

**STATE BOARD OF TECHNICAL EDUCATION  
& TRAINING::AP, VIJAYAWADA**



**DIPLOMA IN ELECTRONICS & COMMUNICATIO ENGG.**

**III SEMESTER**

**ANALOG AND DIGITAL COMMUNICATION SYSTEMS LAB (EC-309)**

**MANUAL (AS PER C-20 CURRICULUM)**

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## INTRODUCTION

### 1.0 INTRODUCTION

The Curriculum of Technical Education should invariably provide for knowledge, attitudes and skills required by the technicians /technologists in the country. In this context the laboratory courses form a vital portion in the entire curriculum of technician education. The laboratory courses shall therefore be so designed and delivered that they help the students acquire attitudes and motor skills that are essential to function effectively as technicians/technologists.

The planning, organization and implementation of lab courses need a detailed description of tasks to be performed by the students. Well thought out instructional objectives to a large extent give these descriptions. The analysis of tasks (by identifying the activities the students are expected to do) help prepare the objectives meticulously. In other words the objectives would be clearer, when the task analysis is done to spell out the sub tasks for each objective.

A survey of the practices currently followed in the technical/technician education shows an urgent need to plug in gaps in instructional procedures. The reasons for these gaps are ambiguity in the minds of the teachers regarding tasks to be performed, levels of competency to be achieved by the students and the weightage to be allocated for each task. This aids in scientific design of instructional plan (optimizing the resources, budgeting the time & content).

The task analysis, teaching points and the structured scheme of evaluation are very important in focusing the instruction on specific skill of desired outcome and in evaluating the same. The Instruction and evaluation in Laboratory courses are different from that of cognitive lessons in the sense that adequate importance and hence weightage needs to be given for all three domains of learning viz. cognitive, psychomotor and affective. Since both training and evaluation of traits of affective domain are practically difficult, a few traits (called values) most relevant and essential to occupations/professions after the Course may be identified for the purpose. It is imperative to integrate these values during instruction and evaluation and also overtly notify the same to the students.

A technician, in addition to performing a skill needs to prepare a report of testing that includes the description of procedure, details of measurements made, reasoning based inferences and so on.,. The current practice of record writing has failed to achieve this purpose as most of the time students end up with making copies of available material.

Therefore, for sensitizing the need for the changes in laboratory instruction, the present hand book has been prepared to meet the above requirements. As such the hand book comprises four parts that intend to :

- Present task analysis, teaching points which can be used for effective design of instruction
- provide a scheme of evaluation with rationally allocated weightage to each significant skill component
- offer a set of questions designed at different levels of competencies for assessment enabling the teacher to set the question paper with balanced levels of competencies

- present pre set worksheets that cultivate the habit of systematic recording of observations and writing the technical report.
- Provide all important data related to particular laboratory activity at one point in the form of annexure

### 1.1. STRUCTURE OF THE BOOK

The hand book is presented in four parts viz., Laboratory sheets, Worksheet, Experimental Methodology and Annexure. The description of each part is given in the following sections

#### Part I. Laboratory Sheet

The information provided in this part is useful for the teacher for designing the instruction, planning & organization of the experiment and for scientific evaluation of the students. The major features of the Laboratory sheet are further explained below.

##### 1. Objective

It indicates the **Task** to be performed and completed by the student during the specified duration of time.

##### 2. Task Analysis

It is the process of identifying the component activities (sub tasks) to be carried out by the student in order to achieve the stipulated objective. As the task analysis aim at fitting the instructional objectives into various classes of behaviour, it would help the teacher to determine any particular type of behaviour the student has learnt / failed to perform.

The task analysis would help the teacher in identifying the specific activities to be performed by the students. This could also be used as some kind of check list to compare with activities planned for the laboratory. Further it would give clue to the teacher to make students think originally & act independently. It includes both psychomotor learning and the related cognitive information and hence the task analysis is presented as Knowledge and skill parts.

**A. Knowledge Part:** That includes the cognitive aspects of the task.

**B. Skill Part:** That includes Psychomotor & Affective aspects of the task.

##### 3. Teaching Points:

This includes the points based on the SKILL identified with suggested duration for each point and total duration which helps the teacher for the time and content budgeting during instruction.

#### **4. Need and Scope:**

The purpose, application and scope of the task to be performed are normally included in this sub section.

#### **5. Planning and Organisation:**

It lists actions to be taken to perform various activities and hence useful in planning the instruction and organizing the resources and equipment

#### **6. Scheme of Valuation:**

The information provided in this section helps the teacher to devise a tool for rational measurement assessment of the competencies accomplished by the student.

### **Part II. Work Sheet**

It is designed for the student, where in the student enters his personal data of identification, details of the experiment, stepwise procedure, observations made during experiment, a sample calculation, free hand typical graph, graph from experimental data and inference with discussion.

### **Part III. Experimental Methodology**

This section furnishes information with regard to standard procedure to conduct the experiment along with the description of equipment/apparatus and the basic theory/concept involved in the conduct of the experiment. Thus this section is very useful for both teacher and student as well to conduct the experiment systematically. Thus this section is presented in four sub section as described below:

#### ➤ **Description**

It gives the detailed description of apparatus / tools / equipment / materials to be used for the task.

#### ➤ **Theory / Concept**

It gives the concept of the task to be performed with formulae and units.

#### ➤ **Procedure**

It provides the idea of step wise procedure to perform the task.

#### ➤ **Observation and Calculation**

It includes sample observation, sample graph, sample calculation for reference

### **Part IV. Annexure**

All important and useful information that may help in accomplishment of tasks like conversion tables for units, technical & scientific data like material properties, standard trend or characteristic curves (graphs) etc are compiled and presented at one place in this section.

## 1.2. WHO IS TO USE AND HOW TO USE.

The hand book is so designed that it can be beneficially used by different sections of the technical education viz., the teacher, the student, the examiner and the administrator convenient to individual's requirements. A few uses of this hand book each stakeholder could make is outlined in the following sections.

### 1. Teacher

**A. The laboratory sheet** is designed keeping the teacher in mind for the teacher has key responsibility of imparting the skills to the student and hence the information given in the lab sheets may be useful for planning & organizing the experimental set up and designing an effective instruction. Thus the teacher may

**Plan and organize** as per *section 4*,

**Instruct** the students as per *section 2*,

**Demonstrate** each sub task as per *section 1.B* and

**Evaluate** the students as per *section 5*, according to the level of competency.

**Values:** The values in a person are an important personality trait that needs to be nurtured in the learning environment. Further it is also a driving component in any individual to deliver the best and hence this component is also included in the evaluation. However only five key dimensions, that are important in the teaching-learning environment, are taken into consideration for nurturing and evaluation. A little information about these five dimensions is given below as a guideline for the teacher while assessing students.

**1. Co-operation:** It is the voluntary arrangement in which two or more students engage in a mutually beneficial exchange, instead of competition. Cooperation can happen where resources adequate for both students exist or are created by their interaction.

**2. Co-ordination:** It is the unification, integration, synchronization of the effect of group members so as provide unity of action in the pursuit of common goals. It is an integral element and required in each & every function and at each & every stage & therefore it cannot be separated.

**3. Communication;** Communication skill is the set of skills that enables a student to convey information so that it is received and understood.

**4. Sharing:** A part or portion belonging to, distributed to, contributed by, owed by a person or a group **Or** To participate in, use, enjoy or experience jointly or in turns.

**s5. Leadership:** Students with the following leadership qualities are almost always the ones that rise above the crowd.

1. Trustworthiness: This refers to integrity.

2. Inspiration: Guides, leads and inspiring others to want to participate in the process of moving towards the vision.

3. Self awareness: It is the individual awareness of him or her self – their abilities and the impact that they have on others.

4. Acceptance of responsibility: True leaders are accepting responsibility for all that comes their way and taking ownership and responsibilities for getting things back on track. Blaming, justifying and excuse making just is not in their responsibility.

**B.** The **Experimental methodology** is designed for both teacher and student. The teacher can refer the experimental methodology for the details of equipment/apparatus/materials/tools, procedure to be followed, observations to be made, graphs to be drawn and calculations to be done for the task to be performed

## **2. Student**

The Worksheet is designed keeping in view the needs, deficiencies and the adolescent characteristics of the student for student.

The students submit the filled in work sheet given by the teacher on the day of experiment after referring to experimental methodology and listening to instructions of teacher. The design of the worksheet is made user friendly and the contents are so logically sequenced that the student finds it easy to understand and develop the skill of recording and report writing skill. It also helps the student to actively participate in skill learning. More importantly the student gets immediate meaningful feedback of his performance since the competency wise assessment is done and that too on the same day.

## **3. Examiner**

The examiner may find this hand book very useful as Laboratory sheets and Scheme of evaluation provides information with regard to various competencies (skills) the students is expected to acquire during the course of study and the relative weightages of each competency. This information helps him to design a well balance question paper/measurement tool for assessment.

## Amplitude Modulation

**OBJECTIVE:**

- 1) To observe Amplitude modulated waveform and determine Modulation Index using CRO.

**APPARATUS REQUIRED:**

1. Amplitude modulation and demodulation trainer kit.
2. Dual trace CRO.
3. AF signal generator.
4. RF signal generator.
5. Patch cords.

**2. TASK ANALYSIS:****A. KNOWLEDGE**

1. Transistor working principle in non-linear region.
2. Familiarization of different functionalities on front panel of CRO
3. Handling of CRO to measure the amplitude and frequency of analog signal
4. Theoretical calculations of the percentage of modulation.
5. Precautions.

**B. SKILL**

Handling of Apparatus	<ul style="list-style-type: none"> <li>• Identifying various terminals in the kit.</li> <li>• Using CRO.</li> <li>• Using of AF and RF signal generators</li> <li>• Identification of various components</li> <li>• Selecting the connecting wires.</li> </ul>
Manipulation of apparatus	<ul style="list-style-type: none"> <li>• Draw the Circuit Diagram.</li> <li>• Making the connections as per the circuit diagram.</li> <li>• Select AF Analog signal as modulating wave</li> <li>• Select RF Analog signal as carrier wave</li> <li>• Use CRO to see various wave forms (Like modulating, carrier and modulated signal)</li> </ul>
Precise operations/Activities	<ul style="list-style-type: none"> <li>• Observe AM signal using CRO</li> <li>• Measure the values <math>V_{Max}</math> and <math>V_{Min}</math> (in Volts) of AM Wave using CRO</li> <li>• Calculate the percentage of modulation.</li> <li>• By varying amplitudes of modulating signal, observe AM Wave for             <ol style="list-style-type: none"> <li>1) Under modulation (<math>V_m &lt; V_c</math> or <math>m &lt; 1</math>),</li> <li>2) Critical modulation (<math>V_m = V_c</math> or <math>m = 1</math>), and</li> <li>3) Over modulation (<math>V_m &gt; V_c</math> or <math>m &gt; 1</math>).</li> </ol> </li> </ul>

### 3. Teaching Points

Sl No	Teaching Point	Suggested Time-15 min
1.	Need for modulation	1
2	Principle of Modulation and De Modulation	2
3	Types of Modulation	1
4	Transistor working principle in non-linear region.	2
5	Handling of CRO and measuring the amplitude and frequency of analog signal	3
6	Theoretical calculations of the percentage of modulation.	1
7	Precautions.	1

#### A. PROCEDURAL PRECAUTIONS:

- Disconnect all the equipment from mains before making connections
- Connect the circuit as per the circuit diagram.
- Get the connections checked by the concerned staff member
- Select correct range on CRO (Volts/Div, Time/ Div ).
- Give proper input AF and RF signals and collect the output at appropriate points in the kit.
- Ensure that there are no loose connections.
- Calibrate the CRO for getting accurate result.

#### B. SAFETY PRECAUTIONS:

- Never work on a circuit while power is applied.
- Do not connect power to a circuit until the circuit is finished and you have carefully checked your work.
- If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.
- Keep your work area dry.

**3. NEED AND SCOPE OF EXPERIMENT**

This experiment is essential to understand the process by which low frequency (i.e., AF) signal transmitted over the long distance using the high frequency carrier signal (i.e., RF).

**4. PLANNING AND ORGANISATION:**

ACTION	ACTIVITY
Check for	<ul style="list-style-type: none"> <li>• The components on the trainer kit</li> <li>• Various adjustments on the CRO</li> <li>• Connecting wires and probes</li> <li>• The students entry behavior</li> </ul>
For Design of Instruction	<ul style="list-style-type: none"> <li>• Read teaching points carefully.</li> </ul>

**5. SCHEME OF EVALUATION:**

CATEGORY OF SKILL	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY										
1. Handling of apparatus	A. Identifying various Modules in the trainer kit. B. Identification of various components C. Setting the CRO to correct positions. D. Usage of AF and RF signal generators.	<table border="1" data-bbox="1078 1381 1333 1524"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>1</td> <td>2</td> <td>5</td> </tr> </tbody> </table>	A	B	C	D	T	1	1	1	2	5
A	B	C	D	T								
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<p>2. Manipulation of apparatus</p>	<p>A. Draw the Circuit Diagram.                  B. Making the connections as per the Circuit Diagram.                  C. Select AF Analog signal as modulating wave and RF Analog signal as carrier wave                  D. Use CRO to see various wave forms (Like modulating, carrier and modulated signal)</p>	<table border="1"> <tr> <td>A</td> <td>B</td> <td>C</td> <td>D</td> <td>T</td> </tr> <tr> <td>3</td> <td>3</td> <td>4</td> <td>5</td> <td>15</td> </tr> </table>	A	B	C	D	T	3	3	4	5	15
A	B	C	D	T								
3	3	4	5	15								
<p>3.Precise operations/Activities</p>	<p><b><u>Modulation.</u></b></p> <p>A. Observe AM signal using CRO                  B. Measure the values <math>V_{Max}</math> and <math>V_{Min}</math> (in Volts) of AM Wave using CRO                  C. Calculating the percentage of modulation.                  D. By varying amplitude of modulating signal, observe AM Wave for</p> <ol style="list-style-type: none"> <li>Under modulation  <math>(V_m &lt; V_c \text{ or } m &lt; 1)</math>,</li> <li>Critical modulation  <math>(V_m = V_c \text{ or } m = 1)</math>, and</li> <li>Over modulation  <math>(V_m &gt; V_c \text{ or } m &gt; 1)</math>.</li> </ol>	<table border="1"> <tr> <td>A</td> <td>B</td> <td>C</td> <td>D</td> <td>T</td> </tr> <tr> <td>4</td> <td>5</td> <td>4</td> <td>12</td> <td>25</td> </tr> </table>	A	B	C	D	T	4	5	4	12	25
A	B	C	D	T								
4	5	4	12	25								
<p>4.Values</p>	<p>A. Co-operation.                  B. Co-ordination                  C. Communication                  D. Sharing                  E. leadership</p>	<table border="1"> <tr> <td></td> </tr> <tr> <td>5</td> </tr> </table>		5								
5												
<p>Total</p>		<p>50</p>										

**ASSESSMENT :**

- A. 1. Identify the major sections in the AM trainer board.
2. Identify the components used in AM modulator circuit.
3. Select the proper frequency and amplitude ranges of message and carrier signals.
- B. 1. Make the connections on the trainer board to observe the AM waveform on CRO.
2. Set the 100 % modulated AM wave on CRO.
3. Set the over modulation wave on CRO.
- C. 1. Observe the AM waveform and calculate modulation index using CRO
2. Observe and sketch the message signal, carrier signal and AM modulated signal
3. Observe the AM waveform and calculate percentage of modulation using CRO
4. Observe and sketch the critical modulated, over modulated and under modulated AM modulated signal

**VIVA QUESTIONS:**

1. How do you differentiate modulating signal and Carrier signal?
2. Why do we need Modulation?
3. What is Modulation?
4. What is Amplitude Modulation?
5. What is modulation index?.
6. When only carrier input given to AM modulator, what will be the output?
7. How do you differentiate AM based on Modulation Index?
8. Where do you find the applications of AM?
9. How do you generate different types of AM?
10. What is AM demodulation?
11. What will be output of AM De-modulator if modulation index of AM wave is greater than 1?
12. How do you detect AM?

**FREQUENCY MODULATION**

**OBJECTIVE:** 1.To observe FM signal waveform and find Modulation index using CRO.

**APPARATUS REQUIRED**

- 1.FM modulation and demodulation kit
2. CRO
3. AF and RF signal generators
4. Probes
5. Connecting wires

**TASK ANALYSIS:****A. KNOWLEDGE**

1. Purpose of modulation
2. Calculation of modulation index
3. Identification of various components values like resistor, capacitor, diode, transistors, etc,
4. Applications VCO
5. Theoretical value of modulation index
6. Precautions.

**B. SKILL**

Handling of Apparatus	<ul style="list-style-type: none"> <li>• Identification of various electronic components.</li> <li>• Identification of concerned IC number</li> <li>• Identifying various terminals</li> <li>• Setting the CRO to correct positions ( volt/div.,time/div)</li> </ul>
Manipulation of apparatus	<ul style="list-style-type: none"> <li>• Draw the Circuit Diagram.</li> <li>• Making the connections as per the circuit diagram.</li> <li>• Calibrate the CRO for getting accurate result</li> <li>• Selection of correct waveform and right frequency from the AF and RF signal generators</li> <li>• Proper adjustment of time/div. and volt/div. for the concerned channel in the CRO.</li> </ul>
Precise operations/Activities	<ul style="list-style-type: none"> <li>• Observe the waveform in the CRO</li> <li>• Record the amplitude and frequency values of waveforms.</li> <li>• Calculate the value of modulation index.</li> <li>• Draw the graph.</li> <li>• Comparison of theoretical and practical values of modulation index.</li> <li>• Obtain the accurate modulated waveform.</li> </ul>

**2. TEACHING POINTS:**

Sl No	Teaching Point	Suggested Time-15 min
1.	Definition of frequency modulation.	2
2.	Operation of CRO.	2
3.	Working of VCO.	2
4.	Purpose and use of various electronic component Like resistor, capacitor and diode	2
5.	Study of data sheet of concerned IC.	1
6.	Procedure for calculating modulation index.	2
7.	Trouble shooting technique procedure	1
8.	Applications of FM	2
9.	Precautions.	1

**A. PROCEDURAL PRECAUTIONS:**

- Disconnect all the equipment from mains before making connections
- Ensure the correct frequency range of AF and RF signal generators.
- Connect the circuit as per the circuit diagram and check for polarity
- Get the connections checked by the concerned staff member
- Calibrate the CRO for getting accurate result.
- Ensure that there are no loose connections
- Capacitor should be connected with proper polarity.
- Avoid parallax error while observing the values of waveforms on CRO

**B. SAFETY PRECAUTIONS:**

- Never do modification of connections on a circuit while power is ON.
- Do not switch on power to a circuit until the circuit is finished and you have carefully checked your work.
- If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.
- Keep your work area dry.

**3. NEED AND SCOPE OF EXPERIMENT:**

Need of frequency Modulation is to reduce the size of antenna, to separate the signals from different transmitter. Also Modulation allows us to transmit the message signal to longer distance without interference. FM modulation can be used in telemetry, FM radio broadcasting, radar and seismic prospecting etc.,

**4. PLANNING AND ORGANISATION:**

ACTION	ACTIVITY
Check for	<ul style="list-style-type: none"><li>• Various adjustments on CRO.</li><li>• FM Trainer kit</li><li>• The students entry behavior</li><li>• Usage of proper wires or patch cords.</li></ul>
For Design of Instruction	<ul style="list-style-type: none"><li>• Read teaching points carefully.</li></ul>

**5. SCHEME OF EVALUATION:**

CATEGORY OF SKILL	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY												
1. Handling of apparatus	A) Identify various terminals B) Set the CRO to correct positions. C) Identification of various electronic components. D) Identification of concerned IC number.	<table border="1" data-bbox="1089 898 1349 1016"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2</td> <td>1</td> <td>1</td> <td>5</td> </tr> </tbody> </table>	A	B	C	D	T	1	2	1	1	5		
A	B	C	D	T										
1	2	1	1	5										
2. Manipulation of apparatus	A) Draw the Circuit Diagram. B) Making the connections as per the circuit diagram. C) Calibrate the CRO for getting accurate result D) Selection of correct waveform and right frequency from the AF and RF signal generators E) Proper adjustment of time/div. and volt/div. for the concerned channel.	<table border="1" data-bbox="1089 1245 1419 1362"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>3</td> <td>2</td> <td>3</td> <td>4</td> <td>15</td> </tr> </tbody> </table>	A	B	C	D	E	T	3	3	2	3	4	15
A	B	C	D	E	T									
3	3	2	3	4	15									

<p>3.Precise operations/Activities</p>	<p>A) Observe the waveform in the CRO                  B) Record the amplitude and frequency values of waveforms.                  C) Calculate the value of modulation index.                  D) Draw the graph.                  E) Compare theoretical and practical values of modulation index.                  F) Get the accurate waveform</p>	<table border="1" data-bbox="1149 359 1484 478"> <tr> <td>A</td> <td>B</td> <td>C</td> <td>D</td> <td>E</td> <td>F</td> <td>T</td> </tr> <tr> <td>5</td> <td>4</td> <td>5</td> <td>5</td> <td>4</td> <td>2</td> <td>25</td> </tr> </table>	A	B	C	D	E	F	T	5	4	5	5	4	2	25
A	B	C	D	E	F	T										
5	4	5	5	4	2	25										
<p>4.Values</p>	<p>A. Co-operation.                  B. Co-ordination                  C. Communication                  D. Patience.                  E. leadership</p>	<table border="1" data-bbox="1157 919 1351 1031"> <tr> <td></td> </tr> <tr> <td>5</td> </tr> </table>		5												
5																
<p>Total</p>		<p>50</p>														

**VIVA QUESTIONS:**

1. What is modulation and demodulation?
2. While transmitting voice signal, Frequency modulation is preferable. Why?
3. What happens to message signal frequency, if modulation index is increased?
4. What is the modulation index of FM?
5. Differentiate AM and FM?
6. If  $\beta$  is less than 1, what will be the resultant modulation?
7. How to generate the FM signal?
8. What is the formula for frequency deviation of FM?
9. What are the applications of FM?
10. Is there any phase reversal in FM wave?

**PULSE AMPLITUDE MODULATION AND DEMODULATION**

**OBJECTIVE:** To plot the waveform for Pulse Amplitude modulator and demodulator for given message signal and Carrier signal

**APPARATUS REQUIRED:**

1. Transistor (BC107)
2. Resistors-10 K $\Omega$
3. Digital Multimeter
4. CRO (0-100MHz)
5. Decade Resistance Box (DRB)-(0-1K $\Omega$ )
6. Bread Board
7. Connecting wires
8. Capacitor-1 $\mu$ F

**2. TASK ANALYSIS:****A. KNOWLEDGE**

1. Message signal, Carrier signal, Modulation and Demodulation
2. Discrete signal, Analog and Digital Modulation
3. Sampling Technique
3. Working principle of PAM Modulator and Demodulator
4. Low Pass filter using R,C components.

**2. TEACHING POINTS:**

Sl No	Teaching Point	Suggested Time-15 min
1.	Transistor as switch.	1
2.	Capacitor used in the circuit	1
3.	R, C components as filter circuit.	2
4.	Selecting the frequency and amplitude of sine and square wave in Function generator	2
5.	Observation of waveforms in CRO.	2
6.	Procedure for measuring Amplitude and Frequency in the CRO	2
7.	Procedure for comparing input and output signals.	2
8.	Interpreting Various sections of circuit.	2
9.	Precautions.	1

**A. PROCEDURAL PRECAUTIONS:**

- Disconnect all the equipment from mains before making connections
- Connect the circuit as per the circuit diagram and check for polarity
- Get the connections checked by the concerned staff member
- Calibrate the CRO for getting accurate result
- Ensure that there are no loose connections
- Capacitor should be connecting with proper polarity
- Calibrate theFunction generator for getting accurate result.

**B. SAFETY PRECAUTIONS:**

- Never work on a circuit while power is applied.
- Do not connect power to a circuit until the circuit is finished and you have carefully checked your work.
- If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.

- Keep your work area dry.

### **3. NEED AND SCOPE OF EXPERIMENT**

This experiment is essential to understand the performance of Pulse amplitude Modulator and demodulator Circuit. PAM modulation is simple and relatively cheap, so they are used in Ethernet communication, and in micro-controllers for generating the control signals. PAM can generate other pulse modulation signals and can carry the message at the same time.

### **4. PLANNING AND ORGANISATION:**

ACTION	ACTIVITY
Check for	<ul style="list-style-type: none"> <li>• Function generators and CRO.</li> <li>• Transistor, DRB</li> <li>• Resistors and Capacitors</li> <li>• The students entry behavior</li> <li>• First aid kit</li> <li>• Wires of Standard colors and Gauges</li> </ul>
For Design of Instruction	<ul style="list-style-type: none"> <li>• Read teaching points carefully.</li> </ul>

**5. SCHEME OF VALUATION:**

CATEGORY OF SKILL	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY																						
1. Handling of apparatus	A) Identifying various terminals of Transistor. B) Identification of capacitor and Resistor values. C) Identifying the range of Decade resistance box D) Selecting the correct wires and probes	<table border="1" data-bbox="976 401 1230 520"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2</td> <td>1</td> <td>1</td> <td>5</td> </tr> </tbody> </table>	A	B	C	D	T	1	2	1	1	5												
A	B	C	D	T																				
1	2	1	1	5																				
2. Manipulation of apparatus	A) Draw the Circuit Diagram. B) Making the connections as per the circuit diagram. C) Set the Amplitude, Frequency of message signal and Carrier signal. D) Adjusting DRB to Correct value.	<table border="1" data-bbox="976 884 1279 1003"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>5</td> <td>3</td> <td>2</td> <td>15</td> </tr> </tbody> </table>	A	B	C	D	T	5	5	3	2	15												
A	B	C	D	T																				
5	5	3	2	15																				
3. Precise operations/Activities	<p style="text-align: center;"><b><u>PAM Modulator</u></b></p> A) Measure I/P message signal amplitude and Frequency. B). Measure I/P Carrier signal amplitude and Frequency C) Observing the waveforms on CRO. D) Note the Amplitude and Frequency of PAM modulated output. E) Compare the waveform of PAM Modulator with Input message signal.	<table border="1" data-bbox="976 1352 1531 1493"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>F</th> <th>G</th> <th>H</th> <th>I</th> <th>J</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>3</td> <td>1</td> <td>2</td> <td>4</td> <td>2</td> <td>1</td> <td>3</td> <td>4</td> <td>2</td> <td>25</td> </tr> </tbody> </table>	A	B	C	D	E	F	G	H	I	J	T	3	3	1	2	4	2	1	3	4	2	25
A	B	C	D	E	F	G	H	I	J	T														
3	3	1	2	4	2	1	3	4	2	25														

	<p style="text-align: center;"><b><u>PAM Demodulator</u></b></p> <p>F) Adjust the DRB for filter operation.          G) Observing the waveforms on CRO          H) Note the Amplitude and Frequency of Demodulated Wave          I) Compare the waveform of PAM Demodulator with Input message signal.          J) Draw the graphs</p>			
<p>4.Values</p>	<p>A. Co-operation.          B. Co-ordination          C. Communication          D. Sharing          E. leadership</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="width: 100px; height: 20px;"></td> </tr> <tr> <td style="text-align: center;">5</td> </tr> </table>		5
5				
<p>Total</p>	<p>50</p>			

**VIVA QUESTIONS:**

1. Inputs required for PAM.
2. How the Pulse Modulation schemes are different from analog modulation?
3. Condition for sampling frequency?
4. Why Aliasing effect occurs?
5. How many types of sampling techniques?
6. Difference between Flat top and Natural Sampling?
7. What happened if filter is absent?
8. Where we can use PAM?
9. Disadvantages of PAM?

**TYPICAL PROBLEMS MAY OCCUR IN THE EXERCISE:**

1. Output is a clipped modulated waveform  
Sol: Improper placement of Transistor terminals
2. Carrier overlapping on the demodulated output  
Sol: select proper filter values
3. No modulation at the modulator output  
Sol: check proper connections and levels of signals

## **PULSE WIDTH MODULATION AND DEMODULATION**

**OBJECTIVE:** Verify and observe pulse width modulation and Demodulation waveforms on CRO

### **APPARATUS REQUIRED:**

1. 555 timer IC -1No
2. DC Power Supplies and leads
3. Diodes (1N4007)-1No.
4. CRO and Probes
5. Pulse generators and leads
6. Sine wave generators and leads
7. 4.3 k $\Omega$   $\frac{1}{4}$  watt resistor -1 No
8. 0.1 $\mu$ F Capacitors – 2 No
9. 10 $\mu$ F Capacitors – 1 No
10. 100 $\mu$ F Capacitors – 1 No
11. Bread Board
12. Connecting wires

## **2. TASK ANALYSIS:**

### **A. KNOWLEDGE**

1. 555 timer IC working principle
2. Function of each PIN in 555 IC timer
3. Working of PN-Junction diode
4. The roll of capacitors and its use
5. Applications of PN Junction diode and Capacitor
6. Different applications of digital modulation

**B. SKILL**

Handling of Apparatus	<p>A) Identifying various terminals</p> <p>B) Using correct range Resistors , Capacitors.</p> <p>C) Identify each pin of 555 IC timer.</p> <p>D) Identification of 555 IC timer terminals by markings.</p> <p>E) Identification of terminals of diode and capacitor</p>
Manipulation of apparatus	<ul style="list-style-type: none"> <li>• Draw and identify the test points in Circuit Diagram.</li> <li>• Making the connections as per the circuit diagram.</li> <li>• Vary input sinusoidal wave form (<math>v_i</math>) and Pulse wave form</li> <li>• Connect capacitor filter as shown in the figure.</li> </ul>
Precise operations/Activities	<ul style="list-style-type: none"> <li>• Connect Sine wave generators and Measure <math>V_i</math></li> <li>• Connect Pulse generators and Measure <math>V_i</math></li> <li>• Using DC Power Supplies and provide Proper biasing to the circuit</li> <li>• Observing the readings in the multimeter</li> <li>• Observing the waveforms on CRO.</li> <li>• Observe the Pulse width variation with respect to the amplitude of sinusoidal wave form.</li> </ul>

**2. TEACHING POINTS:**

Sl No	Teaching Point	Suggested Time-15 min
1.	Working of 555 timer IC	2
2.	Function of each PIN in 555 IC timer	5
3.	Use of a PN-Junction diode in this experiment	2
4.	Roll of capacitors in this experiment and its uses.	1
5.	Operation of CRO	1
6.	Function and operation of signal generators	1
7.	Interpreting 555 timer IC Manual.	2
8.	Precautions.	1

**A. PROCEDURAL PRECAUTIONS:**

- Disconnect all the equipment from mains before making connections
- Ensure the correct range of meters
- Connect the circuit as per the circuit diagram and check for polarity
- Get the connections checked by the concerned staff member
- Calibrate the CRO for getting accurate result.
- Use the proper signal generators
- Ensure that there are no loose connections
- Filter capacitor should be connecting with proper polarity.

**B. SAFETY PRECAUTIONS:**

- Never work on a circuit while power is applied.
- Do not connect power to a circuit until the circuit is finished and you have carefully checked your work.
- If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.
- Keep your work area dry.
- Always wear safety goggles.

### **3. NEED AND SCOPE OF EXPERIMENT**

This experiment is essential to understand the performance of Pulse width modulation and Demodulation. The amplitude is constant; width of the pulse is proportional to the amplitude of the modulating signal. Bandwidth on transmission channel depends on rise time of the pulse. The demodulation circuit used is a simple filter circuit that demodulates the PWM signal and gives the original message input..

### **4. PLANNING AND ORGANISATION:**

<b>ACTION</b>	<b>ACTIVITY</b>
Check for	<ul style="list-style-type: none"> <li>• The circuit, Diodes and CRO.</li> <li>• 555 IC timer</li> <li>• The students entry behavior</li> <li>• First aid kit</li> <li>• Wires of Standard colours and Gauges</li> </ul>
For Design of Instruction	<ul style="list-style-type: none"> <li>• Read teaching points carefully.</li> </ul>

### **5. SCHEME OF EVALUATION**

<b>CATEGORY OF SKILL</b>	<b>SUB TASK</b>	<b>WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY</b>												
1. Handling of apparatus	A) Identifying various terminals B) Using correct range Resistors , Capacitors. C) Identify each pin of 555 IC timer. D) Identification of 555 IC timer terminals by markings. E) Identification of capacitor and resistors values..	<table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>5</td> </tr> </tbody> </table>	A	B	C	D	E	T	1	1	1	1	1	5
A	B	C	D	E	T									
1	1	1	1	1	5									

<p>2. Manipulation of apparatus</p>	<p>A) Draw the Circuit Diagram.                  B). Making the connections as per the circuit diagram.                  C). Vary input sinusoidal wave form (<math>v_i</math>) and Pulse wave form</p>	<table border="1"> <tr> <td>A</td> <td>B</td> <td>C</td> <td>D</td> <td>T</td> </tr> <tr> <td>5</td> <td>5</td> <td>3</td> <td>2</td> <td>15</td> </tr> </table>	A	B	C	D	T	5	5	3	2	15				
A	B	C	D	T												
5	5	3	2	15												
<p>3.Precise operations/Activities</p>	<p>A). Connect Sine wave generators and measure <math>V_i</math>                  B).Connect Pulse generators and measure <math>V_i</math>                  C)Use DC Power Supplies and provide proper biasing to the circuit                  D). Observe the readings in the millimeter                  E).Observe the waveforms on CRO.                  F).Observe the Pulse width variation with respect to the sinusoidal wave form</p>	<table border="1"> <tr> <td>A</td> <td>B</td> <td>C</td> <td>D</td> <td>E</td> <td>F</td> <td>T</td> </tr> <tr> <td>4</td> <td>4</td> <td>4</td> <td>5</td> <td>4</td> <td>4</td> <td>25</td> </tr> </table>	A	B	C	D	E	F	T	4	4	4	5	4	4	25
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<p>4.Values</p>	<p>A. Co-operation.                  B. Co-ordination                  C. Communication                  D. Sharing                  E. leadership</p>	<table border="1"> <tr> <td style="height: 20px;"></td> </tr> <tr> <td style="text-align: center;">5</td> </tr> </table>		5												
5																
<p>Total</p>		<p>50</p>														

**ASSESSMENT / VIVA QUESTIONS:**

1. What is a Pulse width modulation?
2. What is the roll of diode in this circuit?
3. What is the another name of pulse width modulation?
4. Is the output pulse width truly proportional to the modulation voltage?

**PULSE POSITION MODULATION AND DEMODULATION**

**OBJECTIVE:** To implement pulse position modulation and demodulation and observe the Waveforms on CRO.

**APPARATUS REQUIRED:**

1. IC 555
2. Transistor BC-107
3. Resistors
4. Capacitors
5. Regulated DC Power supply
6. CRO
7. Waveform generator
8. Connecting wires
9. CRO probes
10. Bread board

**2. TASK ANALYSIS:****A. KNOWLEDGE**

1. Working of IC 555.
2. Applications of IC 555
3. Types of transistors
4. Working of transistor
5. Transistor operating modes.
6. Types of capacitors and its use
7. Working of CRO.
8. Working of function generator.
9. Pin diagram of IC 555.
10. Precautions.

**B. SKILL**

Handling of Apparatus	<ul style="list-style-type: none"> <li>• Identifying pins in IC 555.</li> <li>• Identifying transistor terminals.</li> <li>• Identifying resistors.</li> <li>• Identifying Capacitors.</li> <li>• Select the appropriate signal in function generator.</li> </ul>
Manipulation of apparatus	<ul style="list-style-type: none"> <li>• Draw the Circuit Diagram.</li> <li>• Making the connections as per the circuit diagram.</li> <li>• Switch on the power supply.</li> <li>• Apply the function generator output to the input of the circuit.</li> <li>• Apply the PPM output to the input of the Demodulated circuit.</li> </ul>
Precise operations/Activities	<ul style="list-style-type: none"> <li>• Observe the input waveform and measure amplitude and time period.</li> <li>• Observe the clock signal and measure the amplitude and time period.</li> <li>• Observe the output waveform and measure its amplitude.</li> <li>• Observe the demodulated output waveform and measure its amplitude and time period</li> <li>• .Record, <math>V_{in}</math>, <math>f_{in}</math>, <math>f_{clk}</math>, <math>V_o</math> and demodulated signal amplitude and time period.</li> <li>• Draw the waveforms for input, clock, output and demodulated output with respect to voltage and frequency.</li> </ul>

**2. TEACHING POINTS:**

Sl No	Teaching Point	Suggested Time-15 min
1.	Working of IC 555.	3
2.	Applications of IC 555.	2
3.	Operation of CRO.	2
4.	Operation of function generator.	2
5.	Working of capacitors and its types.	1
6.	Working of resistor and its types	1
7.	Procedure for calculating amplitude.	1
8.	Procedure for calculating time period.	1
9.	Procedure for calculating frequency.	1
10.	Precautions.	1

**A. PROCEDURAL PRECAUTIONS:**

- Disconnect all the equipment from mains before making connections
- Ensure that IC and transistor properly placed.
- Connect the circuit as per the circuit diagram and check for polarity
- Get the connections checked by the concerned staff member
- Calibrate the CRO for getting accurate result.
- Use the function generator in proper mode.
- Ensure that there are no loose connections.
- Connect the power supply to the IC with proper polarity.
- Make DC offset as zero in function generator.

**B. SAFETY PRECAUTIONS:**

- Never work on a circuit while power is applied.
- Do not connect power to a circuit until the circuit is finished and you have carefully checked your work.

- If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.
- Keep your work area dry.
- Always wear safety goggles.

### **3. NEED AND SCOPE OF EXPERIMENT**

This experiment is essential to understand the performance of pulse position modulation and demodulation input and output wave forms. It is the technique that allows the computers to share data by measuring the time each data packet takes to reach the computer. It is often used in optical communication, such as fiber optics, in which there is little multi-pathway interference.

### **4. PLANNING AND ORGANISATION:**

<b>ACTION</b>	<b>ACTIVITY</b>
Check for	<ul style="list-style-type: none"> <li>• IC, Transistor and CRO.</li> <li>• Waveform generator.</li> <li>• Resistors and capacitors</li> <li>• Regulated power supply</li> <li>• The students entry behavior</li> <li>• First aid kit</li> <li>• Wires of Standard colours and Gauges</li> </ul>
For Design of Instruction	<ul style="list-style-type: none"> <li>• Read teaching points carefully.</li> </ul>

**5. SCHEME OF EVALUATION:**

CATEGORY OF SKILL	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY										
1. Handling of apparatus	A) Identifying various pins. B) Selecting the input signal in Wave form generator. C) Identification of Transistor terminals D) Identification of capacitor and resistors values circuits.	<table border="1" data-bbox="1089 632 1349 751"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>1</td> <td>1</td> <td>1</td> <td>5</td> </tr> </tbody> </table>	A	B	C	D	T	2	1	1	1	5
A	B	C	D	T								
2	1	1	1	5								
2. Manipulation of apparatus	A) Draw the Circuit Diagram. B) Making the connections as per the circuit diagram. C) apply the input signal from function generator D) apply the PPM signal to Demodulation circuit	<table border="1" data-bbox="1089 1016 1393 1136"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>5</td> <td>3</td> <td>2</td> <td>15</td> </tr> </tbody> </table>	A	B	C	D	T	5	5	3	2	15
A	B	C	D	T								
5	5	3	2	15								

<p>3.Precise operations/Activities</p>	<p>A) Observing the input waveform on CRO.                  B) Measure amplitude &amp; time period.                  C) Observing the clock signal on CRO.                  D) Measure amplitude &amp; time period.                  D) Observing the output waveform on CRO.                  E) Measure amplitude.                  F) Observe the demodulated output waveform                  G)measure amplitude and time period                  H) Record <math>V_{in}, f_{in}, f_{clk}, V_o</math> and demodulated signal amplitude and frequency..                  J) draw the waveforms on graph sheet</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>F</th> <th>G</th> <th>H</th> <th>J</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>2</td> <td>1</td> <td>2</td> <td>2</td> <td>1</td> <td>2</td> <td>6</td> <td>7</td> <td>25</td> </tr> </tbody> </table>	A	B	C	D	E	F	G	H	J	T	2	2	1	2	2	1	2	6	7	25
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<p>4.Values</p>	<p>A. Co-operation.                  B. Co-ordination                  C. Communication                  D. Sharing                  E. leadership</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="height: 20px;"></td> </tr> <tr> <td style="text-align: center;">5</td> </tr> </table>		5																		
5																						
<p>Total</p>		<p>50</p>																				

**ASSESSMENT / VIVA QUESTIONS:**

1. What is a IC 555?
2. What is the function of IC 555?
3. How many pins in IC 555?
4. Which pin indicates the output in IC 555 ?
5. What is the function of pin 2 in IC 555?
6. What is the pin for power supply in IC 555?
7. What is the function of pin 4 in IC 555?
8. Which pin indicates the ground in IC 555?
9. Where the ppm output have maximum pulse gap?
10. Where the ppm output have minimum pulse gap?
11. How many types of wave forms are generated by wave form generator?
12. How many control knobs are there in wave form generator?
13. Which multivibrator is used in PPM modulator?
14. Which transistor configuration is used in PPM demodulation?
15. What are the types of transistors.
16. Why NPN transistor used rather than PNP.

**AMPLITUDE SHIFT KEYING MODULATOR AND DEMODULATOR**

**OBJECTIVE:** To set up ASK modulator and demodulator circuits and to observe the waveforms

**APPARATUS REQUIRED:**

**ASK MODULATOR AND DEMODULATOR TRAINER BOARD**

**(OR)**

1. Diode (1N4007)-1No.
2. Transistor (BC 107)
3. Digital Multimeter
4. CRO (0-100MHz)
5. Resistors-22 k  $\Omega$ , 2.2 k  $\Omega$ , 1 k  $\Omega$
6. Function generators
7. Capacitor– 0.1 $\mu$ F
8. IC 741
9. IC MAX 232
10. Bread board
11. Connecting wires
12. Potentiometer-0-10K $\Omega$
13. Regulated power Supply (0-30V)

**2. TASK ANALYSIS:**

**A. KNOWLEDGE**

1. Message signal, Carrier signal, Modulation and Demodulation
2. Discrete signal, Analog and Digital Modulation
3. Working principal of ASK Modulator and Demodulator
4. Use of PN Junction diode as Rectifier.
5. Low Pass filter using R,C components
4. IC 741 Pin diagram
5. Using 741 as Voltage Comparator
6. IC MAX 232 Pin diagram
7. IC MAX 232 Voltage Converter
8. Precautions.

**B. SKILL**

Handling of Apparatus	<ul style="list-style-type: none"> <li>A. Identifying various blocks of trainer board or Identifying various components required</li> <li>B. Identifying the Pins of IC 741 ,IC MAX 232</li> <li>C. Identifying terminals of Potentiometer (POT).</li> <li>D. Identification of capacitor and Resistor values.</li> <li>E. Selecting the correct wires.</li> </ul>
Manipulation of apparatus	<ul style="list-style-type: none"> <li>A. Draw the Circuit Diagram.</li> <li>B. Making the connections as per the circuit diagram.</li> <li>C. Set the Amplitude and Frequency of message and Carrier signals.</li> <li>D. Adjusting the Potentiometer (POT)to set the Reference Voltage.</li> <li>E. Set Correct operating voltages for IC741, IC MAX 232.</li> </ul>
Precise operations/Activities	<p style="text-align: center;"><b><u>ASK Modulator</u></b></p> <ul style="list-style-type: none"> <li>A. Measure I /P Message signal Amplitude ,time period and Frequency.</li> <li>B. Measure I /P Carrier signal amplitude,time period and Frequency.</li> <li>C. Observe the readings in the multimeter.</li> <li>D. Observing the waveforms on CRO.</li> <li>E. Note the Amplitude and time period of the Modulated Wave.</li> </ul> <p style="text-align: center;"><b><u>ASK Demodulator</u></b></p> <ul style="list-style-type: none"> <li>F. Adjust the POT for Comparator operation.</li> <li>G. Observing the waveforms on CRO</li> <li>H. Note the Amplitude ,time period and frequency of Demodulated Wave</li> </ul>

**2. TEACHING POINTS:**

Sl No	Teaching Point	Suggested Time-15 min
1.	Data signal, carrier signal,	2
2.	Principle of ASK modulation and demodulation	3
3.	IC MAX 232 as voltage converter.	1
4.	Selecting the frequency and amplitude of sine and square wave in Function generator	1
5.	Observation of waveforms in CRO.	4
6.	Procedure for comparing input and output signals.	2
7.	Interpreting Various sections of circuit.	1
8.	Precautions.	1

**A. PROCEDURAL PRECAUTIONS:**

- Disconnect all the equipment from mains before making connections
- Connect the circuit as per the circuit diagram and check for polarity
- Get the connections checked by the concerned staff member
- Calibrate the CRO, function generator for getting accurate result
- Ensure that there are no loose connections
- Capacitor should be connecting with proper polarity
- IC's should be connecting according to their pin description
- Calibrate the RPS for getting accurate result.

**B. SAFETY PRECAUTIONS:**

- Never work on a circuit while power is applied.
- Do not connect power to a circuit until the circuit is finished and you have carefully checked your work.
- If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.
- Keep your work area dry.

### **3. NEED AND SCOPE OF EXPERIMENT**

This experiment is essential to understand the performance of Amplitude shift keying Modulator and demodulator Circuit. Compare to the Analog modulation schemes, ASK requires low transmission power. Because during logic 0 bit transmission there is no power required. The circuit for ASK modulation is simple and relatively cheap, so they are used in low cost systems for low communication range such as RFID, ETC.

### **4. PLANNING AND ORGANISATION:**

<b>ACTION</b>	<b>ACTIVITY</b>
Check for	<ul style="list-style-type: none"> <li>• The Multimeter, Diodes and CRO.</li> <li>• Transistor, Capacitors.</li> <li>• Function generators ,Regulated power supply</li> <li>• IC's</li> <li>• The students entry behavior</li> <li>• First aid kit</li> <li>• Wires of Standard colors and Gauges</li> </ul>
For Design of Instruction	<ul style="list-style-type: none"> <li>• Read teachingpointscarefully.</li> </ul>

**5. SCHEME OF EVALUATION:**

CATEGORY OF SKILL	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY												
1. Handling of apparatus	<p>A. Identifying various blocks of trainer board or Identifying various components required</p> <p>B. Identifying the Pins of IC 741 ,IC MAX 232</p> <p>C. Identifying terminals of Potentiometer (POT).</p> <p>D. Identification of capacitor and Resistor values.</p> <p>E. Selecting the correct wires.</p>	<table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>5</td> </tr> </tbody> </table>	A	B	C	D	E	T	1	1	1	1	1	5
A	B	C	D	E	T									
1	1	1	1	1	5									
2. Manipulation of apparatus	<p>A) Drawthe Circuit Diagram.</p> <p>B) Making the connections as per the circuit diagram.</p> <p>C) Set the Amplitude, Frequency of message signal and Carrier signal.</p> <p>D) Adjusting the Potentiometer (POT) for required Reference voltage level.</p> <p>E) Set Correct operating voltages for IC741, IC MAX 232 .</p>	<table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>5</td> <td>3</td> <td>1</td> <td>1</td> <td>15</td> </tr> </tbody> </table>	A	B	C	D	E	T	5	5	3	1	1	15
A	B	C	D	E	T									
5	5	3	1	1	15									

<p>3.Precise operations/Activities</p>	<p><b><u>ASK Modulator</u></b>                  A) Measure I/P message signal amplitude ,time period and Frequency.                  B). Measure I/P Carrier signal amplitude, time period and Frequency                  C) Observing the waveforms on CRO.                  D) Note the Amplitude and Frequency ASK modulated output.                  E) Compare the waveform of ASK Modulator with Input message signal.</p> <p><b><u>ASK Demodulator</u></b>                  F) ASK modulated signal to voltage comparator to setting of Potentiometer (POT).                  G)Measure Demodulated signal amplitude ,time period and frequency.                  Tabulate the readings and observe the waveforms on CRO                  H)Drawing the graphs</p>	<table border="1"> <tr> <td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td><td>H</td><td>T</td> </tr> <tr> <td>2</td><td>2</td><td>4</td><td>3</td><td>3</td><td>2</td><td>4</td><td>5</td><td>25</td> </tr> </table>	A	B	C	D	E	F	G	H	T	2	2	4	3	3	2	4	5	25
A	B	C	D	E	F	G	H	T												
2	2	4	3	3	2	4	5	25												
<p>4.Values</p>	<p>A. Co-operation.                  B. Co-ordination                  C. Communication                  D. Sharing                  E. leadership</p>	<table border="1"> <tr> <td style="height: 20px;"></td> </tr> <tr> <td style="text-align: center;">5</td> </tr> </table>		5																
5																				
<p>Total</p>	<p>50</p>																			

**ASSESSMENT / VIVA QUESTIONS:**

1. Inputs required for ASK.
2. Types of Digital Modulation schemes?
3. When the diode become Reverse bias in the circuit what would be the expected waveform?
4. Why we connect a resistor across a capacitor?
5. Need for filter in the circuit?
6. Why not ASK used for long distance communication?
7. Need of reference voltage in this circuit?
8. Why Voltage Comparator used in this circuit?
9. In the absence of Voltage converter what is the output?
10. How the digital Modulation schemes are different from analog modulation?
11. What happened if filter is absent?
12. Where we can use ASK?
13. Disadvantages of ASK?

**TYPICAL PROBLEMS MAY OCCUR IN THE EXCERCISE:**

1. Output is a clipped modulated waveform  
Sol: Improper placement of Transistor terminals
2. Carrier overlapping on the demodulated output  
Sol: select proper filter values
3. No modulation at the modulator output  
Sol: check proper connections and levels of signals
4. Negative peaks at the diode output  
Sol: diode terminals should interchanged
5. Inverted output at the IC 741  
Sol: Properly connect the inputs to inverting and noninverting pins of IC
6. Bipolar voltages appeared at the output of IC 741  
Sol: use voltage level converter.

## **FSK Modulation and Demodulation**

**OBJECTIVE :** 1.To generate FSK Modulated signal & demodulate it.  
2. To plot the corresponding waveforms.

**APPARATUS REQUIRED :** 1. FSK Modulation and Demodulation Trainer Kit.  
2. CRO and Its probes  
3. Patch chords.

### **1. TASK ANALYSIS:**

#### **A.KNOWLEDGE**

1. Digital modulation technique
2. Difference between Analog modulation Technique & Digital modulation technique.
3. Need for Digital modulation technique.
4. Types of digital modulation techniques.
5. Frequency shift keying.
6. Modulating signal, Carrier signal and Modulated signal
7. About CRO and its different controls
8. High frequencies & Low frequencies in a waveform.
9. Precautions

**B.SKILL****Teaching Points**

Handling of Apparatus	<p>A). Identifying various parts in KIT like DATA signal generator, Carrier signal generator and FSK modulator and FSK demodulator.</p> <p>B) Identifying required patch chords,</p> <p>C) Identifying different controls in CRO.</p>
Manipulation of apparatus	<p>A) Draw the Circuit Diagram.</p> <p>B) Making the connections as per the circuit diagram.</p> <p>C) Switching ON the Power Supply</p> <p>C) Adjusting the controls in CRO to get desired waveforms.</p>
Precise operations /Activities	<p style="text-align: center;"><b><u>FSK Modulation</u></b></p> <p>A) Observe the DATA signal on CRO and record its amplitude, Time period and frequency.</p> <p>B) Observe the carrier signal on CRO and record its amplitude, Time period and frequency.</p> <p>C) Observe the changes in frequencies of Modulated signal on CRO during 1 and 0 of data signal and record its amplitude, Time period and frequency.</p> <p>D) Draw the waveforms in graph sheet.</p>
	<p style="text-align: center;"><b><u>FSK Demodulation</u></b></p> <p>A) Observe the Demodulated DATA signal on CRO and record its amplitude , Time period and frequency.</p> <p>B) Verify that the demodulated DATA signal is same as transmitted one.</p> <p>C) Draw the Waveforms in graph sheet.</p>

S.No	Teaching Points	Suggested Time-15 min
1	Modulation and Demodulation	2
2	Types of modulation techniques	5
3	About FSK and its waveforms	3
4	Operation of CRO	2
5	Procedure for calculating amplitude, Time and Frequency of signal.	2
6	Precautions	1

### **A. Procedural Precautions:**

1. Disconnect all the equipment from mains before making connections
2. Connect the circuit as per the circuit diagram.
3. Get the connections checked by the concerned staff member.
4. Calibrate the CRO for getting accurate result.
5. Ensure that there are NO loose connections.

### **B.Safety Precautions:**

1. Never work on a trainer kit while the power button is ON position.
2. Don't turn ON the supply until sure about the connections.
3. If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.
4. Keep your work area dry.
5. Always wear shoes while working on trainer kits.

### **3. Need and Scope of Experiment:**

This experiment is essential to understand the performance of FSK modulation and demodulation. The technology is used for communication systems such as telemetry, weather balloon radiosondes, caller ID, garage door openers, and low frequency radio transmission in the VLF and ELF bands

- It is used on voice grade lines for data rates up to 1200 bps.
- It is used for high frequency radio transmission from 3 to 30 M Hz.
- It is also used in coaxial cable based LAN (Local Area Network) at higher frequencies.

**4. Planning and Organization :**

Action	Activity
Check for	<ul style="list-style-type: none"> <li>• CRO with probes and patch chords</li> <li>• The students entry behavior</li> <li>• First Aid kit.</li> </ul>
For Design of Instruction	<ul style="list-style-type: none"> <li>• Read teaching points carefully.</li> </ul>

**5. SCHEME OF EVALUATION:**

CATEGORY OF SKILL	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY								
1. Handling of apparatus	<p>A). Identifying various parts in KIT like DATA signal generator, Carrier signal generator and FSK modulator and FSK demodulator.</p> <p>B) Identifying required patch chords,</p> <p>C) Identifying different controls in CRO..</p>	<table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>1</td> <td>2</td> <td>5</td> </tr> </tbody> </table>	A	B	C	T	2	1	2	5
A	B	C	T							
2	1	2	5							
2. Manipulation of apparatus	<p>A) Draw the Circuit Diagram.</p> <p>B) Making the connections as per the circuit diagram.</p> <p>C) Adjusting the controls in CRO to get desired waveforms.</p>	<table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>6</td> <td>6</td> <td>3</td> <td>15</td> </tr> </tbody> </table>	A	B	C	T	6	6	3	15
A	B	C	T							
6	6	3	15							

3. Precise operations/  
Activities

**For FSK Modulation**

- A) Observe the DATA signal on CRO and record its amplitude, Time period and frequency.
- B) Observe the carrier signal on CRO and record its amplitude, Time period and frequency.
- C) Observe the changes in frequencies of Modulated signal on CRO during 1 and 0 of data signal and record its amplitude, Time period and frequency.
- D) Draw the waveforms in graph sheet.

**For FSK Demodulation**

- E) Observe the Demodulated DATA signal on CRO and record its amplitude, Time period and frequency.
- F) Verify that the demodulated DATA signal is same as transmitted one.

A	B	C	D	E	F	T
4	4	5	3	4	5	25

4.Values	A. Co Operation	<table border="1"><tr><td> </td></tr><tr><td>5</td></tr></table>		5
	5			
	B. Co-Ordination			
	C. Communication			
D. Sharing				
E. Leadership				
Total		50		

**ASSESSMENT / VIVA QUESTIONS:**

1. How FSK is different from ASK?
2. What is digital modulation technique?
3. What will happen if the DATA signal is applied as '0' continuously?
4. Can you tell where the FSK is used?.
5. What happens to the phase of the carrier during FSK modulation?
6. What type of medium is used in between FSK Transmitter and Receiver for Transmission?
7. How to apply multiple data signals to FSK modulator

**PHASE SHIFT KEYING**

**OBJECTIVE:** To generate the phase shift keying (PSK) signal at the modulator and recovering the binary message signal at demodulator output.

**APPARATUS REQUIRED:**

- 1.PSK modulation and demodulation trainer kit
2. CRO
3. CRO Probes
4. Patch Cards

**1. TASK ANALYSIS:****A. KNOWLEDGE**

1. Need for Digital Modulation
2. Types of digital modulation techniques.
3. Difference between Analog and Digital Modulation Techniques
4. Working principle and output of Balanced modulator
5. Operation of CRO front panel controls.
6. Types of PSK generating methods.
7. Levels of binary signal.
8. Applications of PSK
9. Precautions.

**B. SKILL**

Handling of Apparatus	<ul style="list-style-type: none"> <li>A) Identifying various terminals.</li> <li>B) Identifying various blocks present in PSK Trainer Kit.</li> <li>C) Identification of CRO Terminals and channels by markings.</li> <li>D) Identification of binary message and carrier signals in the input side of PSK Trainer kit.</li> </ul>
Manipulation of apparatus	<ul style="list-style-type: none"> <li>A) Draw the Block Diagram and Circuit Diagram.</li> <li>B) Making the connections as per the circuit diagram.</li> <li>C) Connecting the Binary message signal and PSK output signal to Channel 1 and Channel 2 Respectively at Modulator Block.</li> <li>D) Connecting the Binary message signal and Demodulated output signal to Channel 1 and Channel 2 Respectively at Demodulator Block.</li> <li>E) Adjusting CRO Volts/Div and Times/Div knobs according with the signal voltage &amp; frequency.</li> </ul>
Precise operations/Activities	<ul style="list-style-type: none"> <li>A) Observing the Binary message and PSK output signals on CRO.</li> <li>B) Observing the Phase shift in the carrier signal in according with the input binary signal either 'logic 1 ' or 'logic 0'</li> <li>C) Calculating the frequency and peak to peak voltage of input binary message signal , PSK signal and demodulated signal.</li> <li>D) Tabulate the readings and observe the waveforms on CRO.</li> <li>E) Drawing the graphs of input binary message signal , PSK signal and demodulated signal.</li> </ul>

**2. TEACHING POINTS:**

Sl No	Teaching Point	Suggested Time-15 min
1.	Digital Modulation and its' uses in communication.	2
2.	Classification of digital modulation techniques.	1
3.	Difference between Analog and Digital Modulation. Techniques	1
4.	Working principle and output of Balanced modulator.	2
5.	Operation of CRO front panel controls.	2
6.	Types of PSK generating methods.	1
7.	Levels of binary signal.	1
8.	Applications of PSK.	1
9.	Advantages and disadvantages of PSK.	1
10.	Bandwidth requirement of PSK.	1
11.	Differences among ASK,FSK and PSK.	1
12.	Precautions.	1

**A. PROCEDURAL PRECAUTIONS:**

- Disconnect all the equipment from mains before making connections
- Connect the circuit as per the block diagram and check for polarity
- Get the connections checked by the concerned staff member
- Calibrate the CRO for getting accurate result.
- Ensure that there are no loose connections.

**B. SAFETY PRECAUTIONS:**

- Never work on a circuit while power is applied.
- Do not connect power to a circuit until the circuit is finished and you have carefully checked your work.
- If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.
- Keep your work area dry.
- Always wear safety goggles.

**3. NEED AND SCOPE OF EXPERIMENT**

This experiment is essential to generate Phase Shift Keying signal. Due to its high signal to noise ratio, Higher bit rate , low cost and lower errors, it is adopted in the industry for various applications like wireless LANs, RFID ,MODEMS , Bluetooth communication, biometric passports, and credit cards such as American Express's Express Pay.

**4. PLANNING AND ORGANISATION:**

ACTION	ACTIVITY
Check for	<ul style="list-style-type: none"> <li>• CRO and Probes.</li> <li>• PSK Trainer Kit.</li> <li>• The students entry behavior</li> <li>• First aid kit</li> <li>• Different colors of patch cards</li> </ul>
For Design of Instruction	<ul style="list-style-type: none"> <li>• Read teaching points carefully.</li> </ul>

**5. SCHEME OF EVALUATION:**

CATEGORY OF SKILL	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY										
1. Handling of apparatus	A) Identifying various terminals B) Identifying various blocks present in PSK Trainer Kit. C) Identification of CRO Terminals and channels by markings. D) Identification of binary message and carrier signals in the input side of PSK Trainer kit.	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>2</td> <td>1</td> <td>5</td> </tr> </tbody> </table>	A	B	C	D	T	1	1	2	1	5
A	B	C	D	T								
1	1	2	1	5								

<p>2. Manipulation of apparatus</p>	<p>A) Draw the Block Diagram and Circuit Diagram.</p> <p>B) Making the connections as per the circuit diagram.</p> <p>C) Connecting the Binary message signal and PSK output signal to Channel 1 and Channel 2 Respectively at Modulator Block.</p> <p>D) Connecting the Binary message signal and Demodulated output signal to Channel 1 and Channel 2 Respectively at Demodulator Block.</p> <p>E) Adjusting CRO Volts/Div and Times/Div knobs According with the signal.</p>	<table border="1" data-bbox="1118 470 1451 611"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>3</td> <td>2</td> <td>2</td> <td>5</td> <td>15</td> </tr> </tbody> </table>	A	B	C	D	E	T	3	3	2	2	5	15
A	B	C	D	E	T									
3	3	2	2	5	15									
<p>3.Precise operations/Activities</p>	<p>A) Observing the Binary message and PSK output signals on CRO.</p> <p>B) Observing the Phase shift in the carrier signal in according with the input binary signal either 'logic 1 ' or 'logic 0'</p> <p>C) Calculating the frequency and peak to peak voltage of input binary message signal , PSK signal and demodulated signal.</p> <p>D) Tabulate the readings and observe the waveforms on CRO.</p> <p>E) Drawing the graphs of input binary message signal , PSK signal and demodulated signal.</p>	<table border="1" data-bbox="1105 1115 1395 1255"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>5</td> <td>5</td> <td>5</td> <td>5</td> <td>25</td> </tr> </tbody> </table>	A	B	C	D	E	T	5	5	5	5	5	25
A	B	C	D	E	T									
5	5	5	5	5	25									

4.Values	<p>A. Co-operation.</p> <p>B. Co-ordination</p> <p>C. Communication</p> <p>D. Sharing</p> <p>E. leadership</p>	<table border="1" data-bbox="1175 298 1459 470"> <tr> <td>A</td> <td>B</td> <td>C</td> <td>D</td> <td>E</td> <td>T</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>5</td> </tr> </table>	A	B	C	D	E	T	1	1	1	1	1	5
A	B	C	D	E	T									
1	1	1	1	1	5									
Total		50												

**ASSESSMENT / VIVA QUESTIONS:**

1. How much phase difference present in carrier signal for binary logic 1 and logic 0?
2. Why phase of the carrier signal is not changing when D.C signal is applied.
3. What are the differences between the FSK & PSK?
4. Can you generate the PSK signal for input analog signal instead of binary input data?
5. How to generate PSK signal from ASK modulator?
6. What is the effect of carrier amplitude on the output?
7. Why FSK bandwidth is more compared with PSK?
8. What is effect on PSK signal if we changes frequency of input binary message signal?
9. How binary 'logic 1' and 'logic 0' is represented in PSK?

## **TIME DIVISION MULTIPLEXING & DE MULTIPLEXING**

**OBJECTIVE:** To transmit a multiplexed output of different frequency message signals through single Channel using TDM system and recover back the original message signals through a De multiplexer at receiver end.

### **APPARATUS REQUIRED:**

1. TDM trainer Kit
2. Voltage source (2Vp-p)
3. IC CD 4051
4. CRO (0 – 100 MHz)
5. Function generator (0- 100 M Hz)
6. Connecting wires

### **2. TASK ANALYSIS:**

#### **A. KNOWLEDGE**

1. Sampling theorem
2. Working principle of TDM
3. Types of multiplexing
4. Sampling rate, channel bandwidth
5. Applications of TDM
6. Need for counter, timer
7. Comparison of TDM, FDM.
8. Precautions.

**B. SKILL**

Handling of Apparatus	<ul style="list-style-type: none"> <li>A. Identifying various terminals</li> <li>B. Using probes, chords.</li> <li>C. Calibrating the CRO/DSO accurate values.</li> <li>D. Identification of terminals by markings.</li> <li>E. Identification of amplitude and frequency ranges of signals to be multiplexed &amp; de multiplexed. On CRO</li> </ul>
Manipulation of apparatus	<ul style="list-style-type: none"> <li>A. Draw the Circuit Diagram.</li> <li>B. Making the connections as per the circuit diagram.</li> <li>C. Adjusting the amplitude and frequency ranges of signals</li> <li>D. Connect the circuit diagram as shown in the figure.</li> </ul>
Precise operations/Activities	<ul style="list-style-type: none"> <li>A. Measure the amplitude &amp; frequency of input signals to be multiplexed.</li> <li>B. Apply the counter/ timer /external signal as selection input line.</li> <li>C. Observe the waveforms on CRO.</li> <li>D. Note down the amplitude and frequency of the multiplexed output signal from CRO.</li> <li>E. Repeat the above steps for de multiplexer</li> </ul>

**2. TEACHING POINTS:**

Sl No	Teaching Point	Suggested Time-15 min
1.	Concept of multiplexing	2
2.	Types of multiplexing	1
3.	Advantages of TDM over FDM	2
4.	Counter/ Timer as Selection line	2
5.	Sampling Theorem sampling rate	1
6.	Need of multiplexing.	1
7.	Procedure for connecting individual signals to be streamed into single line	2
8.	Procedure for connecting counter/timer as selection lines	1
9.	Interpreting trainer kit Details.	2
10.	Precautions.	1

**PRECAUTIONS****A. PROCEDURAL PRECAUTIONS:**

- Disconnect all the equipment from mains before making connections.
- Ensure the correct range of function generator
- Connect the circuit as per the circuit diagram and check for polarity.
- Get the connections checked by the concerned staff member.
- Calibrate the CRO for getting accurate result.
- Ensure that there are no loose connections.

**B. SAFETY PRECAUTIONS:**

- Never work on the trainer kit while power is switched ON.
- Do not connect power to the trainer kit until the circuit connection is fixed.
- If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.
- Keep your work area dry.
- Always wear safety goggles and shoes.

### **3. NEED AND SCOPE OF EXPERIMENT**

This experiment is essential to understand the performance of TDM Circuit for multiple signals to be multiplexed in to single line. Depending on value of selection digital stream, one of the signal is appeared as output on Time sharing manner.

### **4. PLANNING AND ORGANISATION:**

<b>ACTION</b>	<b>ACTIVITY</b>
Check for	<ul style="list-style-type: none"> <li>• Trainer kit,</li> <li>• CRO</li> <li>• The students entry behavior</li> <li>• First aid kit</li> <li>• Connecting wires and</li> </ul>
For Design of Instruction	<ul style="list-style-type: none"> <li>• Read teaching points carefully.</li> </ul>

### **5. SCHEME OF EVALUATION:**

<b>CATEGORY OF SKILL</b>	<b>SUB TASK</b>	<b>WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY</b>												
1. Handling of apparatus	A. Identifying various terminals B. Using probes, chords. C. Calibrating the CRO/DSO accurate values. D. Identification of terminals by markings. E. Identification of amplitude and frequency ranges of signals to be multiplexed & de multiplexed. On CRO	<table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>5</td> </tr> </tbody> </table>	A	B	C	D	E	T	1	1	1	1	1	5
A	B	C	D	E	T									
1	1	1	1	1	5									

2. Manipulation of apparatus	<p>A. Draw the Circuit Diagram.</p> <p>B. Making the connections as per the circuit diagram.</p> <p>C. Adjusting the amplitude and frequency ranges of signals</p> <p>D. Connect the circuit diagram as shown in the figure.</p>	<table border="1" data-bbox="1052 239 1349 359"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>5</td> <td>3</td> <td>2</td> <td>15</td> </tr> </tbody> </table>	A	B	C	D	T	5	5	3	2	15		
A	B	C	D	T										
5	5	3	2	15										
3. Precise operations/Activities	<p>A. Measure the amplitude &amp; frequency of input signals to be multiplexed.</p> <p>B. Apply the counter/ timer /external signal as selection input line.</p> <p>C. Observe the waveforms on CRO.</p> <p>D. Note down the amplitude and frequency of the multiplexed output signal from CRO.</p> <p>E. Repeat the above steps for de multiplexer</p>	<table border="1" data-bbox="1052 709 1459 850"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>3</td> <td>4</td> <td>5</td> <td>10</td> <td>25</td> </tr> </tbody> </table>	A	B	C	D	E	T	3	3	4	5	10	25
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4. Values	<p>A. Co-operation.</p> <p>B. Co-ordination</p> <p>C. Communication</p> <p>D. Sharing</p> <p>E. leadership</p>	<table border="1" data-bbox="1117 1081 1308 1192"> <tbody> <tr> <td style="height: 20px;"></td> </tr> <tr> <td style="text-align: center;">5</td> </tr> </tbody> </table>		5										
5														
Total		50												

**ASSESSMENT / VIVA QUESTIONS:**

1. Why we are doing Multiplexing?
2. In What way TDM and FDM differ?
3. Define Cross talk effect in PAM/TDM system ?.
4. Give the advantages of TDM system over FDM?
5. Give the value of  $T_s$  in TDM system?
6. How signal overlapping is occur red?
7. Which type of modulation technique is used in TDM?
8. What happens if we apply sine wave at selection input lines?

## **FREQUENCY DIVISION MULTIPLEXING & DE MULTIPLEXING**

**OBJECTIVE:** To transmit a multiplexed output of different frequency message signals through single Channel using FDM system and recover back the original message signals through a De multiplexer at receiver end.

### **APPARATUS REQUIRED:**

1. FDM trainer Kit
2. Voltage source (2Vp-p)
3. Bread board
4. Resistors 3.9K, 3K, 10K, 680K
5. Capacitors 0.01 $\mu$ F, 60 $\mu$ F
6. IC 741, IC 555
7. CRO (0 – 100 MHz)
8. Function generator (0- 100 M Hz)
9. RPS 0-30V,1A
10. Connecting wires

### **2. TASK ANALYSIS:**

#### **A. KNOWLEDGE**

1. Sampling theorem
2. Working principal FDM
3. Types of multiplexing
4. Sampling rate, channel bandwidth
5. Applications of FDM
6. Need for counter, timer
7. Compare TDM, FDM.
8. OP-AMP working and applications
9. Precautions.

**B. SKILL**

Handling of Apparatus	<ul style="list-style-type: none"> <li>A. Identifying various terminals</li> <li>B. Using probes, chords.</li> <li>C. Calibrating the CRO/DSO accurate values.</li> <li>D. Identification of terminals by markings.</li> <li>E. Identification of amplitude and frequency ranges of signals to be multiplexed &amp; de multiplexed. On CRO</li> </ul>
Manipulation of apparatus	<ul style="list-style-type: none"> <li>A. Draw the Circuit Diagram.</li> <li>B. Making the connections as per the circuit diagram.</li> <li>C. Adjusting the amplitude and frequency ranges of signals</li> <li>D. Connect the circuit diagram as shown in the figure.</li> </ul>
Precise operations/Activities	<ul style="list-style-type: none"> <li>A. Measure the amplitude &amp; frequency of input signals to be multiplexed.</li> <li>B. Apply the counter/ timer /external signal as selection input line.</li> <li>C. Observe the waveforms on CRO.</li> <li>D. Note down the amplitude and frequency of the multiplexed output signal from CRO.</li> <li>E. Repeat the above steps for de multiplexer</li> </ul>

**2. TEACHING POINTS:**

Sl No	Teaching Point	Suggested Time-15 min
1.	Concept of multiplexing	2
2.	Types of multiplexing	1
3.	Advantages of FDM	2
4.	Counter/ Timer as Selection line	2
5.	Sampling Theorem sampling rate	1
6.	Working of op-amp	1
7.	Procedure for connecting individual signals to be streamed into single line	2
8.	Procedure for connecting counter/timer as selection lines	1
9.	Interpreting trainer kit Details.	2
10.	Precautions.	1

**PRECAUTIONS****A. PROCEDURAL PRECAUTIONS:**

- Disconnect all the equipment from mains before making connections.
- Ensure the correct range of function generator
- Connect the circuit as per the circuit diagram and check for polarity.
- Get the connections checked by the concerned staff member.
- Calibrate the CRO for getting accurate result.
- Ensure that there are no loose connections.

**B. SAFETY PRECAUTIONS:**

- Never work on the trainer kit while power is switched ON.
- Do not connect power to the trainer kit until the circuit connection is fixed.
- If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.
- Keep your work area dry.
- Always wear safety goggles and shoes.

### **3. NEED AND SCOPE OF EXPERIMENT**

Frequency Division Multiplexing (FDM) is a networking technique in which multiple data signals are combined for simultaneous transmission via a shared communication medium. FDM uses a carrier signal at a discrete frequency for each data stream and then combines many modulated signals.

When FDM is used to allow multiple users to share a single physical communications medium (i.e. not broadcast through the air), the technology is called frequency-division multiple access (FDMA).

### **4. PLANNING AND ORGANISATION:**

<b>ACTION</b>	<b>ACTIVITY</b>
Check for	<ul style="list-style-type: none"><li>• Trainer kit,</li><li>• CRO</li><li>• The students entry behavior</li><li>• First aid kit</li><li>• Connecting wires and</li></ul>
For Design of Instruction	<ul style="list-style-type: none"><li>• Read teaching points carefully.</li></ul>

**5. SCHEME OF EVALUATION:**

CATEGORY OF SKILL	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY												
1. Handling of apparatus	A. Identifying various terminals B. Using probes, chords. C. Calibrating the CRO/DSO accurate values. D. Identification of terminals by markings. E. Identification of amplitude and frequency ranges of signals to be multiplexed & de multiplexed. On CRO	<table border="1" data-bbox="1049 428 1352 548"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>5</td> </tr> </tbody> </table>	A	B	C	D	E	T	1	1	1	1	1	5
A	B	C	D	E	T									
1	1	1	1	1	5									
2. Manipulation of apparatus	A. Draw the Circuit Diagram. B. Making the connections as per the circuit diagram. C. Adjusting the amplitude and frequency ranges of signals D. Connect the circuit diagram as shown in the figure.	<table border="1" data-bbox="1049 968 1352 1087"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>5</td> <td>3</td> <td>2</td> <td>15</td> </tr> </tbody> </table>	A	B	C	D	T	5	5	3	2	15		
A	B	C	D	T										
5	5	3	2	15										
3. Precise operations/Activities	A. Measure the amplitude & frequency of input signals to be multiplexed. B. Apply the counter/ timer /external signal as selection input line. C. Observe the waveforms on CRO. D. Note down the amplitude and frequency of the multiplexed output signal from CRO. E. Repeat the above steps for de multiplexer	<table border="1" data-bbox="1049 1438 1459 1579"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>3</td> <td>4</td> <td>5</td> <td>10</td> <td>25</td> </tr> </tbody> </table>	A	B	C	D	E	T	3	3	4	5	10	25
A	B	C	D	E	T									
3	3	4	5	10	25									

4.Values	A. Co-operation. B. Co-ordination C. Communication D. Sharing E. leadership	<table border="1"><tr><td data-bbox="1117 296 1308 348"></td></tr><tr><td data-bbox="1117 348 1308 407">5</td></tr></table>		5
5				
Total		50		

**ASSESSMENT / VIVA QUESTIONS:**

1. Why we r doing Multiplexing?
2. What way TDM and FDM differs?
3. Why noise is occurred in FDM system?.
4. give the advantages of FDM system
5. How signal overlapping is occurred?
6. Which type of modulation technique is used in FDM?
7. What happens if we not use modulation techniques
8. What happens if we use low frequency signals
9. Can we use two or more signals to be multiplexed

## Simulation of Amplitude Modulation

### **OBJECTIVE:**

- 1) To Simulate Amplitude modulated waveform and determine Modulation Index using PSPICE.

### **APPARATUS REQUIRED:**

1. Personal Computer
2. PSPICE or Equivalent Software
3. Printer

### **2. TASK ANALYSIS:**

#### **A. KNOWLEDGE**

1. Basics of PSPICE / MULTISIM software
2. Transistor working principle in non-linear region.
3. Need of modulation
4. Types of signals and parameters of signals.
5. Types of different analog modulation techniques
6. Familiarization of different functionalities of CRO
7. Theoretical calculations of percentage of modulation.
8. Precautions.

**B. SKILL**

Familiarization of PSPICE / MULTISIM software	<ul style="list-style-type: none"> <li>A. Identification of PSPICE /MULTISIM software application on the desktop</li> <li>B. Identification of various components</li> <li>C. Identification of PSPICE / MULTISIM software application on the desktop</li> </ul>
Preparation of Schematic using PSPICE / MULTISIM software	<ul style="list-style-type: none"> <li>A. Identification of various <b>toolbars</b> and <b>workspace</b> of <b>software interface</b></li> <li>B. Select the required components from respective group of library</li> <li>C. Set the values of components as per the requirement.</li> <li>D. Make the connections as per the circuit diagram in the workspace</li> </ul>
Simulation and Result Analysis.	<ul style="list-style-type: none"> <li>A. Set the amplitude and frequency of modulating signal and carrier signal</li> <li>B. Run the simulation and rectify the errors if any by modifying the connections.</li> <li>C. Observe the resultant Amplitude Modulated signal.</li> <li>D. Measure the values <math>V_{Max}</math> and <math>V_{Min}</math> (in Volts) of AM Wave using CRO</li> <li>E. Calculate the percentage of modulation</li> <li>F. By varying the amplitudes of modulating signal, observe AM Wave for <ul style="list-style-type: none"> <li>a. 1) Under modulation (<math>V_m &lt; V_c</math> or <math>m &lt; 1</math>),</li> <li>b. 2) Critical modulation (<math>V_m = V_c</math> or <math>m = 1</math>), and</li> <li>c. 3) Over modulation (<math>V_m &gt; V_c</math> or <math>m &gt; 1</math>).</li> </ul> </li> </ul>

### 3. Teaching Points

Sl No	Teaching Point	Suggested Time-15 min
1.	Need for modulation	1
2	Familiarization of PSPICE / MULTISIM software	8
3	Principle of Modulation and De Modulation	2
4	Types of Modulation	1
5	Calculation of Modulation Index	2
6	Precautions.	1

#### A. PRECAUTIONS:

- Connections should be proper
- Handling the computer system properly.
- Select the appropriate components from the library.

### 3. NEED AND SCOPE OF EXPERIMENT

This experiment is essential to understand the process by which low frequency (i.e., AF) signal transmitted over the long distance using the high frequency carrier signal (i.e., RF) by varying one of the parameters (i.e., Amplitude, frequency and Phase).

This experiment is essential to understand the process by which an un distorted low frequency signal can be regenerated using demodulator at the distant end when the percentage of modulation index is less than or equal to 1.

**4. PLANNING AND ORGANISATION:**

<b>ACTION</b>	<b>ACTIVITY</b>
Check for	<ul style="list-style-type: none"> <li>• Computer system with suitable OS and PSPICE or Equivalent software</li> <li>• Proper maintenance of power supply to the laboratory</li> <li>• First-aid kit</li> <li>• The students entry behavior</li> </ul>
For Design of Instruction	<ul style="list-style-type: none"> <li>• Read teaching points carefully.</li> </ul>

**5. SCHEME OF EVALUATION:**

<b>CATEGORY OF SKILL</b>	<b>SUB TASK</b>	<b>WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY</b>								
1 Familiarization of PSPICE / MULTISIM software	<p>A. <b>Identification of PSPICE /MULTISIM software application on the desktop</b></p> <p>B. Identification of various components</p> <p>C. Identification of PSPICE / MULTISIM software application on the desktop</p>	<table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>3</td> <td>5</td> </tr> </tbody> </table>	A	B	C	T	1	1	3	5
A	B	C	T							
1	1	3	5							

<p>2. Preparation of Schematic using PSPICE / MULTISIM software</p>	<p>A. Identification of various <b>toolbars</b> and <b>workspace</b> of <b>software interface</b></p> <p>B. Select the required components from respective group of library</p> <p>C. Set the values of components as per the requirement.</p> <p>D. Make the connections as per the circuit diagram in the workspace</p>	<table border="1" data-bbox="1081 218 1354 373"> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>T</th> </tr> <tr> <td>2</td> <td>4</td> <td>4</td> <td>5</td> <td>15</td> </tr> </table>	A	B	C	D	T	2	4	4	5	15				
A	B	C	D	T												
2	4	4	5	15												
<p>3.Precise operations/Activities</p>	<p>A. Set the amplitude and frequency of modulating signal and carrier signal</p> <p>B. Run the simulation and rectify the errors if any by modifying the connections.</p> <p>C. Observe the resultant Amplitude Modulated signal.</p> <p>D. Measure the values <math>V_{Max}</math> and <math>V_{Min}</math> (in Volts) of AM Wave using CRO</p> <p>E. Calculate the percentage of modulation</p> <p>F. By varying the amplitudes of modulating signal, observe AM Wave for</p> <ol style="list-style-type: none"> <li>a. 1) Under modulation (<math>V_m &lt; V_c</math> or <math>m &lt; 1</math>),</li> <li>b. 2) Critical modulation (<math>V_m = V_c</math> or <math>m = 1</math>), and</li> <li>c. 3) Over modulation (<math>V_m &gt; V_c</math> or <math>m &gt; 1</math>).</li> </ol>	<table border="1" data-bbox="1073 1152 1471 1308"> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>F</th> <th>T</th> </tr> <tr> <td>2</td> <td>4</td> <td>6</td> <td>5</td> <td>4</td> <td>4</td> <td>25</td> </tr> </table>	A	B	C	D	E	F	T	2	4	6	5	4	4	25
A	B	C	D	E	F	T										
2	4	6	5	4	4	25										

4.Values	A. Co-operation. B. Co-ordination C. Communication D. Sharing E. leadership	<table border="1" data-bbox="1208 226 1398 333"><tr><td data-bbox="1208 226 1398 275"></td></tr><tr><td data-bbox="1208 275 1398 333">5</td></tr></table>		5
5				
Total		50		

**ASSESSMENT / VIVA QUESTIONS:**

1. How do you differentiate modulating signal and Carrier signal?
2. Why we need Modulation?
3. What is Modulation?
4. What is Amplitude Modulation?
5. What is modulation index?.
6. When only carrier input given to AM modulator, what will be the output?
7. How do you differentiate AM based on Modulation Index?
8. Where do you find the applications of AM?
9. How do you generate different types of AM?
10. What is AM demodulation?
11. What will be output of AM De-modulator if modulation index of AM wave is greater than 1?
12. How do you detect AM?

## SIMULATION OF PULSE AMPLITUDE MODULATION AND DEMODULATION

**OBJECTIVE:** To Simulate the Pulse Amplitude modulator and demodulator circuits using PSPICE or Equivalent software and observe the waveforms .

**APPARATUS REQUIRED:**

1. Personal Computer
2. PSPICE or Equivalent Software
3. Printer

**2. TASK ANALYSIS:****A. KNOWLEDGE**

1. Basics of PSPICE / MULTISIM software
2. Message signal, Carrier signal, Modulation and Demodulation
3. Discrete signal, Analog and Digital Modulation
4. Sampling Technique
5. Working principle of PAM Modulator and Demodulator
6. Low Pass filter using R,C components.

**B.SKILL**

Familiarization of PSPICE / MULTISIM software	<ol style="list-style-type: none"> <li>A. Identification of PSPICE /MULTISIM software application on the desktop</li> <li>B. Identification of various components</li> <li>C. Identification of PSPICE / MULTISIM software application on the desktop</li> </ol>
Preparation of Schematic using PSPICE / MULTISIM software	<ol style="list-style-type: none"> <li>A. Identification of various <b>toolbars</b> and <b>workspace</b> of <b>software interface</b></li> <li>B. Select the required components from respective group of library</li> <li>C. Set the values of components as per the requirement</li> <li>D. Make the connections as per the circuit diagram in the workspace</li> </ol>

Simulation and Result Analysis.	<p><b><u>PAM Modulation</u></b></p> <p>A. Measure I /P Message signal Amplitude ,time period and Frequency.</p> <p>B. Measure I /P Carrier signal amplitude,time period and Frequency.</p> <p>C. Observing the PAM waveforms on CRO.</p> <p>D. Note the Amplitude,time period and Frequency of Modulated Wave.</p> <p>E. Compare the waveform of PAM Modulator with messagesignal.</p>
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## **2. TEACHING POINTS:**

Sl No	Teaching Point	Suggested Time-15 min
1.	Selecting the frequency and amplitude of sine and square wave in Function generator	2
2.	R, C components as filter circuit.	1
3.	Observation of waveforms in CRO.	2
4.	Procedure for measuring Amplitude and Frequency in the CRO	2
5.	Procedure for comparing input and output signals.	2
6.	Interpreting Various sections of circuit.	2
7.	Familiarization of PSPICE / MULTISIM software	3
8.	Precautions.	1

### A. PRECAUTIONS:

- Connections should be proper
- Handling the computer system properly.
- Select the appropriate components from the library

## **3. NEED AND SCOPE OF EXPERIMENT**

This experiment is essential to understand the performance of Pulse amplitude Modulator and demodulator Circuit. PAM modulation is simple and relatively cheap, so they are used in Ethernet communication, and in micro-controllers for generating the

control signals. PAM can generate other pulse modulation signals and can carry the message at the same time.

#### 4. PLANNING AND ORGANISATION:

ACTION	ACTIVITY
Check for	<ul style="list-style-type: none"> <li>• Computer system with suitable OS and software</li> <li>• Proper maintenance of power supply to the laboratory</li> <li>• First-aid kit</li> <li>• The students entry behavior</li> </ul>
For Design of Instruction	<ul style="list-style-type: none"> <li>• Read teaching points carefully.</li> </ul>

#### 5. SCHEME OF EVALUATION:

CATEGORY OF SKILL	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY										
1. Familiarization of PSPICE / MULTISIM software	A. Identification of PSPICE /MULTISIM software application on the desktop B. Identification of various components C. Identification of PSPICE / MULTISIM software application on the desktop	<table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>3</td> <td>5</td> </tr> </tbody> </table>	A	B	C	T	1	1	3	5		
A	B	C	T									
1	1	3	5									
2. Preparation of Schematic using PSPICE / MULTISIM software	A. Identification of various <b>toolbars</b> and <b>workspace of software interface</b> B. Select the required components from respective group of library C. Set the values of components as per the requirement D. Make the connections as per the circuit diagram in the workspace	<table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>3</td> <td>3</td> <td>4</td> <td>15</td> </tr> </tbody> </table>	A	B	C	D	T	3	3	3	4	15
A	B	C	D	T								
3	3	3	4	15								

<p>3. Simulation and Result Analysis.</p>	<p>A. Run simulation                  B. Measure I/P Message signal Amplitude and Frequency.                  C. Measure I/P Carrier signal amplitude and Frequency                  D. Observing the PAM waveforms on CRO.                  E. Note the Amplitude and Frequency of Modulated Wave.                  F. Compare the waveform of PAM Modulator with messagesignal.</p>	<table border="1" data-bbox="1043 259 1540 405"> <tr> <td>A</td> <td>B</td> <td>C</td> <td>D</td> <td>E</td> <td>T</td> </tr> <tr> <td>6</td> <td>6</td> <td>2</td> <td>5</td> <td>6</td> <td>25</td> </tr> </table>	A	B	C	D	E	T	6	6	2	5	6	25
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6	6	2	5	6	25									
<p>4.Values</p>	<p>A. Co-operation.                  B. Co-ordination                  C. Communication                  D. Sharing                  E. leadership</p>	<table border="1" data-bbox="1139 864 1334 972"> <tr> <td></td> </tr> <tr> <td>5</td> </tr> </table>		5										
5														
<p>Total</p>		<p>50</p>												

**ASSESSMENT / VIVA QUESTIONS:**

1. Inputs required for PAM.
2. How the Pulse Modulation schemes are different from analog modulation?
3. Condition for sampling frequency?
4. Why Aliasing effect occurs?
5. How many types of sampling techniques?
6. Difference between Flat top and Natural Sampling?
7. What happened if filter is absent?
8. Where we can use PAM?
9. Disadvantages of PAM?

**TYPICAL PROBLEMS MAY OCCUR IN THE EXERCISE:**

1. Output is a clipped modulated waveform  
Sol: Improper placement of Transistor terminals
2. Carrier overlapping on the demodulated output  
Sol: select proper filter values
3. No modulation at the modulator output  
Sol: check proper connections and levels of signals

**SIMULATION OF PULSE WIDTH MODULATION AND DEMODULATION**

**OBJECTIVE:** To Simulate the Pulse Width modulator and demodulator circuits using PSPICE or Equivalent software and observe the waveforms.

**APPARATUS REQUIRED:**

1. Personal Computer
2. PSPICE or Equivalent Software
3. Printer

**2. TASK ANALYSIS:****A. KNOWLEDGE**

- 1 Basics of PSPICE / MULTISIM software
2. 555 timer IC working principle
3. Function of each PIN in 555 IC timer
4. Working principle of PWM Modulator and Demodulator

**B. SKILL**

Familiarization of PSPICE / MULTISIM software	<p>A) Identification of PSPICE /MULTISIM software application on the desktop</p> <p>B) Identification of various components</p> <p>C) Identification of PSPICE / MULTISIM software application on the desktop</p>
Preparation of Schematic using PSPICE / MULTISIM software	<p>A. Identification of various <b>toolbars</b> and <b>workspace</b> of <b>software interface</b></p> <p>B. Select the required components from respective group of library</p> <p>C. Set the values of components as per the requirement</p> <p>D. Make the connections as per the circuit diagram in the workspace</p>
Simulation and Result Analysis.	<p style="text-align: center;"><b><u>PWM Modulation</u></b></p> <p>A. Measure I /P Message signal Amplitude and Frequency.</p> <p>B. Measure I /P Carrier signal amplitude and Frequency.</p> <p>C. Observe the PWM waveforms on CRO by varying the amplitude of the message signal</p> <p>D. Note the Amplitude and Frequency of the Modulated Wave.</p> <p>E. Compare the waveform of PWM signal with messagesignal.</p>

**2. TEACHING POINTS:**

Sl No	Teaching Point	Suggested Time-15 min
1.	Working of 555 timer IC	2
2.	Function of each PIN in 555 IC timer	5
3.	Use of a PN-Junction diode Capacitors in this experiment	2
4.	Function and operation of signal Generators, CRO	1
5.	Interpreting 555 timer IC Manual.	1
6.	Familiarization of PSPICE / MULTISIM software	3
7.	Precautions.	1

**A. PRECAUTIONS:**

- Connections should be proper
- Handling the computer system properly.
- Select the appropriate components from the library

**3. NEED AND SCOPE OF EXPERIMENT**

This experiment is essential to understand the performance of Pulse width modulation and Demodulation. The amplitude is constant; width of the pulse is proportional to the amplitude of the modulating signal. Bandwidth on transmission channel depends on rise time of the pulse. The demodulation circuit used is a simple filter circuit that demodulator the PWM signal and gives the original message input.

**4. PLANNING AND ORGANISATION:**

ACTION	ACTIVITY
Check for	<ul style="list-style-type: none"> <li>• Computer system with suitable OS and software</li> <li>• Proper maintenance of power supply to the laboratory</li> <li>• First-aid kit</li> <li>• The students entry behavior</li> </ul>
For Design of Instruction	<ul style="list-style-type: none"> <li>• Read teaching points carefully.</li> </ul>

**5. SCHEME OF EVALUATION:**

CATEGORY OF SKILL	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY										
Familiarization of PSPICE / MULTISIM software	<p>A) Identification of PSPICE /MULTISIM software application on the desktop</p> <p>B) Identification of various components</p> <p>C) Identification of PSPICE / MULTISIM software application on the desktop</p>	<table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>3</td> <td>5</td> </tr> </tbody> </table>	A	B	C	T	1	1	3	5		
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Preparation of Schematic using PSPICE / MULTISIM software	<p>A. Identification of various <b>toolbars</b> and <b>workspace</b> of <b>software interface</b></p> <p>B. Select the required components from respective group of library</p> <p>C. Set the values of components as per the requirement</p> <p>D. Make the connections as per the circuit diagram in the workspace</p>	<table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>4</td> <td>3</td> <td>4</td> <td>15</td> </tr> </tbody> </table>	A	B	C	D	T	3	4	3	4	15
A	B	C	D	T								
3	4	3	4	15								
	<p><b>PWM MODULATION</b></p> <p>A. Measure I/P Message signal Amplitude and Frequency.</p> <p>B. Measure I/P Carrier signal</p>											

<p>Simulation and Result Analysis.</p>	<p>amplitude and Frequency.</p> <p>C. Observe the PWM waveforms on CRO by varying the amplitude of the message signal</p> <p>D. Note the Amplitude and Frequency of the Modulated Wave.</p> <p>E. Compare the waveform of PWM signal with message signal.</p>	<table border="1" data-bbox="967 396 1516 537"> <tr> <td>A</td> <td>B</td> <td>C</td> <td>D</td> <td>E</td> <td>T</td> </tr> <tr> <td>6</td> <td>6</td> <td>2</td> <td>4</td> <td>6</td> <td>25</td> </tr> </table>	A	B	C	D	E	T	6	6	2	4	6	25
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<p>4.Values</p>	<p>A. Co-operation.</p> <p>B. Co-ordination</p> <p>C. Communication</p> <p>D. Sharing</p> <p>E. leadership</p>	<table border="1" data-bbox="1133 848 1338 957"> <tr> <td></td> </tr> <tr> <td>5</td> </tr> </table>		5										
5														
<p>Total</p>		<p>50</p>												

**ASSESSMENT / VIVA QUESTIONS:**

1. What is a Pulse width modulation?
2. What is the roll of diode in this circuit?
3. What is another name of pulse width modulation?
4. Is the output pulse width truly proportional to the modulation voltage?

**SIMULATION OF ASK MODULATOR AND DEMODULATOR**

**OBJECTIVE:** To Simulate Amplitude shift keying modulator and demodulator for given message signal and Carrier signal using PSPICE/OR EQUIVALENT SOFTWARE.

**APPARATUS REQUIRED**

1. Personal Computer
2. PSPICE or Equivalent Software
3. Printer

**2. TASK ANALYSIS:****A. KNOWLEDGE**

1. Basics of PSPICE / MULTISIM software.
2. Discrete signal, Analog and Digital Modulation
3. Working principle of ASK Modulator and Demodulator
4. Use of PN Junction diode as Rectifier.
5. Low Pass filter using R,C components
4. IC 741 Pin diagram
5. Using 741 as Voltage Comparator
6. IC MAX 232 Pin diagram
7. IC MAX 232 Voltage Converter
8. Precautions.

**B. SKILL**

Familiarization of PSPICE / MULTISIM software	<ul style="list-style-type: none"> <li>• Identification of PSPICE /MULTISIM software application on the desktop</li> <li>• Identification of various components</li> <li>• Identification of PSPICE / MULTISIM software application on the desktop</li> </ul>
Preparation of Schematic using PSPICE / MULTISIM software	<ol style="list-style-type: none"> <li>A. Identification of various <b>toolbars</b> and <b>workspace</b> of <b>software interface</b></li> <li>B. Select the required components from respective group of library</li> <li>C. Set the values of components as per the requirement.</li> <li>D. Make the connections as per the circuit diagram in the workspace</li> </ol>
Simulation and Result Analysis.	<p style="text-align: center;"><b><u>ASK Modulator</u></b></p> <ol style="list-style-type: none"> <li>A. Set the amplitude and frequency of modulating signal and carrier signal</li> <li>B. Run the simulation and rectify the errors if any by modifying the connections.</li> <li>C. Observe the resultant Amplitude Modulated signal.</li> <li>D. Measure data signal Amplitude and Frequency.</li> <li>E. Measure I /P Carrier signal amplitude and Frequency.</li> <li>F. Observing the waveforms on CRO.</li> <li>G. Note the Amplitude and Frequency of Modulated Wave.</li> </ol> <p style="text-align: center;"><b><u>ASK Demodulator</u></b></p> <ol style="list-style-type: none"> <li>H. Adjust the POT for Comparator operation.</li> <li>I. Observing the waveforms on CRO</li> <li>J. Note the Amplitude and Frequency of Demodulated Wave</li> </ol>

**2. TEACHING POINTS:**

Sl No	Teaching Point	Suggested Time-15 min
1.	Familiarization of PSPICE / MULTISIM software	10
2.	Construction of the circuit	3
3.	Simulation of the circuit	2

**A. PROCEDURAL PRECAUTIONS:**

- Connections should be proper
- Handling the computer system properly.
- Select the appropriate components from the library.

**3. NEED AND SCOPE OF EXPERIMENT**

This experiment is essential to understand the performance of Amplitude shift keying Modulator and demodulator Circuit. Compare to the Analog modulation schemes, ASK requires low transmission power. Because during logic 0 bit transmission there is no power required. The circuit for ASK modulation is simple and relatively cheap, so they are used in low cost systems for low communication range such as RFID, ETC.

**4. PLANNING AND ORGANISATION:**

ACTION	ACTIVITY
Check for	<ul style="list-style-type: none"> <li>• Computer system with suitable OS and software</li> <li>• Proper maintenance of power supply to the laboratory</li> <li>• First-aid kit</li> <li>• The students entry behavior</li> </ul>
For Design of Instruction	<ul style="list-style-type: none"> <li>• Read teaching points carefully.</li> </ul>

**5. SCHEME OF EVALUATION:**

CATEGORY OF SKILL	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY												
Familiarization of PSPICE / MULTISIM software	<p>A. Identification of PSPICE /MULTISIM software application on the desktop</p> <p>B. Identification of various components</p> <p>C. Identification of PSPICE / MULTISIM software application on the desktop</p>	<table border="1" data-bbox="1172 611 1377 747"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>3</td> <td>5</td> </tr> </tbody> </table>	A	B	C	T	1	1	3	5				
A	B	C	T											
1	1	3	5											
2. Preparation of Schematic using PSPICE / MULTISIM software	<p>A. A) Draw the Circuit Diagram.</p> <p>B. Identification of various <b>toolbars</b> and <b>workspace</b> of <b>software interface</b></p> <p>C. Select the required components from respective group of library</p> <p>D. Make the connections as per the circuit diagram in the workspace</p> <p>E .Modify the values for the selected components</p>	<table border="1" data-bbox="1045 1157 1369 1297"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>3</td> <td>3</td> <td>4</td> <td>2</td> <td>15</td> </tr> </tbody> </table>	A	B	C	D	E	T	3	3	3	4	2	15
A	B	C	D	E	T									
3	3	3	4	2	15									

<p>3. Simulation and Result Analysis.</p>	<p><b><u>ASK Modulator</u></b></p> <p>A) Measure I/P message signal amplitude and Frequency.</p> <p>B). Measure I/P Carrier signal amplitude and Frequency</p> <p>C) Observing the waveforms on CRO.</p> <p>D) Note the Amplitude and Frequency ASK modulated output.</p> <p>E) Compare the waveform of ASK Modulator with Input message signal.</p> <p style="text-align: center;"><b><u>ASK Demodulator</u></b></p> <p>F) ASK modulated signal to voltage comparator to setting of Potentiometer (POT).</p> <p>G)Measure Demodulated signal amplitude and frequency.</p> <p>Tabulate the readings and observe the waveforms on CRO</p> <p>H)Drawing the graphs</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>F</th> <th>G</th> <th>H</th> <th>T</th> </tr> <tr> <td>2</td> <td>2</td> <td>4</td> <td>3</td> <td>3</td> <td>2</td> <td>4</td> <td>5</td> <td>25</td> </tr> </table>	A	B	C	D	E	F	G	H	T	2	2	4	3	3	2	4	5	25
A	B	C	D	E	F	G	H	T												
2	2	4	3	3	2	4	5	25												
<p>4.Values</p>	<p>A. Co-operation.</p> <p>B. Co-ordination</p> <p>C. Communication</p> <p>D. Sharing</p> <p>E. leadership</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="height: 20px;"></td> </tr> <tr> <td style="text-align: center;">5</td> </tr> </table>		5																
5																				
<p>Total</p>		<p style="text-align: center;">50</p>																		

**ASSESSMENT / VIVA QUESTIONS:**

1. Inputs required for ASK.
2. Types of Digital Modulation schemes?
3. When the diode become Reverse bias in the circuit what would be the expected waveform?
4. Why we connect a resistor across a capacitor?
5. Need for filter in the circuit?
6. Why not ASK used for long distance communication?
7. Need of reference voltage in this circuit?
8. Why Voltage Comparator used in this circuit?
9. In the absence of Voltage converter what is the output?
10. How the digital Modulation schemes are different from analog modulation?
11. What happened if filter is absent?
12. Where we can use ASK?
13. Disadvantages of ASK?

**TYPICAL PROBLEMS MAY OCCUR IN THE EXERCISE:**

1. Output is a clipped modulated waveform  
Sol: Improper placement of Transistor terminals
2. Carrier overlapping on the demodulated output  
Sol: select proper filter values
3. No modulation at the modulator output  
Sol: check proper connections and levels of signals
4. Negative peaks at the diode output  
Sol: diode terminals should interchanged
5. Inverted output at the IC 741  
Sol: Properly connect the inputs to inverting and non inverting pins of IC
6. Bipolar voltages appeared at the output of IC 741  
Sol: use voltage level converter.

**SIMULATION OF FSK MODULATION AND DEMODULATION**

**OBJECTIVE :** To simulate the FSK modulator and demodulator circuits using PSPICE  
and observe the output waveforms.

**APPARATUS REQUIRED :**

1. Personal Computer
2. PSPICE or Equivalent Software
3. Printer

**1. TASK ANALYSIS:****A.KNOWLEDGE**

1. Basics of PSPICE / MULTISIM software
2. Difference between Analog modulation Technique & Digital modulation technique.
3. Need for Digital modulation technique.
4. Types of digital modulation techniques.
5. Frequency shift keying.
6. Modulating signal, Carrier signal and Modulated signal
7. About CRO and its different controls
8. High frequencies & Low frequencies in a waveform.
9. Precautions

**B.SKILL**

Familiarization of PSPICE / MULTISIM software	<ul style="list-style-type: none"> <li>A. Identification of PSPICE /MULTISIM software application on the desktop</li> <li>B. Identification of various components</li> <li>C. Identification of PSPICE / MULTISIM software application on the desktop</li> </ul>
Preparation of Schematic using PSPICE / MULTISIM software	<ul style="list-style-type: none"> <li>A. Identification of various <b>toolbars</b> and <b>workspace</b> of <b>software interface</b></li> <li>B. Select the required components from respective group of library</li> <li>C. Set the values of components as per the requirement.</li> <li>D. Make the connections as per the circuit diagram in the workspace</li> </ul>
Simulation and Result Analysis.	<p style="text-align: center;"><b><u>FSK Modulation</u></b></p> <ul style="list-style-type: none"> <li>A. Observe the DATA signal on CRO and record its amplitude, Time period and frequency.</li> <li>B. Observe the carrier signal on CRO and record its Amplitude, Time period and frequency.</li> <li>C. Observe the changes in frequencies of Modulated Signal on CRO during 1 and 0 of data signal and record its amplitude, Time period and frequency.</li> <li>D. Draw the waveforms in graph sheet.</li> </ul>

	<b><u>FSK Demodulation</u></b>
	D. Observe the Demodulated DATA signal on CRO and record its amplitude , Time period and frequency.
	E. Verify the demodulated DATA signal is same as transmitted signal.
	F. Draw the waveforms in graph sheet

**3. Teaching Points:**

S.No	Teaching Points	Suggested Time-15 min
1	Familiarization of PSPICE / MULTISIM software	2
2	Types of modulation techniques	5
3	About FSK and its waveforms	3
4	Operation of CRO	2
5	Procedure for calculating amplitude, Time and Frequency of signal.	2
6	Precautions	1

**A. PRECAUTIONS:**

- Connections should be proper
  - Handling the computer system properly.
  - Select the appropriate components from the library.

**3. Need and Scope of Experiment:**

This experiment is essential to understand the performance of FSK modulation and demodulation. The technology is used for communication systems such as telemetry, weather balloon radiosondes, caller ID, garage door openers, and low frequency radio transmission in the VLF and ELF bands

- It is used on voice grade lines for data rates up to 1200 bps.
- It is used for high frequency radio transmission from 3 to 30 M Hz.
- It is also used in coaxial cable based LAN (Local Area Network) at higher frequencies.

**4. Planning and Organization :**

<b>ACTION</b>	<b>ACTIVITY</b>
Check for	<ul style="list-style-type: none"> <li>• Computer system with suitable OS and PSPICE or Equivalent software</li> <li>• Proper maintenance of power supply to the laboratory</li> <li>• First-aid kit</li> <li>• The students entry behavior</li> </ul>
For Design of Instruction	<ul style="list-style-type: none"> <li>• Read teaching points carefully.</li> </ul>

**5 . SCHEME OF EVALUATION:**

<b>CATEGORY OF SKILL</b>	<b>SUB TASK</b>	<b>WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY</b>								
1.Familiarization of PSPICE / MULTISIM software	<p>A. Identification of PSPICE /MULTISIM software application on the desktop</p> <p>B. Identification of various components</p> <p>C. Identification of PSPICE / MULTISIM software application on the desktop</p>	<table border="1" data-bbox="959 1367 1166 1488"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>T</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>1</td> <td>2</td> <td>5</td> </tr> </tbody> </table>	A	B	C	T	2	1	2	5
A	B	C	T							
2	1	2	5							

<p>2. Preparation of Schematic using PSPICE / MULTISIM software</p>	<p>A. Identification of various <b>toolbars</b> and <b>workspace</b> of <b>software interface</b></p> <p>B. Select the required components from respective group of library</p> <p>C. Set the values of components as per the requirement.</p> <p>D. Make the connections as per the circuit diagram in the workspace</p>	<table border="1" data-bbox="833 514 1424 646"> <tr> <td>A</td> <td>B</td> <td>C</td> <td>D</td> <td>T</td> </tr> <tr> <td>2</td> <td>4</td> <td>4</td> <td>5</td> <td>15</td> </tr> </table>	A	B	C	D	T	2	4	4	5	15				
A	B	C	D	T												
2	4	4	5	15												
<p>Simulation and Result Analysis.</p>	<p><b><u>For Modulation</u></b></p> <p>A. Observe the DATA signal on CRO and record its amplitude , Time period and frequency.</p> <p>B. Observe the carrier signal on CRO and record its amplitude , Time period and frequency.</p> <p>C. Observe the changes in frequencies of Modulated signal on CRO during 1 and 0 of data signal and record its amplitude , Time period and frequency.</p> <p>D. Draw the waveforms in graph sheet.</p>	<table border="1" data-bbox="930 1251 1263 1371"> <tr> <td>A</td> <td>B</td> <td>C</td> <td>D</td> <td>E</td> <td>F</td> <td>T</td> </tr> <tr> <td>4</td> <td>4</td> <td>5</td> <td>3</td> <td>4</td> <td>5</td> <td>25</td> </tr> </table>	A	B	C	D	E	F	T	4	4	5	3	4	5	25
A	B	C	D	E	F	T										
4	4	5	3	4	5	25										

	<p style="text-align: center;"><b><u>For Demodulation</u></b></p> <p>E. Observe the Demodulated DATA signal on CRO and record its amplitude , Time period and frequency.</p> <p>F. Verify that the demodulated DATA signal is same as transmitted one.</p>			
<p>4.Values</p>	<p>A. Co Operation</p> <p>B. Co-Ordination</p> <p>C. Communication</p> <p>D. Sharing</p> <p>E. Leadership</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="width: 100px; height: 20px;"></td> </tr> <tr> <td style="text-align: center;">5</td> </tr> </table>		5
5				
<p>Total</p>		<p>50</p>		

**ASSESSMENT / VIVA QUESTIONS:**

1. How FSK is different from ASK?
2. What is digital modulation technique?
3. What will happen if the DATA signal is applied as '0' continuously?
4. Can you tell where the FSK is used?.
5. What happens to the phase of the carrier during FSK modulation?
6. What type of medium is used in between FSK Transmitter and Receiver for Transmission?
7. How to apply multiple data signals to FSK modulator

**WORK SHEET**

Name of the student :		Date of experiment:
PIN :	Branch:	
Institution:		Experiment No.

**1. Title of the Experiment:**

**2. Objective of the Experiment:**

\_\_\_\_\_

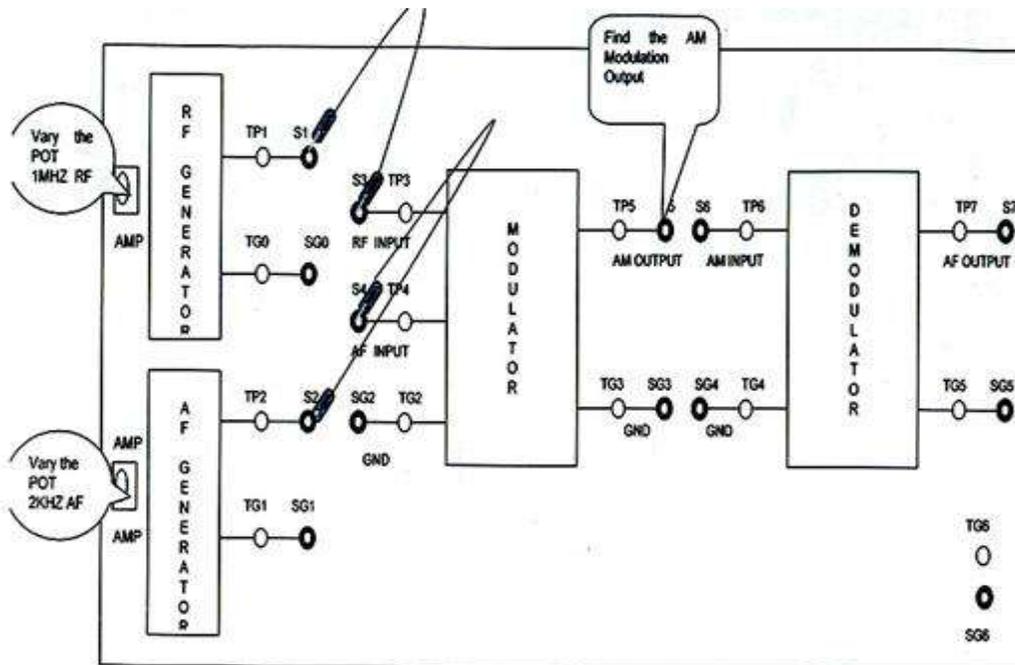
**3. Equipment Required:**

\_\_\_\_\_

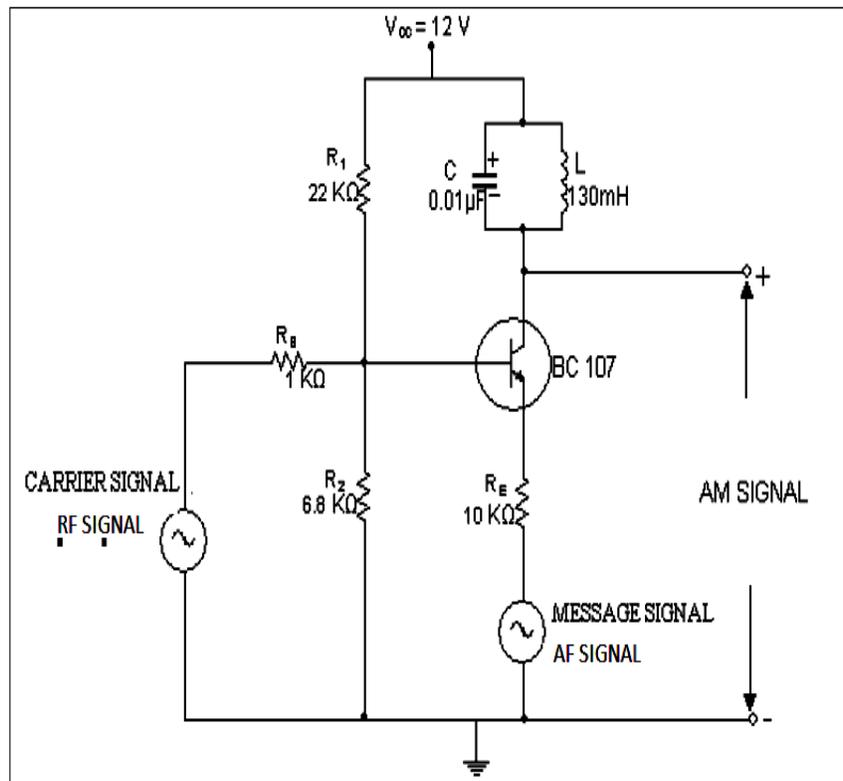
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**4. Trainer kit Block diagram and Circuit Diagram:**

**Modulation Block Diagram**



**Modulator circuit diagram:**



**5. Procedure:**

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10	

## 6. Readings:

### Modulation:

Parameter	Modulating Signal	Carrier Signal
Amplitude (volts)		
Time Period (sec)		
Frequency (Hz)		

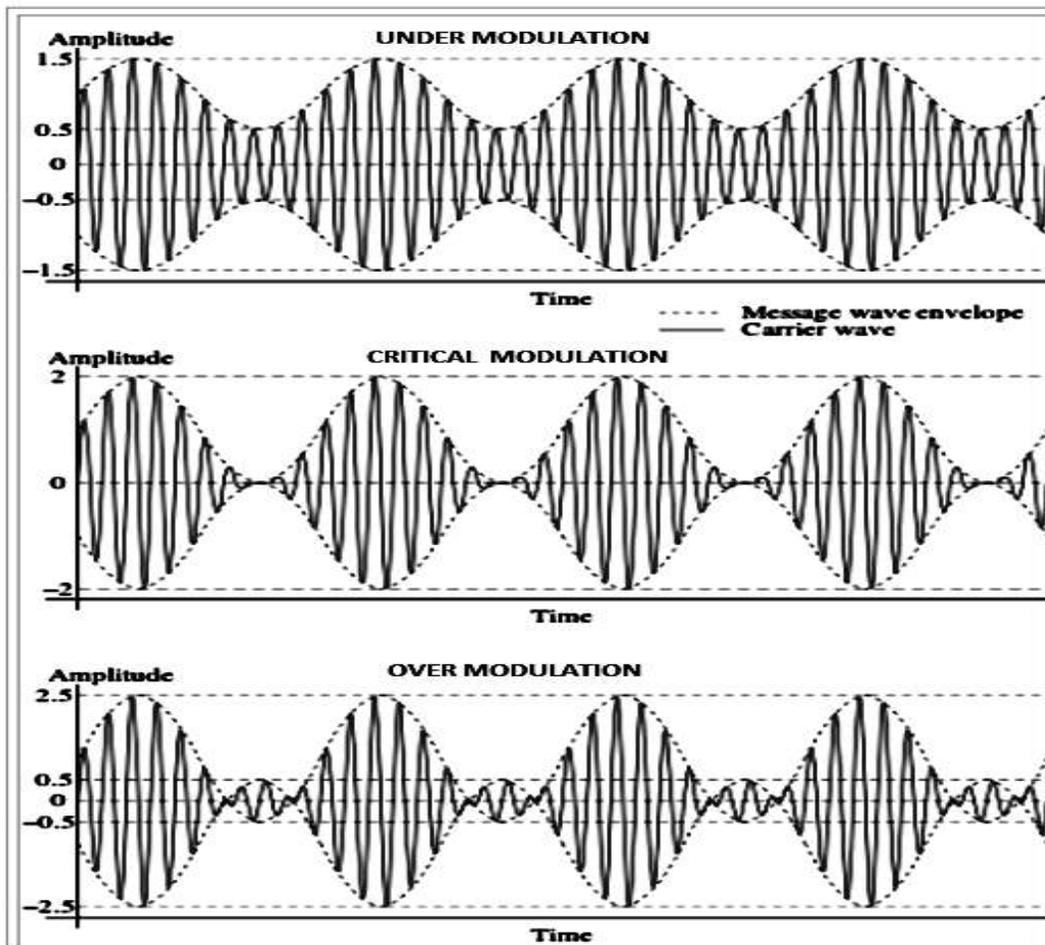
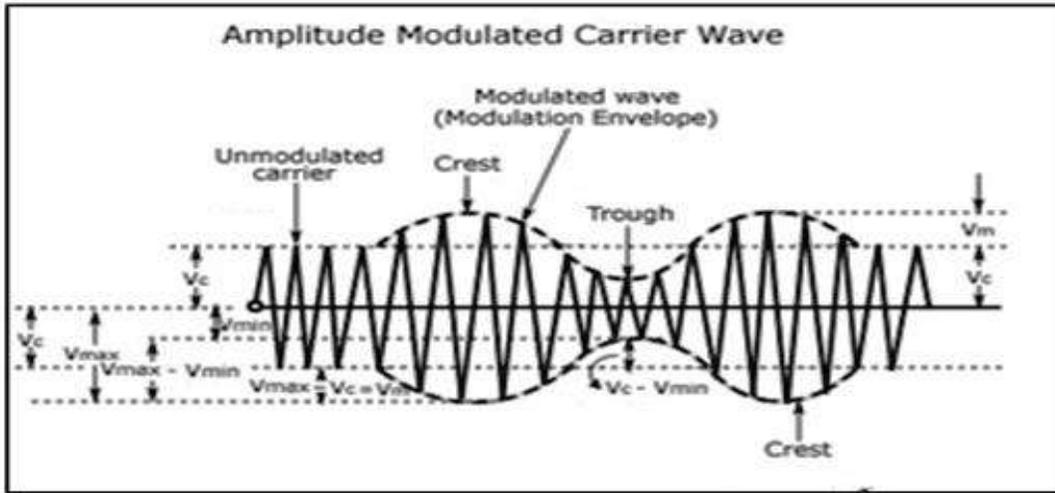
S.No.	Modulated Signal		Modulation Index $m = \frac{V_{Max} - V_{Min}}{V_{Max} + V_{Min}}$
	$V_{Max}$ In Volts	$V_{Min}$ In Volts	
1			
2			
3			

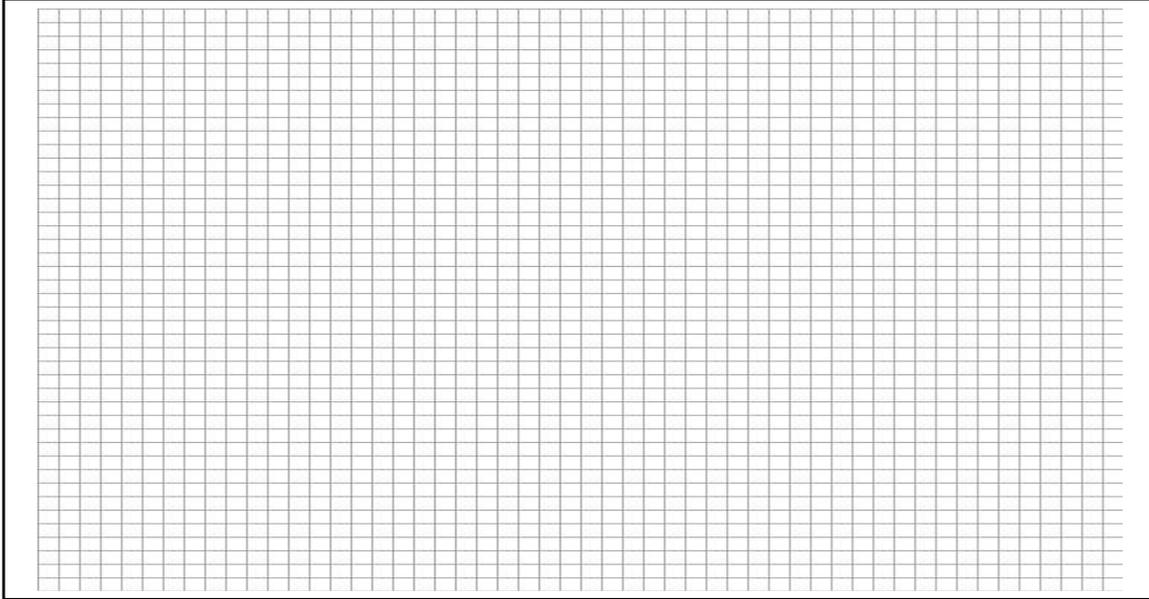
**Note:** Select proper amplitudes of input signals to observe under modulation, Critical

### Modulation and Over Modulation

## 7. Model Graph:

**Modulation:**



**8. Graph:****Observed Waveforms****9. Discussions:****5. SCHEME OF EVALUATION:**

CATEGORY OF SKILL	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY	
1. Handling of apparatus	A. Identifying various Modules in the trainer kit. B. Identification of various components C. Setting the CRO to correct positions. D. Using of AF and RF signal generators.	<div style="border: 1px solid black; padding: 5px; text-align: center;">5</div>	

<p>2. Manipulation of apparatus</p>	<p>A. Draw the Circuit Diagram.                  B. Making the connections as per the Circuit Diagram.                  C. Select AF Analog signal as modulating wave and RF Analog signal as carrier wave                  D. Use CRO to see various wave forms (Like modulating, carrier and modulated signal)</p>	<table border="1" style="width: 100%; height: 100%;"> <tr><td style="height: 20px;"> </td></tr> <tr><td style="text-align: center;">15</td></tr> </table>		15	
15					
<p>3. Precise operations/Activities</p>	<p>A. Observe AM signal using CRO                  B. Measure the values <math>V_{Max}</math> and <math>V_{Min}</math> (in Volts) of AM Wave using CRO                  C. Calculating the percentage of modulation.                  D. By varying amplitude of modulating signal, observe AM Wave for                  a. Under modulation (<math>V_m &lt; V_c</math> or <math>m &lt; 1</math>),                  b. Critical modulation (<math>V_m = V_c</math> or <math>m = 1</math>), and                  c. Over modulation (<math>V_m &gt; V_c</math> or <math>m &gt; 1</math>).   <u><b>De-Modulation.</b></u>                  E. Observe De-modulated signal using CRO for various modulation index values                  a. Under modulation                  b. Critical modulation                  c. Over modulation</p>	<table border="1" style="width: 100%; height: 100%;"> <tr><td style="height: 20px;"> </td></tr> <tr><td style="text-align: center;">25</td></tr> </table>		25	
25					
<p>4. Values</p>	<p>A. Co-operation.                  B. Co-ordination                  C. Communication                  D. Sharing                  E. Leadership</p>	<table border="1" style="width: 100%; height: 100%;"> <tr><td style="height: 20px;"> </td></tr> <tr><td style="text-align: center;">5</td></tr> </table>		5	
5					
<p>Total</p>					
			<p>50</p>		

Signature of the staff

Signature of the Student

**WORK SHEET**

Name of the student :		Date of experiment:
PIN :	Branch:	
Institution:		Experiment No.

**1. Title of the Experiment:** Frequency Modulation

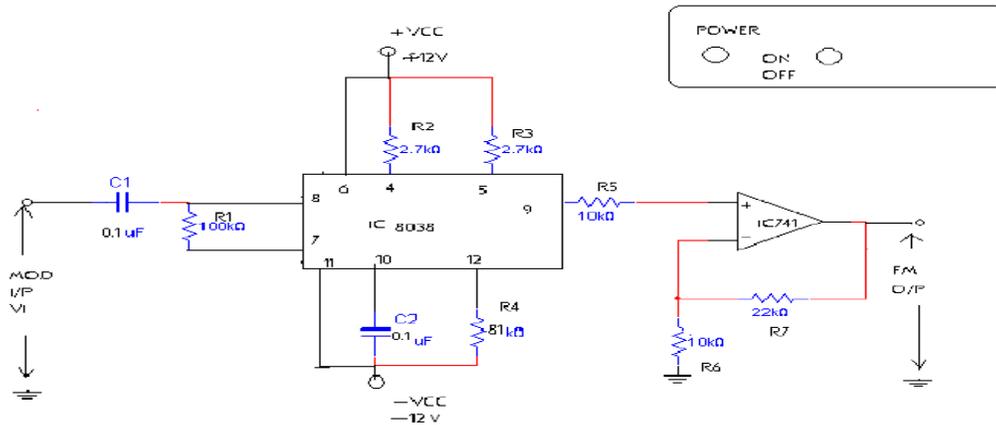
**2. Objective of the Experiment:** 1.To observe FM signal waveform and find Modulation index

**3. Equipment Required:** 1.FM modulation and demodulation kit

- 2. CRO
- 3. AF/RF signal generator
- 4. Probes
- 5. Connecting wires

**4. Circuit Diagram:**

FM Modulation Using IC8038



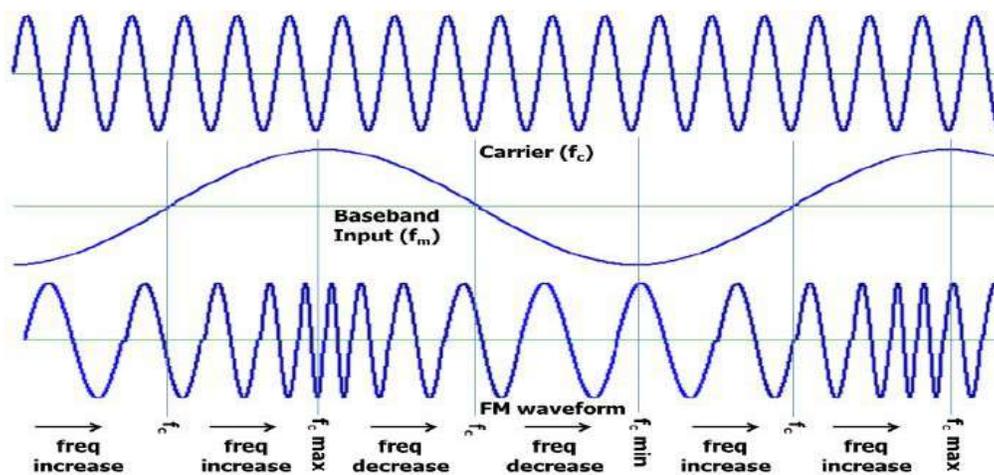
**5. Procedure:**

SI No.	Procedure
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**6. Calculations:**

- A. Modulation index  $\beta = \Delta f / f_m = \dots\dots$
- B. Frequency deviation  $\Delta f = \text{maximum frequency} - \text{minimum frequency} = \dots\dots$
- C. Frequency of message signal  $f_m = \dots\dots$

**7. Model Graph:**



**8. Discussion:**

Measurement of amplitude and frequency of message and FM wave, trouble shooting of circuit, calculation of modulation index should be discussed.

**9. Scheme of Evaluation**

**WORK SHEET**

Name of the student :		Date of experiment:
PIN :	Branch:	
Institution:		Experiment No.

1. Title of the Experiment: \_\_\_\_\_

2. Objective of the Experiment: \_\_\_\_\_

3. Equipment Required: \_\_\_\_\_

\_\_\_\_\_

4. Circuit Diagram:

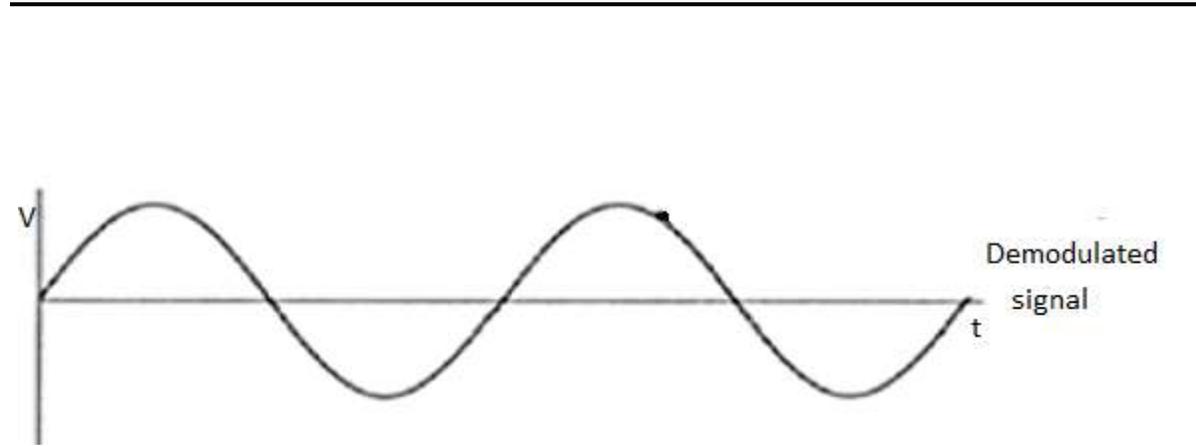
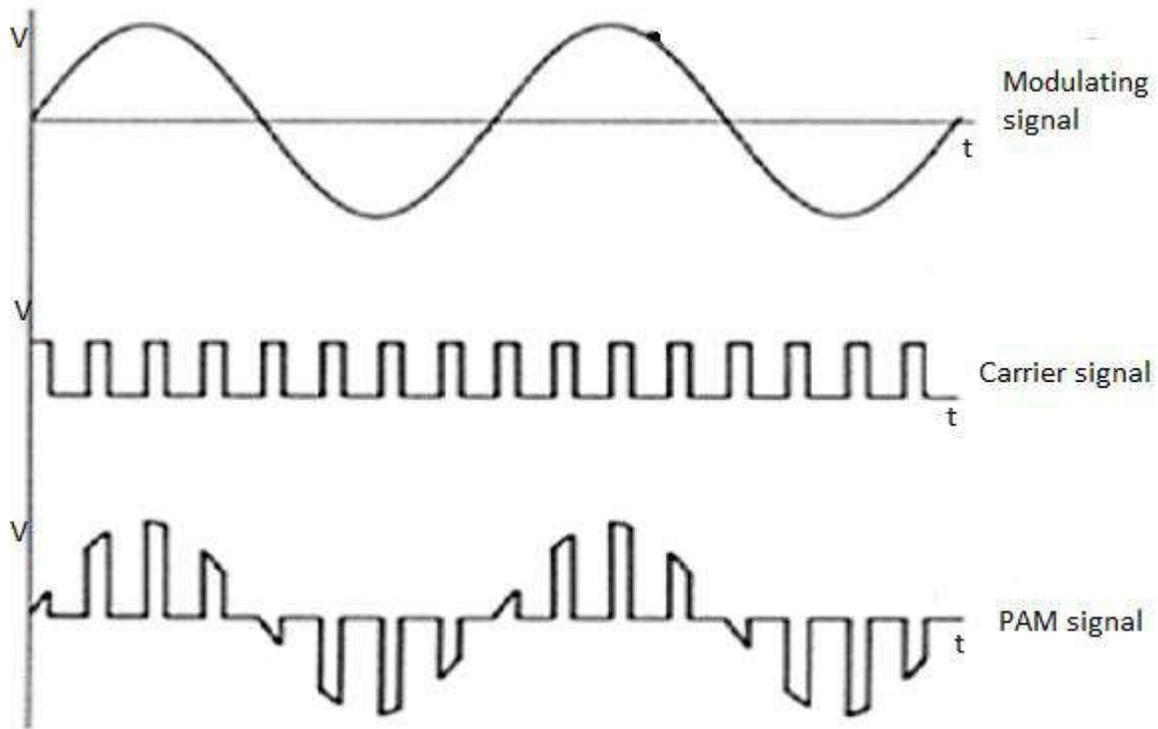
5. Procedure:

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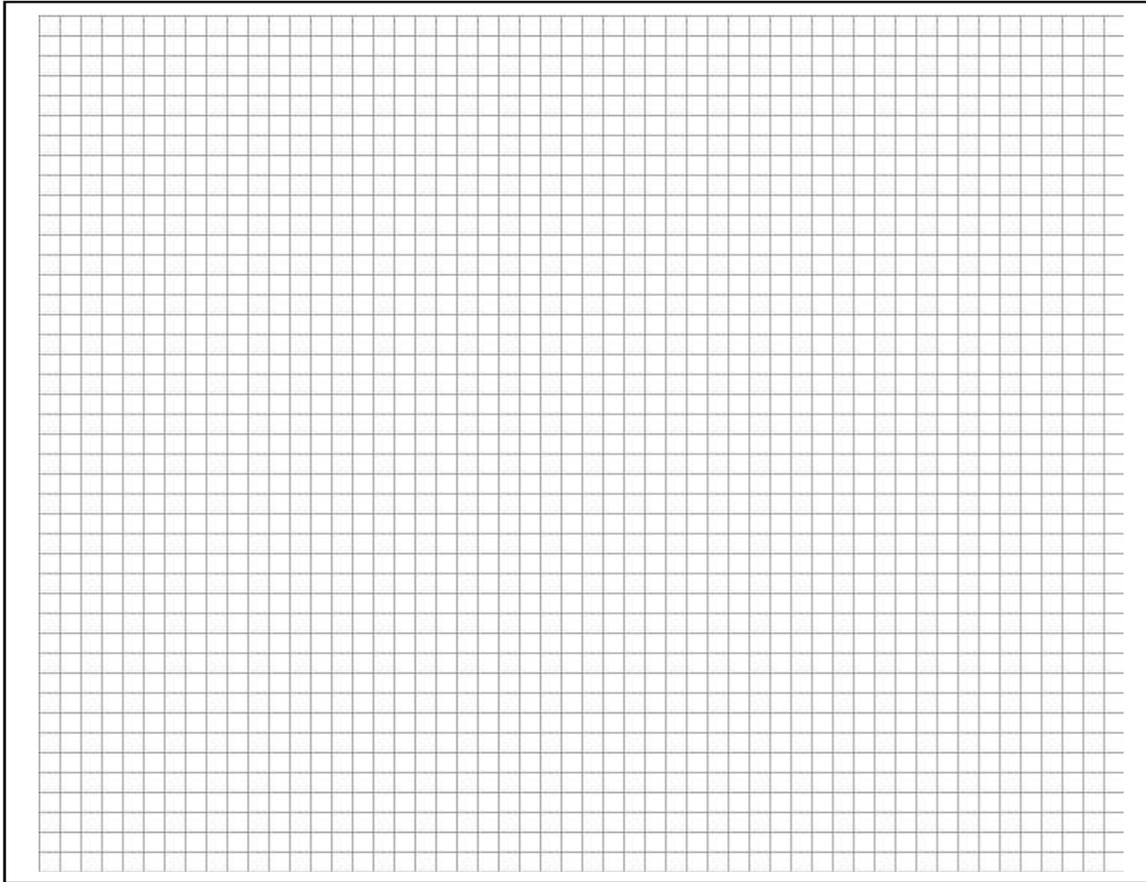
**6. Readings:**

Parameter	Message signal	Carrier signal	PAM modulated signal	PAM demodulated signal
Amplitude (v)				
Frequency(Hz)				
Time period(sec)				

7. Model Graph:



**8. Graph:**



**Observed Waveforms**

**9. Discussion ( Mandatory):**

**10. SCHEME OF EVALUATION:**

<b>CATEGORY OF SKILL</b>	<b>SUB TASK</b>	<b>WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY</b>		
1. Handling of apparatus	A) Identifying various terminals of Transistor. B) Identification of capacitor and Resistor values. C) Identifying the range of Decade resistance box D) Selecting the correct wires and probes	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td style="width: 100px; height: 20px;"></td></tr> <tr><td style="text-align: center;">5</td></tr> </table>		5
5				
2. Manipulation of apparatus	A) Draw the Circuit Diagram. B) Making the connections as per the circuit diagram. C) Set the Amplitude, Frequency of message signal and Carrier signal. D) Adjusting DRB to Correct value.	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td style="width: 100px; height: 20px;"></td></tr> <tr><td style="text-align: center;">15</td></tr> </table>		15
15				
3. Precise operations /Activities	<p style="text-align: center;"><b>PAM Modulator</b></p> A) Measure I/P message signal amplitude and Frequency. B). Measure I/P Carrier signal amplitude and Frequency C) Observe the waveforms on CRO. D) Note the Amplitude and Frequency PAM modulated output. E) Compare the waveform of PAM Modulator with Input message signal.	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td style="width: 100px; height: 20px;"></td></tr> <tr><td style="text-align: center;">25</td></tr> </table>		25
25				

	<p style="text-align: center;"><b><u>PAM Demodulator</u></b></p> <p>F) Adjust the DRB for filter operation.</p> <p>G) Observing the waveforms on CRO</p> <p>H) Note the Amplitude and Frequency of Demodulated Wave</p> <p>I) Compare the waveform of PAM Demodulator with Input message signal.</p> <p>J) Draw the graphs</p>			
<p>4.Values</p>	<p>A. Co-operation.                  B. Co-ordination                  C. Communication                  D. Sharing                  E. leadership</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="width: 100px; height: 15px;"></td> </tr> <tr> <td style="text-align: center;">5</td> </tr> </table>		5
5				
<p>Total</p>		<p>50</p>		
<p><b>Signature of the staff</b></p>		<p><b>Signature of the student</b></p>		

**WORK SHEET**

Name of the student :		Date of experiment:
PIN :	Branch:	
Institution:		Experiment No.

1. Title of the Experiment: \_\_\_\_\_

2. Objective of the Experiment: \_\_\_\_\_

3. Equipment Required: \_\_\_\_\_

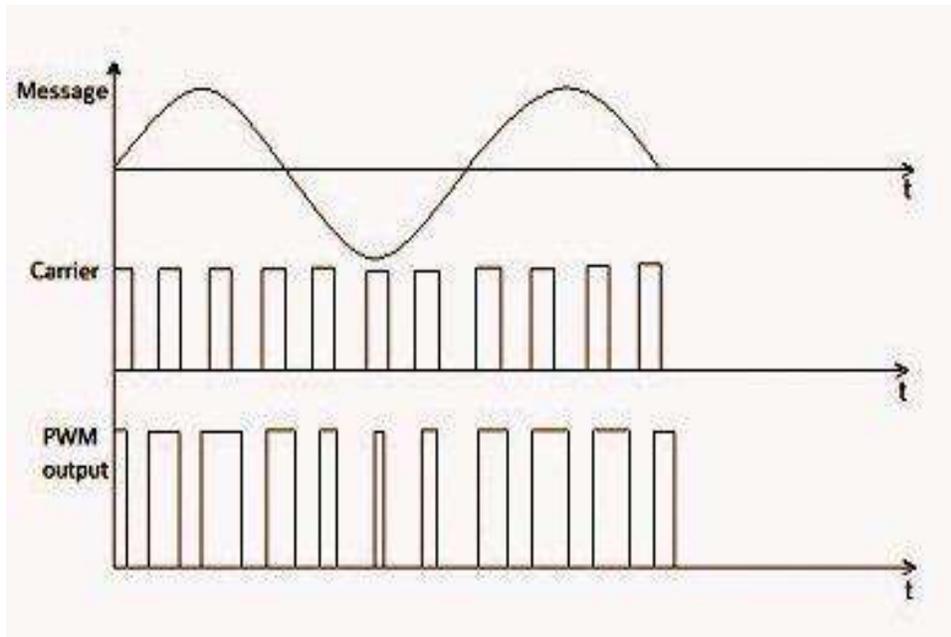
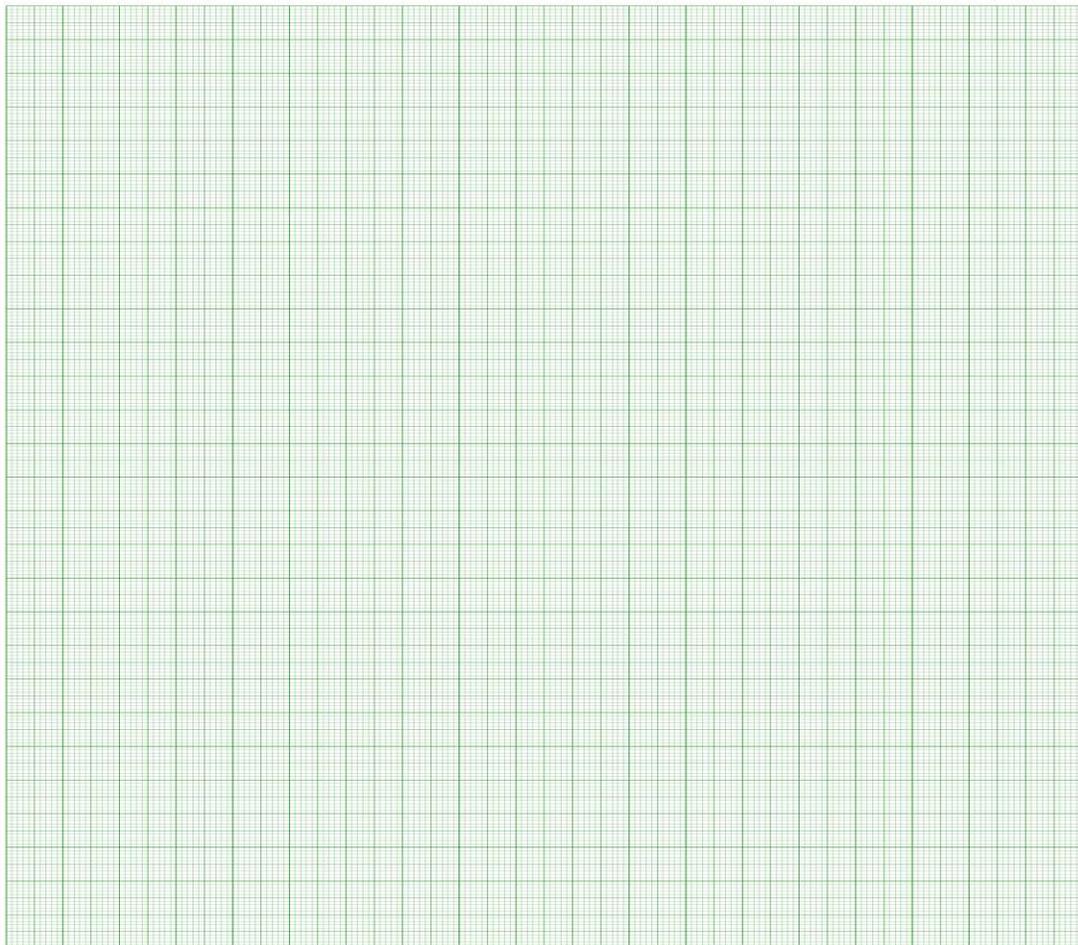
\_\_\_\_\_

4. Circuit Diagram:

5. Procedure:

SI No.	Procedure
1	
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**7. Model Graph:****8. Graph:****Observed Waveforms**

9. Inference and interpretation:  
10. SCHEME OF EVALUATION

Category of skill	Sub task	Weightage with	Marks
-------------------	----------	----------------	-------

		competency level individually	awarded		
1. Handling of apparatus	A) A Identifying various terminals B) Using correct range Resistors , Capacitors. C) Identify each pin of 555 IC timer. D) Identification of 555 IC timer terminals by markings. E) Identification of capacitor and resistors values..	<table border="1" style="margin: auto;"> <tr><td> </td></tr> <tr><td style="text-align: center;">5</td></tr> </table>		5	
5					
2. Manipulation of apparatus	A). Draw the Circuit Diagram. B). Make the connections as per the circuit diagram. C). Vary input sinusoidal wave form ( $v_i$ ) and Pulse wave form Connect capacitor filter as shown in the figure. D) Connect capacitor filter.	<table border="1" style="margin: auto;"> <tr><td> </td></tr> <tr><td style="text-align: center;">15</td></tr> </table>		15	
15					
3.Precise operations /Activities	A) Connect Sine wave generators and Measure $V_i$ B) Connect Pulse generators and Measure $V_i$ C) Using DC Power Supplies and provide Proper biasing to the circuit D) Observing the readings in the multimeter E) Observing the waveforms on CRO. F) Observe the Pulse width variation with respect to the sinusoidal wave form	<table border="1" style="margin: auto;"> <tr><td> </td></tr> <tr><td style="text-align: center;">25</td></tr> </table>		25	
25					
4.Values	A) Co Operation B) Co-Ordination C) Communication D) Sharing A. Leadership	<table border="1" style="margin: auto;"> <tr><td> </td></tr> <tr><td style="text-align: center;">5</td></tr> </table>		5	
5					
<b>Total</b>			<b>50</b>		
Signature of the Staff		Signature of the Student			

**WORK SHEET**

Name of the student :		Date of experiment:
PIN :	Branch:	
Institution:		Experiment No.

1. Title of the Experiment: \_\_\_\_\_

2. Objective of the Experiment: \_\_\_\_\_

3. Equipment Required: \_\_\_\_\_

4. Circuit Diagram:

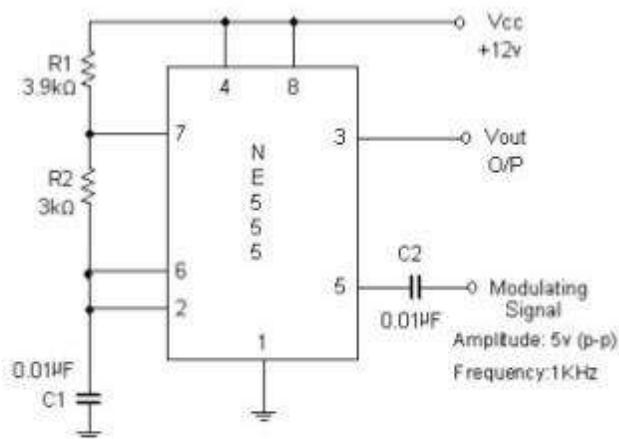


Fig: 1 Pulse Position Modulation Circuit

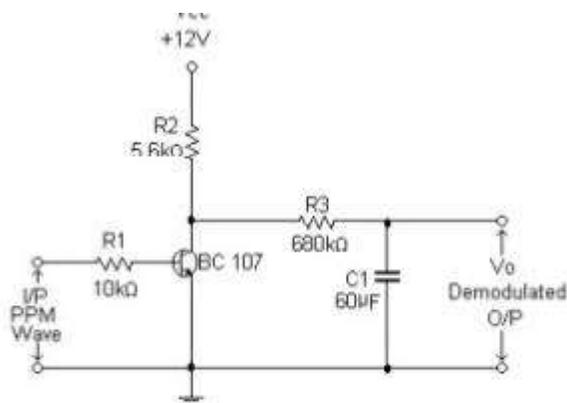


Fig: 2 Demodulation Circuit

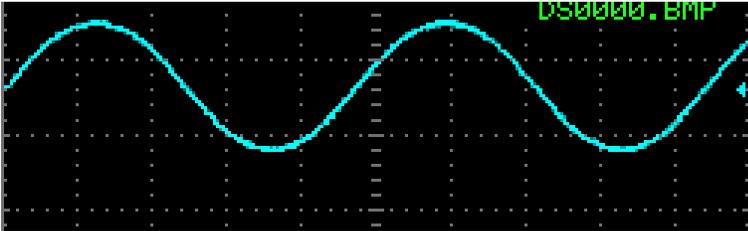
**5. Procedure:**

SI No.	Procedure
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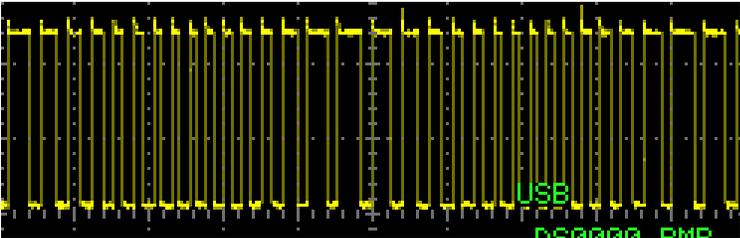
**6. Readings:**

SI No.	Signal	Amplitude(volts)	Timeperiod	Frequency
01	Input			
02	PPM output			
03	Demodulation output			

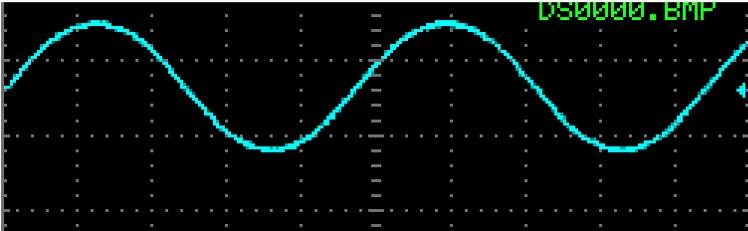
7. Model Graph:



input signal

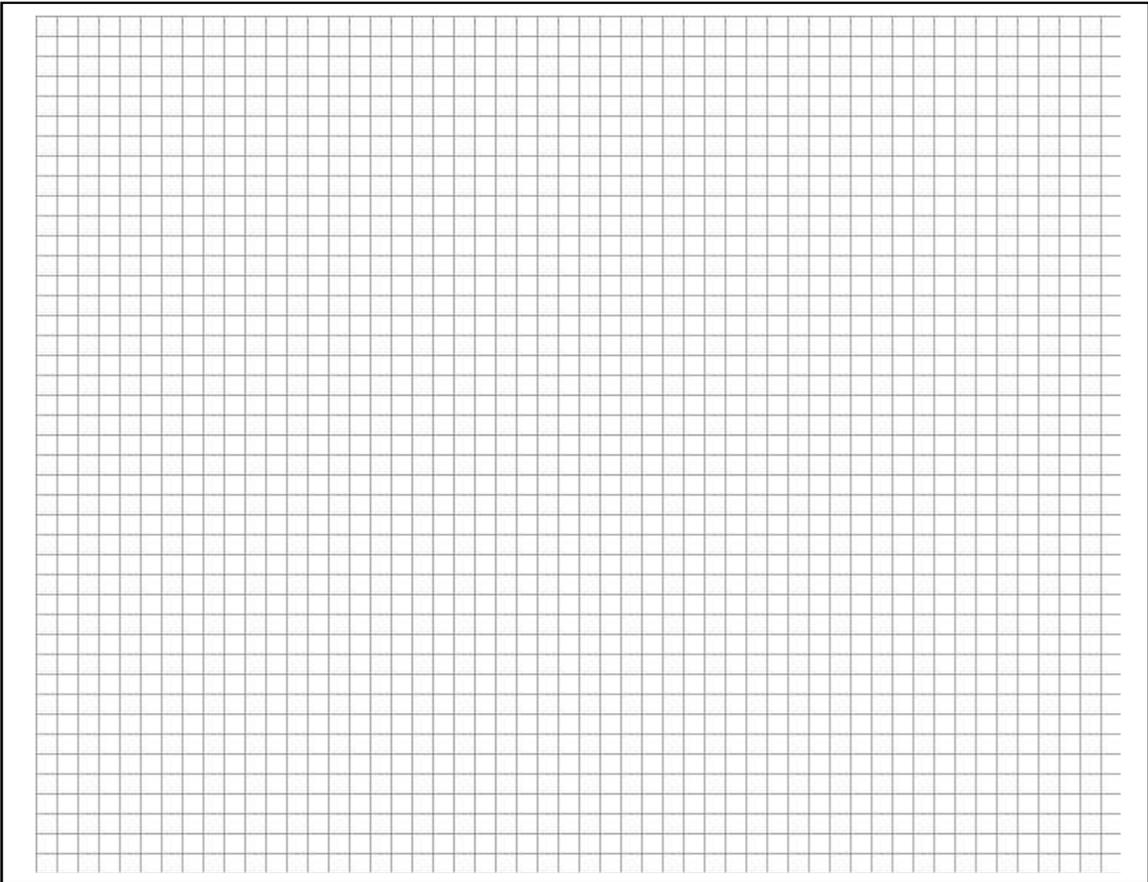


PPM output



demodulation output

**8. Graph:**



**Observed Waveforms**

**9. Discussion:**

**Scheme of Evaluation:**

Category of skill	Sub task	Weightage with competency level individually	Marks awarded
1. Handling of apparatus	A). Identifying various pins. B) Selecting the input signal in Wave form generator. C) Identification of Transistor terminals D) Identification of capacitor and resistors values circuits.	<div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto;"></div> <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto; text-align: center;">5</div>	
2. Manipulation of apparatus	A) Draw the Circuit Diagram. B) Making the connections as per the circuit diagram. C) Apply the input signal from function generator D) Apply the PPM signal to Demodulation circuit	<div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto;"></div> <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto; text-align: center;">15</div>	

<p>3.Precise operations /Activities</p>	<p>A) Observing the input waveform on CRO.                  B) Measure amplitude &amp; time period.                  C) Observing the clock signal on CRO.                  D) Measure amplitude &amp; time period.                  D) Observing the output waveform on CRO.                  E) Measure amplitude.                  F) Observe the demodulated output waveform                  G)Measure amplitude and time period                  H) Record <math>V_{in}, f_{in}, f_{clk}, V_o</math> and demodulated signal amplitude and frequency..                  J) draw the waveforms on graph sheet</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td> </td></tr> <tr><td style="text-align: center;">25</td></tr> </table>		25	
25					
<p>4.Values</p>	<p>A. Co Operation                  B. Co-Ordination                  C. Communication                  D. Sharing                  E. Leadership</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td> </td></tr> <tr><td style="text-align: center;">5</td></tr> </table>		5	
5					
			Total		
			50		
<p>Signature of the Staff</p>		<p>Signature of the Student</p>			

**WORK SHEET**

Name of the student :		Date of experiment:
PIN :	Branch:	
Institution:		Experiment No.

**1. Title of the Experiment:** \_\_\_\_\_

**2. Objective of the Experiment:** \_\_\_\_\_

**3. Equipment Required:** \_\_\_\_\_

**4. Circuit Diagram:** \_\_\_\_\_

**5. Procedure: ASK MODULATOR**

<b>SI No.</b>	<b>Procedure</b>
1	
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**Procedure: ASK DEMODULATOR**

<b>SI No.</b>	<b>Procedure</b>
1	
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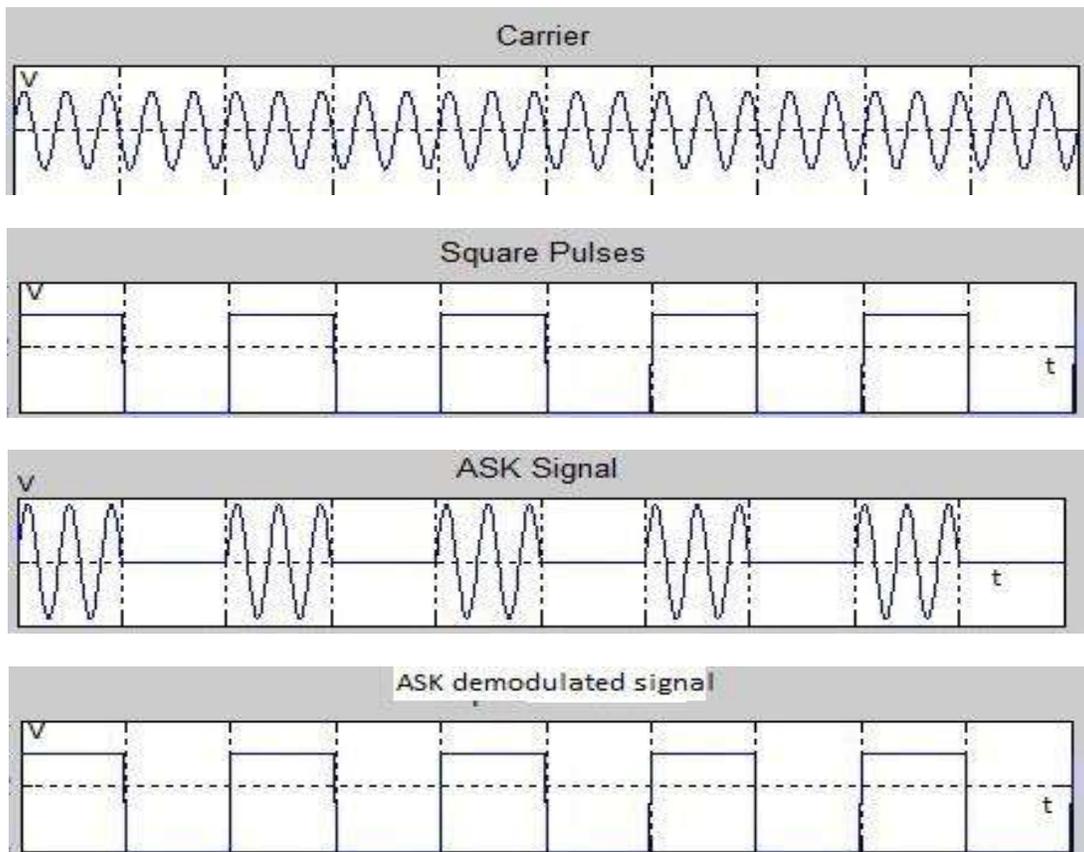
**6. Readings:**

Parameter	Message signal	Carrier signal	ASK modulated signal	ASK demodulated signal
Amplitude (v)				
Frequency(Hz)				
Time period(sec)				

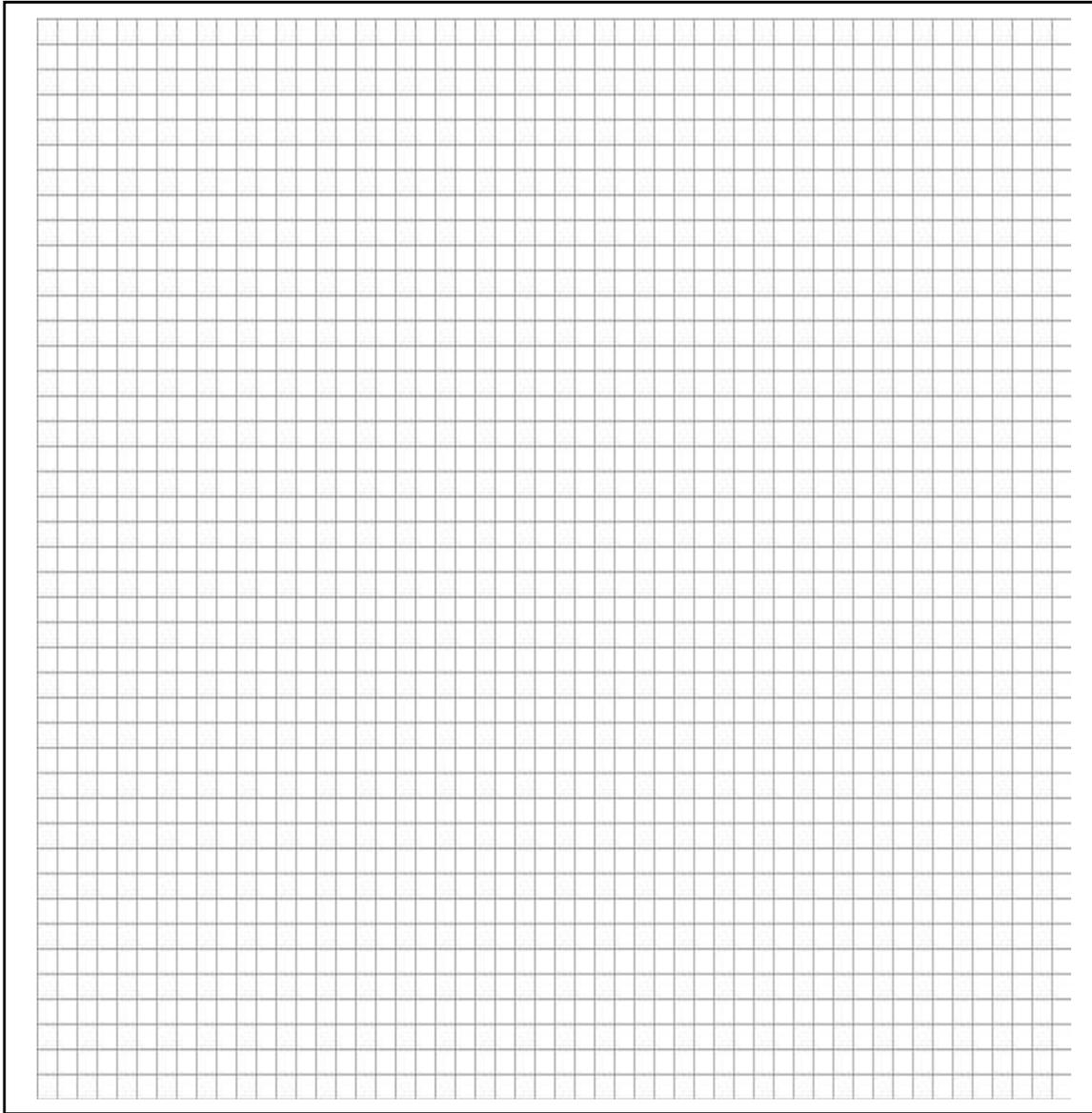
**Message signal : ON Period:**

**OFF period:**

**7. Model Graph:**



**8. Graph:**



**Observed Waveforms**

**9. Discussion (Mandatory):**

**10. SCHEME OF EVALUATION**

CATEGORY OF SKILL	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY	MARKS AWARDED
1. Handling of apparatus	A) Identifying various terminals B) Using correct range multimeter. C) Setting the Potentiometer ( POT) to correct values. D) Identification of Pins of IC741 and IC MAX 232 E) Identification of capacitor and Resistor values.	<div style="border: 1px solid black; width: 100%; height: 100%; display: flex; align-items: center; justify-content: center;"> <div style="border: 1px solid black; width: 80%; height: 80%; margin: auto; display: flex; align-items: center; justify-content: center;"> <div style="border: 1px solid black; width: 80%; height: 80%; margin: auto; display: flex; align-items: center; justify-content: center;">5</div> </div> </div>	
2. Manipulation of apparatus	A) Draw the Circuit Diagram. B) Making the connections as per the circuit diagram. C) Set the Amplitude, Frequency of message signal and Carrier signal. D) Adjusting the Potentiometer (POT) for required Reference voltage level. E) Set Correct operating voltages for IC741, IC MAX 232 .	<div style="border: 1px solid black; width: 100%; height: 100%; display: flex; align-items: center; justify-content: center;"> <div style="border: 1px solid black; width: 80%; height: 80%; margin: auto; display: flex; align-items: center; justify-content: center;">15</div> </div>	

<p>3.Precise operations/Activities</p>	<p style="text-align: center;"><b><u>ASK Modulator</u></b></p> <p>A) Measure I/P message signal amplitude ,time period and Frequency.                  B). Measure I/P Carrier signal amplitude, time period and Frequency                  C) Observing the waveforms on CRO.                  D) Note the Amplitude and Frequency ASK modulated output.                  E) Compare the waveform of ASK Modulator with Input message signal.</p> <p style="text-align: center;"><b><u>ASK Demodulator</u></b></p> <p>F) ASK modulated signal to voltage comparator to setting of Potentiometer (POT) .                  G) Measure Demodulated signal amplitude and frequency.                  Tabulate the readings and observe the waveforms on CRO                  H)Drawing the graphs</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td style="width: 100px; height: 20px;"></td></tr> <tr><td style="text-align: center;">25</td></tr> </table>		25	
25					
<p>4.Values</p>	<p>A. Co-operation.                  B. Co-ordination                  C. Communication                  D. Sharing                  E. leadership</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td style="width: 100px; height: 20px;"></td></tr> <tr><td style="text-align: center;">5</td></tr> </table>		5	
5					
<p>Total</p>		<p>50</p>			

Signature of the staff

Signature of the student

**WORK SHEET**

Name of the student :		Date of experiment:
PIN :	Branch:	
Institution:		Experiment No.

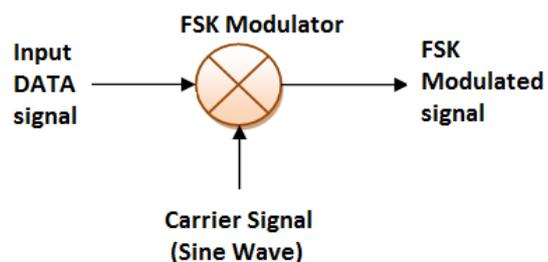
1. Title of the Experiment: **FSK Modulation and Demodulation**

2. Objective of the Experiment:

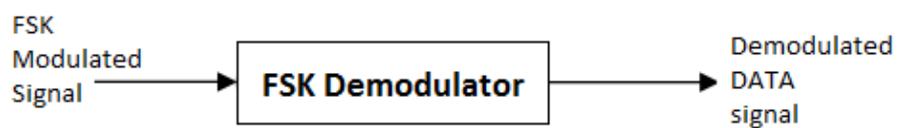
3. Equipment Required:

4. Circuit Diagram:

**FSK Modulation :**



**FSK Demodulation :**



**5. Procedure:****FSK Modulation :**

SI No.	Procedure
1	
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4	

**FSK Demodulation :**

SI No.	Procedure
1	
2	
3	

**6. Readings:****Modulation:**

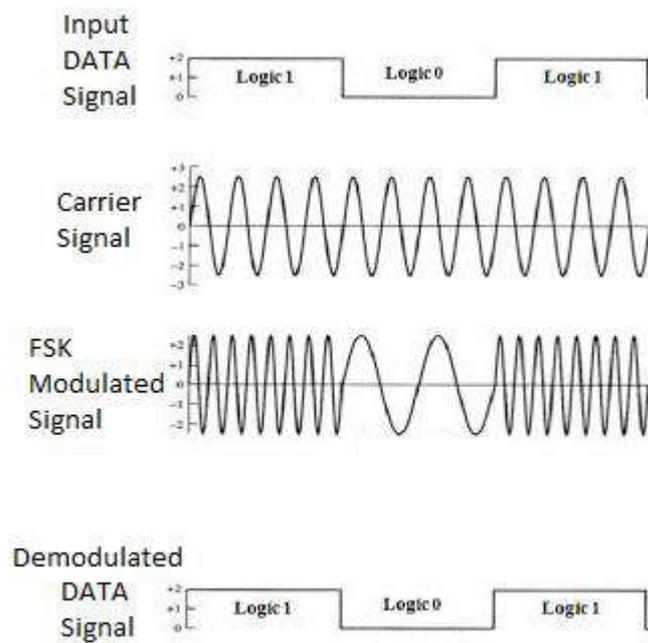
<b>Input DATA signal</b>	<b>Amplitude :</b> volts
	<b>Time Period :</b> Sec
	<b>T<sub>ON</sub> :</b> Sec <b>T<sub>OFF</sub> :</b> Sec
	<b>Frequency :</b> Hz
<b>Carrier Signal</b>	<b>Amplitude :</b> volts
	<b>Time Period :</b> Sec
	<b>Frequency :</b> Hz

<b>Modulated Signal</b>	<b>Amplitude : volts</b>	
	<b>For '0' data input</b>	<b>Time Period : Sec</b>
		<b>Frequency : Hz</b>
	<b>For '1' data input</b>	<b>Time Period : Sec</b>
<b>Frequency : Hz</b>		

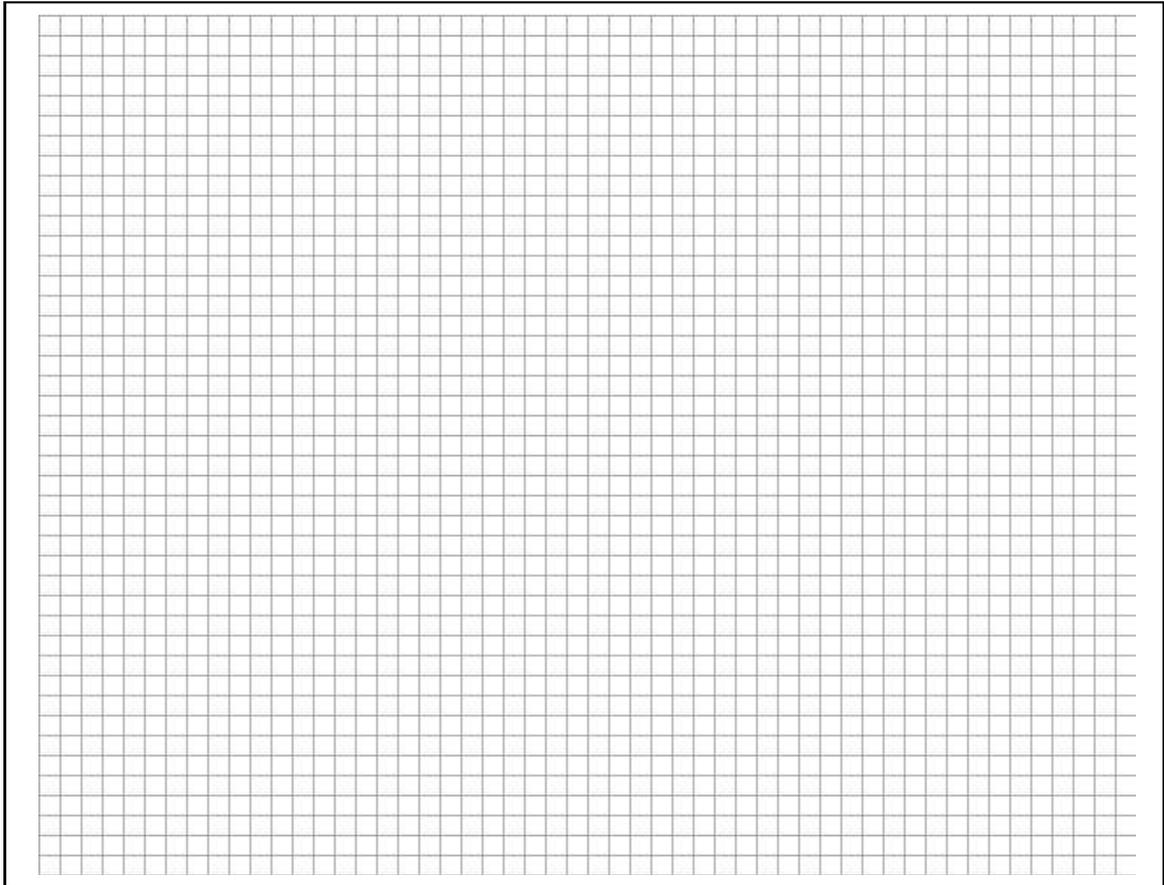
**Demodulation :**

<b>Demodulated signal</b>	<b>Amplitude : volts</b>	
	<b>Time Period : Sec</b>	
	<b>Frequency : Hz</b>	

**7. Model Graph:**



**8. Graph:**



**9. Inference and interpretation:**

**10. Scheme of Evaluation:**

Category of skill	Sub task	Weightage with competency level individually	Marks awarded		
1. Handling of apparatus	<p>A). Identifying various parts in KIT like DATA signal generator, Carrier signal generator and FSK modulator and FSK demodulator.</p> <p>B) Identifying required patch chords,</p> <p>C) Identifying different controls in CRO.</p>	<table border="1"> <tr><td> </td></tr> <tr><td>5</td></tr> </table>		5	
5					
2. Manipulation of apparatus	<p>A) Draw the Circuit Diagram.</p> <p>B) Making the connections as per the circuit diagram.</p> <p>C) Adjusting the controls in CRO to get desired waveforms.</p>	<table border="1"> <tr><td> </td></tr> <tr><td>15</td></tr> </table>		15	
15					
3.Precise operations /Activities	<p style="text-align: center;"><b><u>For FSK Modulation</u></b></p> <p>A) Observe the DATA signal on CRO and record its amplitude ,Time period and frequency.</p> <p>B) Observe the carrier signal on CRO and record its amplitude ,Time period and frequency.</p> <p>C) Observe the changes in frequencies of Modulated signal on CRO during 1 and 0 of data signal and record its amplitude ,Time period and frequency.</p> <p>D) Draw the waveforms in graph sheet.</p>	<table border="1"> <tr><td> </td></tr> <tr><td>25</td></tr> </table>		25	
25					
	<p style="text-align: center;"><b><u>For FSK Demodulation</u></b></p> <p>E) Observe the Demodulated DATA signal on CRO and record its amplitude ,Time period and frequency.</p> <p>F) Verify that the demodulated DATA signal is same as transmitted one.</p>				

	G) Draw the Waveforms in graph sheet.				
4.Values	<ul style="list-style-type: none"> <li>A. Co Operation</li> <li>B. Co-Ordination</li> <li>C. Communication</li> <li>D. Sharing</li> <li>E. Leadership</li> </ul>	<table border="1" style="margin: auto;"> <tr><td style="width: 100px; height: 15px;"></td></tr> <tr><td style="text-align: center;">5</td></tr> </table>		5	
5					
Total			50		

Signature of the Staff

Signature of the Student

**WORK SHEET**

Name of the student :		Date of experiment:
PIN :	Branch:	
Institution:		Experiment No.

**1. Title of the Experiment:** \_\_\_\_\_

**2. Objective of the Experiment:** \_\_\_\_\_

**3. Equipment Required:** \_\_\_\_\_

\_\_\_\_\_

**4. Block Diagram: Modulator and Demodulator**

**Circuit Diagram**

**5. Procedure:**

SI No.	Procedure
1	
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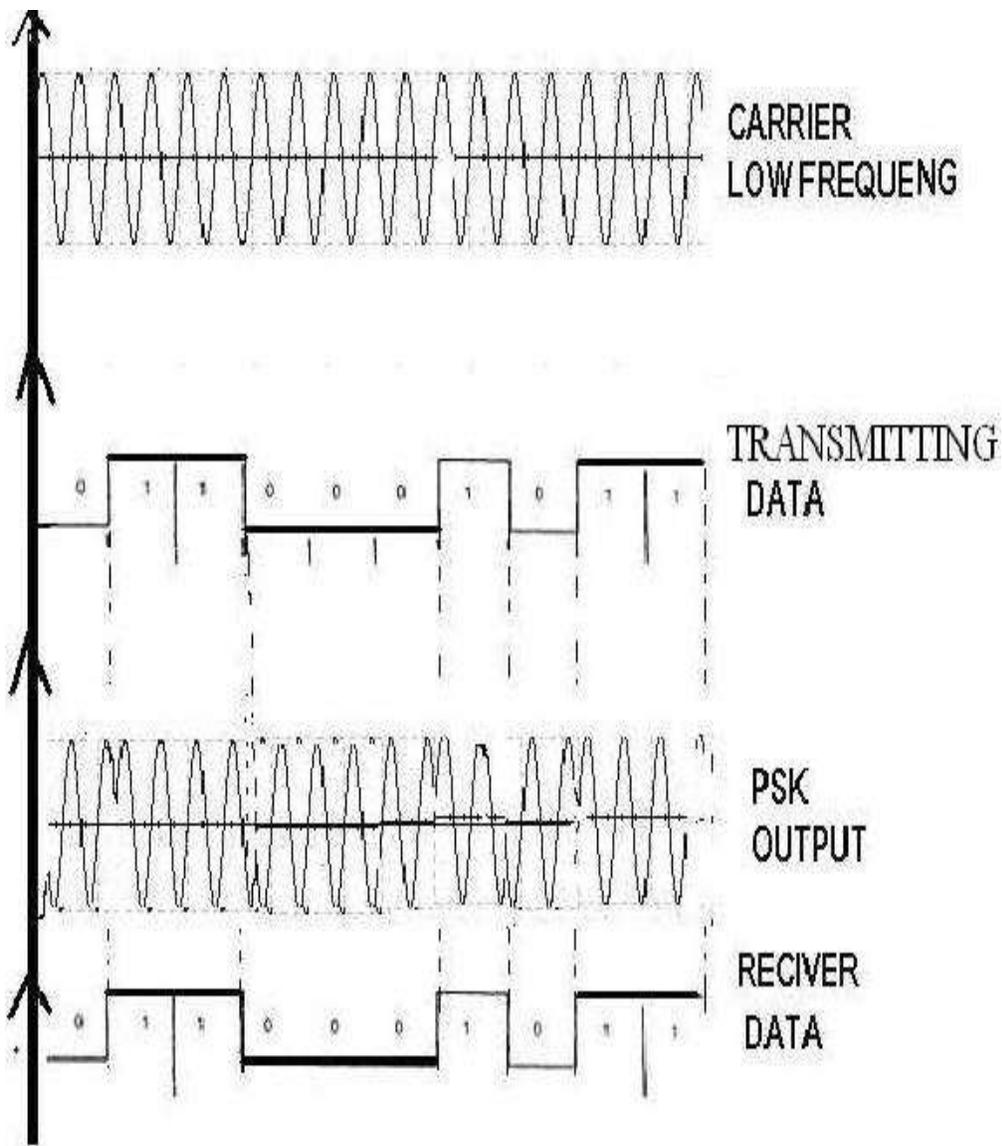
**6. Readings: Modulation:**

Input DATA signal	Amplitude :                      volts
	Time Period :                      Sec
	T <sub>ON</sub> :                      Sec      T <sub>OFF</sub> :                      Sec
	Frequency :                      Hz
Carrier Signal	Amplitude :                      volts
	Time Period :                      Sec
	Frequency :                      Hz
Modulated Signal	Amplitude :                      volts
	Phase reversal period:

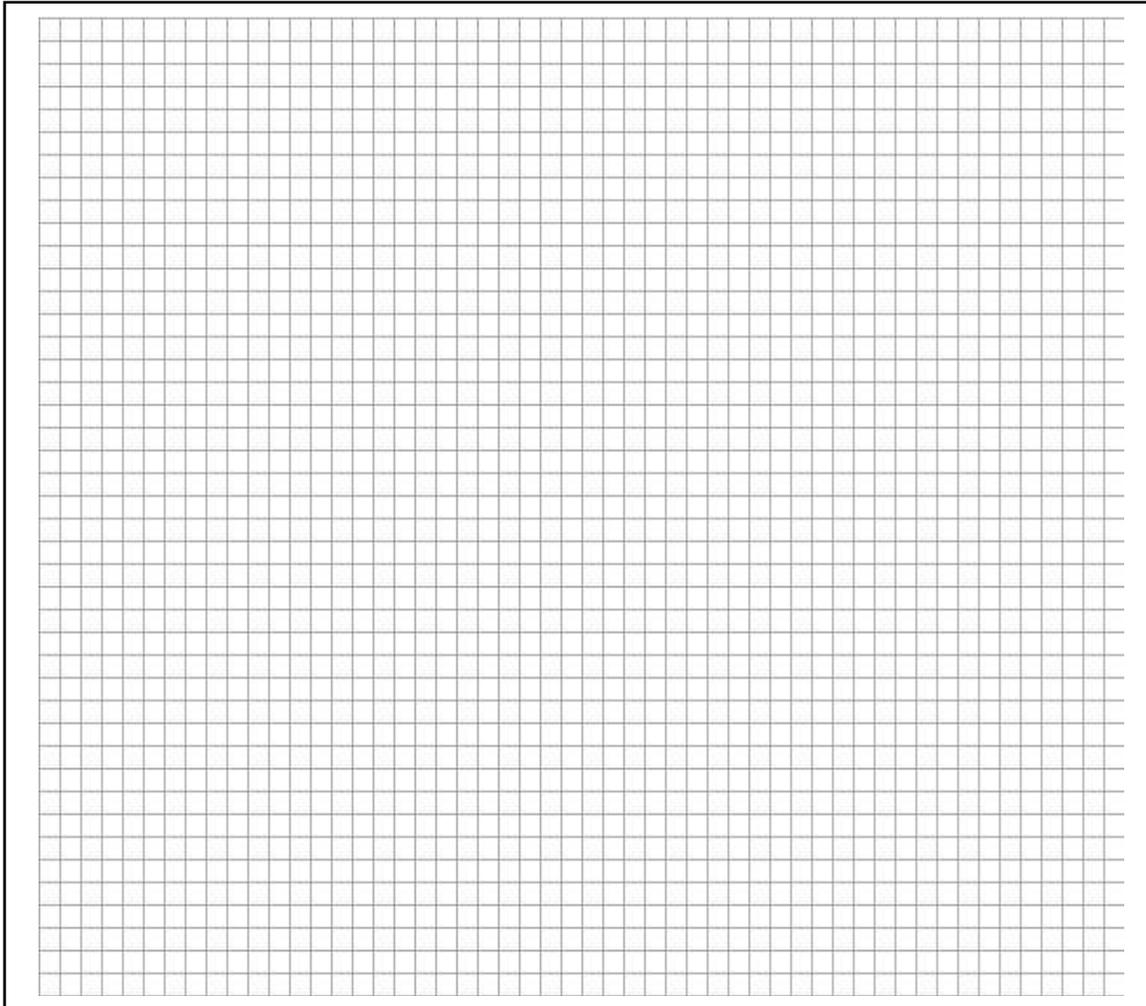
**Demodulation :**

<b>Demodulated DATA signal</b>	<b>Amplitude :</b>	<b>volts</b>	
	<b>Time Period :</b>	<b>Sec</b>	
	<b>T<sub>ON</sub> :</b>	<b>Sec</b>	<b>T<sub>OFF</sub> :</b> <b>Sec</b>
	<b>Frequency :</b>	<b>Hz</b>	

**7. Model Graph:**



**8. Graph:**



**Observed Waveforms**

**9. Discussion:**

**SCHEME OF VALUATION:**

Category of skill	Sub task	Weightage with competency level individually	Marks awarded
1. Handling of apparatus	A) Identifying various terminals B) Identifying various blocks present in PSK Trainer Kit. C) Identification of CRO Terminals and channels by markings. D) Identification of binary message and carrier signals in the input side of PSK Trainer kit.	<div style="border: 1px solid black; width: 100%; height: 100%; display: flex; align-items: center; justify-content: center;"> <div style="border: 1px solid black; width: 80%; height: 80%; display: flex; align-items: center; justify-content: center;">5</div> </div>	
2. Manipulation of apparatus	A) Draw the Block Diagram and Circuit Diagram. B) Making the connections as per the circuit diagram. C) Connecting the Binary message signal and PSK output signal to Channel 1 and Channel 2 Respectively at Modulator Block. D) Connecting the Binary message signal and Demodulated output signal to Channel 1 and Channel 2 Respectively at Demodulator Block. E) Adjusting CRO Volts/Div and Times/Div knobs According with the signal.	<div style="border: 1px solid black; width: 100%; height: 100%; display: flex; align-items: center; justify-content: center;"> <div style="border: 1px solid black; width: 80%; height: 80%; display: flex; align-items: center; justify-content: center;">15</div> </div>	

3.Precise operations /Activities	<p>A) Observing the Binary message and PSK output signals on CRO.</p> <p>B) Observing the Phase shift in the carrier signal in according with the input binary signal either 'logic 1 ' or 'logic 0'</p> <p>C) Calculating the frequency and peak to peak voltage of input binary message signal , PSK signal and demodulated signal.</p> <p>D) Tabulate the readings and observe the waveforms on CRO.</p> <p>E) Drawing the graphs of input binary message signal, PSK signal and demodulated signal.</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td style="width: 100px; height: 15px;"></td></tr> <tr><td style="text-align: center;">25</td></tr> </table>		25	
25					
4.Values	<p>A. Co Operation</p> <p>B. Co-Ordination</p> <p>C. Communication</p> <p>D. Sharing</p> <p>E. Leadership</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td style="width: 100px; height: 15px;"></td></tr> <tr><td style="text-align: center;">5</td></tr> </table>		5	
5					
Total			50		
Signature of the Staff		Signature of the Student			

**WORK SHEET**

Name of the student :		Date of experiment:
PIN :	Branch:	
Institution:		Experiment No.

**1. Title of the Experiment:** \_\_\_\_\_

**2. Objective of the Experiment:** \_\_\_\_\_

**3. Equipment Required:** \_\_\_\_\_

\_\_\_\_\_

**4. Block diagram of TDM multiplexer and Demultiplexer**

**5. Procedure:**

SI No.	Procedure
1	
2	
3	
4	
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6	
7	

**6. Readings:****Input signal**

Sl.no	Type of signal	Amplitude	timeperiod	Frequency
1	Sine wave			
2	Square wave			

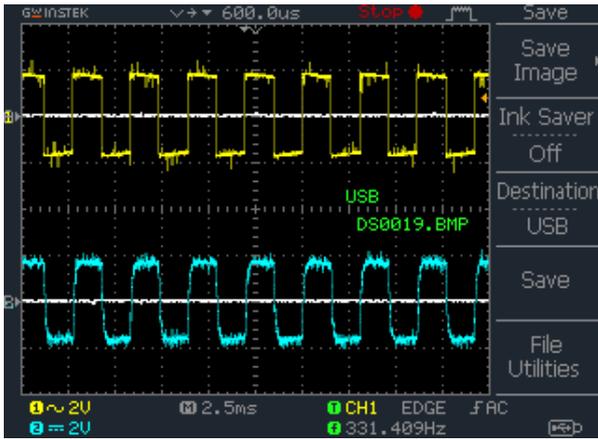
**Clock or Switching signal (from function generator)**

Sl.no	Type of signal	Amplitude	T <sub>ON</sub>	T <sub>OFF</sub>
1	Square wave			

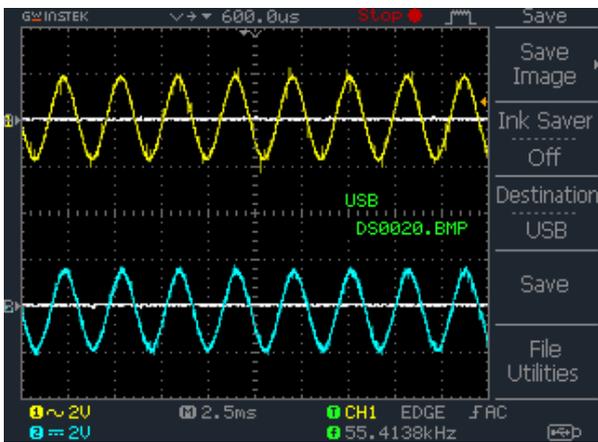
**Output signal**

Sl.n	output	Type of signal	Amplitude	Time period	Frequency
1	multiplexed	Multiplexed signal			
2	demultiplexed	Sine wave			
		Square wave			

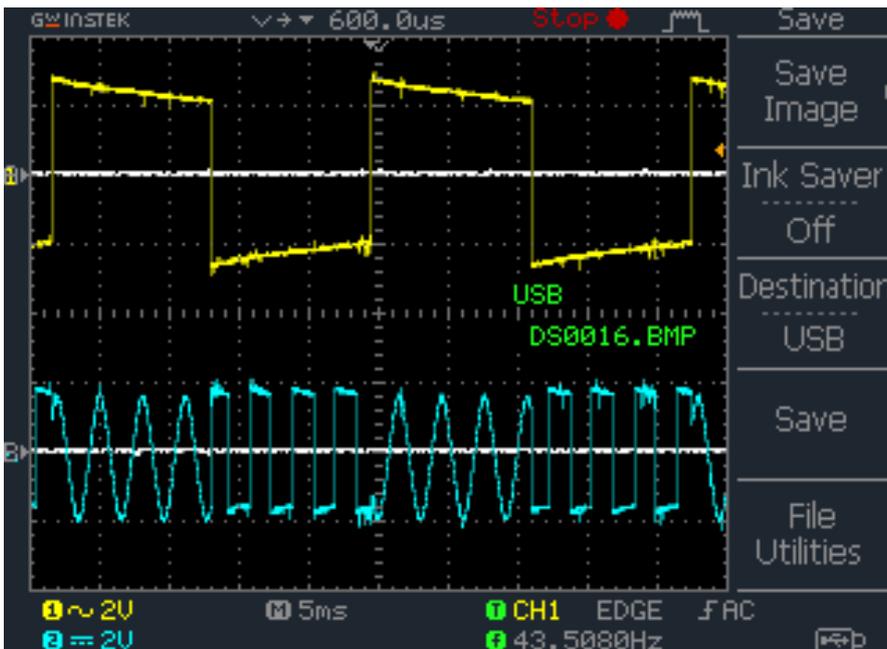
7. Model Graph:



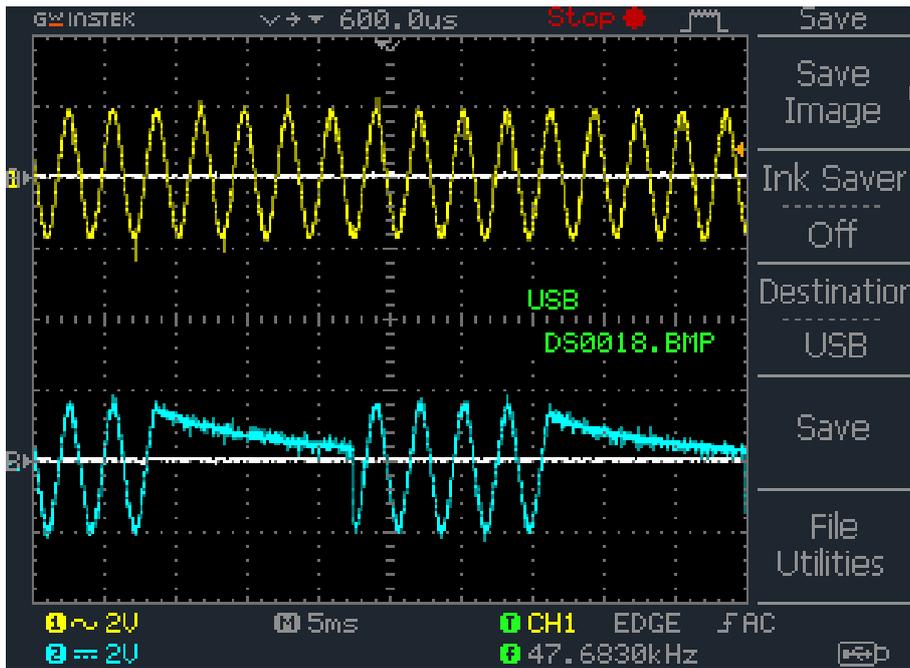
Input Square wave m1(t)



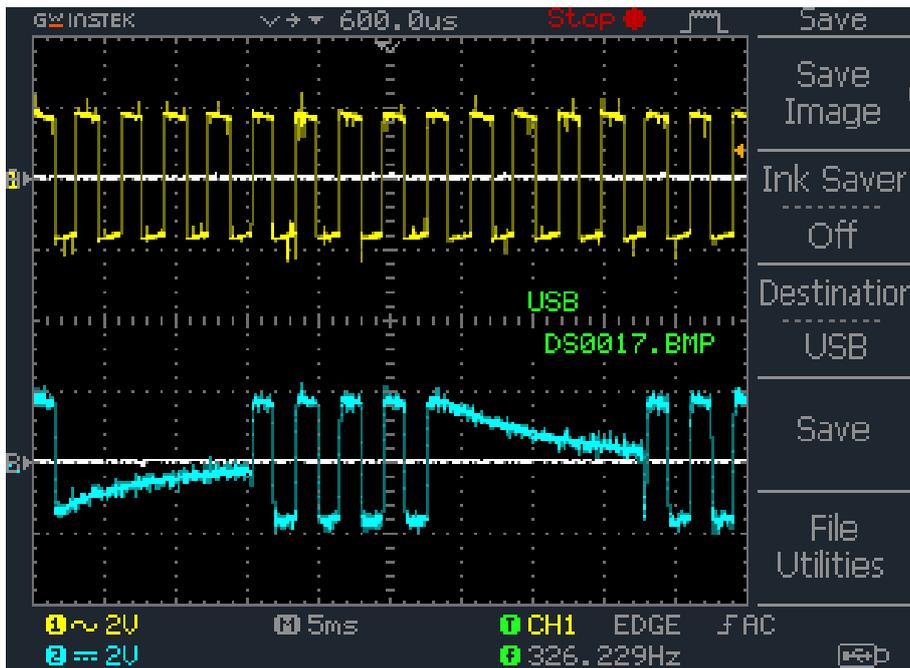
Input sine wave m2(t)



Multiplexed output signal

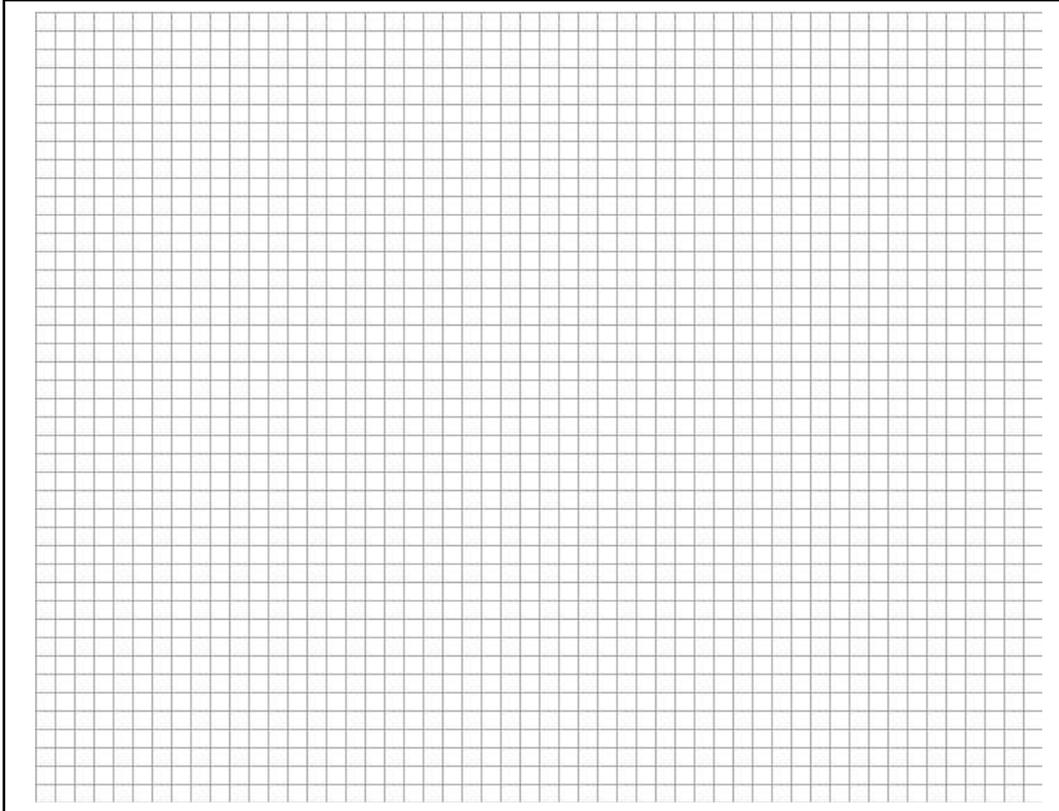


Demultiplexed output signal  $m_1(t)$  (at Low frequency selection input )



Demultiplexed output signal  $m_2(t)$  (at Low frequency selection input )

**8. Graph:**



**Observed Waveforms**

**9. Discussion**

**10. Scheme of Evaluation**

Category of skill	Sub task	Weightage with competency level individually	Marks awarded		
1. Handling of apparatus	A. Identifying various terminals B. Using probes, chords. C. Calibrating the CRO/DSO accurate values. D. Identification of terminals by markings E. Identification of amplitude and frequency ranges of signals to be multiplexed & de multiplexed. On CRO	<table border="1" style="width: 100px; height: 60px;"> <tr><td style="height: 30px;"></td></tr> <tr><td style="text-align: center;">5</td></tr> </table>		5	
5					
2. Manipulation of apparatus	A. Draw the Circuit Diagram. B. Making the connections as per the circuit diagram. C. Adjusting the amplitude and frequency ranges of signals D. Connect the circuit diagram as shown in the figure.	<table border="1" style="width: 100px; height: 60px;"> <tr><td style="height: 30px;"></td></tr> <tr><td style="text-align: center;">15</td></tr> </table>		15	
15					
3. Precise operations/ Activities	A. Measure the amplitude , time period and frequency of input signals to be multiplexed. B. Apply the counter/ timer /external signal as selection input line. C. Observe the waveforms on CRO. D. Note down the amplitude ,time period and frequency of the multiplexed output signal from CRO. E. Repeat the above steps for de multiplexer	<table border="1" style="width: 100px; height: 60px;"> <tr><td style="height: 30px;"></td></tr> <tr><td style="text-align: center;">25</td></tr> </table>		25	
25					
4. Values	A. Co-operation. B. Co-ordination C. Communication D. Sharing E. leadership	<table border="1" style="width: 100px; height: 60px;"> <tr><td style="height: 30px;"></td></tr> <tr><td style="text-align: center;">5</td></tr> </table>		5	
5					
Total			50		
Signature of the Staff		Signature of the Student			

**WORK SHEET**

Name of the student :		Date of experiment:
PIN :	Branch:	
Institution:		Experiment No.

**1. Title of the Experiment:** \_\_\_\_\_

**2. Objective of the Experiment:** \_\_\_\_\_

**3. Equipment Required:** \_\_\_\_\_

\_\_\_\_\_

**4. Circuit Diagram:**

**5. Procedure:**

SI No.	Procedure
1	
2	
3	
4	
5	
6	
7	

**6. Readings:****Input signal**

Sl.no	Type of signal	Amplitude	timeperiod
1	Sine wave		
2	Square wave		

**Selection input (from function generator)**

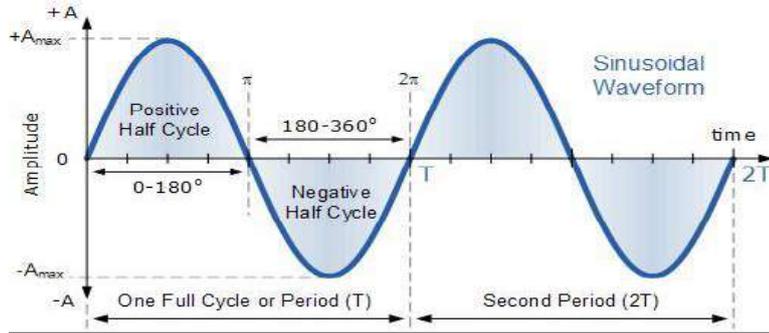
Sl.no	Type of signal	Amplitude	Time period
1	Square wave		

**Output signal**

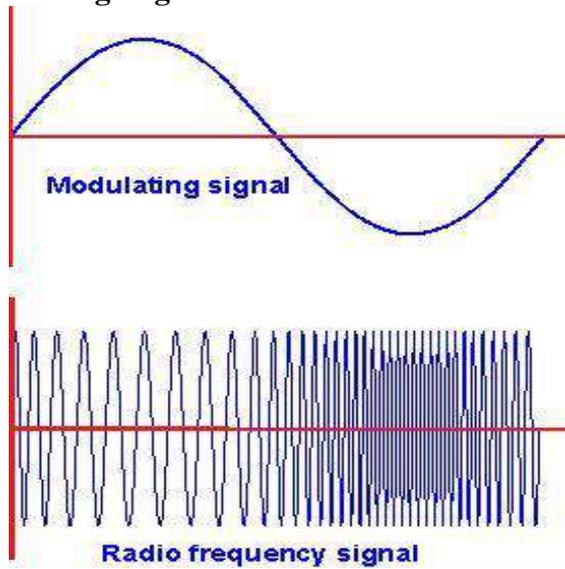
Sl.n	output	Type of signal	Amplitude	Time period
1	multiplexed	Multiplexed signal		
2	demultiplexed	Sine wave		
		Square wave		

**7. Model Graph:**

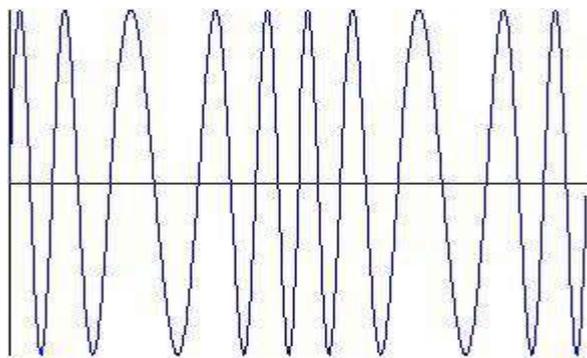
**Message signal 1**



**Message signal 2 and FM wave 1**

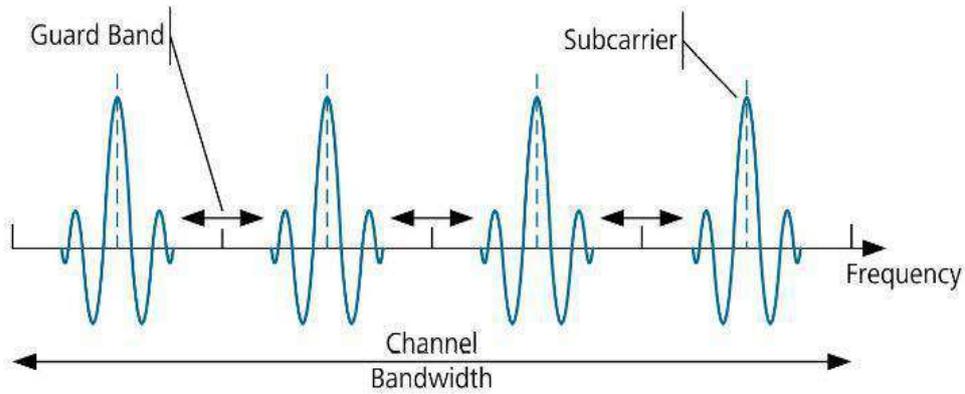


**FM Wave 2**

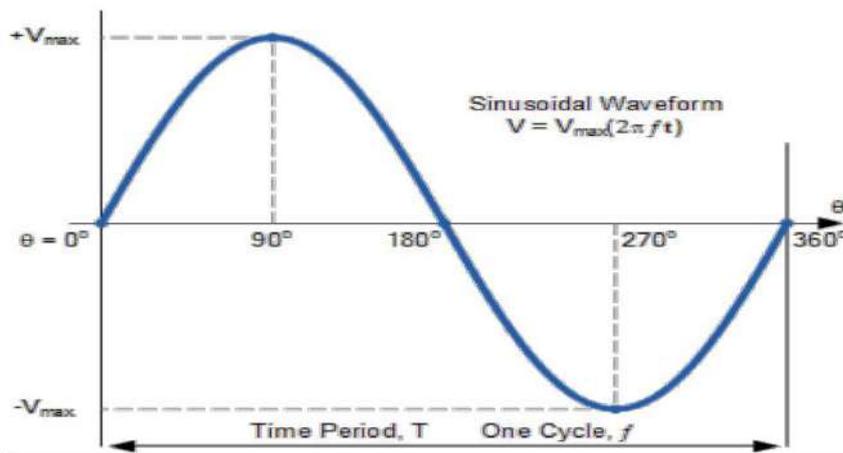
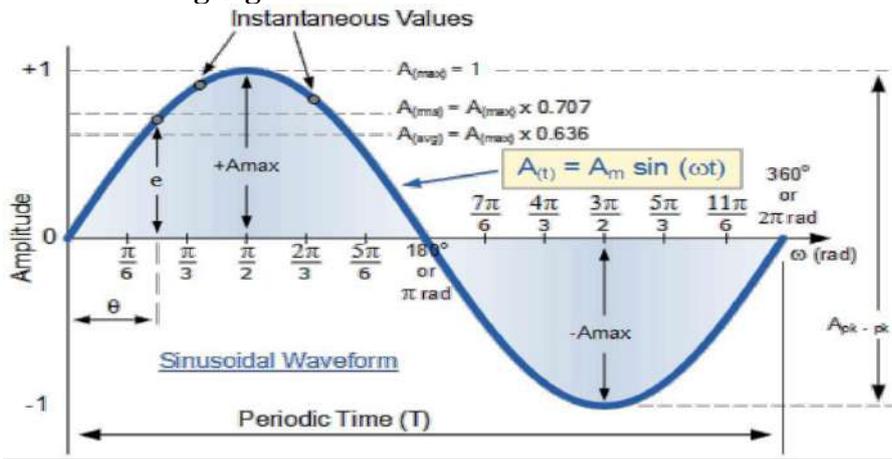


**FDM Output**

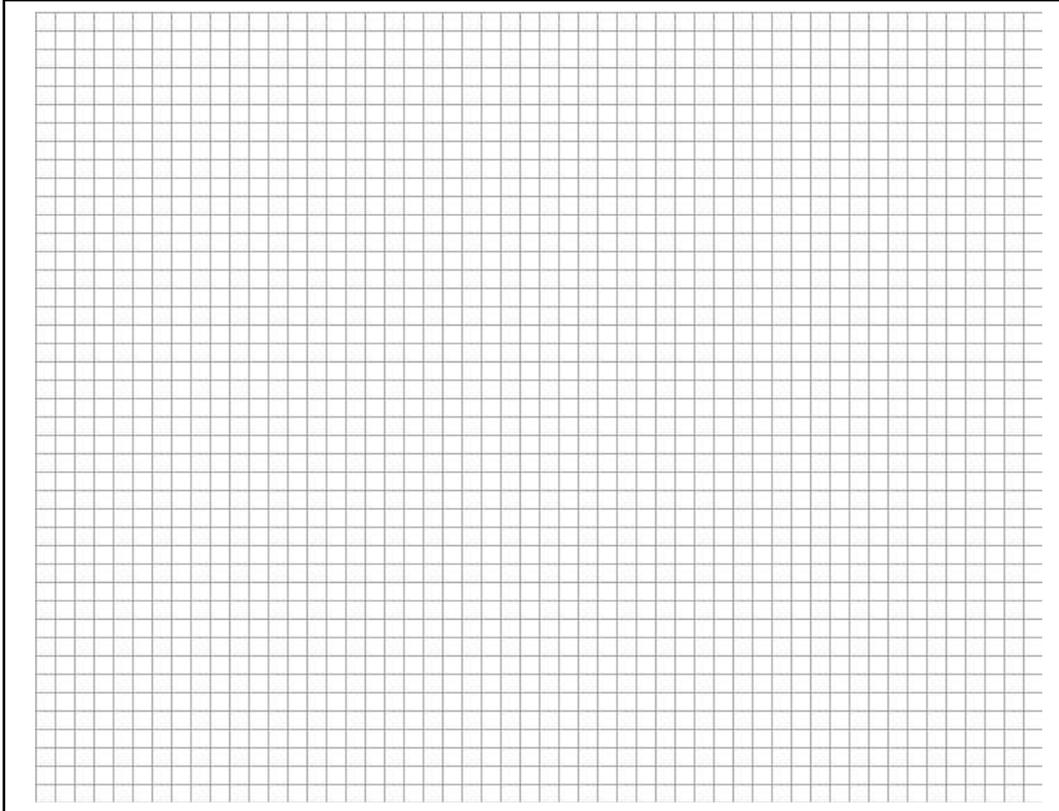
# Frequency Division Multiplexing



## Demodulating Signals



**8. Graph:**



**Observed Waveforms**

**9. Discussion**

**10. Scheme of Evaluation**

Category of skill	Sub task	Weightage with competency level individually	Marks awarded		
1. Handling of apparatus	A. Identifying various terminals B. Using probes, chords. C. Calibrating the CRO/DSO accurate values. D. Identification of terminals by markings E. Identification of amplitude and frequency ranges of signals to be multiplexed & de multiplexed. On CRO	<table border="1" style="width: 100px; height: 40px;"> <tr><td style="height: 20px;"></td></tr> <tr><td style="text-align: center;">5</td></tr> </table>		5	
5					
2. Manipulation of apparatus	A. Draw the Circuit Diagram. B. Making the connections as per the circuit diagram. C. Adjusting the amplitude and frequency ranges of signals D. Connect the circuit diagram as shown in the figure.	<table border="1" style="width: 100px; height: 40px;"> <tr><td style="height: 20px;"></td></tr> <tr><td style="text-align: center;">15</td></tr> </table>		15	
15					
3. Precise operations/ Activities	A. Measure the amplitude & frequency of input signals to be multiplexed. B. Apply the counter/ timer /external signal as selection input line. C. Observe the waveforms on CRO. D. Note down the amplitude and frequency of the multiplexed output signal from CRO. E. Repeat the above steps for de multiplexer	<table border="1" style="width: 100px; height: 40px;"> <tr><td style="height: 20px;"></td></tr> <tr><td style="text-align: center;">25</td></tr> </table>		25	
25					
4. Values	A. Co-operation. B. Co-ordination C. Communication D. Sharing E. leadership	<table border="1" style="width: 100px; height: 40px;"> <tr><td style="height: 20px;"></td></tr> <tr><td style="text-align: center;">5</td></tr> </table>		5	
5					
Total			50		
Signature of the Staff		Signature of the Student			

**WORK SHEET**

Name of the student :		Date of experiment:
PIN :	Branch:	
Institution:		Experiment No.

**1. Title of the Experiment:**

**2. Objective of the Experiment:**

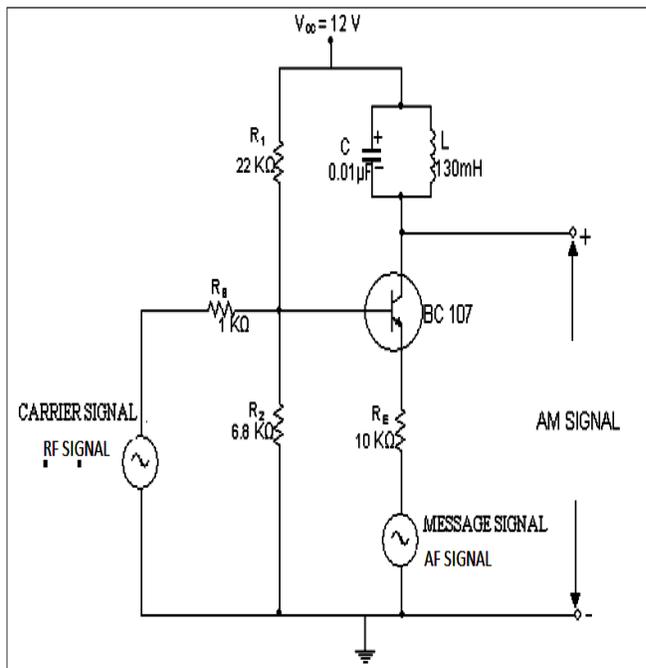
\_\_\_\_\_

**3. Equipment Required:**

\_\_\_\_\_

\_\_\_\_\_

**4. Modulator circuit diagram:**



**5. Procedure:**

Sl No.	
1	
2	
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**6. Readings:****Modulation:**

Parameter	Modulating Signal	Carrier Signal
Amplitude (volts)		
Time Period (sec)		
Frequency (Hz)		

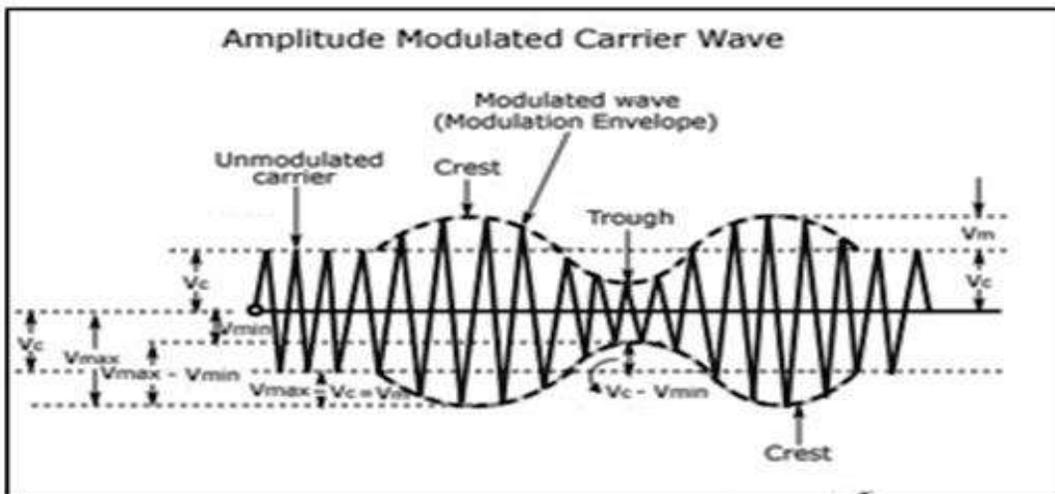
S.No.	Modulated Signal		Modulation Index $m = \frac{V_{Max} - V_{Min}}{V_{Max} + V_{Min}}$
	$V_{Max}$ In Volts	$V_{Min}$ In Volts	
1			
2			
3			

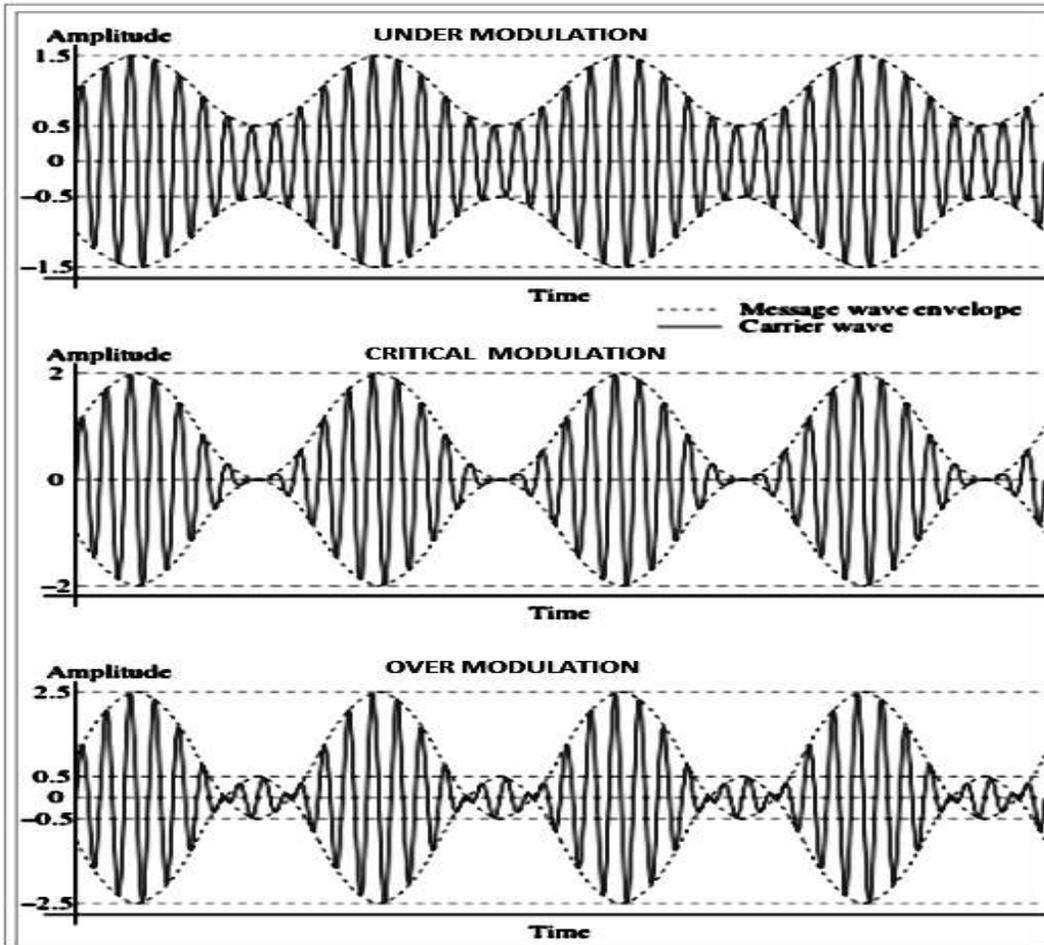
Note: Select proper amplitudes of input signals to observe under modulation, Critical

**Modulation and Over Modulation**

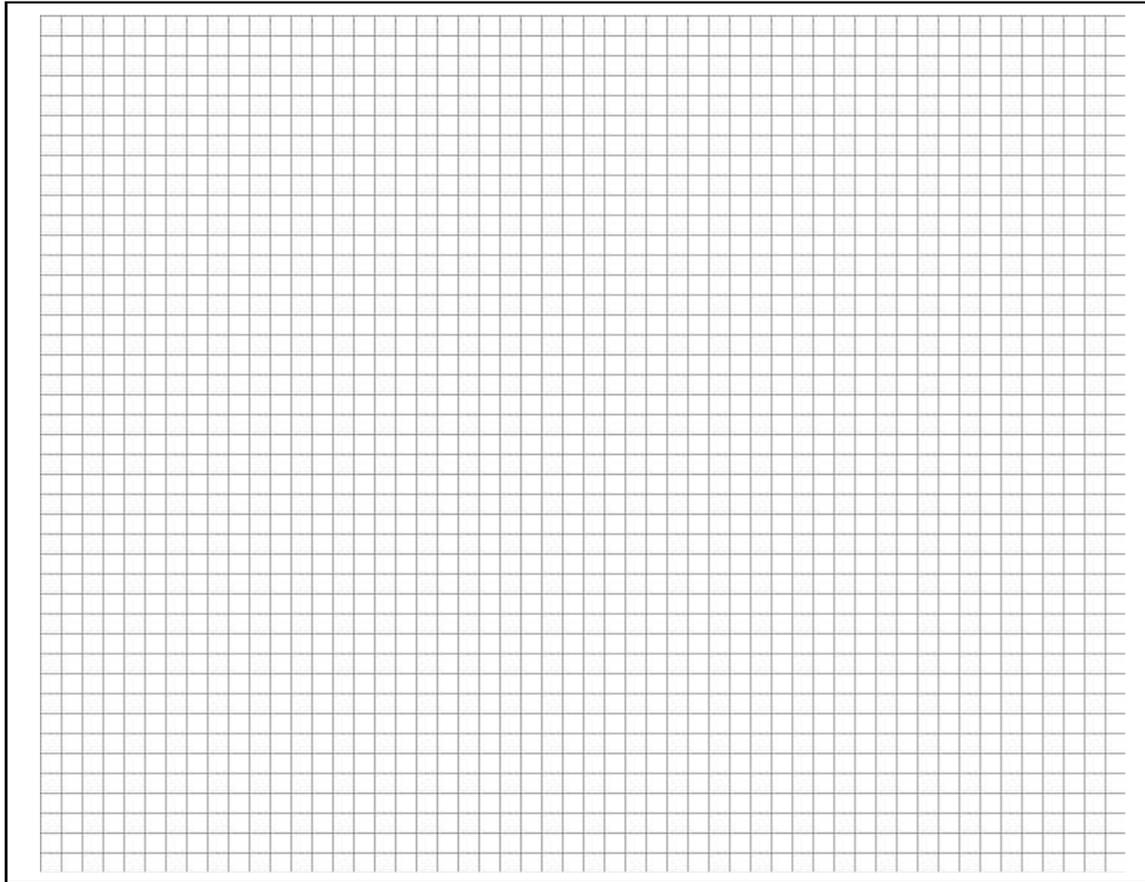
**7. Model Graph:**

**Modulation:**





**8. Graph:**



**Observed Waveforms**

**9. Discussions:**

<b><u>10. SCHEME OF EVALUATION:</u></b>					
<b>CATEGORY OF SKILL</b>	<b>SUB TASK</b>	<b>WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY</b>	<b>Marks Awarded</b>		
1 Handling of PSPICE / MULTISIM software	<p>A. <b>Identification of PSPICE</b> /MULTISIM software application on the desktop</p> <p>B. Identification of various components</p> <p>C. Identification of PSPICE / MULTISIM software application on the desktop</p>	<table border="1"> <tr> <td></td> </tr> <tr> <td>5</td> </tr> </table>		5	
5					

<p>2. Manipulation of PSPICE / MULTISIM software</p>	<p>A. Draw the Circuit Diagram.</p> <p>B. Identification of various <b>toolbars</b> and <b>workspace</b> of <b>software interface</b></p> <p>C. Select the required components from respective group of library</p> <p>D. Make the connections as per the circuit diagram in the workspace</p> <p>E. Modify the values for the selected components</p>	<table border="1" style="width: 100%; height: 100%;"> <tr><td style="height: 20px;"></td></tr> <tr><td style="text-align: center;">15</td></tr> </table>		15	
15					
<p>3.Precise operations/Activities</p>	<p style="text-align: center;"><b><u>Modulation.</u></b></p> <p>A. Observe AM signal using CRO</p> <p>B. Measure the values <math>V_{Max}</math> and <math>V_{Min}</math> (in Volts) of AM Wave using CRO</p> <p>C. Calculating the percentage of modulation.</p> <p>D. By varying amplitudes of modulating and carrier signals, observe AM Wave for</p> <ol style="list-style-type: none"> <li>a. Under modulation <b><math>(V_m &lt; V_c \text{ or } m &lt; 1)</math>,</b></li> <li>b. Critical modulation <b><math>(V_m = V_c \text{ or } m = 1)</math>,</b> and</li> <li>c. Over modulation <b><math>(V_m &gt; V_c \text{ or } m &gt; 1)</math>.</b></li> </ol>	<table border="1" style="width: 100%; height: 100%;"> <tr><td style="height: 20px;"></td></tr> <tr><td style="text-align: center;">25</td></tr> </table>		25	
25					

4.Values	A. Co-operation. B. Co-ordination C. Communication D. Sharing E. leadership	<table border="1"><tr><td data-bbox="1078 247 1265 300"></td></tr><tr><td data-bbox="1078 300 1265 352">5</td></tr></table>		5	
5					
Total		50			

**Signature of the staff**

**Signature of the Student**

**WORK SHEET**

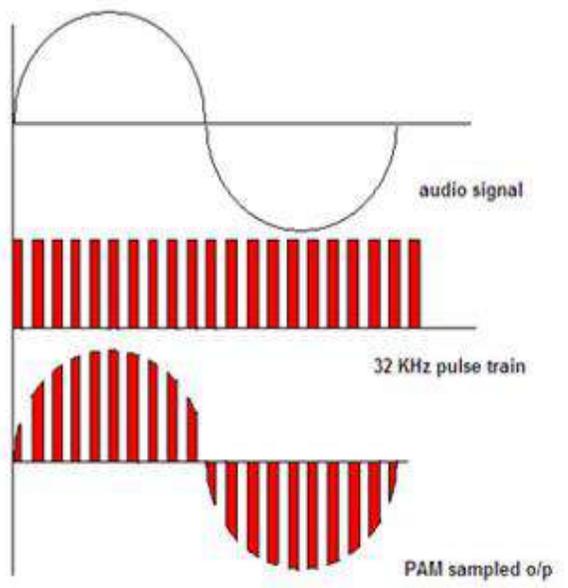
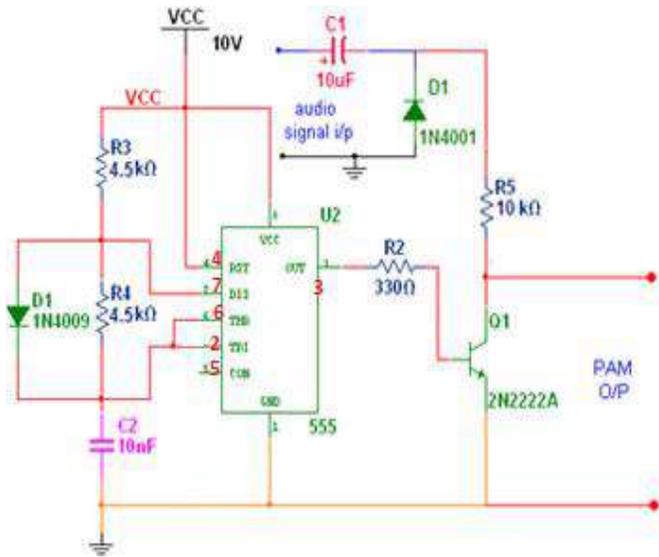
Name of the student :		Date of experiment:
PIN :	Branch:	
Institution:		Experiment No.

1. Title of the Experiment: \_\_\_\_\_

2. Objective of the Experiment: \_\_\_\_\_

3. Equipment Required: \_\_\_\_\_  
 \_\_\_\_\_

4. Circuit Diagram:



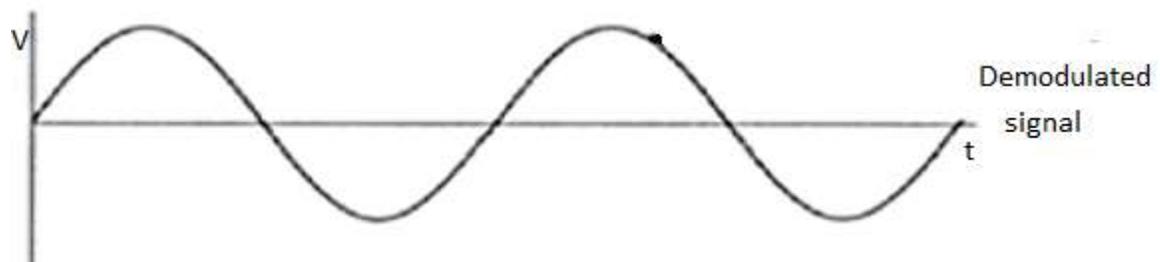
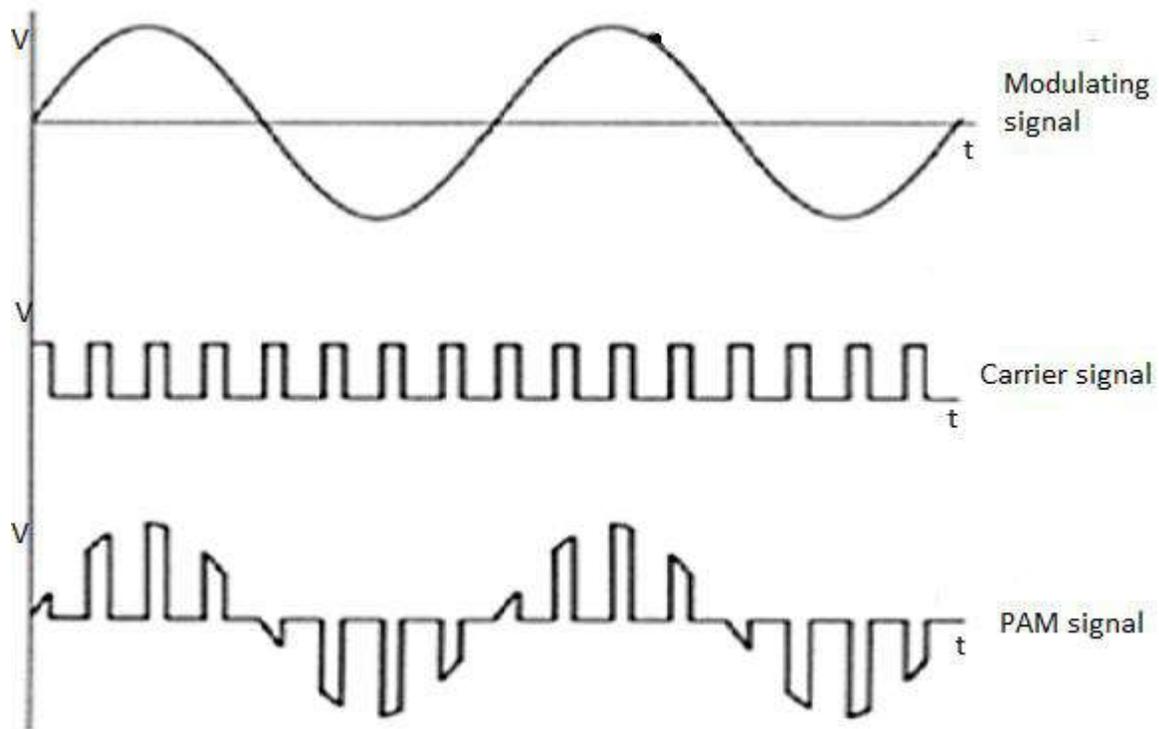
**5. Procedure:**

Sl No.	Procedure
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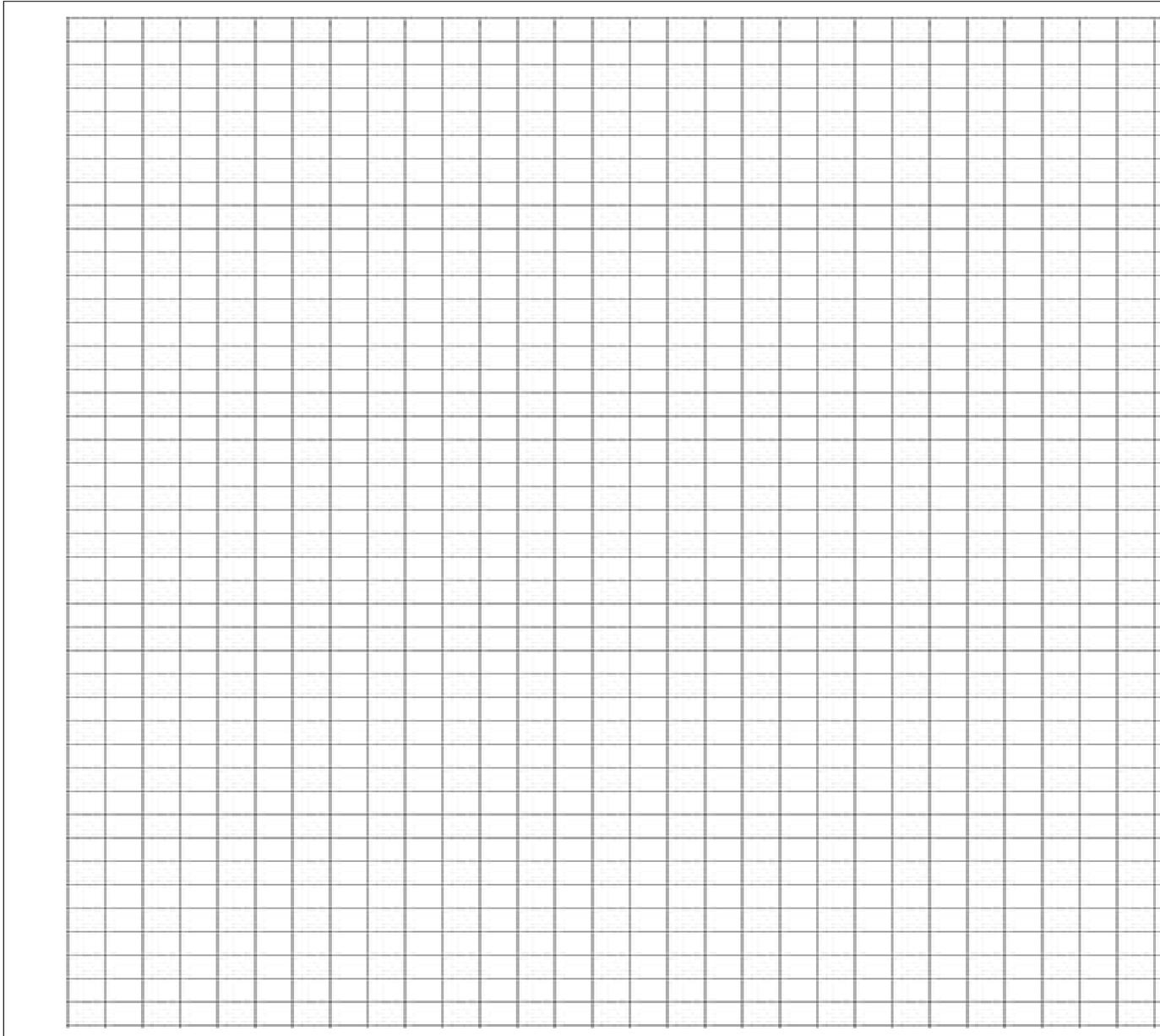
**6. Readings:**

Parameter	Message signal	Carrier signal	PAM modulated signal
Amplitude (v)			
Frequency(Hz)			
Time period(sec)			

**7. Model Graph:**



**8. Graph:**



**Observed Waveforms**

**9. Discussion ( Mandatory):**

**10. SCHEME OF EVALUATION:**

CATEGORY OF SKILL	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY	Marks Awarded		
Familiarization of PSPICE / MULTISIM software	A. Identification of PSPICE /MULTISIM software application on the desktop  B. Identification of various components  C. Identification of PSPICE / MULTISIM software application on the desktop	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="width: 40px; height: 20px;"></td> </tr> <tr> <td style="text-align: center;">5</td> </tr> </table>		5	
5					

<p>Preparation of Schematic using PSPICE / MULTISIM software</p>	<p>A. Identification of various <b>toolbars</b> and <b>workspace</b> of <b>software interface</b></p> <p>B. Select the required components from respective group of library</p> <p>C. Set the values of components as per the requirement</p> <p>D. Make the connections as per the circuit diagram in the workspace</p>	<div style="border: 1px solid black; width: 100px; height: 40px; margin-bottom: 5px;"></div> <div style="border: 1px solid black; width: 100px; height: 40px; display: flex; align-items: center; justify-content: center;">15</div>	
<p>Simulation and Result Analysis.</p>	<p>A. Measure I/P</p>	<div style="border: 1px solid black; width: 100px; height: 40px; margin-bottom: 5px;"></div> <div style="border: 1px solid black; width: 100px; height: 40px; display: flex; align-items: center; justify-content: center;">25</div>	

	<p>Message signal Amplitude and Frequency.</p> <p>B. Measure I/P Carrier signal amplitude and Frequency.</p> <p>C. Observing the PAM waveforms on CRO.</p> <p>D. Note the Amplitude and Frequency of Modulated Wave.</p> <p>E. Compare the waveform of PAM Modulator with message signal.</p> <p><b><u>PA</u></b> <b><u>M</u></b> <b><u>De</u></b> <b><u>m</u></b> <b><u>od</u></b> <b><u>ul</u></b> <b><u>ati</u></b> <b><u>on</u></b></p> <p>F. Adjust the DRB for filter operation.</p> <p>G. Observing the waveforms on CRO</p> <p>H. Note the Amplitude and Frequency of Demodulated Wave</p> <p>I. Compare the waveform of PAM Demodulato r with Input</p>		
--	--	--	--

	<p>message signal.</p> <p>J. Draw the waveforms.</p>				
4.Values	<p>A. Co-operation.</p> <p>B. Co-ordination</p> <p>C. Communication</p> <p>D. Sharing</p> <p>E. leadership</p>	<table border="1"> <tr> <td></td> </tr> <tr> <td>5</td> </tr> </table>		5	
5					
Total		50			

**Signature of the staff**

**Signature of the student**

**WORK SHEET**

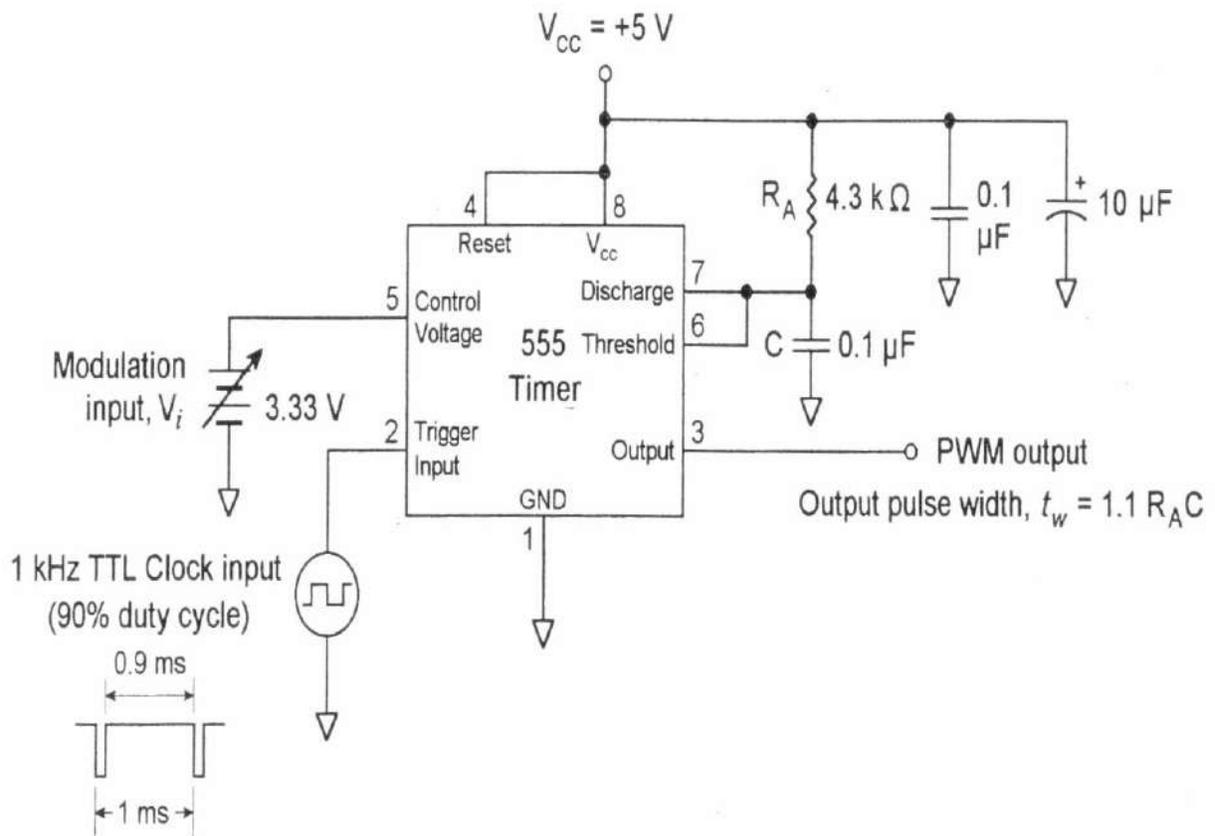
Name of the student :		Date of experiment:
PIN :	Branch:	
Institution:		Experiment No.

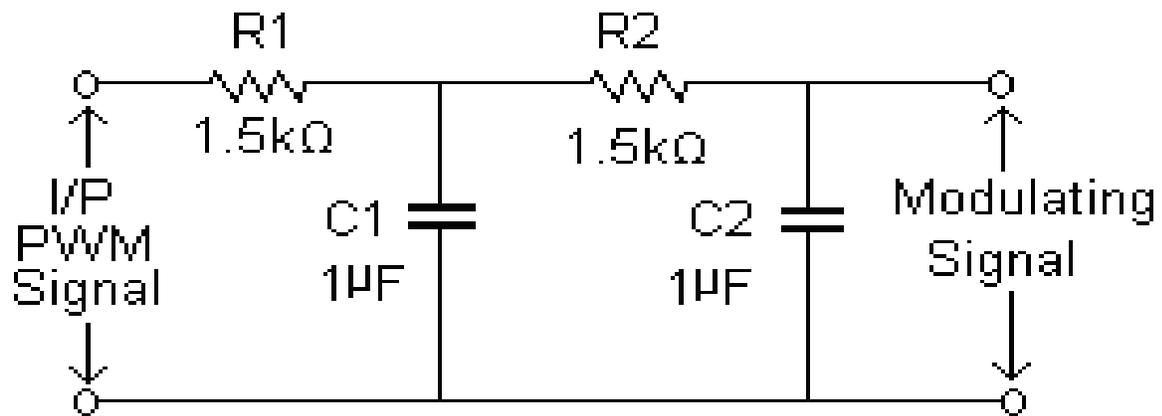
1. Title of the Experiment: \_\_\_\_\_

2. Objective of the Experiment: \_\_\_\_\_

3. Equipment Required: \_\_\_\_\_

4. Circuit Diagram:



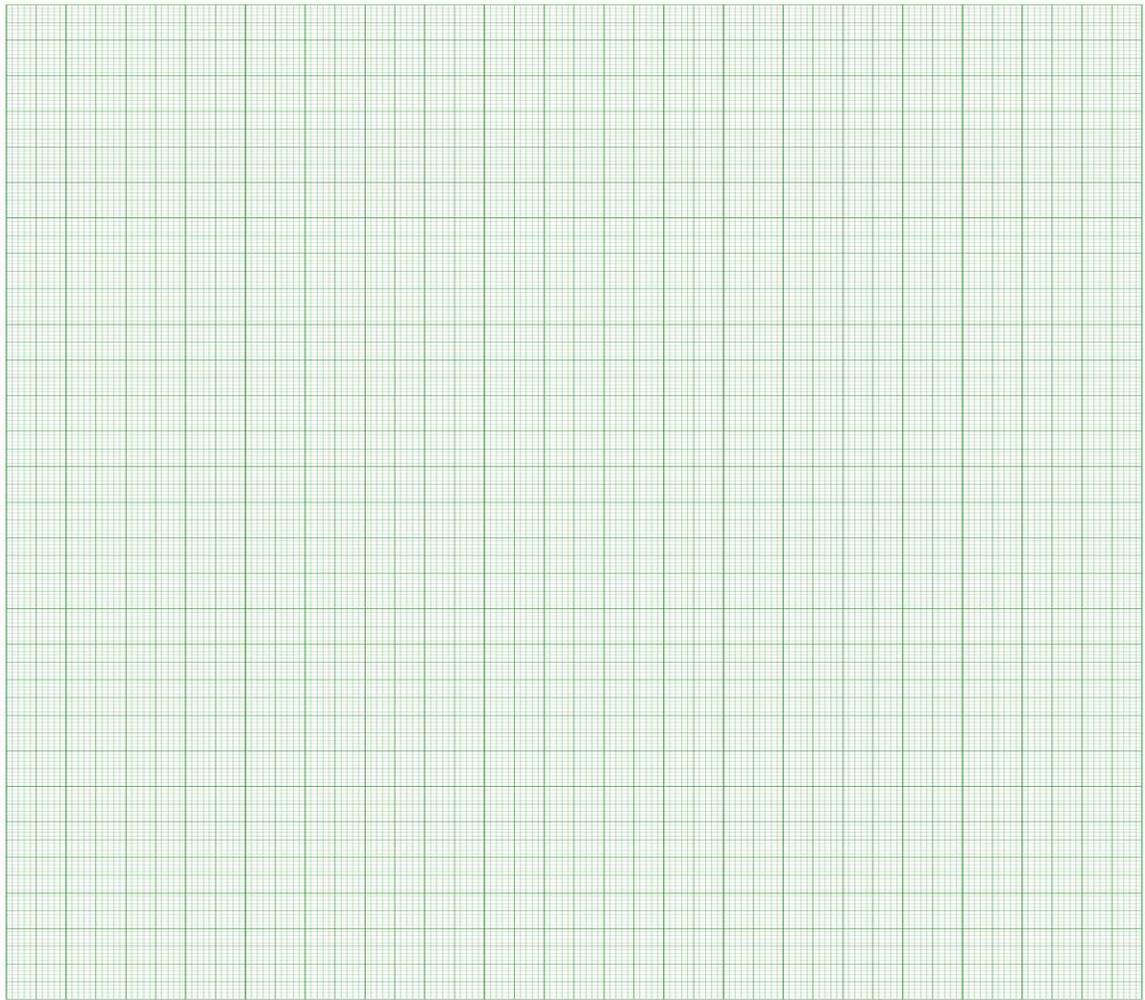


### 5. Procedure:

SI No.	Procedure
1	
2	
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4	
5	
6	
7	
8	



**8. Graph:**



**Observed Waveforms**

**9. Inference and interpretation:**

### Scheme of Evaluation

CATEGORY OF SKILL	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL INDIVIDUALLY	Marks Awarded
Familiarization of PSPICE / MULTISIM software	A) Identification of PSPICE /MULTISIM software application on the desktop B) Identification of various components C) Identification of PSPICE / MULTISIM software application on the desktop	<div style="border: 1px solid black; width: 60px; height: 20px; margin-bottom: 5px;"></div> <div style="border: 1px solid black; width: 60px; height: 20px; display: flex; align-items: center; justify-content: center;">5</div>	
Preparation of Schematic using PSPICE / MULTISIM software	A. Identification of various <b>toolbars</b> and <b>workspace of software interface</b> B. Select the required components from respective group of library C. Set the values of components as per the requirement D. Make the connections as per the circuit diagram in the workspace	<div style="border: 1px solid black; width: 60px; height: 20px; display: flex; align-items: center; justify-content: center;">:</div> <div style="border: 1px solid black; width: 60px; height: 20px; display: flex; align-items: center; justify-content: center;">15</div>	
Simulation and Result Analysis.	<b>PWM MODULATION</b> A. Measure I /P Message signal Amplitude and Frequency. B. Measure I /P Carrier signal amplitude and Frequency. C. Observe the PWM waveforms on CRO by varying the amplitude of the message signal	<div style="border: 1px solid black; width: 60px; height: 20px; margin-bottom: 5px;"></div> <div style="border: 1px solid black; width: 60px; height: 20px; display: flex; align-items: center; justify-content: center;">25</div>	

	<p>D. Note the Amplitude and Frequency of the Modulated Wave.</p> <p>E. Compare the waveform of PWM signal with message signal.</p> <p><b><u>PWM DEMODULATION</u></b></p> <p>F. Adjust the DRB for filter operation.</p> <p>G. Observing the waveforms on CRO</p> <p>H. Note the Amplitude and Frequency of Demodulated Wave</p> <p>I. Compare the waveform of PWM Demodulator with Inputmessage signal.</p> <p>J. Draw the waveforms.</p>				
<p>4.Values</p>	<p>A. Co-operation.</p> <p>B. Co-ordination</p> <p>C. Communication</p> <p>D. Sharing</p> <p>E. leadership</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="width: 100px; height: 15px;"></td> </tr> <tr> <td style="text-align: center;">5</td> </tr> </table>		5	
5					
<p>Total</p>		<p>50</p>			

<p><b>Signature of the staff</b></p>	<p><b>Signature of the student</b></p>
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**WORK SHEET**

Name of the student :		Date of experiment:
PIN :	Branch:	
Institution:		Experiment No.

**1. Title of the Experiment:** \_\_\_\_\_

**2. Objective of the Experiment:** \_\_\_\_\_

**3. Equipment Required:** \_\_\_\_\_

\_\_\_\_\_

**4. Circuit Diagram:**

**5. Procedure: ASK MODULATOR**

<b>SI No.</b>	<b>Procedure</b>
<b>1</b>	
<b>2</b>	
<b>3</b>	
<b>4</b>	
<b>5</b>	
<b>6</b>	
<b>7</b>	

**Procedure: ASK DEMODULATOR**

<b>SI No.</b>	<b>Procedure</b>
<b>1</b>	
<b>2</b>	
<b>3</b>	
<b>4</b>	
<b>5</b>	
<b>6</b>	
<b>7</b>	

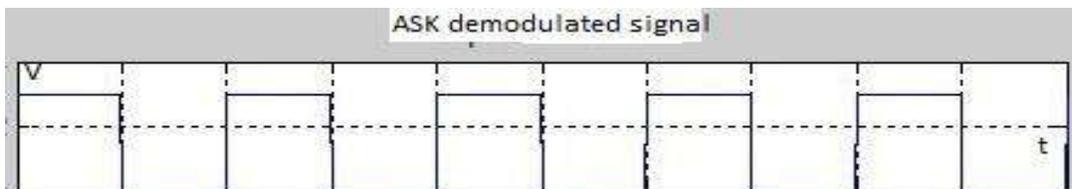
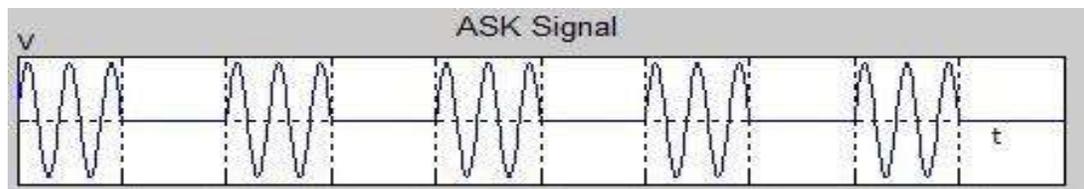
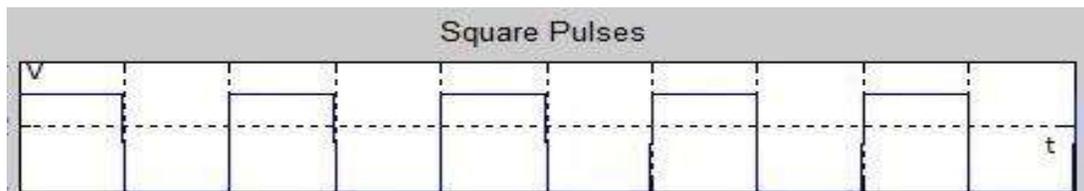
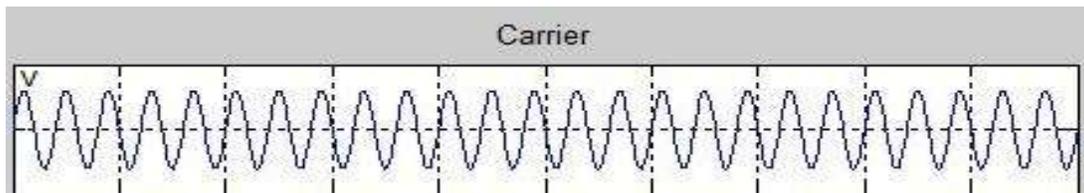
**6. Readings:**

Parameter	Message signal	Carrier signal	ASK modulated signal	ASK demodulated signal
Amplitude (v)				
Frequency(Hz)				
Time period(sec)				

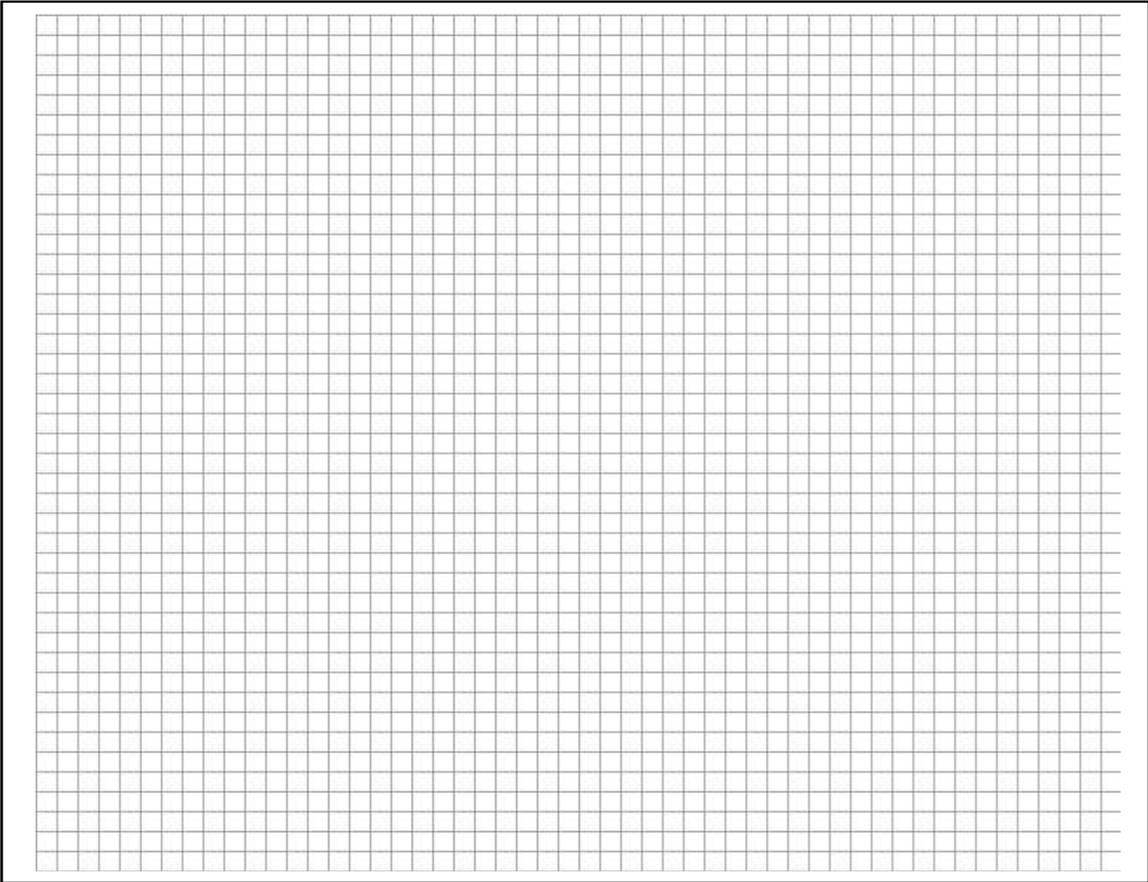
**Message signal : ON Period:**

**OFF period:**

**7. Model Graph:**



**8. Graph:**



**Observed Waveforms**

**9. Discussion ( Mandatory):**

## 10. SCHEME OF EVALUATION:

CATEGORY OF SKILL	SUB TASK	WEIGHTAGE WITH COMPETENCY LEVEL	MARKS AWARDED
Familiarization of PSPICE / MULTISIM software	<ul style="list-style-type: none"> <li>• Identification of PSPICE /MULTISIM software application on the desktop</li> <li>• Identification of various components</li> <li>• Identification of PSPICE / MULTISIM software application on the desktop</li> </ul>	5	
Preparation of Schematic using PSPICE / MULTISIM software	<p>A. Identification of various <b>toolbars</b> and <b>workspace of software interface</b></p> <p>B. Select the required components from respective group of library</p> <p>C. Set the values of components as per the requirement.</p> <p>D. Make the connections as per the circuit diagram in the workspace</p>	15	
Simulation and Result Analysis.	<p><b><u>ASK Modulator</u></b></p> <p>A) Measure I/P message signal amplitude and Frequency.</p> <p>B) Measure I/P Carrier signal amplitude and Frequency</p> <p>C) Observing the waveforms on CRO.</p> <p>D) Note the Amplitude and Frequency ASK modulated output.</p> <p>E) Compare the waveform of ASK Modulator with Input message signal.</p> <p><b><u>ASK Demodulator</u></b></p> <p>F) ASK modulated signal to voltage comparator to setting of Potentiometer (POT).</p> <p>G) Measure Demodulated signal amplitude and frequency. Tabulate the readings and observe the waveforms on CRO</p> <p>H) Drawing the graphs</p>	25	

Values	A. Co-operation. B. Co-ordination C. Communication D. Sharing E. leadership	<table border="1"><tr><td data-bbox="1161 243 1349 268"></td></tr><tr><td data-bbox="1161 268 1349 300">5</td></tr></table>		5	
5					
Total		50			

**Signature of the staff**

**Signature of the student**

**WORK SHEET**

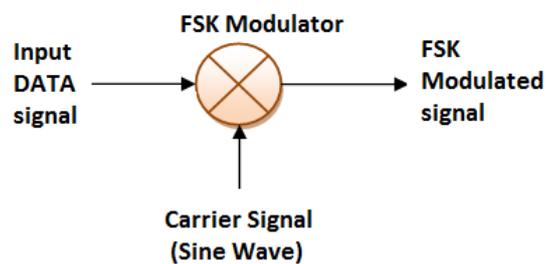
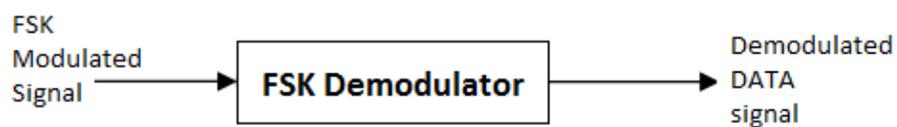
Name of the student :		Date of experiment:
PIN :	Branch:	
Institution:		Experiment No.

1. Title of the Experiment:

2. Objective of the Experiment:

3. Equipment Required:

4. Circuit Diagram:

**FSK Modulation :****FSK Demodulation :**

**5. Procedure:****FSK Modulation :**

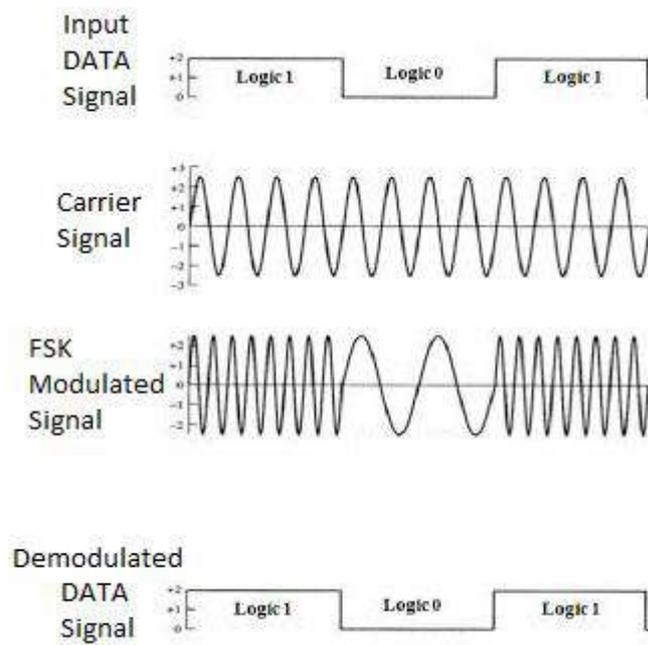
SI No.	Procedure

**6. Readings:****Modulation:**

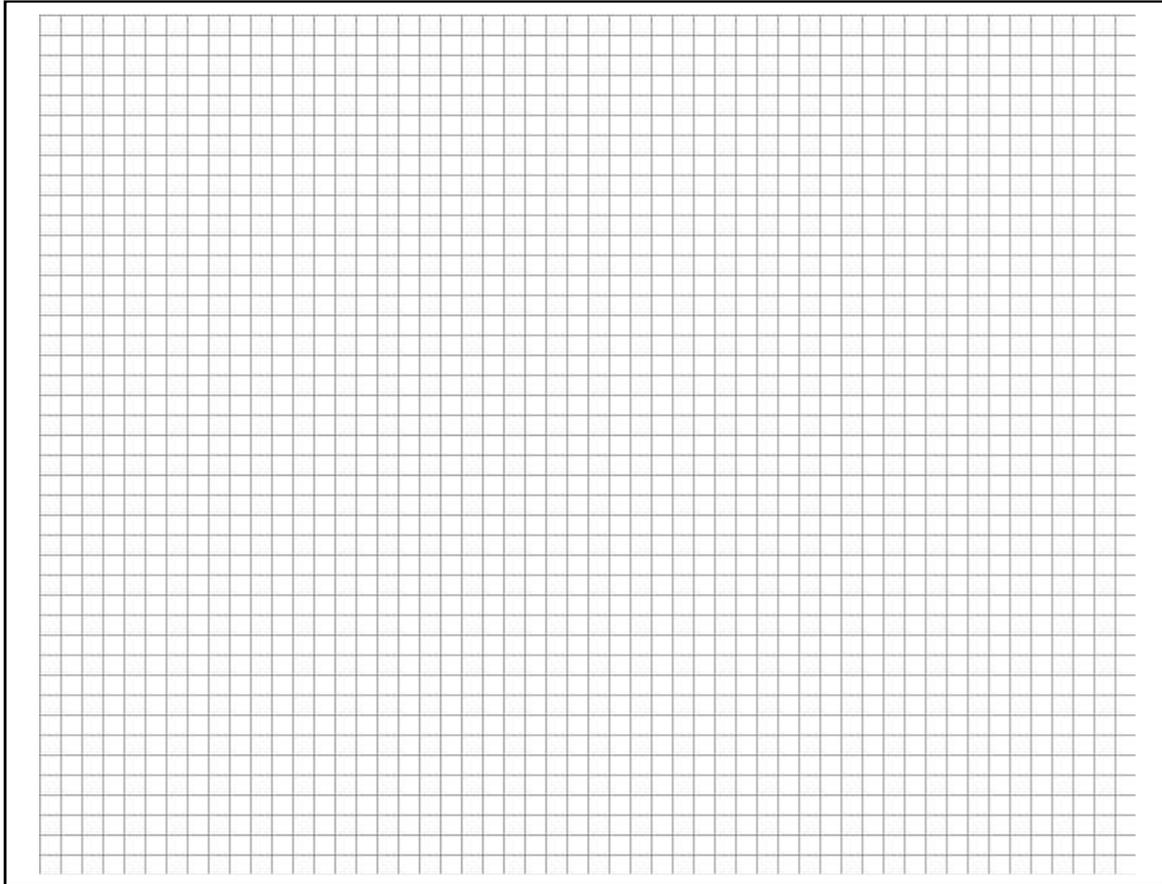
Input DATA signal	Amplitude : volts	
	TimePeriod : Sec	
	Frequency : Hz	
Carrier Signal	Amplitude : volts	
	TimePeriod : Sec	
	Frequency : Hz	
Modulated Signal	Amplitude : volts	
	For '0' data input	TimePeriod : Sec
		Frequency : Hz
	For '1' data input	TimePeriod : Sec
Frequency : Hz		

**Demodulation :**

Demodulated DATA signal	Amplitude :	volts
	TimePeriod :	Sec
	Frequency :	Hz

**7. Model Graph:**

**8. Graph:**



**9. Inference and interpretation:**

**10. Scheme of Evaluation :**

Category of skill	Sub task	Weightage with competency level individually	Marks awarded		
1.Familiarizatio of PSPICE / MULTISIM software	A. Identification of PSPICE /MULTISIM software application on the desktop B. Identification of various components C. Identification of PSPICE / MULTISIM software application on the desktop	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td style="width: 100px; height: 15px;"></td></tr> <tr><td style="text-align: center;">5</td></tr> </table>		5	
5					
2. Preparation of Schematic using PSPICE / MULTISIM software	A. Identification of various <b>toolbars</b> and <b>workspace</b> of <b>software interface</b> B. Select the required components from respective group of library C. Set the values of components as per the requirement. D. Make the connections as per the circuit diagram in the workspace	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td style="width: 100px; height: 15px;"></td></tr> <tr><td style="text-align: center;">15</td></tr> </table>		15	
15					

3.Simulation and Result Analysis.	<p style="text-align: center;"><b><u>For Modulation</u></b></p> <p>A .Observe the DATA signal on CRO and record its amplitude , Time period and frequency.</p> <p>B. Observe the carrier signal on CRO and record its amplitude , Time period and frequency.</p> <p>C. Observe the changes in Frequencies of Modulated signal on CRO during 1 and 0 of data signal and record its amplitude, Time period and frequency.</p> <p>D .Draw the waveforms in graph sheet.</p>	<table border="1" style="margin: auto;"> <tr><td style="width: 50px; height: 15px;"></td></tr> <tr><td style="text-align: center;">25</td></tr> </table>		25	
25					
	<p style="text-align: center;"><b><u>For Demodulation</u></b></p> <p>E. Observe the Demodulated DATA signal on CRO and record its amplitude , Time period and frequency.</p> <p>F. Verify that the demodulated DATA signal is same as transmitted one.</p>				
4.Values	<p>A. Co Operation</p> <p>B. Co-Ordination</p> <p>C. Communication</p> <p>D. Sharing</p> <p>E. Leadership</p>	<table border="1" style="margin: auto;"> <tr><td style="width: 50px; height: 15px;"></td></tr> <tr><td style="text-align: center;">5</td></tr> </table>		5	
5					
Total			50		
Signature of the Staff		Signature of the Student			

**Amplitude modulation**

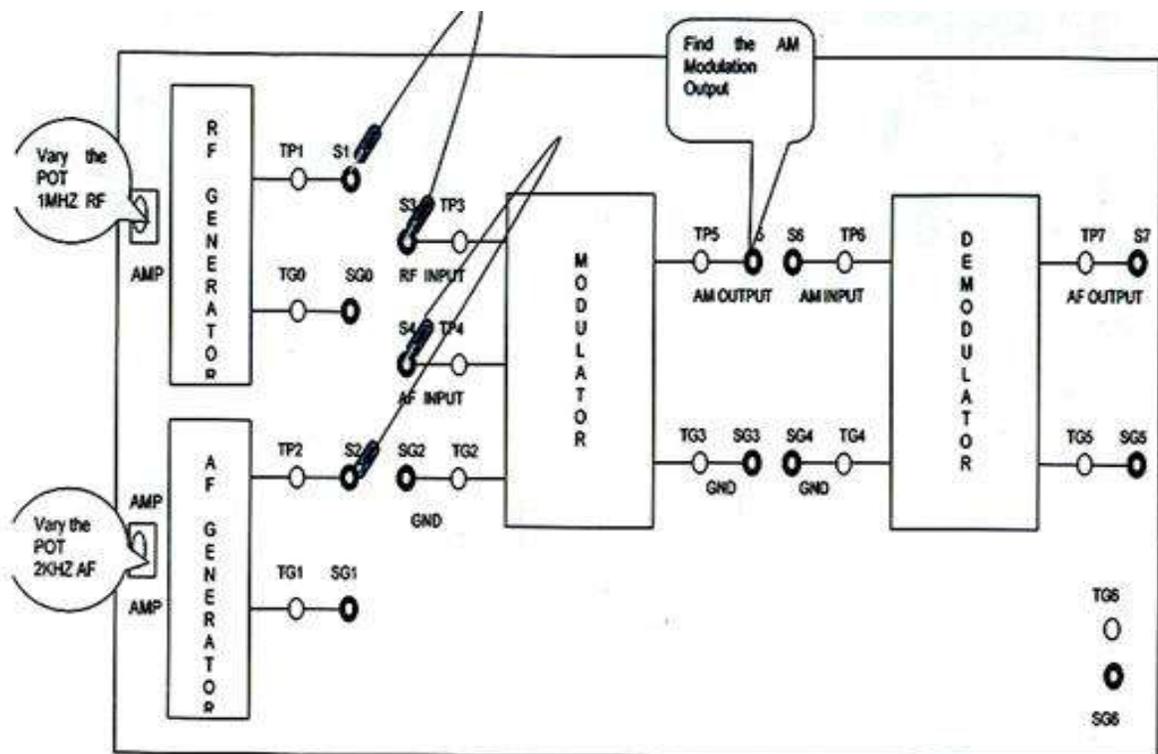
**1. Description**

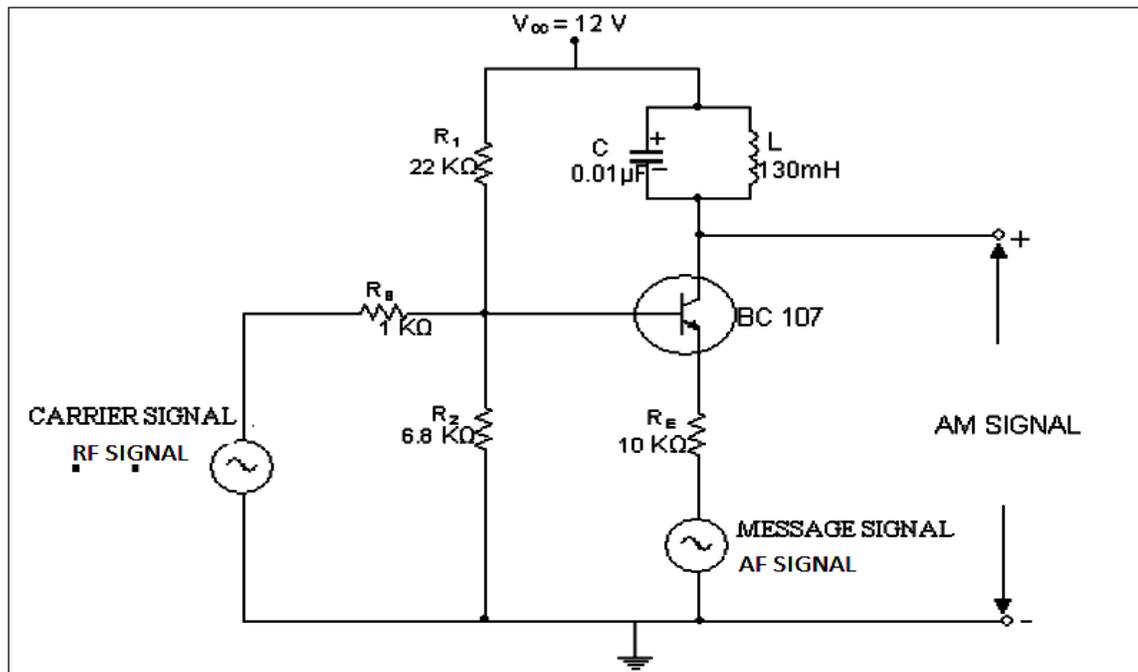
The setup for this experiment requires the following equipment

Name	Quantity	Purpose
Amplitude modulation and demodulation trainer kit	1	
Dual traces CRO	1	1) To observe modulating signal, carrier signal and modulated signal 2) To measure the amplitude and frequency of the signals.
AF signal generator	1	To generate Low frequency signal
RF signal generator	1	To generate high frequency signal
Patch cords	As required	To connect various circuit points

**CIRCUIT DIAGRAM**

**Modulator Block diagram**



**Modulator****Theory:**

Amplitude Modulation is a process in which the amplitude of the high frequency carrier wave  $c(t)$  is varied linearly with the instantaneous amplitude of the low frequency message signal  $m(t)$ .

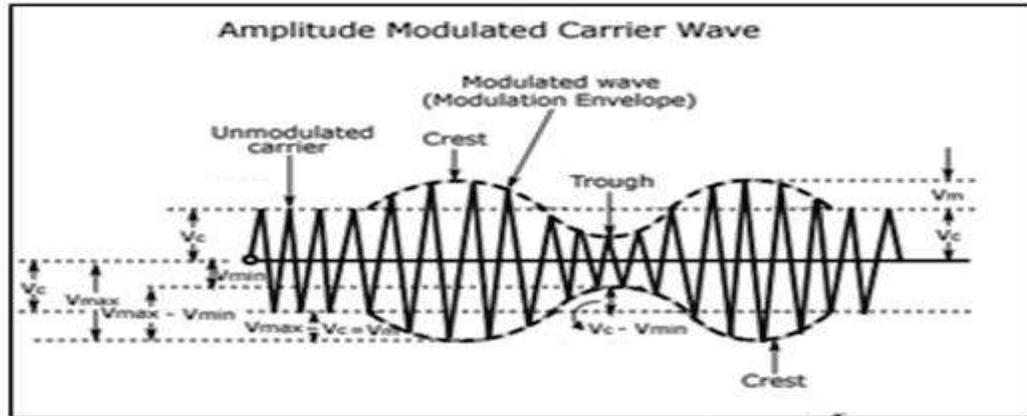
$$c(t) = V_c \sin \omega_c t$$

$$m(t) = V_m \sin \omega_m t.$$

$$s(t) = V_c (1 + m \sin \omega_m t) \sin \omega_c t.$$

$$\text{Where } m = \frac{V_m}{V_c}$$

The demodulation circuit is used to recover the message signal from the incoming AM wave at the receiver. An envelope detector is a simple and yet highly effective device that is well suited for the demodulation of AM wave, for which the percentage modulation is less than 100%. Ideally, an envelope detector produces an output signal that follows the envelope of the input signal wave form exactly



The Modulation Index of AM signal

$$m = \frac{V_{Max} - V_{Min}}{V_{Max} + V_{Min}}$$

Where  $V_{max}$  and  $V_{min}$  are the maximum and minimum amplitudes of the modulated wave.

### Procedure

#### Modulation:

1. As the circuitry is already wired you just have to trace the circuit according to the Block diagram given
2. Connect trainer to the mains and switch ON the power supply
3. Observe output of RF and AF signal generator using CRO.
4. Apply Low frequency modulating signal to the modulator from AF generator.
5. Apply High frequency carrier signal to the modulator from RF generator.
6. Note down values of  $V_{max}$  and  $V_{min}$  of AM signal for various amplitudes of modulating signal.
7. Calculate modulation index using equation
8. Repeat step 4 by varying frequency of the modulating signal.
9. Plot the graph for modulation index  $m < 1$ ,  $m = 1$  and  $m > 1$ .

#### Observations

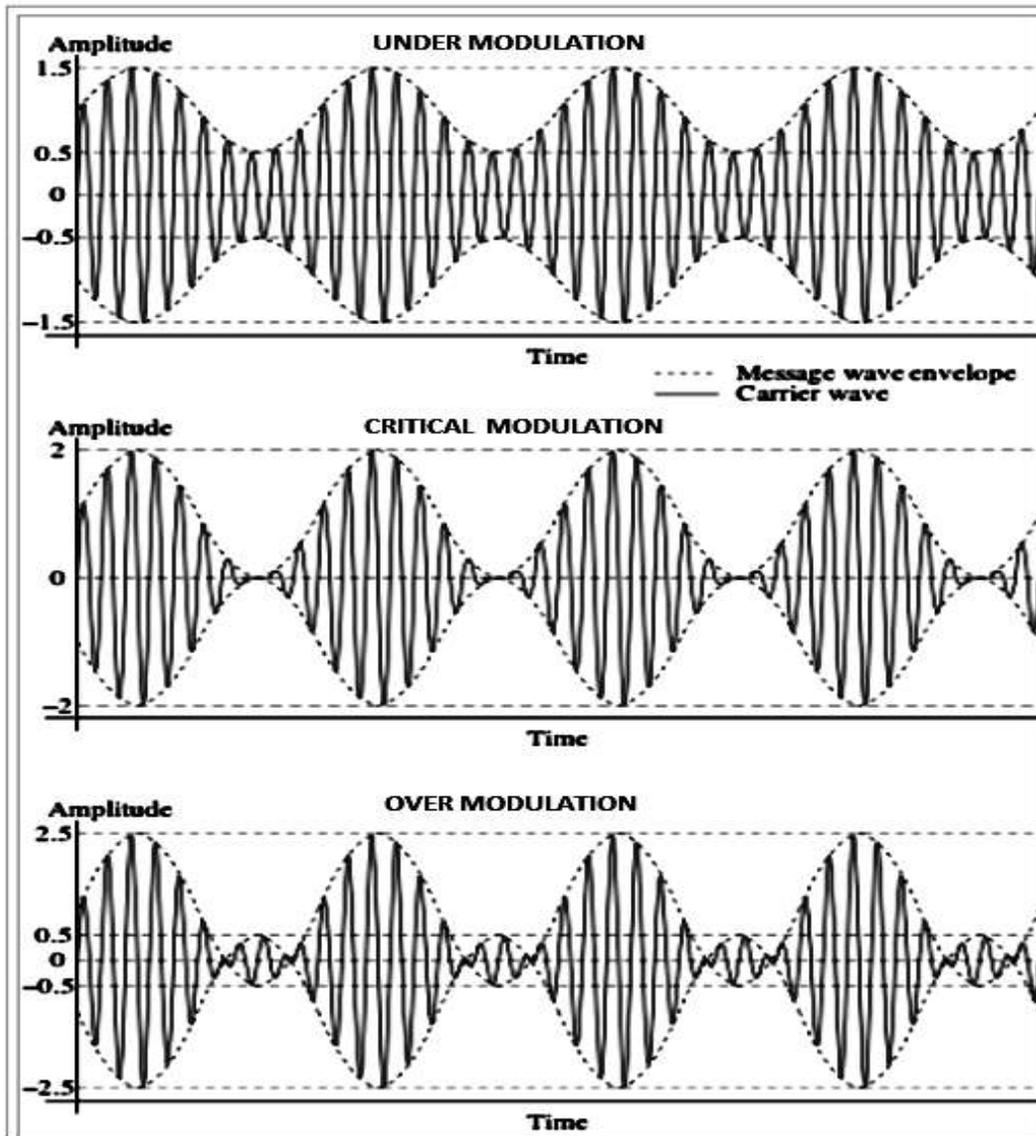
#### Modulation

Parameter	Modulating Signal	Carrier Signal
Amplitude (volts)		
Time Period (Sec)		
Frequency [Hz]		

S.No.	Modulated Signal		Modulation Index $m = \frac{V_{Max} - V_{Min}}{V_{Max} + V_{Min}}$
	V <sub>Max</sub> Volts	V <sub>Min</sub> Volts	
1			
2			
3			

**Graphs:**

**Modulation:**

**Precautions:**

1. Connections should be tight.
2. Handling the Equipment Carefully.
3. Avoid parallax error while observing the values of waveforms on CRO.

## FREQUENCY MODULATION

### 1. Description

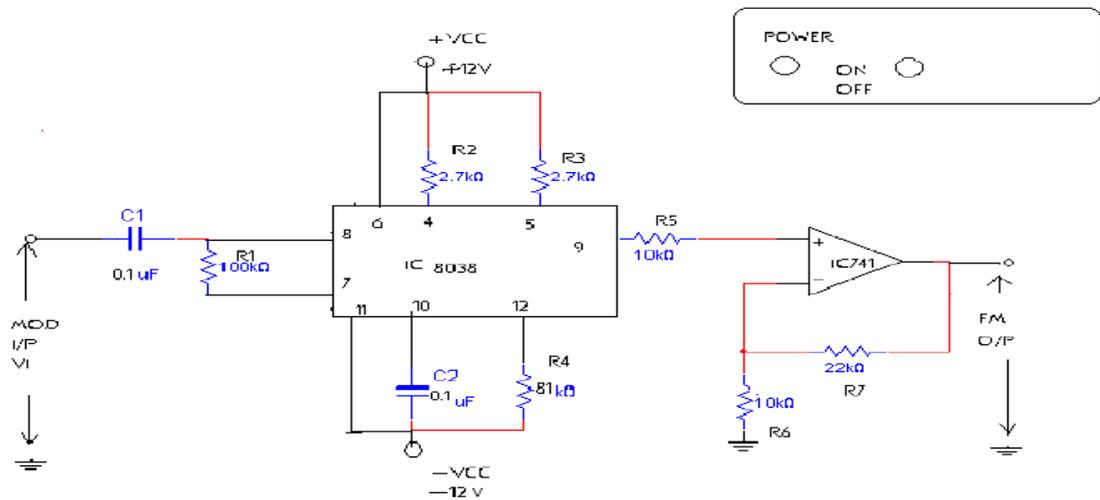
The setup for this experiment requires the following equipment

Name	Specification/range	Quantity	Purpose
FM Trainer board	-	1	To connect the components
C.R.O	0-100 MHz	1	To observe the message and FM waveforms
AF/RF Function generator	-	1	To apply audio/ radio frequency signals
Connecting wires	Proper wires/patch cords .	10	To make connections as per the circuit

### CIRCUIT DIAGRAM

#### FM MODULATOR

FM Modulation Using IC8038



### Theory

The process of changing the frequency of high frequency carrier wave by using amplitude of low frequency message signal is called Frequency Modulation. In this process phase and amplitude of carrier is not altered. The modulation index,  $\beta$  is a measure of the peak frequency deviation,  $\Delta f$ .

Extraction of message signal from the modulated FM wave is called as demodulation. To get the accurate message signal, modulation index value should be high.

### Procedure

#### FM MODULATOR

- 1) Study the circuit diagram provided on the front panel of the kit.
- 2) Connect dual trace CRO at input and output side
- 3) Without applying modulating i/p signal observe and note Sinusoidal o/p on CRO (carrier signal)  
 $f_c = \dots\dots\dots \text{Hz}$ ,  
 $V_c = \dots\dots\dots \text{V}$
- 4) Connect sine wave i/p of around 100Hz, 10Vp-p from signal generator to the point marked as "MOD i/p" keep it's amplitude constant and vary the potentiometer R1 to change amplitude of o/p signal.
- 5) Adjust the amplitude and frequency of modulating signal to get F.M. output
- 6) Now increase Time/div control of CRO. You will get deviated waveform.  
 Note its difference which is called frequency deviation  $\Delta f$
- 7) Find modulation index,  $\beta = \Delta f / f_m$

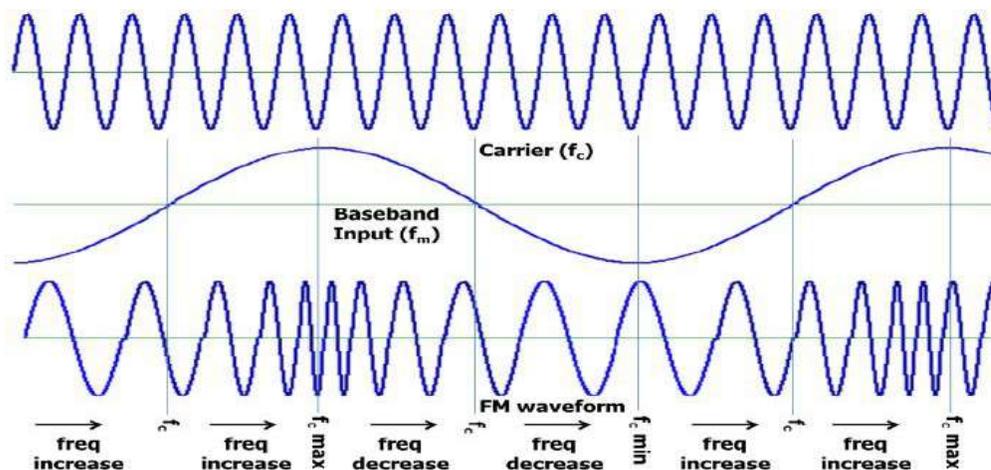
#### Calculation:

$$\text{Modulation index } \beta = \Delta f / f_m$$

$$\text{Frequency deviation } \Delta f = \text{maximum frequency} - \text{minimum frequency.}$$

$$\text{Frequency of message signal } f_m = \text{-----}$$

#### Graphs



**A. PROCEDURAL PRECAUTIONS:**

- Disconnect all the equipment from mains before making connections
- Ensure the correct frequency range of function generator.
- Connect the circuit as per the circuit diagram and check for polarity
- Get the connections checked by the concerned staff member
- Calibrate the CRO for getting accurate result.
- Ensure that there are no loose connections
- Capacitor should be connecting with proper polarity.
- Avoid parallax error while observing the values of waveforms on CRO.

**B. SAFETY PRECAUTIONS:**

- Never do modification of connections on a circuit while power is applied.
- Do not connect power to a circuit until the circuit is finished and you have carefully checked your work.
- If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.
- Keep your work area dry.

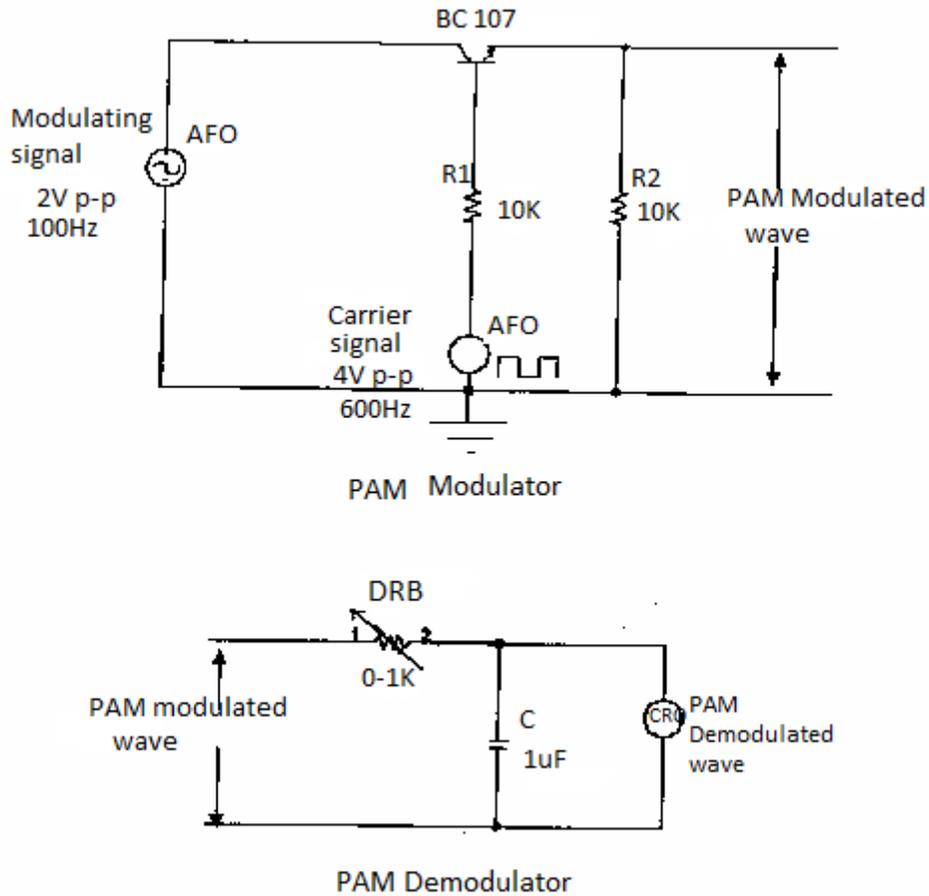
## PULSE AMPLITUDE MODULATOR AND DEMODULATOR

### 1. Description

The setup for this experiment requires the following equipment

Name	Specification/range	Quantity	Purpose
Breadboard	-	1	To connect the components
Transistor	BC 107	1	Act as a switch to allow the carrier wave when message is present
Resistor	10K $\Omega$	1	To limit the current to the transistor
Resistor	10K $\Omega$	1	To act as a load resistor for the PAM signal output
Decade resistance box	0-1K $\Omega$	1	To act as a discharge path for the capacitor
Capacitor	1 $\mu$ F	1	To allow the low frequency signal of the modulated output
C.R.O Dual channel	0-100Mhz	1	To observe the input output waveforms
Multimeter		1	To measure voltages
Connecting wires			To connect the circuit components
Function generators	1MHz	2	To generate carrier and message signal

**CIRCUIT DIAGRAM**



**Fig.1**

**Theory**

Pulse amplitude modulation is a scheme, which alters the amplitude of regularly spaced rectangular pulses in accordance with the instantaneous values of a continuous message signal. Then amplitude of the modulated pulses represents the amplitude of the message signal. A train of very short pulses of constant amplitude and fast repetition rate is chosen the amplitude of these carrier pulse is made to vary in accordance with that of a slower modulating signal the result is that of multiplying the carrier by the modulating signal the envelope of the pulse height corresponds to the modulating wave. To

demodulate PAM waves, the signal is passed through a low pass filter having a cut off frequencies equal to the highest frequency in the modulating signal. At the output of the filter is available the modulating signal along with the DC component.

### Procedure

#### PAM modulator:

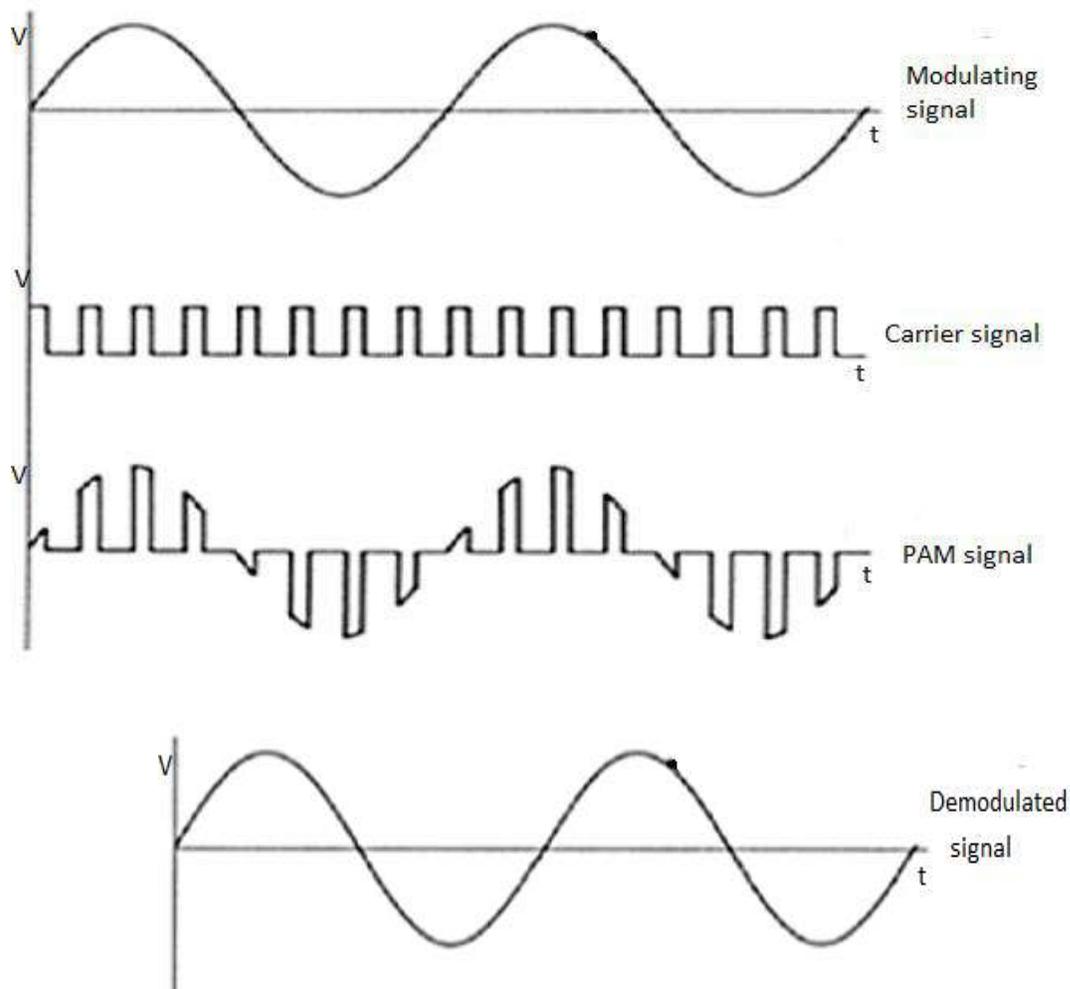
1. Connect the circuit as shown in the fig.1.
2. Apply a square wave carrier signal of 600 Hz of 4 VP-P
3. Apply a sine wave message signal of 100 Hz of 2 VP-P amplitude.
4. Observe PAM modulated waveform at the emitter of transistor and note down the amplitude and frequency values.
5. Plot the waveforms of message signal, carrier signal and PAM modulated signal with correct scaling on graph sheet.

#### PAM demodulator:

1. Apply PAM modulated output to the Low pass filter circuit.
2. Observe PAM demodulated waveform across capacitor and note down the amplitude and frequency values.
3. Compare PAM demodulated waveform with input message waveform.
4. Plot the waveform of PAM demodulated signal with correct scaling on graph sheet.

#### Observations:

Parameter	Message signal	Carrier signal	PAM modulated signal	PAM demodulated signal
Amplitude (v)				
Frequency(Hz)				
Time period(sec)				

**Graphs:****A. PROCEDURAL PRECAUTIONS:**

- Disconnect all the equipment from mains before making connections
- Connect the circuit as per the circuit diagram and check for polarity
- Get the connections checked by the concerned staff member
- Calibrate the CRO for getting accurate result
- Ensure that there are no loose connections
- Capacitor should be connecting with proper polarity

**B. SAFETY PRECAUTIONS:**

- Never work on a circuit while power is applied.
- Do not connect power to a circuit until the circuit is finished and you have carefully checked your work.
- If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.
- Keep your work area dry.

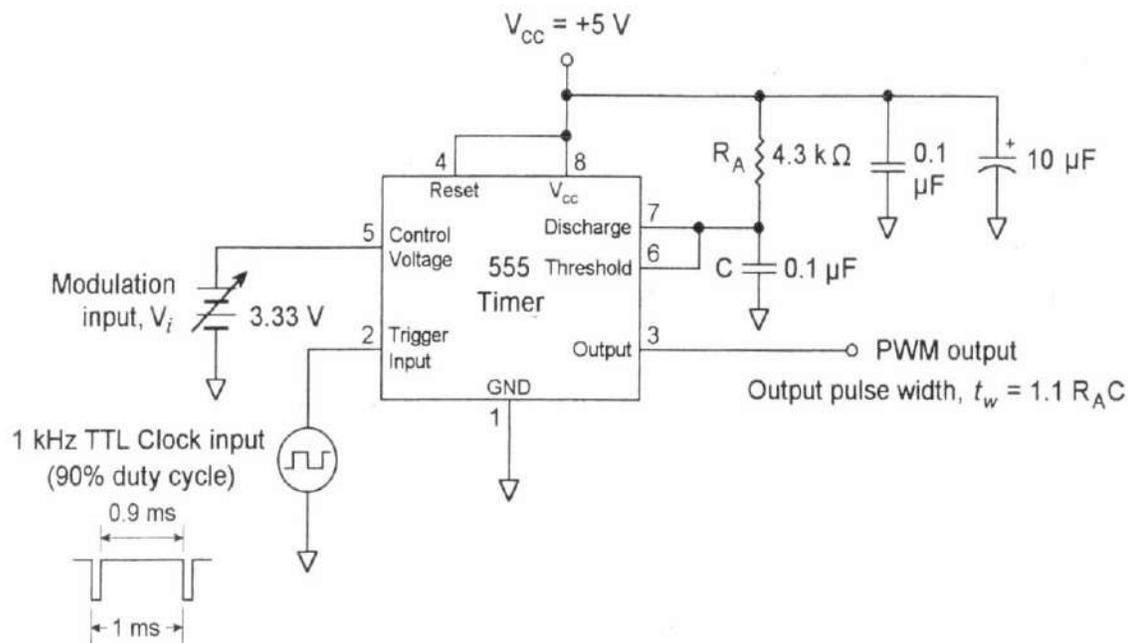
## PULSE WIDTH MODULATION AND DEMODULATION

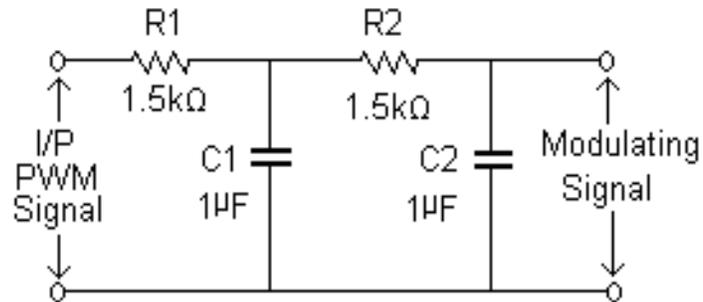
### 1. Description

The setup for this experiment requires the following equipment

Name	Specification/range	Quantity	Purpose
Breadboard	-	1	To connect the components
Diodes	1N4007	1	
555 IC timer		1	
C.R.O	-	1	To observe the output waveforms
Pulse generator		1	To generate clock with 90% duty cycle
Sine wave generator		1	To generate input wave form
DC Power supplies		1	
Capacitors	100 $\mu$ f	1	
	10 $\mu$ f	1	
	0.1 $\mu$ f	2	
Resistors	4.3k $\Omega$ ( $\frac{1}{4}$ Watt resistor)	1	
Connecting wires			

**CIRCUIT DIAGRAM- PWM MODULATOR (Fig-1)**



**CIRCUIT DIAGRAM- PWM DEMODULATOR (Fig-2)****Theory**

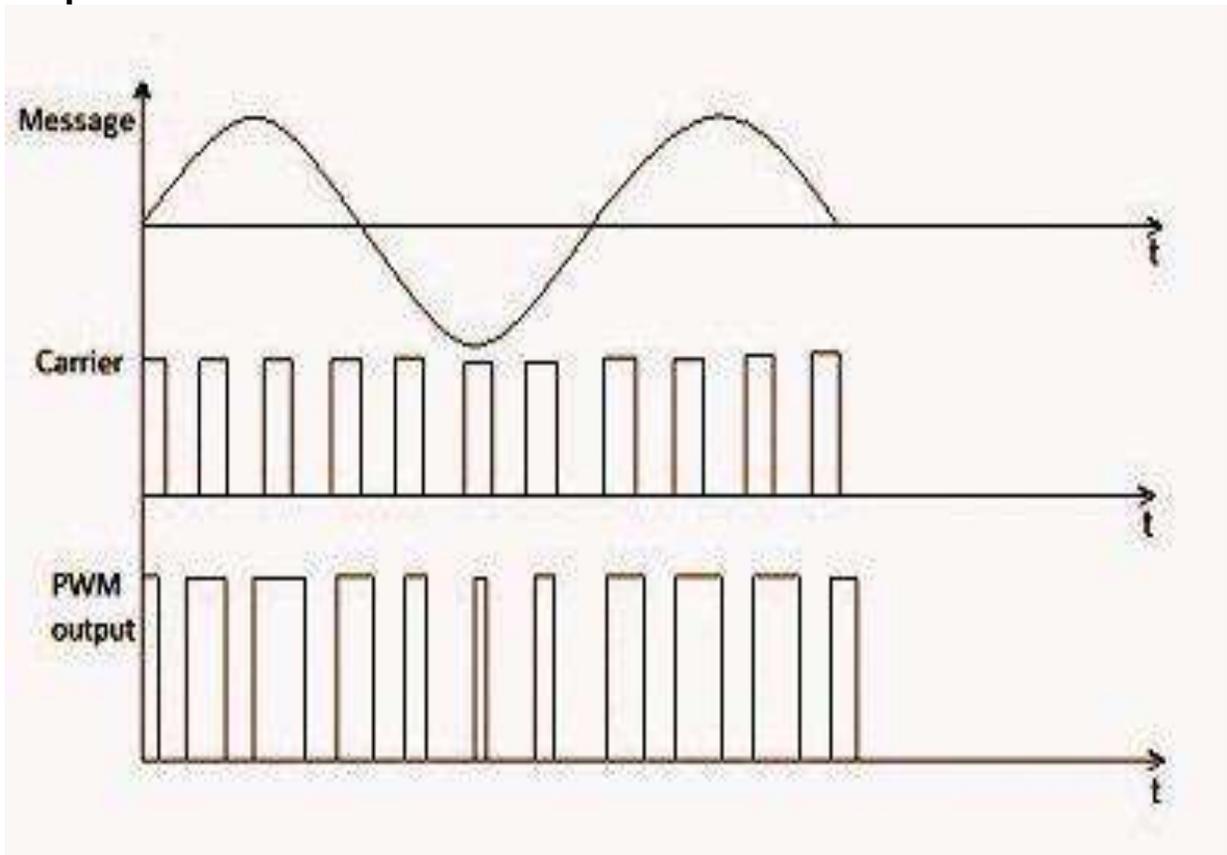
Pulse Time Modulation is also known as Pulse Width Modulation or Pulse Length Modulation. In PWM, the samples of the message signal are used to vary the duration of the individual pulses. Width may be varied by varying the time of occurrence of leading edge, the trailing edge or both edges of the pulse in accordance with modulating wave. It is also called Pulse Duration Modulation.

**Procedure**

1. Connect the circuit as per circuit diagram shown in fig-1
2. Apply a trigger signal (Pulse wave) of frequency 2 KHz with amplitude of 5v (p-p).
3. Observe the sample signal at the pin3.
4. Apply the ac signal at the pin 5 and vary the amplitude.
5. Note that as the control voltage is varied output pulse width is also varied.
6. Observe that the pulse width increases during positive slope condition & decreases under negative slope condition. Pulse width will be maximum at the +ve peak and minimum at the -ve peak of sinusoidal waveform. Record the observations.
7. Feed PWM waveform to the circuit of Fig-2. and observe the resulting demodulated waveform.



## Graphs



### Precautions:

1. Connections should be tight.
2. Handling the Equipment Carefully.
3. Avoid parallax error while observing the values of waveforms on CRO.

## PULSE POSITION MODULATION AND DEMODULATION

### 1. Description:

The setup for this experiment requires the following equipment.

Name	Specification/range	Quantity	Purpose
Breadboard	-	1	To connect the components
IC	555	1	
TRANSISTOR	BC107	1	
C.R.O	-	1	To observe the output waveforms
Capacitors	60 $\mu$ f	1	
Capacitors	0.01 $\mu$ f	2	
Resistors	3k $\Omega$ ,3.9k $\Omega$	1	
Resistors	10 k $\Omega$ , 5.6 k $\Omega$ ,680 k $\Omega$	1	
Connecting wires			
Function generator		1	To apply input
DC power supply	0-30v	1	To apply DC voltage

### CIRCUIT DIAGRAM:

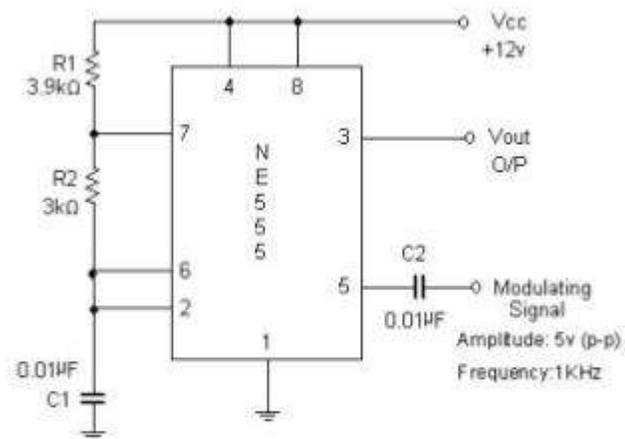


Fig: 1 Pulse Position Modulation Circuit

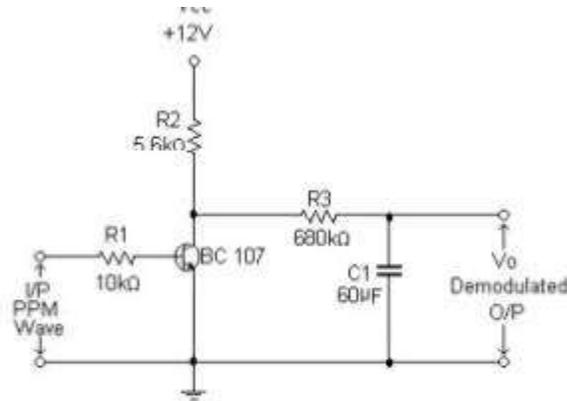


Fig: 2 Demodulation Circuit

### Theory:

Pulse position modulation is defined as the position each pulse varies in accordance with the amplitudes of modulating signal and amplitude and width of the pulses kept constant. It is easily generated by using IC 555 timer. It works based on the concept of astable multivibrator. PPM has so many applications especially in RF communications like remote controlled air craft, cars, boats and other vehicles and is responsible for conveying a transmitter's controls to a receiver.

### Procedure:

#### MODULATION:

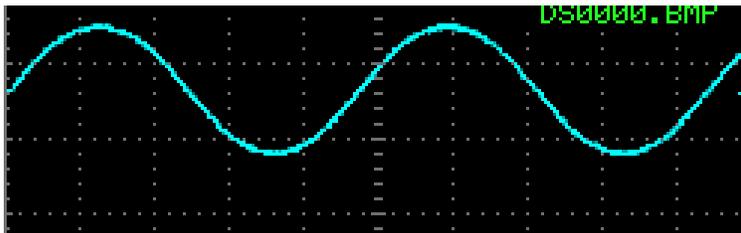
1. **Connect** the circuit as per the **circuit** diagram
2. Connect **input** signal from **wave form generator**.
3. **Observe** the input signal by using **CRO**.
4. **Measure** the input **amplitude** and **time period**
5. **Connect** the **CRO** probe at **output** terminal.
6. **Observe** the **output** signal.
7. **Measure** the **amplitude** of output signal.

#### DEMODULATION:

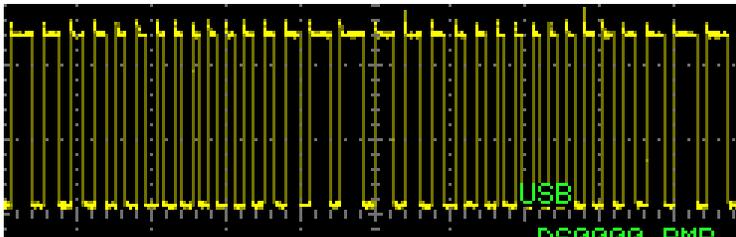
1. **Connect** the circuit as per the **circuit** diagram
2. Connect **PPM output** as **input** to the **demodulation** circuit.
3. **Observe** the **input** signal by using **CRO**.
4. **Connect** the **CRO** probe at **output** of the circuit.
5. **Observe** the **output** signal and **measure** the **amplitude** and **time period**.
6. **Calculate** the output **frequency**.
7. **Compare** the **output** signal with **input** signal.

**Observations:**

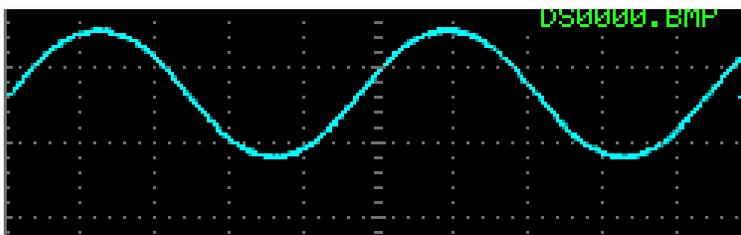
Sl No.	Signal	Amplitude(volts)	Time period	Frequency
01	Input			
02	PPM output			
03	Demodulation output			

**Graphs:**

Input signal



ppm output



demodulation output

**Precautions:**

1. Connections should be tight.
2. Handling the Equipment Carefully.
3. Avoid parallax error while observing the values of waveforms on CRO.

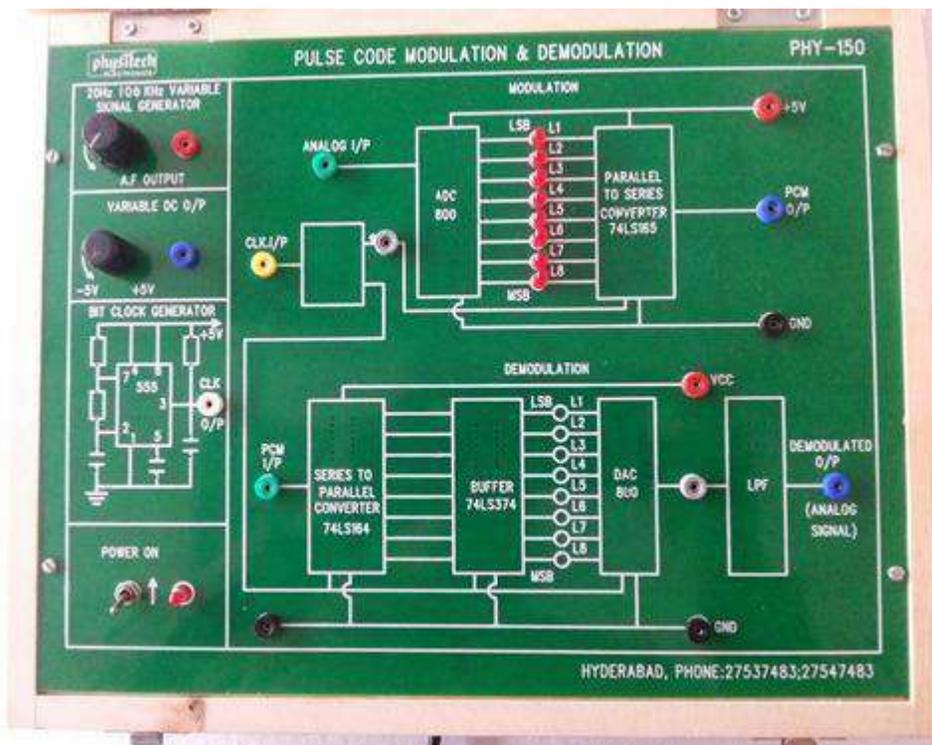
### PULSE CODE MODULATION AND DEMODULATION

#### 1. Description:

The setup for this experiment requires the following equipment

Name	Specification/range	Quantity	Purpose
Breadboard	-	1	To connect the components
Parallel to serial converter	74LS165	1	
Serial to parallel converter	74LS164	1	
ADC	ADC800	1	
DAC	DAC800	1	
Sample and hold circuit		1	
Low pass filter	2 <sup>nd</sup> order	1	
Astable multivibrator	IC 555	1	
CRO		1	To observe signals
Connecting wires			
Function generator		1	To apply input
DC power supply	0-30v	1	To apply DC voltage

#### CIRCUIT DIAGRAM:



**Theory:**

A signal is pulse code modulated to convert its analog information into a binary sequence, i.e., 1s and 0s. The output of a PCM will resemble a binary sequence. The following figure shows an example of PCM output with respect to instantaneous values of a given sine wave. Instead of a pulse train, PCM produces a series of numbers or digits, and hence this process is called as digital. Each one of these digits, though in binary code, represent the approximate amplitude of the signal sample at that instant.

In Pulse Code Modulation, the message signal is represented by a sequence of coded pulses. This message signal is achieved by representing the signal in discrete form in both time and amplitude.

**Procedure :****MODULATION:**

1. **Connect** the circuit as per the **circuit** diagram
2. Connect **input signal** from **wave from generator**.
3. **Observe** the input signal by using **CRO**.
4. **Measure** the input **voltage** and **time period**
5. Apply **clock signal** to the **sample and hold** circuit.
6. **Observe** the **clock** signal and measure amplitude and **time period**.
7. **Observe** the **sampled signal** at sample and hold circuit output using CRO.
8. **Connect** the sampled signal to the **ADC**.
9. Observe the ADC **output** at **LEDs**.
10. **Observe** the **PCM output** and **record** the **data** in **PCM** signal from the CRO.

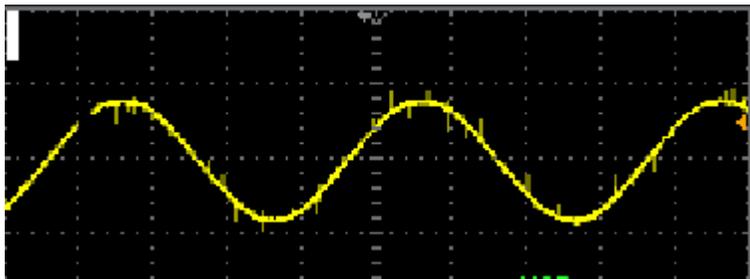
**DEMODULATION:**

1. **Connect** PCM output to the **demodulation input**.
2. **Observe** the **DAC output** by using CRO.
3. Measure step size in DAC output.
4. Connect the CRO probe at LPF output terminal.
5. **Observe** the output signal.
6. **Measure** the **amplitude** and **time period** of **output** signal.
7. **Compare** the **output** signal and **input** signal.

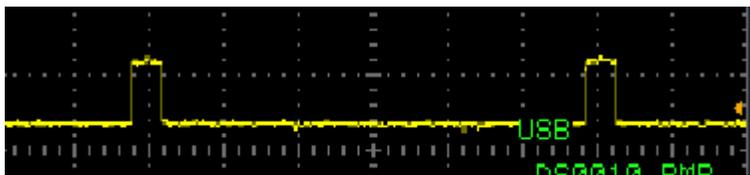
**Observations**

SI No.	Signal	Amplitude(volts)	Time period	frequency
01	Input			
	Clock signal			
02	Sampled output			
	PCM output			
	DAC output			
03	Demodulation output			

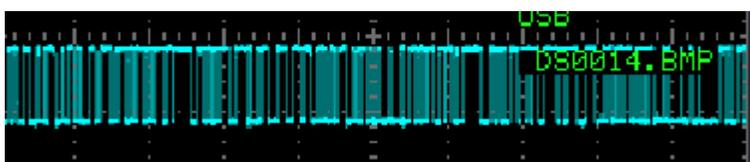
**Graphs:**



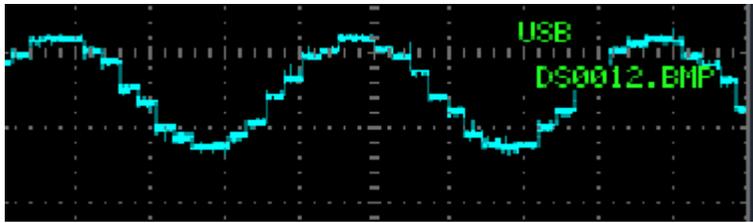
modulating input



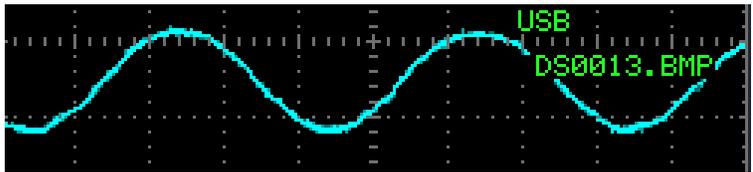
sampling signal



PCM output



ADC output



demodulated output

**Precautions:**

1. Connections should be tight.
2. Handling the Equipment Carefully.
3. Avoid parallax error while observing the values of waveforms on CRO.

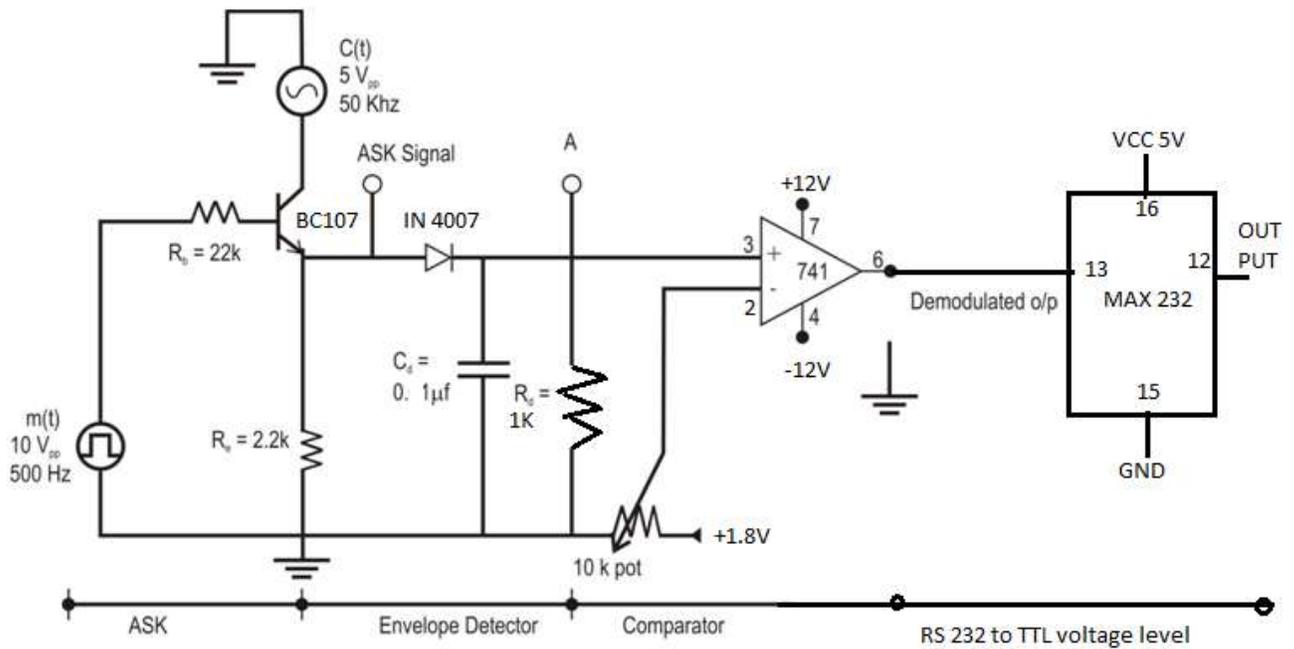
## AMPLITUDE SHIFT KEYING MODULATOR AND DEMODULATOR

### 1. Description

The setup for this experiment requires the following equipment

Name	Specification/range	Quantity	Purpose
Breadboard	-	1	To connect the components
Transistor	BC 107	1	Act as a switch to allow the carrier wave when message is present
Diode	1N4007	1	To rectify the output of the modulator
Resistor	22K $\Omega$	1	To limit the current to the transistor
Resistor	2.2K $\Omega$	1	To act as a load resistor for the ASK signal output
Resistor	1K $\Omega$	1	To act as a discharge path for the capacitor
Capacitor	0.1 $\mu$ F	1	To allow the low frequency signal of the modulated output
Op amp	IC 741	1	Used as a comparator
Potentiometer	10K $\Omega$	1	To adjust the reference voltage for the comparator
Voltage level converter	MAX232N	1	To convert the voltage levels from RS232 to TTL
C.R.O Dual channel	0-20Mhz	1	To observe the input output waveforms
Multimeter		1	To measure voltages
Regulated power supply dual	0-30 volts	2	To give supply to the Op Amp and MAX 232 and as a reference voltage to the Op amp
Connecting wires			To connect the circuit components
Function generators	1MHz	2	To generate carrier and message signal

**CIRCUIT DIAGRAM**



**Fig.1**

**Theory**

**ASK Modulator:**

Amplitude Shift Keying (ASK) is the digital modulation technique. In amplitude shift keying, the amplitude of the carrier signal is varied to create signal elements. Both frequency and phase remain constant while the amplitude changes. In ASK, the amplitude of the carrier assumes one of the two amplitudes dependent on the logic states of the input bit stream. These are related to the number of levels adopted by the digital message. For a binary message sequence there are two levels, one is logic 0 and another is logic 1. When the logic 1 is present in the message input then the carrier is appeared as output. When the logic 0 is present in the message input then the output is zero. This modulated signal can be expressed as:

$$x_c(t) = \begin{cases} 0 & \text{symbol "0"} \\ A \cos \omega_c t & \text{symbol "1"} \end{cases}$$

### ASK Demodulator:

For receiver, we must convert the digital signal back to the modulating signal.

The below figure shows the ASK demodulator. When the ASK signal pass through the rectifier, we can obtain the positive half wave signal. After that the signal will pass through a low-pass filter and obtain envelope detection. Then get rid of the DC signal, the digital signal will be recurred.

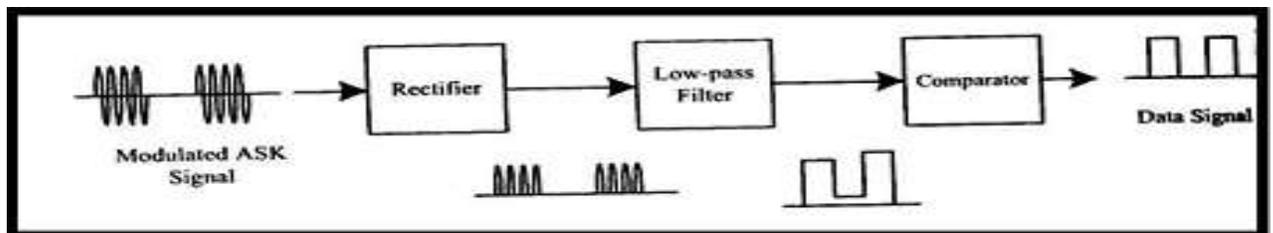


Fig.2

### Procedure

#### ASK modulator:

1. **Connect the circuit** as shown in the fig.1.
2. **Apply a square wave** message signal of **500 Hz of 10VP-P**
3. **Apply a sine wave** carrier signal of **50 kHz of 5VP-P** amplitude.
4. **Observe ASK modulated waveform** at the emitter of transistor and **note down the amplitude and frequency values.**
5. **Plot the waveforms of message signal, carrier signal and ASK modulated signal** with correct scaling on graph sheet.

#### ASK demodulator:

1. Apply ASK modulated output to the envelop detector circuit.
2. **Observe ASK demodulated waveform** at the **IC MAX 232 pin number 12** and **note down the amplitude and frequency values.**
3. **Compare ASK demodulated waveform** with input **message waveform.**
4. **Plot the waveform of ASK demodulated signal** with correct scaling on graph sheet.

**7.CALCULATIONS:**

$V_{p-p} = \text{no. of vertical divisions} \times \text{Volts/div}$

$\text{Time period} = \text{No. of horizontal divisions} \times \text{time/div}$

$\text{Peak amplitude} = V_{p-p}/2$

$\text{Frequency} = 1 / \text{time period}$

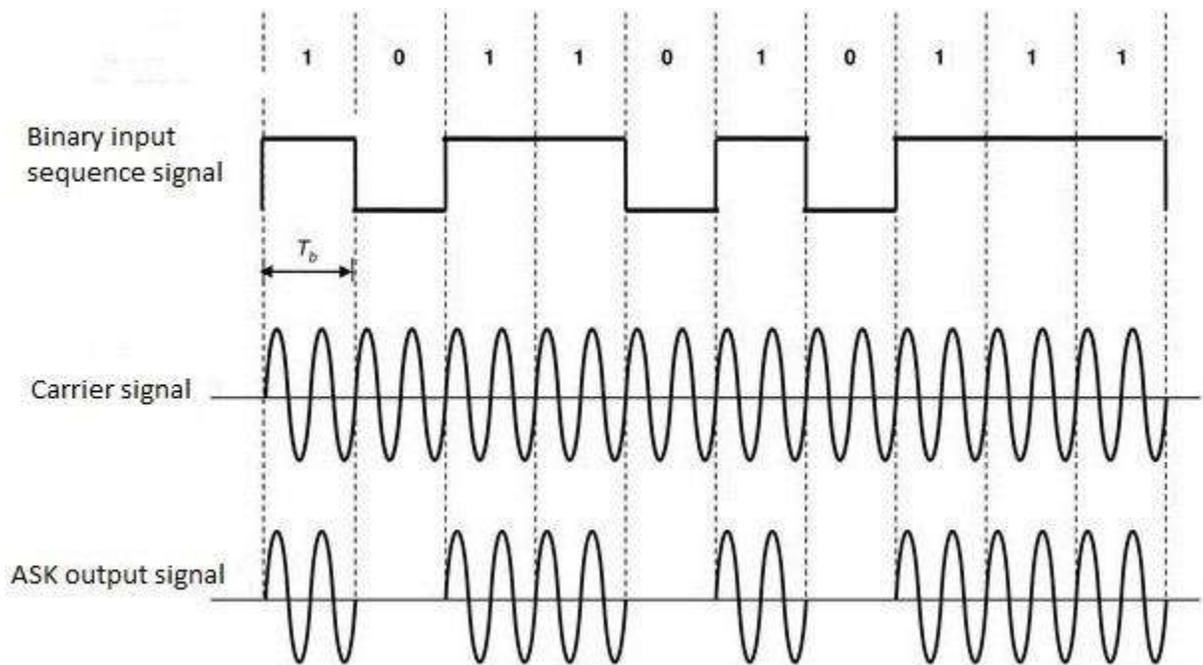
**Observations:**

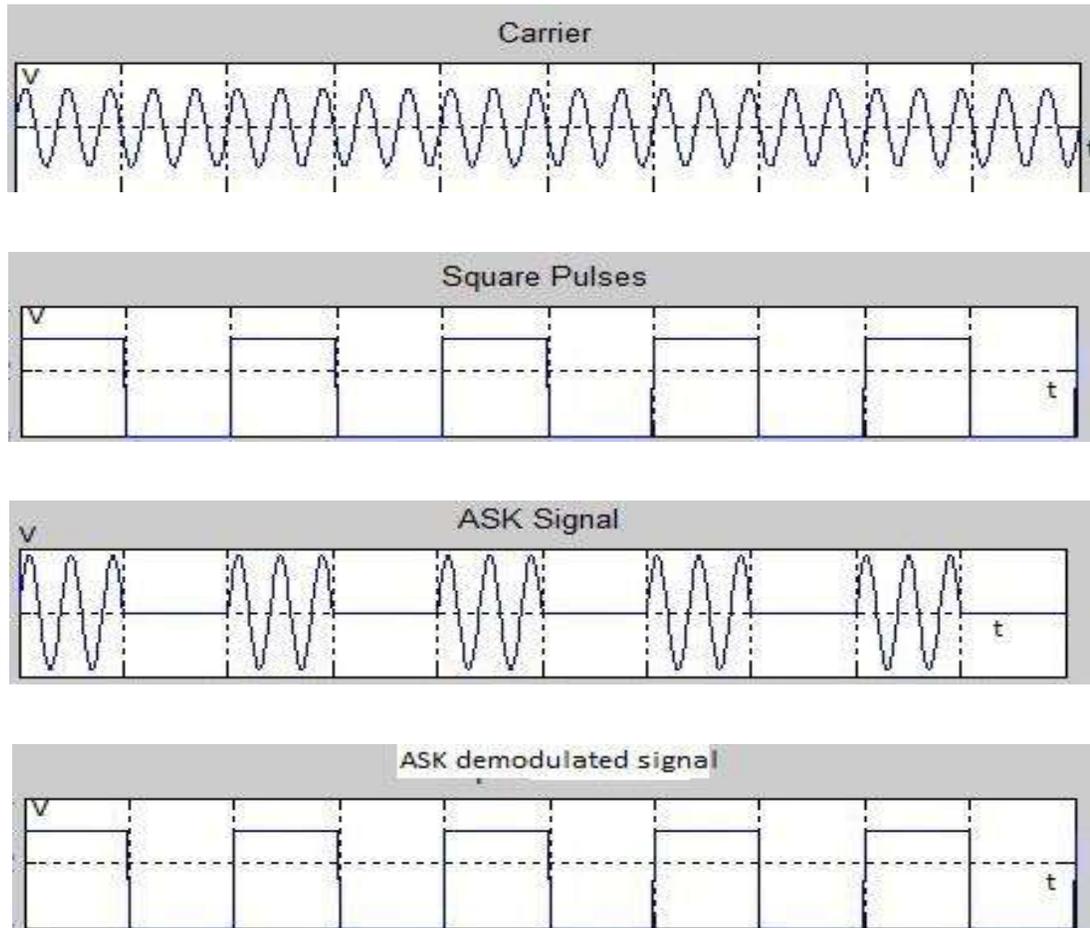
Parameter	Message signal	Carrier signal	ASK modulated signal	ASK demodulated signal
Amplitude (v)				
Frequency(Hz)				
Time period(sec)				

**Data signal: ON Period =**

**OFF Period =**

**Graphs**



**PROCEDURAL PRECAUTIONS:**

- Disconnect all the equipment from mains before making connections
- Connect the circuit as per the circuit diagram and check for polarity
- Get the connections checked by the concerned staff member
- Calibrate the CRO for getting accurate result
- Ensure that there are no loose connections
- Capacitor should be connecting with proper polarity
- IC's should be connecting according to their pin description
- Calibrate the RPS for getting accurate result.

**B. SAFETY PRECAUTIONS:**

- Never work on a circuit while power is applied.
- Do not connect power to a circuit until the circuit is finished and you have carefully checked your work.
- If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.
- Keep your work area dry.

## FSK Modulation and Demodulation

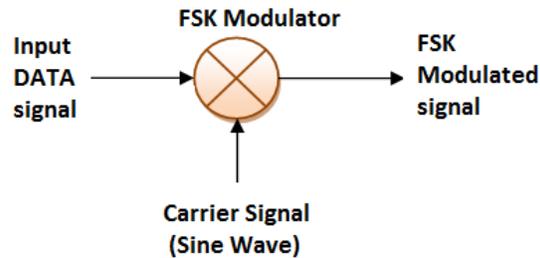
### 1. Description

The setup this experiment requires the following equipment

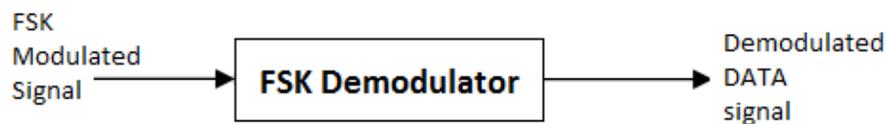
Name	Specification/range	Quantity	Purpose
FSK Modulation and Demodulation Trainer Kit	---	1	To Perform FSK Modulation and Demodulation
C R O	0-30MHz	1	To observe the corresponding waveforms
C R O Probes	1X	2	To make interconnection between test points and CRO
Patch Chords	---	10	To make connections in Trainer Kit.

### 2.Circuit Diagram :

#### FSK Modulation :



#### FSK Demodulation :



### **3.Theory**

Frequency-shift keying (FSK) is a frequency modulation scheme in which digital information is transmitted through discrete frequency changes of a carrier signal.<sup>[1]</sup> The technology is used for communication systems such as telemetry, weather balloon radiosondes, caller ID, garage door openers, and low frequency radio transmission in the VLF and ELFbands. The simplest FSK is binary FSK (BFSK). BFSK uses a pair of discrete frequencies to transmit binary (0s and 1s) information.<sup>[2]</sup> With this scheme, the "1" is called the mark frequency and the "0" is called the space frequency.

### **4.Procedure**

#### **FSK Modulation :**

1. Switch ON the power supply of trainer Kit.
2. Check the wave forms of DATA and Carrier signals (also set required frequency and amplitude) using CRO.
3. Give the Connections as per the circuit diagram given.
4. Observe the Modulated signal at corresponding point using CRO.

#### **FSK Demodulation :**

1. Connect FSK Modulated output to FSK demodulator input.
2. Observe the DATA signal at the corresponding output terminal using CRO.
3. Verify that the received DATA signal is same as transmitted one.

**5.Observations**

**Modulation:**

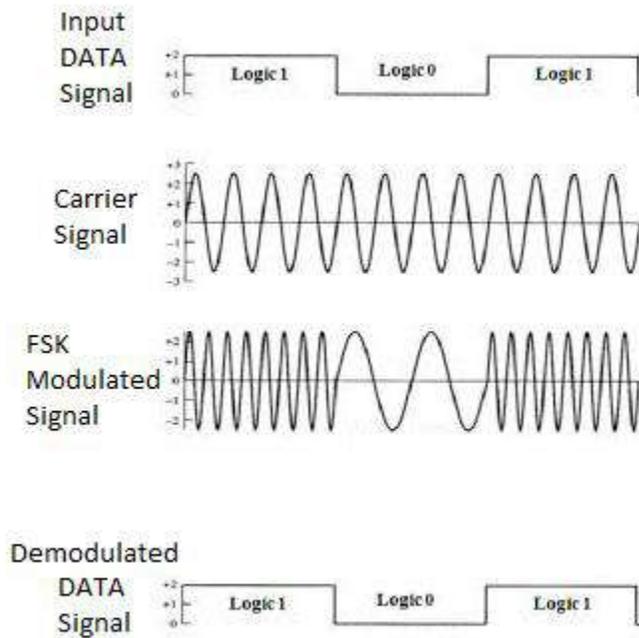
<b>Input DATA signal</b>	<b>Amplitude :</b> volts	
	<b>TimePeriod :</b> Sec	
	<b>T<sub>ON</sub> :</b> Sec	<b>T<sub>OFF</sub> :</b> Sec
	<b>Frequency :</b> Hz	
<b>Carrier Signal</b>	<b>Amplitude :</b> volts	
	<b>TimePeriod :</b> Sec	
	<b>Frequency :</b> Hz	
<b>Modulated Signal</b>	<b>Amplitude :</b> volts	
	<b>For '0' data input</b>	<b>TimePeriod :</b> Sec
		<b>Frequency :</b> Hz
	<b>For '1' data input</b>	<b>TimePeriod :</b> Sec
		<b>Frequency :</b> Hz

#### 4.8.EXPERIMENTAL METHODOLOGY 4.8FSK Modulation and Demodulation

### Demodulation :

<b>Demodulated DATA signal</b>	<b>Amplitude :</b>	<b>volts</b>
	<b>TimePeriod :</b>	<b>Sec</b>
	<b>Frequency :</b>	<b>Hz</b>

### 6.Graphs:



### **7.Calculations :**

- Amplitude (peak to Peak ) = No.of Vertical Divisions X volts/div

=

- Peak Amplitude =  $\frac{\text{Amplitude (peak to Peak )}}{2}$

=

- Time Period = No.of Horizontal divisions X Time/div

=

- Frequency =  $\frac{1}{\text{TimePeriod}}$  =

### **8.Precautions:**

#### **A.Procedural Precautions:**

1. Disconnect all the equipment from mains before making connections
2. Connect the circuit as per the circuit diagram.
3. Get the connections checked by the concerned staff member.
4. Calibrate the CRO for getting accurate result.
5. Ensure that there are NO loose connections.

#### **B.Safety Precautions:**

1. Never work on a trainer kit while the power button is ON position.
2. Don't turn ON the supply until sure about the connections.
3. If you smell anything burning,immediately disconnect the power and examine your circuit to find out what went wrong.
4. Keep your work area dry.
5. Always wear shoes while working on trainer kits.

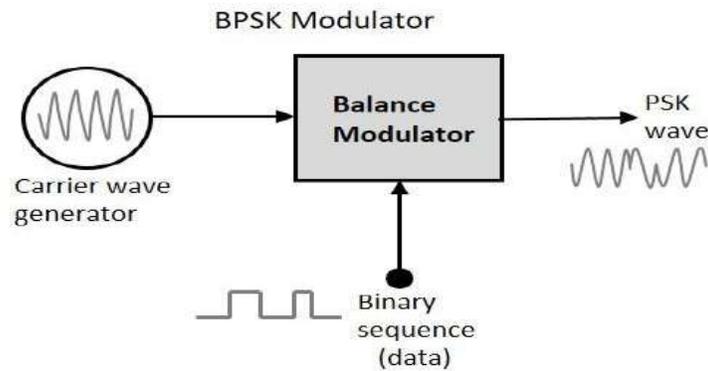
**PHASE SHIFT KEYING**

**1. Description**

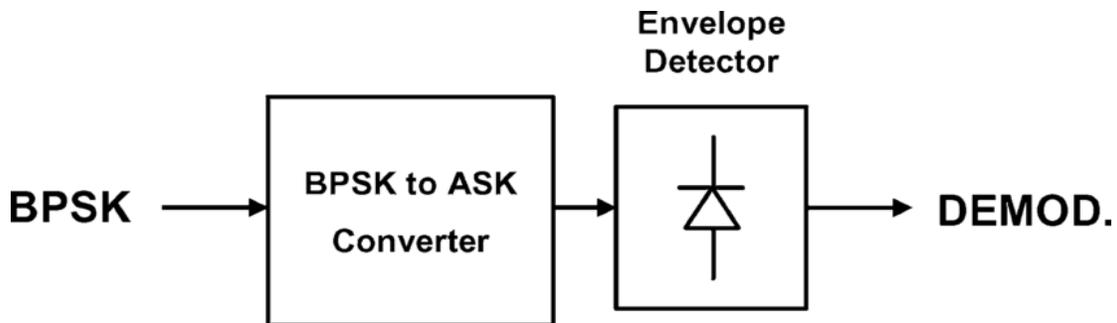
The setup for this experiment requires the following equipment

Name	Specification/range	Quantity	Purpose
PSK Trainer kit	-	1	To perform the exercise
C.R.O	-	1	To observe the output waveforms
C.R.O Probes	-	2	To connect input and outputs from trainer kit to CRO channels.
Patch cards	-		To connect different blocks.

**BLOCK DIAGRAM**

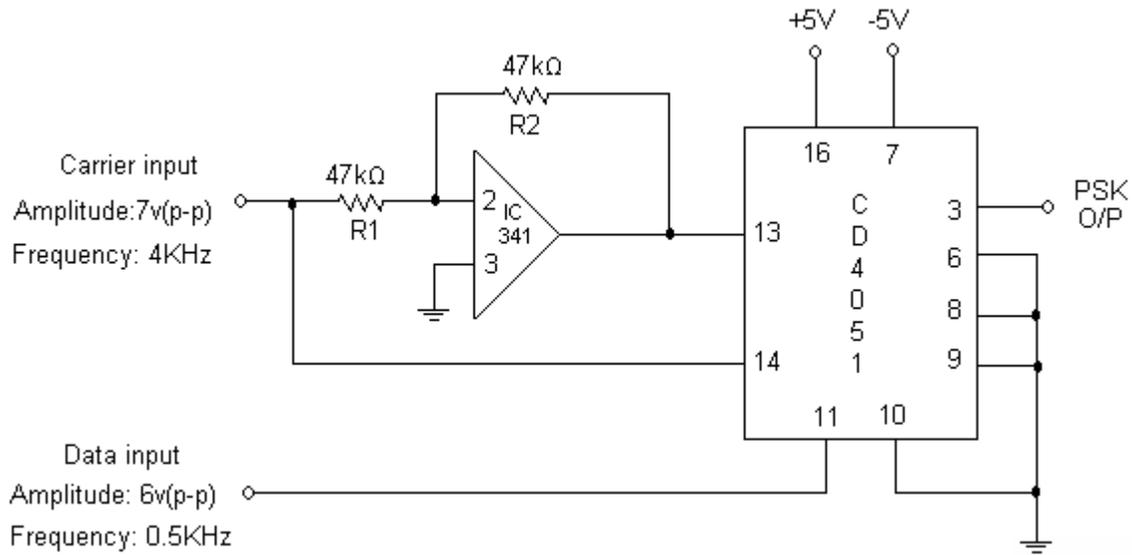


**Fig(1) : PSK Modulator**

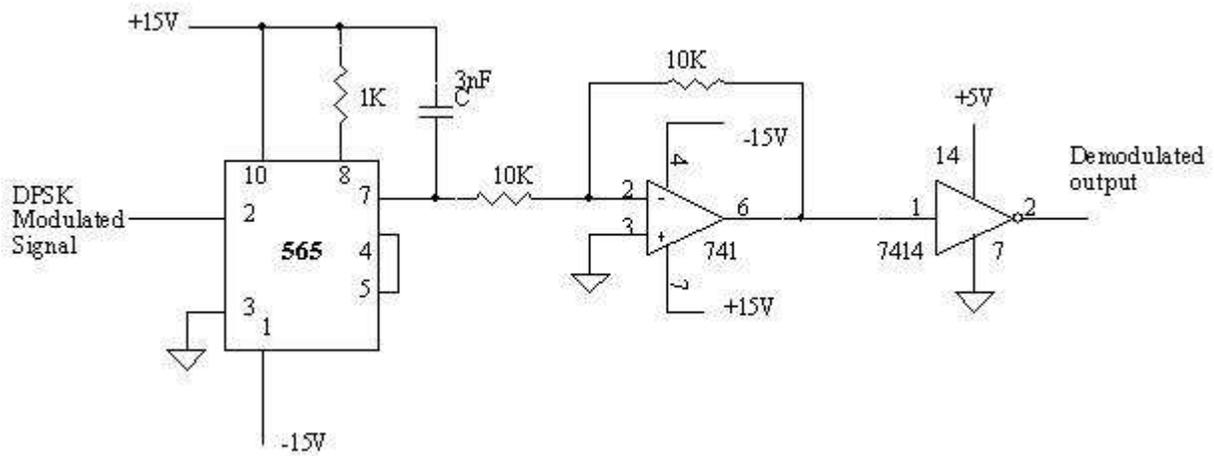


**Fig(2): PSK Demodulator**

**Circuit DIAGRAM**



**PSK MODULATOR CIRCUIT**



**PSK DEMODULATOR CIRCUIT**

**Theory**

Phase shift keying or binary phase shift keying(BPSK) involves the phase change of the carrier sine wave between 0 and 180 in accordance with the data stream to be transmitted. PSK is also known as Phase reversal keying. The equation for PSK signal is given below

**For binary 'logic 1'  $s_1(t) = A_c \cos \omega_c t$**

**For binary 'logic 0'  $s_2(t) = -A_c \cos \omega_c t$**

PSK modulator is shown in figure 1. Functionally, the PSK modulator is very similar to the ASK modulator. Both uses balanced modulator to multiply the carrier with the modulating signal. But in contrast to ASK techniques, the digital signal applied to the modulator input for PSK generation is bipolar i.e. have equal +ve and -ve voltage levels. The unipolar – bipolar converter converts the unipolar data stream to bipolar data. At receiver, the square loop detector circuit is used to demodulate the transmitted PSK signal. The demodulator is shown in figure 2. The incoming PSK signal with 0 & 180 phase changes is first converted to the ASK signal after that demodulated signal is recovered from envelope detector. The phase adjust circuit allows the phase of the digital signal to be adjusted with respect to the input PSK signal.

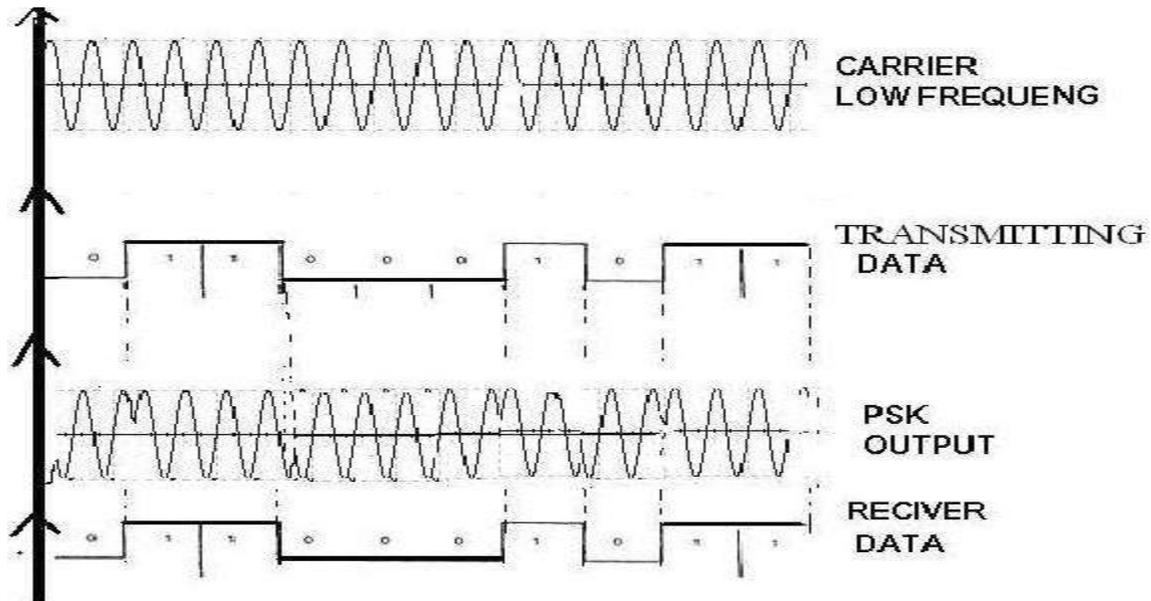
### Procedure

1. Switch on the PSK trainer kit.
2. Connect the different blocks as per the given modulator and demodulator block diagram.
3. Connect the binary message data to the channel 1 of CRO and PSK output to channel 2 of CRO. Now adjust the Volts/Div and Times/Div knobs to observe PSK signal.
4. Observe the Phase difference of carrier signal in according with the binary message data either logic 1 or logic 0.
5. Measure the frequency and peak to peak voltages of binary message data and PSK signal.
6. Disconnect the PSK output from channel 2 of CRO and connect demodulator output to the channel 2 of CRO.
7. Measure frequency and peak to peak voltage of demodulator output.
8. Draw the graph for binary message data, PSK signal and Demodulated signal as per measurements.

### Observations

- a) Binary message signal frequency:
- b) Binary message signal peak to peak voltage  $V_{p-p}$ :
- c) PSK signal frequency:
- d) PSK signal peak to peak voltage  $V_{p-p}$ :
- e) Demodulated signal frequency:
- f) Demodulated signal peak to peak voltage  $V_{p-p}$ :

**Graphs**



**Precautions:**

1. Connections should be tight.
2. Handling the Equipment Carefully.
3. Avoid parallax error while observing the values of waveforms on CRO.

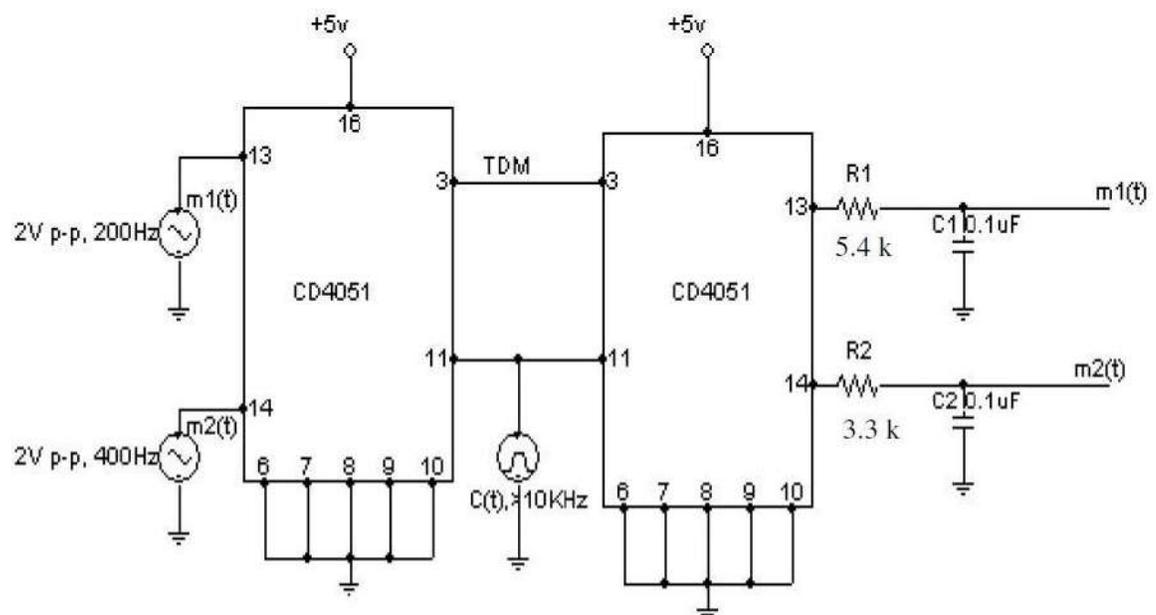
## TIME DIVISION MULTIPLEXING & DEMULTIPLEXING

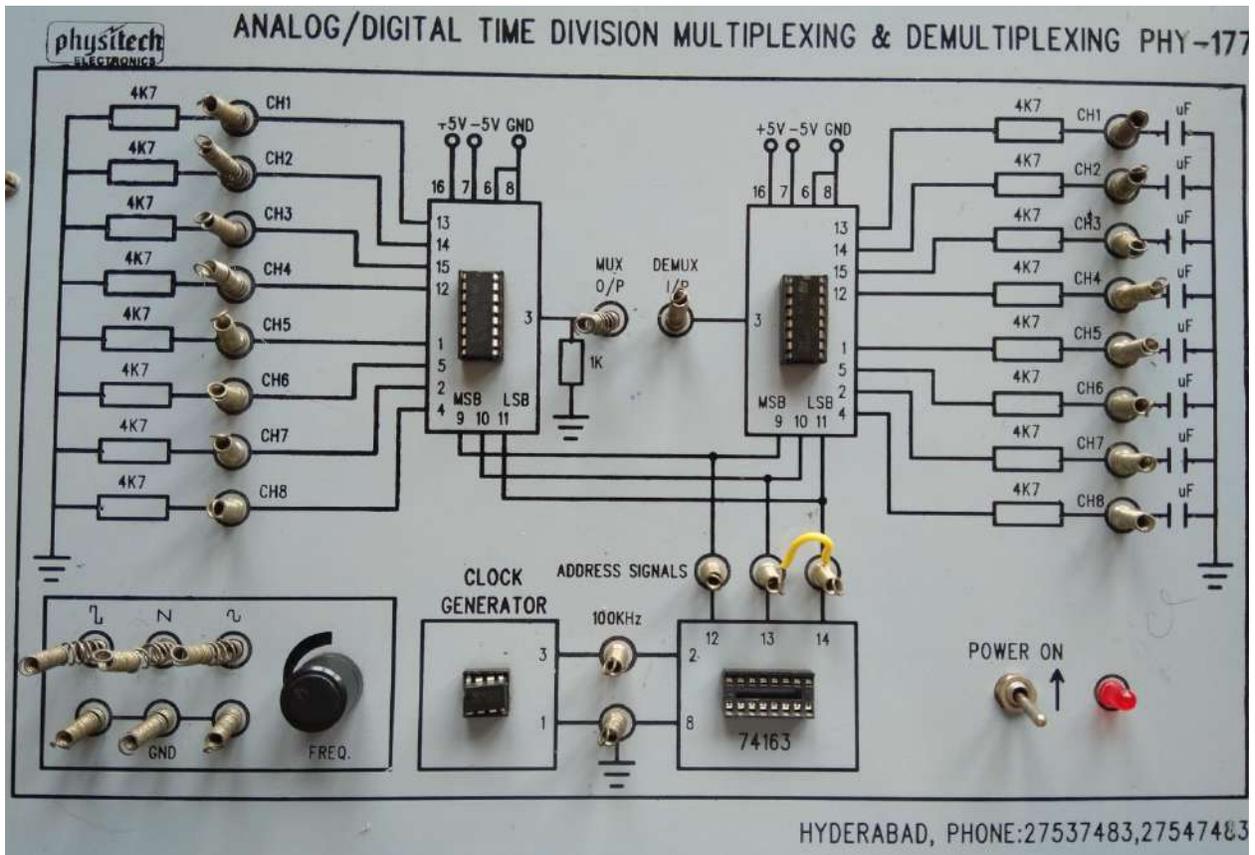
### 1. Description

The setup for this experiment requires the following equipment

Name	Specification/range	Quantity	Purpose
TDM Trainer kit	-	1	To connect the components
Voltage source	2 Vp-p	2	To connect two different signals(sine wave & square wave)
IC CD4051	(-0.5 to 20) Volts	2	analog and digital multiplexer as well as demultiplexer
C.R.O	0-100 MHz	1	To observe the output waveforms
Function generator	1 Hz -100M Hz	1	To connect square wave to the selection input line
Connecting wires and Probes			To make connections and inter connections to equipment

### 2. CIRCUIT DIAGRAM





### 3. Theory

Time-division multiplexing (TDM) is a method of transmitting and receiving independent signals over a common signal path by means of synchronized switches at each end of the transmission line so that each signal appears on the line only a fraction of time in an alternating pattern. It is used when the bit rate of the transmission medium exceeds that of the signal to be transmitted. This form of signal multiplexing was developed in telecommunications for telegraphy systems in the late 19th century, but found its most common application in digital telephony in the second half of the 20th century. In Digital Multiplexing, several low bit-rate signals can be multiplexed or combined, to form one high bit-rate signal, to be transmitted over a high frequency medium. Because the medium is time-shared by various incoming signals, this is a case of TDM. Multiplexing can be done on a bit-by-bit basis (known as digit interleaving), or on a word-by-word basis (known as byte or word-interleaving).

At the receiving terminal, the incoming digit stream must be divided and distributed to the appropriate output channel. For this purpose, the receiving terminal must be

able to correctly identify each bit. This requires the receiving system to uniquely synchronize in time with the beginning of each frame, with each slot in a frame and with each bit within a slot. This is accomplished by adding framing and synchronization bits to the data bits. These bits are part of the so-called overhead bits.

#### 4. Procedure

1. **Connect** the **circuit** as shown in the circuit diagram.
2. **Apply** a square wave (TTL) carrier signal of 2 kHz (or >2 kHz) of 5V amplitude from function generator to the **selection input lines**.
3. **Apply**  $m_1(t)$  and  $m_2(t)$  whose frequencies are  $f_1$  (200 Hz, with DC offset) and  $f_2$  (400 Hz, with DC offset).
4. **Observe** TDM **waveform** at pin number 3 of IC CD4051
5. **Observe** the reconstructed message **waveforms**  $m_1(t)$  and  $m_2(t)$  at pin numbers 13 and 14 of 2<sup>nd</sup> IC CD4051

#### 5. Observations

Peak voltage,  $V_m =$  \_\_\_\_\_ (from CRO for Multiplexed & demultiplexed signals)

Multiplexed output,  $V_m =$  \_\_\_\_\_ (from CRO for Multiplexed signals)

$T =$  \_\_\_\_\_ (from CRO for Multiplexed signals)

De multiplexed output  $V_m =$  \_\_\_\_\_ (from CRO for de multiplexed signals)

$T =$  \_\_\_\_\_ (from CRO for de multiplexed signals)

#### Input signal

Sl.no	Type of signal	Amplitude	timeperiod	Frequency
1	Sine wave			
2	Square wave			

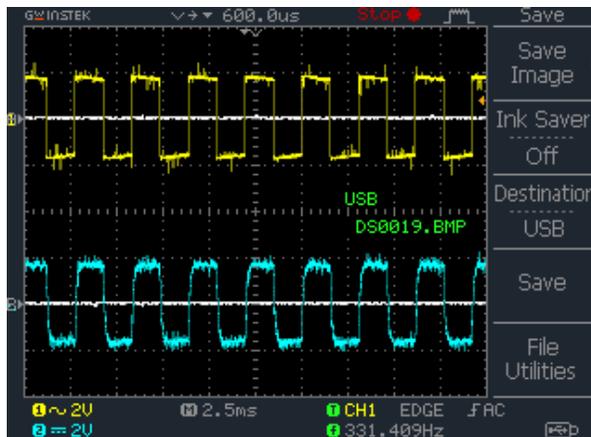
#### Clock or Switching signal (from function generator)

Sl.no	Type of signal	Amplitude	$T_{ON}$	$T_{OFF}$
1	Square wave			

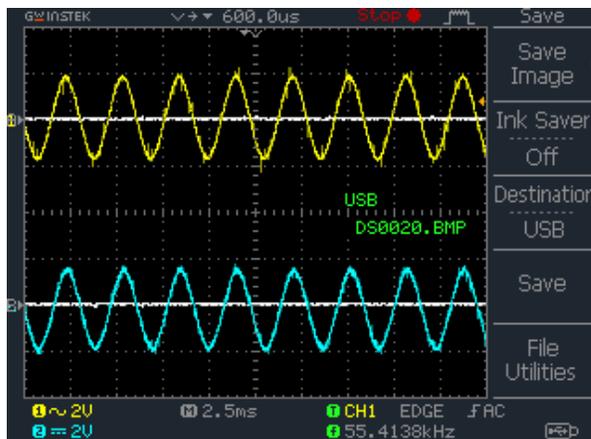
**Output signal**

Sl.n		Type of signal	Amplitude	Time period	Frequency
1		Multiplexed signal			
2	ed	Sine wave			
		Square wave			

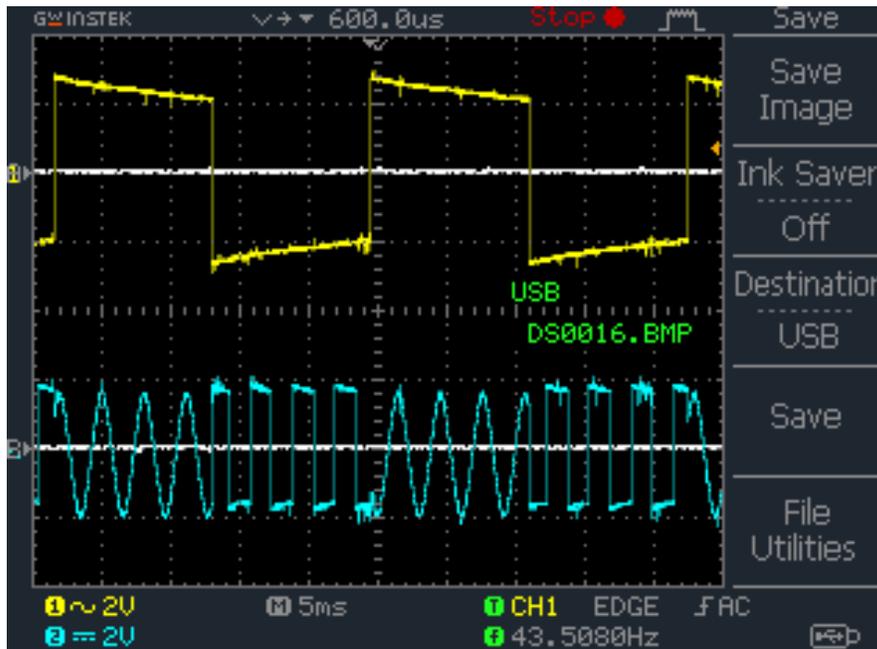
**6. Graphs**



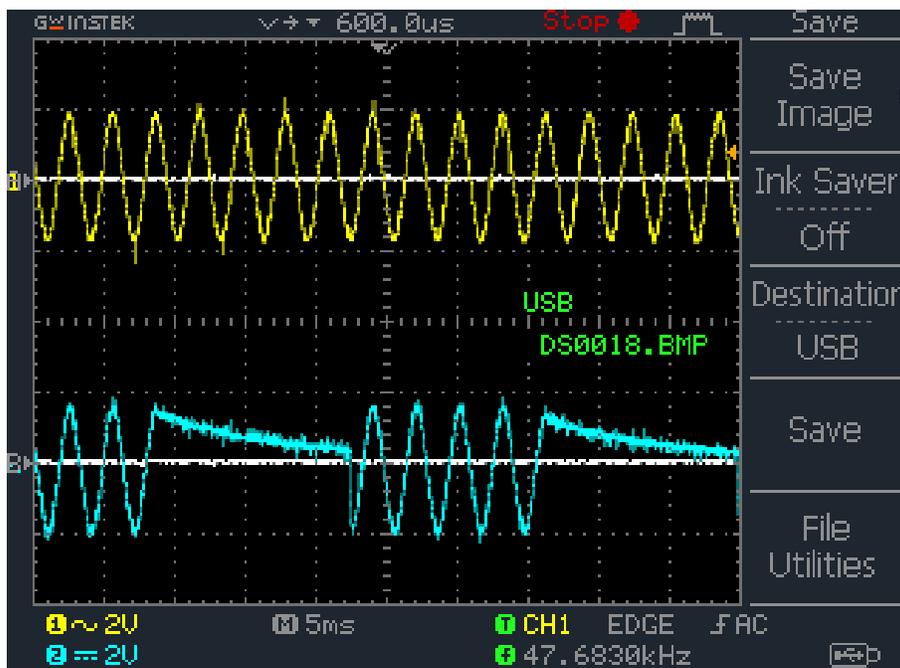
**Input Square wave m1(t)**



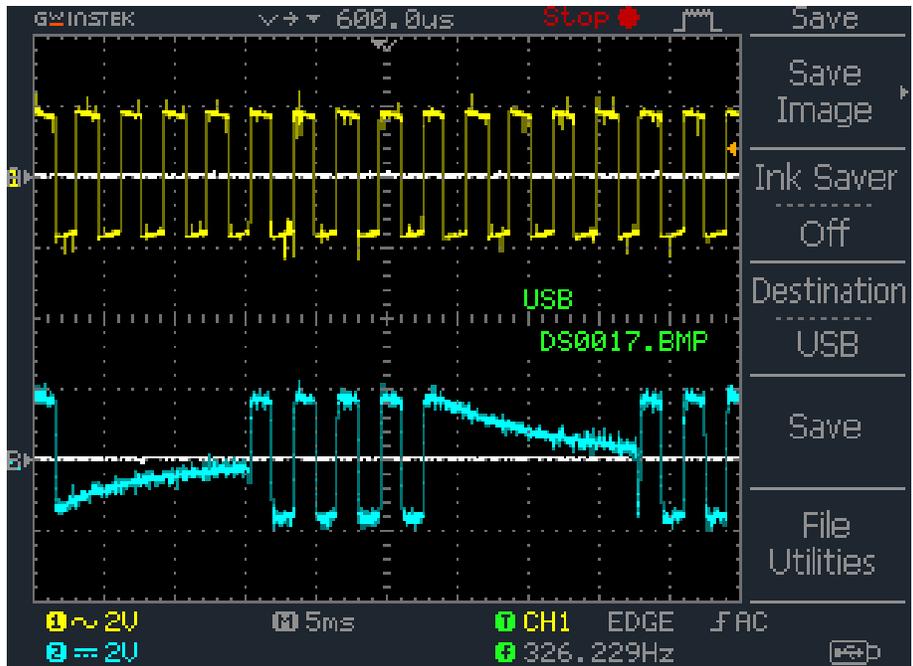
**Input sine wave m2(t)**



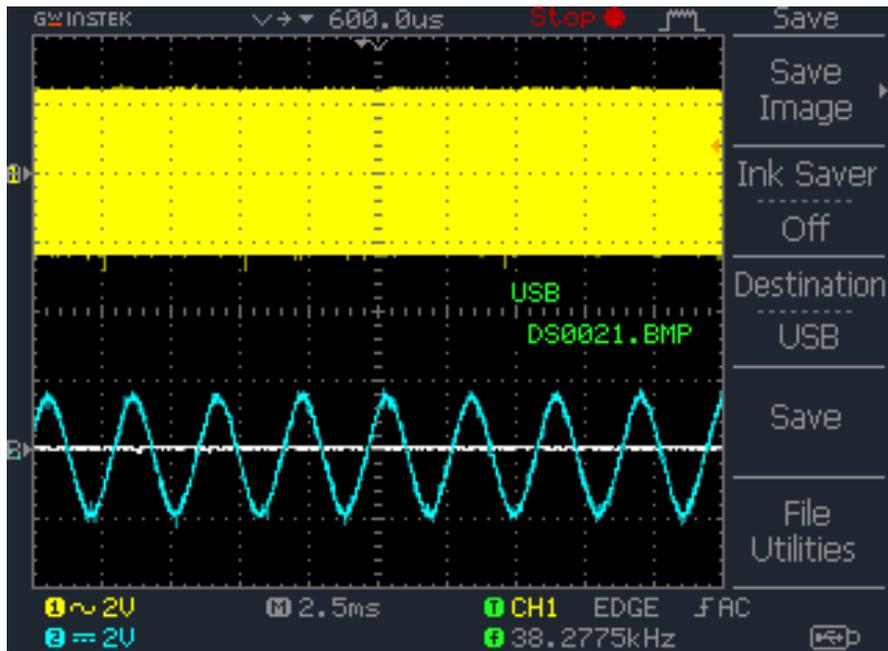
**Multiplexed output signal**



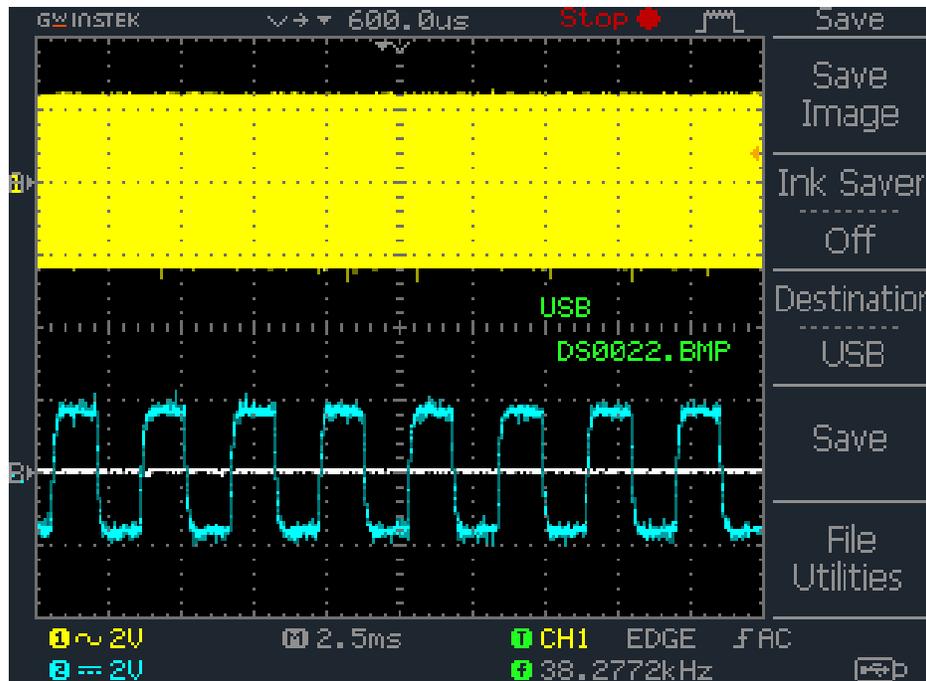
**Demultiplexed output signal m1(t) (at Low frequency selection input )**



Demultiplexed output signal  $m_2(t)$  (at Low frequency selection input )



Demultiplexed output signal  $m_1(t)$  (at Low frequency selection input )



**Demultiplexed output signal  $m_2(t)$  (at Low frequency selection input )**

## 7.CALCULATIONS:

$V_{p-p} = \text{no. of vertical divisions} \times \text{Volts/div}$

$\text{Time period} = \text{No. of horizontal divisions} \times \text{time/div}$

$\text{Peak amplitude} = V_{p-p}/2$

$\text{Frequency} = 1 / \text{time period}$

## 8.PRECAUTIONS:

### A. PROCEEDURAL PRECAUTIONS:

- Disconnect all the equipment from mains before making connections.
- Ensure the correct range of function generator
- Connect the circuit as per the circuit diagram and check for polarity.
- Get the connections checked by the concerned staff member.
- Calibrate the CRO for getting accurate result.

- Ensure that there are no loose connections.

**B. SAFETY PRECAUTIONS:**

- Never work on the trainer kit while power is switched ON.
- Do not connect power to the trainer kit until the circuit connection is fixed.
- If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.
- Keep your work area dry.
- Always wear safety goggles and shoes.

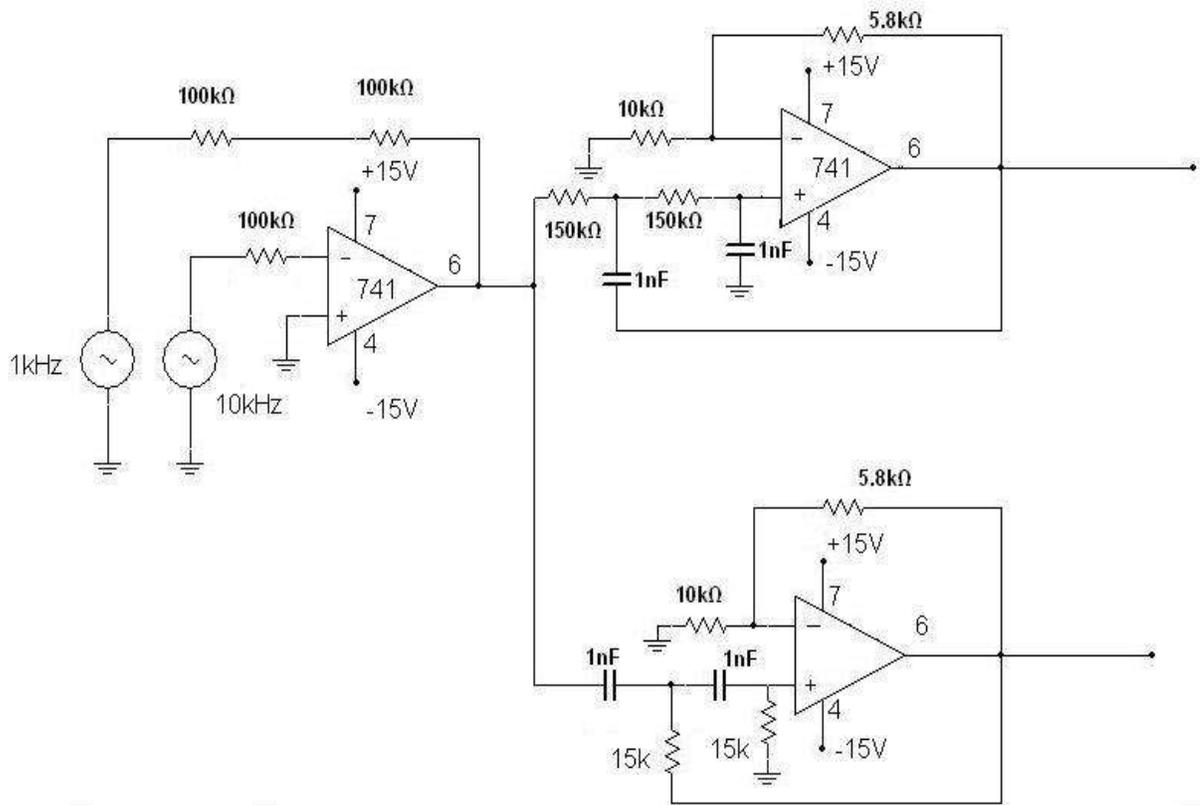
## FREQUENCY DIVISION MULTIPLEXING & DEMULTIPLEXING

### 1. Description

The setup for this experiment requires the following equipment

FDM trainer board (OR)

Name	Specification/range	Quantity	Purpose
Bread board		1	To interconnect the components on it.
Resistors	3.9K, 3K, 10K, 680K	1	To get output across it
Capacitors	0.01 $\mu$ F, 60 $\mu$ F	2,1	To filter AC
IC 555	Operating tem :SE 555 -55°C to 125°C Supply voltage :+5V to +18V	2	To generate the clock pulse
IC 741	Supply voltage :+5V to +18V	1	To invert the input signal
C.R.O	0-100 MHz	1	To observe the output waveforms
Function generator	1 Hz -100M Hz	1	To connect square wave to the selection input line
RPS	0-30v,1A	1	To regulate the bias
Connecting wires	Red, Blue single stand, suitable length		To make connections and inter connections to equipment

**2. CIRCUIT DIAGRAM****3. Theory**

When several communications channels are between the two same point's significant economics may be realized by sending all the messages on one transmission facility a process called multiplexing. Applications of multiplexing range from the vital, if prosaic, telephone networks to the glamour of FM stereo and space probe telemetry system. There are two basic multiplexing techniques

1. Frequency Division Multiplexing (FDM)
2. Time Division Multiplexing (TDM)

The principle of the frequency division multiplexing is that several input messages individually modulate the subcarriers  $f_{c1}$ ,  $f_{c2}$ , etc. after passing through LPFs to limit the message bandwidth. We show the subcarrier modulation as SSB, and it often is; but any of the CW modulation techniques could be employed or a Mixture of them. The modulated signals are then summoned to produce the baseband signal with the spectrum  $X_b(f)$ , the designation “baseband” is used here to indicate that the final carrier modulation has not yet taken place.

The major practical problem of FDM is cross talks, the unwanted coupling of one message into another. Intelligible cross talk arises primarily because of non linearity's in the system, which cause 1 message signal to appear as modulation on subcarrier. Consequently, standard practice calls for negative feedback to minimize amplifier non linearity in FDM systems

#### 4. Procedure

1. **Connections** are given as per the **circuit diagram**.
2. The **FSK** signals are obtained with **two different frequency** pair with two different FSK generators.
3. The **2 signals** are fed to op-amp which **performs adder** operation.
4. The **filter** is designed in such a way that **low frequency** signal is **passed** through the **HPF**.
5. Fixed signal is obtained will be equal to the one signal obtained from FSK modulator.

#### 5. Observations

Peak voltage,  $V_m =$  \_\_\_\_\_ (from CRO for Multiplexed & demultiplexed signals)

Multiplexed output,  $V_m =$  \_\_\_\_\_ (from CRO for Multiplexed signals)

$T =$  \_\_\_\_\_ (from CRO for Multiplexed signals)

De multiplexed output  $V_m =$  \_\_\_\_\_ (from CRO for de multiplexed signals)

$T =$  \_\_\_\_\_ (from CRO for de multiplexed signals)

#### Input signal

Sl.no	Type of signal	Amplitude	timeperiod
1	Sine wave		
2	Sine wave		

**Selection input (from function generator)**

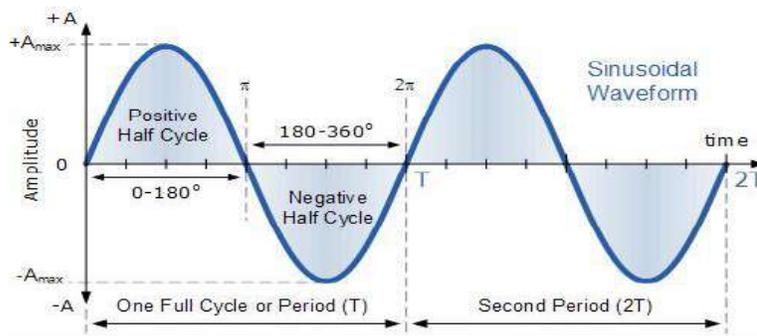
Sl.no	Type of signal	Amplitude	Time period
1	sine wave		

**Output signal**

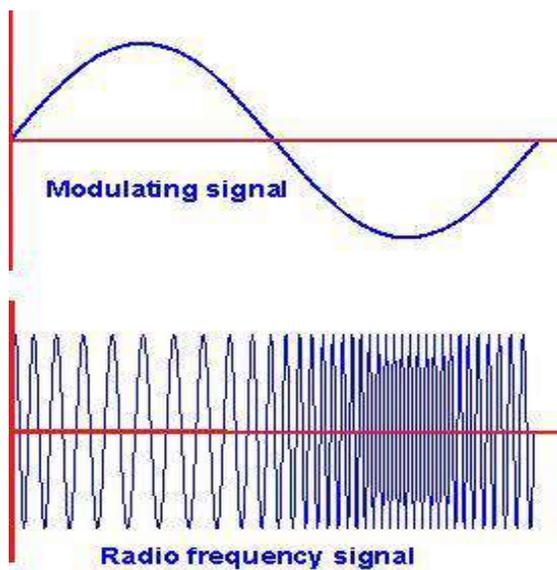
Sl.no	output	Type of signal	Amplitude	timeperiod
1	multiplexed	Multiplexed signal		
2	demultiplexed	Sine wave		
		Sine wave		

**6. Graphs**

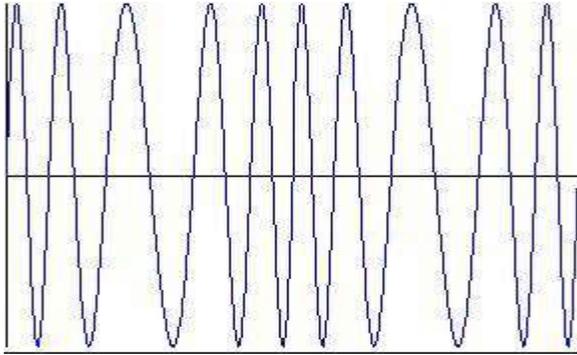
**Message signal 1**



**Message signal 2 and FM wave 1**

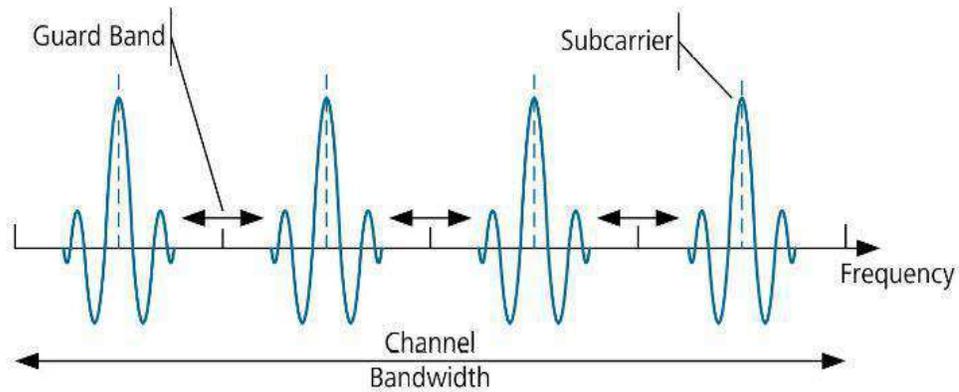


### FM Wave 2

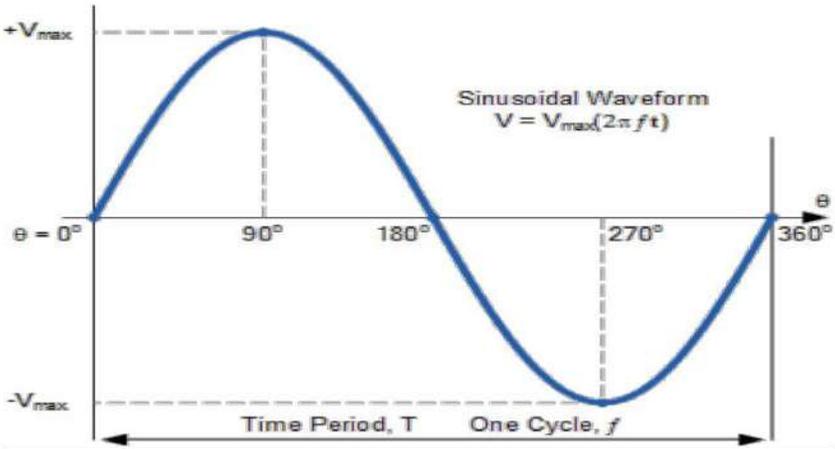
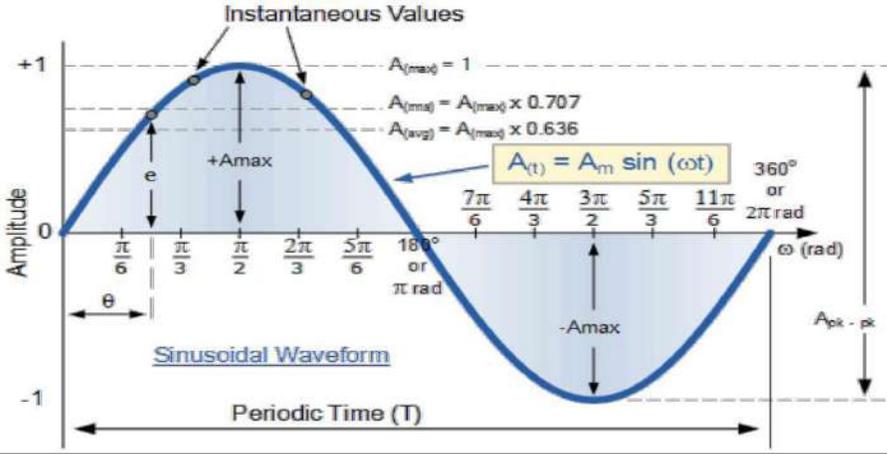


### FDM Output

## Frequency Division Multiplexing



**Demodulating Signals**



## 7. CALCULATIONS:

Amplitude = no. of vertical divisions X Volts/div

Time period = No. of horizontal divisions X time/div

Peak amplitude =  $\text{Amp}_{\text{P-P}}/2$

Frequency =  $1 / \text{time period}$

## 8. PRECAUTIONS:

### A. PROCEEDURAL PRECAUTIONS:

- Disconnect all the equipment from mains before making connections.
- Ensure the correct range of function generator
- Connect the circuit as per the circuit diagram and check for polarity.
- Get the connections checked by the concerned staff member.
- Calibrate the CRO for getting accurate result.
- Ensure that there are no loose connections.

### B. SAFETY PRECAUTIONS:

- Never work on the trainer kit while power is switched ON.
- Do not connect power to the trainer kit until the circuit connection is fixed.
- If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.
- Keep your work area dry.
- Always wear safety goggles and shoes.

**Simulation of Amplitude Modulation**

**1. Description**

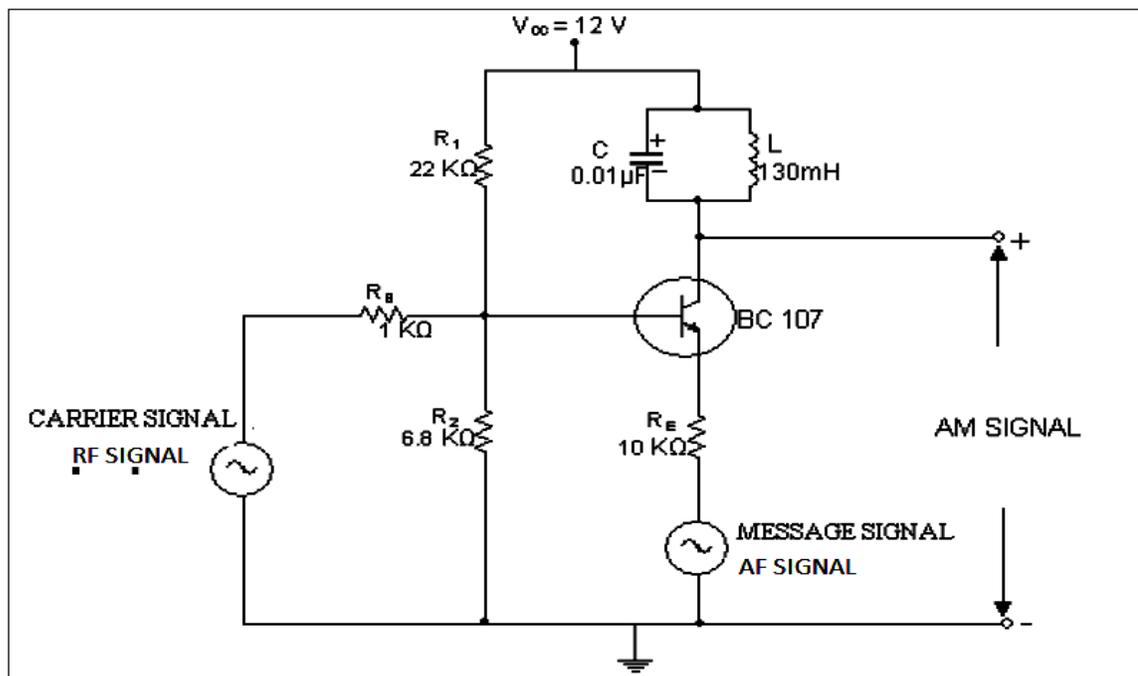
The setup for this experiment requires the following equipment

Name	Quantity	Purpose
A computer with PSPICE/MULTISIM application	1	To develop the circuit
Dual traces CRO	1	1) To observe modulating signal, carrier signal and modulated signal 2) To measure the amplitude and frequency of the signals.
AF signal generator	1	To generate Low frequency signal
RF signal generator	1	To generate high frequency signal
Patch cords	As required	To connect various circuit points

**CIRCUIT DIAGRAM**

**Modulator Block diagram**

**Modulator**



**Theory:**

Amplitude Modulation is a process in which the amplitude of the high frequency carrier wave  $c(t)$  is varied linearly with the instantaneous amplitude of the low frequency message signal  $m(t)$ .

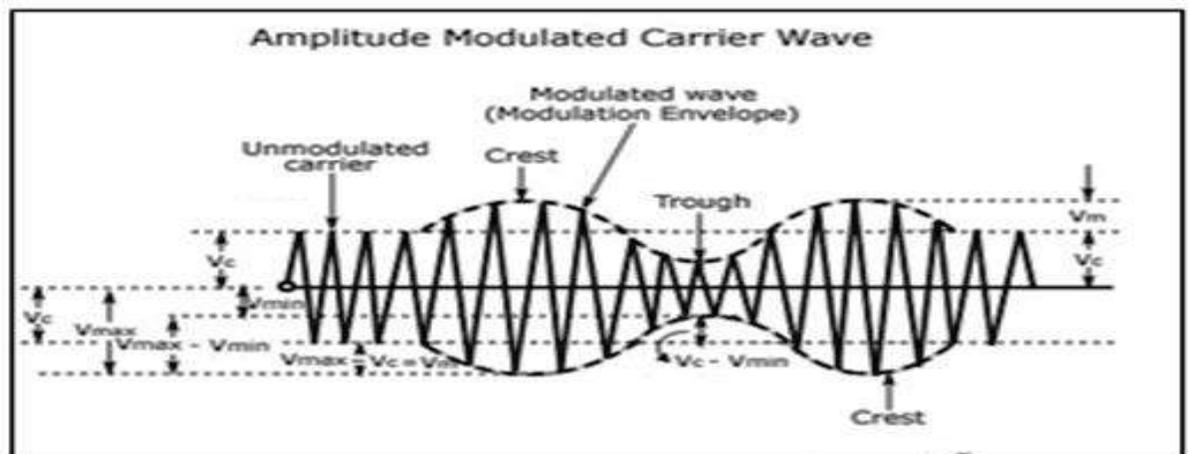
$$c(t) = V_c \sin \omega_c t$$

$$m(t) = V_m \sin \omega_m t.$$

$$s(t) = V_c(1 + m \sin \omega_m t) \sin \omega_c t.$$

$$\text{Where } m = \frac{V_m}{V_c}$$

The demodulation circuit is used to recover the message signal from the incoming AM wave at the receiver. An envelope detector is a simple and yet highly effective device that is well suited for the demodulation of AM wave, for which the percentage modulation is less than 100%. Ideally, an envelope detector produces an output signal that follows the envelope of the input signal wave form exactly



The Modulation Index of AM signal

$$m = \frac{V_{Max} - V_{Min}}{V_{Max} + V_{Min}}$$

Where  $V_{max}$  and  $V_{min}$  are the maximum and minimum amplitudes of the modulated wave.

**Procedure****Modulation:**

1. Open the PSPICE/MULTISIM software.
2. Select and drag the required components from the library.
3. Set appropriate values
4. Make the connections according to the circuit diagram.
5. Run the simulation.
6. Apply Low frequency modulating signal to the modulator from AF generator.
7. Apply High frequency carrier signal to the modulator from RF generator.
8. Observe output of RF and AF signal generator using CRO
9. Note down values of  $V_{max}$  and  $V_{min}$  of AM signal for various amplitudes of modulating signal.
10. Calculate modulation index using equation
11. Plot the graph for modulation index  $m < 1$ ,  $m = 1$  and  $m > 1$ .

**Observations**

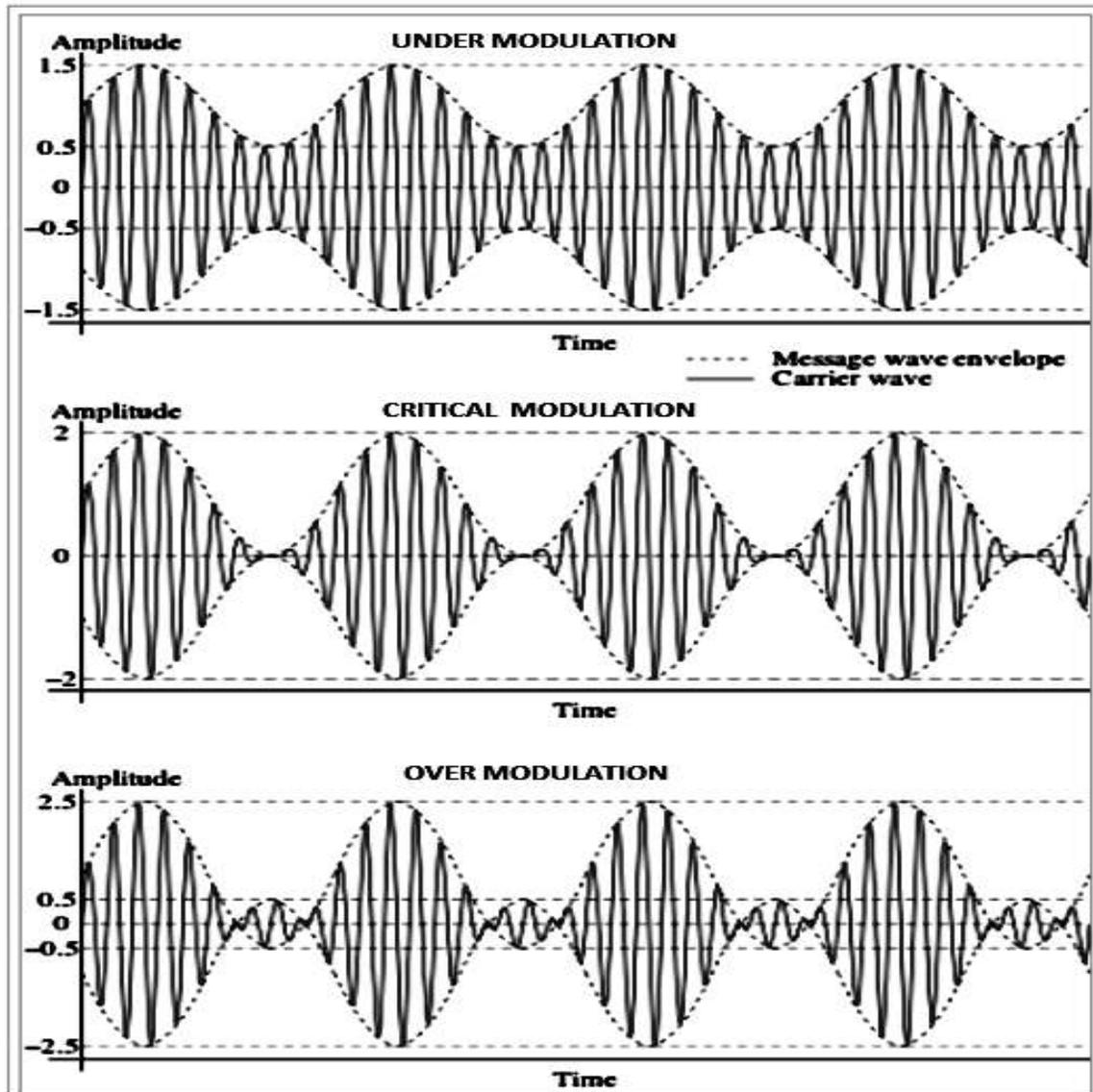
**Modulation**

Parameter	Modulating Signal	Carrier Signal
Amplitude (volts)		
Time Period (Sec)		
Frequency [Hz]		

S.No.	Modulated Signal		Modulation Index  $m = \frac{V_{Max} - V_{Min}}{V_{Max} + V_{Min}}$
	$V_{Max}$  Volts	$V_{Min}$  Volts	
1			
2			
3			

**Graphs:**

**Modulation:**



**Precautions:**

1. Handling the computer system properly.
2. Select the appropriate components from the library
3. Connections should be proper.

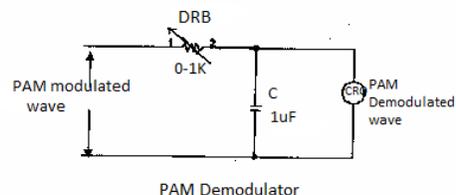
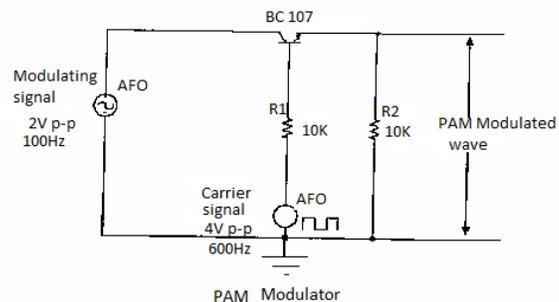
## SIMULATION OF PULSE AMPLITUDE MODULATOR AND DEMODULATOR

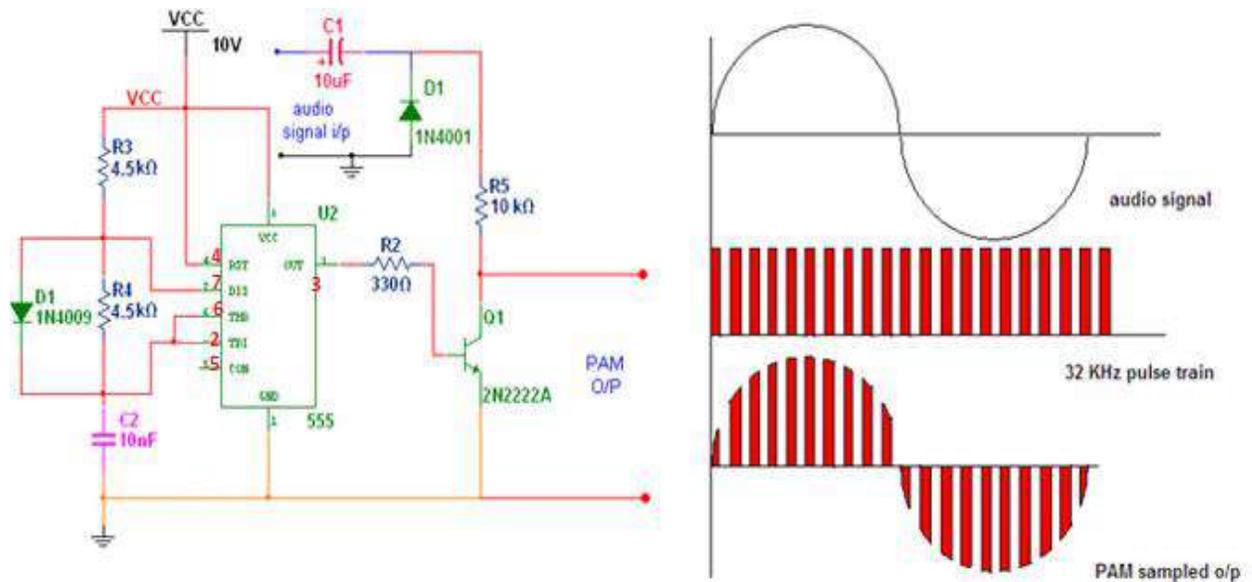
### 1. Description

The setup for this experiment requires the following equipment

Name	Specification/range	Quantity	Purpose
A computer with PSPICE/MULTISIM application	-	1	To develop the circuit
Transistor	BC 107	1	Act as a switch to allow the carrier wave when message is present
Resistor	10K $\Omega$	1	To limit the current to the transistor
Resistor	10K $\Omega$	1	To act as a load resistor for the PAM signal output
Decade resistance box	0-1K $\Omega$	1	To act as a discharge path for the capacitor
Capacitor	1 $\mu$ F	1	To allow the low frequency signal of the modulated output
C.R.O Dual channel	0-100MHz	1	To observe the input output waveforms
Multimeter		1	To measure voltages
Connecting wires			To connect the circuit components
Function generators	1MHz	2	To generate carrier and message signal

### CIRCUIT DIAGRAM1





### Theory

Pulse amplitude modulation is a scheme, which alters the amplitude of regularly spaced rectangular pulses in accordance with the instantaneous values of a continuous message signal. Then amplitude of the modulated pulses represents the amplitude of the message signal. A train of very short pulses of constant amplitude and fast repetition rate is chosen the amplitude of these carrier pulse is made to vary in accordance with that of a slower modulating signal the result is that of multiplying the carrier by the modulating signal the envelope of the pulse height corresponds to the modulating wave. To demodulate PAM waves, the signal is passed through a low pass filter having a cut off frequencies equal to the highest frequency in the modulating signal. At the output of the filter is available the modulating signal along with the DC component.

### Procedure

#### PAM modulator:

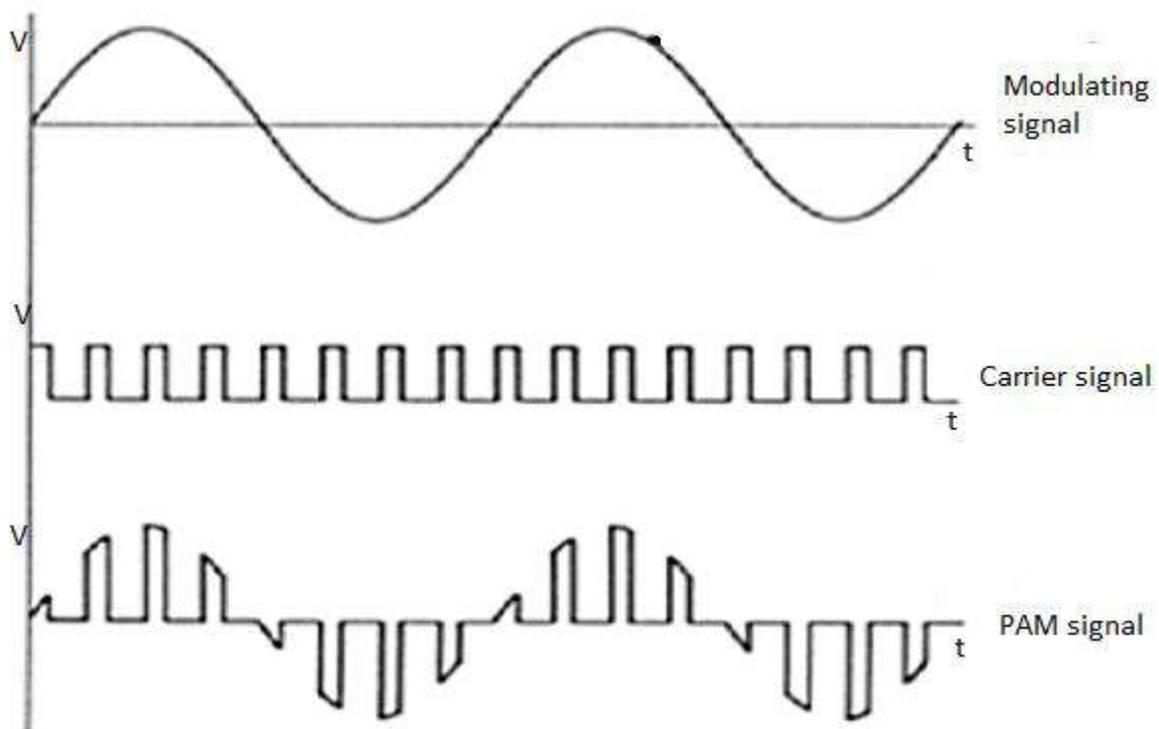
1. Open the PSPICE/MULTISIM software.
2. Select and drag the required components from the library.
3. Set appropriate values
4. Make the connections according to the circuit diagram.
5. Run the simulation.
6. Apply a square wave carrier signal of 600 Hz of 4 V<sub>p-p</sub>
7. Apply a sine wave message signal of 100Hz of 2 V<sub>p-p</sub> amplitude.
8. Observe PAM modulated waveform at the emitter of transistor and note down the amplitude and frequency values.
9. Plot the waveforms of message signal, carrier signal and PAM modulated signal with correct scaling on graph sheet.

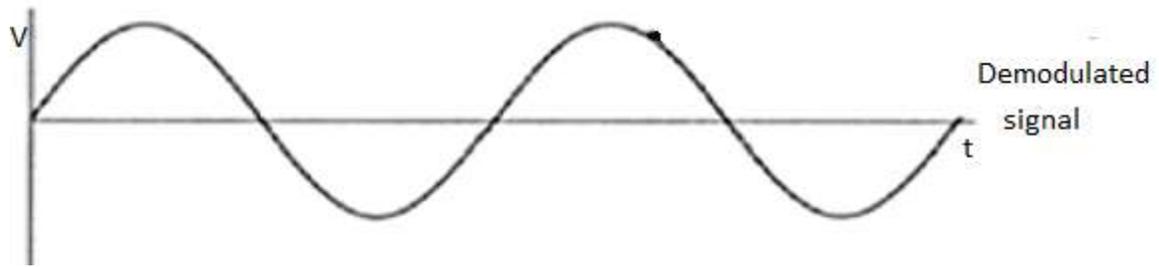
**PAM demodulator:**

1. Apply PAM modulated output to the Low pass filter circuit.
2. **Observe PAM demodulated waveform** across capacitor and **note down the amplitude and frequency values.**
3. **Compare PAM demodulated waveform** with input **message waveform.**
4. **Plot** the waveform of **PAM demodulated signal** with correct scaling on graph sheet.

**Observations:**

Parameter	Message signal	Carrier signal	PAM modulated signal	PAM demodulated signal
Amplitude (v)				
Frequency(Hz)				
Time period(sec)				

**Graphs:**

**Precautions:**

1. Handling the computer system properly.
2. Select the appropriate components from the library
3. Connections should be proper.

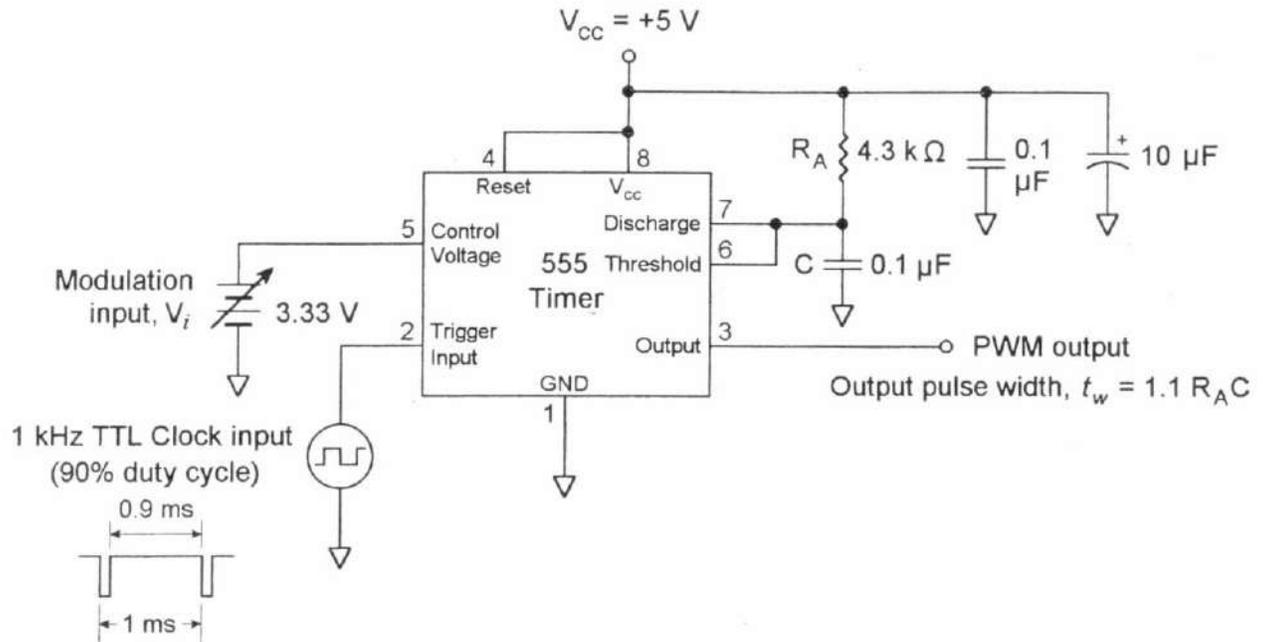
### SIMULATION OF PULSE WIDTH MODULATION AND DEMODULATION

#### 1. Description

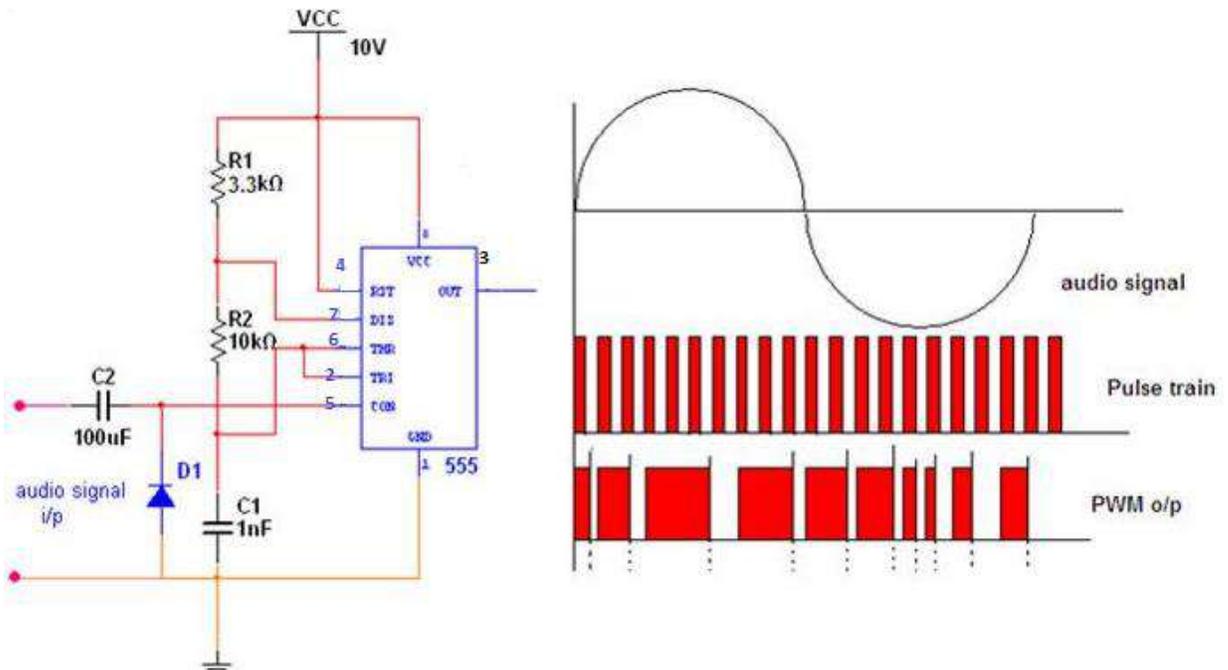
The setup for this experiment requires the following equipment

Name	Specification/range	Quantity	Purpose
A computer with PSPICE/MULTISIM application	-	1	To develop the circuit
Diodes	1N4007	1	
555 IC timer		1	
C.R.O	-	1	To observe the output waveforms
Pulse generator		1	To generate clock with 90% duty cycle
Sine wave generator		1	To generate input wave form
DC Power supplies		1	
Capacitors	100 $\mu$ f	1	
	10 $\mu$ f	1	
	0.1 $\mu$ f	2	
Resistors	4.3k $\Omega$ ( $\frac{1}{4}$ Watt resistor)	1	
Connecting wires			

**CIRCUIT DIAGRAM- PWM MODULATOR (Fig-1)**



**CIRCUIT DIAGRAM- PWM MODULATOR (Fig-2)**



**Theory**

Pulse Time Modulation is also known as Pulse Width Modulation or Pulse Length Modulation. In PWM, the samples of the message signal are used to vary the duration of the individual pulses. Width may be varied by varying the time of occurrence of leading edge, the trailing edge or both edges of the pulse in accordance with modulating wave. It is also called Pulse Duration Modulation.

**Procedure**

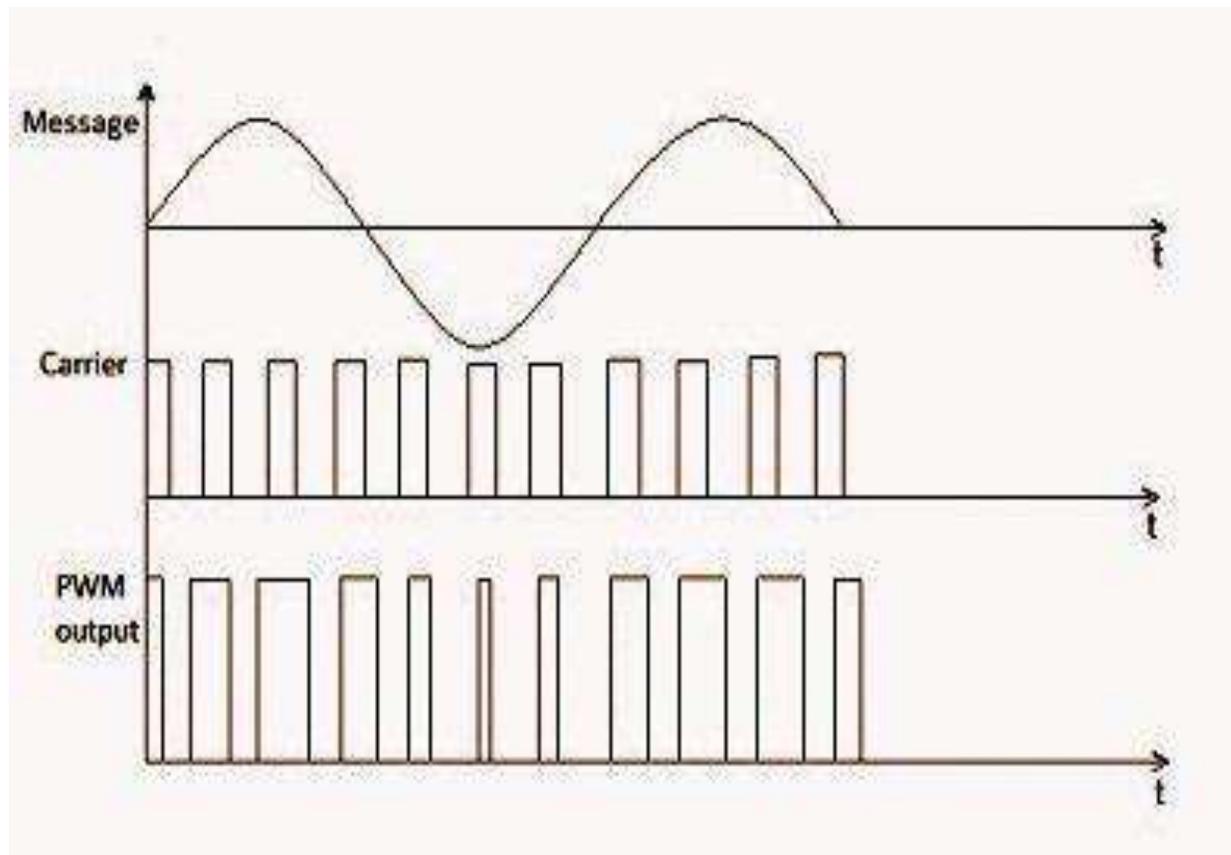
1. Open the PSPICE/MULTISIM software.
2. Select and drag the required components from the library.
3. Set appropriate values
4. Make the connections according to the circuit diagram.
5. Run the simulation.
6. Apply a trigger signal (Pulse wave) of frequency 2 KHz with amplitude of 5 v (p-p).
7. Observe the sample signal at the pin3.
8. Apply the ac signal at the pin 5 and vary the amplitude.
9. Note that as the control voltage is varied output pulse width is also varied.
10. Observe that the pulse width increases during positive slope condition & decreases under negative slope condition. Pulse width will be maximum at the +ve peak and minimum at the -ve peak of sinusoidal waveform. Record the observations.
11. Feed PWM waveform to the circuit of Fig-2. and observe the resulting demodulated waveform.

**Observations**

Measure and record the following data for  $t_w$ , based on the following values of  $V_i$ .

Use your Oscilloscope to measure  $t_w$ .



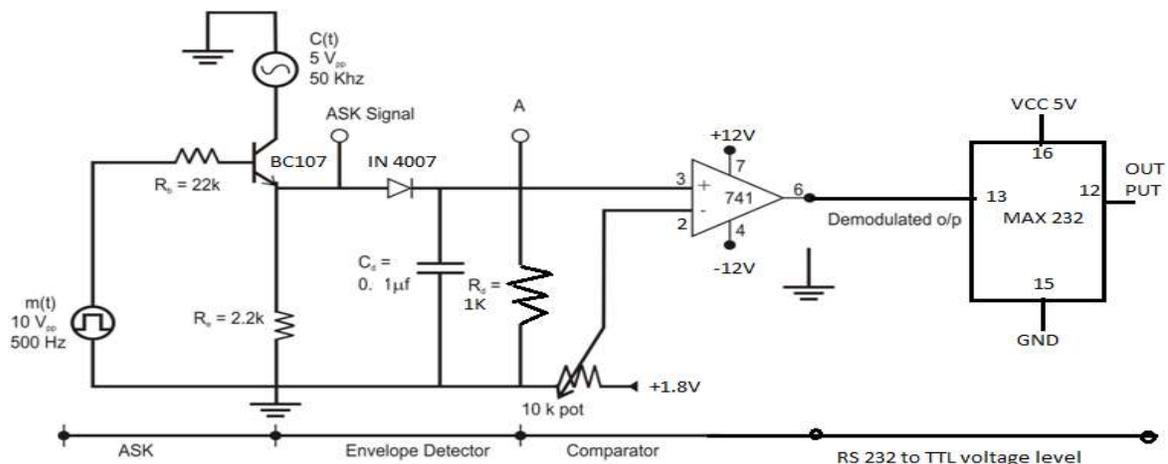
**Precautions:**

1. Handling the computer system properly.
2. Select the appropriate components from the library
3. Connections should be proper.

**SIMULATION OF ASK MODULATOR AND DEMODULATOR****1. Description**

The setup for this experiment requires the following equipment

Name	Specificatio n/range	Qua ntity	Purpose
Breadboard	-	1	To connect the components
Transistor	BC 107	1	Act as a switch to allow the carrier wave when message is present
Diode	1N4007	1	To rectify the output of the modulator
Resistor	22K $\Omega$	1	To limit the current to the transistor
Resistor	2.2K $\Omega$	1	To act as a load resistor for the ASK signal output
Resistor	1K $\Omega$	1	To act as a discharge path for the capacitor
Capacitor	0.1 $\mu$ F	1	To allow the low frequency signal of the modulated output
Op amp	IC 741	1	Used as a comparator
Potentiomet er	10K $\Omega$	1	To adjust the reference voltage for the comparator
Voltage level converter	MAX232N	1	To convert the voltage levels from RS232 to TTL
C.R.O Dual channel	0-20Mhz	1	To observe the input output waveforms
Multimeter		1	To measure voltages
Regulated power supply dual	0-30 volts	2	To give supply to the Op Amp and MAX 232 and as a reference voltage to the Op amp
Connecting wires			To connect the circuit components
Function generators	1MHz	2	To generate carrier and message signal

**CIRCUIT DIAGRAM 1**

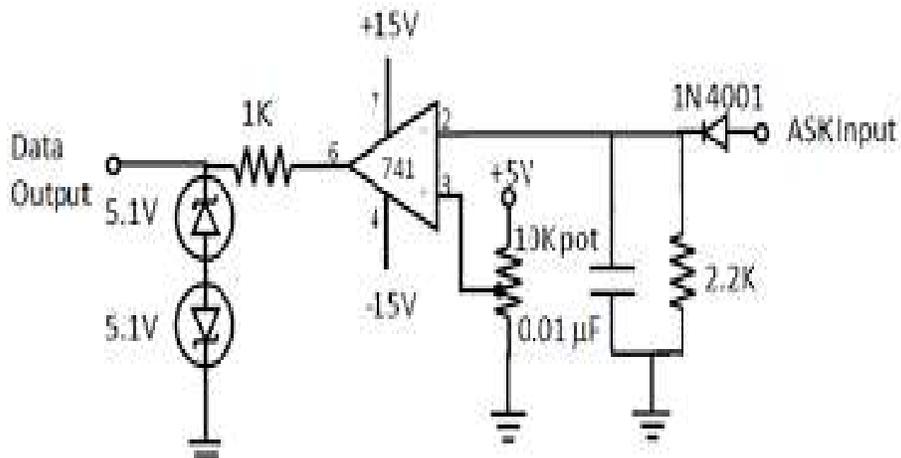
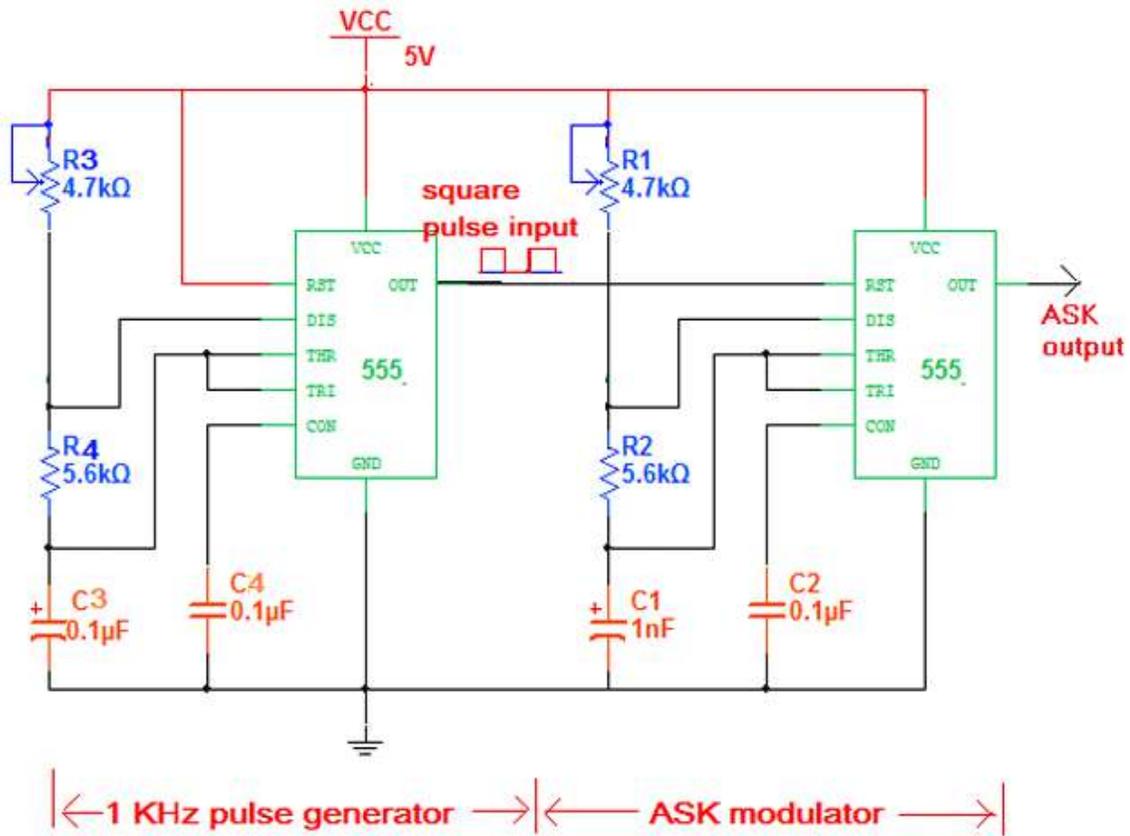


Fig.1

## Theory

### ASK Modulator:

Amplitude Shift Keying (ASK) is the digital modulation technique. In amplitude shift keying, the amplitude of the carrier signal is varied to create signal elements. Both frequency and phase remain constant while the amplitude changes. In ASK, the amplitude of the carrier assumes one of the two amplitudes dependent on the logic states of the input bit stream. These are related to the number of levels adopted by the digital message. For a binary message sequence there are two levels, one is logic 0 and another is logic 1. When the logic 1 is present in the message input then the carrier is appeared as output. When the logic 0 is present in the message input then the output is zero. This modulated signal can be expressed as:

$$x_e(t) = \begin{cases} 0 & \text{symbol "0"} \\ A \cos \omega_c t & \text{symbol "1"} \end{cases}$$

### ASK Demodulator:

Therefore, for receiver, we must convert the digital signal back to the modulating signal.

The below figure shows the ASK demodulator. When the ASK signal pass through the rectifier, we can obtain the positive half wave signal. After that the signal will pass through a low-pass filter and obtain envelope detection. Then get rid of the DC signal, the digital signal will be recurred.

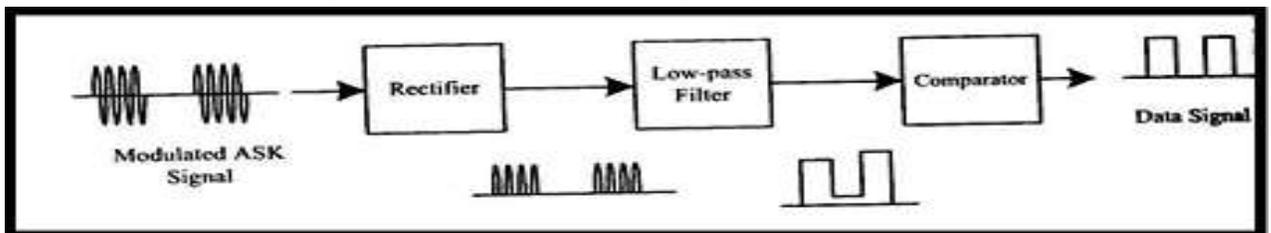


Fig.2

## Procedure

### ASK modulator:

1. Open the PSPICE/MULTISIM software.
2. Select and drag the required components from the library.
3. Set appropriate values
4. Make the connections according to the circuit diagram.
5. Run the simulation.
6. **Apply a square wave message signal of 500 Hz of 10VP-P**
7. **Apply a sine wave carrier signal of 50 kHz of 5VP-P amplitude.**
8. **Observe ASK modulated waveform** at the emitter of transistor and **note down the amplitude and frequency values.**
9. **Plot the waveforms of message signal, carrier signal and ASK modulated signal** with correct scaling on graph sheet.

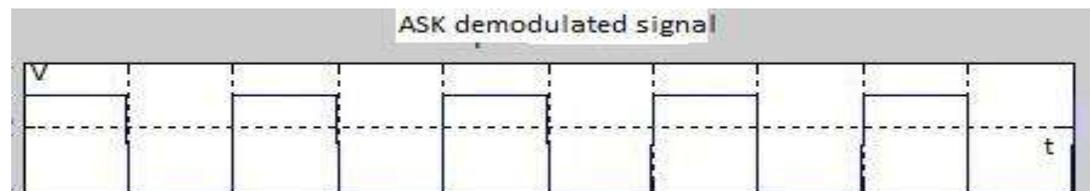
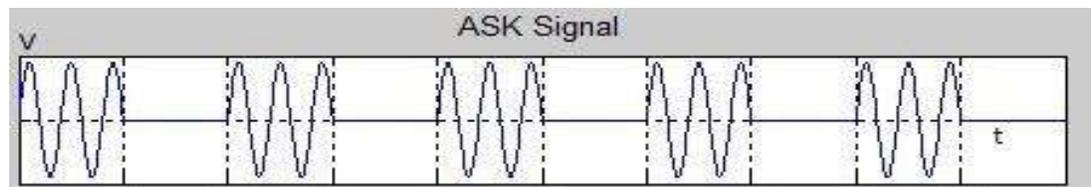
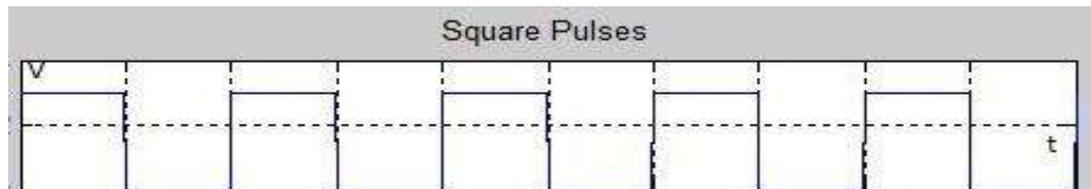
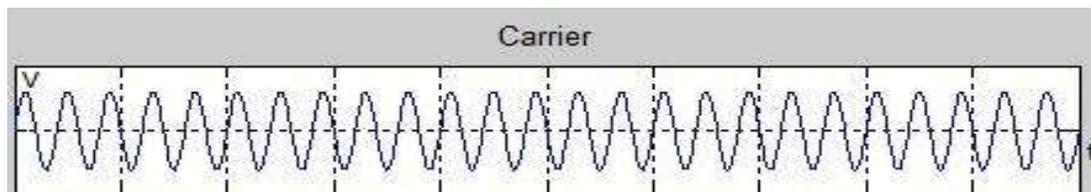
**ASK demodulator:**

1. Apply ASK modulated output to the envelop detector circuit.
2. **Observe ASK demodulated waveform at the IC MAX 232 pin number 12 and note down the amplitude and frequency values.**
3. **Compare ASK demodulated waveform with input message waveform.**
4. **Plot the waveform of ASK demodulated signal with correct scaling on graph sheet.**

**Observations:**

Parameter	Message signal	Carrier signal	ASK modulated signal	ASK demodulated signal
Amplitude (v)				
Frequency(Hz)				
Time period(sec)				

**Graphs**



**PROCEDURAL PRECAUTIONS:**

- Disconnect all the equipment from mains before making connections
- Connect the circuit as per the circuit diagram and check for polarity
- Get the connections checked by the concerned staff member
- Calibrate the CRO for getting accurate result
- Ensure that there are no loose connections
- Capacitor should be connecting with proper polarity
- IC's should be connecting according to their pin description
- Calibrate the RPS for getting accurate result.

**B. SAFETY PRECAUTIONS:**

- Never work on a circuit while power is applied.
- Do not connect power to a circuit until the circuit is finished and you have carefully checked your work.
- If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.
- Keep your work area dry.

## SIMULATION OF FSK Modulation and Demodulation

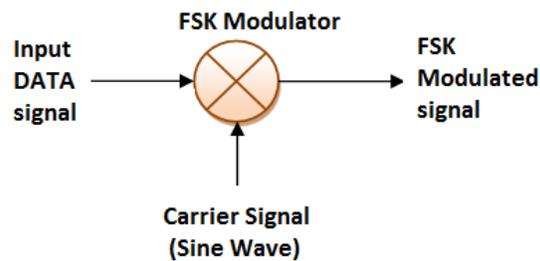
### 1. Description

The setup this experiment requires the following equipment

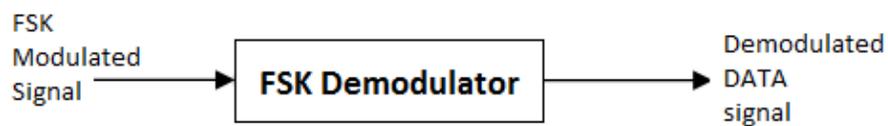
Name	Specification/range	Quantity	Purpose
A computer with PSPICE/MULTISIM application		1	To develop the circuit
C R O	0-30MHz	1	To observe the corresponding waveforms
C R O Probes	1X	2	To make interconnection between test points and CRO
Patch Chords	---	10	To make connections in Trainer Kit.

### 2.Circuit Diagram :

#### FSK Modulation :



#### FSK Demodulation :



### **3.Theory**

Frequency-shift keying (FSK) is a frequency modulation scheme in which digital information is transmitted through discrete frequency changes of a carrier signal.<sup>[1]</sup> The technology is used for communication systems such as telemetry, weather balloon radiosondes, caller ID, garage door openers, and low frequency radio transmission in the VLF bands. The simplest FSK is binary FSK (BFSK). BFSK uses a pair of discrete frequencies to transmit binary (0s and 1s) information. With this scheme, the "1" is called the mark frequency and the "0" is called the space frequency.

### **4.Procedure**

#### **FSK Modulation :**

1. Open the PSPICE/MULTISIM software.
2. Select and drag the required components from the library.
3. Set appropriate values
4. Make the connections according to the circuit diagram.
5. Run the simulation.
6. Switch ON the power supply of trainer Kit.
7. Check the wave forms of DATA and Carrier signals (also set required frequency and amplitude) using CRO.
8. Give the Connections as per the circuit diagram given.
9. Observe the Modulated signal at corresponding point using CRO.

#### **FSK Demodulation :**

1. Connect FSK Modulated output to FSK demodulator input.
2. Observe the DATA signal at the corresponding output terminal using CRO.
3. Verify that the received DATA signal is same as transmitted one.

## 5.Observations

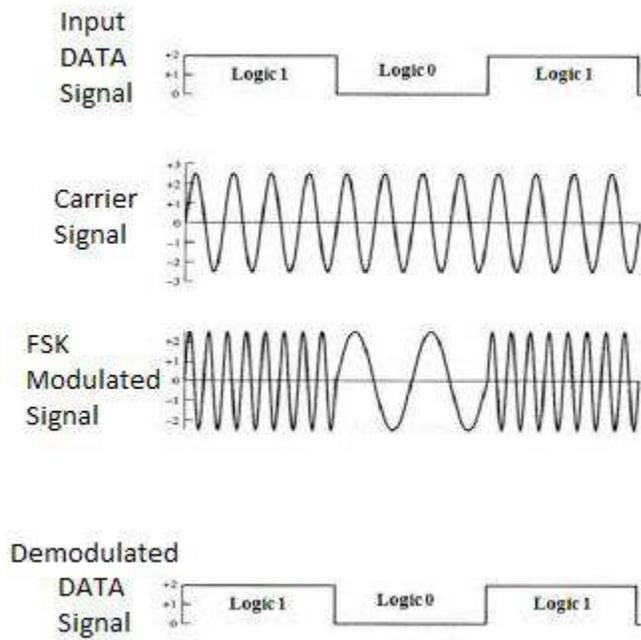
### Modulation:

<b>Input DATA signal</b>	<b>Amplitude :</b> volts	
	<b>TimePeriod :</b> Sec	
	<b>Frequency :</b> Hz	
<b>Carrier Signal</b>	<b>Amplitude :</b> volts	
	<b>TimePeriod :</b> Sec	
	<b>Frequency :</b> Hz	
<b>Modulated Signal</b>	<b>Amplitude :</b> volts	
	<b>For '0' data input</b>	<b>TimePeriod :</b> Sec
		<b>Frequency :</b> Hz
	<b>For '1' data input</b>	<b>TimePeriod :</b> Sec
		<b>Frequency :</b> Hz

**Demodulation :**

<b>Demodulated DATA signal</b>	<b>Amplitude :</b>	<b>volts</b>
	<b>TimePeriod :</b>	<b>Sec</b>
	<b>Frequency :</b>	<b>Hz</b>

**6.Graphs:**



**7.Calculations :**

- Amplitude (peak to Peak ) = No.of Vertical Divisions X volts/div

=

- Peak Amplitude =  $\frac{\text{Amplitude (peak to Peak )}}{2}$

=

- Time Period = No.of Horizontal divisions X Time/div

=

- Frequency =  $\frac{1}{\text{TimePeriod}}$  =

**10. Precautions:**

1. Handling the computer system properly.
2. Select the appropriate components from the library
3. Connections should be proper.

**UNIT TEST –I**  
**Model Question Paper (C-20)**  
**EC-309 Analog and Digital Communication Systems Lab**

TIME: 3 hours

Total Marks: 60

- Instructions: (1) Any one full question of the following shall be allotted to the students on lottery basis.  
(2) All the questions are competency based and are for assessing the candidate's psychomotor skills  
(3) Underpinning knowledge shall be assessed through **viva voce** -6 M

1. A. Identify the major sections in the FM trainer board. 9M (CO1)  
B. Make the connections on the trainer board to observe the PCM waveform on CRO. 10 M (CO2)  
C. Observe the AM waveform and calculate percentage of modulation using CRO 30M (CO1)
2. A. Identify the major sections in the PAM trainer board. 9M (CO1)  
B. Make the connections on the trainer board to observe the ASK waveform on CRO. 15M (CO2)  
C. Observe Frequency Modulation wave forms and calculate modulation index. 30M (CO1)
3. A. Identify the major sections in the FM trainer board. 9M (CO1)  
B. Make the connections on the trainer board to observe the FSK waveform on CRO. 15M (CO2)  
C. Observe Pulse Amplitude Modulation waveform on CRO. 30M (CO1)
4. A. Identify the major sections in the PAM trainer board. 9M (CO1)  
B. Make the connections on the trainer board to observe the FSK waveform on CRO. 15M (CO2)  
C. . Observe Pulse Width Modulation and Demodulation waveforms on CRO. (CO1)

5. A. . Identify the major sections in the FSK trainer board. 9M (CO2)
- B. Make the connections on the trainer board to observe the AM waveform on CRO. 15M (CO1)
- C. . Observe Pulse Position Modulation and demodulation waveforms on CRO.30M (CO1)
6. A. . Identify the major sections in the FM trainer board. 9M (CO1)
- B. Make the connections on the trainer board to observe the ASK waveform on CRO. 15M (CO2)
- C. . Observe Pulse Code Modulation and demodulation waveforms on CRO.30M (CO2)
7. A. . Identify the major sections in the PCM trainer board. 9M (CO2)
- B. Make the connections on the trainer board to observe the PAM Demodulation waveform on CRO. 15M (CO1)
- C. . Set up FSK Modulator, demodulator and observe waveforms on CRO.30M (CO2)
8. A. . Identify the components in AM trainer board. 9M (CO1)
- B. Make the connections on the trainer board to observe the PAM Demodulation waveform on CRO. 15M (CO1)
- C. . Set up FSK Modulator, demodulator and observe waveforms on CRO.30M (CO2)

**UNIT TEST –II**  
**Model Question Paper (C-20)**  
**EC-309 Analog and Digital Communication Systems Lab**

TIME: 3 hours

Total Marks: 60

- Instructions: (1) Any one full question of the following shall be allotted to the students on lottery basis.  
(2) All the questions are competency based and are for assessing the candidate's psychomotor skills  
(3) Underpinning knowledge shall be assessed through **Viva- Voce** -6 M

- |    |   |      |       |
|----|---|------|-------|
| 1. | A. Identify the major sections in PSK trainer board.  | 9M   | (CO2) |
|    | B. Connect AM circuit using PSPICE.   | 15 M | (CO3) |
|    | C. Perform an experiment on TDM circuit and observe the waveforms on CRO.                       | 30M  | (CO2) |
| 2. | A. Identify the major sections in the FDM trainer board.  | 9M   | (CO2) |
|    | B. Construct PWM circuit using PSPICE   | 15M  | (CO3) |
|    | C. Simulate ASK Modulator, demodulator circuits using PSPICE and observe waveforms on CRO       | 30M  | (CO4) |
| 3. | A. Select and Drag the components required to construct PAM modulator from the PSPICE Library.  | 9M   | (CO3) |
|    | B. Make the connections on the trainer board to construct Time Division Demultiplexing circuit. | 15M  | (CO2) |
|    | C. Simulate FSK Modulator, demodulator circuits using PSPICE and observe waveforms on CRO       | 30M  | (CO4) |
| 4. | A. Identify the major sections in the FDM trainer board.  | 9M   | (CO2) |
|    | B. Construct PAM circuit using PSPICE   | 15M  | (CO3) |
|    | C. Simulate PSK Modulator, demodulator and observe waveforms on CRO.                            | 30M  | (CO2) |

5. A. Identify the major sections in the TDM demultiplexer trainer board. 9M (CO2)
- B. Make the connections on the trainer board to observe the PSK demodulated Waveform on CRO. 15M (CO2)
- C. Connect a circuit to generate AM waveform using PSPICE and Determine Modulation index. 30M (CO3)
6. A. Select the components required to construct PAM modulator from the PSPICE Library. 9M (CO3)
- B. Make the connections on the trainer board to observe the PSK modulated waveform and trace the waveform. 15M (CO2)
- C. Connect a circuit to generate PWM waveform using PSPICE. 30M (CO3)
7. A. Select and drag the components required to construct FSK demodulator on the work space using PSPICE 9M (CO4)
- B. Connect Frequency Division Demultiplexing circuit and observe the channel signals on CRO. 15M (CO2)
- C. Connect a circuit to generate PWM waveform using PSPICE and observe the Waveforms. 30M (CO3)
8. A. Select the components required to construct ASK demodulator from the PSPICE. 9M (CO4)
- B. Connect Time Division Demultiplexing Circuit and observe the message signals at the output 15M (CO2)
- C. Perform an experiment on FDM circuit and observe the waveforms on CRO. 30M (CO2)

**END EXAMINATION**  
**Model Question Paper (C-20)**  
**EC-309 Analog and Digital Communication Systems Lab**

TIME: 3 hours

Total Marks: 60

- Instructions: (1) Any one full question of the following shall be allotted to the students on lottery basis.  
(2) All the questions are competency based and are for assessing the candidate's psychomotor skills  
(3) Underpinning knowledge shall be assessed through **viva voce** -6 M

1. A. Identify the major sections in the FM trainer board. 9M (CO1)  
B. Make the connections on the trainer board to observe the PCM waveform on CRO. 10 M (CO2)  
C. Simulate ASK Modulator circuit using PSPICE and observe waveforms 30M (CO4)
2. A. Identify the major sections in the PAM trainer board. 9M (CO1)  
B. Make the connections on the trainer board to observe the ASK waveform on CRO. 15M (CO2)  
C. Observe Frequency Modulation wave forms and calculate modulation index. 30M (CO1)
3. A. Identify the major sections in the FM trainer board. 9M (CO1)  
B. Construct PWM circuit using PSPICE 15M (CO4)  
C. Observe Pulse Amplitude Modulation waveform on CRO. 30M (CO1)
4. A. Identify the major sections in the PAM trainer board. 9M (CO1)  
B. Make the connections on the trainer board to observe the FSK waveform on CRO. 15M (CO2)  
C. . Observe Pulse Width Modulation and Demodulation waveforms on CRO. (CO1)

5. A. Select and drag the components required for FSK modulator on workspace.9M  
(CO4)
- B. Make the connections on the trainer board to observe the AM waveform on  
CRO. 15M (CO1)
- C. . Observe Pulse Position Modulation and demodulation waveforms on CRO.30M (CO1)
6. A. . Identify the major sections in the FM trainer board. 9M (CO1)
- B. Make the connections on the trainer board to observe the ASK waveform on  
CRO. 15M (CO2)
- C. . Observe Pulse Code Modulation and demodulation waveforms on CRO.30M (CO2)
7. A. . Identify the major sections in the PCM trainer board. 9M (CO2)
- B. Make the connections on the trainer board to observe the PAM Demodulation  
waveform on CRO. 15M (CO1)
- C. Set up FSK Modulator, demodulator and observe waveforms on CRO.30M (CO2)
8. A. Identify the components in AM trainer board. 9M (CO1)
- B. Make the connections on the trainer board to observe the PAM Demodulation  
waveform on CRO. 15M (CO1)
- C. Set up FSK Modulator, demodulator and observe waveforms on CRO.30M (CO2)
9. A. Identify the major sections in PSK trainer board. 9M (CO2)
- B. Connect AM circuit using PSPICE. 15 M (CO3)
- C. Perform an experiment on TDM circuit and observe the waveforms  
on CRO. 30M (CO2)
10. A. Identify the major sections in the FDM trainer board. 9M (CO2)
- B. Construct PWM circuit using PSPICE 15M (CO3)
- C. Simulate ASK Modulator circuit using PSPICE and observe waveforms 30M (CO4)

11. A. Select and Drag the components required to construct PAM modulator from the  
PSPICE Library. 9M (CO3)
- B. Make the connections on the trainer board to construct Time Division  
Demultiplexing circuit. 15M (CO2)
- C. Simulate FSK Modulator, demodulator circuits using PSPICE and observe waveforms on  
CRO 30M (CO4)
12. A. Identify the major sections in the FDM trainer board. 9M (CO2)
- B. Construct PAM circuit using PSPICE 15M (CO3)
- C. Simulate PSK Modulator, demodulator and observe waveforms on CRO. 30M (CO2)
13. A. Identify the major sections in the TDM demultiplexer trainer board. 9M (CO2)
- B. Make the connections on the trainer board to observe the PSK demodulated  
Waveform on CRO. 15M (CO2)
- C. Connect a circuit to generate AM waveform using PSPICE and Determine  
Modulation index. 30M (CO3)
14. A. Select the components required to construct PAM modulator from the PSPICE  
Library. 9M (CO3)
- B. Make the connections on the trainer board to observe the PSK modulated  
waveform and trace the waveform. 15M (CO2)
- C. Connect a circuit to generate PWM waveform using PSPICE. 30M (CO3)
15. Identify the component used in the PWM demodulator 9M (CO1)
- B. Connect Frequency Division Demultiplexing circuit and observe the channel signals  
on CRO. 15M (CO2)

C. Connect a circuit to generate PWM waveform using PSPICE and observe the Waveforms. 30M (CO3)

16. A. Select the components required to construct ASK demodulator from the PSPICE.

9M (CO4)

B. Connect PCM modulator Circuit and observe the message signals at the output 15M (CO2)

C. Perform an experiment on FDM circuit and observe the waveforms on CRO. 30M (CO2)