GRAPH:



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?

Exp no:

Date:

12. STUDY ON RADIO RECEIVER/TV RECEIVER DEMO KITS

**ANALOG COMMUNICATIONS LAB
(SIMULATION)
MANUAL**

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 toolboxes (collections of special-purpose MATLAB functions, available separately) 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 for managing 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-D and 3-D graphics functions for visualizing data
- Tools for building custom graphical user interfaces
- Functions for integrating MATLAB based algorithms with external applications and languages, such as C,C++,Fortran, JAVA™, COM and Microsoft Excel.

Exp no:

Date:

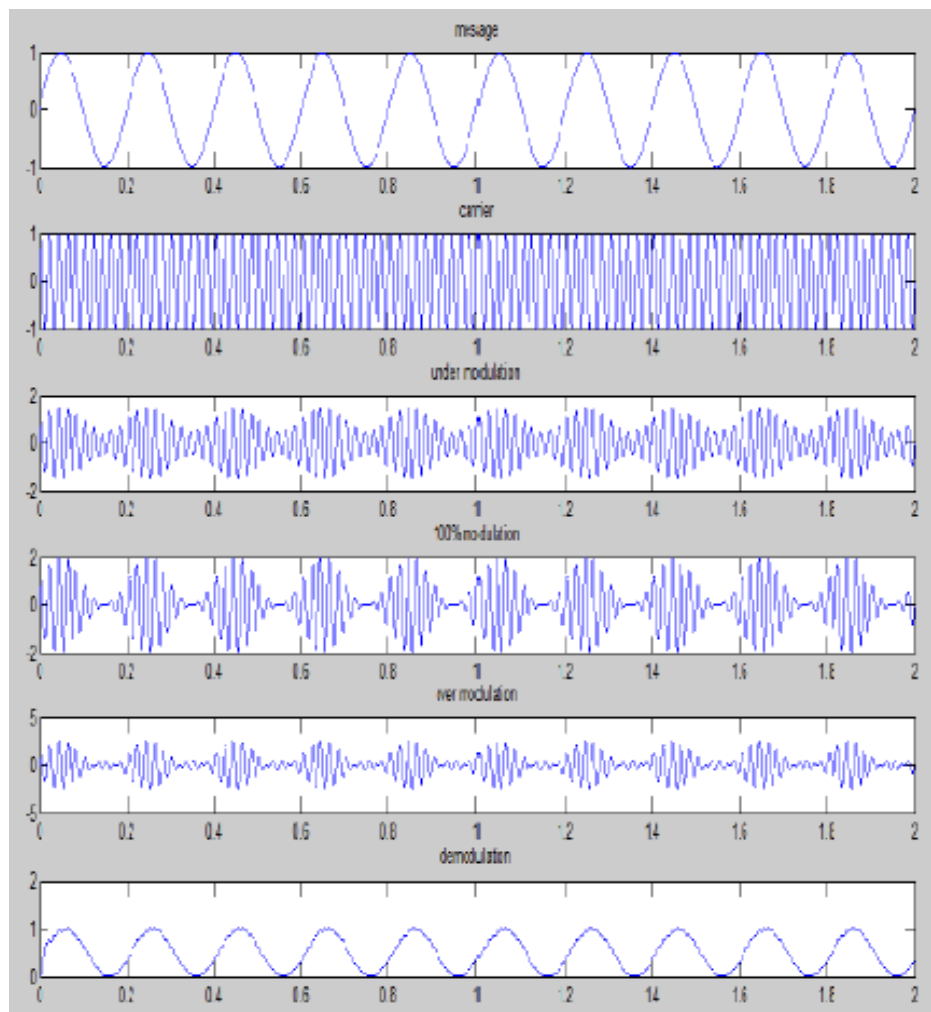
1. AMPLITUDE MODULATION AND DEMODULATION**MATLAB CODE:**

```

fs=8000;
fm=20;
fc=500;
Am=1;
Ac=1;
t=(0:0.1*fs)/fs;
m=Am*cos(2*pi*fm*t);
c=Ac*cos(2*pi*fc*t);
Ka=0.5;
U=Ka*Am;
s1=Ac*(1+U*cos(2*pi*fm*t)).*(cos(2*pi*fc*t));
subplot(4,3,1:3);
plot(t,m);
title('modulating or message signal,(fm=20hz)');
subplot(4,3,4:6);
plot(t,c);
title('carrier signal (tc:500hz)');
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*fc*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*fc*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)');
```

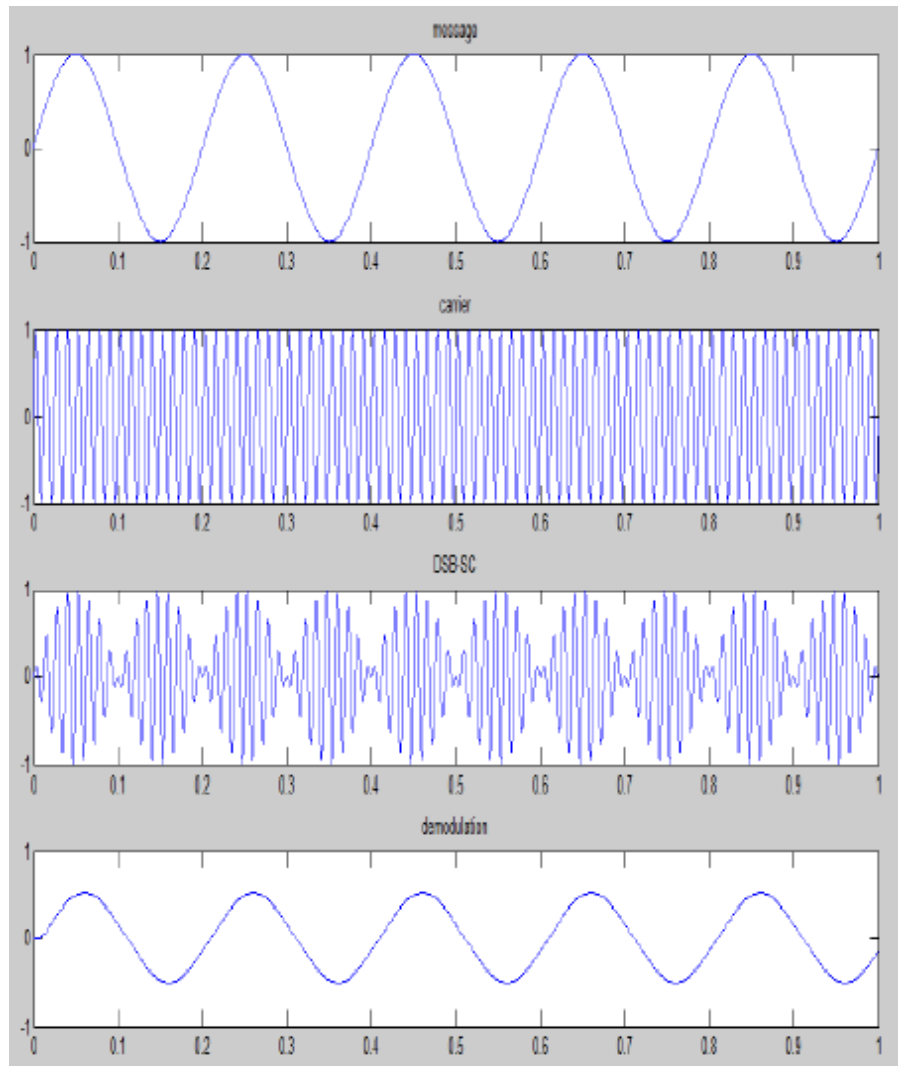
SIMULATION RESULT:

Exp no:

Date:

2.DSB-SC MODULATOR AND DETECTOR**MATLAB CODE:**

```
t=0:0.000001:0.001;
vm=1;
vc=1;
fm=2000;
fc=50000;
m_t=vm*sin(2*pi*fm*t);
subplot(4,1,1)
plot(t,m_t)
c_t=vc*sin(2*pi*fc*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);
mr=filter(b,a,r);
subplot(4,1,4);
plot(t,mr);
```

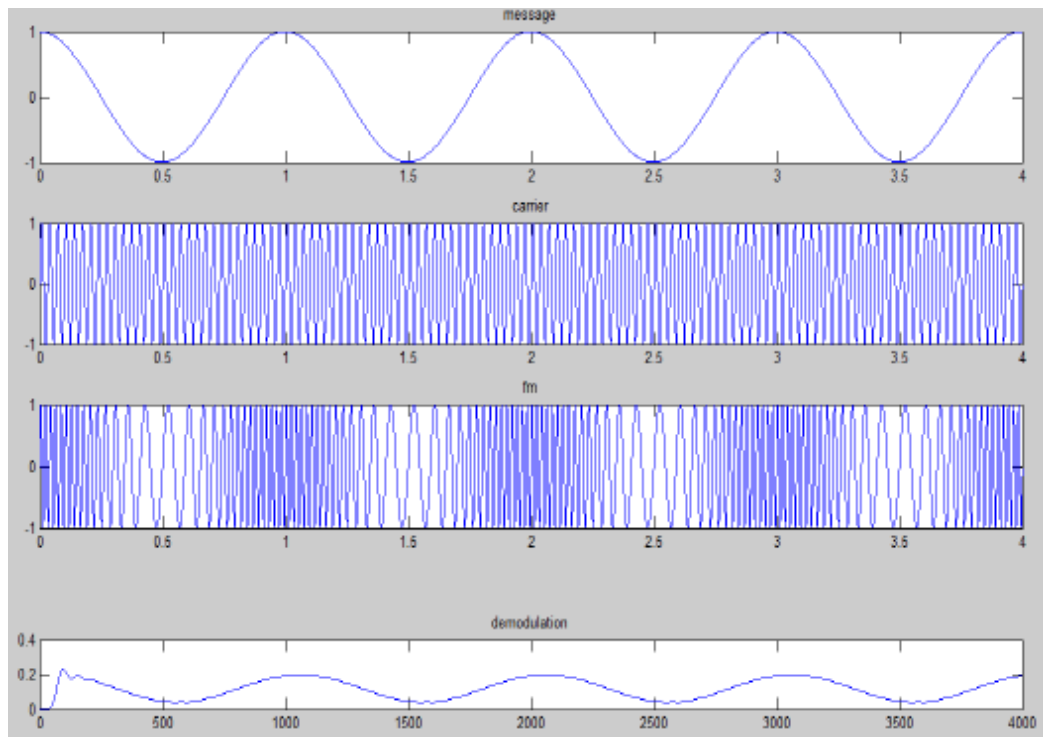
SIMULATION RESULT:

Exp no:

Date:

3. FREQUENCY MODULATION AND DEMODULATION**MATLAB CODE:**

```
fs=10000;
ac=1;
am=1;
fm=35;
fc=500;
b=10;
t=(0:0.1*fs)/fs;
wc=2*pi*fc;
wm=2*pi*fm;
mt=am*cos(wm*t);
subplot(4,1,1);
plot(t,mt);
title('modulating signal');
ct=ac*cos(wc*t);
subplot(4,1,2);
plot(t,ct);
title('carrier signal');
st=ac*cos((wc*t)+b*sin(wm*t));
subplot(4,1,3);
plot(t,st);
title('modulated signal');
d=demod(st,fc,fs,'fm');
subplot(4,1,4);
plot(t,d);
title('demodulated signal');
```

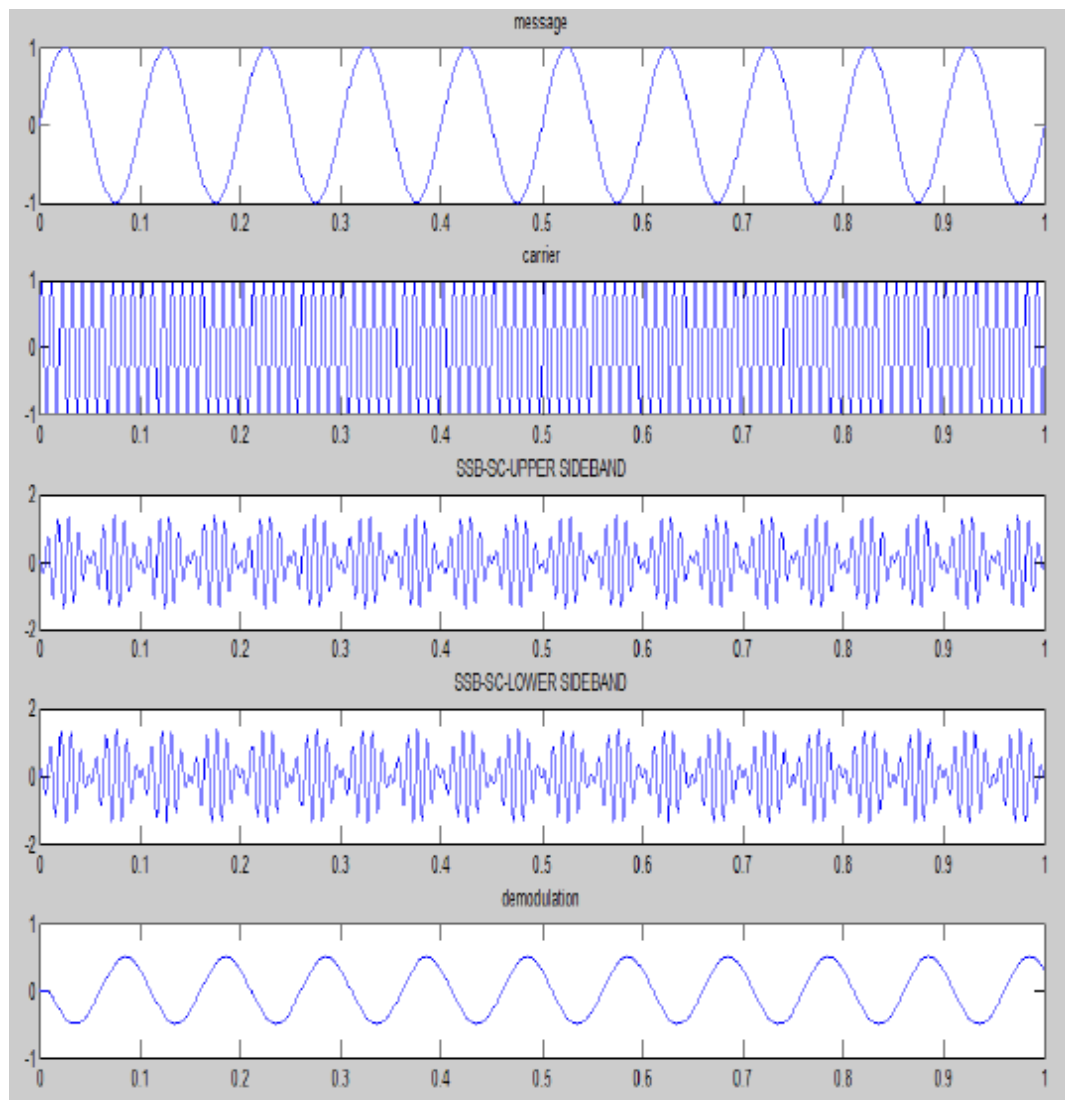

SIMULATION RESULT:

Exp no:**Date:****4. SSB- MODULATION AND DETECTOR****MATLAB CODE:**

```

fs=8000;
fm=20;
fc=50;
am=1;
ac=1;
t=[0:0.1*fs]/fs;
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*fc*t);
plot(t,c1);
title('carrier signal');
c2=ac*sin(2*pi*fc*t);
subplot(5,1,3);
% susb=0.5*am*cos(2*pi*fm*t).*ac*cos(2*pi*fc*t)--
0.5*am*sin(2*pi*fm*t).*ac*sin(2*pi*fc*t);
Susb=0.5*m1.*c1-0.5*m2.*c2;
Plot(t,susb);
Title('ssb-sc signal with usb');
Subplot(5,1,4);
Slsb=0.5*m1.*c1+0.5*m2.*c2;
Plot(t,slsb);

```

SIMULATION RESULT:

Exp no:

Date:

5. PRE-EMPHASIS AND DE-EMPHASIS**MATLAB CODE:**

```

num_samples=2^13;
fs=5000;
ts=1/fs;
fm1=20;
fm2=30;
fc=200;
t=(0:num_samples-1)*ts;
f=(-num_samples/2:num_samples/2-1)*fs/num_samples;
mt=sin(2*pi*fm1*t);
mf=fft shift(abs(fft(mt)));
f_cutoff_pe=15;
wn_pe=f_cutoff_pe/(fs/2);
[b_pe,a_pe]=butter(1,wn_pe);
[h_pe,w]=freqz(a_pe,b_pe);
a_de=b_pe;
b_de=a_pe;
[h_de,w]=frez(a_de,b_de);
mt_pe=filter(a_pe,b_pe,mt);
mf_pe=fft shift(abs(fft(mt_pe)));
figure(1)
subplot(2,1,1);
plot(t,mt);
axis([0.6min(mt)-1 max(mt)+1])
grid on;
title('modulating signal(time domain)');
subplot(2,1,2);
plot(f,mf);
grid on;
axis([-50 50 0 max(mf)+100])
title('modulating signal(frequency domain)');
figure(2)

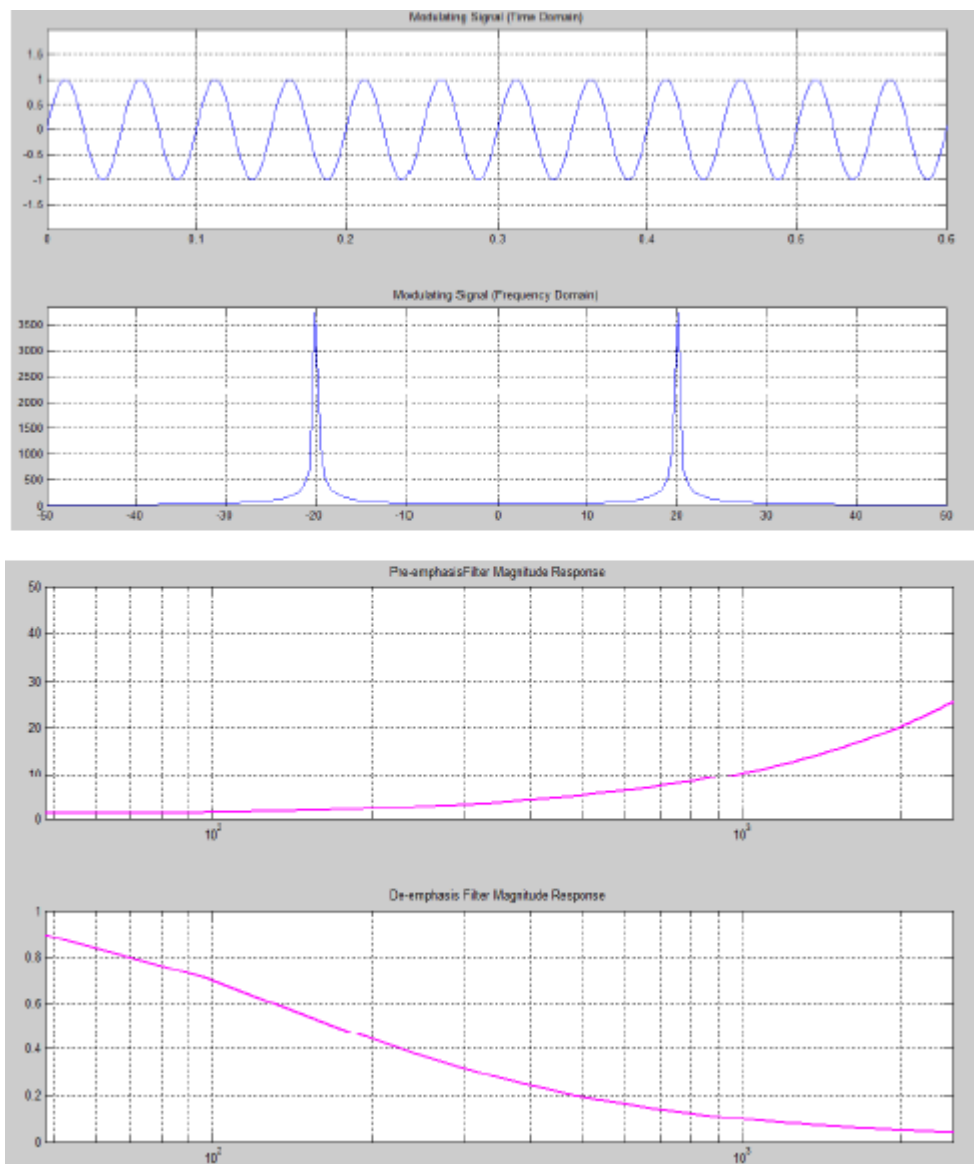
```

```

subplot(2,1,1);
semilogx(w*pi*(fs/2),abs(h_pe),'m','linewidth',2)
axis([0 fs/2 0 50])
grid on;
title('pre-emphasis filter magnitude response');
subplot(2,1,2);
semilogx(w*pi*(fs/2),abs(h_de),'m','linewidth',2)
axis([0 fs/2 0 1])
grid on;
title('de-emphasis filter magnitude response');

```

SIMULATION RESULT:



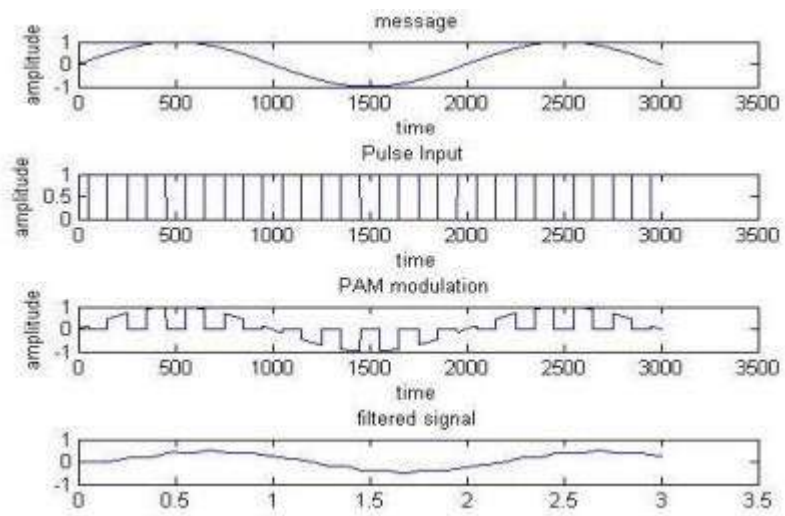
Exp no:**Date:****6. PULSE AMPLITUDE DE MODULATION AND DEMODULATION****MATLAB CODE:**

```

fs=8000;
fm=20;
fc=500;
Am=1
Ac=1
t=[0:0.1*fs]/fs;
m=Am*cos(2*pi*fm*t);
c=Ac*cos(2*pi*fc*t);
Ka=0.5;
U=Ka*Am;
s1=Ac*(1+U*cos(2*pi*fm*t)).*(cos(2*pi*fc*t));
subplot(4,3,1:3);
plot(t,m);
title('modulating or message signal,(fm=20hz)');
subplot(4,3,4:6);
plot(t,c);
title('carrier signal (tc:500hz)');
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*fc*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*fc*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)');
```

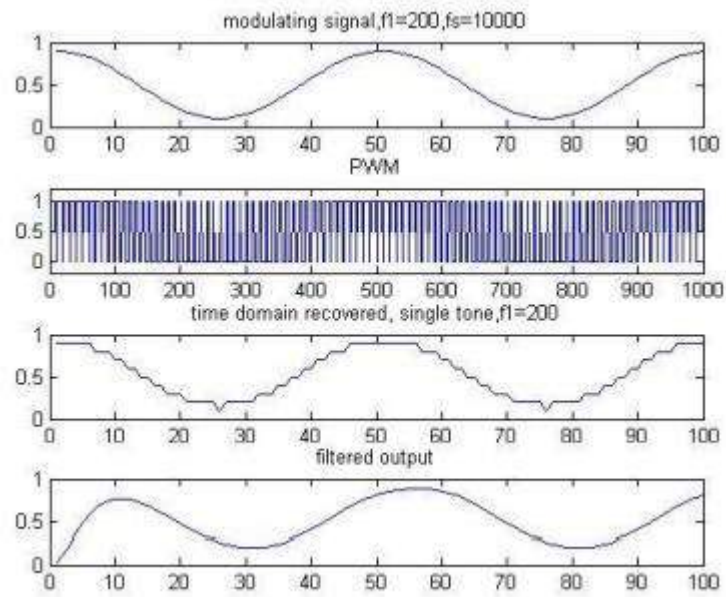
SIMULATION RESULT:

Exp no:**Date:****7. PULSE WIDTH MODULATION AND DEMODULATION****MATLAB CODE:**

```

%pulse width modulation & demodulation
close all
clear all
clc
fc=1000;
fs=10000;
f1=200;
t=0:1/fs:(2/f1)-(1/fs);
x1=0.4*cos(2*pi*f1*t)+0.5;
% modulation
y1=modulate(x1,fc,fs,'pwm');
subplot(411);
plot(x1);
axis([0 100 0 1]);
title('modulating signal,f1=200,fs=10000')
subplot(412);
plot(y1);
axis([0 1000 -0.2 1.2]);
title('PWM')
% demodulation
x1_recov=demod(y1,fc,fs,'pwm');
[den,num]=butter(1,2*pi*f1/fs);
s11=filter(den,num,x1_recov);
s12=filter(den,num,s11);
subplot(413);
plot(x1_recov);
title('time domain recovered,single tone,f1=200')
axis([0 100 0 1]);
subplot(414);
plot(s12);
title('filtered output')
axis([0 100 0 1]);

```

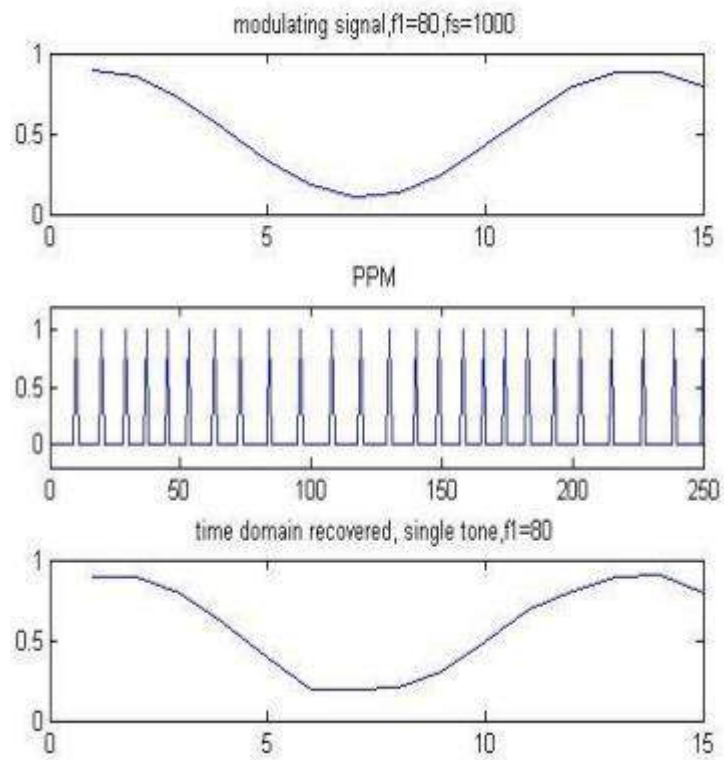
SIMULATION RESULT:

Exp no:**Date:****8. PULSE POSITION MODULATION AND DEMODULATION****MATLAB CODE:**

```

% pulse position modulation
close all
clear all
clc
fc=100;
fs=1000;
f1=80;
t=0:1/fs:((2/f1)-(1/fs));
x1=0.4*cos(2*pi*f1*t)+0.5;
% modulation
y1=modulate(x1,fc,fs,'ppm');
subplot(311);
plot(x1);
axis([0 15 0 1]);
title('modulating signal,f1=80,fs=1000bn ')
subplot(312);
plot(y1);
axis([0 250 -0.2 1.2]);
title('PPM')
% demodulation
x1_recov=demod(y1,fc,fs,'ppm');
subplot(313);
plot(x1_recov);
title('time domain recovered, single tone, f1=80')
axis([0 15 0 1]);

```

SIMULATION RESULT:

Exp no:

Date:

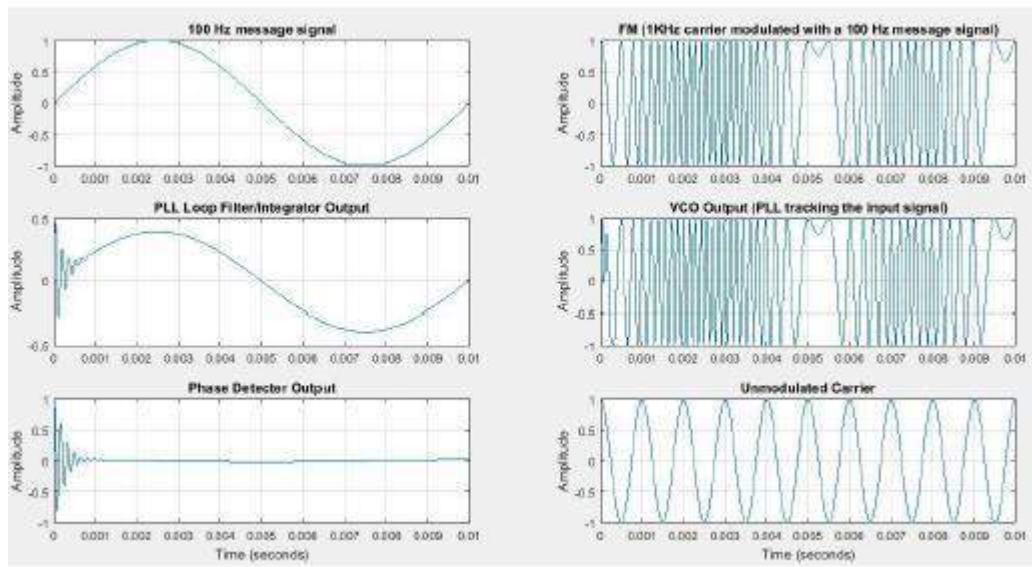
9. PHASE LOCKED LOOP**MATLAB CODE:**

```

reg1=0;
reg2=0;
reg3=0;
eta=sqrt(2)/2;
theta=2*pi*1/100;
Kp=[(4*eta*theta)/(1+2*eta*theta+theta^2)];
Ki=[(4*theta^2)/(1+2*eta*theta+theta^2)];
d_phi_1=1/20;
n_data=100;
for nn=1:n_data
    phi1=reg1+d_phi_1;
    phi1_reg(nn)=phi1;
    s1=exp(j*2*pi*reg1);
    s2=exp(j*2*pi*reg2);
    s1_reg(nn)=s1;
    s2_reg(nn)=s2;
    t=s1*conj(s2);
    phi_error=atan(imag(t)/real(t))/(2*pi);
    phi_error_reg(nn)=phi_error;
    sum1=Kp*phi_error+phi_error*Ki+reg3;
    reg1_reg(nn)=reg1;
    reg2_reg(nn)=reg2;
    reg1=phi1;
    reg2=reg2+sum1;
    reg3=reg3+phi_error*Ki;
    phi2_reg(nn)=reg2;
end
figure(1)
plot(phi1_reg);
hold on
plot(phi2_reg,'r');

```

```
hold off;
grid on;
title('phase plot');
xlabel('Samples');
ylabel('Phase');
figure(2)
plot(phi_error_reg);
title('Phase error of phase detector');
grid on;
xlabel('Samples(n)');
ylabel('Phase error(degrees)');
figure(3)
plot(real(s1_reg));
hold on;
plot(real(s2_reg),'r');
hold off;
grid on;
title('Input signal and output signal of VCO');
xlabel('Samples');
ylabel('Amplitude');
axis([0 n_data-1.1 1.1]);
```

SIMULATION RESULT:

Exp no:

Date:

10. SPECTRUM ANALYSIS OF MODULATION SIGNAL
USING SPECTRUM ANALYZER

MATLAB CODE:

```

fs=100;
t=[0:2*fs+1]/fs;
fc=10;
x=sin(2*pi*2*t);
Ac=1;
Xam=ammod(X,fc,fs,o,ac);
Zam=fft(Xam);
Zam=abs(Zam(1:length(Zam)/2+1));
frqam=[0:length(Zam)-1]*fs/length(Zam)/2;
Ydouble=ammod(X,fc,fs,fs,3.14,0);
Zdouble=fft(ydouble);
Zdouble=abs(zdouble(1:length(zdouble)/2+1));
frqdouble=[0:length(zdouble)-1]*fs/length(zdouble)/2;
ysingle=ssbmod(x,fc,fs,0,'upper');
zsingle=fft(ysingle);
zsingle=abs(zsingle(1:length(zsingle)/2+1));
frqsingle=[0:length(zsingle)-1]*fs/length(zsingle)/2;
figure;
subplot(3,1,1);
plot(frqam,zam);
title('spectrum of am signal');
subplot(3,1,2);
plot(frqdouble,zdouble);
title('spectrum of double-sideband signal');
subplot(3,1,3);plot(frqsingle,zsingle);
xfm=fmmod(x,fc,fs,10);
zfm=fft(xfm);
zfm=abs(zfm(1:length(zfm)/2+1));
frqfm=[0:length(zfm)-1]*fs/length(zfm)/2;

```



```
figure;  
plot(frqfm,zfm);  
title('spectrum of fm signal');
```

Exp no:

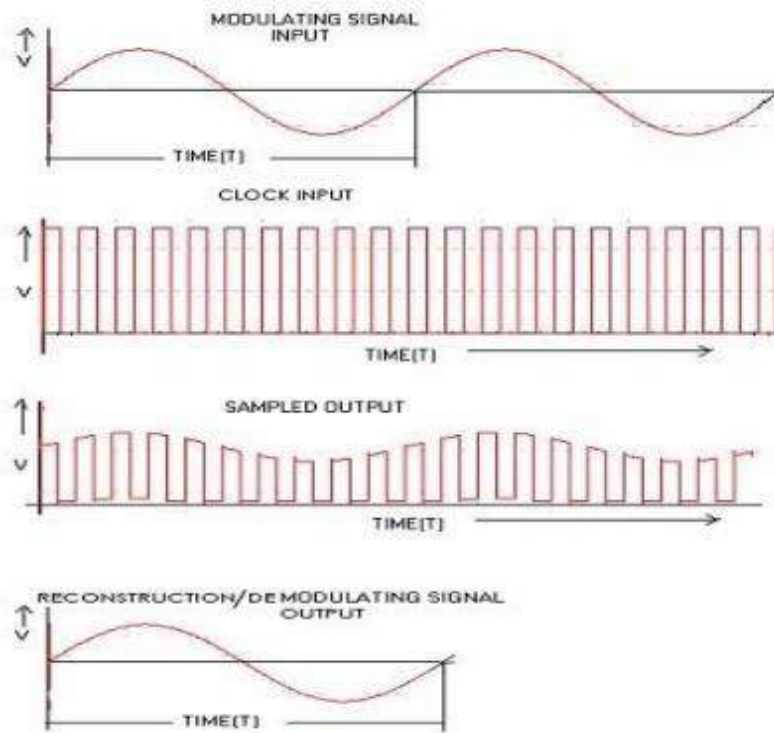
Date:

11. SAMPLING THEOREM**MATLAB CODE:**

```

clear all;
close all;
clc;
tfinal=0.05;
t=0:0.0005:tfinal;fm=input('enter the analog frequency');
xt=cos(2*pi*fm*t);
fsl=1.3*fm;
nl=0:2/fsl:tfinal;
xn=cos(2*pi*nl*fm);
subplot(3,1,1);
plot(t,xt,'b',nl,xn,'r');
title('under sampling plot');
fs2=2*fm;
n2=0:1/fs2:tfinal;
xn=cos(2*pi*fm*n2);
subplot(3,1,2);
plot(t,xt,'b',n2,xn,'r');
title('nyquist plot');
fs3=5*fm;
n3=0:1/fs3:tfinal;
xn=cos(2*pi*fm*n3);
subplot(3,1,3);
plot(t,xt,'b',n3,xn,'r');
title('over sampling plot');
xlabel('time');
ylabel('amplitude');

```

SIMULATION RESULT:

ADD ON EXPERIMENTS

Exp no:

Date:

1. FREQUENCY RESPONSE OF BAND PASS FILTER

AIM: To obtain the frequency response of active Band pass filter

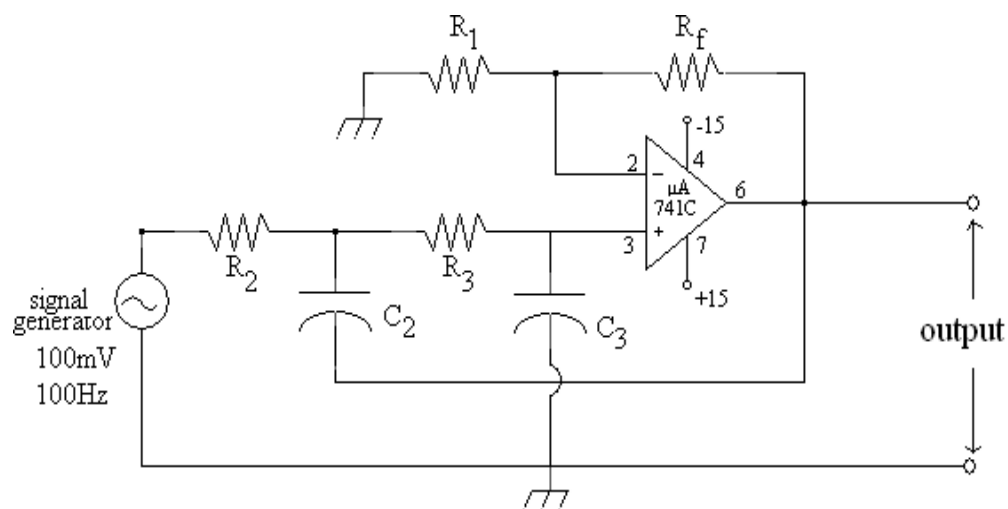
APPARATUS:

1. Fixed power supply
2. CRO
3. Op Amp - μ A 741
4. Resistors – $5.36\text{k}\Omega$, $5.6\text{ k}\Omega$, $5.6\text{k}\Omega$
5. Capacitor – 1000pf , $0.1\mu\text{f}$
6. Signal Generator
7. Bread Board

PROCEDURE:

1. Connect the circuit as shown in the fig.
2. Switch on the power supply and function generator.
3. Apply 20mV signal as an input.
4. Now vary the input frequency, keeping the input voltage constant and at each step note down the output.
5. tabulate the Result:

CIRCUIT:



DESIGN CALCULATIONS:

Cutoff frequency of a LPF is given by

$$f_c = \frac{1}{2\pi\sqrt{R_2R_3C_2C_3}}$$

Let $R_2 = R_3 = R = 1.59K\Omega$, $C_2 = C_3 = C = 0.1\mu f$, $R_1 = 10K\Omega$, $A_v = 1.586$

$$f_c = \frac{1}{2\pi RC} = \frac{1}{2\pi(1.59K \times 0.1\mu)} = 1KHz$$

$$A_v = 1 + \frac{R_f}{R_1}$$

$$1.586 = 1 + \frac{R_f}{10K\Omega}$$

$$0.586 \times 10K\Omega = R_f$$

$$R_f = 5.86K\Omega$$

Tabular Form:Input voltage (V_{in}) = (constant)

S.NO	Frequency	Output voltage (V_o)	Gain in dB= $20 \log(V_o/ V_{in})$

RESULT & DISCUSSION:

VIVA QUESTIONS:

1. Define a filter. How filters are classified?
2. Explain various types of filters along with their frequency response.
3. What do you mean by pass band and stop band of the filter?
4. What is an all pass filter?
5. Write two differences between active and passive filters?
6. Find the center frequency of BPF with $f_H = 1\text{KHz}$ and $f_L = 100\text{Hz}$
Find the quality factor of the narrow band pass filter with $f_L = 16\text{ KHz}$ and $f_H = 32\text{ KHz}$.

Exp no:

Date:

2. FREQUENCY RESPONSE OF LOW PASS FILTER**AIM:** To obtain the frequency response of active Band pass filter**APPARATUS:**

1. Fixed power supply
2. CRO
3. Signal generator
4. Op amp - μA 741
5. Resistors – 1.59K Ω - 2 No, 10K Ω -1 No, 5.86K Ω -1No
6. Capacitor – 0.1 μ f – 2 No
7. Bread Board

Design Steps:

1. Choose the cut-off frequency, f_H .
2. Choose the capacitance usually between 0.001 and 1 μ F. Generally, it is selected as 1 μ F or less than that.
3. Now, for the RC circuit

$$f_H = 1/2\pi RC.$$

Here f_H and C are known, Calculate the value of R.

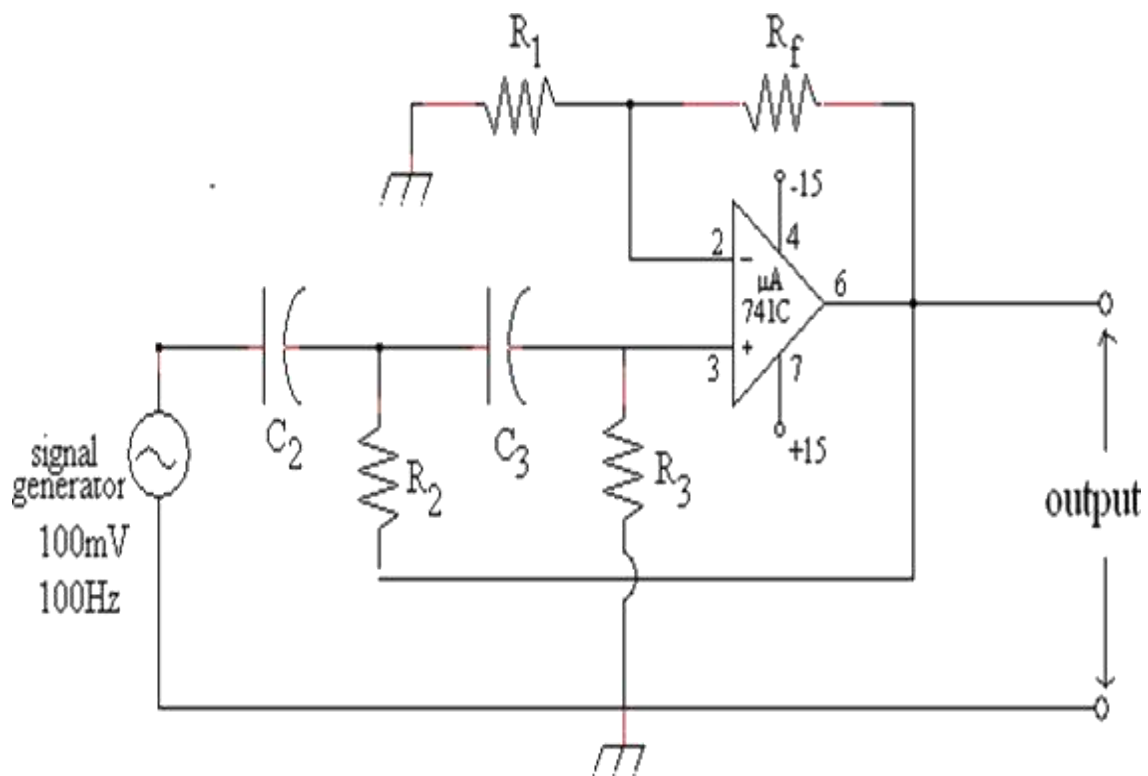
4. The resistances R_f and R_1 can be selected depending on the required gain in the pass band.

$$A_v = 1+(R_f/R_1).$$

Take $A_v = 1.586$.

PROCEDURE:

1. Apply 100mV, 100Hz signal as an input of this filter and note down the output voltage.
2. Now vary the input frequency, keeping the input voltage constant and at each step note down the output.
3. Tabulate the Result.

CIRCUIT:**DESIGN EQUATIONS:**

$$f_c = \frac{1}{2\pi\sqrt{R_2 R_3 C_2 C_3}}$$

let $R_2 = R_3 = R, C_2 = C_3 = C$

take $f_c = 1\text{KHz}, C = 0.0047\mu\text{f}, R = 33\text{K}\Omega$

$$f_c = \frac{1}{2\pi RC}$$

but again $A_{v_o} = 1 + \frac{R_f}{R_1}, R_1 = 27\text{K}\Omega, R_f = 15.8\text{k}\Omega$

RESULT & DISCUSSION:

Active Low pass Filter	Theoretical	Practical
Cutoff Frequency		
Bandwidth		

VIVA QUESTIONS:

1. What is a filter?
2. What are the different types of filters?
3. What are active filters?
4. Why inductors are not often used in active filters?
5. What are the advantages and disadvantages of active filter?
6. Name various active filters?
7. What does the term “pass” mean in any low-or-high pass filters?
8. Define transition Bandwidth?

Exp no:

Date:

3. HARMONIC GENERATOR

AIM: To generate different harmonics for a given fundamental frequency of a harmonic generator.

APPARATUS:

1. Regulator power supply (0-30v)
2. CRO
3. Signal generator
4. Resistor – 10K Ω
5. Capacitor – 0.01 μ f -2no.
6. Decade Capacitance Box
7. Decade Inductance Box

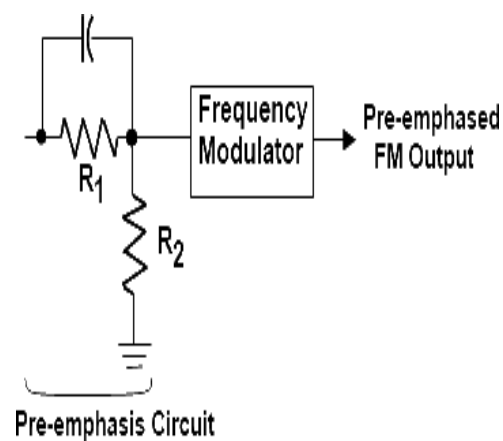
PROCEDURE:

1. Connect the circuit as shown in the fig.
2. Switch on the power supply and function generator.
3. Apply 10 KHz sinusoidal signal as an input.
4. calculate the theoretical value of inductance using the formula

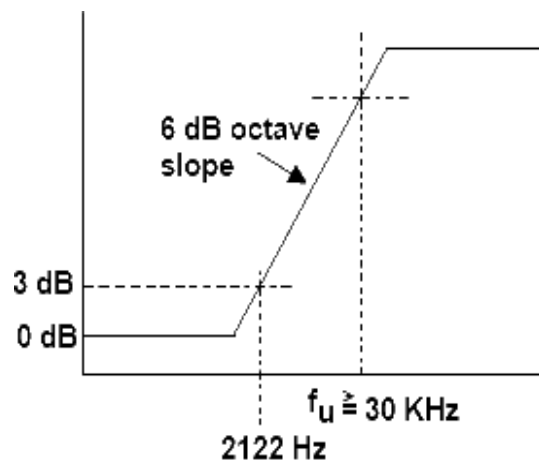
$$f = \frac{1}{2\pi\sqrt{LC}}$$

5. repeat the process for 1st, 2nd, 3rd harmonics
6. Find the O/P frequency and compare the theoretical frequency with that of practical frequency.
7. Tabulate the Result.

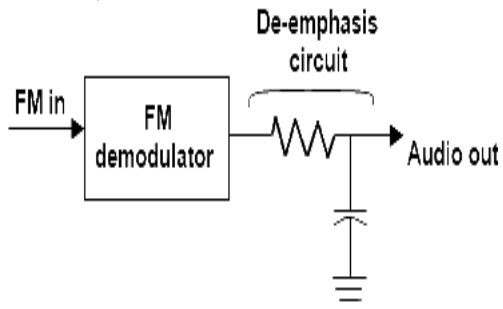
CIRCUIT:



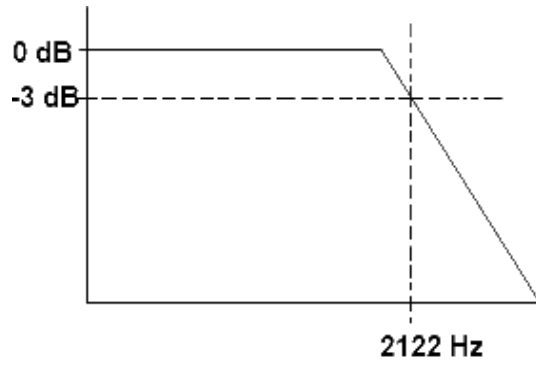
(a) Pre-emphasis Circuit



(b) Pre-emphasis Curve



(c) De-emphasis circuit



(d) De-emphasis Curve

The above figures (a), (b), (c) and (d) shows the circuit and corresponding graphs for pre-emphasis and de-emphasis methods.

TABULAR FORM:

$V_{in} =$

S.NO	I/P Frequency	Capacitance	Output frequency	Theoretical frequency

RESULT & DISCUSSION:**VIVA QUESTIONS:**

1. What is frequency multiplier?
2. Difference between frequency multiplier and frequency mixing?
3. Applications of harmonic generator?
4. Harmonic generator operates in which mode?
5. What is main function of resonance circuit in harmonic generator?