METHODIST

Estd : 2008

METHODIST
COLLEGE OF ENGINEERING AND TECHNOLOGY

Approved by AICTE New Delhi | Affiliated to Osmania University, Hyderabad

Abids, Hyderabad, Telangana, 500001

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

COMMUNICATION LABORATORY

STUDENT LABORATORY MANUAL

(As per 2020-2021 Academic Regulations)

B.E VI SEMISTER ECE

SUBJECT CODE: PC 651 EC

Name:_______________________________________

Roll No.:_____________________________________

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Vision of the Institute

To produce ethical, socially conscious and innovative professionals who would contribute to sustainable technological development of the society.

Mission of the Institute

To impart quality engineering education with latest technological developments and interdisciplinary skills to make students succeed in professional practice.

To encourage research culture among faculty and students by establishing state of art laboratories and exposing them to modern industrial and organizational practices.

To inculcate humane qualities like environmental consciousness, leadership, social values, professional ethics and engage in independent and lifelong learning for sustainable contribution to the society.

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COMMUNICATIONS LABORATORY

STUDENT LABORATORY MANUAL

(As per 2020-2021 Academic Regulations)

B.E VI SEMISTER ECE

SUBJECT CODE: PC 651 EC

Prepared by

Mrs. O. Ameena, Assistant Professor
Mr. Ch. Suresh, Assistant Professor

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

VISION

To strive to become centre of excellence in Education, Research with moral, ethical values and serve society.

MISSION

M1 To provide Electronics & Communication Engineering knowledge for successful career either in industry or research

M2 To develop Industry-Interaction for innovation, product oriented research and development

M3 To facilitate value added education combined with hands-on trainings

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Program Outcomes:

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

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

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

4. 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.

5. 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.

6. 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.

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

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

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. 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.

11. 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 multidisciplinary environments.

12. 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 Specific Outcomes (PSOs):

PSO1: Professional Competence: Apply the knowledge of Electronics & Communication Engineering principles in different domains like VLSI, Signal processing, Communication, Embedded system & Control Engineering.

PSO2: **Technical Skills**: Able to design and implement products using the cutting- edge software and hardware tools and hence provide simple solutions to complex problems.

PSO3: Social consciousness: Graduates will be able to demonstrate the leadership qualities and strive for the betterment of organization, environment and society

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PROGRAM EDUCATIONAL OBJETIVES

After 2-4 years of graduation, The Graduates will able to:

PEO 1: Apply the knowledge of Basic sciences and Engineering in designing and implementing the solutions in emerging areas of Electronics and Communication Engineering.

PEO 2: Pursue the research or higher education and practise profession.

PEO 3: Adapt to the technological advancements for providing the sustainable Engineering solutions to meet organisation/society needs

PEO 4: Work as an individual or in a team with professional ethics and values.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Program Specific Outcomes (PSOs)

PSO1: Professional Competence: Apply the knowledge of Electronics & Communication Engineering principles in different domains like VLSI, Signal processing, Communication, Embedded system & Control Engineering.

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PSO3: Social consciousness: Graduates will be able to demonstrate the leadership qualities and strive for the betterment of organization, environment and society

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LAB INSTRUCTIONS

Lab Rule of conduct, DO's & DON'Ts

1. Conduct yourself in a responsible manner at all times in the laboratory. Don't talk aloud or crack jokes in lab.
2. A lab coat should be worn during laboratory experiments.
3. Dress properly during a laboratory activity. Long hair, dangling jewellery and loose or baggy clothing are a hazard in the laboratory.
4. Observe good housekeeping practices. Replace the materials in proper place after work to keep the lab area tidy.
5. Do not wander around the room, distract other students, startle other students or interfere with the laboratory experiments of others.
6. Do not eat food, drink beverages or chew gum in the laboratory and do not use laboratory glassware as containers for food or beverages.

Rules & Guidelines for conducting Lab-Work

1. Students are not allowed to touch any equipment, in the laboratory area until you are instructed by Teacher or Technician.
2. Before starting Laboratory work follow all written and verbal instructions carefully. If you do not understand a direction or part of a procedure, ASK YOUR CONCERNED TEACHER BEFORE PROCEEDING WITH THE ACTIVITY.
3. Before use equipment must be read carefully Labels and instructions. Set up and use the equipment as directed by your teacher. If you do not understand how to use a piece of equipment, ASK THE TEACHER FOR HELP!
4. Perform only those experiments authorized by your teacher. Carefully follow all instructions, both written and oral. Unauthorized experiments are not allowed in the Laboratory. Students are not allowed to work in Laboratory alone or without presence of the teacher. Any failure / break-down of equipment must be reported to the teacher. Protect yourself from getting electric shock.

Laboratory Code of Conduct

1. Students should report to the concerned labs as per the time table schedule.
2. Studentswhoturnuplatetothelabswillinnocasebepermittedtoperformtheexperiment scheduled for the day.
3. Students should bring a note book of about 100 pages and should enter the readings/observations into the note book while performing the experiment.
4. After completion of the experiment, certification of the concerned staff in-charge in the observation book is necessary.
5. Staff member in-charge shall award 25 marks for each experiment based on continuous evaluation and will be entered in the continuous internal evaluation sheet.
6. The record of observations along with the detailed experimental procedure of the experiment performed in the immediate last session should be submitted and certified by the staff member in-charge.
7. Not more than three students in a group are permitted to perform the experiment on a set-up for equipment-based labs. Only one student is permitted per computer system for computer-based labs.
8. The group-wise division made in the beginning should be adhered to, and no student is allowed to mix up with different groups later.
9. The components required pertaining to the experiment should be collected from the stores in-charge, only after duly filling in the requisition form/log register.
10. When the experiment is completed, students should disconnect the setup made by them, and should return all the components/instruments taken for the purpose.
11. Any damage of the equipment or burn-out of components will be viewed seriously by either charging penalty or dismissing the total group of students from the lab for the semester/year.
12. Students should be present in the labs for the total scheduled duration.
13. Students are required to prepare thoroughly to perform the experiment before coming to Laboratory.
14. Procedure sheets/data sheets provided to the students, if any, should be maintained neatly and returned after the completion of the experiment.

Course Code	Course Title						Core/Elective
PC651EC	**COMMUNICATION LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
AC DC	-	-	-	2	25	50	1

Course Objectives:

1. Demonstrate AM, FM, Mixer, PAM, PWM and PPM techniques.
2. Understand multiplexing techniques.
3. Understand and simulate digital modulation (i.e., ASK, FSK, BPSK, QPSK) generation and detection.
4. Model analog, pulse modulation, PCM, Delta and Digital modulation techniques using CAD tools
5. Obtain data formats.

Course Outcomes:

1. Understand and simulate modulation and demodulation of AM and FM.
2. Construct pre-emphasis and de-emphasis at the transmitter and receiver respectively
3. Understand and simulate the PAM,PWM&PPM circuits
4. Understand baseband transmission (i.e., PCM, DPCM, DM, and ADM) generation and detection.
5. Understand error detection and correction.

PART-A

List of Analog Communication Experiments

1. Perform AM modulation and demodulation
2. Perform FM modulation and demodulation
3. Perform Pre emphasis and De-emphasis
4. Perform Multiplexing Techniques (FDM and TDM)
5. Perform Mixer Characteristics
6. Perform Sampling , PAM, PWM, PPM generation and detection

PART-B

List of Digital Communication Experiments

1. Perform PCM modulation and demodulation
2. Perform channel encoding and decoding.
3. Perform Linear and Adaptive Delta Modulation and Demodulation
4. Perform ASK generation and Detection.
5. Perform FSK and Minimum Shift Keying generation and Detection.
6. Perform Generation and Detection ofPCM, Delta modulation and Digital modulation Schemes (ASK. FSK, BPSK, QPSK) by using MATLAB/Simulink/Lab-view.

Note: At least ten experiments should be conducted in the semester, of which five should be from PART - B.

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Exp No.	Title of the Experiment	Date	Page No.	Marks				Remarks/ Signature
				E	O	R	T	
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								

E: Experiment (10 Marks) O: Observation (10 Marks) R: Record (5Marks) T: Total (25 Marks

Experiment: 1

AM GENERATION & DETECTION

1.1AIM:

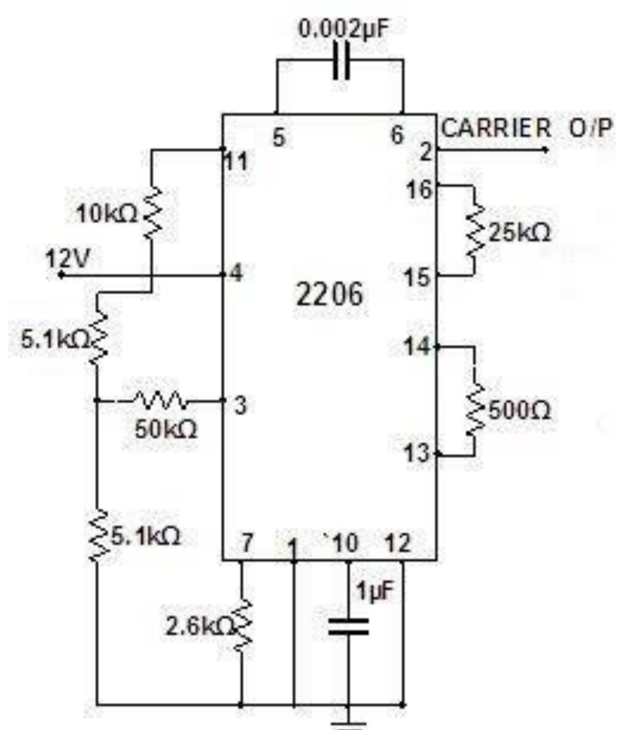
1. To generate amplitude modulated wave and determine the percent modulation.
2. To demodulate the modulated wave using envelope detector.

1.2 COMPONENTS REQUIRED:

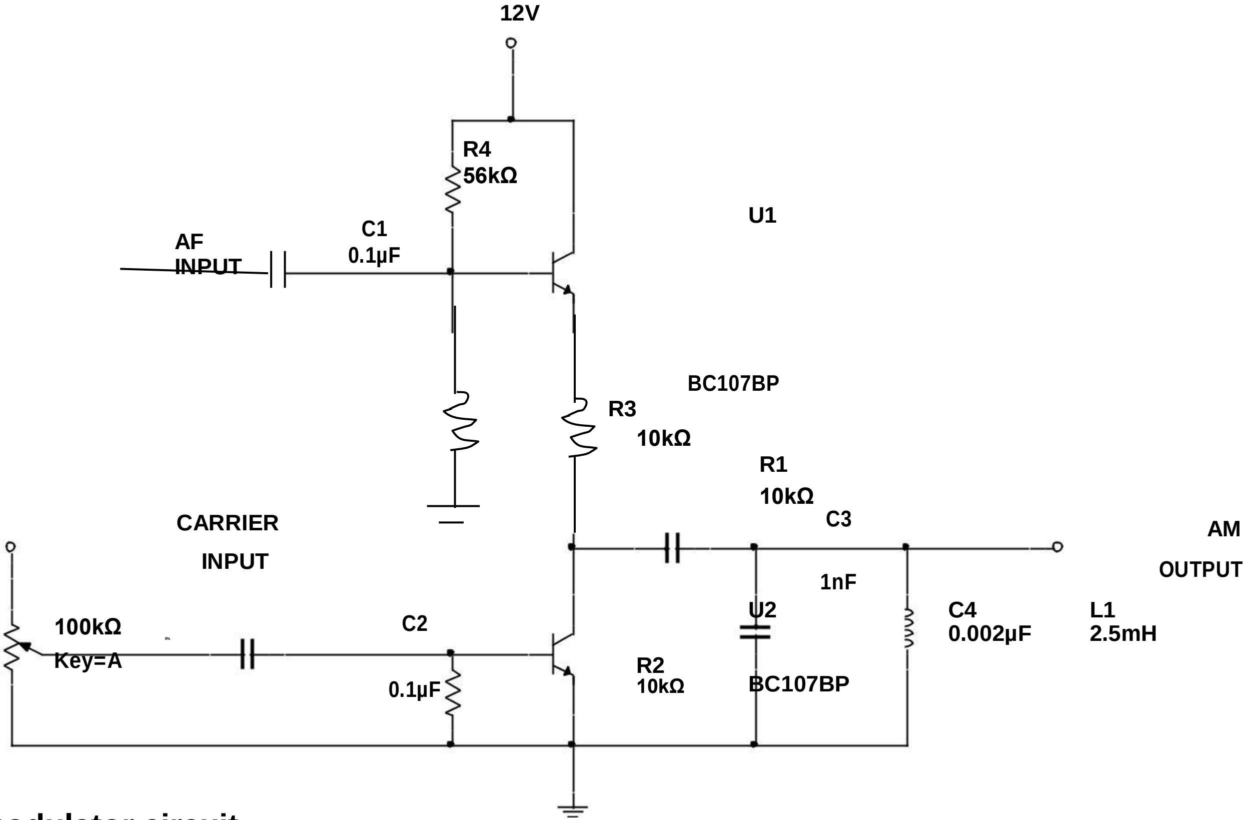
1. Amplitude modulation and demodulation trainer
2. Function generator (20 to 200MHz)
3. Cathode Ray Oscilloscope (30MHz)
4. BNC cables
5. Connecting wires

1.3 CIRCUIT DIAGRAM:

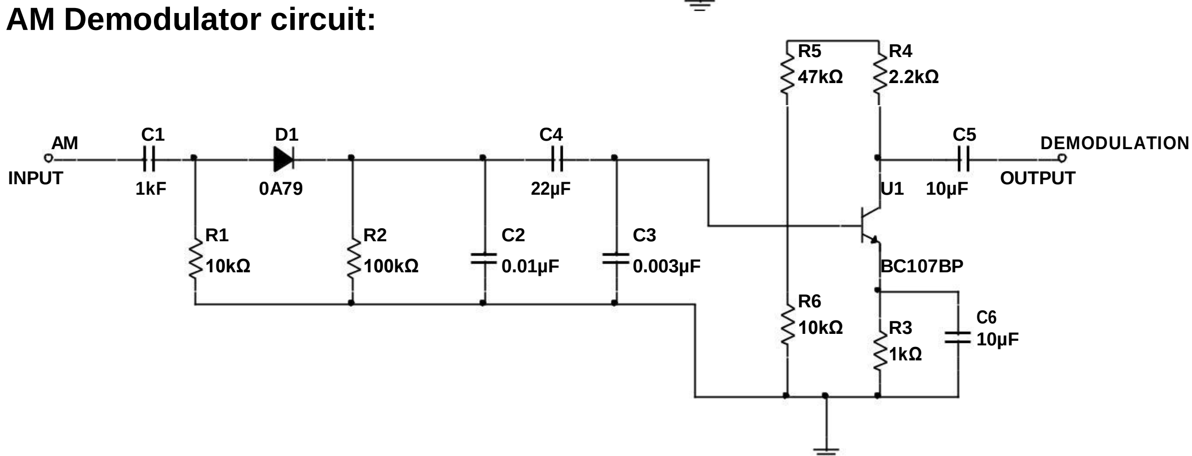
Carrier Generator:



Amplitude modulator circuit:



AM Demodulator circuit:



1.4 THEORY:

In continuous-wave (CW) modulation, a sinusoidal wave is used as the carrier. When the amplitude of the carrier is varied in accordance with the message signal, then that is called amplitude modulation (AM).

An AM wave may thus be described, in its most general form, as a function of time as follows:

$$S(t)=A_c\,[1+K_a m(t)]\,\cos(2\pi f_c t)$$

Where, K_a ⟶ Amplitude Sensitivity of the modulator
$S(t)$ ⟶ Modulated signal

A_C ⟶ Carrier Amplitude
m(t) ⟶ Message Signal

- The amplitude of K_a m(t) is always less than unity, that is | K_a m(t)| <1 for all t. It ensures that the function 1+ K_a m(t) is always positive.
- When the amplitude sensitivity K_a of the modulator is large enough to make | K_a m(t)| >1 for any t, the carrier wave becomes over-modulated, resulting in carrier phase reversals.
- Whenever the factor 1+ K_a m(t) crosses zero, the modulated wave then exhibits envelope distortion.

1.5 PROCEDURE:

1. Switch ON the amplitude modulation and demodulation trainer and check the O/P of carrier generator on oscilloscope (without giving any external signal).
2. Connect around 3 KHz to 10 KHz with 2Volts A.F signal at A.F I/P to the modulator circuit.
3. Connect the carrier signal O/P at carrier I/P of modulator circuit.
4. Observe the modulator O/P signal at AM O/P terminal.
5. Vary the modulating frequency and amplitude and observe the effects on the modulated waveform.
6. Note down the corresponding Vmax and Vmin values.
7. The depth of modulation can be varied using the variable knob (potentiometer) provided at A.F input.
8. Calculate the theoretical modulation index using the following formula:
   $$m = A_m / A_c$$
9. Calculate the practical value of percentage of modulation and modulation index using the following formulae:
   Percentage modulation (M) = $\frac{Vmax-Vmin}{Vmax+Vmin}\times 100$
   (or)
   Modulation index (m) = $\frac{Vmax-Vmin}{Vmax+Vmin}$
10. Connect the output of the modulator to the input of demodulator circuit.
11. Observe the demodulated output at the output terminals of the demodulator on the CRO.
12. Compare this signal with the AF signal.
13. Draw the waveforms of the carrier, message signal, AM envelope and the demodulated waveforms on a graph sheet.

OBSERVATIONS:

WAVEFORM	AMPLITUDE (V)	TIME PERIOD
Carrier wave, c(t)		
Message signal, m(t)		
AM wave, s(t)		
Demodulated wave, m(t)		

V_{max} (Volts)	V_{min} (Volts)	Percent Modulation(M)	
		Practical value	Theoretical value

1.6 CALCULATIONS:

Practical calculations:

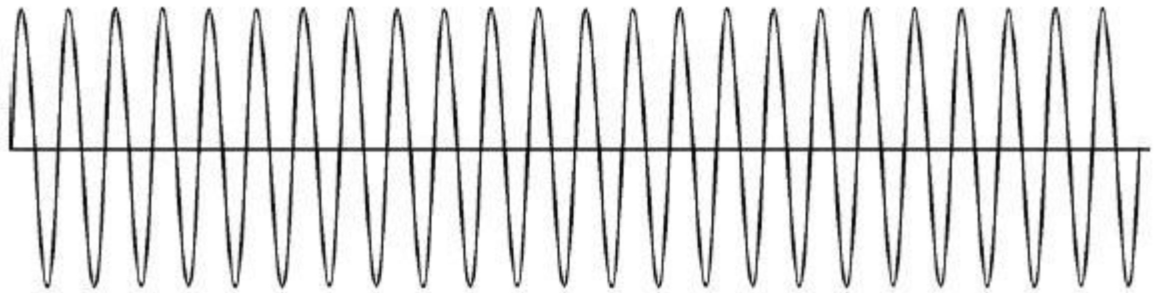
$$m = (V_{max} - V_{min}) / (V_{max} + V_{min})$$

Theoretical calculations:

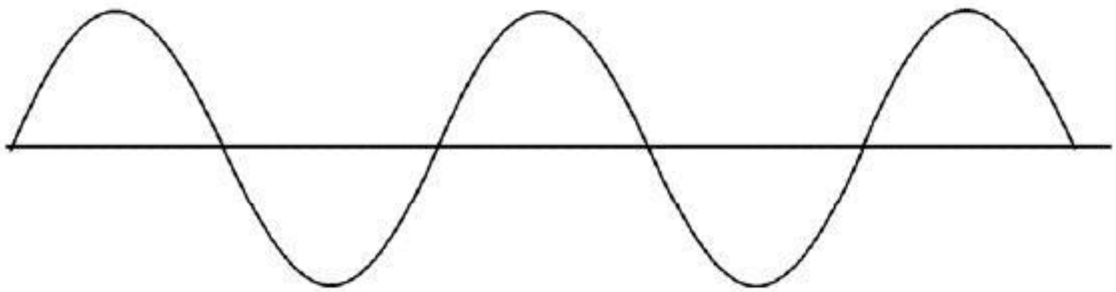
$$m = A_m / A_c$$

1.7 EXPECTED WAVEFORMS:

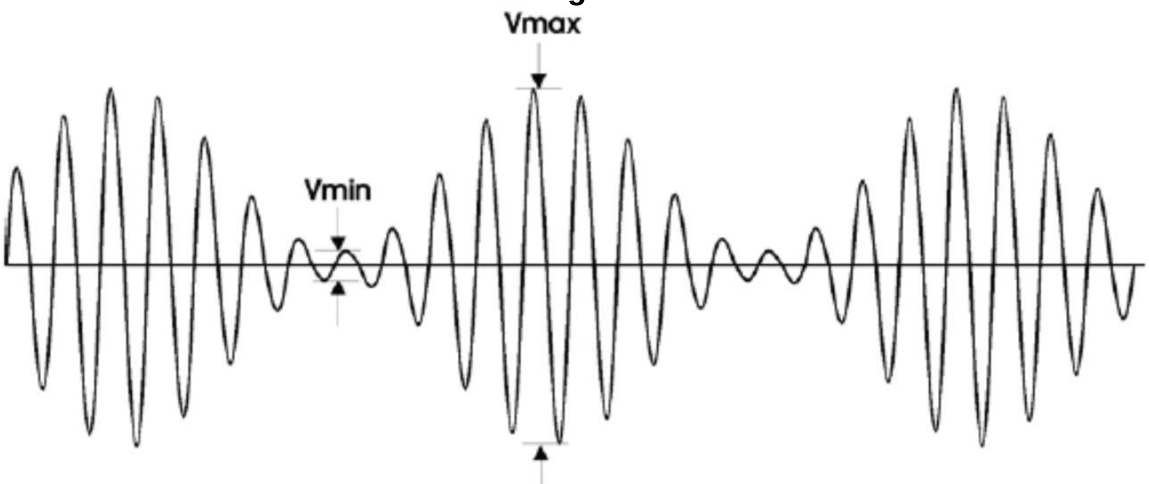
Carrier signal

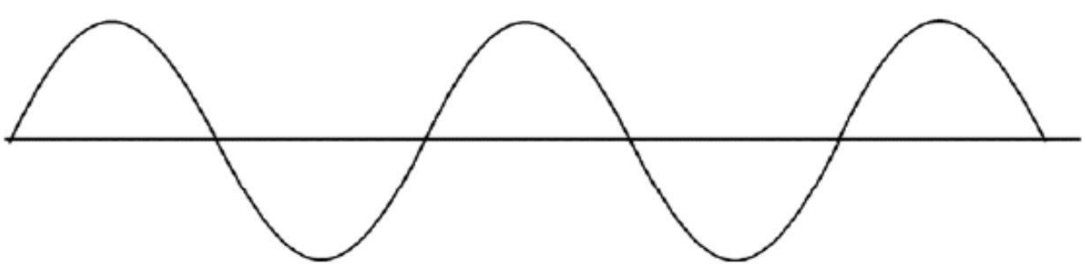


Modulating signal / AF signal



Modulated signal / AM waveform





Demodulated signal

1.8 RESULT:

1.9 INFERENCE

1. What is modulation?
2. What is the need for modulation?
3. Define Amplitude modulation.
4. Define modulation index.
5. What are the advantages of AM?
6. What are the disadvantages of AM?
7. What is the Bandwidth required to transmit AM wave?
8. What are the different types of AM techniques?
9. What are the different types of AM Demodulators?
10. Write the formula for Power calculations in AM?

Experiment: 2

FM GENERATION AND DETECTION

2.1 AIM:

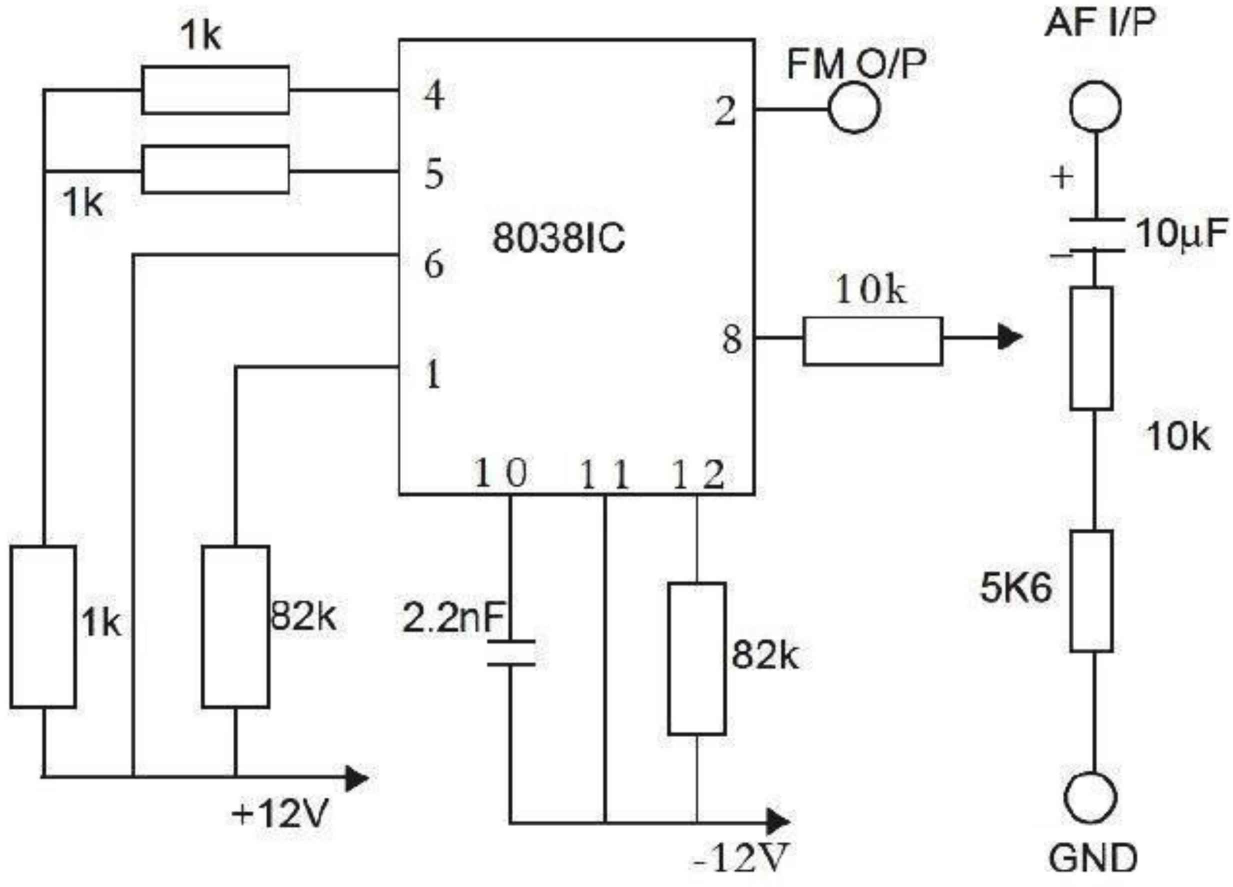
1. To generate frequency modulated signal and determine the modulation index and bandwidth for various values of amplitude and frequency of modulating signal.
2. To demodulate a Frequency Modulated signal using FM detector.

2.2 COMPONENTS REQUIRED:

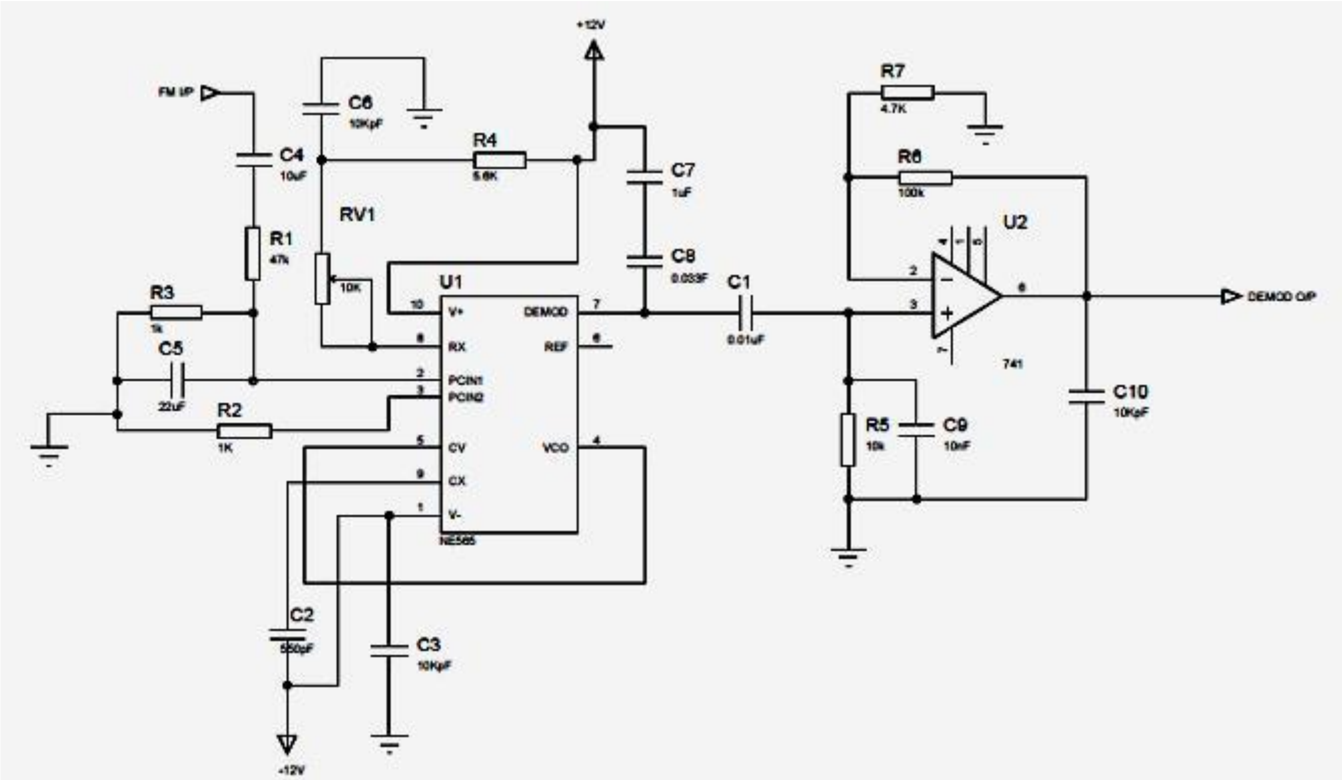
1. Frequency modulator and demodulator trainer kit
2. Cathode Ray Oscilloscope
3. Signal generator (20 to 20 MHz)
4. BNC cables
5. Connecting wires

2.3 CIRCUIT DIAGRAM:

FM Modulator Circuit:



FM Demodulator Circuit:



2.4 THEORY:

The process, in which the frequency of the carrier is varied in accordance with the instantaneous **amplitude of the modulating signal, is called "Frequency Modulation** (FM)**".**

The FM signal is expressed as

$$S(t)=A_C \cos[2\pi f_C t+\beta \sin(2\pi f_m t))]$$

Where, A_C ⟶ Carrier Amplitude

f_m ⟶ frequency of the message signal

f_c ⟶ frequency of the carrier

β ⟶ Modulation index of FM wave

S(t) ⟶ Modulated signal

2.5 PROCEDURE:

1. Switch ON the frequency modulation and demodulation trainer kit.
2. Without giving any AF input signal, observe the carrier signal at the FM O/P terminal and measure the amplitude and frequency of the carrier signal.
3. Connect around 3KHz to 10 KHz with 3 Vpp sine wave (A.F signal) to the input of the frequency modulator at AF input terminal.
4. Now observe the frequency modulator output on the CRO and adjust the amplitude of the AF signal to get clear frequency modulated wave form.
5. Now slowly increase the amplitude of modulating signal and measure f_{min} and maximum frequency deviation (**Δf) at each step.**
6. Evaluate the modulating index (m_f **= β) using the formula β = Δf /** f_m

where $\Delta f = |fc$ - $f_{min}|$.

7. **Calculate Bandwidth, BW = 2 (β + 1) f_m = 2(Δf + f_m)**
8. Vary the modulating frequency (AF Signal) and amplitude and observe the effects on the modulated waveform.
9. Connect the FM o/p to the FM i/p of demodulator.
10. By varying the potentiometer provided in the demodulator section, observe the output.
11. Draw the Carrier signal, baseband signal, FM output and the demodulated waveform on a graph sheet.

OBSERVATIONS:

WAVEFORM	AMPLITUDE	TIMEPERIOD
Carrier wave, c(t)		
Message signal, m(t)		
FM wave, s(t)		
Demodulated wave, m(t)		

2.6 CALCULATIONS:

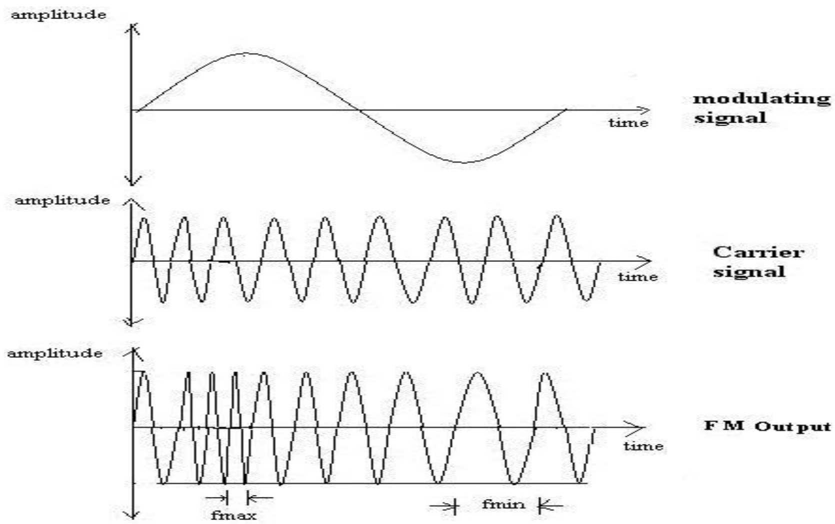
f_m (KHz)	T_{max} (µsec)	f_{min} (KHz)	Δf (KHz)	β	BW (KHz)

modulating index, $\beta = \Delta f / f_m$

where $\Delta f = |fc - f_{min}|$

Bandwidth, BW = 2 (β + 1) f_m = 2(Δf + f_m)

2.7 EXPECTED WAVEFORMS:



2.8 RESULT:

2.9 INFERENCE

1. Define Frequency modulation.
2. What is frequency deviation?
3. Define modulation index of FM.
4. What are the advantages of FM over AM?
5. Compare AM and FM with respect to bandwidth and circuit complexity.
6. Why carrier power is constant in FM?
7. What is FM Radio Band and its Bandwidth?
8. Why Pre emphasis circuit is used in FM Transmitter?
9. How Bandwidth and Deviation Related in FM?
10. Write different types of FM Demodulators?

Experiment: 3

PRE-EMPHASIS AND DE-EMPHASIS CIRCUITS

3.1 AIM:

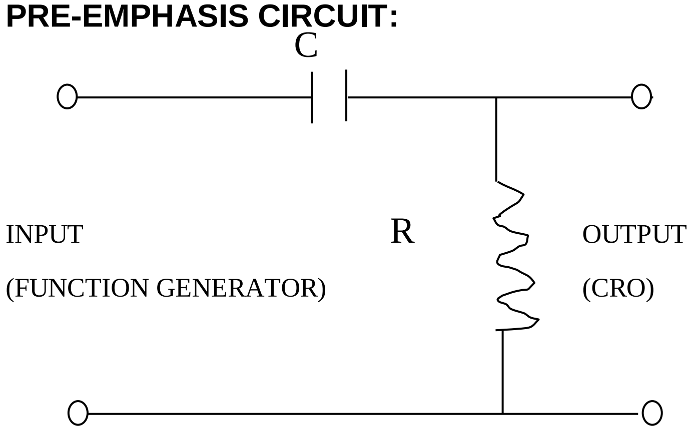
To study the frequency response of pre-emphasis and de–emphasis circuits.

3.2 COMPONENTS REQUIRED:

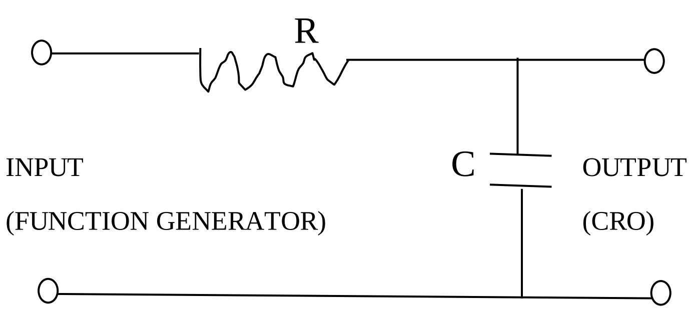
1. Pre-emphasis & de-emphasis circuits trainer
2. Cathode Ray Oscilloscope
3. Signal generator (20 to 20 MHz)
4. BNC probes
5. Connecting wires

3.3 CIRCUIT DIAGRAM:

PRE-EMPHASIS CIRCUIT:



DE-EMPHASIS CIRCUIT:



3.4 THEORY:

Pre-emphasis refers to boosting the relative amplitudes of the modulating voltage for higher audio frequencies. Pre-emphasis is done at the transmitting side of the frequency modulator. Signals with higher modulation frequencies have lower SNR. In order to compensate this, the high frequency signals are emphasised or boosted in amplitude at the transmitter section of a communication system prior to the modulation process. That is, the pre- emphasis network allows the high frequency modulating signal to modulate the carrier at higher level, this causes more frequency deviation. The circuit consists of a transistor, resistor and an inductor. It is basically a high pass filter or Differentiator. A pre-emphasis circuit produces a constant increase in the amplitude of the modulating signal with an increase in frequency. The cut off frequency is determined by the RC or L/R time constant of the network. Normally, the cut off frequency occurs at the frequency where capacitive reactance or inductive reactance equals R.

The cut off frequency is given by the formula

$$fc = \mathbf{R/(2\pi}\ L)$$

By the use of an active pre-emphasis network we can reduce the signal loss and distortion with the increase of SNR. Also the output amplitude of the network increases with frequencies above cut off frequency.

De-emphasis is the complement of pre-emphasis, in the antinoise system called emphasis. This circuit is used to attenuate the high frequency signal that is boosted at the transmitter section. The circuit is placed at the receiving side.

It acts as a low pass filter. The cut off frequency is given by the formula

$$fc = \mathbf{1/(2\pi RC)}$$

The circuit consists of a passive network consisting of a resistor and a capacitor. It is basically a low pass filter or integrator. The pre- emphasis network in front of the FM modulator and a de-emphasis network at the output of the FM demodulator improves the Signal to Noise Ratio for higher modulating signal frequencies, thus producing a more uniform SNR at the output of demodulator.

3.5 PROCEDURE:

1. Switch ON the pre-emphasis and de-emphasis trainer.
2. Give the input from signal generator to AF input of pre-emphasis circuit. By varying the **amplitude knob, set the input voltage to some milli volts (say 4mV, 6mV …), set the** frequency to 4 KHz.
3. Connect either 75mH or 50mH inductor.
4. By increasing the input signal frequency from 500Hz to 20 KHz, observe the pre-emphasis output voltage (Vo) on the CRO and calculate the gain using the formula 20 log (Vo / Vi).
5. Connect the output of pre-emphasis to the input of de-emphasis circuit and connect either **75KΩ or 50KΩ resistor.**
6. Observe the De-emphasis output at AF O/P of De-emphasis circuit.
7. Draw the graph between frequency (X – axis) and attenuation in dB (Y – axis) to shown the emphasis curves on semi log graph.

OBSERVATIONS:

Pre – emphasis:

Input voltage, Vi = **inductor, L =**

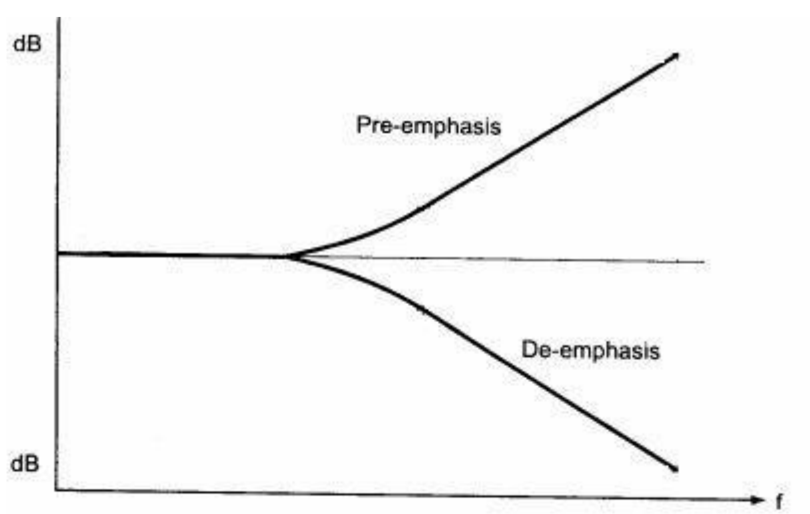
Frequency (Hz)	Output voltage (V)	Gain in dB 20 log (Vo / Vi)

De – emphasis:

Input voltage, Vi = **inductor, L =**

Frequency (Hz)	Output voltage (V)	Gain in dB 20 log (Vo / Vi)

3.6 EXPECTED GRAPHS:



3.7 RESULT:

3.8 INFERENCE

1. What do you understand by pre-emphasis?
2. What is de-emphasis?
3. What should be the time constant for the de emphasis circuit?
4. Why pre-emphasis is done after modulation?
5. List some applications of pre-emphasis circuit.
6. What are the standards used in India for Pre emphasis and De emphasis?
7. How pre emphasis take care in SNR of FM signal?
8. What is the formula for cutoff frequency of pre emphasis circuit?
9. What is the theoretical formula for gain in terms of frequency?
10. What is the formula for cutoff frequency of de emphasis circuit?

Experiment: 4

MULTIPLEXING TECHNIQUES: TIME DIVISION MULTIPLEXING AND DEMULTIPLEXING

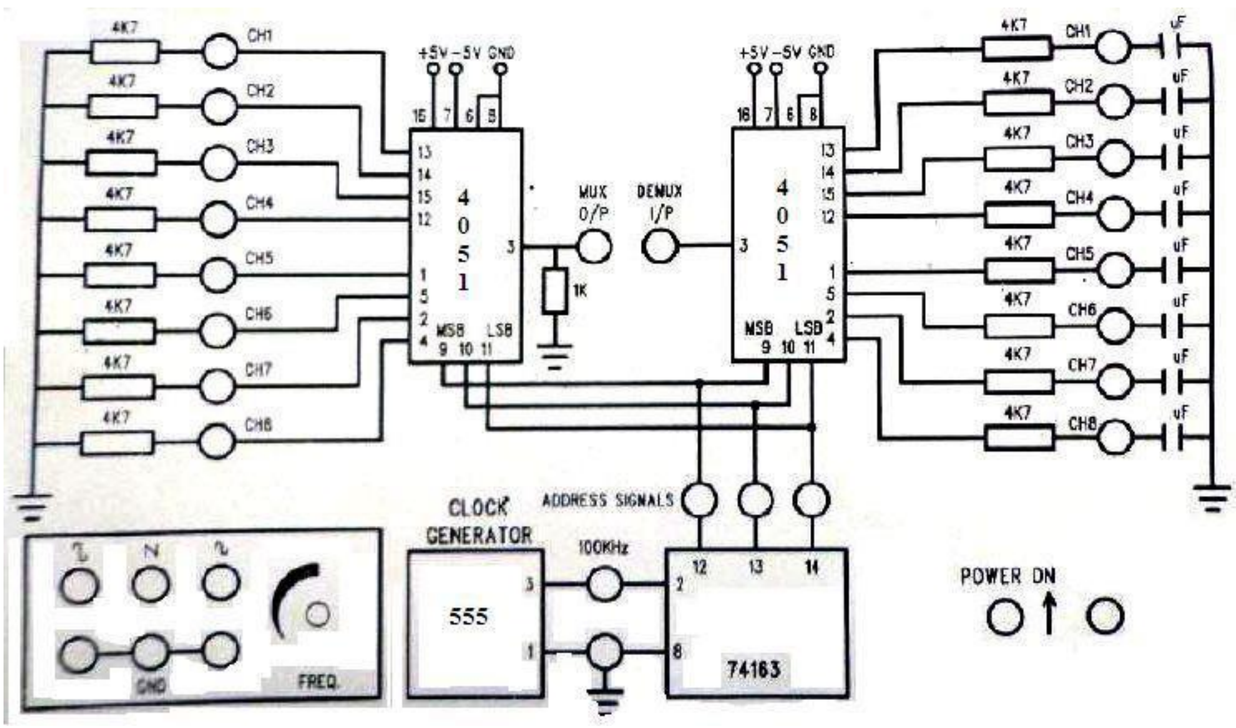
4.1 AIM:

To study the operation of Time Division Multiplexer and De-multiplexer.

4.2 COMPONENTS REQUIRED:

1. Time Division Multiplexing and De Multiplexing Trainer
2. Dual-channel 20MHZ oscilloscope
3. BNC cables
4. Connecting wires

4.3 CIRCUIT DIAGRAM:



4.4 THEORY:

Time division multiplexing is method of sharing the channel that is particularly suited to digital communications. TDM involves giving multiple users exclusive access to the entire channel (or to a carrier frequency if TDM is used in conjunction with FDM) Importantly , provided the duration of access is extremely short (much less than a second) and the rate of the access is fast, the users appear to have simultaneous and continuous access to the channel(or carrier). The primary advantage of TDM is that several channels of information can be transmitted simultaneously over a single cable.

TDM (or TDMA for time division multiple access) has been used extensively in telecommunications with PCM digital data. PCM samples analog signals converting them to proportional binary numbers. The binary numbers are then transmitted serially in frames usually containing an additional bit (or bits) for frame synchronization by the PCM decoder. The PCM **encoder's clock and the frame**-size determine the sample rate.

Suppose the PCM decoder only reads and decodes the contents of every alternate frame in the serial data. The effect of this is the same as halving the sample rate. So, the maximum message frequency would also be halved. The benefit of reading only every second frame however is, the unread frames are free to be filled with the PCM data for a second message having a maximum frequency equal to the first. Of course, for TDM to work with PCM signals, the PCM decoder must be designed to read the alternate frames as separate sets of data.

4.5 PROCEDURE:

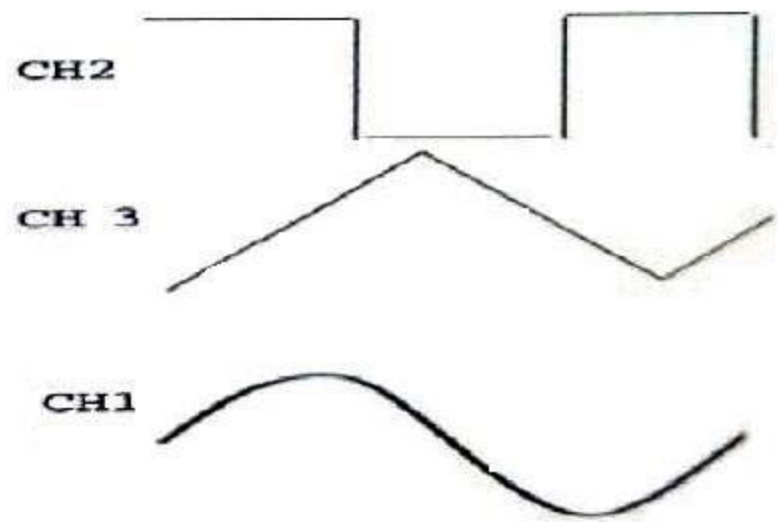
1. Connect the trainer TDM multiplexer to the mains and switch on the power supply.
2. Connect the sine wave to channel 1, square wave to channel 2 and triangle wave form to channel 3 terminals of 8x1 multiplexer.
3. Observe the sine, square and triangular waveforms on the kit and make a note of the corresponding amplitudes and time periods.
4. Connect the sine wave to ch1, square wave to ch2 and triangular wave to ch3 terminals of 8x1 multiplexer.
5. Observe the multiplexer output on channel 1 of CRO.
6. Observe TDM wave form using CRO at different values of clock frequency, input signal voltage levels and sketch them.
7. Connect MUX output to demux input.
8. Observe the corresponding signal outputs at channel 2 of CRO.
9. Note down amplitudes and time periods of all the waveforms.
10. Plot multiplexing and de-multiplexing output waveforms on a graph sheet.

OBSERVATIONS:

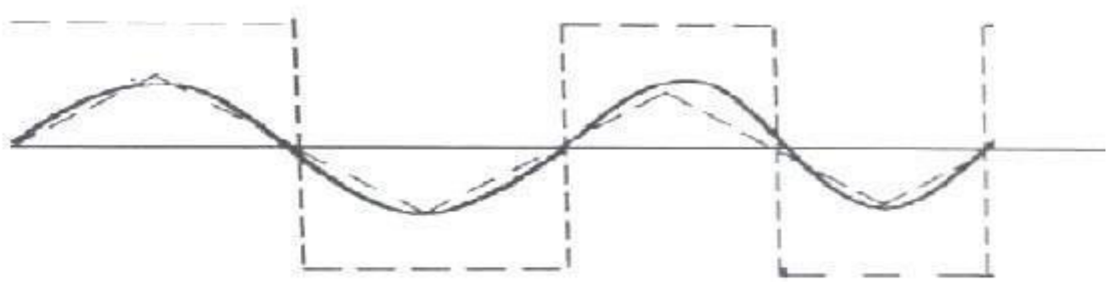
	Multiplexing		Demultiplexing	
Signals	**Amplitude Vp-p**	**Time period (msec)**	**Amplitude Vp-p**	**Time period (msec)**
Sinusoidal wave				
Square wave				
Triangular wave				

4.6 EXPECTED GRAPHS:

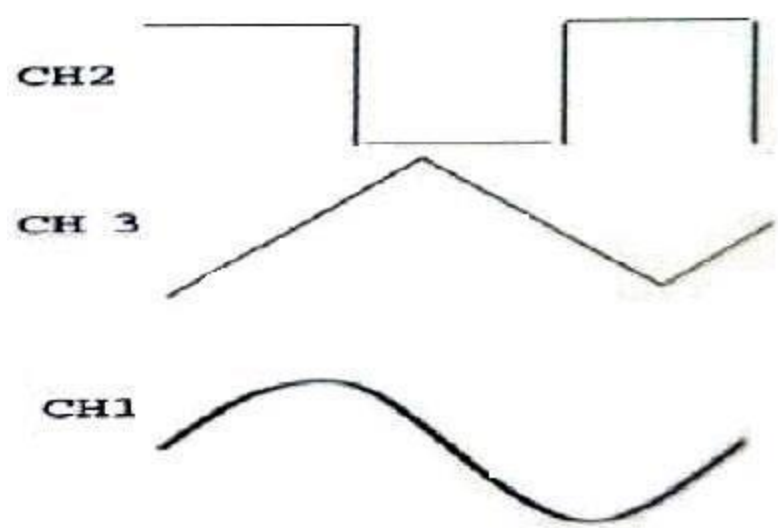
Multiplexer inputs:



Multiplexed output:



Demultiplexed outputs:



4.7RESULT:

4.8 INFERENCE

1. In what situation multiplexing is used?
2. Mention the types of multiplexing?
3. Why sync pulse is required in TDM?
4. What are the functions of commutator switch?
5. Give the advantages of multiplexing.
6. Write real time applications of TDM technique?
7. What if Puffing in TDM?
8. Define TDM?
9. Define FDM?
10. Write Advantage of TDM over FDM?

Experiment: 5

MIXER CHARACTERISTICS

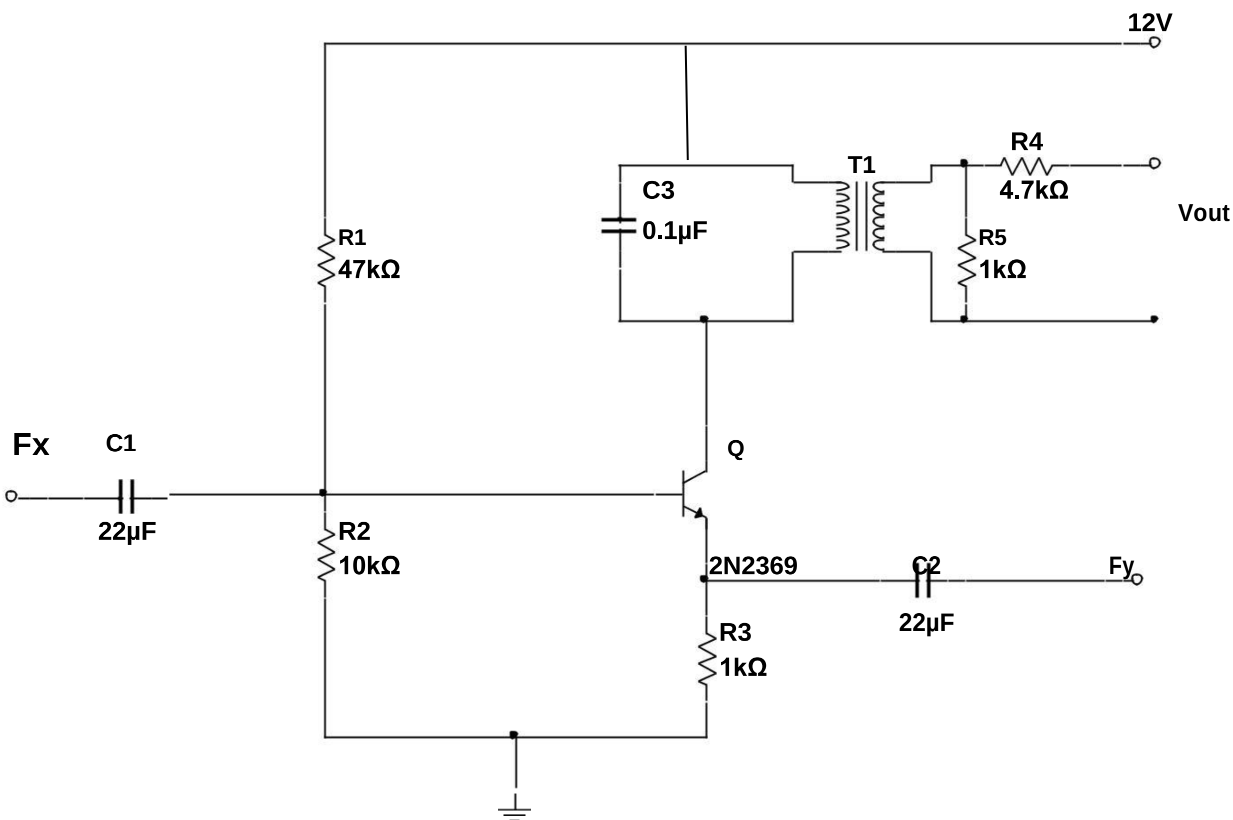
5.1 AIM:

To observe the characteristics of the frequency mixer and to measure its conversion gain.

5.2 COMPONENTS REQUIRED:

1. Frequency mixer trainer
2. Function generator (20 to 200MHz) --- 2
3. Cathode Ray Oscilloscope (30MHz)
4. BNC cables
5. Connecting wires

5.3 CIRCUIT DIAGRAM:



5.4 THEORY:

The mixer is a nonlinear device that mixes the incoming signal of frequency f_C with a local oscillator voltage of frequency f_l and generates an output voltage of an intermediate frequency (f_l-f_C). The nonlinear mixer circuit has two sets of input terminals and one set of output terminals. Mixer will have several frequencies present in its output, including the difference between the two input frequencies and other harmonic components.

5.5 PROCEDURE:

1. Switch ON the power supply of trainer kit.
2. Connect the circuit as per the circuit diagram.
3. Apply 90 KHz signal to the base of the transistor (fx) and 100 KHz signal to the emitter of the transistor (fy) by using function generators.
4. Observe a sinusoidal signal with a difference of 10 KHz frequency across the output terminals of frequency mixer circuit by using CRO.
5. By varying the base signal frequency, take a note of the amplitudes of the base signal and the output signal in CRO.
6. Now, calculate the conversion gain using the following formula

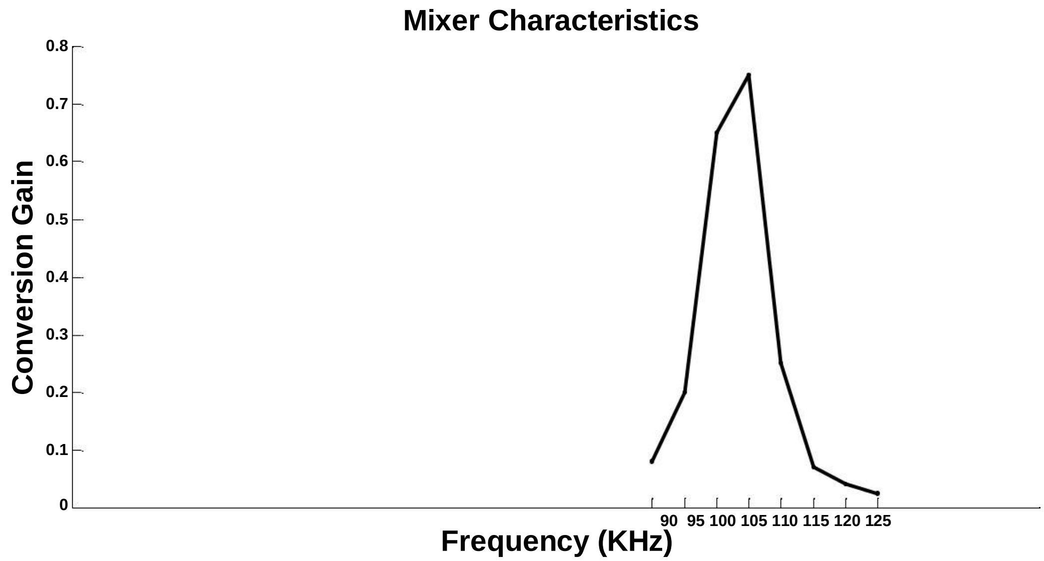
$$\text{Conversion gain} = \frac{\text{Output voltage}}{\text{Base signal voltage}}$$

7. Plot conversion gain Vs base signal frequency.

OBSERVATIONS:

FREQUENCY (BASE SIGNAL) (Hz)	VOLTAGE (BASE SIGNAL) (V)	OUTPUT VOLTAGE (V)	CONVERSION GAIN

5.6 EXPECTED GRAPHS:



5.7 RESULT:

5.8 INFERENCE

1. What is a mixer?
2. What is the need of mixer in a receiver?
3. Draw the mixer characteristics.
4. What are the main components of RF receiver?
5. What is the relation between dBm, dBW and Watt?
6. What is the role of mixer in Image frequency rejection?
7. What is IF range?
8. What is advantage of IF frequency?
9. Write drawback of TRF receiver?
10. What is super heterodyne receiver?

Experiment: 6

PULSE WIDTH MODULATION AND DEMODULATION

6.1 AIM:

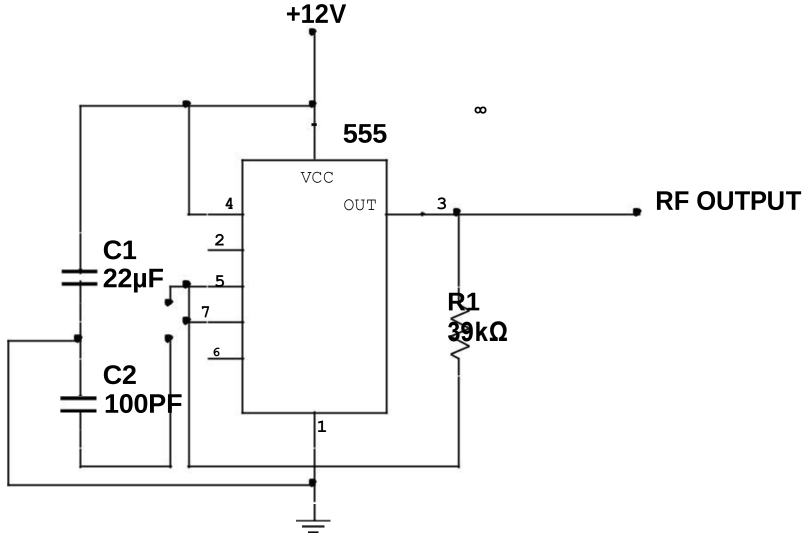
To study the pulse width modulation and demodulation.

6.2 COMPONENTS REQUIRED:

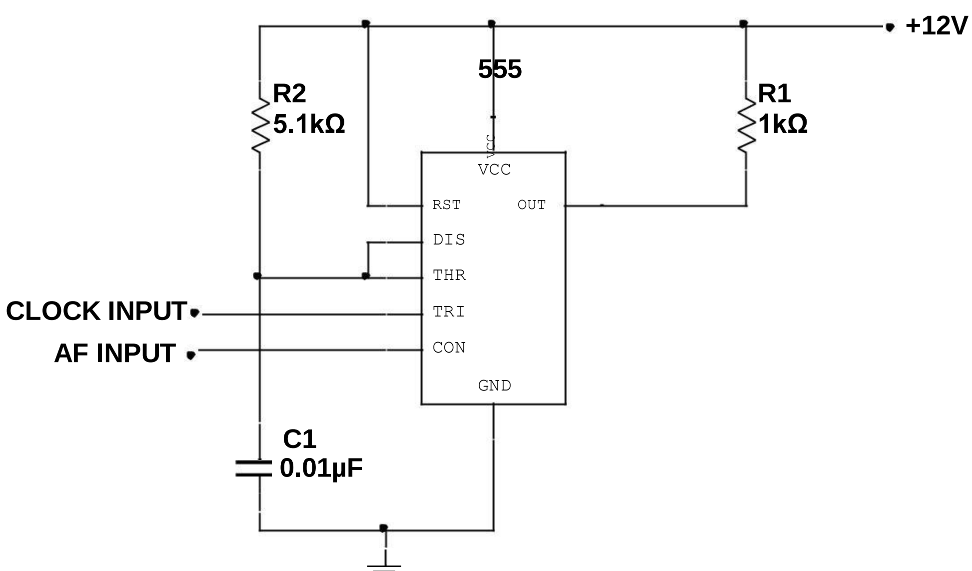
1. Pulse width modulation and demodulation trainer
2. Cathode Ray Oscilloscope
3. BNC probes
4. Connecting wires

6.3 CIRCUIT DIAGRAM:

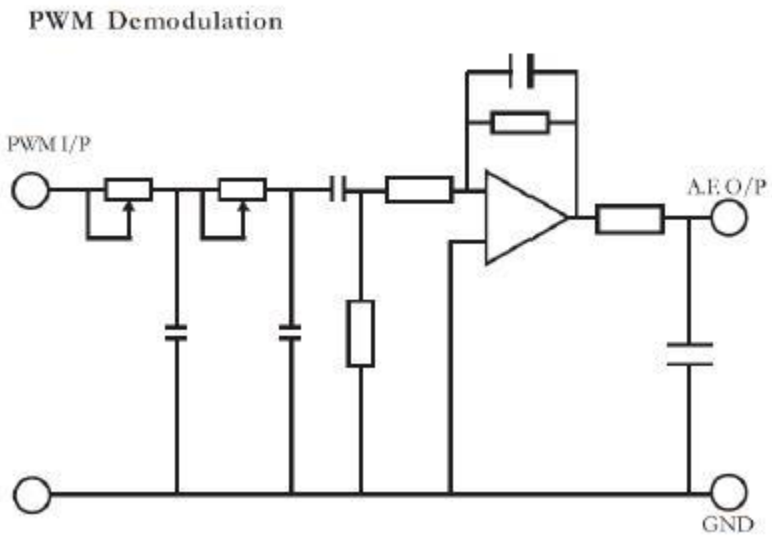
Clock generator:



PWM modulator:



PWM demodulator:



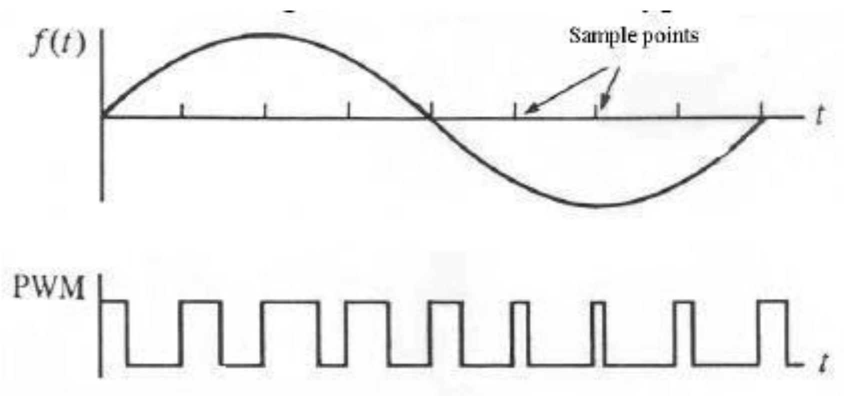
6.4 PROCEDURE:

1. Switch ON the pulse width modulation and demodulation trainer.
2. Connect the clock output to the clock input terminal (pin 2) of the PWM modulator.
3. Connect the AF output to the AF input terminal (pin 5) of the PWM modulator.
4. Observe the PWM output at pin 3 of IC 555 on CRO.
5. By varying frequency and amplitude of the modulating signal, observe the corresponding changes in the width of the output pulses.
6. Connect the PWM output to the PWM input terminals of the PWM demodulation circuit.
7. Observe the demodulated output at the AF output terminals of the PWM demodulation circuit on the CRO.
8. Plot the waveforms of the Clock, AF signal, PWM output and the demodulated output.

OBSERVATIONS:

WAVEFORM	AMPLITUDE	TIMEPERIOD
Clock signal		
Message signal, m(t)		
PWM wave, s(t)		
Demodulated wave		

6.5 EXPECTED GRAPHS:



6.6RESULT:

6.7 INFERENCE

1. Define PWM and draw the waveforms of PWM.
2. Explain how a PWM waveform can be generated.
3. What are the advantages of PWM compared to PPM?
4. What is the disadvantage of PWM?
5. Explain the operation of the PWM circuit used in the experiment.
6. Explain the purpose of various components used in the PWM circuit.
7. What are the advantages of using pulse modulation techniques compared to analog modulation techniques?
8. Explain how a PWM is demodulated?
9. What is application of PWM?
10. Explain PWM modulatation using monostable multivibrator.

Experiment: 7

PPM GENERATION & DETECTION

7.1 AIM:

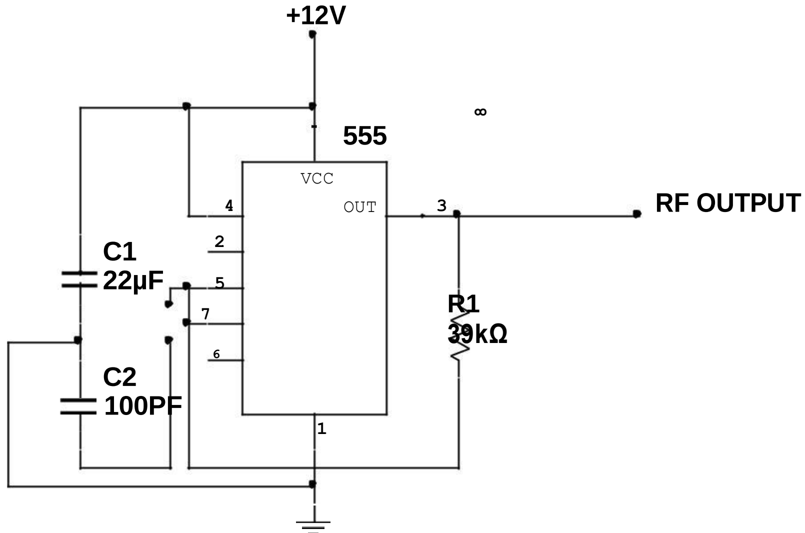
To study the pulse position modulation and demodulation.

7.2 COMPONENTS REQUIRED:

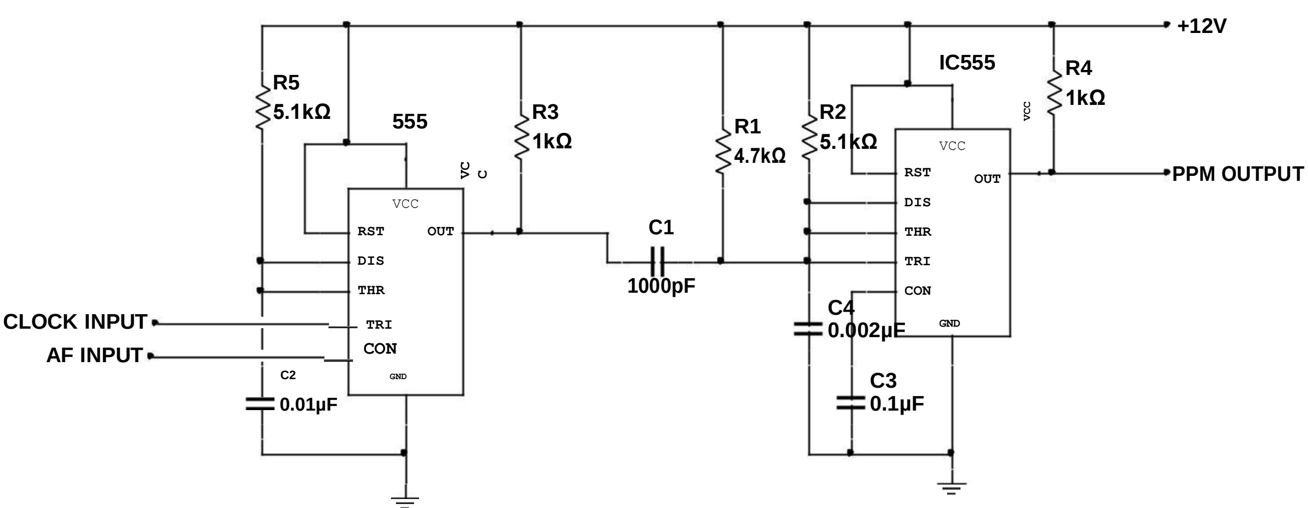
1. Pulse Position Modulation and demodulation trainer
2. Cathode Ray Oscilloscope
3. BNC probes
4. Connecting wires

7.3 CIRCUIT DIAGRAM:

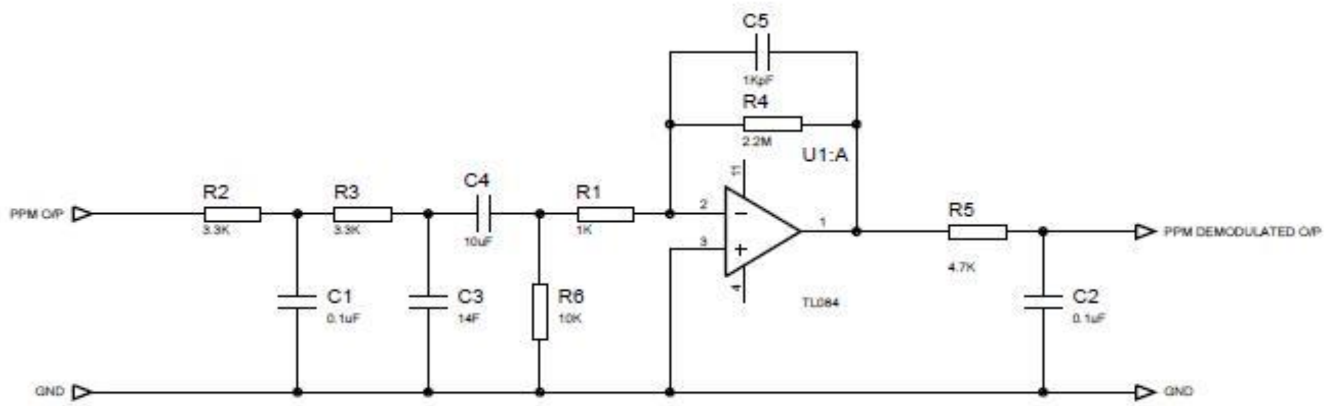
Clock generator:



PPM Modulation:



PPM Demodulation:



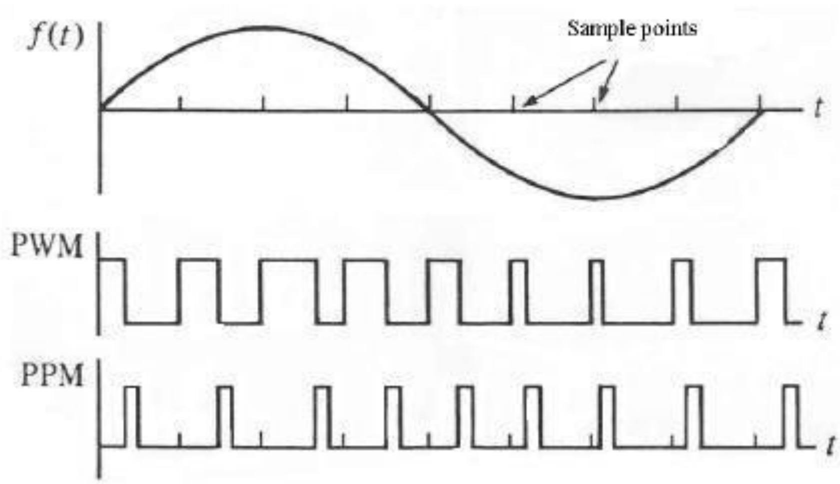
7.4 PROCEDURE:

1. Switch ON the PPM modulator and demodulator trainer.
2. Connect the clock output to pin 2 of IC 555.
3. Connect the AF output to the pin 5 of IC 555.
4. Observe the PWM output at the pin 3 of IC 555 on the CRO.
5. Now, connect the PWM output to the PPM input of the second IC 555. (pin 2)
6. Observe the PPM output at the pin 3 of the second IC 555 on the CRO.
7. Connect PPM output to PPM input of the PPM demodulator.
8. Observe the demodulated output on the CRO.
9. Draw the clock signal, AF signal, PWM output, PPM output and demodulated signal waveforms on a graph sheet.

OBSERVATIONS:

WAVEFORM	AMPLITUDE	TIMEPERIOD
Clock signal		
Message signal, m(t)		
PWM wave		
PPM wave		
Demodulated wave		

7.5 EXPECTED GRAPHS:



7.6RESULT

7.7 INFERENCE

1. Define PPM? Draw the waveforms of PPM.
2. Explain, how a PPM wave can be generated and demodulated?
3. What are the advantages of PPM over PWM?
4. What is the disadvantage of PPM compared to PWM?
5. Explain the operation of the PPM circuit used in the experiment.
6. Draw the internal block diagram of 555 timer.
7. Explain the astablemode operation and monostable mode operation of 555 timer.
8. Give some applications of 555 timer.
9. Explain the purpose of various components used in the PPM circuit.
10. What is the role of synchronization in PPM?

Experiment: 8

PULSE CODE MODULATION (PCM) GENERATION & DETECTION

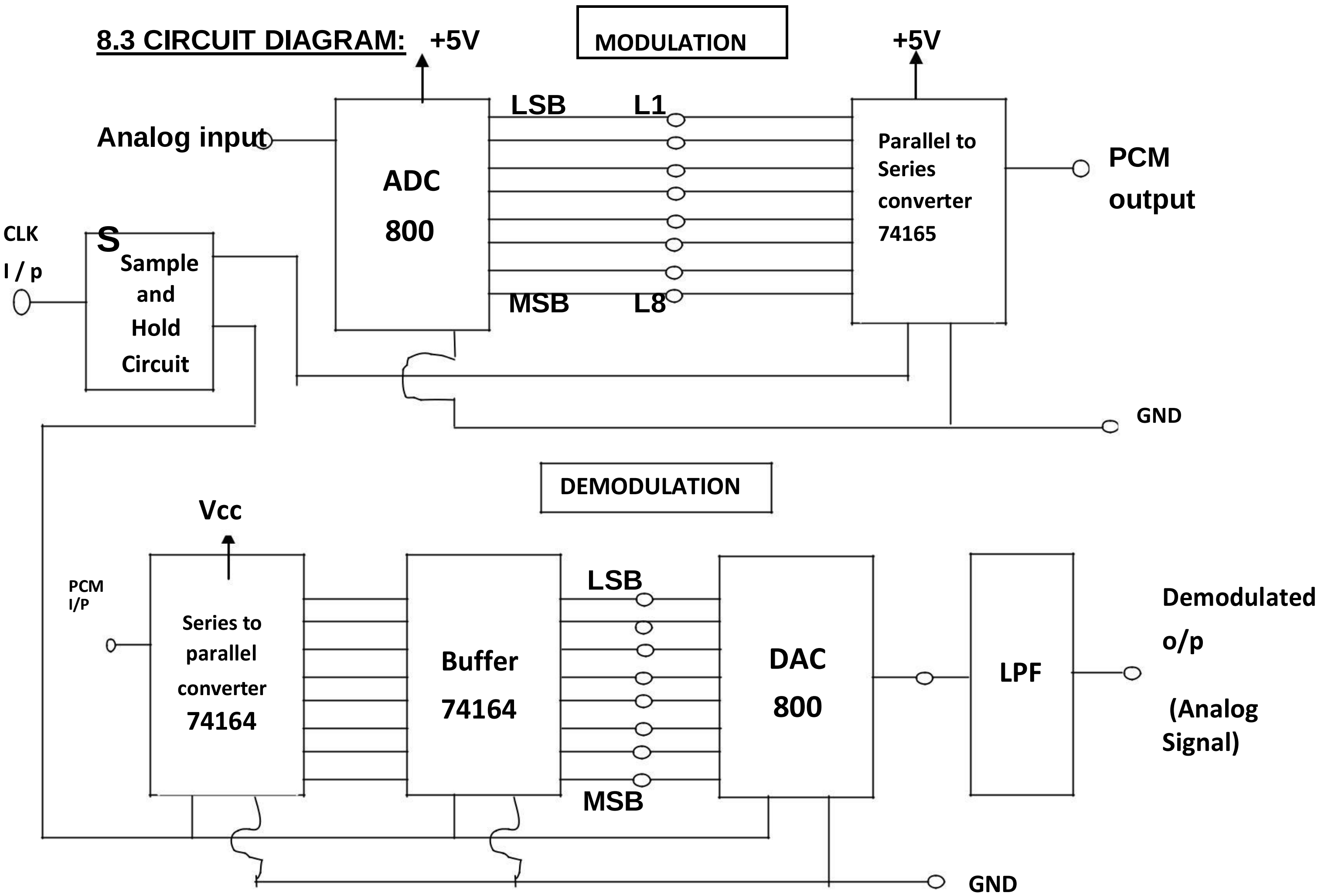
8.1 AIM:

To study and understand the operation of Pulse Code Modulation (PCM) and demodulation.

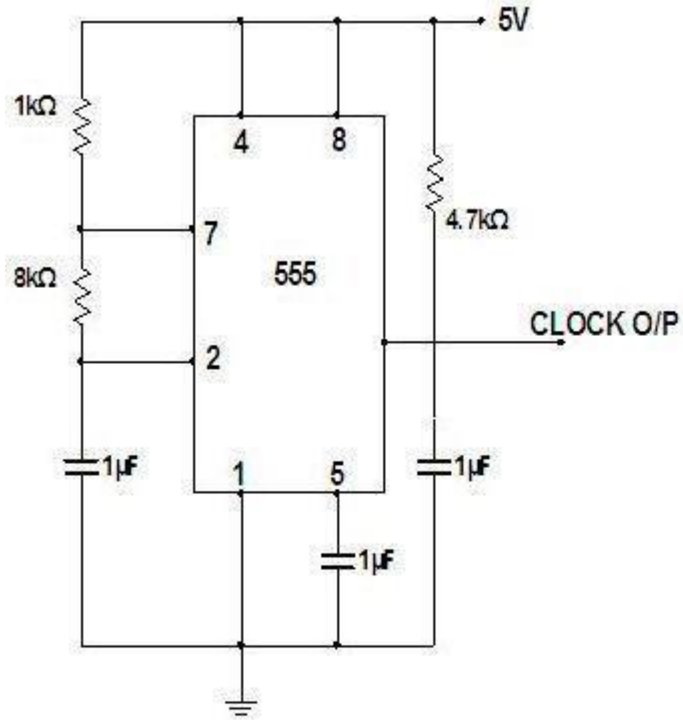
8.2 COMPONENTS REQUIRED:

1. Pulse Code Modulation and Demodulation Trainer Kit
2. Cathode Ray Oscilloscope (CRO)
3. Probes
4. Connecting wires

8.3 CIRCUIT DIAGRAM:



BIT CLOCK GENERATOR



8.4THEORY:

In pulse code modulation (PCM) a message signal is represented by a sequence of coded pulses, which is accomplished by representing the signal in discrete form in both time and amplitude. The basic operations performed in the transmitter of a PCM system are sampling, quantizing and encoding. To ensure perfect reconstruction of the message signal at the receiver, the sampling rate must be greater than twice the highest frequency component W of the message signal in accordance with the sampling theorem.

The quantizing and encoding operations are usually performed in an analog-to-digital converter. The sampled version of the message signal is then quantized, thereby providing a new representation of the signal that is discrete in both time and amplitude.

8.5PROCEDURE:

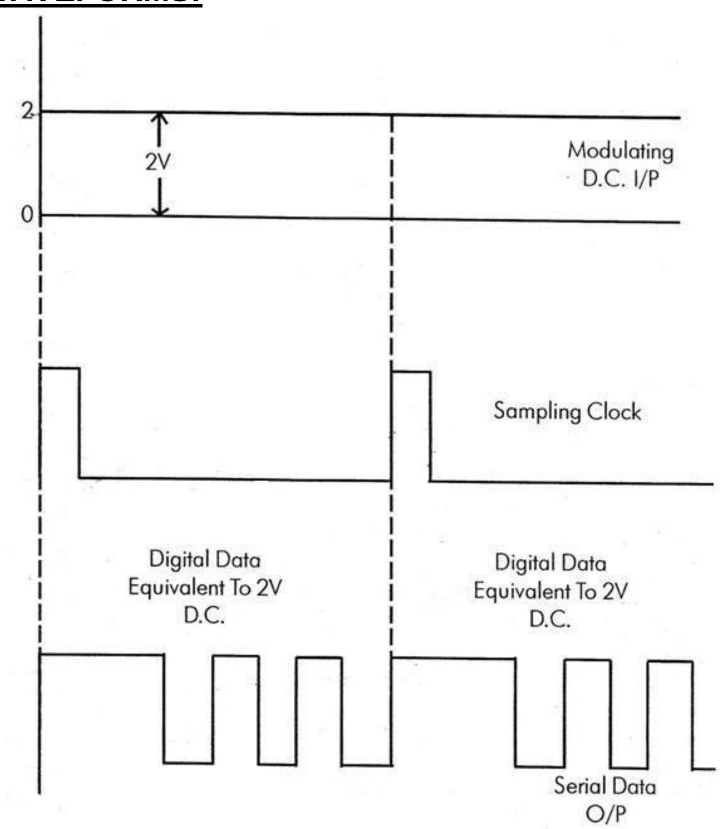
1. Switch ON the trainer kit.
2. Observe the clock output of bit clock generator and note down its amplitude and time period.
3. Connect the variable DC output to the Analog input of Modulation section.
4. Connect the clock output of bit clock generator to the clock input of the modulator section.
5. Observe the sampling output at the output of Sample and Hold block and make a note of the amplitude and time period of the sampled waveform.
6. By varying the DC output, observe the PCM output on the CRO.
7. Connect the AF output to the Analog input of the modulation section by removing variable DC output.

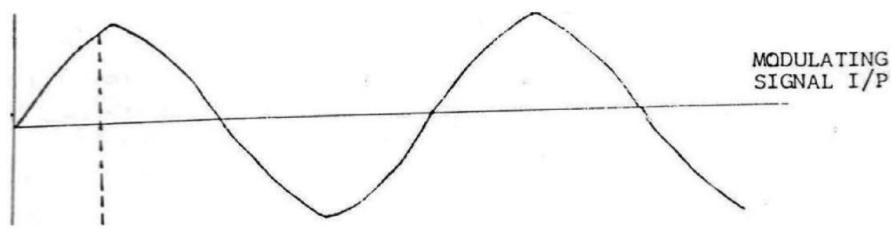
8. Connect the PCM output to the PCM input of the Demodulation section.
9. Observe the DAC output at channel 1 of CRO and observe the demodulated output at channel 2 of CRO.

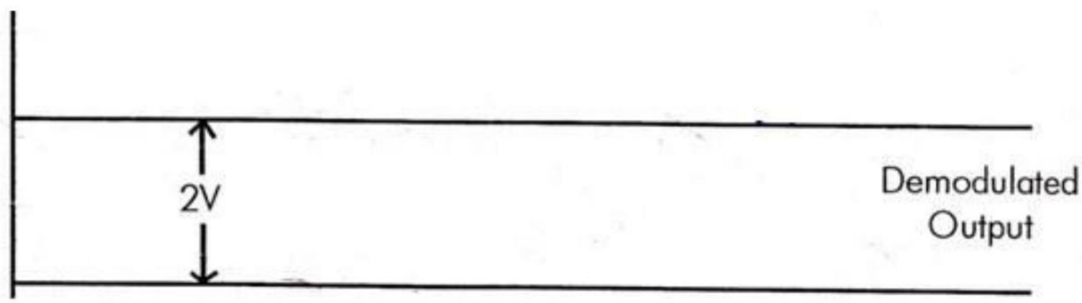
OBSERVATION TABLE:

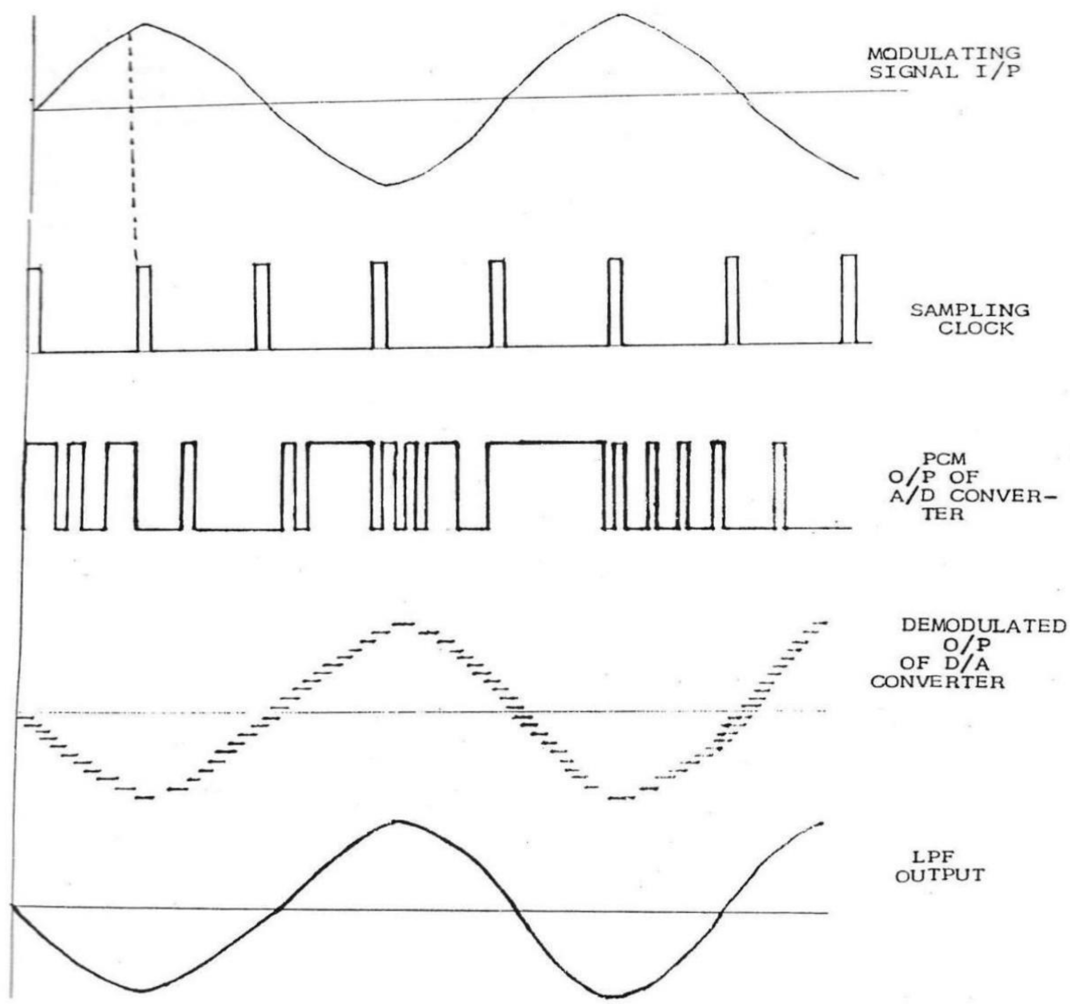
Signal	Amplitude (V)	Time Period (ms)
Clock Signal		
Sampling Signal		
Modulating Signal		
PCM wave		
DAC output		
LPF (Demodulated) output		

8.6 EXPECTED WAVEFORMS:




MODULATING
SIGNAL I/P


2V
Demodulated
Output


MODULATING
SIGNAL I/P
SAMPLING
CLOCK
PCM
O/P OF
A/D CONVER-
TER
DEMODULATED
O/P
OF D/A
CONVERTER
LPF
OUTPUT

8.7RESULT:

8.8 INFERENCE

1. What is meant by pulse code modulation?
2. What are the applications of PCM?
3. What is companding?
4. What is A-law?
5. What is μ -law?
6. Draw the block diagram of PCM.
7. Define Quantization?
8. Write different types of quantization?
9. What is the difference between PCM and DPCM?
10. Advantage of PCM over analog modulations?

Experiment: 9

LINEAR DELTA MODULATION AND DEMODULATION

9.1AIM:

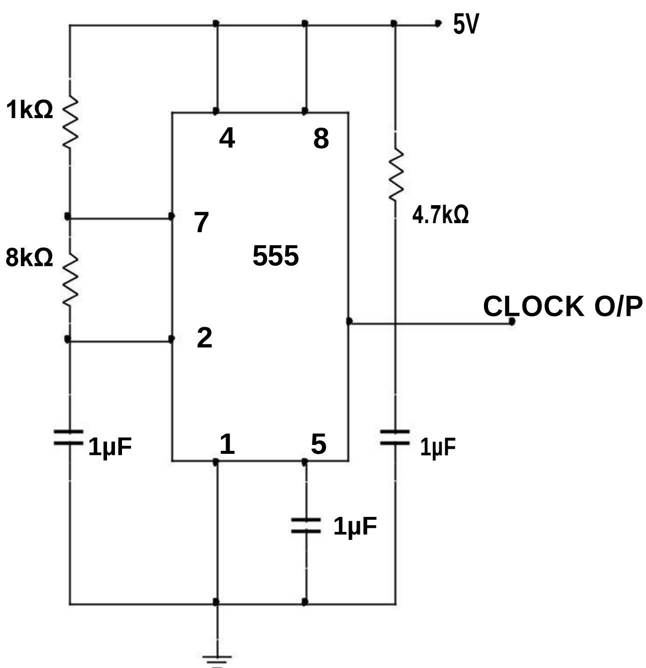
To study the Delta Modulation and demodulation.

9.2 COMPONENTS REQUIRED:

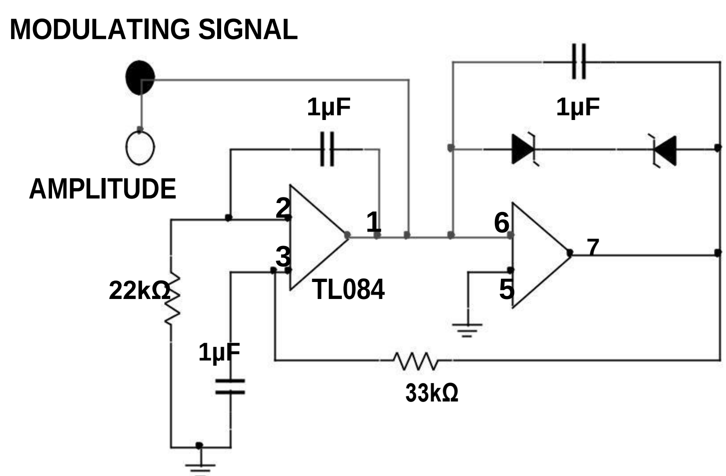
1. Delta Modulation and Demodulation Trainer Kit
2. Cathode Ray Oscilloscope (CRO)
3. Probes
4. Connecting wires

9.3 CIRCUIT DIAGRAM:

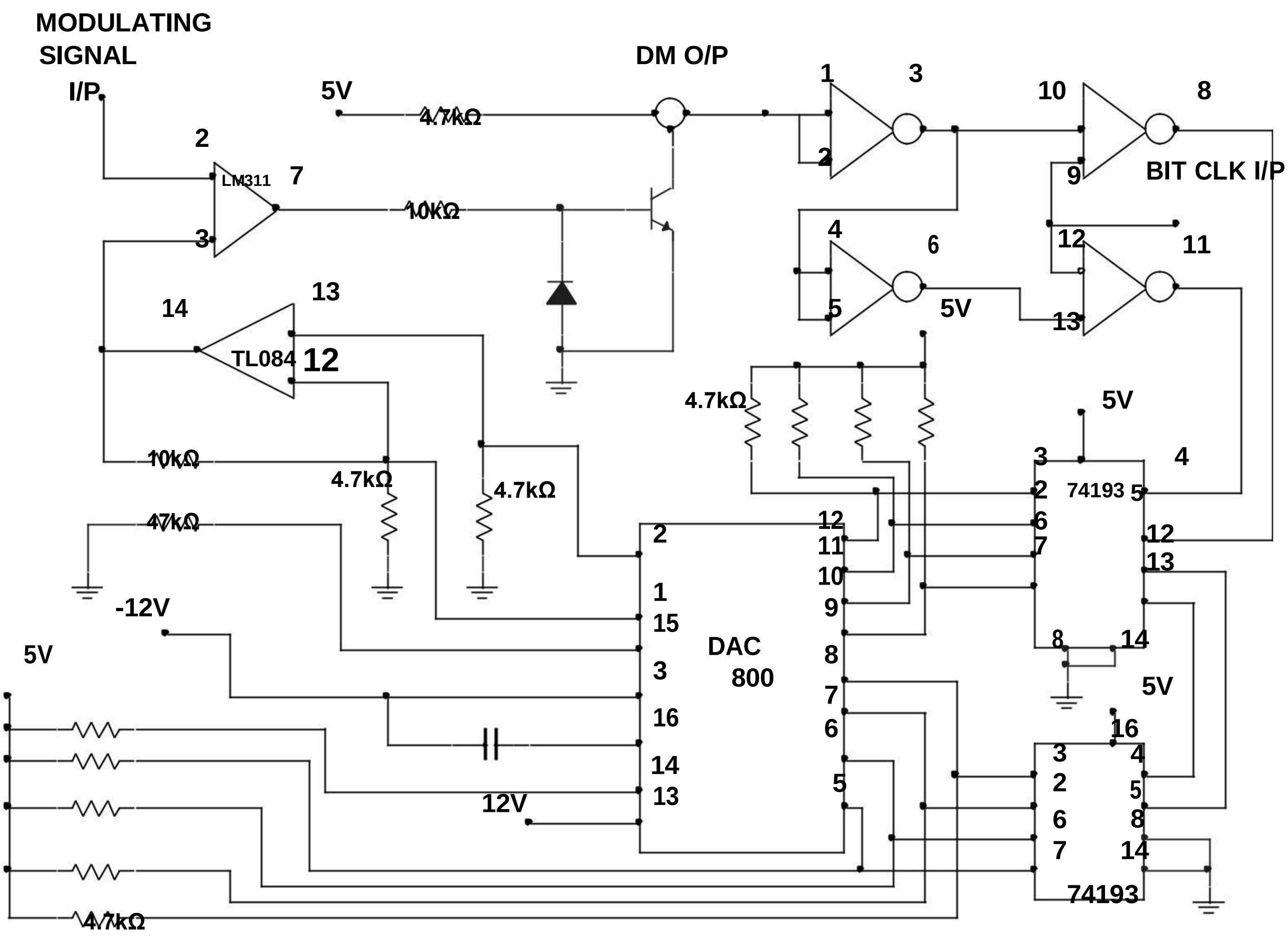
BIT CLOCK GENERATOR



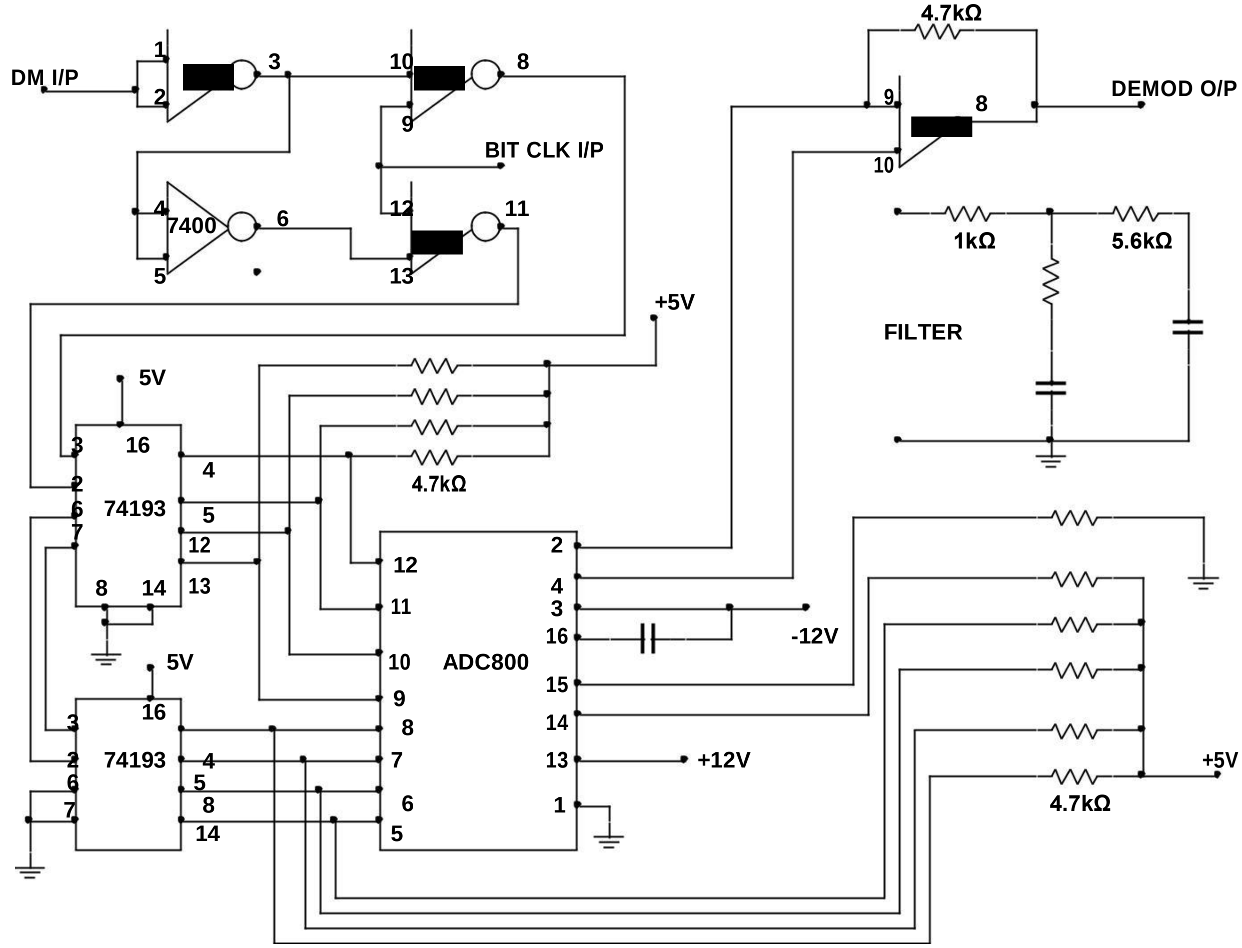
MODULATING SIGNAL GENERATOR



Delta Modulator:



Delta Demodulator:



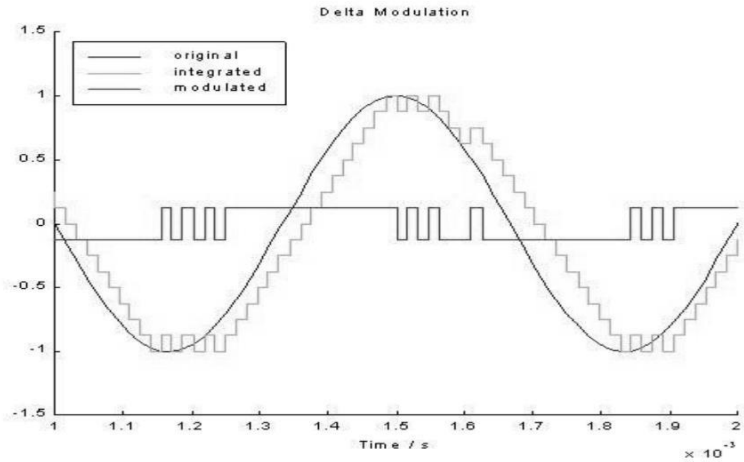
9.5THEORY:

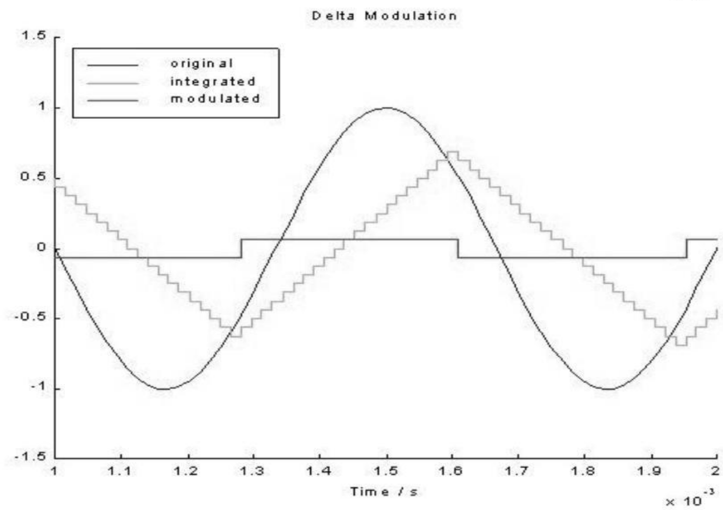
Delta Modulation (DM) is an analog-to-digital and digital-to-analog signal conversion technique used for transmission of voice information where quality is not of primary importance. DM is the simplest form of a DPCM wave. DM is one-bit quantization of a DPCM wave.
Its main features are:

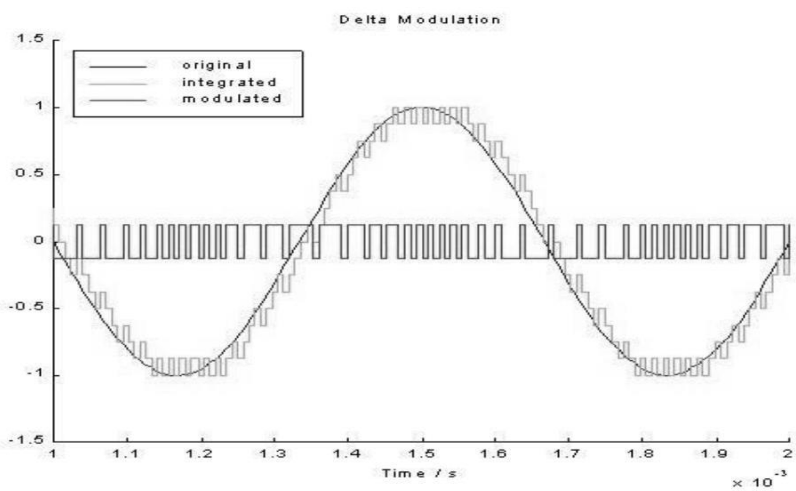
- The analog signal is approximated with a series of segments.
- Each segment of the approximated signal is compared to the original analog wave to determine the increase or decrease in relative amplitude.
- The decision process for establishing the state of successive bits is determined by this comparison.
- Only the change of information is sent, that is, only an increase or decrease of the signal amplitude from the previous sample is sent whereas a no-change condition causes the modulated signal to remain at the same 0 or 1 state of the previous sample.

Depending on the modulating signal, we get the quantized signal and the delta modulated waves.

The following are the various cases of DM wave:


Delta Modulation
original
integrated
modulated
Time / s
x 10^-3


Delta Modulation
original
integrated
modulated
Time / s
x 10^-3


Delta Modulation
original
integrated
modulated
Time / s
x 10^-3

9.6 PROCEDURE:

1. Switch ON the Delta Modulation Trainer kit.
2. Observe the clock output of bit clock generator and note down its amplitude and time period.
3. Observe and note the amplitude and time period readings of the modulating signal from the CRO.
4. Connect the clock signal of the bit clock generator to the bit clock input of delta modulator circuit.
5. Connect the modulating signal of the modulating signal generator to the modulating signal input of the Delta Modulator.
6. Observe the quantized output at the output of IC TL084 on the CRO.
7. Observe the Delta Modulator output on the CRO.
8. Connect the output of the Modulator section to the Demodulator input of the demodulating section.
9. Connect the clock signal to the bit clock input of the demodulator circuit.**(don't** remove the clock signal from the modulator section)
10. Observe the demodulated output on the CRO.
11. Connect the demodulated output to the filter input of the demodulator circuit.
12. Observe the demodulated output with the filter on the CRO.

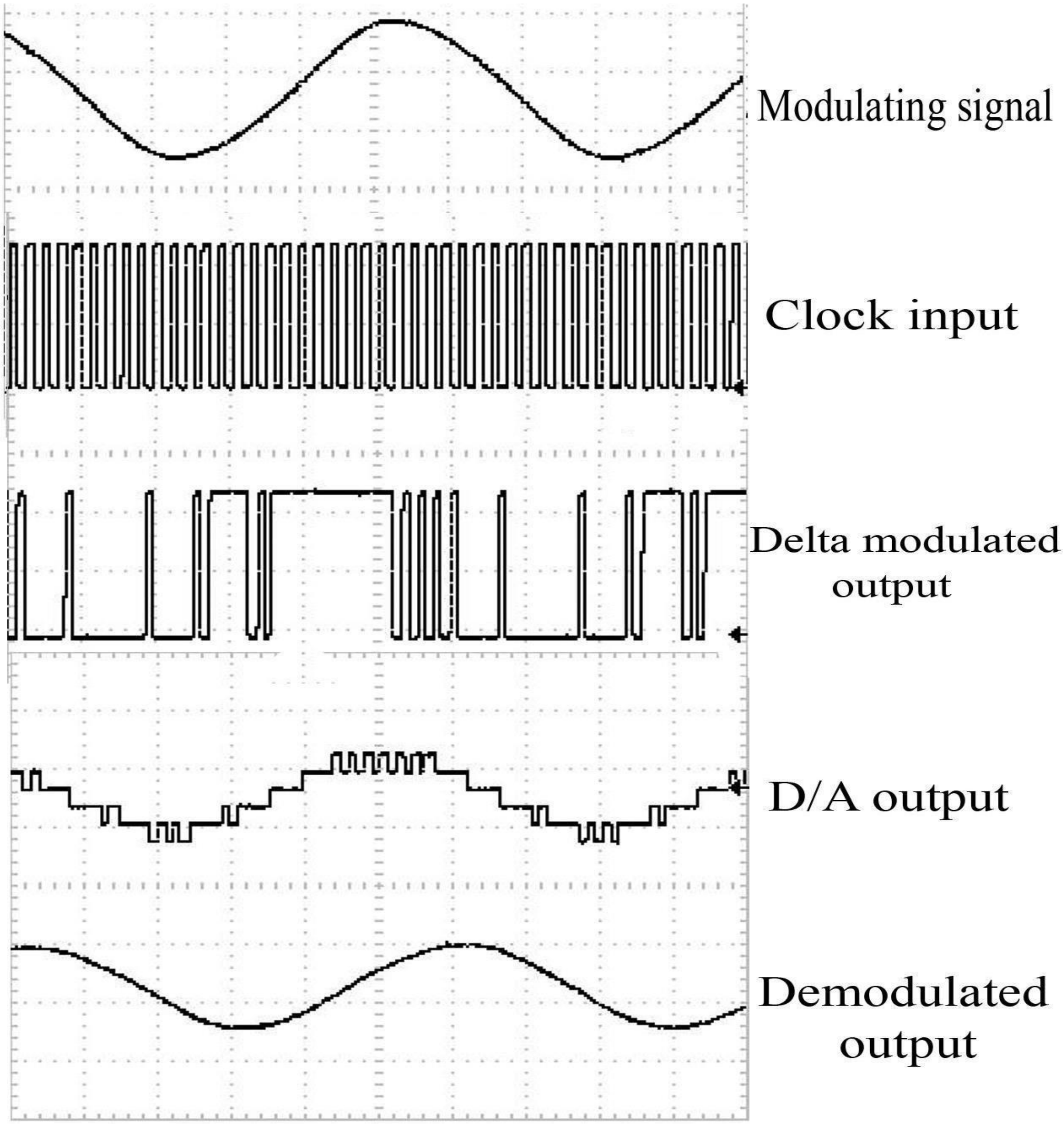
PRECAUTIONS:

- Slope of the modulating signal should not vary rapidly.
- Rapid variation of the signal causes slope overload.

OBSERVATION TABLE:

Signal	Amplitude (V)	Time Period (ms)
Clock Signal		
Modulating Signal		
Quantized signal		
DM wave		
De-quantized output		
Filter (Demodulated) output		

9.7 EXPECTED WAVEFORMS:



9.8RESULT:

9.9 INFERENCE

1. What is meant by delta modulation?
2. What is meant by quantization?
3. What is slope overload?
4. What are quantization errors?
5. What is meant by granular noise?
6. What are the advantages of DM?
7. What is meant by DM transmitter?
8. What is meant by DM receiver?
9. In DM how many bits can transmit per sample?
10. What is advantage of DM over PCM?

Experiment: 10

AMPLITUDE SHIFT KEYING (ASK) GENERATION AND DETECTION

10.1 AIM:

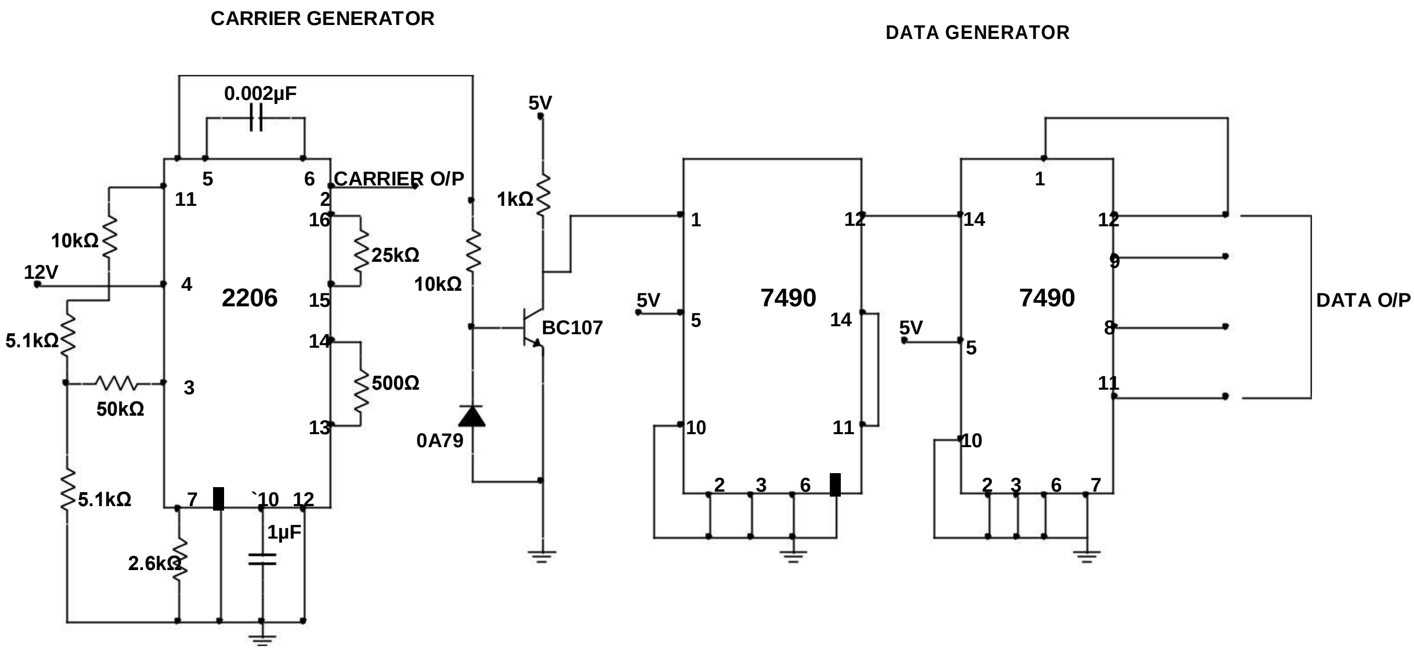
To study the Modulation and demodulation techniques of Amplitude Shift Keying (ASK).

10.2 COMPONENTS REQUIRED:

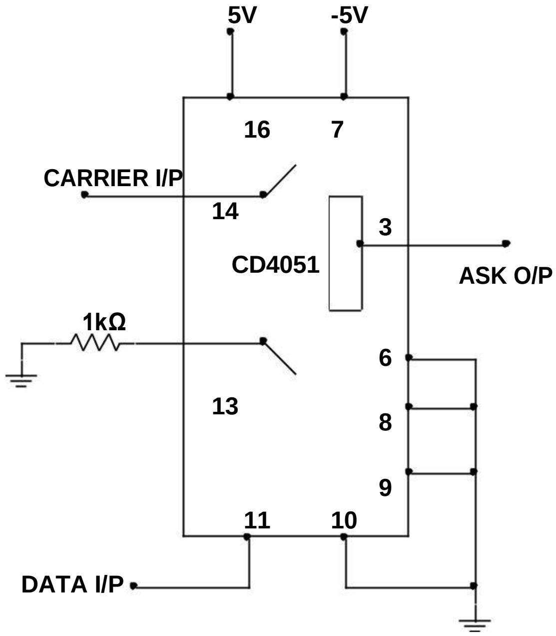
1. ASK Modulation and Demodulation Trainer Kit
2. Cathode Ray Oscilloscope (CRO)
3. CRO Probes
4. Connecting wires

10.3 CIRCUIT DIAGRAM:

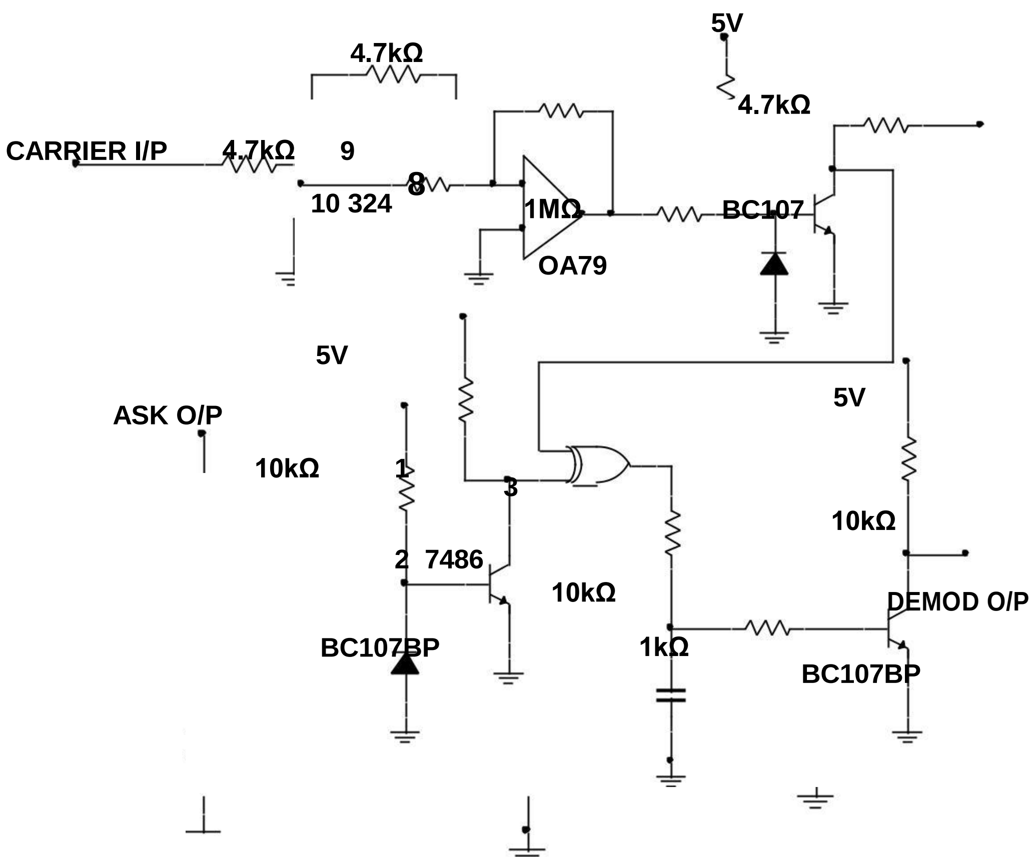
ASK Carrier and Data Generators:



ASK Modulator:



ASK Demodulator:



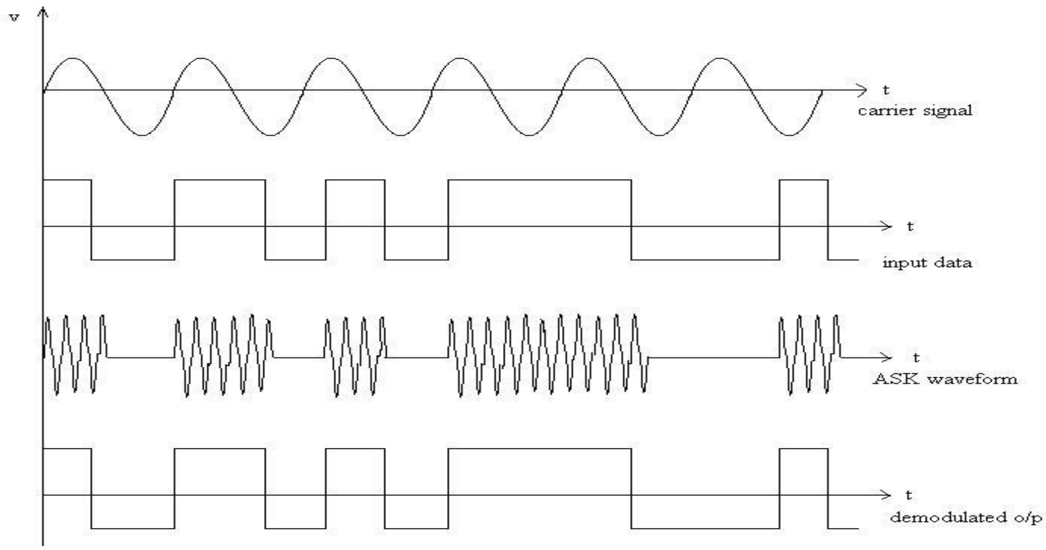
10.4 PROCEDURE:

1. Switch ON the kit.
2. Observe the carrier output of carrier generator and note down its amplitude and time period.
3. Connect the output of the carrier output provided on the kit to the input of carrier input terminal.
4. Observe all the data outputs and tabulate their readings of amplitude and time period.
5. Connect one of the data outputs to the Data input terminal on the modulator section.
6. Observe the ASK output by connecting it to the CRO. Thus, ASK modulation can be achieved.
7. For ASK Demodulation, connect ASK output terminal to the ASK input terminal of the Demodulator.
8. Observe the demodulated wave at demodulated output terminal by connecting it to the CRO.
9. Observe the demodulated signal and compare that with data signal.

OBSERVATION TABLE:

Signal	Amplitude (V)	Time period (ms)
Carrier input		
Data Output1		
Data Output2		
Data Output3		
Data Output4		
ASK output for channel 1		
Demodulated output1		
ASK output for channel 2		
Demodulated output2		
ASK output for channel 3		
Demodulated output3		
ASK output for channel4		
Demodulated output4		

10.5 EXPECTED WAVEFORMS:



10.6 RESULT:

PRE-LAB QUESTIONS:

1. What do you mean by keying?
2. What are the types of keying?
3. What is the other name for ASK?
4. Draw the waveforms of ASK.
5. What are the applications of ASK?
6. Write the signal space diagram of ASK and also find the distance between the two points?
7. Write the advantages and disadvantages of ASK?
8. Draw the block diagram of coherent and non coherent ASK demodulator?
9. Draw the block diagram of ASK generator?
10. What is the bandwidth required for ASK technique

Experiment: 11

FREQUENCY SHIFT KEYING (FSK) GENERATION & DETECTION

11.1 AIM:

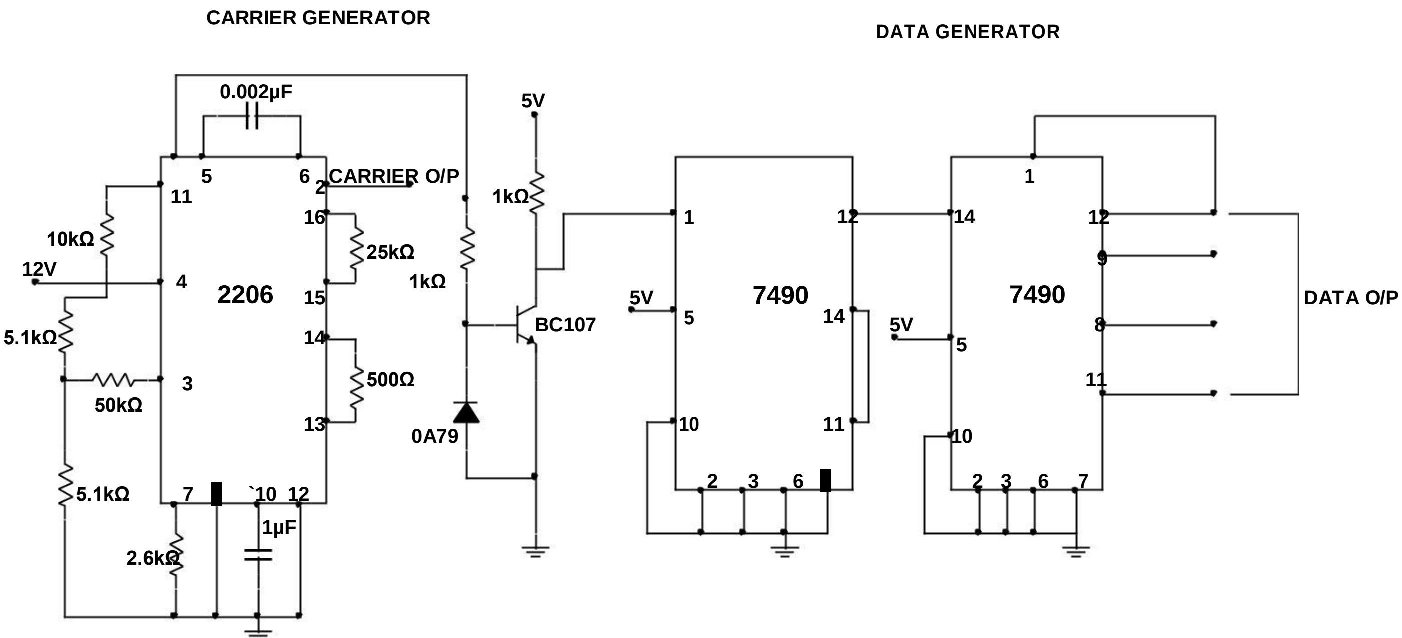
To study the Modulation and demodulation of Frequency Shift Keying (FSK).

11.2 COMPONENTS REQUIRED:

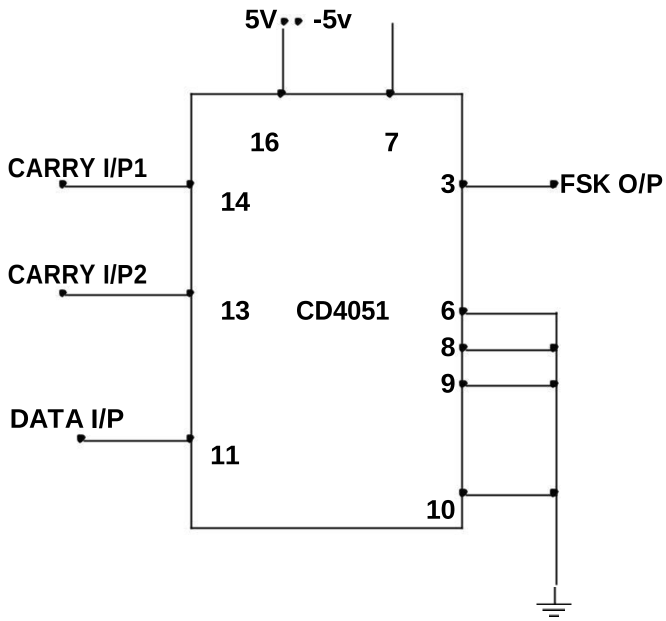
1. FSK Modulation and Demodulation Trainer Kit
2. Cathode Ray Oscilloscope (CRO)
3. CRO Probes
4. Function Generator
5. Connecting wires

11.3 CIRCUIT DIAGRAM:

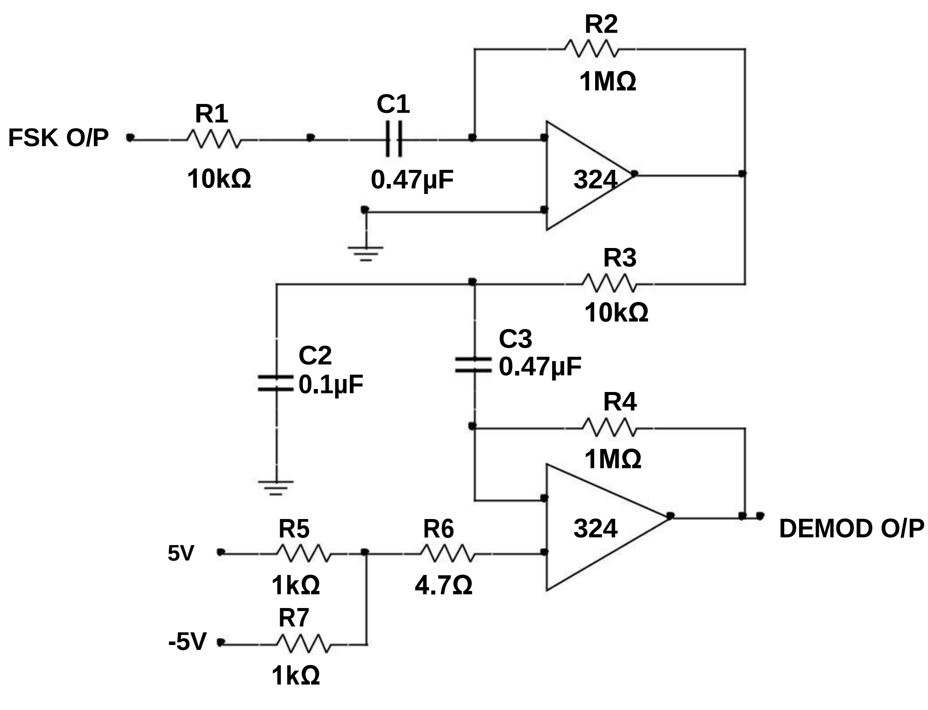
FSK Carrier and Data Generators:



FSK Modulator:



FSK Demodulator:



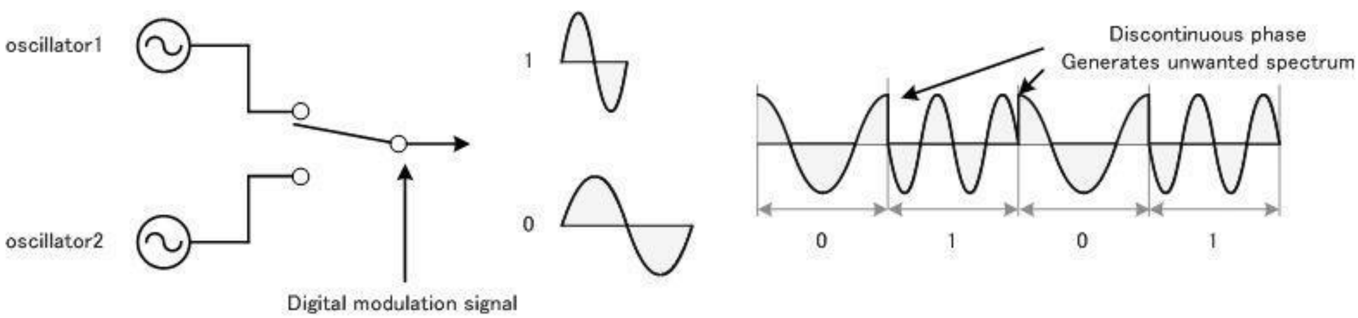
11.4 THEORY:

Frequency-shift keying (FSK) allows digital information to be transmitted by changes or shifts in the frequency of a carrier signal, most commonly an analog carrier sine wave. There are two binary states in a signal, zero (0) and one (1), each of which is represented by an analog wave form. This binary data is converted by a modem into an FSK signal, which can be transmitted via telephone lines, fiber optics or wireless media.

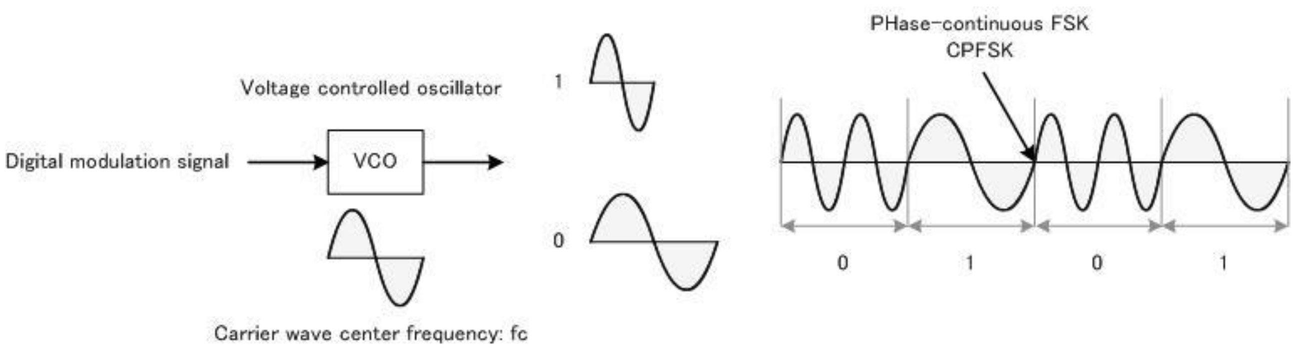
FSK is commonly used for caller ID and remote metering applications.

FSK modulation assigns different frequencies to each information signal status. On the receiving side it is passed through a circuit that determines differences in the frequency of the received signal and obtains the original information signal.

FSK uses a modulator to shift the frequency of the carrier wave proportionally to the level of the digital signal, which is the information signal. However, a digital signal has only two statuses, 0 and 1, and so a high frequency f_1 is assigned to signal 1 and a low frequency f_0 is assigned to signal 0 in relation to the center frequency fc of the carrier wave.



In many cases, FSK modulation uses a VCO (Voltage Controlled Oscillator). The VCO changes the frequency proportionally to the voltage of the modulating signal so that the phase between bits is continuous. CPFSK (Continuous Phase FSK) is characterized by its low levels of unwanted emissions (spurious emissions) which cause various adverse effects.



11.5 PROCEDURE:

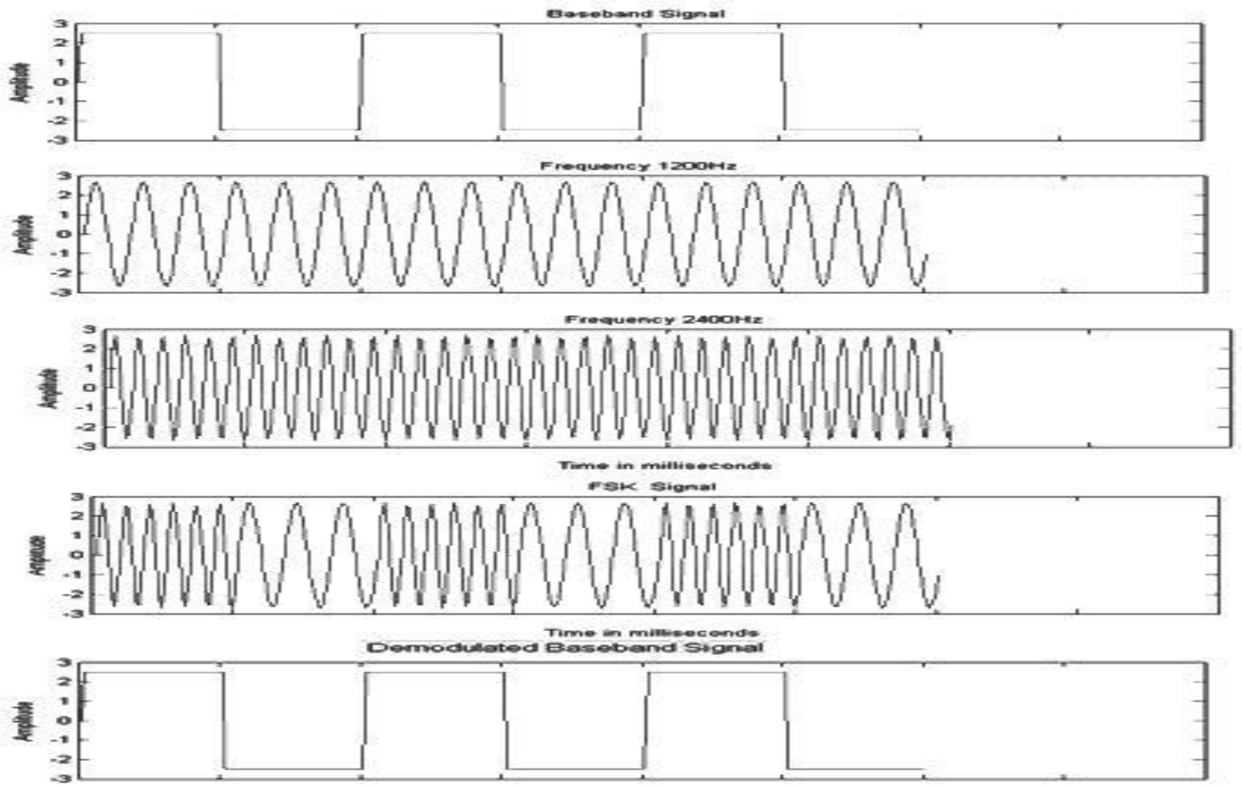
1. Switch ON the kit.
2. Observe the carrier output of carrier generator and note down its amplitude and time period.
3. Connect the output of the carrier output provided on the kit to the input of carrier input 1 terminal.

4. Provide a sine wave of different frequency and with the same amplitude from the function generator connect the function generator to the carrier input 2 terminal.
5. Observe all the data outputs and tabulate their readings of amplitude and time period.
6. Connect one of the data outputs to the Data input terminal on the modulator section.
7. Observe the FSK output by connecting it to the CRO. Thus, FSK modulation can be achieved.
8. For FSK Demodulation, connect FSK output terminal to the FSK input terminal of the Demodulator.
9. Observe the demodulated wave at demodulated output terminal by connecting it to the CRO.

OSERVATION TABLE:

Signal	Amplitude (V)	Time period (ms)
Carrier input1		
Carrier input2		
Data Output1		
Data Output2		
Data Output3		
Data Output4		
FSK output for channel 1		
Demodulated output1		
FSK output for channel 2		
Demodulated output2		
FSK output for channel 3		
Demodulated output3		
FSK output for channel4		
Demodulated output4		

11.6 EXPECTED WAVEFORMS:



11.7 RESULT:

11.8 INFERENCE

1. What do you mean by keying?
2. What are the types of keying?
3. Draw the waveforms of FSK.
4. What are the applications of FSK?
5. Explain the operation of FSK.
6. What is the bandwidth required for FSK?
7. How many carrier frequencies required in MFSK generation?
8. What is the necessity of level shifter in FSK generation?
9. Write the signal space representation of orthogonal FSK?
10. What is the disadvantage of BFSK?

Experiment: 12

BINARY PHASE SHIFT KEYING (BPSK) GENERATION & DETECTION

12.1 AIM:

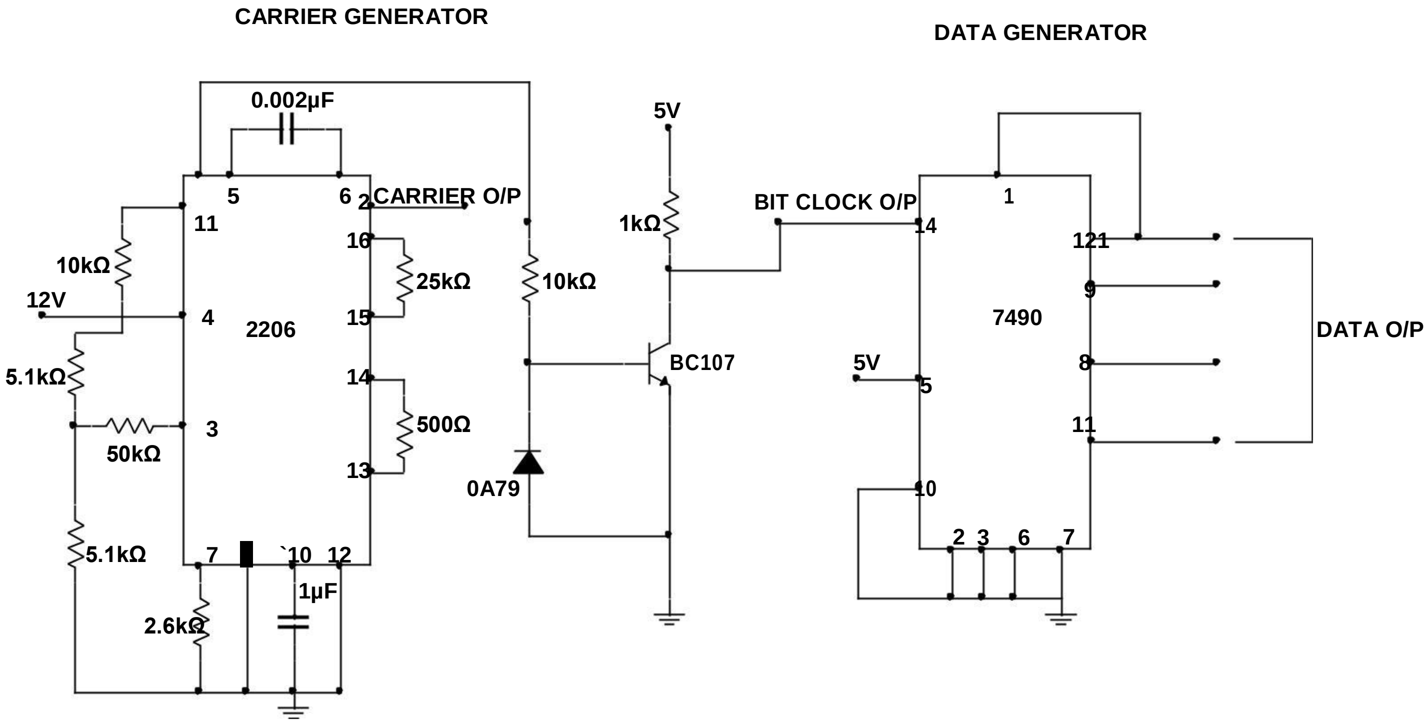
To study the various steps involved in generating the phase shift keyed signal at the modulator end and recovering the binary signal from the received PSK signals.

12.2 COMPONENTS REQUIRED:

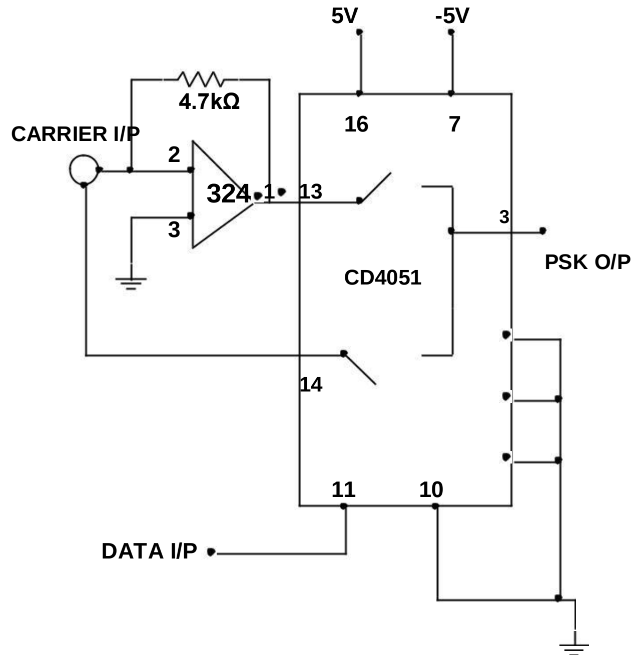
1. PSK Modulator and Demodulator Trainer Kit
2. Cathode Ray Oscilloscope (CRO)
3. CRO Probes
4. Connecting wires

12.3 CIRCUIT DIAGRAM:

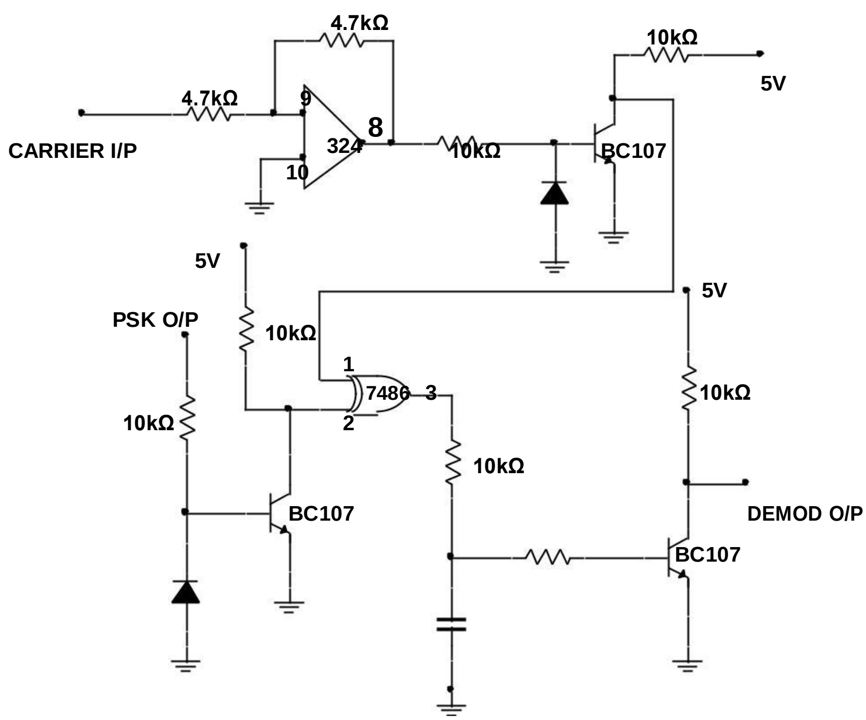
PSK Carrier Generator and Data Generator:



PSK Modulator:



PSK Demodulator:



12.4 THEORY:

Phase Shifting Keying (PSK) is a modulating / Data transmitting technique in which phase of the carrier signal is shifted between two distinct levels. In a simple PSK (i.e. Binary PSK) unshifted carrier Vcos W_0 t is transmitted to indicate a 1 condition , and the carrier shifted by 180 ^{0} i.e. -V cos W_0 t is transmitted to indicate a 0 condition.

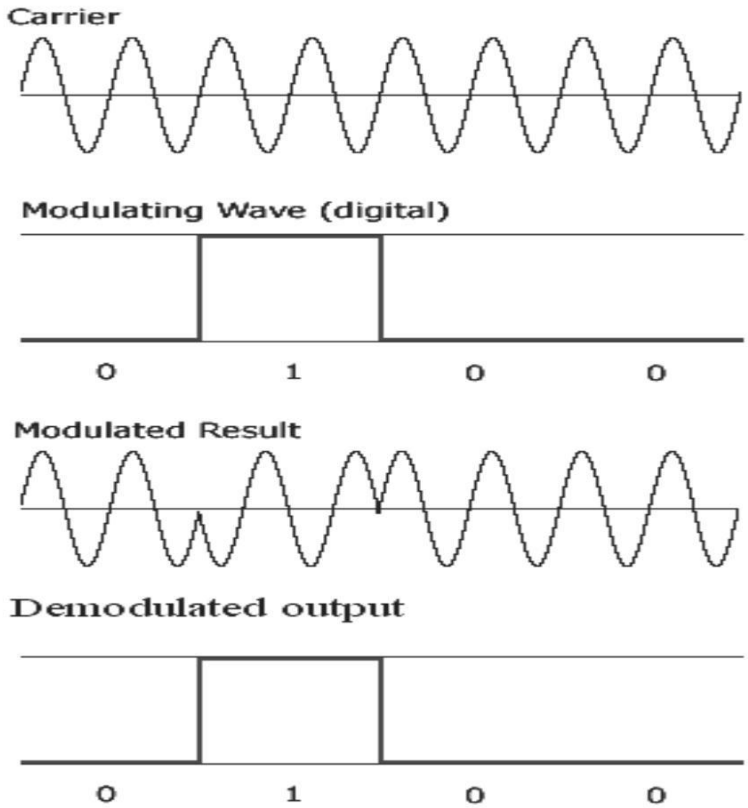
12.5 PROCEDURE:

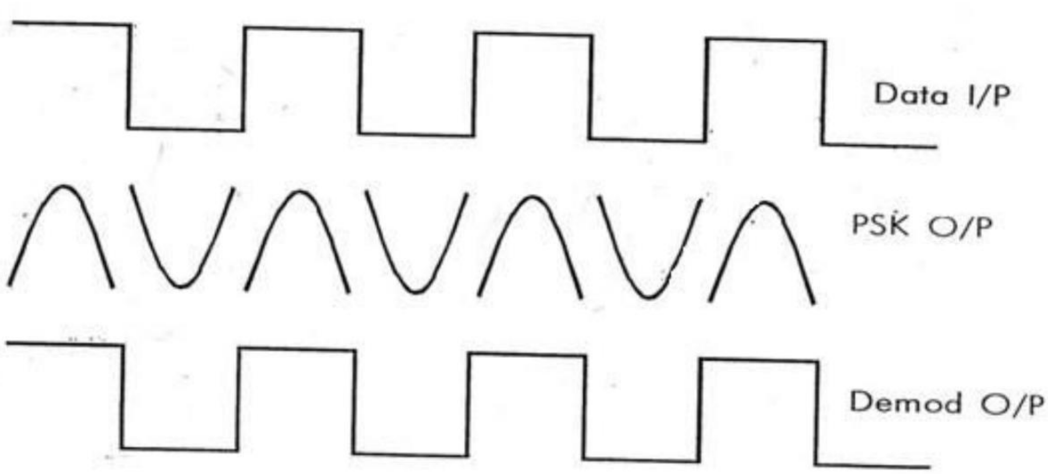
1. Switch ON the kit.
2. Observe the carrier output of carrier generator and note down its amplitude and time period.
3. Connect the output of the carrier output provided on the kit to the input of carrier input terminal.
4. Observe all the data outputs and tabulate their readings of amplitude and time period.
5. Connect one of the data outputs to the Data input terminal on the modulator section.
6. Observe the PSK output by connecting it to the CRO. Thus, PSK modulation can be achieved.
7. For PSK Demodulation, connect PSK output terminal of the modulator to the PSK input terminal of the Demodulator.
8. Connect the carrier generator output to the carrier input terminal of the Demodulator section as well.
9. Connect channel 1 of the CRO at the output of demodulator.
10. Observe the PSK demodulated signal on the CRO.

OBSERVATION TABLE:

Signal	Amplitude (V)	Time period (ms)
Carrier input		
Data Output1		
Data Output2		
Data Output3		
Data Output4		
PSK output for channel 1		
Demodulated output1		
PSK output for channel 2		
Demodulated output2		
PSK output for channel 3		
Demodulated output3		
PSK output for channel4		
Demodulated output4		

12.6 EXPECTED WAVEFORMS:





12.7 RESULT:

12.8 INFERENCE

1. What is meant by BPSK?
2. Draw the waveforms of BPSK.
3. Compare ASK, FSK and PSK.
4. What are the applications of BPSK?
5. Draw the constellation diagram of BPSK.
6. What is the bandwidth required to transmit BPSK signal?
7. Draw the coherent and non coherent detectors of BPSK?
8. What is the difference between coherent and non coherent detectors?
9. Explain squaring circuit (square law device)?
10. What is the function of integrator circuit in BPSK demodulator?

ADDITIONAL EXPERIMENTS

EXPERIMENT NO. 1
DOUBLE SIDEBAND SUPRESSED CARRIER MODULATION AND DEMODULATION

1.1 AIM: To generate dsb-sc signal and demodulate the obtained signal by using MATLAB software.

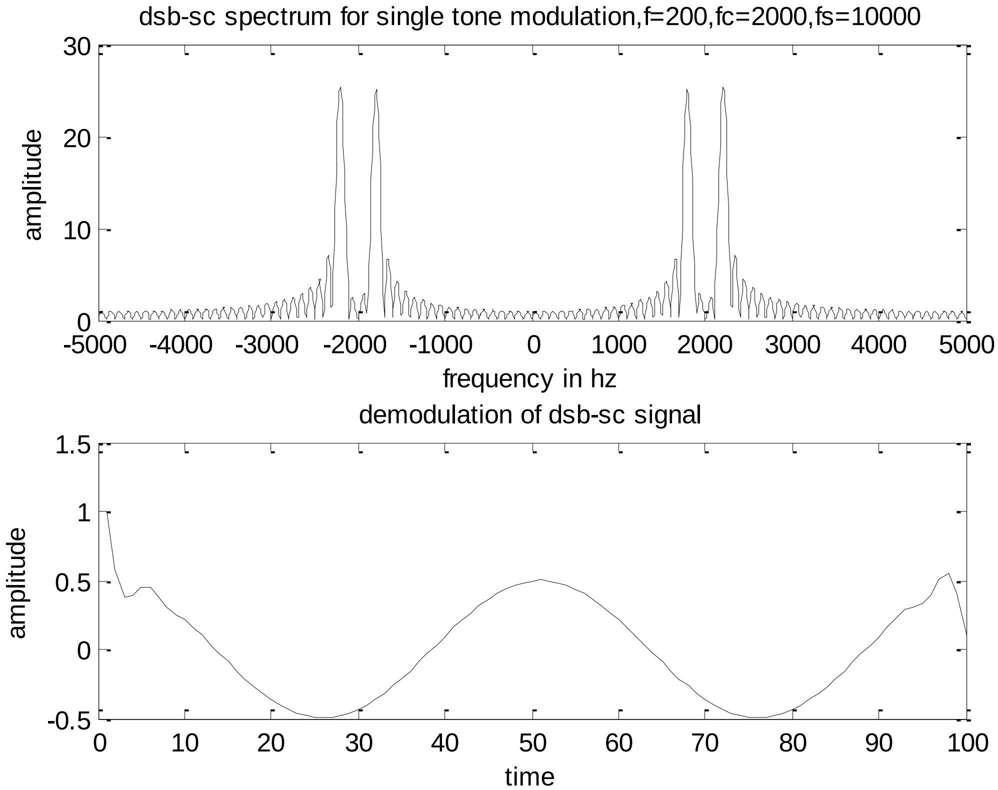
1.2 EQUIPMENT: MATLAB software 7.0 and above.

1.3 PROGRAM:

```
fc=2000;
fs=10000;
f=200;
t=0:1/fs:((2/f)-(1/fs));
x=cos(2*pi*f*t);
y_dsb_sc=modulate(x,fc,fs,'amdsb-sc');
f_dsb_sc=abs(fft(y_dsb_sc,1024));
f_dsb_sc=[f_dsb_sc(514:1024),f_dsb_sc(1:513)];
f=(-511*fs/1024):(fs/1024):(512*fs/1024);
figure(1);
subplot(2,1,1);
plot(f,f_dsb_sc);
title('dsb-sc spectrum for single tone modulation,f=200,fc=2000,fs=10000');
xlabel('frequency in hz');
ylabel('amplitude');
s=demod(y_dsb_sc,fc,fs);
subplot(2,1,2);
plot(s);
xlabel('time');
ylabel('amplitude');
title('demodulation of dsb-sc signal');
```

1.4 OUTPUT:

Figure 2. 1



1.5 RESULT: Double sideband suppressed carrier signal is generated and demodulated.

EXPERIMENT NO. 2
SINGLE SIDEBAND SUPPRESSED CARRIER MODULATION AND DEMODULATION

2.1AIM: To generate single side band suppressed carrier signal and demodulate the obtained signal using MATLAB software.

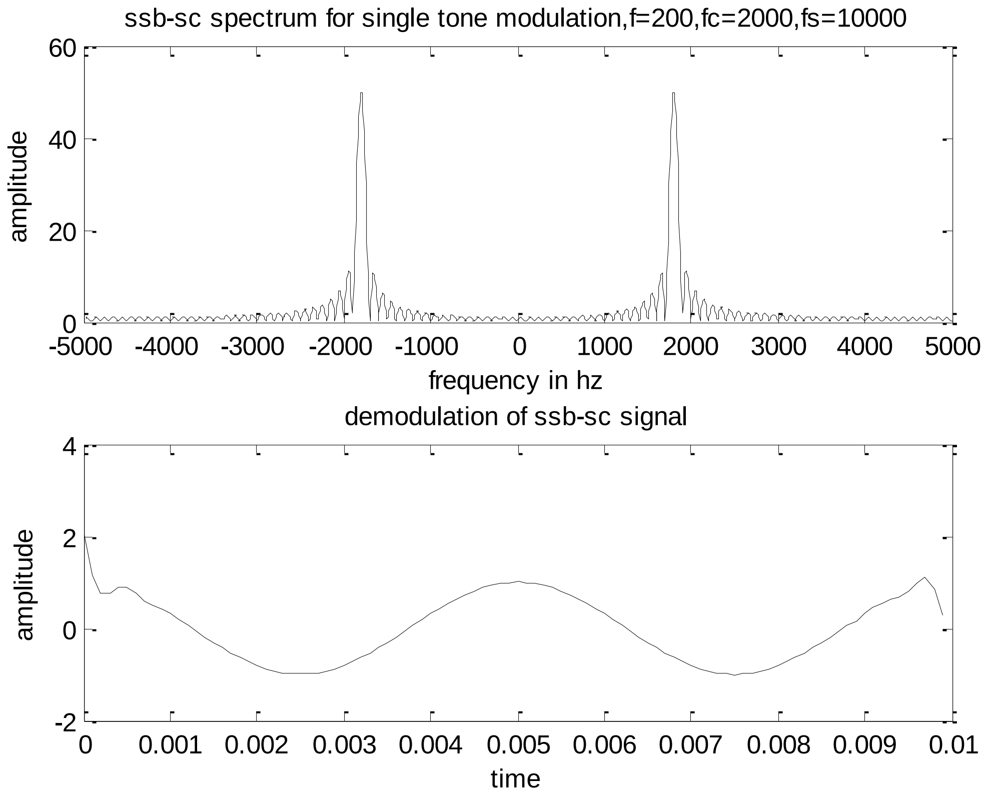
2.2EQUIPMENT: MATLAB software7.0 and above.

2.3 PROGRAM:

```
fc=2000;
fs=10000;
f=200;
t=0:1/fs:((2/f)-(1/fs));
x=cos(2*pi*f*t);
y_ssb_sc=modulate(x,fc,fs,'amssb');
f_ssb_sc=abs(fft(y_ssb_sc,1024));
f_ssb_sc=[f_ssb_sc(514:1024),f_ssb_sc(1:513)];
f=(-511*fs/1024):(fs/1024):(512*fs/1024);
figure(1);
subplot(2,1,1);
plot(f,f_ssb_sc);
title('ssb-sc spectrum for single tone modulation,f=200,fc=2000,fs=10000');
xlabel('frequency in hz');
ylabel('amplitude');
s=ssbdemod(y_ssb_sc,fc,fs);
subplot(2,1,2);
plot(t,s);
xlabel('time');
ylabel('amplitude');
title('demodulation of ssb-sc signal');
```

2.4OUTPUT:

Figure3. 1



2.5 RESULT: Single sideband suppressed carrier is signal is generated and demodulated.