JHARSUGUDA ENGINEERING SCHOOL

JHARSUGUDA

ANALOG & DIGITAL COMMUNICATION LAB MANUAL

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Year & Semester: 3RD Year, 5TH Semester
Subject code/Name: Pr-1 Analog & Digital Communication Lab

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

VISION OF THE DEPARTMENT:-

To contribute in the nation development in the field of Electronics and Telecommunication by imparting quality education, promoting academic achievement to produce internationally accepted high quality human and technological resource for the country.

MISSION OF THE DEPARTMENT

1 To prepare students for a brilliant career/entrepreneurship along with the development of the knowledge, skills, attitude and teamwork through the designed programme.

2. To impart quality teaching-learning experience with state of the art curriculum.

3. To undertake collaborative projects which offer opportunities for long term interaction with academia and industry. Sustained interaction with the alumni, students, parents, faculty and other stake holders.

4. To develop human potential to its fullest extent so that intellectually capable and imaginative gifted leaders can emerge in a range of professions.

PROGRAM EDUCATIONAL OBJECTIVE:-

1. To impart analytic and thinking skills to develop initiatives and innovative ideas for R&D, Industry and societal requirements.

2. To understand the facets of advanced technologies, processes and materials necessary in the engineering field.

3. To provide sound theoretical and practical knowledge of E&C Engineering, managerial and entrepreneurial skills to enable students to contribute to sustenance of society with a global outlook.

4. To inculcate qualities of teamwork, good social, interpersonal and leadership skills and an ability to adapt to evolving professional environments in the domains of engineering and technology.

5. To appreciate the significance of collaborations in designing, planning, and implementing solutions for practical problems and facilitate the networking with national research and academic organization

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EXPERIMENT -1

Aim of the Experiment:

Simulation of AM Modulation and Demodulation Using PSPICE

Equipment:

1. Personal Computer with PSPICE software
2. Analog Signal Source (sine wave generator)
3. Voltage-controlled oscillator (VCO)
4. Envelope detector circuit
5. Low-pass filter
6. Oscilloscope (virtual within PSPICE)
7. Resistors, capacitors, and diodes as per the schematic

Theory:

AM modulation involves superimposing a message signal (low-frequency signal) onto a carrier signal (high-frequency signal). In this experiment, we will modulate a sinusoidal message signal onto a carrier signal and then demodulate it back to the original message signal. The key components are:

1. **Modulator:** A circuit that combines the message signal and the carrier signal to generate an AM signal.
2. **Demodulator:** A circuit that extracts the original message signal from the AM signal.

Circuit Diagram:

Amplitude Modulation
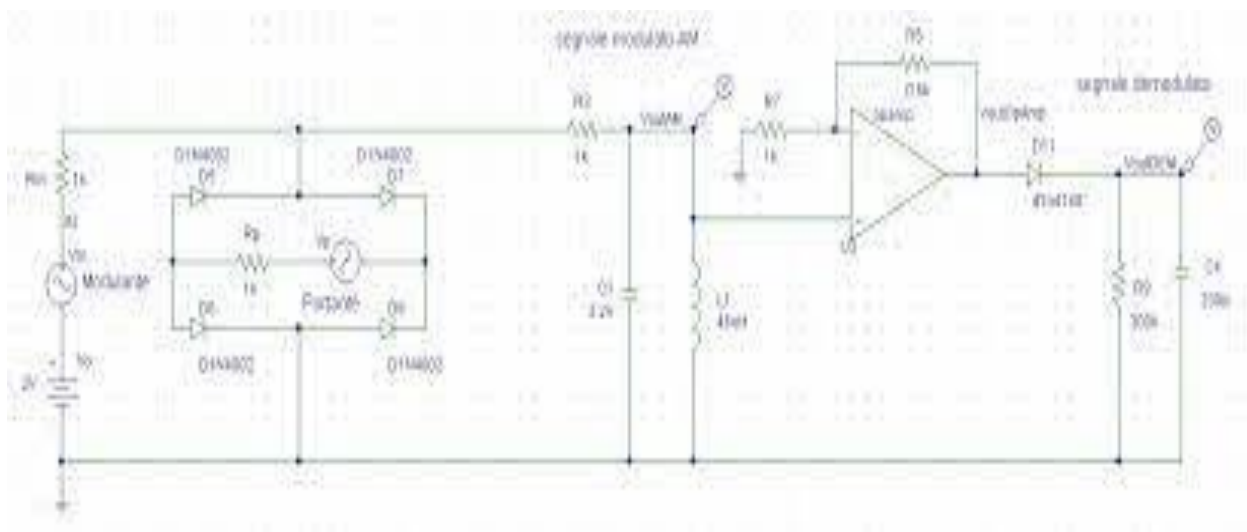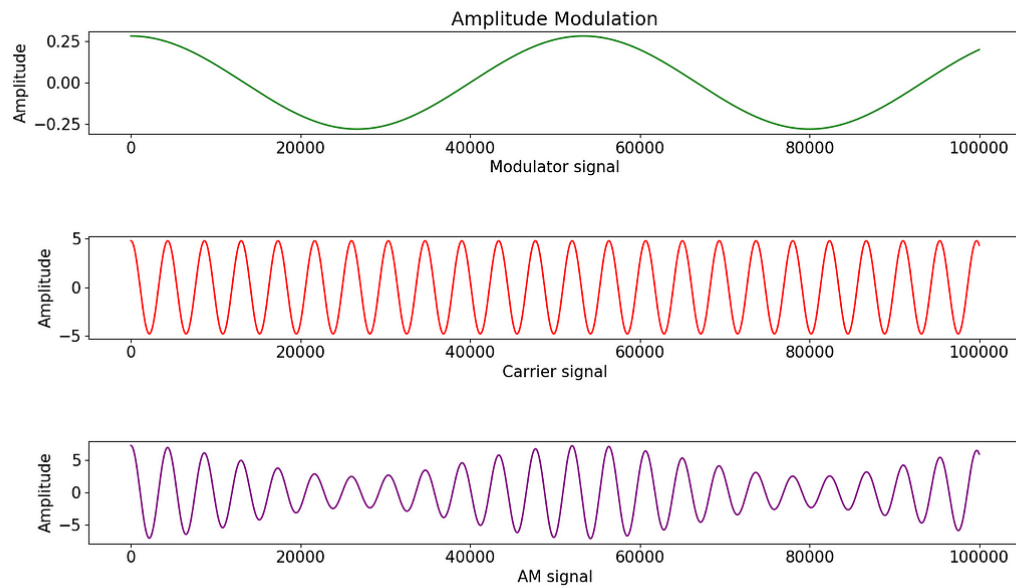
Procedure:

1. Open PSPICE on your computer.
2. Create a new project and schematic.
3. Build the AM modulation circuit:
   a. Generate the message signal using the sine wave generator.
   b. Generate the carrier signal using the VCO.
   c. Combine the message and carrier signals using a mixer circuit.
4. Build the demodulation circuit:
   a. Pass the AM signal through an envelope detector.
   b. Filter the demodulated signal using a low-pass filter.
5. Connect the output of the demodulation circuit to a virtual oscilloscope within PSPICE to observe the recovered message signal.
6. Set appropriate frequencies and amplitudes for both the message and carrier signals.
7. Simulate the circuits.
8. Record the input and output signals' characteristics in a tabular format.

Tabulation:

Parameter	Value/Description
Carrier Frequency	
Message Frequency	
Modulation Index (m)	
Input AM Signal	
Envelope Detector Output	
Demodulated Message Signal	

Conclusion:

In this experiment, we successfully simulated the AM modulation and demodulation processes using PSPICE.

EXPERIMENT -2

Aim of the Experiment:

Simulation of FM Modulation and Demodulation Using PSPICE

Equipment:

1. Personal Computer with PSPICE software
2. Analog Signal Source (sine wave generator)
3. Voltage-controlled oscillator (VCO)
4. Phase-locked loop (PLL)
5. Low-pass filter
6. Oscilloscope (virtual within PSPICE)
7. Resistors, capacitors, and other components as per the schematic

Theory:

Frequency Modulation (FM) is a method of modulating a carrier signal by varying its frequency in proportion to a message signal. In this experiment, we will modulate a message signal onto a carrier signal using FM and then demodulate it back to the original message signal. Key components involved are:

Modulator: A circuit that varies the frequency of the carrier signal according to the message signal to generate an FM signal.

Demodulator: A circuit that recovers the original message signal from the FM signal.

Circuit Diagram:

[Insert a clear and labeled circuit diagram here]

Procedure:

1. Open PSPICE on your computer.
2. Create a new project and schematic.
3. Build the FM modulation circuit:
   a. Generate the message signal using the sine wave generator.
   b. Generate the carrier signal using the VCO.

       c. Connect the VCO's control voltage input to the message signal to achieve frequency modulation.
4. Build the FM demodulation circuit:
       a. Pass the FM signal through a phase-locked loop (PLL).
       b. Connect the output of the PLL to a low-pass filter to extract the demodulated message signal.
5. Set appropriate parameters such as modulation index, carrier frequency, and message signal frequency.
6. Simulate the circuits.
7. Record the input and output signals' characteristics in a tabular format.

Tabulation:

Parameter	Value/Description
Carrier Frequency	
Message Frequency	
Modulation Index (β)	
Input FM Signal	
Phase-Locked Loop (PLL) Output	
Demodulated Message Signal	

Conclusion:

In this experiment, we successfully simulated the FM modulation and demodulation processes using PSPICE.

Aim of the Experiment:

Simulate ASK Modulation and demodulation using the simulation tool like PSPICE/multisim/orcad/tina

Materials and Equipment:

1. Computer with Multisim software installed.
2. Multisim simulation environment.

Theory:

Amplitude Shift Keying (ASK) is a digital modulation technique in which the amplitude of a carrier signal is varied to represent digital data. In ASK modulation, a binary '1' is represented by one amplitude level, while '0' is represented by another amplitude level.

ASK Modulation and Demodulation Circuit Diagram :
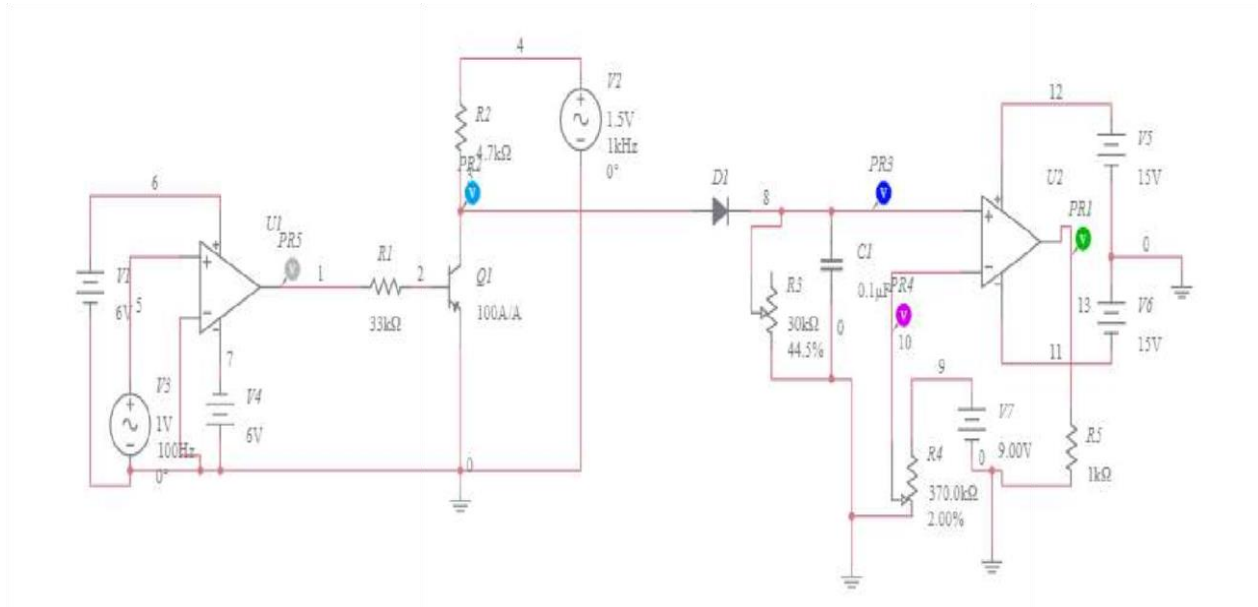
Procedure:

1. Open Multisim:

   Launch Multisim on your computer.

2. Create the ASK Modulation Circuit:

   a. Transmitter (Modulator):

   - Design the ASK modulation circuit in Multisim.

   - Components:

   - Binary Data Source: Generates a digital binary signal (0s and 1s).

   - Carrier Signal Generator: Produces a carrier sinusoidal signal (e.g., 1 kHz).

   - Voltage Controlled Voltage Source (VCVS): Modulates the carrier signal based on the binary data.

      -Connect the binary data source to the modulation input of the VCVS.

      -Connect the carrier signal source to the carrier input of the VCVS.

      - Configure the VCVS to modulate the carrier based on the binary input. b. Receiver (Demodulator):

   - Design the ASK demodulation circuit in Multisim.

   - Components:

   - Envelope Detector: Rectifies the modulated ASK signal.

   - Low-pass Filter: Filters the rectified signal.

   - Comparator: Compares the filtered signal with a threshold to demodulate the binary data.

      -Connect the output of the ASK modulator to the input of the envelope detector.

         -Connect the output of the envelope detector to the input of the low-pass filter.

         -Connect the output of the low-pass filter to the input of the comparator.

-Configure the threshold for the comparator to differentiate between '0' and '1'.

3. Configure Simulation Parameters:

Set the simulation parameters, including the time duration and the frequency of the carrier signal.

4. Simulate ASK Modulation:

Run the simulation to observe the ASK modulation process. The output of the modulator should show how the carrier's amplitude varies according to the binary input signal.

5. Simulate ASK Demodulation:
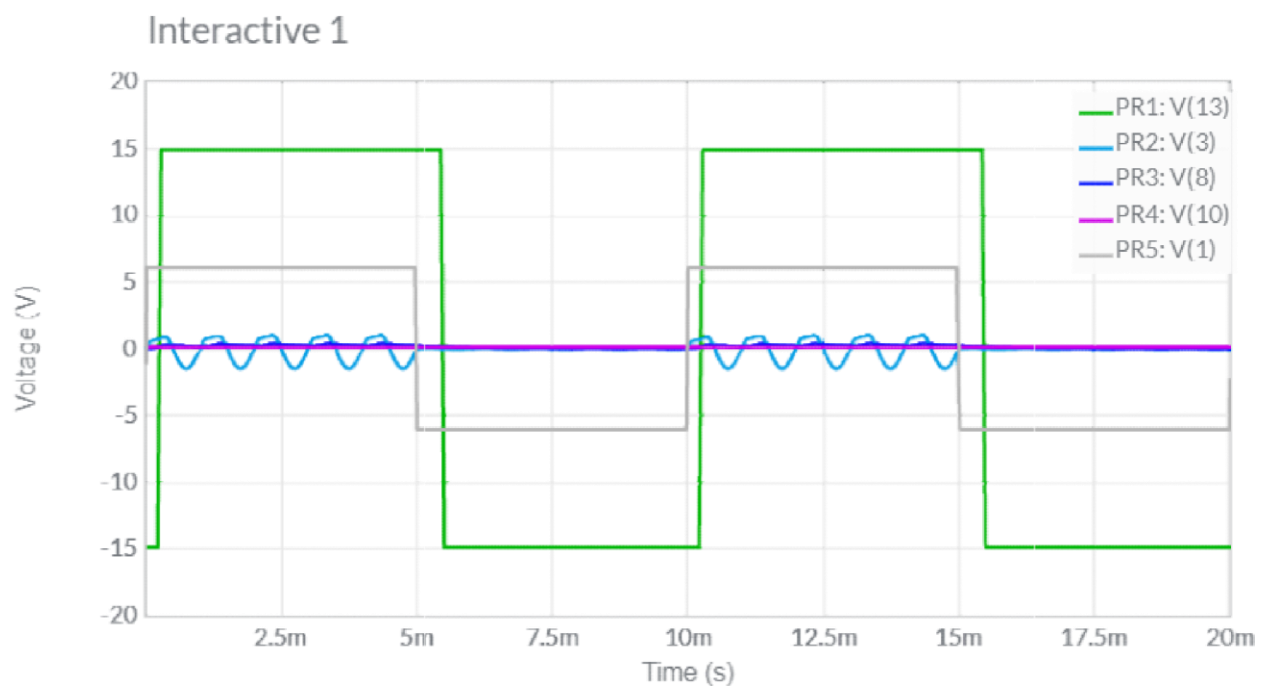
Run the simulation to observe the ASK demodulation process. The output of the comparator should show the demodulated binary signal.

6. *Tabulation:*

Time(t)	Binary input	Modulated ASK Signal	Demodulated binary signal
1			
2			
3			

Conclusion:

Record the simulated data in a tabular format, including time, binary input, modulated ASK signal, and demodulated binary output.

Aim of the Experiment:

 Simulate PSK Modulation and demodulation using the simulation tool Multisim.

EQUIPMENT REQUIRED:

1. Multisim simulation software.

2. A computer with the necessary software installed.

THEORY:

PSK is a modulation technique in which the phase of the carrier signal is varied to represent digital data. In this experiment, we will simulate BPSK (Binary Phase Shift Keying), a common form of PSK, where two phases, typically 0° and 180°, are used to represent binary 0 and 1, respectively.
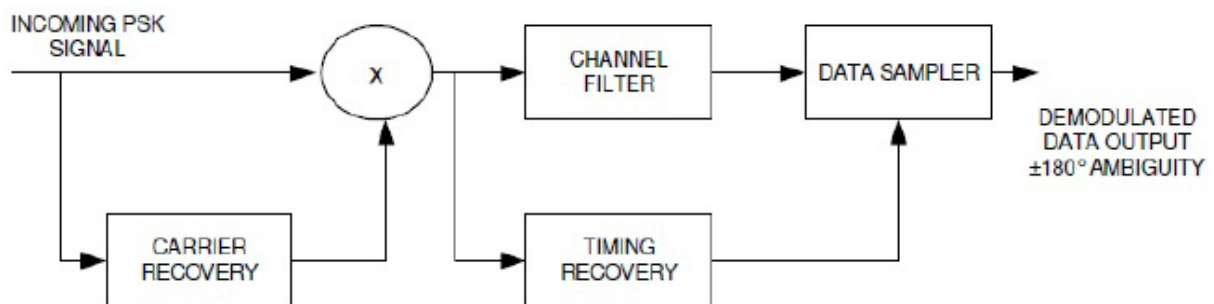
PROCEDURE:

Circuit Setup:

- Use voltage sources to generate the carrier signal (sine wave) and the binary data signal (square wave).
- Connect the binary data signal to a switch to control the data input.
- Use an XOR gate to modulate the carrier signal with the binary data signal.
- Connect the modulated signal to the scope for observation.

Simulation Setup:

Configure the simulation parameters as follows:

- Set the carrier frequency to a value like 1 kHz.
- Set the data rate (symbol rate) to a value like 100 bps.
- Ensure the simulation time is sufficient to observe multiple cycles of the modulated signal.

Modulation:

a. Run the simulation.

b. Observe the modulated signal on the oscilloscope. You should see phase shifts corresponding to the binary data input.
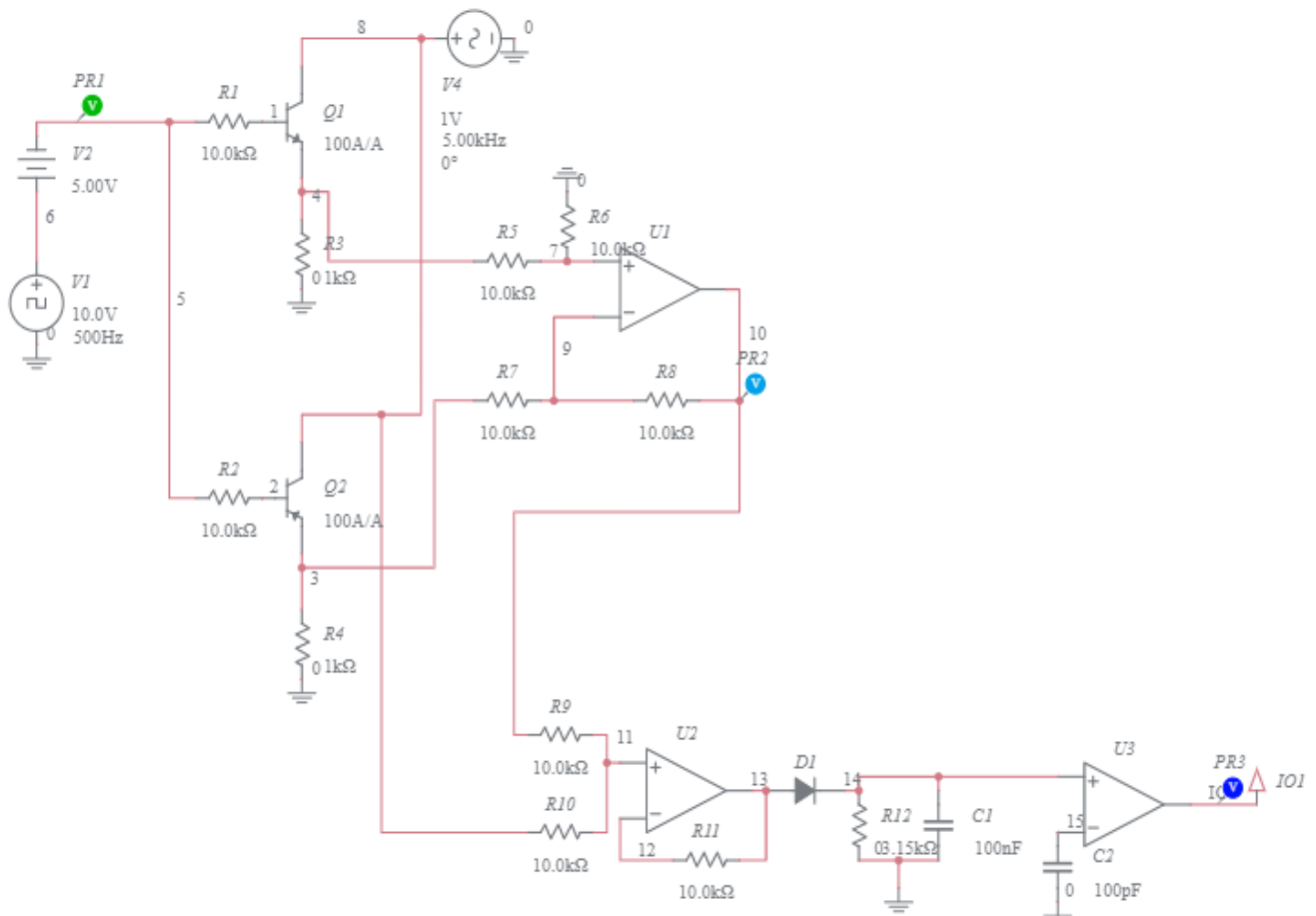
Demodulation:

Now, create the demodulation circuit:

- Use an XOR gate to demodulate the received signal.
- Connect the received signal to one input of the XOR gate.
- Connect the carrier signal (generated separately) to the other input of the XOR gate.
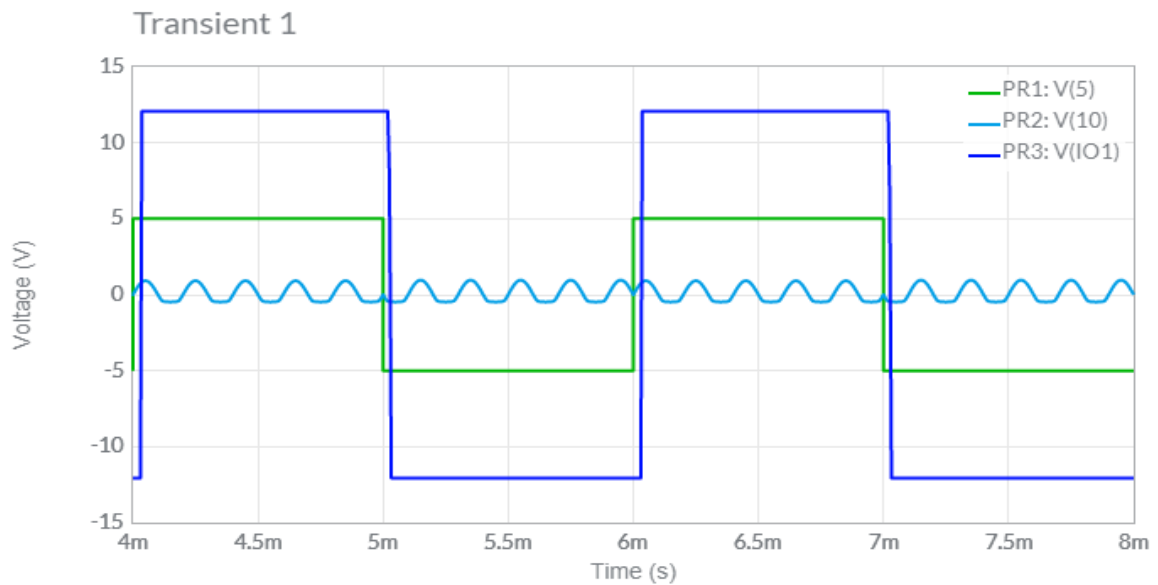- Observe the output of the XOR gate using the scope.

Simulation and Observation:

a. Run the simulation.

b. Observe the demodulated signal on the oscilloscope. You should see the original binary data signal.

CIRCUIT DIAGRAM:

WAVE FORM:

TABULATION:

Time (s)	Modulated Signal	Demodulated Signal
0		
1		
…		

CONCLUSION:

From the above experiment , we have studied to simulate PSK Modulation and demodulation using the simulation tool Multisim.

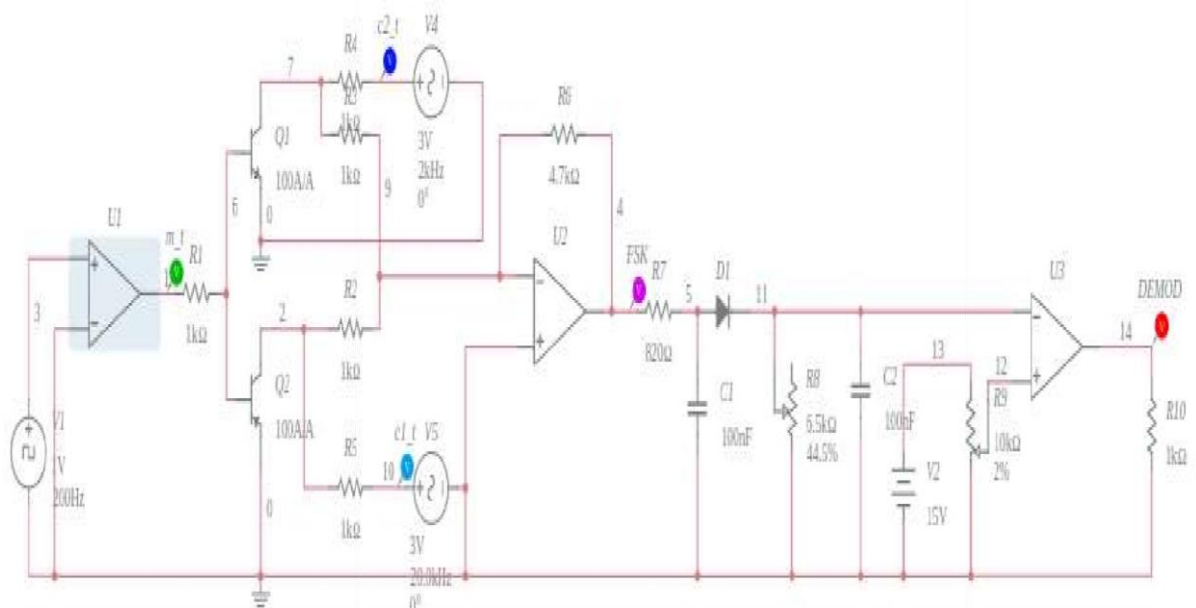Aim: Simulate FSK Modulation and demodulation using the simulation tool like PSPICE/ multisim/orcad/tina.

Equipment Required:

1. Simulation software (PSPICE, Multisim, Orcad, TINA)

2. Computer with the installed simulation tool

3. Passive electronic components (resistors, capacitors, inductors)

4. Signal sources (voltage sources)

5. Voltage-controlled voltage source (VCVS)

6. Operational amplifiers (Op-Amps)

7. Frequency generator

8. Oscilloscope (virtual oscilloscope in the simulation tool)

Theory:

Frequency Shift Keying (FSK) is a modulation technique where the carrier frequency is varied based on the input digital signal. In binary FSK, two frequencies are used to represent binary 0 and 1. The modulation index (frequency separation) is a critical parameter in FSK.

Circuit Diagram:

Procedure:

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1. FSK Modulator Simulation:
a. Set up the circuit based on the FSK modulator circuit diagram.

b. Provide a binary input signal (0 or 1) using a switch or digital signal source.

c. Run the simulation and observe the output waveform on the virtual oscilloscope.

2. FSK Demodulator Simulation:

a. Set up the circuit based on the FSK demodulator circuit diagram.

b. Provide an FSK modulated signal as input.

c. Run the simulation and observe the demodulated signal on the virtual oscilloscope.

3. Parameter Variation:

a. Change the modulation index and observe its effect on the demodulated signal.

b. Analyze the impact of noise on the demodulation process.

Tabulation:

Modulation Index	Input Signal	Modulated Signal	Demodulated Signal
Varied	Binary 0		
Varied	Binary 1		
Fixed	Varied		

Conclusion:

From this above experiment, we have studied to simulate FSK Modulation and demodulation using the simulation tool like PSPICE/ multisim/orcad/tina.

Aim of the Experiment:

 Construct the circuit in AM transmitter & Detector Trainer Board/Kit and observe the waveform at different test point & Determine percentage of Modulation Index of AM.

EQUIPMENT REQUIRED:

1. AM Transmitter & Detector Trainer Board/Kit
2. Oscilloscope
3. Function Generator
4. Multimeter
5. Connecting wires
6. BNC cables
7. AC Power source

THEORY:

Amplitude Modulation (AM) is a method of transmitting information by varying the amplitude of a carrier signal in accordance with the message signal. The modulation index (also known as modulation depth or modulation ratio) is a measure of how much the amplitude of the carrier signal is varied by the message signal. It is defined as:

Modulation Index (MI) = (Amplitude of Message Signal / Amplitude of Carrier Signal) * 100

CIRCUIT DIAGRAM:
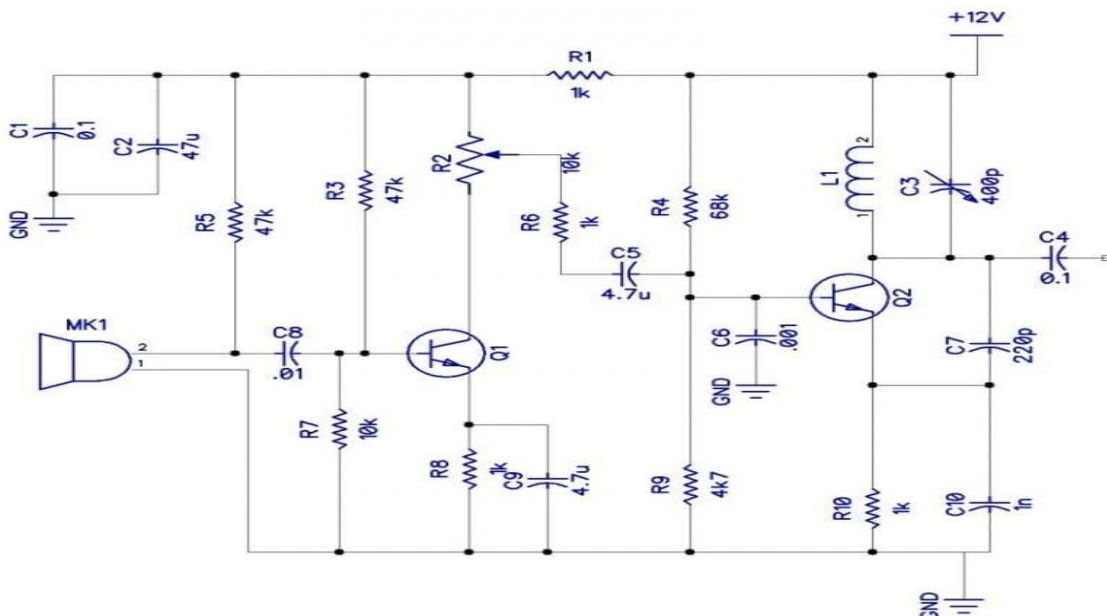
PROCEDURE:

Circuit Connection:
  - Connect the AM transmitter and detector trainer board/kit as per the provided circuit diagram.
  - Ensure that all connections are secure and follow safety precautions.

Power Up:
  - Power up the AM transmitter and detector circuit using the AC power source.
  - Set the power source to the appropriate voltage and ensure that it's stable.

Signal Generation:
  - Connect the function generator to the message signal input of the transmitter.
  - Set the function generator to generate a sinusoidal message signal at a specific frequency (e.g., 1 kHz) and amplitude (e.g., 1 Vpp).

Observation of Waveform:
  - Connect the oscilloscope to different test points on the circuit, such as the input, output, and demodulated signal points.
  - Observe and record the waveforms at each test point.
  - Ensure that the carrier signal and the modulated signal are clearly visible on the oscilloscope.

Measurement of Amplitude:
  - Using the oscilloscope, measure the amplitudes of the carrier signal (A_c) and the modulated signal (A_m).

Calculation of Modulation Index:
  - Calculate the modulation index (MI) using the formula:
  $MI = (A\_m / A\_c) * 100$

TABULATION:

Test Point	Observed Waveform Description	Amplitude (A_c or A_m)	Modulation Index (MI)
Input (Carrier)	|[Describe waveform]	A_c	
Output (Modulated)	[Describe waveform]	A_m	
Demodulated Signal	[Describe waveform]		

CONCLUSION:

From this above experiment we have studied to construct the circuit in AM transmitter & Detector Trainer Board/Kit and observe the waveform at different test point & Determine percentage of Modulation Index of AM.

Experiment-7

Aim of the Experiment:

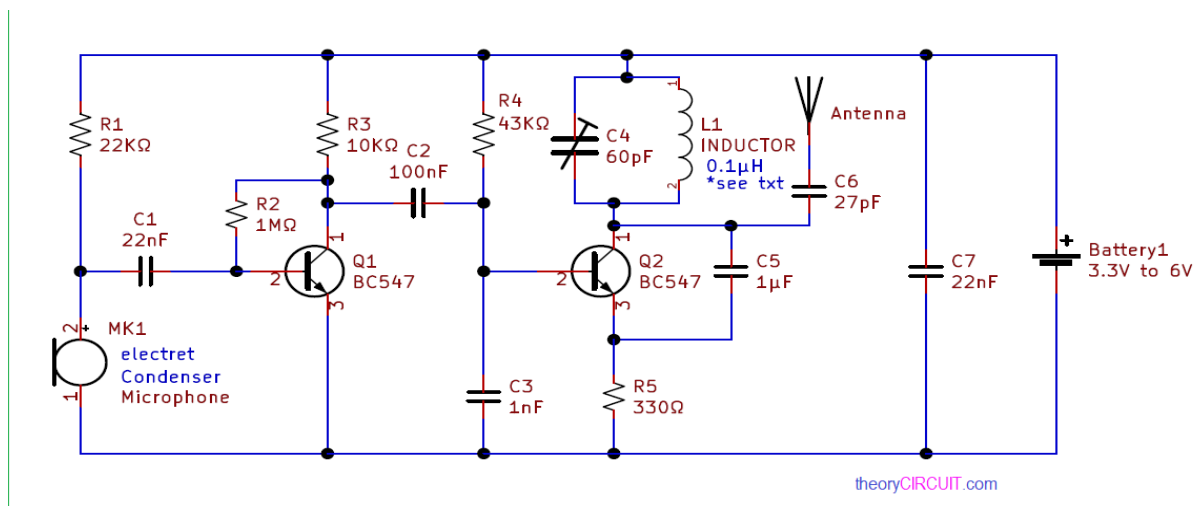Construct the circuit in FM transmitter and detector trainer kit and observe the waveform at different section.

EQUIPMENT REQUIRED:

1. FM Transmitter and Detector Trainer Kit
2. Oscilloscope
3. BNC Cables
4. Frequency Counter
5. Function Generator
6. Connecting Wires

THEORY:

Frequency Modulation (FM) is a method of encoding information in a carrier wave by varying the instantaneous frequency of the signal according to the modulating signal. The FM transmitter and detector circuit consists of several key components:
- Voltage-Controlled Oscillator (VCO): Generates the carrier signal with a frequency that varies with the input voltage.
- Modulator: Modulates the VCO output with the input signal.
- Amplifier: Amplifies the modulated signal before transmission.
- Antenna: Radiates the FM signal.
- Detector: Recovers the modulating signal from the received FM signal.
- Demodulator: Extracts the original audio signal from the detected signal.

PROCEDURE:

Circuit Construction

1. Connect the FM transmitter and detector trainer kit to the power source.
2. Follow the circuit diagram provided with the trainer kit to assemble the FM transmitter and detector circuit.
3. Ensure all connections are secure and that there are no short circuits.

Initial Setup:-
1. Connect the output of the function generator to the input of the modulator.
2. Connect the output of the modulator to the input of the amplifier.
3. Connect the output of the amplifier to the antenna.
4. Connect the antenna to the transmitter output.
5. Connect the detector input to the output of the FM transmitter.
6. Connect the output of the detector to the oscilloscope.

1. Power on the FM transmitter and detector circuit.
2. Set the function generator to produce an audio signal (e.g., a sine wave) at a low frequency.
3. Observe the waveform on the oscilloscope at the detector output.

Frequency Modulation
1. Gradually increase the frequency of the function generator, while monitoring the waveform on the oscilloscope.

2. Observe how the amplitude of the waveform remains constant while the frequency varies.

3. This demonstrates frequency modulation.
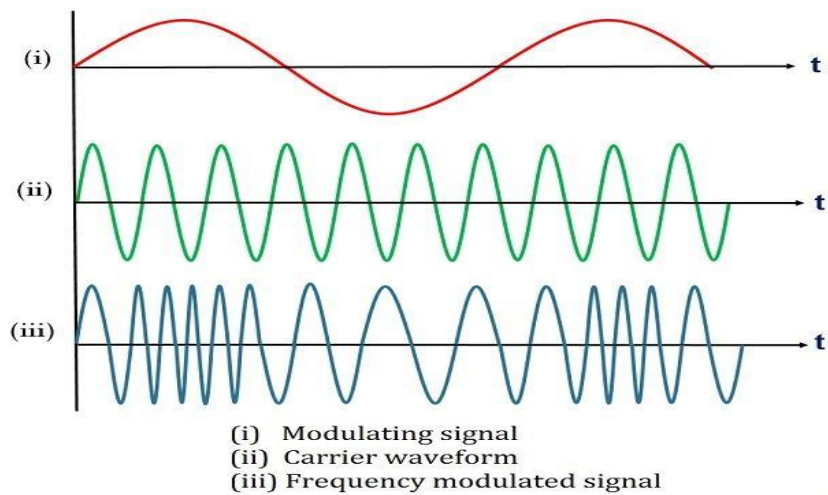
Frequency Detection

1. Switch the function generator back to the lower audio frequency.

2. Observe the waveform on the oscilloscope at the detector output.

3. Use the frequency counter to measure the frequency of the detected signal.

4. Compare it to the input audio frequency.

WAVE FORM DIAGRAM:-

(i)   Modulating signal
(ii) Carrier waveform
(iii) Frequency modulated signal

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TABULATION:

Input Frequency (Hz)	Detected Frequency (Hz)

CONCLUSION:

From this above experiment, we have studied to construct the circuit in FM transmitter and detector trainer kit and observe the waveform at differnt section.

EXPERIMENT NO- 08

AIM: Construct the circuit in FSK modulator & demodulator Trainer Board/Kit
& observe the waveform at different section.

Equipment Required:
1. FSK modulator and demodulator Trainer Board/Kit
2. Dual-channel oscilloscope
3. Function generator
4. BNC cables
5. Breadboard and jumper wires
6. 5V DC power supply
7. Connecting probes
8. Passive components: resistors, capacitors
9. Active components: transistors, operational amplifiers
10. Frequency counter
11. Multimeter

Theory:
Frequency Shift Keying (FSK) is a digital modulation technique where the
carrier frequency is varied between two discrete frequencies to represent
binary data. In this experiment, we will construct an FSK modulator and
demodulator circuit.

Circuit Diagram:
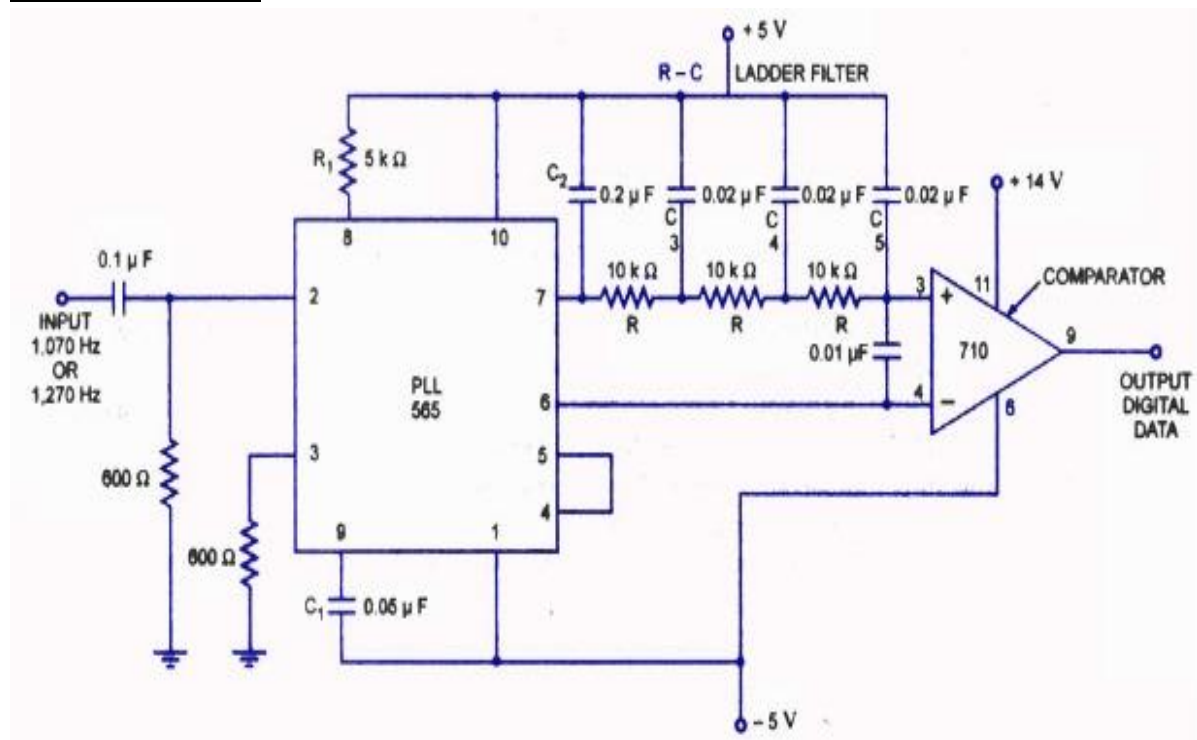
Procedure:

FSK Modulator Construction:
 a. Connect the Trainer Board/Kit to the power supply.
 b. Using a breadboard, construct the FSK modulator circuit. The modulator typically consists of a voltage-controlled oscillator (VCO) and an input switch for binary data.
 c. Connect the output of the VCO to the input of the Trainer Board/Kit.
 d. Set up the function generator to provide the binary data input.
 e. Connect the oscilloscope to different points in the modulator circuit (input, VCO output, etc.).
 f. Observe and record the waveforms at each point as you change the input data.

FSK Demodulator Construction:
 a. On the Trainer Board/Kit, construct the FSK demodulator circuit, typically comprising a phase-locked loop (PLL) or a bandpass filter.
 b. Connect the output of the FSK demodulator to the oscilloscope and frequency counter.

c. Connect the binary data input from the function generator to the demodulator circuit.

d. Observe and record the demodulated signal and frequency measurements.

Tabulation:

Section	Input Signal	Observed Waveform
FSK Modulator	Binary Data VCO Output	Modulated FSK Signal
FSK Demodulator	Modulated Signal (from modulator)	Demodulated Binary Data Output

WAVEFORM:

Data

Carrier

Modulated Signal
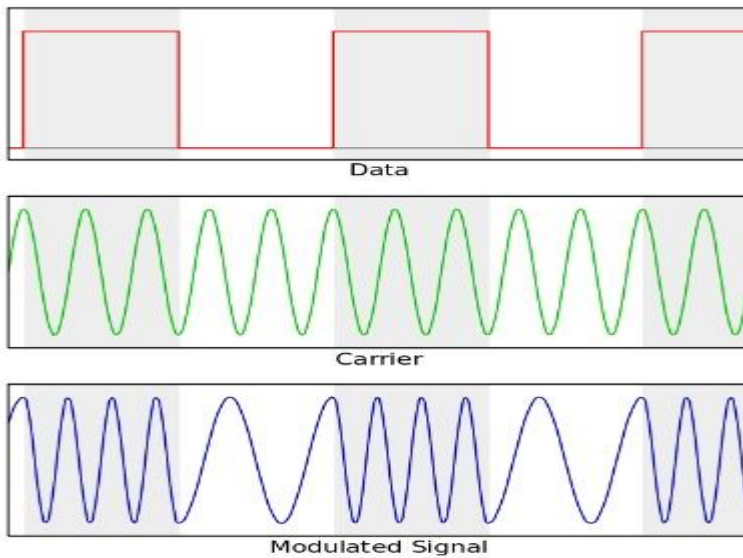
Conclusion:

<h1 style="text-align:center">Experiment-9</h1>

Aim of the Experiment:

Construct the circuit in sampling theorem Trainer Kit & observe the waveform at different section.

EQUIPMENT REQUIRED:

1. Sampling Theorem Trainer Board/Kit
2. Oscilloscope
3. Function generator
4. BNC cables
5. Digital multimeter
6. Power supply
7. Connecting wires
8. Probes for the oscilloscope

THEORY:

The Sampling Theorem (Nyquist-Shannon Theorem) states that to accurately reconstruct a continuous signal from its samples, the sampling frequency (Fs) must be at least twice the highest frequency component present in the signal, i.e., Fs ≥ 2 * fmax. Failure to meet this criterion can lead to aliasing, where high-frequency components fold back into the lower frequency range.
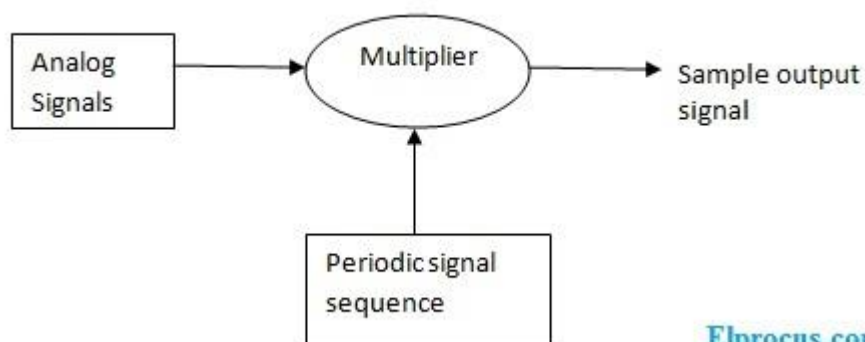
Elprocus.com

PROCEDURE:

1. Setup:

  a. Set up the Sampling Theorem Trainer Board/Kit on a stable workbench.

  b. Connect the function generator's output to the input of the Trainer Board/Kit.

c. Connect an oscilloscope probe to the Trainer Board/Kit's output for signal observation.

d. Ensure that all equipment is properly grounded.

2. Continuous Signal Observation:

a. Turn on the function generator and set it to produce a sinusoidal signal of a known frequency (e.g., 1 kHz).

b. Connect the oscilloscope probe to the Trainer Board/Kit's input to observe the continuous analog signal.

c. Adjust the oscilloscope settings for a clear view of the input signal.

3. Sampling:

a. Connect the oscilloscope probe to the Trainer Board/Kit's output, representing the sampled signal.

b. Observe the sampled signal and take note of the sample rate (Fs).

4. Variation of Sampling Rate:

a. Using the controls on the Trainer Board/Kit, vary the sample rate (Fs) while observing the sampled signal.

b. Note any changes in the sampled waveform, especially when the sample rate is below the Nyquist rate (Fs < 2 * fmax).

5. Aliasing Effects:

a. Reduce the sample rate below the Nyquist rate and observe the aliasing effects on the sampled signal.

b. Discuss how the high-frequency components fold back into the lower frequency range.

6. Reconstruction:

a. Connect the oscilloscope probe to the Trainer Board/Kit's reconstructed signal output.

b. Observe the reconstructed signal and compare it to the original continuous analog signal.

7. Measurement**:**

a. Use a digital multimeter to measure the voltage levels at key points in the circuit, including the input, sampled output, and reconstructed output.

b. Record these voltage measurements in a table.

WAVE FORM DIAGRAM:
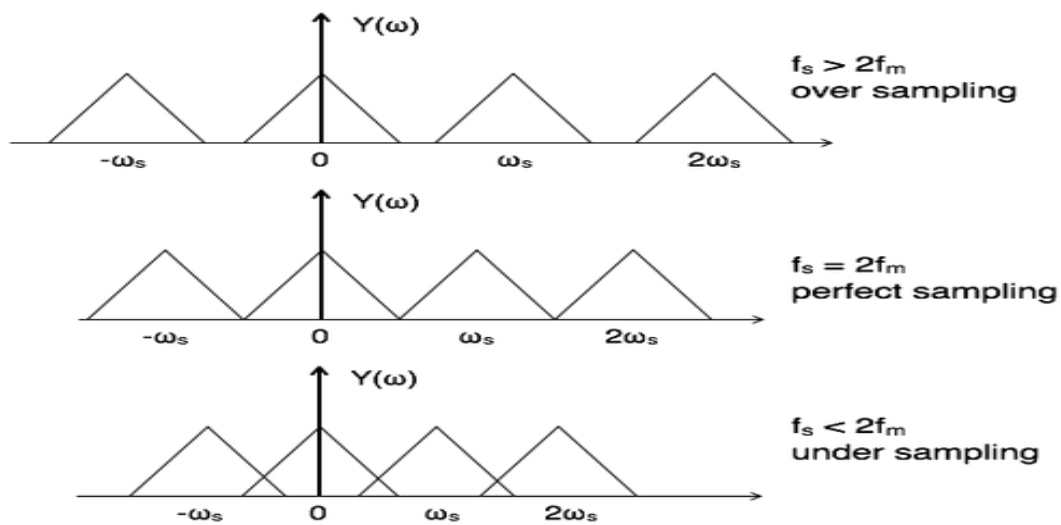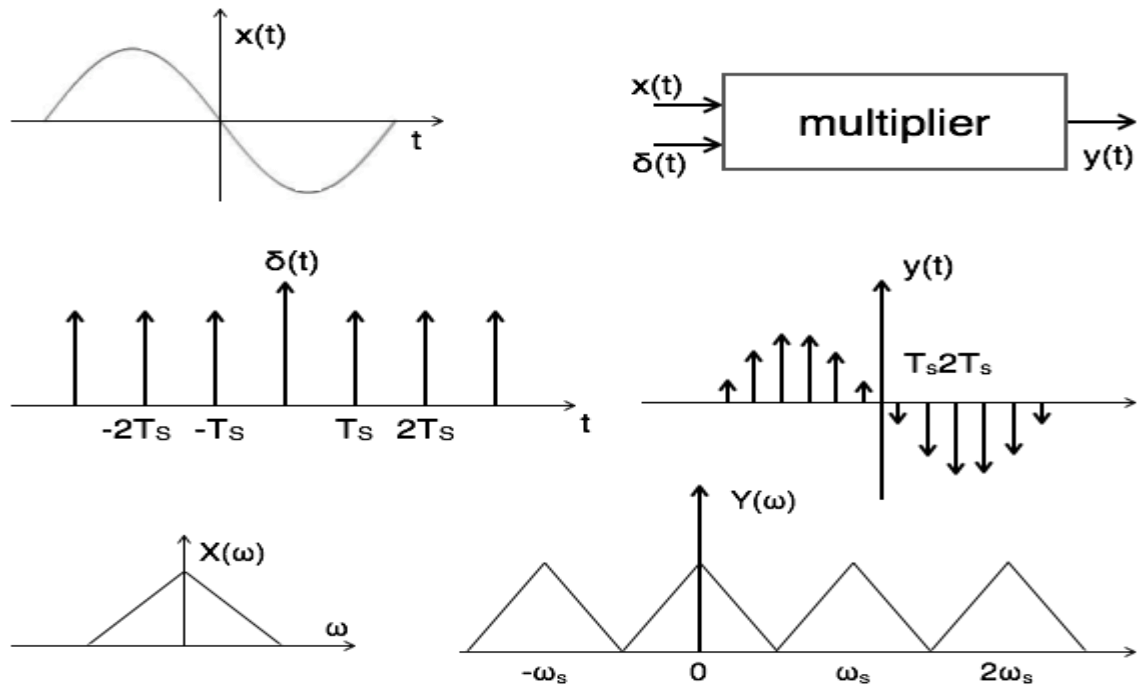
TABULATION:

Observation Point	Voltage Measurement (V)
Input Signal (Continues)	
Sampled Signal	
Reconstructed Signal	

CONCLUSION:

From the above experiment we studied to Construct the circuit in sampling theorem Trainer Board/Kit & observe the waveform at different section.

Aim of the Experiment:

Construct the circuit in PCM transmitter & receiver Trainer Board/Kit & observe the waveform at Different section.

EQUIPMENT REQUIRED:

1. Multisim software
2. PC with appropriate specifications to run Multisim
3. Function generator
4. Oscilloscope
5. Passive components (resistors, capacitors)

THEORY:

PSK modulation is a digital modulation technique that encodes digital data by varying the phase of the carrier signal. In this experiment, we will simulate Binary Phase Shift Keying (BPSK) modulation and demodulation, which uses two phases to represent binary 0 and 1.
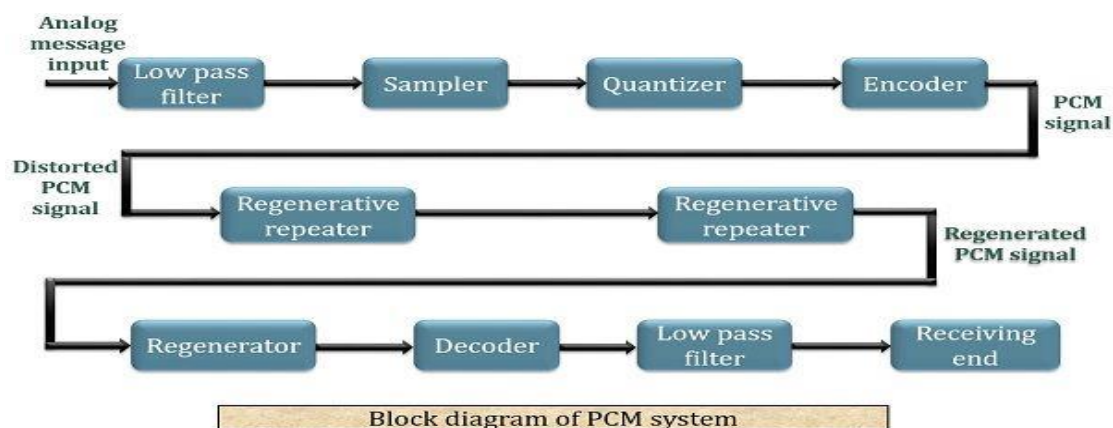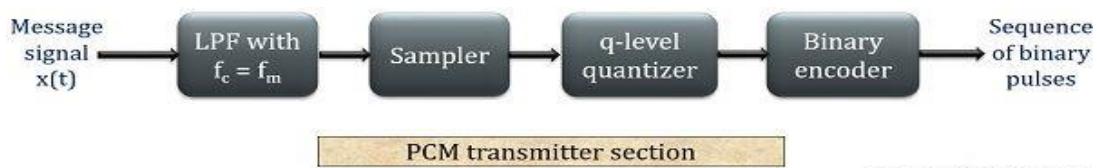
BPSK Modulation:
- Binary 0 is represented by a phase shift of 0 degrees.
- Binary 1 is represented by a phase shift of 180 degrees.

BPSK Demodulation:
- The received signal is compared with a reference signal (in-phase) and its 180-degree out-of-phase counterpart.
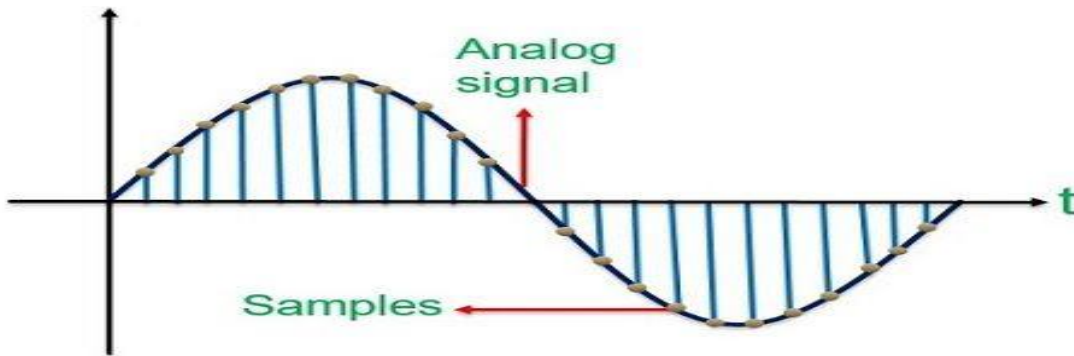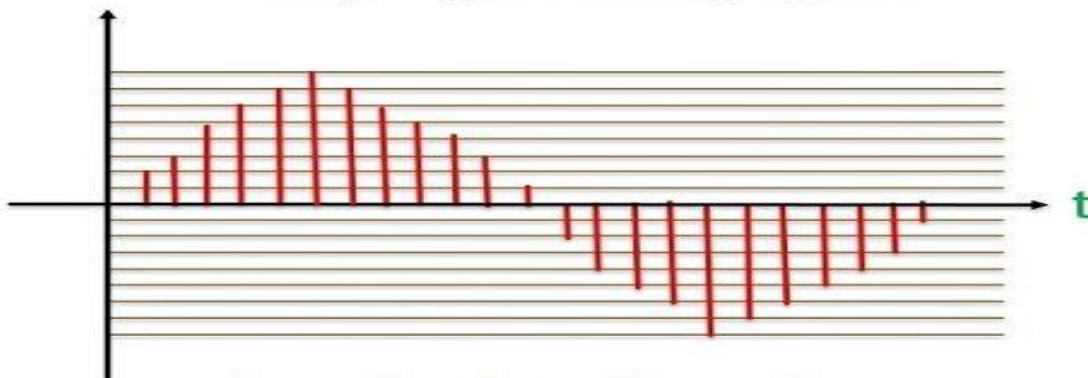- The phase comparison helps determine whether a 0 or 1 was transmitted.

DIAGRAM:

Block diagram of PCM system

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PCM transmitter section

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PCM receiver section
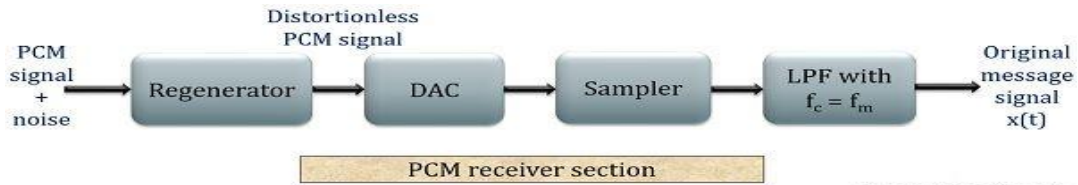
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Sampling of analog signal

Quantization of samples

PROCEDURE:

1. Connect the function generator to the "Carrier Input" and set it to a frequency of your choice (e.g., 1 kHz) and amplitude (e.g., 5V).
2. Connect the "Digital Input" to a square wave generator configured for binary data (0s and 1s) with the same frequency as the carrier signal.
3. Observe the "PSK Modulated Signal" on the oscilloscope.

4. To demodulate the signal, use a phase comparator or XOR gate to compare the received signal with a reference signal (square wave).
5. Observe the "Demodulated Output" on the oscilloscope.
6. Analyze the output to determine if the demodulation was successful in recovering the original binary data.

TABULATION:

Time (ms)	Input Signal	Modulated Signal	Demodulated Signal	Decoded Data

CONCLUSION:

From this above experiment we have studied to construct the circuit in PCM transmitter & receiver Trainer Board/Kit & observe the waveform at Different section

Experiment -11

Aim of the expt :-

Construct the circuit in Delta Modulator and Demodulator &observe the waveform at different section

Equipment:

1. Breadboard
2. Operational Amplifiers (Op-Amps)
3. Resistors (various values)
4. Capacitors (various values)
5. Diodes (1N4148 or similar)
6. Signal generator
7. Oscilloscope
8. Power supply
9. Connecting wires

Theory:

Delta modulation is a method of analog-to-digital conversion that encodes the difference between the current and previous analog signal samples. In this experiment, we will construct a simple Delta Modulator and Demodulator circuit to understand its working. The circuit consists of three main sections:

1. **Delta Modulator (Transmitter):** This section samples and quantizes the input analog signal to produce a stream of 1-bit digital samples.
2. **Transmission Medium:** In practice, this could represent a noisy channel or transmission medium. In this experiment, we will assume an ideal transmission.
3. **Delta Demodulator (Receiver):** This section reconstructs the analog signal from the 1-bit digital samples received from the transmission medium.

Circuit Diagram:

Delta modulation transmitter

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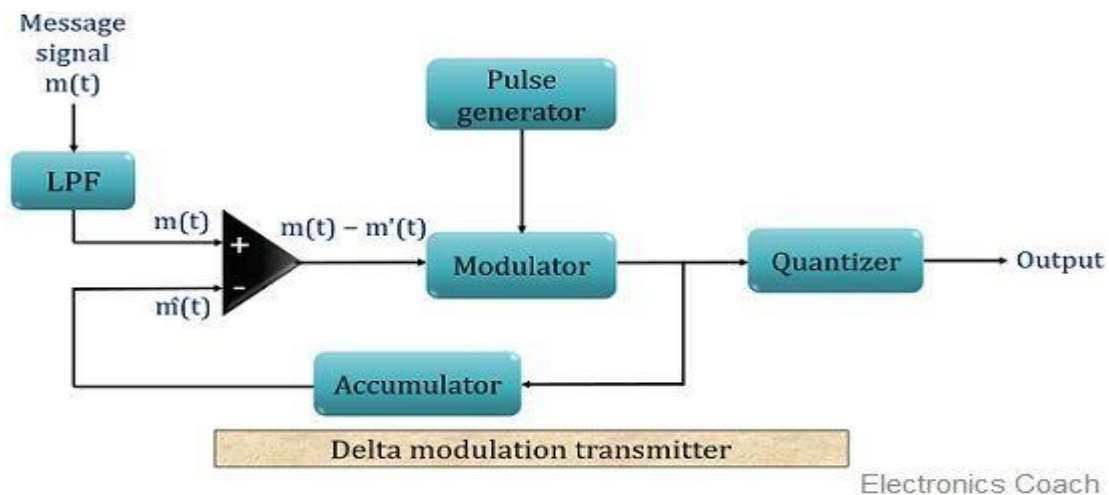
Procedure:

Delta Modulator (Transmitter):

1. Construct the Delta Modulator circuit as shown in the circuit diagram.
2. Connect the signal generator to the input of the modulator.
3. Set the signal generator to produce a sine wave signal (analog input).
4. Adjust the sampling frequency and quantization levels by choosing suitable resistors and capacitors in the circuit.
5. Observe and record the waveform at the output of the modulator on an oscilloscope.

Delta Demodulator (Receiver):

1. Construct the Delta Demodulator circuit as shown in the circuit diagram.
2. Connect the output of the modulator to the input of the demodulator.
3. Observe and record the waveform at the output of the demodulator on an oscilloscope.
4. Adjust the demodulator circuit to recover the analog signal as accurately as possible.
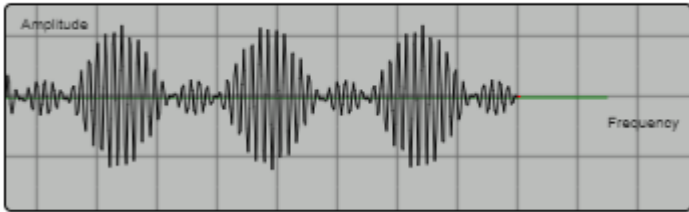
Waveform :-

Message Signal $m(t) = A_m \cos(2\pi f_m t)$
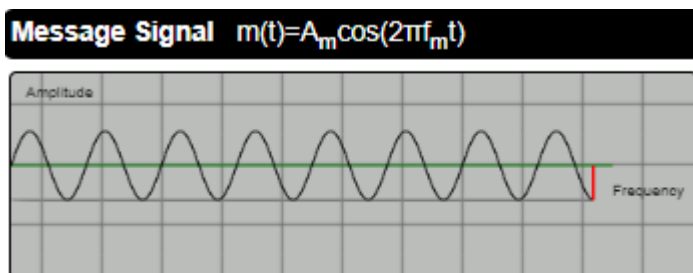
Carrier Signal $c(t)=A_c\cos(2\pi f_c t)$
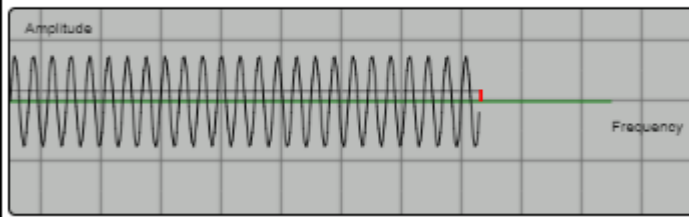
Amplitude Modulated Signal

[**Tabulation (Observations):**

Record the following observations in a tabular format:

Section	Parameter/Component	Value/Setting	Observation/Waveform
Modulator	Modulator Input signal		
Modulator	Sampling frequency		
Modulator	Quantization levels		
Modulator	Output waveform		
Demodulator	Input waveform		
Demodulator	Output waveform		
Demodulator	Recovered signal		

Conclusion:

In this experiment, we constructed a Delta Modulator and Demodulator circuit to observe its operation. We learned that delta modulation is a simple method of analog-to-digital conversion, which quantizes the difference between successive samples of the input signal.

EXPERIMENT -12

Aim of the experiment:-

Construct the circuit in   Super heterodyne Radio Receiver & observe the waveform at different section

Equipment:-

1. Breadboard
2. Transistor (NPN type, e.g., 2N3904)
3. Resistors (various values)
4. Capacitors (various values)
5. Inductors (various values)
6. Diodes (various types, e.g., 1N4148)
7. Signal generator (RF signal source)
8. Oscilloscope
9. Power supply
10. Connecting wires

Theory:

The superheterodyne receiver is a key component in radio communication systems. It is used to convert incoming radio frequency (RF) signals into intermediate frequencies (IF) for easier amplification and demodulation. The key sections of the superheterodyne receiver include:

1. **RF Amplifier:-** This section amplifies the incoming RF signal to increase its strength and reduce interference.
2. **Mixer:-** The mixer combines the RF signal with a locally generated oscillator signal to produce the intermediate frequency (IF) signal.
3. **Local Oscillator:-** The local oscillator generates a signal that is mixed with the RF signal to produce the IF signal.
4. **IF Amplifier:-** The IF amplifier amplifies the IF signal for further processing.
5. **Demodulator:-** The demodulator recovers the original audio signal from the IF signal.

Circuit Diagram:-
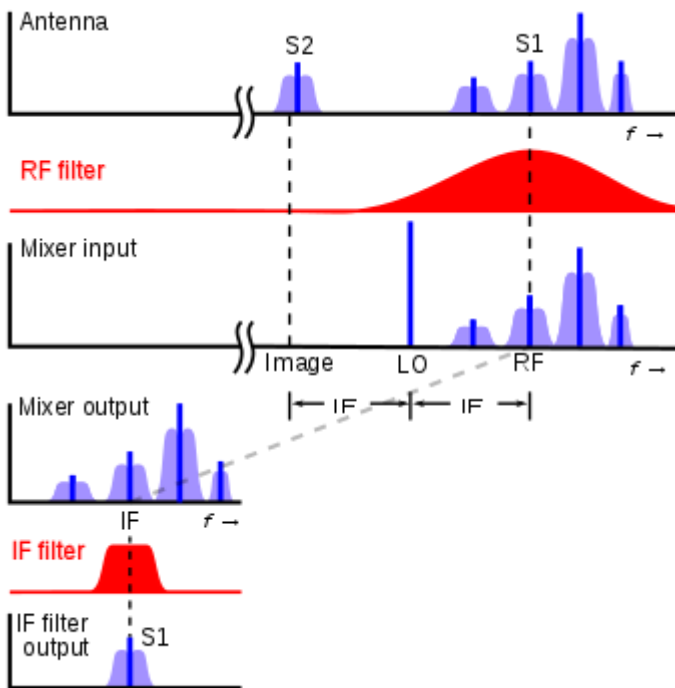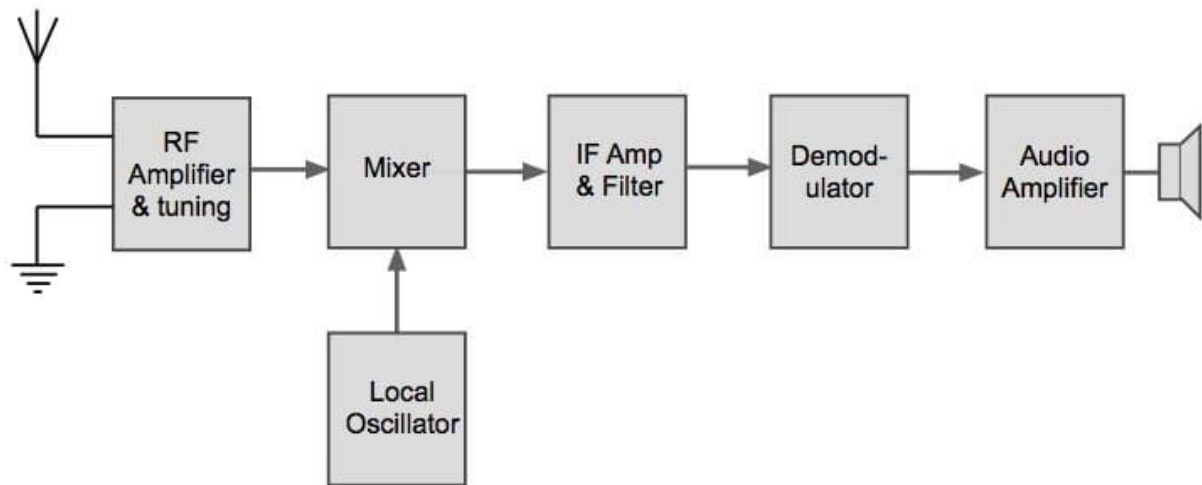
Procedure:-

RF Amplifier:-

1. Construct the RF amplifier circuit as shown in the circuit diagram.
2. Connect the RF signal generator to the input of the RF amplifier.
3. Adjust the RF signal generator to provide a test RF signal.
4. Observe and record the waveform at the output of the RF amplifier on an oscilloscope.

Mixer:-

1. Construct the mixer circuit with the local oscillator as shown in the circuit diagram.
2. Connect the output of the RF amplifier to the input of the mixer.
3. Connect the local oscillator to the mixer.
4. Adjust the frequency of the local oscillator to the desired IF frequency.
5. Observe and record the waveform at the output of the mixer on an oscilloscope.

IF Amplifier:-

1. Construct the IF amplifier circuit as shown in the circuit diagram.
2. Connect the output of the mixer to the input of the IF amplifier.
3. Adjust the IF amplifier for proper amplification.
4. Observe and record the waveform at the output of the IF amplifier on an oscilloscope.

Demodulator:-

1. Construct the demodulator circuit as shown in the circuit diagram.
2. Connect the output of the IF amplifier to the input of the demodulator.
3. Adjust the demodulator circuit to recover the audio signal.
4. Observe and record the waveform at the output of the demodulator on an oscilloscope.

Tabulation (Observations):-

Record the following observations in a tabular format:

Section	Component Value/Setting	Observation/Waveform
RF Amplifier	RF Signal Generator	
RF Amplifier	Output Frequency	waveform
Mixer	Local Oscillator	
Mixer	Output waveform	
IF Amplifier	IF Amplifier	Gain
IF Amplifier	Output waveform	
Demodulator	Output waveform	

Conclusion:

In this experiment, we constructed a Superheterodyne Radio Receiver circuit to observe its operation.

EXPERIMENT - 13

Aim of the experiment:-

Construct the principle of Stereophonic System

Equipment:-

1. Two audio sources (e.g., smartphones, MP3 players)
2. Two speakers (or headphones)
3. Stereo amplifier (optional, for better sound quality)
4. Audio cables (3.5mm or RCA cables)
5. Breadboard and connecting wires (for demonstration)

Theory:-

A stereophonic audio system is designed to reproduce audio in a way that creates a sense of spatial sound. It utilizes at least two audio channels, typically left and right, to provide a more immersive listening experience. In this experiment, we will create a basic stereo system with two audio sources and speakers.

Circuit Diagram:
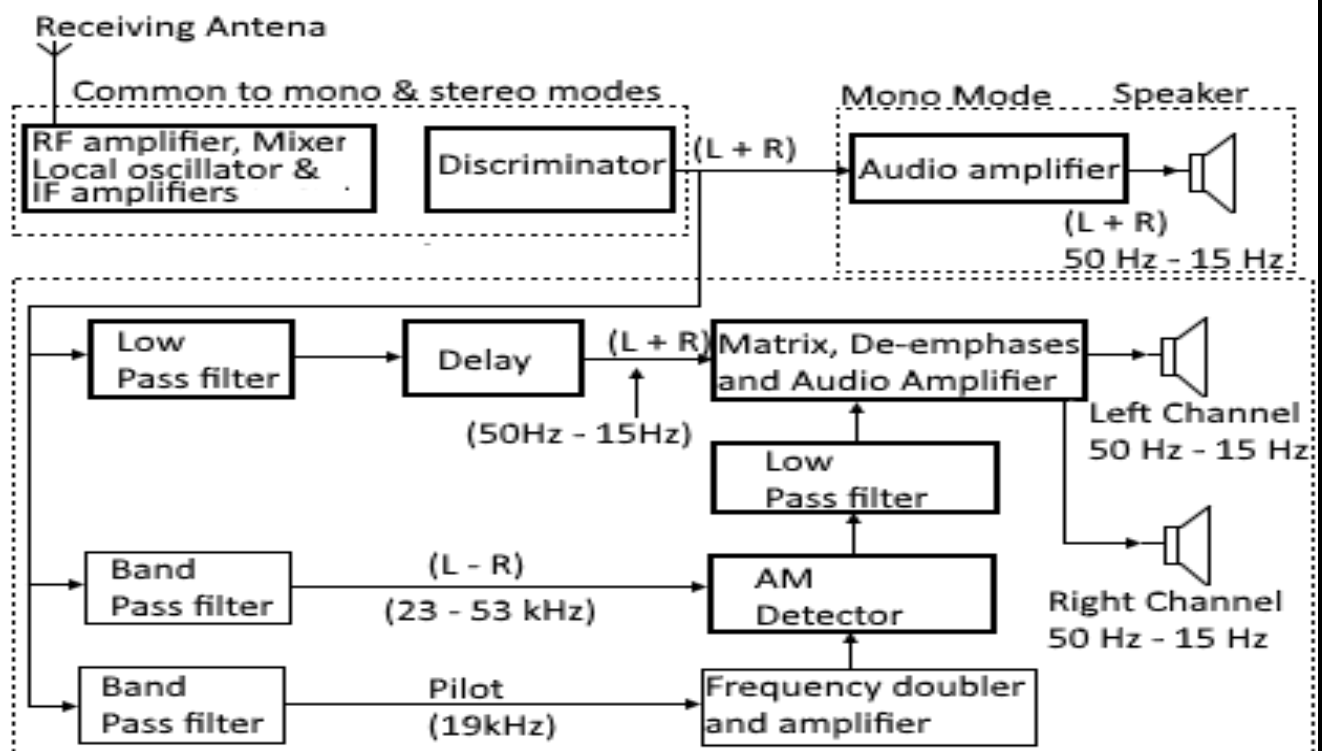
Procedure:-

1. Mono Audio Setup:-

1. Begin by setting up a mono audio system. Connect one audio source to one speaker or headphone using the audio cable.
2. Play a mono audio source (e.g., a song that is the same in both channels) and listen to the sound.
3. Record your observations, especially noting the lack of spatial separation in the sound.

2. Stereo Audio Setup:-

1. Now, set up a stereo audio system. Connect both audio sources to the left and right channels of the stereo amplifier (or directly to the speakers if they have built-in amplification).
2. Play stereo audio (e.g., a song with different sounds in the left and right channels) and listen to the audio.
3. Record your observations about the spatial separation and improved audio experience.

3. Breadboard Demonstration (Optional):-

1. If you have a breadboard and connecting wires, you can set up a simple demonstration of the principles of stereo audio. Place two small speakers or piezoelectric transducers on the breadboard.
2. Connect the left channel of one audio source to one speaker and the right channel to the other speaker.
3. Play stereo audio and observe how each speaker reproduces the audio from its respective channel, creating spatial separation.

Tabulation (Observations):

Record your observations in a tabular format:

Setup	Audio Sources	Output Speakers	Observations
Mono	1 source	1 Speaker	No spatial separation
Stereo	2 sources	2 speakers	Spatial separation, immersive
Breadboard	2 sources	2 speakers	reproduces its channel

Conclusion:

In this experiment, we constructed a simple Stereophonic system to understand the principles of stereo audio reproduction.

AIM of the Experiment:

Construct the circuit in to determine the output of a TDM signal

Equipment Required:

1. Breadboard or PCB for circuit construction
2. Digital logic gates (AND gates, multiplexers)
3. Oscilloscope
4. Function generator (for input signals)
5. Logic probe or multimeter
6. Connecting wires
7. Power supply
8. Resistors and capacitors (as needed)
9. DIP switches (optional)
10. LED indicators (optional)

Theory:

Time output signal, allowing us to visualize the TDM process.Division Multiplexing (TDM) is a digital transmission technique used to transmit multiple signals over a single communication channel by allocating specific time slots to each signal. In this experiment, we will create a simple TDM circuit that combines multiple input signals into a single

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BLOCK DIAGRAM OF TDM:

Block diagram of PAM/TDM system

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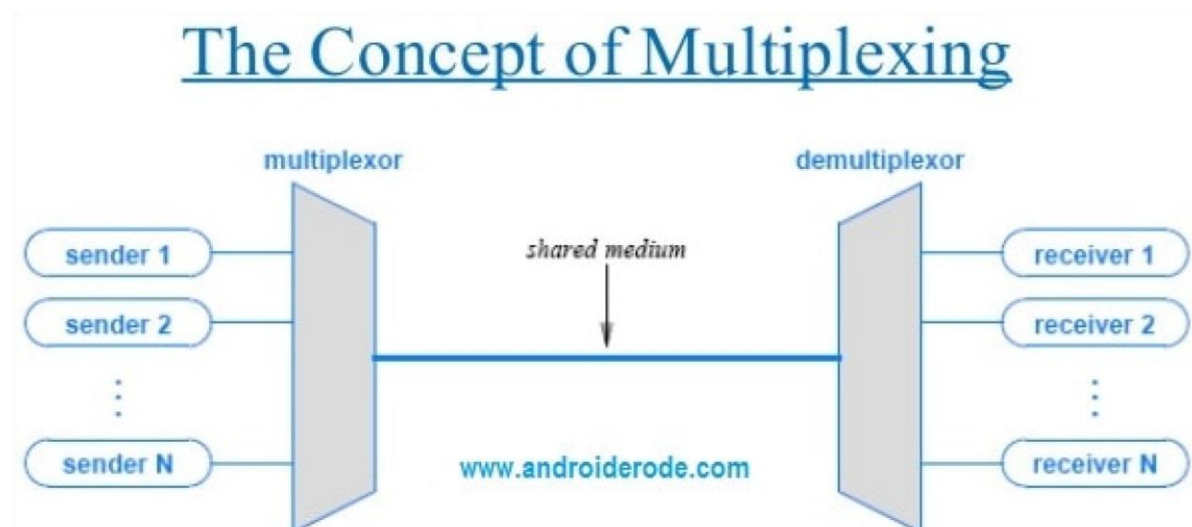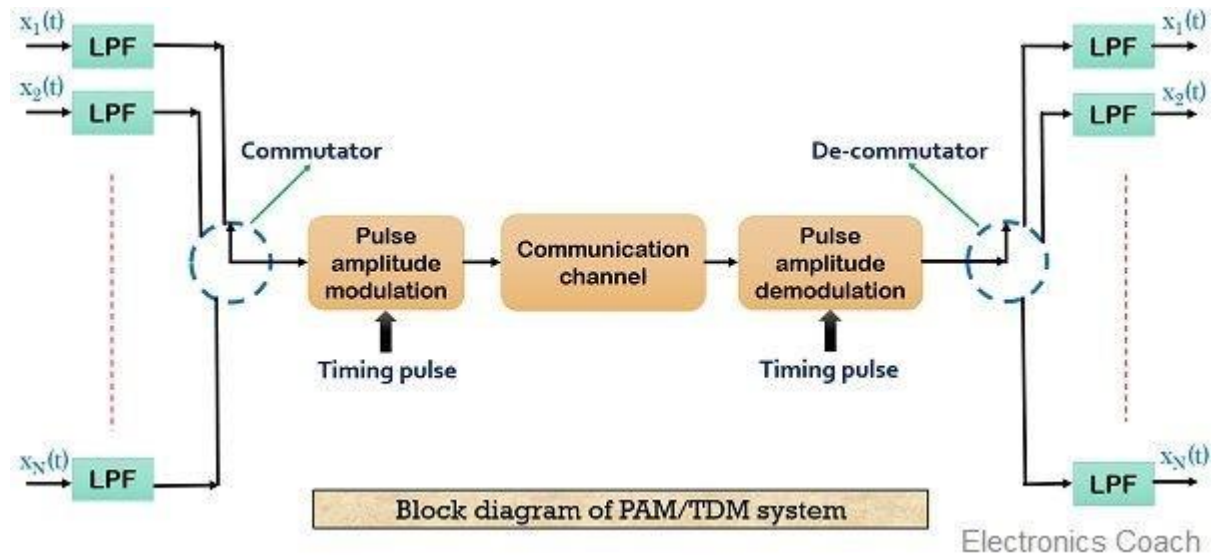
Procedure:

1. Circuit Design:

Design the TDM circuit using digital logic gates and multiplexers. The circuit should have multiple input channels and one output channel.

You can use AND gates and multiplexers to create the TDM logic.

2. Connect Input Signals:

Generate multiple input signals using a function generator or by manually toggling DIP switches.

Connect these input signals to the appropriate input channels of the TDM circuit.

3. Connect Oscilloscope:

Connect an oscilloscope to the output of the TDM circuit to monitor the combined signal.

4. Set Multiplexing Rate:

Configure the TDM circuit to sample each input signal in a sequential manner at a specific multiplexing rate.

You can use clock signals to control the multiplexing rate.

5. Simulate TDM Process:

Power up the circuit and observe the output signal on the oscilloscope.
The output signal will show the combination of all input signals in a time-multiplexed fashion.

6. Record and Tabulate:

Time slot	Input Channel -1	Input Channel -2	Input Channel N	Output
1				
2				
3				
4				

Conclusion:

Record the multiplexing rate and the time slots for each input signal in your lab notebook.

Use a logic probe or multimeter to measure and record signal levels at various time slots.

Experiment-15

Aim of the experiment:-

Construct the circuit in MODEM Trainer Board/Kit and observe the waveform at different section.

EQUIPMENT REQUIRED:

1. Modem Trainer Board/Kit
2. Dual-channel oscilloscope
3. Function generator
4. BNC cables
5. Multimeter
6. Connectors and wires

THEORY:

Modulation is the process of superimposing a low-frequency information signal (baseband signal) onto a high-frequency carrier signal to transmit the information over a communication channel. Demodulation is the reverse process, extracting the original baseband signal from the modulated carrier signal. In this experiment, we will create an AM (Amplitude Modulation) circuit and observe the waveforms a t different stages.
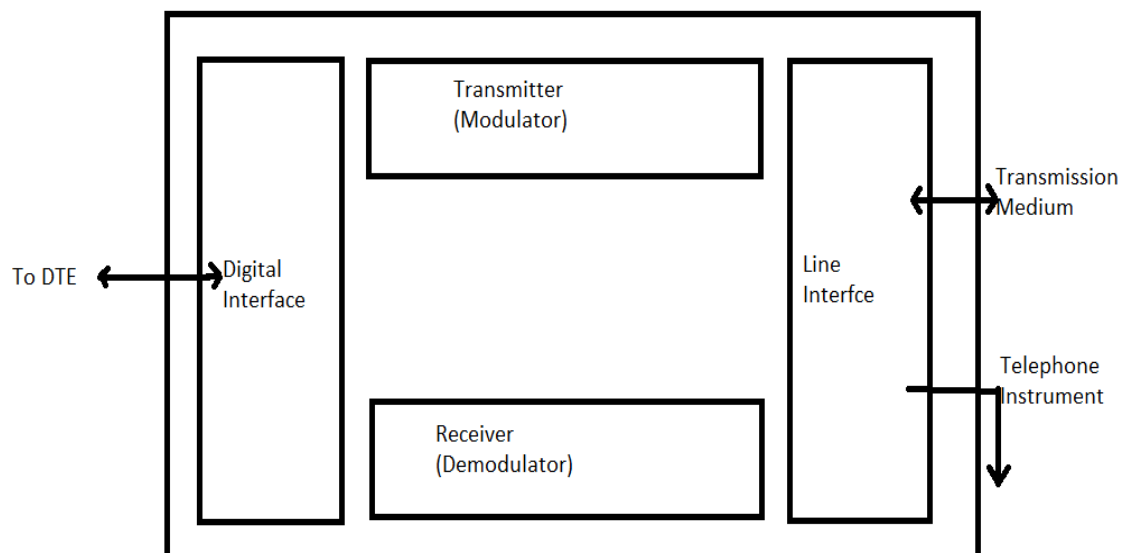
Building blocks of a Modem

PROCEDURE:

1. Setting up the Modem Trainer Board:
   a. Ensure that the Modem Trainer Board/Kit is powered off.
   b. Connect the power supply to the Modem Trainer Board and turn it on.
   c. Connect the dual-channel oscilloscope to the Modem Trainer Board using BNC cables.

2. Creating the AM Modulation Circuit:
   a. Refer to the Modem Trainer Board's user manual to identify the modulation and demodulation sections.
   b. Connect the audio source (function generator) to the modulation input of the Modem Trainer Board.
   c. Connect the output of the Modem Trainer Board to the oscilloscope's Channel 1 input.
   d. Ensure that the carrier signal source on the Modem Trainer Board is set to an appropriate frequency.

3. Observing Waveforms:
   a. Turn on the Modem Trainer Board.
   b. Set the function generator to provide a low-frequency audio signal (e.g., 1 kHz).
   c. Observe the waveform at the modulation input and the output on Channel 1 of the oscilloscope.
   d. Take note of the changes in amplitude and shape of the waveform as it gets modulated.

4. Creating the AM Demodulation Circuit:
   a. Switch to the demodulation section of the Modem Trainer Board.
   b. Connect the output of the modulation section to the input of the demodulation section.
   c. Connect the output of the demodulation section to the oscilloscope's Channel 2 input.

5. Observing Demodulated Waveforms:
   a. Observe the waveform at the demodulation input on Channel 1 of the oscilloscope.

b. Observe the waveform at the demodulation output on Channel 2 of the oscilloscope.

   c. Compare the output waveform to the original audio signal from the function generator.

TABULATION:

Section	Input Waveform	Output Waveform
Modulation Input		
Demodulation Input		

CONCLUSION:

From this above experiment we have studied to Construct the circuit in MODEM Trainer Board/Kit and observe the waveform at different section.