I

Name ______________________________

Roll No. ____________ Year 20 ______ 20 ______

Exam Seat No. ______________________

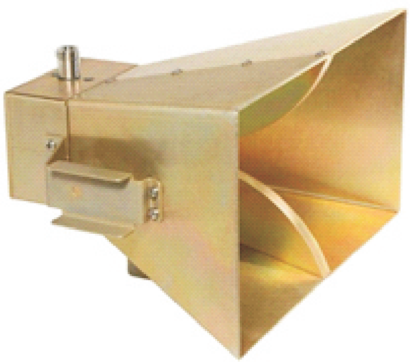
ELECTRONICS GROUP | SEMESTER - III | DIPLOMA IN ENGINEERING AND TECHNOLOGY

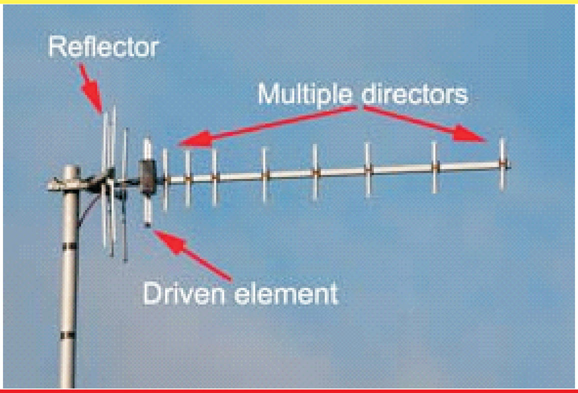
A LABORATORY MANUAL

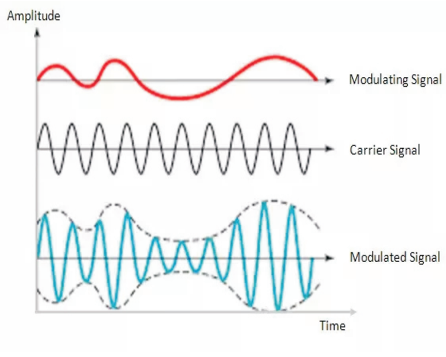
FOR

PRINCIPLES OF ELECTRONICS COMMUNICATION

(22334)







MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

(Autonomous) (ISO 9001 : 2015) (ISO / IEC 27001 : 2013)

VISION

To ensure that the Diploma level Technical Education constantly matches the latest requirements of technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the changing technological and environmental challenges.

QUALITY POLICY

We, at MSBTE are committed to offer the best in class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation, evaluation and monitoring system along with adequate faculty development programmes.

CORE VALUES

MSBTE believes in the followings:

- Education industry produces live products.
- Market requirements do not wait for curriculum changes.
- Question paper is the reflector of academic standards of educational organization.
- Well designed curriculum needs effective implementation too.
- Competency based curriculum is the backbone of need based program.
- Technical skills do need support of life skills.
- Best teachers are the national assets.
- Effective teaching learning process is impossible without learning resources.

A Laboratory Manual

for

Principles of Electronics Communication

(22334)

Semester-III

(EJ/ET/EN/EX/EQ)

Maharashtra State

Board of Technical Education, Mumbai

(Autonomous) (ISO:9001:2015) (ISO/IEC 27001:2013)

Maharashtra State Board of Technical Education,
(Autonomous) (ISO:9001:2015) (ISO/IEC 27001 : 2013)
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Bandra (East), Mumbai - 400051.
(Printed on June, 2018)

MAHARASHTRA STATE

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Certificate

This is to certify that Mr. / Ms. …………………………………………..……… Roll No. ……………….…., of Third Semester of Diploma in ……………………..………………………………………………… of Institute, ……………..……………………….……………………………………………..… (Code: …………...) has completed the term work satisfactorily in course **Principles of Electronics Communication (22334)** for the academic year 20…….. to 20…….. as prescribed in the curriculum.

Place: …………… Enrollment No:.……………

Date: …………… Exam. Seat No: ……………

Subject Teacher **Head of the Department** **Principal**

Seal of Institution

Preface

The primary focus of any engineering laboratory/field work in the technical education system is to develop the much needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'I' Scheme curricula for engineering diploma programmes with outcome-based education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making each teacher; instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome-based curriculum, every practical has been designed to serve as a 'vehicle' to develop this industry identified competency in every student. The practical skills are difficult to develop through 'chalk and duster' activity in the classroom situation. Accordingly, the 'I' scheme laboratory manual development team designed the practical to focus on the outcomes, rather than the traditional age old practice of conducting practical to 'verify the theory' (which may become a byproduct along the way).

This laboratory manual is designed to help all stakeholders, especially the students, teachers and instructors to develop in the student the pre-determined outcomes. It is expected from each student that at least a day in advance, they have to thoroughly read through the concerned practical procedure that they will do the next day and understand the minimum theoretical background associated with the practical. Every practical in this manual begins by identifying the competency, industry relevant skills, course outcomes and practical outcomes which serve as a key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and necessary precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This manual also provides guidelines to teachers and instructors to effectively facilitate student-centered lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students.

In the 21st century electronic communication plays vital role in every aspect of human life. Diploma Engineers (also called technologists) have to deal with the various electronic communication circuits while maintaining electronics communication systems. The study of basic operating principles and handling of various electronics communication system will help them to troubleshoot and maintain electronics communication systems used for various type of communication. This course is developed in such a way that, students will be able to apply the domain knowledge to solve broad communication engineering application problems in electronic communication engineering field.

Although best possible care has been taken to check for errors (if any) in this laboratory manual, perfection may elude us as this is the first edition of this manual. Any errors and suggestions for improvement are solicited and highly welcome.

Programme Outcomes (POs) to be achieved through Practical of this Course

Following programme outcomes are expected to be achieved through the practical of the course:

PO 1. Basic knowledge: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.

PO 2. Discipline knowledge: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems

PO 3. Experiments and practice: Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems

PO 4. Engineering tools: Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.

PO 5. The engineer and society: Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in field of Electronics and Telecommunication engineering.

PO 6. Environment and sustainability: Apply Electronics and Telecommunication engineering solutions also for sustainable development practices in societal and environmental contexts

PO 7. Ethics: Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of Electronics and Telecommunication engineering

PO 8. Individual and team work: Function effectively as a leader and team member in diverse/ multidisciplinary teams

PO 9. Communication: Communicate effectively in oral and written form.

PO 10. Life-long learning: Engage in independent and life-long learning activities in the context of technological changes also in the Electronics and Telecommunication engineering and allied industry

Program Specific Outcomes (PSO) :-

PSO 1. Electronics and Telecommunication Systems: Maintain various types of Electronics and Telecommunication systems.

PSO 2. EDA Tools Usage: Use EDA tools to develop simple Electronics and Telecommunication engineering related circuits.

Practical- Course Outcome matrix

Course Outcomes (COs)

a. Use relevant frequency range for different communication systems.
b. Use relevant modulation technique for the specified application.
c. Maintain transmitter and receiver circuits of AM and FM.
d. Use relevant media for transmission and reception of signals.
e. Use relevant type of antenna for various applications.

S. No.	Practical Outcomes	CO a.	CO b.	CO c.	CO d.	CO e.
1.	Use simple wires, switches and LEDs to establish simplex and half duplex communication link	√	-	-	-	-
2.	Use simple wires, switches and LEDs to establish full duplex communication link	√	-	-	-	-
3.	Observe the AM modulated waveforms generated for different carrier frequencies.	-	√	√	-	-
4.	Generate AM wave and measure its modulation index .	-	√	√	-	-
5.	Use any simulation software to generate AM wave.	-	√	-	-	-
6.	Use voltage controlled oscillator to generate FM wave and measure the frequency deviation.	-	√	√	-	-
7.	Generate FM wave and measure its modulation index.	-	√	√	-	-
8.	Use any simulation software to generate FM wave.	-	√	-	-	-
9.	Use AM demodulator circuit to detect the received AM signal.	-	-	√	-	-
10.	Use IC 566 to generate FM waveform and measure modulation index	-	-	√	-	-
11.	Use IC 564 / IC 565for FM demodulation and trace its input and output waveforms.	-	-	√	-	-

12.	Use any simulation software to measure 1. MUF for the given critical frequency and incident angle. 2. Radio horizon for given height of transmitting and receiving antenna	-	-	-	√	-
13.	Use field meter to plot the radiation pattern of the given dipole antenna.	-	-	-	-	√
14.	Use field meter to plot the radiation pattern of given Yagi-Uda antenna.	-	-	-	-	√
15.	Use any simulation software to plot radiation pattern of the given type of antenna.	-	-	-	-	√

List of Industry Relevant Skills

The following industry relevant skills of the competency "**Maintain basic Electronic Communication Systems**" are expected to be developed in the student by undertaking the practical of this laboratory manual.

1. Identify the electronic communication system.
2. Interpret waveforms of different electronic communication system
3. Select the proper electronic communication system as per the requirement.
4. Compare the observed output with the expected output.

Guidelines to Teachers

1. Teacher is expected to refer complete curriculum document and follow guidelines for implementation before start of curriculum.
2. Teacher should at every beginning make the students acquainted with any of the given simulation software environment as few experiments are based on simulation.
3. Teacher should provide the guideline with demonstration of practical to the students with all features.
4. Teacher shall explain prior concepts to the students before starting of each practical
5. Involve students in performance of each experiment.
6. Teacher should ensure that the respective skills and competencies are developed in the students after the completion of the practical exercise.
7. Teachers should give opportunity to students for hands on experience after the demonstration.
8. Teacher is expected to share the skills and competencies to be developed in the students.
9. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected the students by the industry.
10. Finally give practical assignment and assess the performance of students based on task assigned to check whether it is as per the instructions.
11. If practical is in two parts -Part I and Part II it should be conducted in two weeks.
12. Teacher is expected to refer complete curriculum document and follow guidelines for implementation

Instructions for Students

1. Listen carefully the lecture given by teacher about course, curriculum, learning structure, skills to be developed.
2. Before performing the practical student shall read lab manual of related practical to be conducted.
3. For incidental writing on the day of each practical session every student should maintain a dated log book for the whole semester, apart from this laboratory manual which s/he has to submit for assessment to the teacher.
4. Organize the work in the group and make record of all observations.
5. Students shall develop maintenance skill as expected by industries.
6. Student shall attempt to develop related hand-on skills and gain confidence.
7. Student shall develop the habits of evolving more ideas, innovations, skills etc. those included in scope of manual
8. Student shall refer technical magazines, IS codes and data books.
9. Student should develop habit to submit the practical on date and time.
10. Student should well prepare while submitting write-up of exercise.

Content Page

List of Practicals and Progressive Assessment Sheet

- **To be transferred to Proforma of CIAAN-2017**.

Practical No.1: Establish simplex and half duplex communication link

I Practical Significance:

A radio station usually sends signals to the audience but never receives signals from them, thus a radio station is a simplex channel. Walky-talky is a typical half duplex device as in this communication is possible in both direction but not simultaneously. This practical is designed to explain how data flows in simplex and half duplex system.

II Relevant Program Outcomes (POs)

1. **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
2. **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
4. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
5. **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry-identified Competency: **'*Maintain Basic Electronic Communication Systems*'**

1. Components (LED, switch) identification skill.
2. Mount the components on breadboard and test.
3. Use DC Power supply to provide supply to the test circuit.

IV Relevant Course Outcomes

Use relevant frequency range for different communication systems.

V Practical Outcome

Use simple wires, switches and LEDs to establish simplex and half duplex communication link.

VI Relevant Affective domain unrelated Outcome(s)

1. Follow safe practices.
2. Handle instruments carefully.

VII Minimum Theoretical Background

A simplex communication link can transmit data only in one direction as shown in Fig.1.1, this happens because the communication channel is only used by transmitter. In the figure-1.1 Terminal A is a transmitter and terminal B is receiver. As shown in figure 1.1 Terminal A is sending data towards terminal B and terminal B is only receiving the data.

Example: A mouse sending data to CPU is simplex communication.

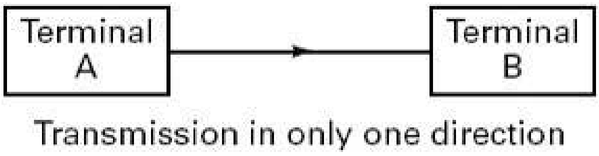

Fig 1.1: Simplex communication link

Half-Duplex communication link means that the communication can take place in either direction between two systems but only one at a time as shown in Fig 1.2. Here Terminal A and Terminal B both work as a transmitter and receiver and can send and receive data one at a time but not simultaneously.
An example of Half-Duplex communication is walky-talky system.

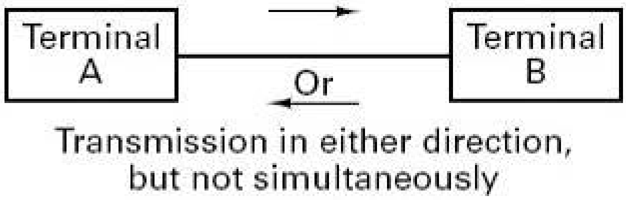

Fig 1.2: Half duplex communication link

VIII Practical Circuit Diagram :

a) Sample circuit diagram(Figure 1.3)/experimental set up (Figure 1.4 and Figure 1.5)
<u>Simplex:</u>

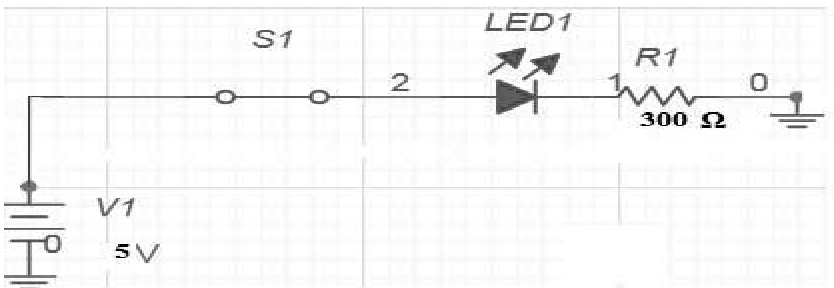

Fig 1.3 Circuit diagram of Simplex communication using LED and switch

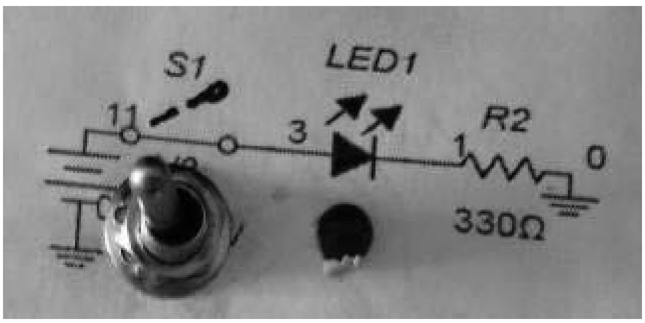

Fig 1.4 Experimental set up of simplex used in laboratory when S1 is open

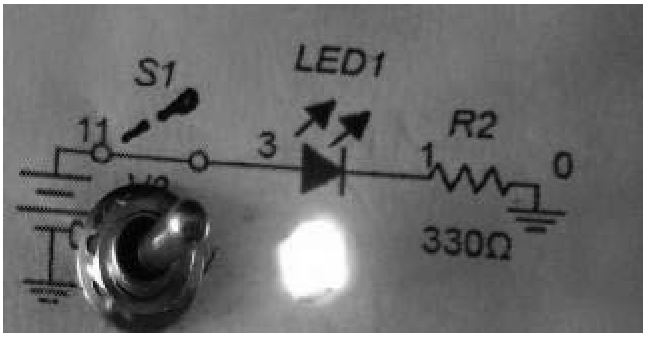

Fig 1.5 Experimental set up of simplex used in laboratory when S1 is closed

Sample circuit diagram (Fig 1.6)/ experimental setup.(Fig 1.7 and Fig 1.8)

Half duplex:

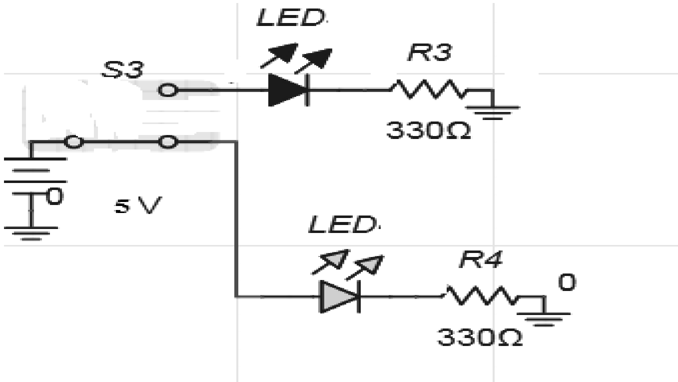

Fig 1.6 Circuit of Half duplex used in laboratory

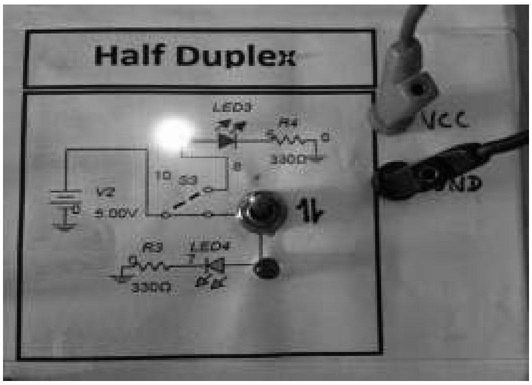

Fig 1.7 Circuit diagram of Half duplex in forward direction

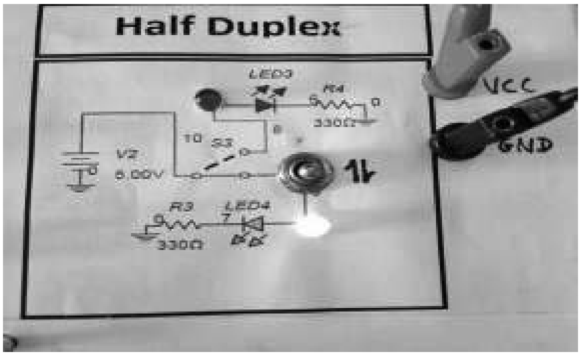

Fig 1.8 Circuit diagram of Half duplex in reverse direction

b) Actual Experimental set up used in laboratory
(Students should draw experimental set up used in their laboratory)

Simplex:

Half duplex:

IX Resources required

Sr. No.	Instrument /Components	Specification	Quantity	Remarks
1.	DC Regulated power supply	Variable DC power supply 0-30V, 2A, SC protection, display for voltage and current.	1	
2.	Switch(Simplex)	Toggle Switch	1	
3.	SPDT switch(Half duplex)	SPDT Switch	1	
4.	LED	1.8V to 2.2V	3	
5.	Bread board	5.5cm x 17cm	1	
6.	Resistor	330Ω(0.5watts/0.25watts)	1	
7.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement	

X Precautions

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the experiment do not exceed the input voltage beyond the rated voltage of LED and switch.

XI Procedure

Simplex:

1. Connect the electrical circuit as shown in figure 1.3.
2. Switch ON the power supply and set 5 volts.
3. Close switch S1 and observe the LEDs status. Note it in table 1.
4. Open switch S1 and observe the LEDs status. Note it in table 1.

Half Duplex link:

1. Connect the circuit as shown in figure 1.6.
2. Switch ON the power supply and select 5 volts.
3. During first throw of switch S3. Observe the LED3 and LED4. Note it in table 2.
4. During second throw of switch S3. Observe the LED3 and LED4. Note it in table 2.
5. At a time only one LED glows.

XII Resources used (with major specifications)

Sr. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………

XIV Precautions followed

……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………

XV Observations and Calculations:

Table 1: Simplex Communication link

Sr. No.	Switch S1	LED1 Status
1	ON	
2	OFF	

Table 2: Half duplex communication link

Sr. No.	Switch S3	LED Status(ON/OFF)	
		LED 3	LED 4
1	First Throw		
2	Second throw		

XVI Results

Simplex

1. Table 1 signifies ……………………….communication link that is Simplex.

Half duplex

1. Table 2 signifies ………………………… communication link that is Half duplex.

XVII Interpretation of results

……………………………………………………………………………………………
……………………………………………………………………………………………

XVIII Conclusions & Recommendation

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XIX Practical related Questions

Note: Below few sample questions are given for the reference. Teachers <u>must design</u> more such questions so as to ensure the achievement of identified CO.

1. Name the type of communication link/mode used for television broadcasting.
2. Give the example of two way communication system.
3. Which form of communication link/mode is used mobile communication?

4. Name the type of communication link that is used in FM radio.
5. What is the basic difference in simplex and half duplex communication link?

[Space for Answers]

XX References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=73zvwDBpYJs
2. https://www.youtube.com/watch?v=9-Vpq3fcmHA
3. https://www.youtube.com/watch?v=wkSLcYfQeWU

XXI Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …………………………
2. …………………………
3. …………………………
4. …………………………

Marks Obtained			Dated signature of Teacher
Process Related(15)	Product Related(10)	Total (25)	

Practical No.2: Establish full duplex communication link

I Practical Significance:

In full duplex system transmitter and receiver both can communicate with each other simultaneously. An example of a full-duplex system is telephone.This practical is design to explain how data flows in full-duplex system.

II Relevant Program Outcomes (POs)

1. **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
2. **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
4. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
5. **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry-identified Competency: **'*Maintain Basic Electronic Communication System*'**

1. Component (LED, Toggle switch) identification skills.
2. Component mounting skills on bread board.
3. Use DC Power supply to give voltage.

IV Relevant Course Outcomes

Use relevant frequency range for different communication systems.

V Practical Outcome

Use simple wires, switches and LEDs to establish full duplex communication link.

VI Relevant Affective domain unrelated Outcome(s)

1. Follow safe practices.
2. Handle instruments carefully.

VII Minimum Theoretical Background

Full duplex mode:

Full-duplex data transmission means that data can be transmitted in both directions on a same channel at the same time as shown in figure 2.1.

Example: Land-line telephone networks are full-duplex, since they allow both callers to speak and be heard at the same time.

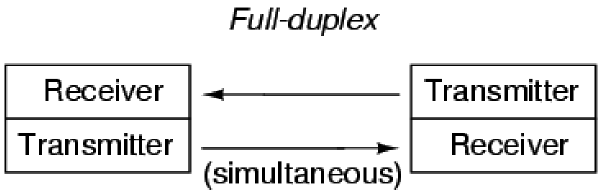

Fig 2.1: Full duplex communication mode

VIII Practical Circuit Diagram :

a) Sample Circuit(Fig 2.2)/Experimental setup (Fig 2.3 / Fig 2.4/ Fig 2.5)

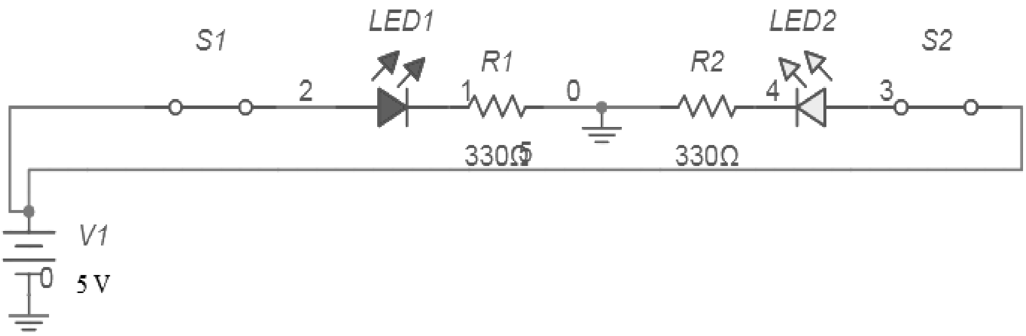

Fig 2.2: Circuit of Full duplex used in laboratory

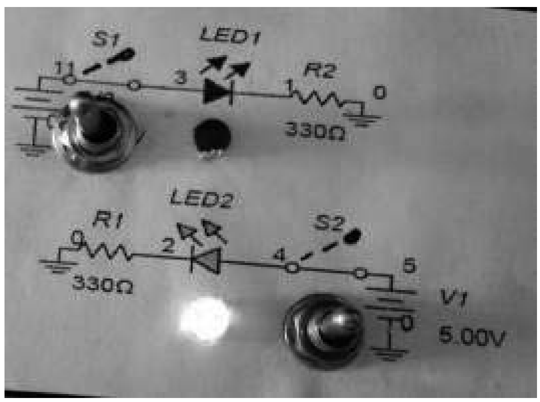

Fig 2.3: Experimental set up of Full duplex used in laboratory when S2 is closed

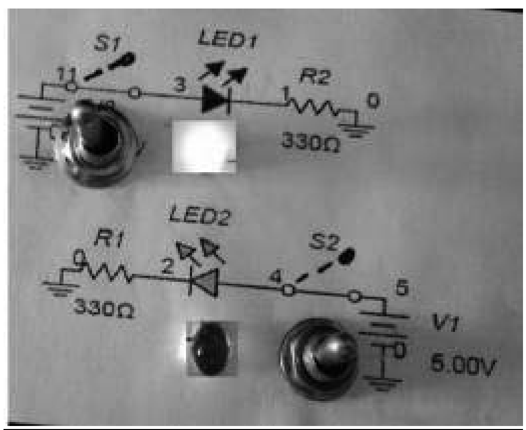

Fig 2.4.: Experimental set up of Full duplex used in laboratory when S1 is closed

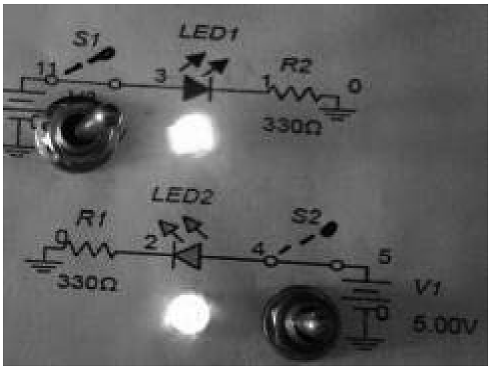

Fig 2.5: Experimental set up of Full duplex used in laboratory when S1 and S2 is closed

b) Actual Experimental set up of full duplex used in laboratory (Students should draw experimental set up used in their laboratory)

IX Resources required

Sr. No.	Instrument /Components	Specification	Quantity	Remarks
1.	DC Regulated power supply	Variable DC power supply 0- 30V, 2A, SC protection, display for voltage and current.	1	
2	Switch	Toggle switch	2	
4	LED	1.8V to 2.2V	2	
5	Bread board	5.5cm x 17cm	1	
6	Resistor	330Ω(0.5watts/0.25watts)	1	
7	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement	

X Precautions

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the experiment do not exceed the input voltage beyond the rated voltage of LED and switch.

XI Procedure:

1. Connect the electrical circuit as shown in figure 2.2.
2. Switch ON the power supply and set at 5 V.
3. Close the switch S1 and open switch S2 observe the LEDs status. Note down in Table 1.
4. Open the switch S1 and close the switch, observe the LEDs status. Note down in Table 1.
5. Close the switch S1 and S2, observe the LEDs status. Note down in Table 1.
6. Open the switch S1 and S2, observe the LEDs status. Note down in Table 1

XII Resources used (with major specifications)

Sr. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

…………………………………………………………………………………………
…………………………………………………………………………………………
…………………………………………………………………………………………

XIV Precautions followed

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XV Observations and Calculations:

Table 1: Full duplex communication link

Sr. No.	Switch status	LED Status(ON/OFF)	
		LED 1	LED 2
1	S1 ON S2 OFF		
2	S1 OFF S2 ON		
3	S1 ON S2 ON		
4	S1 OFF S2 OFF		

XVI Results

1. S1-ON ,S2 OFF
   Given system will work as ………………….communication link.
2. S1-OFF ,S2 ON
   Given system will work as ………………….communication link.
3. S1-ON ,S2 ON
   Given system will work as ………………….communication link.

XVII Interpretation of results

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XVIII Conclusions & Recommendation

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XIX Practical related Questions

Note: Below few sample questions are given for the reference. Teachers <u>must design</u> more such questions so as to ensure the achievement of identified CO.

1. Which type of communication link is used in cordless Telephone?
2. Name the type of communication link used in fax machine.
3. From experiment, how do you interpret the concept of full duplex communication?

[Space for Answers]

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XX References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=73zvwDBpYJs
2. https://www.youtube.com/watch?v=9-Vpq3fcmHA
3. https://www.youtube.com/watch?v=wkSLcYfQeWU

XXI Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …………………………
2. …………………………
3. …………………………
4. …………………………

Marks Obtained			**Dated signature of Teacher**
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 3: Generation of Amplitude modulated signal.

I Practical Significance:

Amplitude Modulation (AM) has been in use for the earliest days of radio communication and it is still widely used for the long, medium and short wave communication. The concept of AM is the basis to understand the other types of modulations like frequency and phase modulation. This practical will enable the students to generate and analyze AM signal.

II Relevant Program Outcomes (POs)

1. **Basic knowledge**: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
2. **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
4. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
5. **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry-identified Competency: '***Maintain Basic Electronic Communication Systems***'.

1. Select proper range of voltage and frequency of signals (modulating and carrier).
2. Use CRO/DSO to measure the voltage and frequency.

IV Relevant Course Outcomes

1. Use relevant modulation technique for specified application.
2. Maintain Transmitter and receiver circuit of AM and FM.

V Practical Outcome

Observe the AM modulated waveforms generated for different carrier frequencies.

VI Relevant Affective domain related Outcome(s)

1. Follow safe practices.
2. Handle instruments carefully.

VII Minimum Theoretical Background

In modulation process, two signals are used namely the modulating signal and the carrier signal. The modulating signal is a low frequency information signal while the carrier is a high frequency signal. Figure 3.1 show how AM signal is generated.

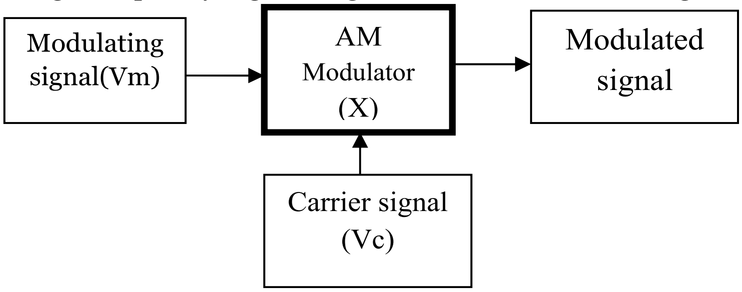

Fig 3.1: Generation of AM

In Amplitude modulation, amplitude of the carrier signal is varied in accordance with instantaneous amplitude of modulating signal keeping its frequency and phase constant as shown in Figure 3.2

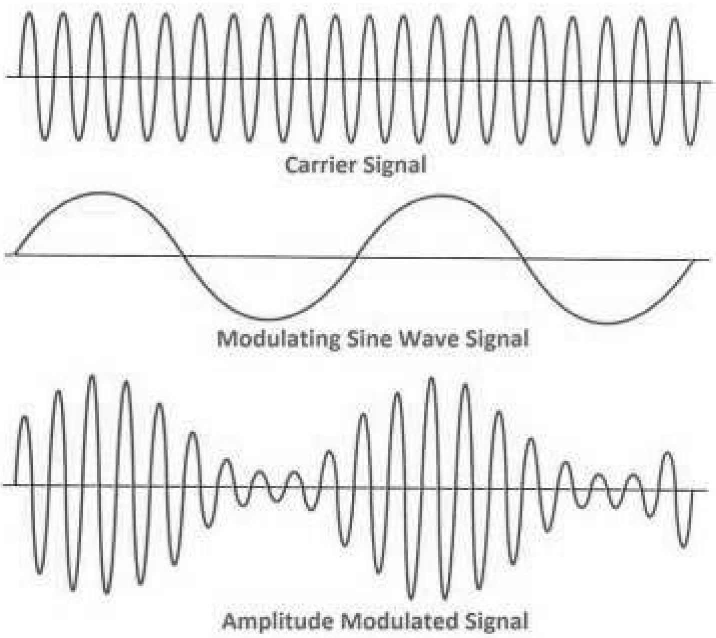

Fig 3.2: Waveform of AM modulation

In the sample experimental trainer kit as shown in Fig 3.5/Fig 3.6 AM signal is generated from **IC TL084 and IC 3086.** Both modulating and carrier waveforms are generated by quadrature oscillator circuits. The circuit uses operational amplifier, one as a non- inverting integrator & the other as an inverting integrator. The two amplifiers are connected in cascade to form a feedback. IC TL084 is a quad-op-amp IC, requires both positive supply voltage (pin 4) and negative supply (pin 11) voltages. IC3086 IC is the transistor array used as an input amplifier.

Pin Diagram of IC TL084

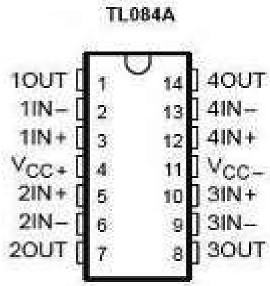

Fig 3.3: Pin Diagram of IC TL084

Pin Diagram of IC 3086

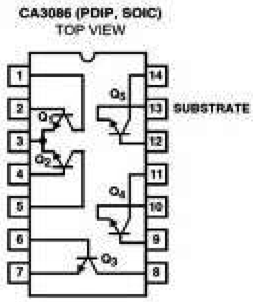

Fig 3.4: Pin Diagram of IC 3086

VIII Practical set-up

a) **Sample circuit diagram (Fig 3.5)/Trainer kit(Fig 3.6)/Experimental set up(Fig 3.7)**

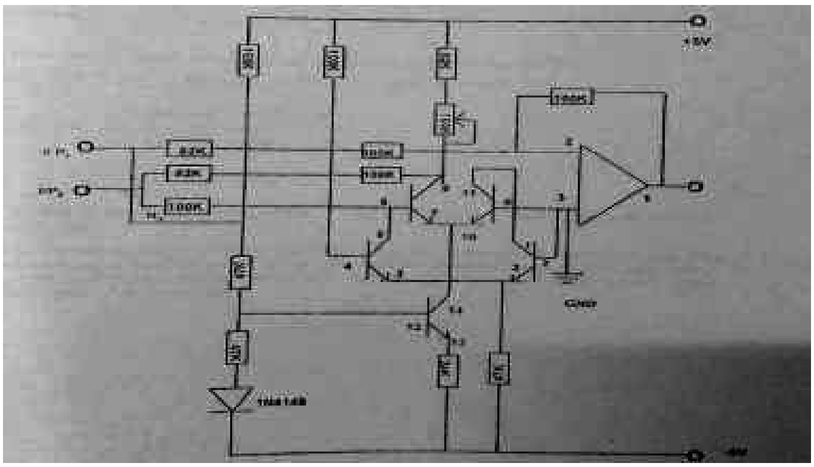

Fig 3.5: AM modulation circuit diagram using IC TL084 and 3086

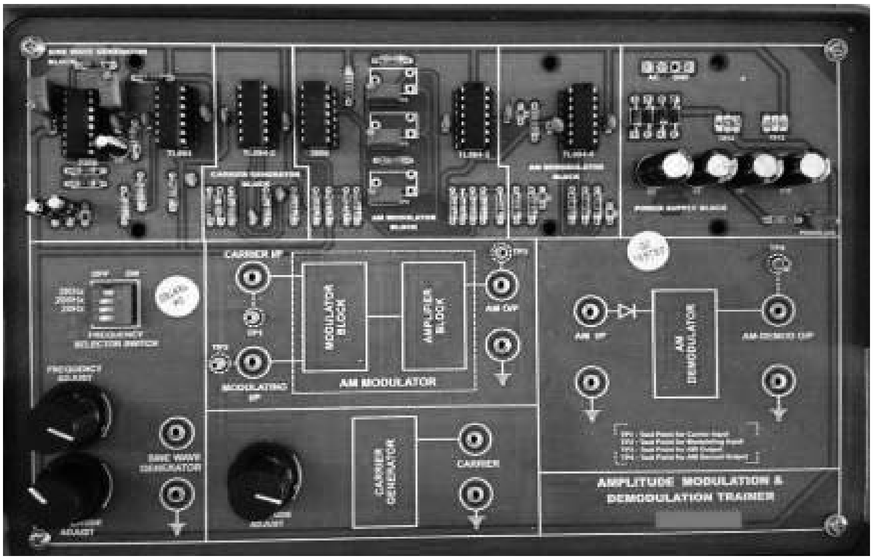

Fig 3.6: AM modulator trainer kit

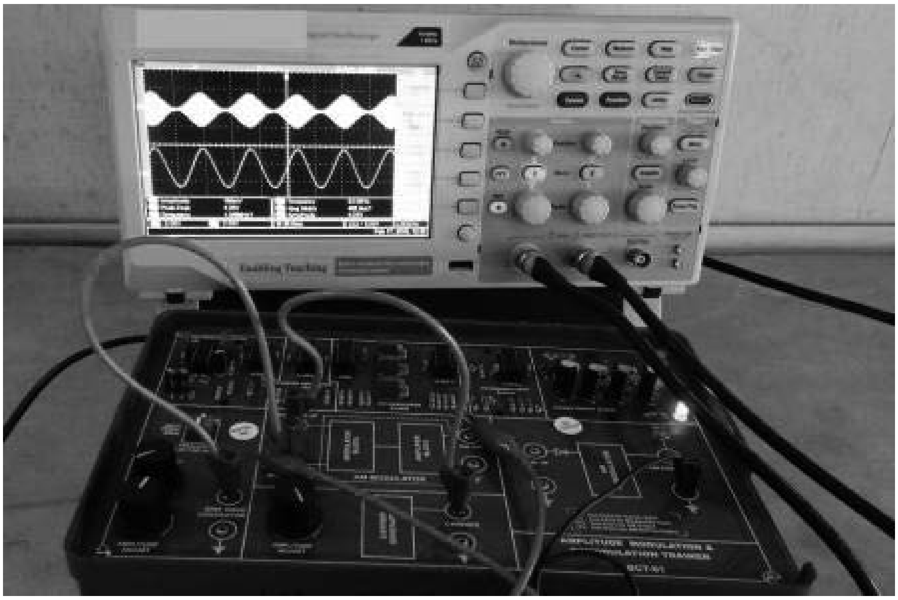

Fig 3.7: Experimental set up of AM modulator

b) Actual Experimental set up used in laboratory
(Students should draw experimental set up used in their laboratory)

IX Resources required

Sr. No.	Instrument /Components	Specification	Quantity	Remarks
1.	AM trainer kit	Modulating signal- 0-2kHz Carrier signal 100kHz	1	Amplitude modulation and demodulation facility in single kit will be preferred.
2.	Function generator	0.01Hz to 1MHz , 10Vp-p output.	2	If modulating and carrier signal generator is built in trainer kit then there is no need of function generator.
3.	CRO	25 MHz, dual scope	1	Either we can use CRO or DSO to interpret waveform.
	DSO	Bandwidth 30MHz – 200MHz Analog channels 2-4	1	
4.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement	

X Precautions

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the experiment adjust proper volt/div and times/div selection on CRO/DSO.
3. Connect kit and CRO as shown in figure 3.5.

XI Procedure

1. Make connections as shown in figure 3.7.
2. Switch on the power supply.
3. Select sine wave of amplitude 1Vp-p and frequency 1 kHz as a modulating signal from function generator-1 and give it as one of the input to modulator.
4. Select sine wave of amplitude 2Vp-p and 5 kHz as a carrier signal from function generator-2 and give it as other of the input to modulator.
5. Observe AM waveform on CRO.
6. Change the frequency carrier in steps of 5 kHz (say) and note down the reading in the observation table1.
7. Draw the waveform of modulating signal, carrier signal and AM signal on graph paper for any one sample of observed value.

XII Actual Resources used (with major specifications)

Sr. No.	Instrument /Components	Specification	Quantity	Remarks
1				
2				
3				
4				

XIII Actual procedure followed

…………………………………………………………………………………………
…………………………………………………………………………………………
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XIV Precautions followed

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XV Observations and Calculations:

Table 1: Measurement of V_{max} and V_{min}

Sr. No.	Modulating signal		Carrier signal frequency		Amplitude Modulated Signal	
	Amplitude (V_m)Volts	Frequency (f_m)KHz.	Amplitude (V_c)Volts	Frequency (f_c)KHz.	V_{max} Volts	V_{min} Volts
1	1V	1kHz	2V	5kHz		
2	1V	1kHz	2V	10 kHz		
3	1V	1kHz	2V	15 kHz		
4	1V	1kHz	2V	20kHz		
5	1V	1kHz	2V	25 kHz		

Calculations:

Modulating signal:

- Amplitude (V_m)Volts=
- Frequency (f_m)KHz.=

Carrier signal frequency:

- Amplitude (V_c)Volts=
- Frequency1 (f_c)KHz.=
- Frequency2 (f_c)KHz.=

Amplitude Modulated Signal

- V_{max} Volts=
- V_{min} Volts=

XVI Result

As carrier frequency is increased step by step, the effect on V_{max} and V_{min} is ……………………………………………… (increases/decreases/no change)

XVII Interpretation of result

…………………………………………………………………………………………

…………………………………………………………………………………………

XVIII Conclusions

…………………………………………………………………………………………

…………………………………………………………………………………………

XIX Practical related Questions

Note: Below few sample questions are given for the reference. Teachers <u>must design</u> more such questions so as to ensure the achievement of identified CO.

1. State the effect of carrier frequency variation on AM wave observed on CRO.
2. Why Modulation is necessary?
3. Why modulation index for AM should be between 0 and 1?
4. Keeping f_c (carrier frequency) as 5 kHz, change amplitude of carrier (V_c) and observe its effect on AM waveform.
5. List applications of AM (any two).

[Space for Answers]

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XX References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=QEubAxBfqKU
2. https://www.youtube.com/watch?v=0DcxmkLbBuE
3. https://www.youtube.com/watch?v=fGf_ng7qljI

XXI Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the trainer kit	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …………………………
2. …………………………
3. …………………………
4. …………………………

Marks Obtained			**Dated signature of Teacher**
Process Related(15)	**Product Related(10)**	**Total (25)**	

Scale

X-axis -

Y-axis -

Practical No. 4: Measurement of AM Wave Modulation Index.

I Practical Significance:

Modulation index determines the strength and quality of transmitted signal. Amplitude of sideband and total power of the modulated wave depends on the modulation index. If the modulation index is small, then the power requirement for transmission of AM signal is less and vice versa. In this practical, students will understand the concept of modulation index and its effect on amplitude modulated wave.

II Relevant Program Outcomes (POs)

1. **Basic knowledge**: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
2. **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
4. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
5. **Individual and team work**: Function effectively as a leader and team member in diverse /multidisciplinary teams.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry-identified Competency: **'*Maintain Basic Electronic Communication Systems*.'**

1. Select proper range of voltage and frequency signals(modulating and carrier).
2. Use CRO/DSO to measure the voltage and frequency

IV Relevant Course Outcomes

1. Use relevant modulation technique for the specified application.
2. Maintain transmitter and receiver circuits of AM and FM.

V Practical Outcome

Generate AM wave and Measure its modulation index.

VI Relevant Affective domain related Outcome(s)

1. Handle components and equipment carefully.
2. Select instruments of required range.

VII Minimum Theoretical Background

Modulation Index:

The ratio of maximum amplitude of the modulating signal to the maximum amplitude of carrier signal is defined as the amplitude modulation index and denoted by 'm'. The modulation index is also known as depth of modulation or degree of modulation. Normally the value of 'm' lies between 0 to 1.The modulation index is given by expression

$$m = V_m / V_c$$

V_m= maximum amplitude of the modulating signal
V_c= maximum amplitude of carrier signal
It can be seen from the resultant of AM waveform

V_m =(Vmax-Vmin)/2-------------(1)

V_c =(Vmax+Vmin)/2--------------(2)

m==(Vmax-Vmin)/ (Vmax+Vmin)----------(3)

1. **$V_m < V_c$-------50%modulation**
   m <1

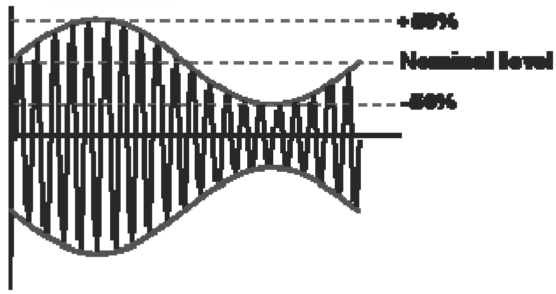

Fig. 4.1: m= 0.5

2. **$V_m = V_c$-----100% modulation**
   m=1

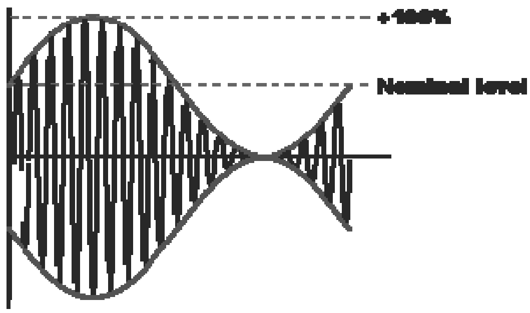

Fig. 4.2: m= 100

3. **$V_m > V_c$------Over modulation**
   m>1

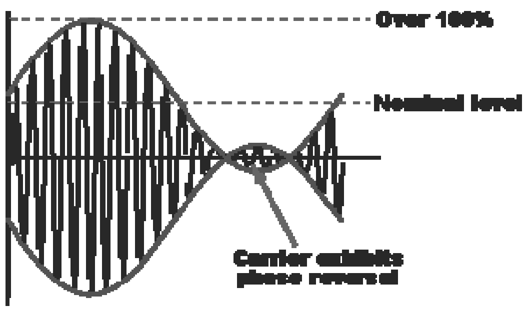

Fig. 4.3: m > 100

In the sample experimental trainer kit as shown in Fig 4.7, AM signal is generated using IC TL084 and IC 3086. Both modulating and carrier waveforms are generated by quadrature oscillator circuits. The circuit uses operational amplifier, one as a non-inverting integrator & the other as an inverting integrator. The two amplifiers are connected in cascade. ICTL084 is a quad-op-amp IC, requires both positive (pin 4) and negative supply (pin 11) voltage. IC 3086 is the transistor array used as an input amplifier.

Pin Diagram of IC TL084

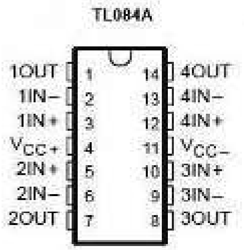

Fig 4.4: Pin Diagram of IC TL084

Pin Diagram of IC 3086

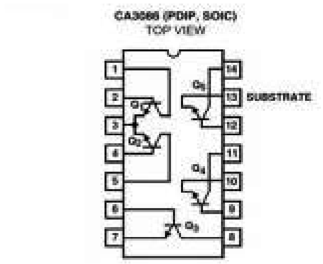

Fig 4.5: Pin Diagram of IC 3086

VIII Practical set-up

a) Sample circuit diagram (Fig4.6)/ Trainer kit(Fig4.7)/ Experimental setup(Fig.4.8 to Fig.4.10)

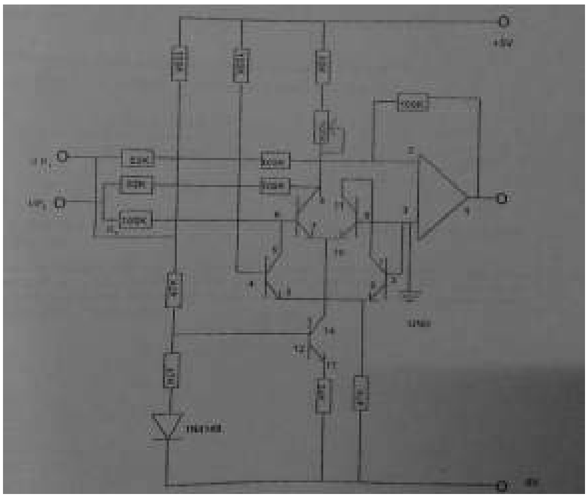

Fig 4.6: Circuit diagram of AM generation using ICTL084 and IC 3086

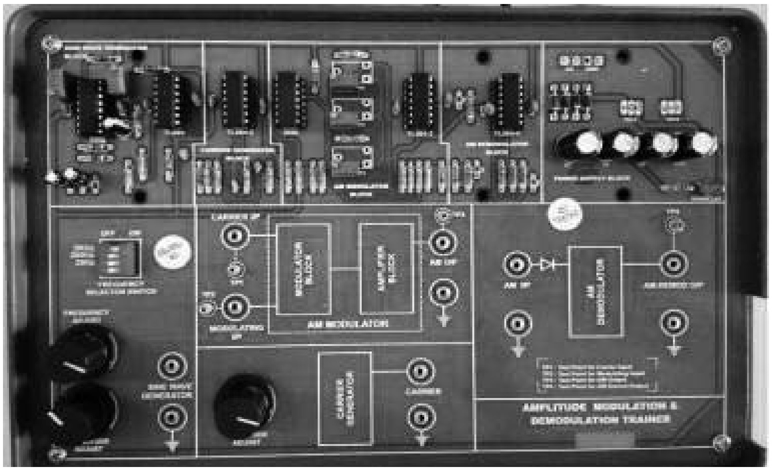

Fig 4.7: Trainer kit of AM Wave

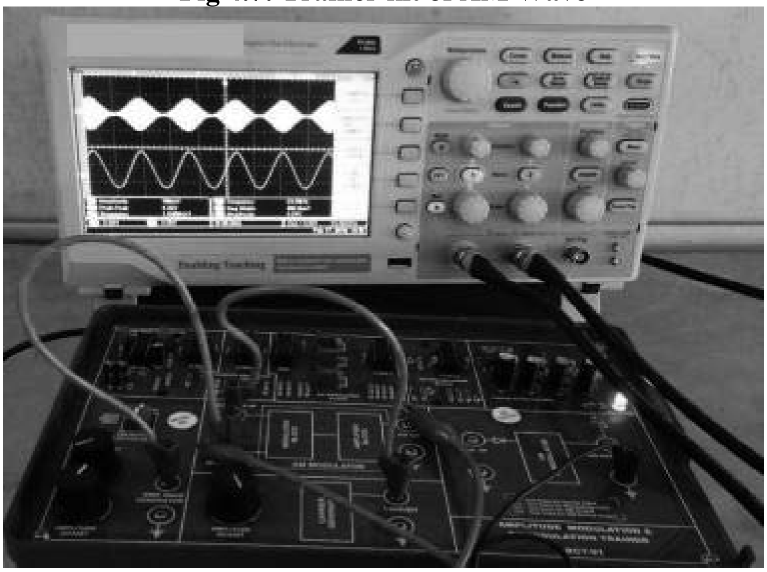

Fig 4.8: AM Wave $V_m<V_c$ i.e m<1

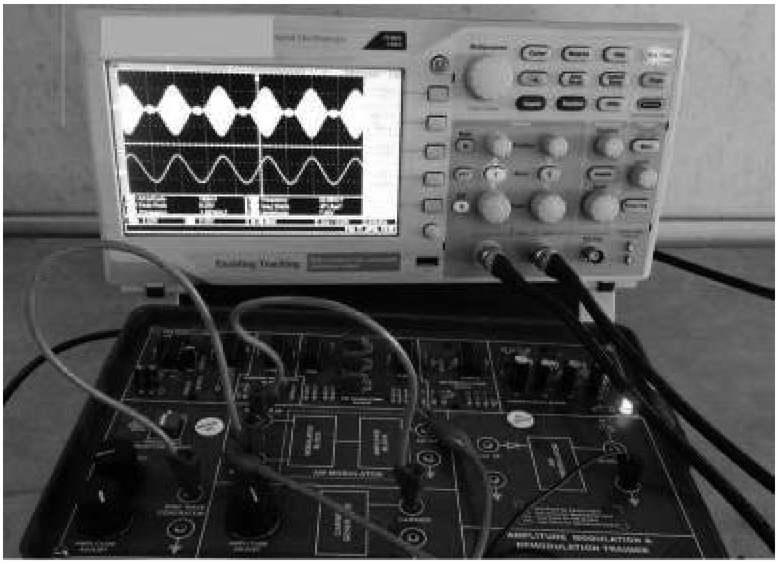

Fig 4.9: AM Wave $V_m>V_c$ i.e m>1

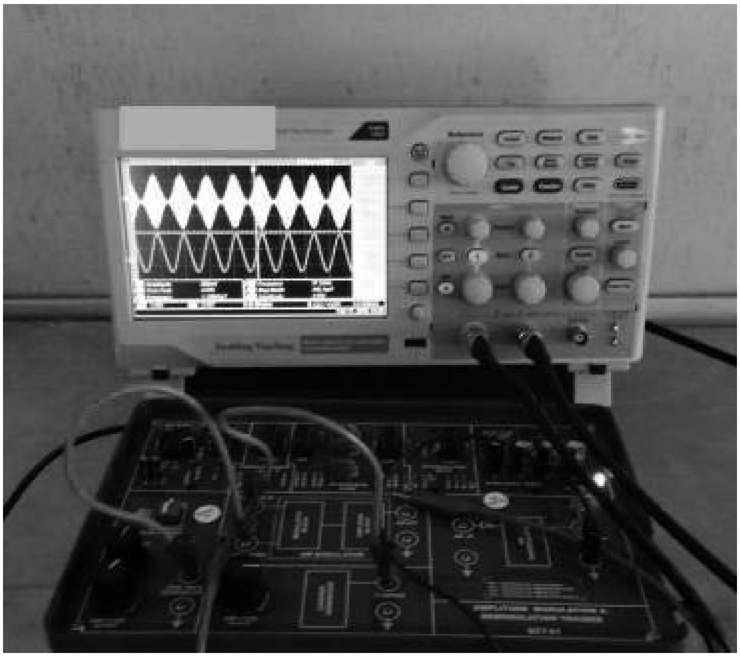

Fig 4.10 AM Wave V_m=V_c i.e m=1

b) Actual Experimental Set up used in laboratory
(Students should draw experimental set up used in their laboratory)

IX Resources required

Sr. No.	Instrument /Components	Specification	Quantity	Remarks
1.	AM trainer kit	Modulating signal- 0-2kHz Carrier signal 100kHz	1	Amplitude modulation and demodulation facility in single kit will be preferred.
2.	Function generator	0.01Hz to 1MHz, 10V p-p output.	2	If modulating and carrier signal generator is built in trainer kit then there is no need of function generator.
3.	CRO	25MHz, dual scope	1	Either we can use CRO or DSO to interpret waveform.
	DSO	Bandwidth 30MHz – 200MHz Analog channels 2-4	1	
4.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement	

X Precautions

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the experiment adjust proper volt/div and times/div selection on CRO/DSO.

XI Procedure

1. For m<1 as shown in figure 4.8, Switch on the trainer kit and check the output of the carrier generator on oscilloscope
2. Select sine wave of amplitude 1Vp-p and frequency 1 kHz as a modulating signal from function generator and connect it to AM modulator.
3. Select sine wave of amplitude 2Vp-p and 50 kHz as a carrier signal from function generator and connect it to AM modulator.
4. Observe AM wave on CRO.
5. Vary the modulating signal amplitude and observe the effects on the modulated waveform.
6. The depth of modulation can be varied using the variable knob provided at A.F. input.
7. The percentage modulation can be calculated using the formula.

$$\text{Percentage modulation} = \frac{V_{max} - V_{min}}{V_{max} + V_{min}} \times 100$$

$$\text{Modulation factor} = \frac{V_{max} - V_{min}}{V_{max} + V_{min}}$$

XII Resources used (with major specifications)

Sr. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

……………………………………………………………………………………………
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XIV Precautions followed

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……………………………………………………………………………………………
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……………………………………………………………………………………………

XV Observations and Calculations:

Table 1: Measurement of Modulation Index of AM wave.

Carrier frequency f_c=
Carrier amplitude V_c=
Modulating frequency f_m=

Sr.No	Amplitude of modulating signal (V_m)	V_{max} of AM signal(volts)	V_{min} of AM signal (volts)	Percentage modulation = $\frac{V_{max}-V_{min}}{V_{max}+V_{min}} \times 100$
1.				
2.				
3.				
4.				

Calculations:

$$\textbf{Percentage modulation} = \frac{V_{max} - V_{min}}{V_{max} + V_{min}} \times 100$$

=

$$\textbf{Modulation factor} = \frac{V_{max} - V_{min}}{V_{max} + V_{min}}$$

=

XVI Results

1. If $V_m < V_c$, then m =..............................
2. If $V_m = V_c$, then m =..............................
3. If $V_m > V_c$, then m =..............................

XVII Interpretation of results

…………………………………………………………………………………………

…………………………………………………………………………………………

XVIII Conclusions

…………………………………………………………………………………………

…………………………………………………………………………………………

XIX Practical related Questions

1. Vary V_m, such that we get waveform on CRO as Fig 4.2 and note its corresponding V_{max} and V_{min}.
2. Calculate m for reading in question 1.
3. Vary V_m, such that we get waveform on CRO as in Fig 4.3.Calculate m.
4. State different AM stations and their corresponding frequency range.
5. $2V_{P-P}$ carrier signal is modulated to a depth of 60%. Find the maximum amplitude of the modulating signal.
6. Explain over-modulation, its reasons and how it can be prevented?

[Space for Answers]

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XX References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=vddBNW18fgI
2. https://www.youtube.com/watch?v=vVrXYA4PJvs

XXI Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the trainer kit	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……………………..……..
2. …………………….…...
3. …………………………
4. …………………………

Marks Obtained			**Dated signature of Teacher**
Process Related(15)	**Product Related(10)**	**Total (25)**	

Scale

X-axis -

Y-axis -

Practical No. 5: Generation of AM wave using any simulation software.

I Practical Significance

AM is widely used in electronic communication field. The generations of AM signal using simulation software is very easy. Here we are simply adding the carrier amplitude with message signal to obtain AM signal, then the instantaneous amplitude of carrier gets altered with respect to modulating signal. The MATLAB code is given below. The AM generation can be done by using other simulation software.

II Relevant Program Outcomes (POs)

1. **Basic knowledge**: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
2. **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
4. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
5. **Individual and team work**: Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency '**Maintain Basic Electronic Communication System'.**

1. Use basic programming skills to simulate communication system.
2. Debug and execute the program.
3. Interpret the output.
4. Calculate various parameters.

IV Relevant Course Outcomes

1. Use relevant modulation technique for the specified application.
2. Maintain transmitter and receiver circuits of AM and FM.

V Practical Outcome

Use any simulation software to generate AM wave.

VI Relevant Affective domain unrelated Outcome(s)

1. Select proper programming environment.
2. Follow ethical practices

VII Minimum Theoretical Background

To generate AM wave using software we use principle of analog multiplication

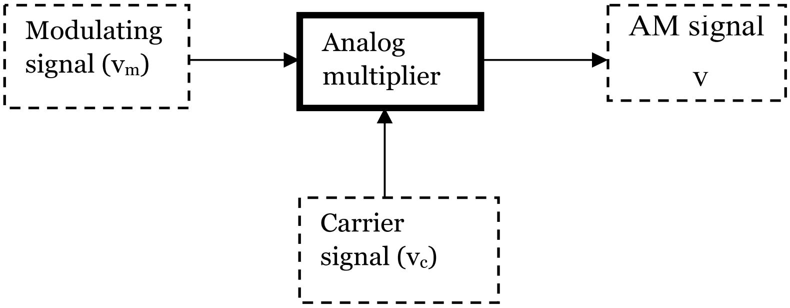

Fig 5.1: Block diagram representation of generation of AM signal

The modulating signal mathematically represented by,

$$v_m = V_m \sin(2\pi f_m t)$$

Where, v_m - Instantaneous amplitude of modulating signal.

V_m -Amplitude of modulating signal

f_m -Modulating signal frequency

Carrier signal by,

$$v_C = V_c \sin(2\pi f_c t)$$

Where, v_c- Instantaneous amplitude of carrier signal.

V_c -Amplitude of carrier signal

f_c - Carrier signal frequency

Then the output of analog multiplier is,

$$v = V_c \sin w_c t + \frac{mV_c}{2}\cos(w_c - w_m)t - \frac{mV_c}{2}\cos(w_c + w_m)t$$

Where, $m = \frac{V_m}{V_c}$ - Modulation index

When,

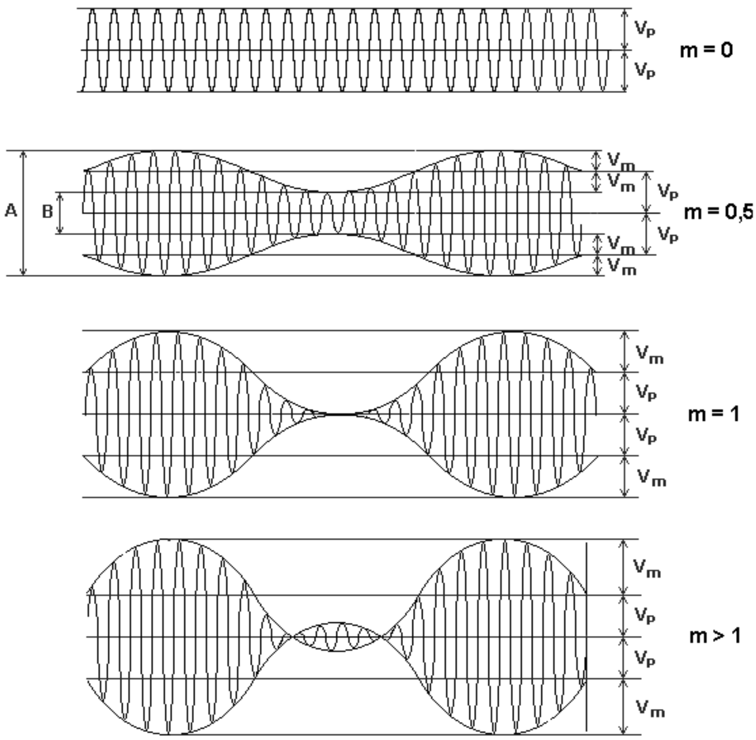

Fig 5.2 AM Waveform

VIII Sample simulation code :

a) AM Generation using MATLAB -simulink (Fig 5.3)

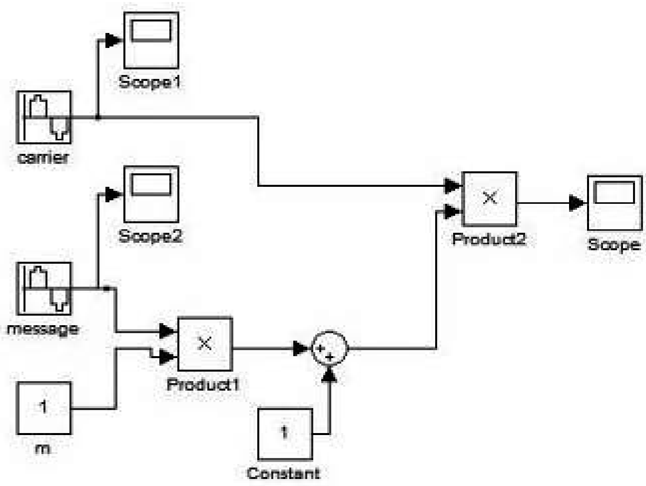

Figure 5.3: AM Generation using MATLAB -Simulink

<u>OR</u>

AM Generation using MATLAB-code

Program:

```
clc;
clear all;
close all;
t=0:0.001:1;
set(0,'defaultlinelinewidth',2);
A=0.2;
B=2;
fm=input('Message frequency=');
fc=input('Carrier frequency=');
mi=1;
em=A*sin(2*pi*fm*t);
subplot(3,1,1);
plot(t,em);
xlabel('Time');
ylabel('Amplitude');
title('Message Signal');
grid on;
ec=B*sin(2*pi*fc*t);
subplot(3,1,2);
plot(t,ec);
xlabel('Time');
ylabel('Amplitude');
title('Carrier Signal');
grid on;
eam=(2+mi*em).*sin(2*pi*fc*t);
subplot(3,1,3);
plot(t,eam);
xlabel('Time');
ylabel('Amplitude');
title('AM Signal');
grid on;
```

IX Resources required

Sr. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Computer	Latest processor	1	
2.	Simulation Software	Lab view/MATLAB/SCILAB/ P Spice/HS Spice/ Multisim/Proteus or any relevant open source simulation software	1	

X Precautions

1. Ensure proper earthing to the equipment.
2. Use proper toolbox of software.
3. Use proper functions of software.

XI Procedure

1. Open Simulink and create a new model file.
2. Select modulating signal generator and AM modulator from the blocks library.
3. Connect blocks according to figure 5.1.
4. Set the amplitude=0.5V and frequency=10Hz of modulating signal
5. Set the amplitude=2V and frequency=1000Hz of carrier signal
6. Observe the output AM signal on the scope and Measure V_{max} and V_{min}. Save the result.
7. Now increase the amplitude of modulating signal and repeat step 6.
8. Note the output in table 1.

XII Resources used (with major specifications)

Sr. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			

XIII Actual procedure followed

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XIV Precautions followed

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XV Observations and Calculations:

Amplitude of carrier signal V_c=……V.
Frequency of carrier signal f_c=……Hz
Keep frequency of modulating signal constant and vary amplitude.
Frequency of modulating signal f_m=…….Hz.

Table 1: Measurement of V_{max} and V_{min}

Sr.No	Amplitude of modulating signal(V_m)	V_{max}	V_{min}
1.			
2.			
3.			

Sample AM:

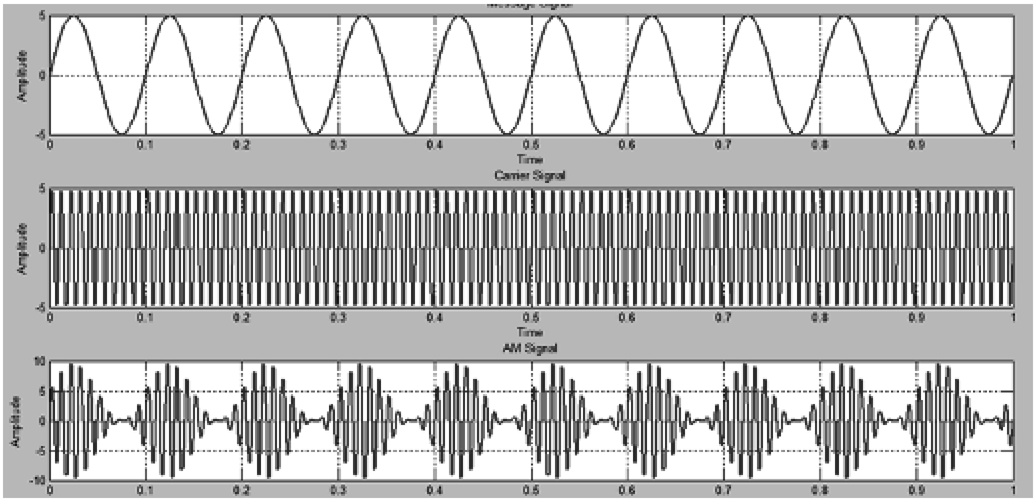

Fig 5.4: Suggested sample output

Actual AM observed:

(Students should paste AM output)

XVI Results

Amplitude of modulating signal(V_m)-………………V

$V_{max=}$………V

$V_{min=}$……….V

As Vm increases V_{max}………… (decreases/increases)

and V_{min}…………(decreases/increases)

XVII Interpretation of results

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XVIII Conclusions

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XIX Practical related Questions

1. State the effect of carrier frequency variation on AM wave observed on output.
2. Change the carrier signal amplitude and write down effect on AM waveform observed.
3. Observe and draw the waveform when modulation index is greater than 1.
4. For m=70%, adjust values of V_c and V_m, note the corresponding values V_{max} and V_{min} on scope. Calculate m.

[Space for Answers]

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XX References / Suggestions for further

1. https://www.youtube.com/watch?v=dEG_hv5E8VQ
2. http://www.youtube.com/watch?v=fGf_ng7qljI
3. https://www.youtube.com/watch?v=7BlwG7BBm2k
4. https://www.youtube.com/watch?v=p-lfEoyKX2M

XXI Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Debugging ability	10 %
2	Follow ethical practices	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Correctness of output	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …………………………
2. …………………………
3. …………………………
4. …………………………

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Scale

X-axis -

Y-axis -

Practical No. 6: Generation of FM Waveform using VCO

I. Practical Significance

A voltage-controlled-oscillator (VCO) is an electronic oscillator whose oscillation frequency is controlled by a input voltage. Consequently, a VCO can be used for frequency modulation (FM) by applying a modulating signal to the control input. Frequency modulation is widely used for FM radio broadcasting, telemetry, radar etc. In this practical, students will understand the concept of frequency modulated wave.

II. Relevant Program Outcomes (POs)

1. **Basic knowledge**: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
2. **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
4. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
5. **Individual and team work**: Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III. Competency and Practical Skills

This practical is expected to develop the following skills for the industry-identified competency: **'*Maintain Basic Electronic Communication Systems*'**

1. Select proper range of voltage and frequency signals (modulating and carrier).
2. Use CRO/DSO to measure the voltage and frequency

IV. Relevant Course Outcomes

1. Use relevant modulation technique for specified application.
2. Maintain Transmitter and receiver circuit of AM and FM.

V. Practical Outcome

Use voltage controlled oscillator to generate FM wave and measure the frequency deviation.

VI. Relevant Affective domain related Outcome(s)

1. Follow safe practices.
2. Handle instruments carefully.

VII. Minimum Theoretical Background

In modulation process, two signals are used namely the modulating signal and the carrier signal .The modulating signal is the information signal while the carrier is the high frequency signal as shown in figure 6.1.

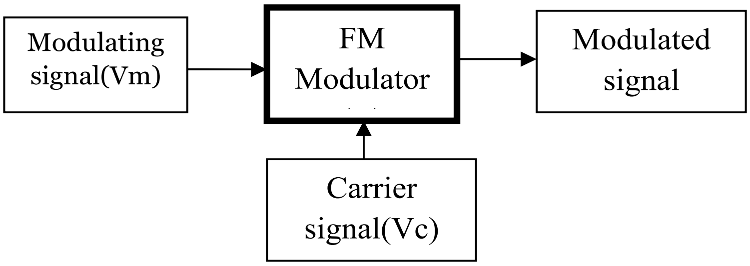

Fig 6.1: FM generation

In frequency modulation frequency of the carrier signal is varied in accordance with instantaneous amplitude of modulating signal keeping amplitude constant as shown in figure 6.2.

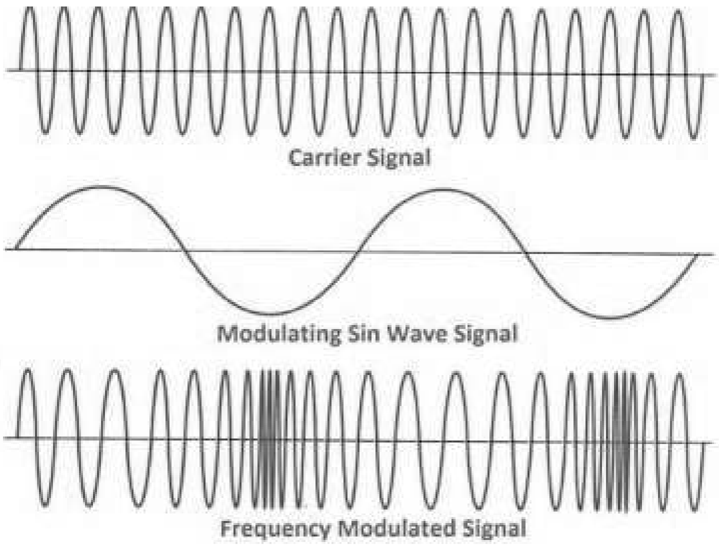

Fig 6.2: FM waveforms

VIII. Practical Circuit Diagram:

(a) Sample circuit diagram(figure 6.3)/Experimental setup(figure 6.4 and figure 6.5)

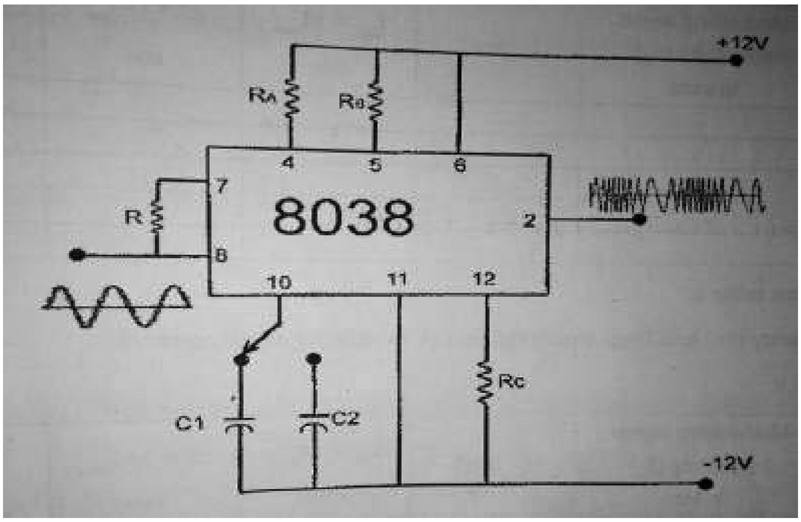

Fig 6.3: FM modulation circuit diagram using 8038

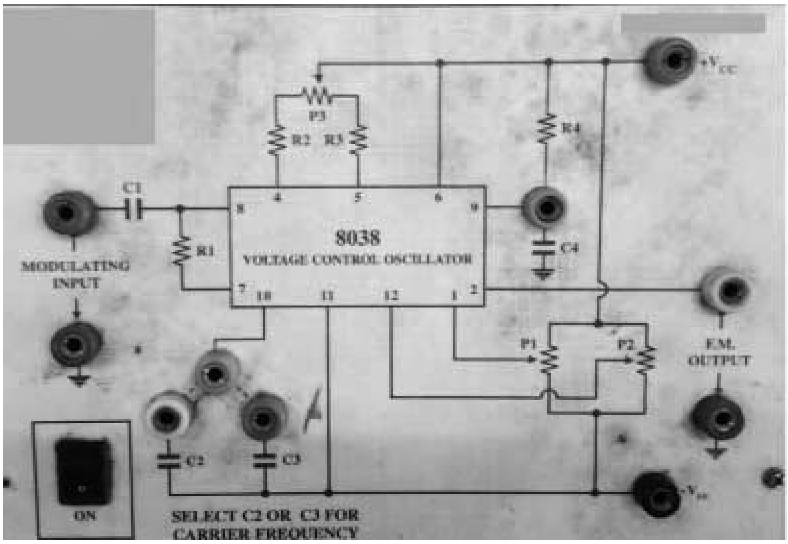

Fig 6.4: FM modulation trainer kit

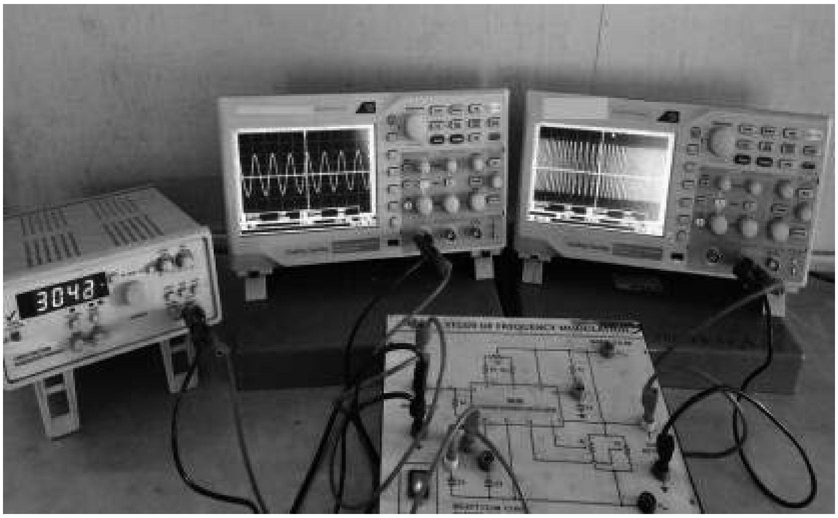

Fig 6.5:FM generation using VCO 8038

(b) Actual Experimental set up used in laboratory
(Student should draw Experimental set up used in their laboratory)

IX. Resources required

Sr. No.	Instrument /Components	Specification	Quantity	Remarks
1.	FM generation trainer kit using VCO 8038	Modulating signal- 0-5KHz Carrier signal 100KHz	1	
2.	Function generator	0.01Hz to 1MHz, 10V p-p output.	1	If modulating and carrier signal generator is built in trainer kit then there is no need of function generator.
3.	CRO	25MHz, dual scope	2	Either we can use CRO or DSO to interpret waveform
	DSO	Bandwidth 30MHz – 200MHz Analog Channels 2-4	2	
4.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement	

X. Precautions to be Followed

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the experiment adjust proper volt/div and times/div selection on CRO/DSO.

XI. Procedure

1. Make connections as shown in figure 6.5.
2. Before applying modulating signal check the output of IC 8038 at pin no 2 and measure frequency fc.
3. Switch on the power supply.
4. Connect the inbuilt carrier on the kit to the modulator.
5. Apply modulating signal from function generator as input to trainer kit as well as to the first channel of CRO as shown in fig 6.5.
6. Connect CRO at FM output terminal second channel of CRO/DSO as shown in Fig 6.5.
7. Observe FM output signal on CRO and measure time in terms of time deviation as t_{max} and calculate $f_{min.}$
8. Repeat step 6 for different amplitude values of modulating signal keeping frequency constant (f_m).Write down the readings in observation table 1.
9. Repeat step 6 for different frequency values of modulating signal keeping amplitude constant (V_m).Write down the readings in observation table 2.
10. Calculate frequency deviation $\Delta f = f_c - f_{m.}$
11. Draw the waveform of modulating signal, carrier signal and AM signal on graph paper.

XII. Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XIII. Actual Procedure Followed

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XIV. Precautions Followed

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XV. Observations and Calculations

Table 1: Calculation of frequency deviation of FM.

Vary amplitude Vm and keep the modulating frequency (fm) constant.

f_m = ... Hz

Sr.No	Modulating signal amplitude(v_m)	t_{max}(ms)	f_{min}=1/tmax KHz	$\Delta f = fc - f_{min}$ KHz
1				
2				
3				
4				

Table 2: Calculation of frequency deviation of FM.

Vary frequency fm and keep the modulating voltage (Vm) constant.

V_m =.........

Sr.No	Modulating signal frequency(fm) in Hz	t_{max}(ms) of FM	f_{min}=1/tmax KHz	$\Delta f = fc - f_{min}$ KHz
1				
2				
3				
4				

Calculations:

t_{max}= ……………. ms
$f_{min=}$ ------------------------------ KHz

$\Delta f = fc - f_{min}$= ------------------ KHz

XVI. Results

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XVII. Interpretation of results

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XVIII. Conclusions

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XIX. Practical related Questions

Note: Below given are few sample questions for reference. Teachers <u>must design</u> more such questions so as to ensure the achievement of identified CO.

1. What will be the changes in FM wave when the amplitude of the modulating signal is increased?
2. Draw time domain and frequency domain spectrum of FM wave.
3. Write applications of FM.
4. Give frequency range for FM band.
5. What will be the changes in FM when the frequency of the carrier signal is increased?

[Space for Answers]

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XX References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=OoJ_hWvWIoM
2. https://www.youtube.com/watch?v=f7S05QBWOvs
3. https://www.youtube.com/watch?v=jco8yWnI5qo

XXI Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the trainer kit	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …………………………
2. …………………………
3. …………………………
4. …………………………

Marks Obtained			**Dated signature of Teacher**
Process Related(15)	**Product Related(10)**	**Total (25)**	

Scale

X-axis -

Y-axis -

RENESAS **DATASHEET**

ICL8038

Precision Waveform Generator/Voltage Controlled Oscillator

FN2864
Rev.4.00
Apr 2001

The ICL8038 waveform generator is a monolithic integrated circuit capable of producing high accuracy sine, square, triangular, sawtooth and pulse waveforms with a minimum of external components. The frequency (or repetition rate) can be selected externally from 0.001Hz to more than 300kHz using either resistors or capacitors, and frequency modulation and sweeping can be accomplished with an external voltage. The ICL8038 is fabricated with advanced monolithic technology, using Schottky barrier diodes and thin film resistors, and the output is stable over a wide range of temperature and supply variations. These devices may be interfaced with phase locked loop circuitry to reduce temperature drift to less than 250ppm/°C.

Features

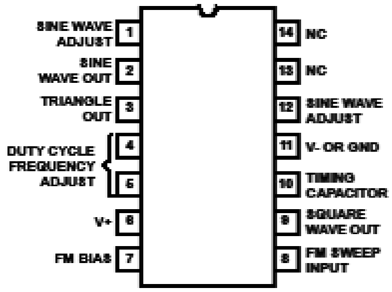
- Low Frequency Drift with Temperature. . . . . . 250ppm/°C
- Low Distortion . . . . 1% (Sine Wave Output)
- High Linearity . . . . .0.1% (Triangle Wave Output)
- Wide Frequency Range . . . . .0.001Hz to 300kHz
- Variable Duty Cycle . . . . 2% to 98%
- High Level Outputs. . . . . TTL to 28V
- Simultaneous Sine, Square, and Triangle Wave Outputs
- Easy to Use - Just a Handful of External Components Required

Ordering Information

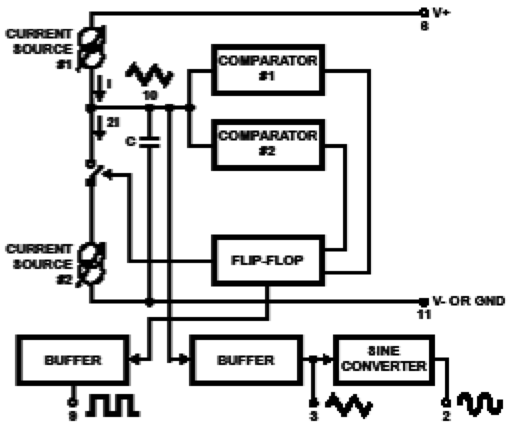
PART NUMBER	STABILITY	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
ICL8038CCPD	250ppm/°C (Typ)	0 to 70	14 Ld PDIP	E14.3
ICL8038CCJD	250ppm/°C (Typ)	0 to 70	14 Ld CERDIP	F14.3
ICL8038BCJD	180ppm/°C (Typ)	0 to 70	14 Ld CERDIP	F14.3
ICL8038ACJD	120ppm/°C (Typ)	0 to 70	14 Ld CERDIP	F14.3

Pinout

ICL8038
(PDIP, CERDIP)
TOP VIEW



Functional Diagram



Practical No.7: Measurement of modulation index of FM wave

I Practical Significance

Frequency modulation is widely used for FM radio broadcasting. FM is commonly used at VHF radio frequencies for high-fidelity broadcasts of music and speech. Analog TV sound is also broadcast using FM. Narrowband FM is used for voice communications in commercial and amateur radio settings. In broadcast services, where audio fidelity is important, wideband FM is generally used. If $m<1$the modulation is called narrowband FM and its bandwidth is approximately 2fm. If $m>1$, the modulation is called wideband FM and its bandwidth is approximately $2\Delta f$. While wideband FM uses more bandwidth, it can improve the signal-to-noise ratio significantly In this practical students will understand the concept of modulation index of FM.

II Relevant Program Outcomes (POs)

1. **Basic knowledge**: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
2. **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
4. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
5. **Individual and team work**: Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry-identified competency: '***Maintain Basic Electronic Communication Systems***'

1. Select proper range of voltage and frequency signals (modulating and carrier).
2. Use CRO/DSO to measure the voltage and frequency

IV Relevant Course Outcomes

1. Use relevant modulation technique for the specified application.
2. Maintain transmitter and receiver circuits of AM and FM.

V Practical Outcome

Generate FM wave and Measure its modulation index.

VI Relevant Affective domain related Outcome(s)

1. Follow safe practices.
2. Handle instruments carefully.

VII Minimum Theoretical Background

The FM modulation index is equal to the ratio of the frequency deviation to the modulating frequency.

Formula for the modulation index for FM:

$$m = \frac{(\text{Frequency deviation})}{(\text{Modulation frequency})}$$

1. If m<1the modulation is called narrowband FM , and its bandwidth is approximately 2fm.
2. If m>1, the modulation is called wideband FM and its bandwidth is approximately 2Δf. While wideband FM uses more bandwidth, it can improve the signal-to-noise ratio significantly.

FM -Modulator circuit using IC 8038 is shown in Fig 7.1 Same IC is used in trainer kit BCT- 02 as shown in Fig 7.2.

VIII Practical Circuit Diagram:

a) Sample: Any relevant circuit (Fig 7.1)/Experimental trainer kit diagram (Fig 7.2)/Experimental set up (Fig 7.3, Fig 7.4)

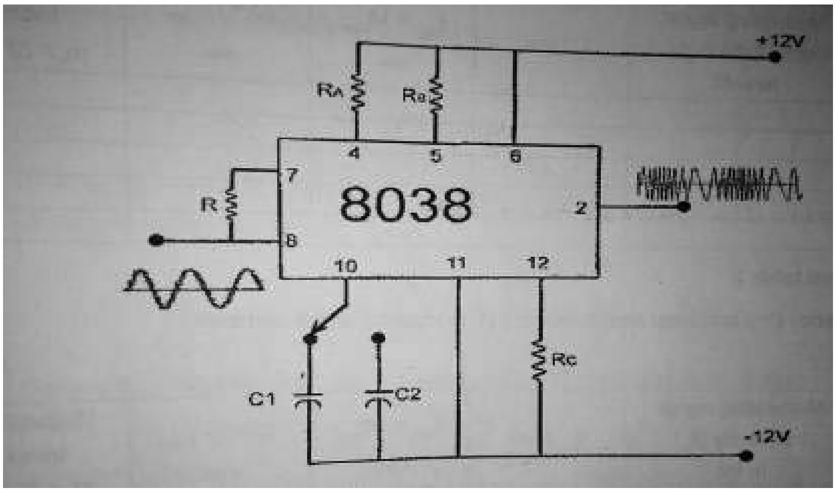


Fig 7.1: Circuit diagram of FM generation

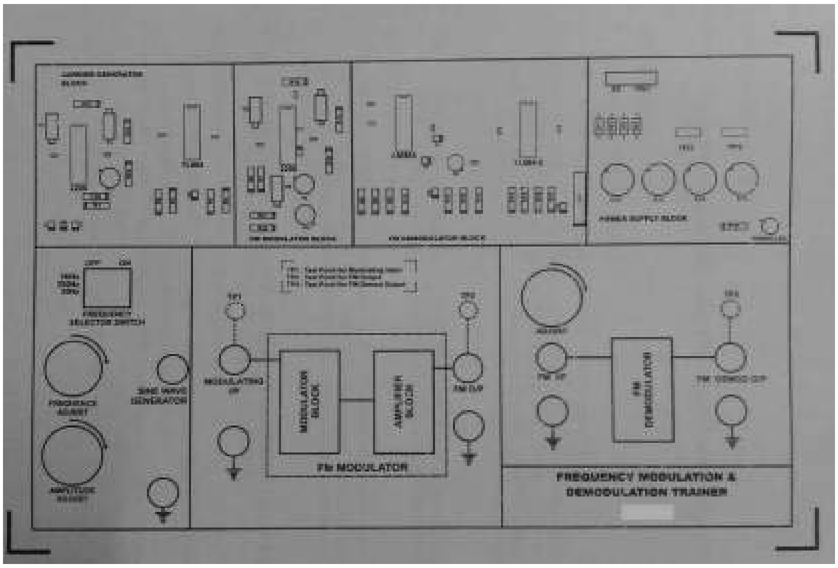


Fig7.2: Trainer kit diagram of FM generation

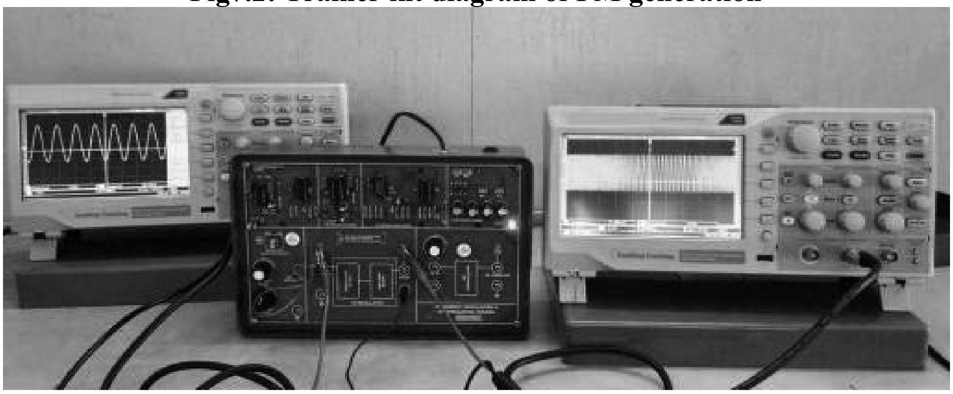


Fig7.3: Experimental set up of FM generation using trainer kit

<u>OR</u>

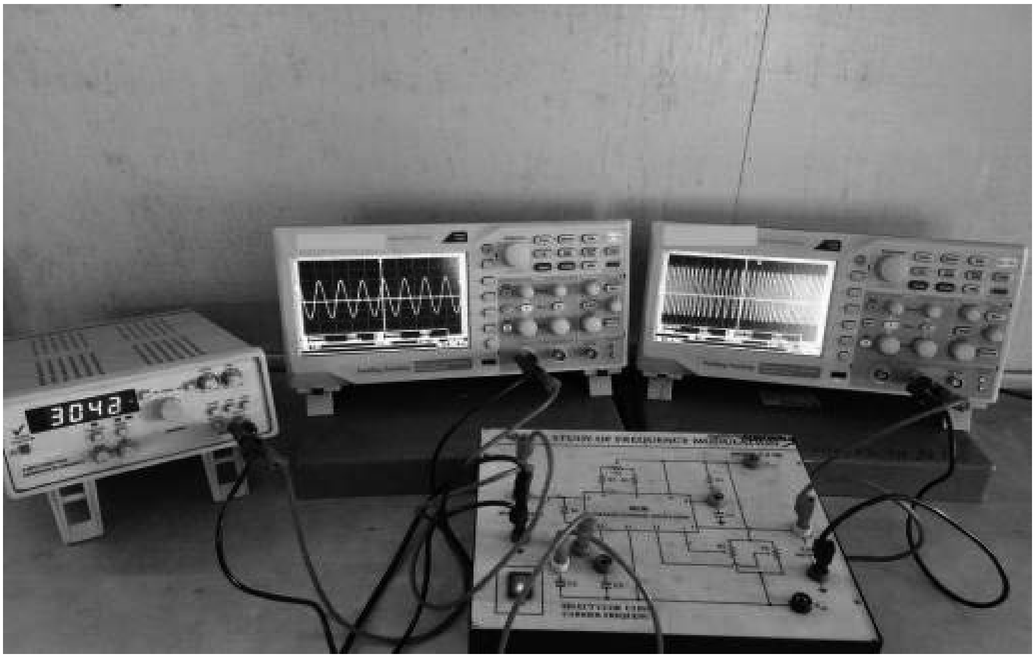


Fig7.4: Experimental set up of FM generation using IC 8038

b) Actual Experimental set up used in laboratory
(Student should draw Experimental set up used in their laboratory)

IX Resources required

Sr. No.	Instrument /Components	Specification	Quantity	Remarks
1.	FM generation trainer kit	Modulating signal- 0-5KHz Carrier signal 100KHz	1	
2.	Function generator	0.01Hz to 1MHz, 10V p-p output.	1	If modulating and carrier signal generator is built in trainer kit then there is no need of function generator.
3.	CRO	25MHz, dual scope	2	Either we can use CRO or DSO to interpret waveform.
	DSO	Bandwidth 30MHz – 200MHz Analog channels 2-4	2	
4.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement	

X Precautions to be followed

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the experiment adjust proper volt/div and times/div selection on CRO/DSO

XI Procedure

1. Make connections as per the given practical set-up as shown in Fig7.3/Fig 7.4.
2. Switch on the power supply.
3. Set sine wave of amplitude 1Vpp and frequency 3 kHz as a modulating signal from function generator inbuilt generator. Connect modulating signal to FM modulator.

4. Set sine wave of amplitude 2Vpp and 50 kHz as a carrier signal from function generator inbuilt generator. Connect carrier signal to FM modulator.
5. Observe FM wave on CRO.
6. Vary amplitude (V_m) and keep frequency of modulating signal constant, Observe FM wave on CRO. Write down the readings in observation table 1.
7. Vary the frequency fm and keep amplitude Vm of modulating signal constant. Observe FM wave on CRO. Write down the readings in observation table 2.
8. Calculate frequency deviation Δf using formula $\Delta f = f_c - f_{min}$.
9. Calculate modulation index using formula $m = \Delta f / f_m$
10. Draw the waveform of modulating signal, carrier signal and FM signal on graph paper for one sample.

XII Resources Used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
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XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Table 1: Calculation of modulation index of FM.

Vary amplitude Vm and keep the modulating frequency (fm) constant.

f_m = ... Hz

Sr.No	Modulating signal amplitude(v_m) volts	t_{max}(ms)	f_{min}=1/t_{max} KHz	Δf = fc -f_{min} KHz	Modulation Index m =Δf /f_m
1					
2					
3					
4					

Table 2: Calculation of modulation index of FM.

Vary frequency fm and keep the modulating voltage (Vm) constant.

Vm = ...volts

Sr.No	Modulating signal frequency(fm) in Hz	t_{max}(ms)	f_{min}=1/t_{max} KHz	Δf = fc -f_{min} KHz	Modulation Index m =Δf /f_m
1					
2					
3					
4					

Calculations:

t_{max}=----------------- ms
$f_{min=}$------------------------------KHz

Δf = fc -f_{min}=------------------ KHz

m =Δf /$f_{m=}$

XVI Results

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XVII Interpretation of results

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XVIII Conclusions

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XIX Practical related Questions

1. List different FM broadcasting stations with value of corresponding frequency.
2. Define frequency deviation.
3. What are the different types of FM modulation based on modulation index?
4. Compare NBFM and WBFM (any 2 parameters).
5. List advantages of FM over AM. (any 2)

[Space for Answers]

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XX References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=2605Y4OSGb0
2. https://www.youtube.com/watch?v=HX-3Z4omvwk
3. http://ieeexplore.ieee.org/document/1697191/?reload=true

XXI Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the trainer kit	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ………………………...
2. ………………………...
3. …………………………
4. …………………………

Marks Obtained			**Dated signature of Teacher**
Process Related(15)	**Product Related(10)**	**Total (25)**	

Scale

X-axis -

Y-axis -

Practical No. 8: Generation of FM Wave using any simulation Software

I Practical Significance

In FM, frequency of the carrier signal is varied in accordance with the instantaneous amplitude of the modulating signal having low frequency. FM signals can be easily plotted using simple MATLAB functions or Simulink. The MATLAB code is shown below, the FM generation can be done by using other simulation software also.

II Relevant Program Outcomes (POs)

1. **Basic knowledge**: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
2. **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
4. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
5. **Individual and team work**: Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency '**Maintain Basic Electronic Communication Systems'.**

1. Use basic programming skills to simulate communication system.
2. Debug and execute the program
3. Interpret the output.
4. Calculate various parameters

IV Relevant Course Outcomes

1. Use relevant modulation technique for the specified application.
2. Maintain transmitter and receiver circuits of AM and FM.

V Practical Outcome

Use any simulation software to generate FM wave.

VI Relevant Affective domain unrelated Outcome(s)

1. Select proper programming environment.
2. Follow ethical practices

VII Minimum Theoretical Background

The modulating signal is mathematically represented as,

$$v_m = V_m \cos(2\pi f_m t) \text{---------------(1)}$$

Where, v_m - Instantaneous amplitude of modulating signal.
V_m -Amplitude of modulating signal
f_m -Modulating signal frequency

Carrier signal is mathematically represented as,

$$v_C = V_c \sin(2\pi f_c t + \square) \text{----------------(2)}$$

Where, v_c- Instantaneous amplitude of carrier signal.

V_c -Amplitude of carrier signal

f_c - Carrier signal frequency

FM wave is mathematically represented as,

$$v_{FM} = Vc \sin [w_c t + \frac{\delta}{f_m} \sin w_m t] \text{-----------------(3)}$$

Where, $m = \frac{\delta}{f_m}$ - Modulation index of FM wave

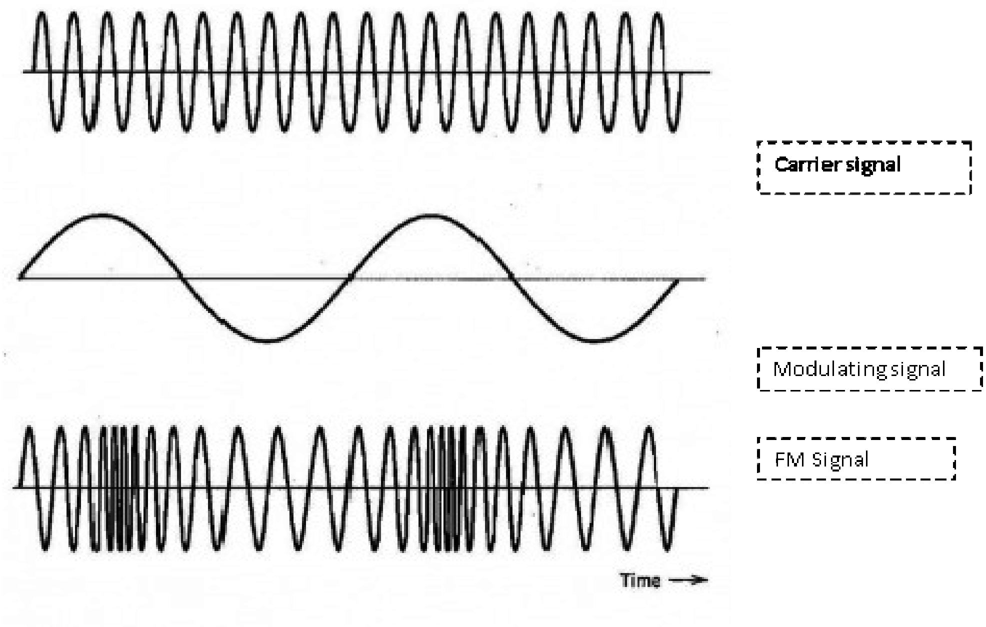

Fig 8.1: FM waveforms

VIII Sample simulation code:

a) FM Generation using MATLAB -simulink (Fig8.2)

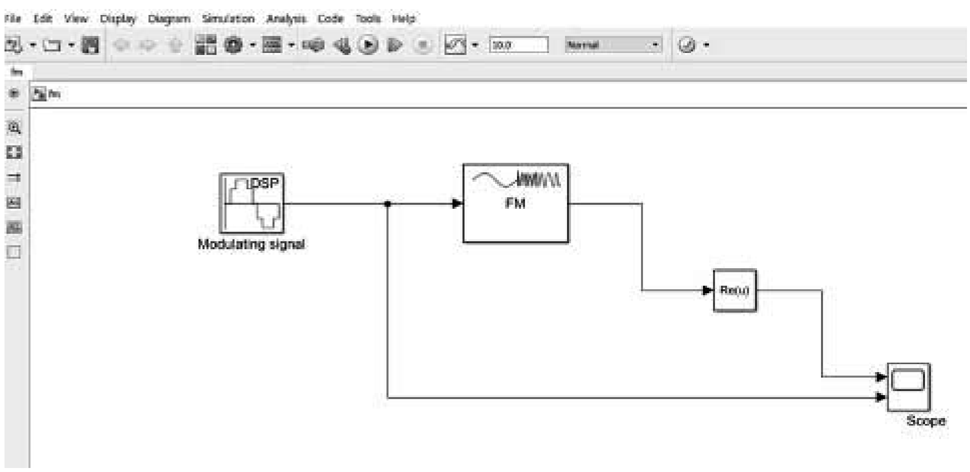

Fig 8.2: FM Generation using MATLAB -simulink

OR

Sample code for FM generation using MATLAB-code

```
clc;
clear all;
close all;
fm=input('Message Frequency=');
fc=input('Carrier Frequency=');
mi=input('Modulation Index=');
t=0:0.0001:0.1;

vm=sin(2*pi*fm*t);
subplot(3,1,1);
plot(t,vm);
xlabel('Time');
ylabel('Amplitude');
title('Message Signal');

grid on;
vc=sin(2*pi*fc*t);
subplot(3,1,2);
plot(t,vc);
xlabel('Time');
ylabel('Amplitude');
title('Carrier Signal');

grid on;
vfm=sin(2*pi*fc*t+(mi.*sin(2*pi*fm*t)));
subplot(3,1,3);
plot(t,y);
xlabel('Time');
ylabel('Amplitude');
title('FM Signal');
grid on;
```

b) Actual simulation code

IX Resources required

Sr. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Computer	Latest Processor	1	
2.	Simulation Software	Lab view/ MATLAB /SCILAB/P Spice /HS Spice / Multisim/ Proteus or any other relevant open source software	1	

X Precautions

1. Ensure proper earthing to the computer system.
2. Ensure compatibility of computer system with software.
3. Ensure proper installation of simulation software.

XI Procedure

1. Open Simulink and create a new model file.
2. Select modulating signal generator and FM baseband modulator from the blocks library.
3. Connect blocks according to figure 8.2
4. Set the amplitude = 1V and frequency of modulating signal 4Hz.
5. Set frequency deviation δf =50Hz for FM baseband modulator.
6. Observe the output FM signal on the scope and save the result.
7. Now increase the amplitude of modulating signal and repeat step 6.

XII Resources used (with major specifications)

Sr. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

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……………………………………………………………………………………………
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XIV Precautions followed

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XV Observations and Calculations

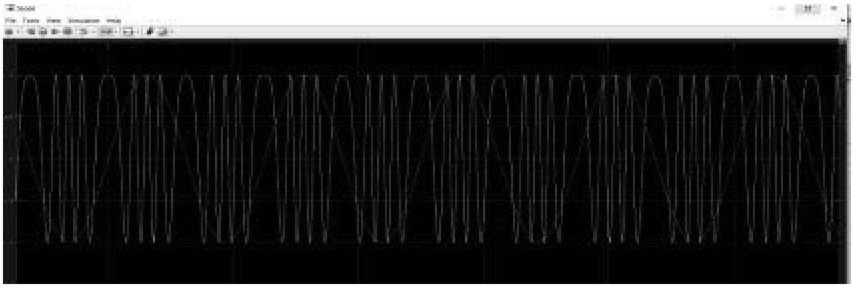

Fig 8.3: FM observed signal on scope (for vm=1, fm=4Hz and f=50Hz**)**

Actual FM observed
(Student should paste the FM waveform for different values of deviation)

XVI Interpretation of results

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XVII Conclusions & Recommendation

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…………………………………………………………………………………………

XVIII Practical related Questions

Note: Below few sample questions are given for the reference. Teachers <u>must design</u> more such questions so as to ensure the achievement of identified CO.

1. State the effect of variation in modulating signal voltage on FM waveform
2. Change the modulating signal frequency and write down effect on FM waveform observed**?**
3. What is the value of modulation index of observed FM waveform?
4. Draw frequency spectrum of FM
5. Calculate bandwidth for observed FM wave by Carson's rule.

[Space for Answers]

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XX References / Suggestions for further Reading

1. http://www.circuitsgallery.com/2012/05/matlab-code-for-amplitude-modulation-am.html
2. https://www.youtube.com/watch?v=t06MYwVjXEQ
3. https://www.youtube.com/watch?v=P1Rb6nNrpZQ

XIX Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of simulation software	10 %
2	Building of diagram	20 %
3	Measuring values from PC Screen	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Correctness of output	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …………………………
2. …………………………
3. …………………………
4. …………………………

Marks Obtained			**Dated signature of Teacher**
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 9: Demodulation of AM signal

I Practical Significance

Demodulation is extracting the original information (message) signal from a modulated signal. The signal output from a demodulator may represent sound (an analog audio signal),images (an analog video signal) or binary data (a digital signal). The diode detector is a very simple method of demodulation. In this practical, students will understand the concept of demodulation of AM signal.

II Relevant Program Outcomes (POs)

1. **Basic knowledge**: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
2. **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
4. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
5. **Individual and team work**: Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry-identified Competency: '***Maintain Basic Electronic Communication Systems***'

1. Select proper range of voltage, frequency of modulating and carrier signals.
2. Use CRO/DSO to measure the voltage and frequency.

IV Relevant Course Outcomes

1. Use relevant modulation technique for the specified application.
2. Maintain transmitter and receiver circuits of AM and FM.

V Practical Outcome

Use AM demodulator circuit to detect the received AM signal.

VI Relevant Affective domain related Outcome(s)

1. Follow safe practices.
2. Handle instruments carefully.

VII Minimum Theoretical Background

The process in which modulated signal is converted back into original modulating signal is called demodulation or detection.

When demodulating a signal, two basic steps may be considered:

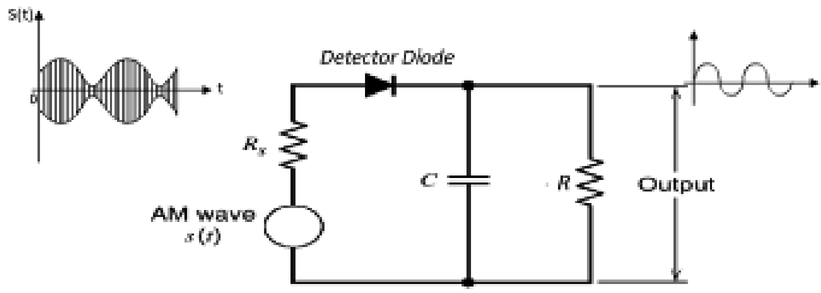

Fig 9.1: AM Demodulation circuit diagram

- **Create baseband signal:** The main element of AM demodulation is to create the baseband signal. This can be achieved in a number of ways - one of the easiest is to use a simple diode.
- **Filter:** The filtering removes any unwanted high frequency elements in the demodulation process.

The AM demodulation process is outlined in the figure 9.2 below.

Fig 9.2: AM demodulation

Diode detector: This is the simplest form of AM demodulator or detector, requiring just a semiconductor (or other form) of diode along with a capacitor to remove the high frequency components as shown in figure 9.2.

In experimental trainer kit as shown in Fig 9.3 AM Modulator circuit is made up of IC TL084 and IC 3086and and AM Demodulator is Diode detector method is made up of IC 565 using PLL(Fig 9.1)

VIII Practical Circuit diagram:

a) Trainer kit used in laboratory(figure 9.3)/ experimental setup(Fig 9.4)

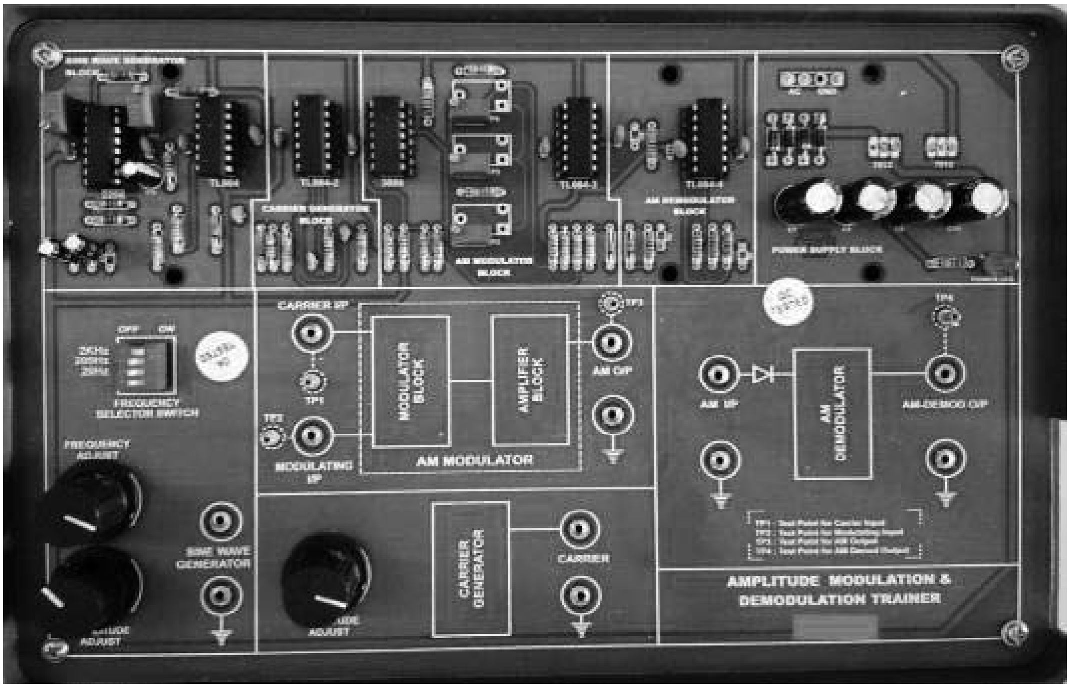

Fig 9.3: AM Demodulation trainer kit

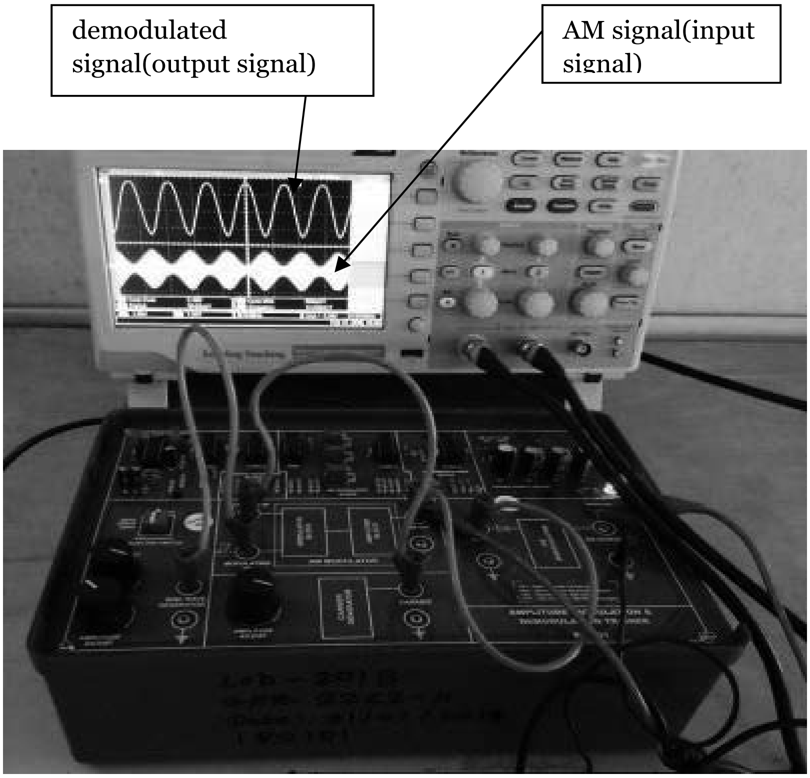

Fig 9.4: AM Demodulation experimental setup

b) Experimental Set up used in laboratory
(Student should draw Experimental set up used in their laboratory)

IX Resources required
X

Sr. No.	Instrument /Components	Specification	Quantity	Remarks
1.	AM demodulation trainer kit	Modulating signal- 0-2kHz Carrier signal 100kHz	1	
2.	Function generator	0.01Hz to 1MHz, 10V p-p output.	1	If modulating and carrier signal generator is built in trainer kit then there is no need of function generator.
3.	CRO	25MHz, dual scope	2	Either we can use CRO or DSO to interpret waveform.
	DSO	Bandwidth 30MHz – 200MHz Analog channels 2-4	2	
4.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement	

XI Precautions to be Followed

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the experiment adjust proper volt/div and times/div selection on CRO/DSO.

XII Procedure

1. Connections are made on AM modulator and demodulator kit as shown in Fig 9.4.
2. Switch on the power supply.
3. Apply sinusoidal signal of 1 KHz frequency and amplitude 2 Vp-p as modulating signal
4. Carrier signal of frequency 11 KHz and amplitude 15 Vp-p.
5. Now slowly increase the amplitude of the modulating signal up to 7V and note down values of V_{max} and V_{min}.
6. Calculate modulation index using equation.
7. Repeat step 5 by varying frequency of the modulating signal.
8. Feed the AM wave to the demodulator circuit and observe the output of LPF.
9. Note down frequency and amplitude of the demodulated output waveform.
10. Draw the demodulated waveform on graph paper for any one reading.

XIII Resources Used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

XIV Actual Procedure Followed

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XV Precautions Followed

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XVI Observations and Calculations

Input AM signal frequency f_c= ------KHz

Table 1: Measurement of %modulation and observation of demodulated signal

Sr.No	V_{max} of input AM signal(volts)	V_{min} of input AM signal(volts)	%m	Peak to peak amplitude of detected output signals V_d(volts)	Frequency of demodulated output signal f_d (Hz)
1					
2					
3					
4					

Calculations

V_{max} =

V_{min} =

%m= $(V_{max}-V_{min})/(V_{max}+V_{min})*100$

Frequency of demodulated output signal f_d (Hz) =

XVII Results

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XVIII Interpretation of results

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XIX Conclusions

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XX Practical related Questions

Note: Below few sample questions are given for the reference. Teachers <u>must design</u> more such questions so as to ensure the achievement of identified CO.

1. What is the charging time of capacitor given?
2. What is the discharging time of capacitor given?
3. List different types of AM detectors.
4. Which AM detector is commonly used?
5. What is the diode number used as diode detection?
6. What is the role of diode in demodulation process?

[Space for Answers]

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XX References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=vddBNW18fgI&t=2s
2. https://www.youtube.com/watch?v=e_gTCU2fnD8
3. https://www.youtube.com/watch?v=GdunxCyMGuw
4. https://www.youtube.com/watch?v=quaKs-68DMk

XXI Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the trainer kit	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Interpretation of result	15%
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …………………………
2. …………………………
3. …………………………
4. …………………………

Marks Obtained			**Dated signature of Teacher**
Process Related(15)	**Product Related(10)**	**Total (25)**	

Scale

X-axis -

Y-axis -

Practical No. 10: Generation of FM wave Using IC 566

I Practical Significance:

Voltage controlled oscillator is a type of oscillator where the frequency of the output oscillations can be varied by varying the amplitude of an input voltage signal. Voltage controlled oscillators are commonly used in frequency (FM), pulse (PM) modulators and phase locked loops (PLL). In this practical students will understand the concept of demodulation of FM signal using IC 566.

II Relevant Program Outcomes (POs)

1. **Basic knowledge**: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
2. **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
4. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
5. **Individual and team work**: Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry-identified Competency: **'*Maintain Basic Electronic Communication Systems*'**

1. Select proper range of voltage, frequency of signal (modulating and carrier).
2. Use CRO/DSO to measure the voltage and frequency of signals(modulating, carrier and modulated).

IV Relevant Course Outcomes

1. Use relevant modulation technique for the specified application.
2. Maintain transmitter and receiver circuits of AM and FM.

V Practical Outcome

Use IC 566 to generate FM waveform and measure modulation index.

VI Relevant Affective domain related Outcomes

1. Follow safe practices.
2. Handle instruments carefully.

VII Minimum Theoretical Background

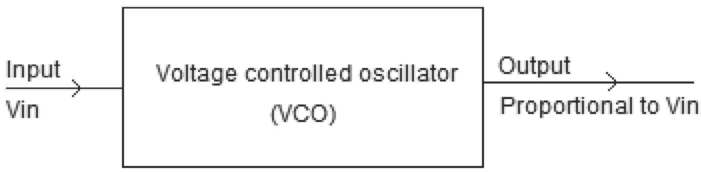

Fig 10.1 Voltage controlled Oscillator

LM566 is a **monolithic voltage controlled oscillator**. It can be used to generate square and triangle waveforms simultaneously. The frequency of the output waveform can be adjusted using an external control voltage. The output frequency can be also programmed using a set of external resistor and capacitor. Typical applications of LM566 IC are signal generators, FM modulators, FSK modulators, tone generators etc. The LM566 IC can be operated from a single supply or dual supply. While using single supply, the supply voltage range is from 10V to 24V. The IC has a very linear modulation characteristics and has excellent thermal stability. The circuit diagram of a voltage controlled oscillator using LM566 is shown in the figure 10.2.

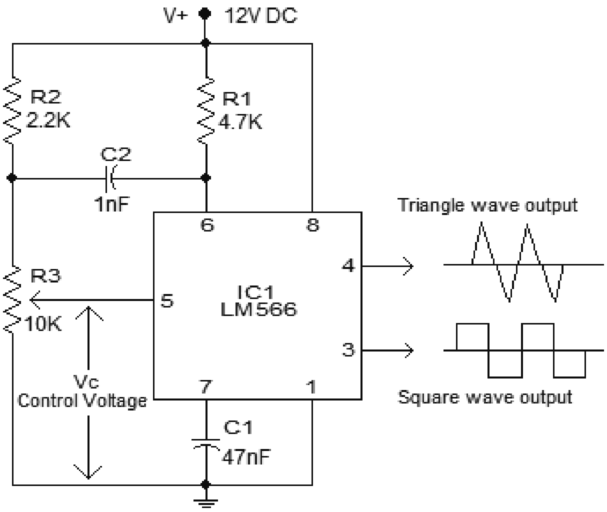

Fig 10.2 FM modulator using IC 566

Resistor R1 and capacitor C1 forms the timing components. Capacitor C2 is used to prevent the parasitic oscillations during VCO switching. Resistor R3 is used to provide the control voltage Vc. Triangle and square wave outputs are obtained from pins 4 and 3 respectively.

VIII Practical Circuit Diagram

a) Sample circuit diagram(Fig10.3)/ Experimental set up (Fig10.4)

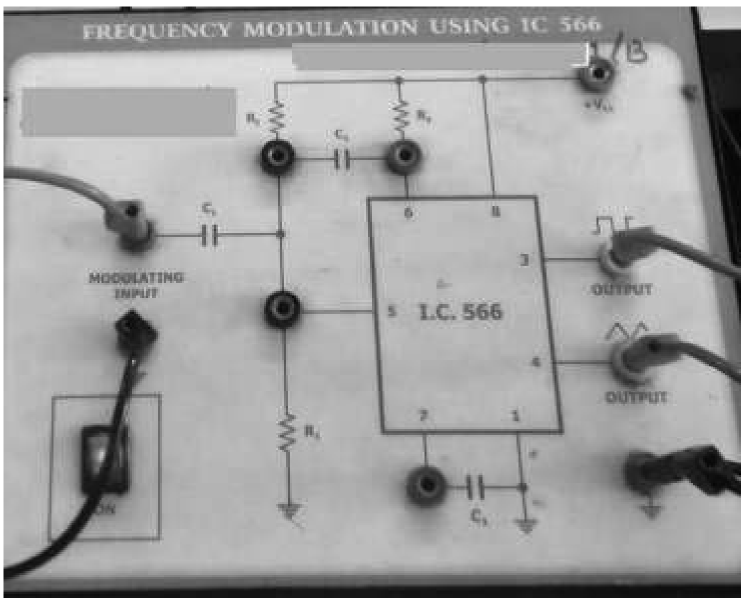

Fig 10.3: Circuit diagram of FM generation using IC 566

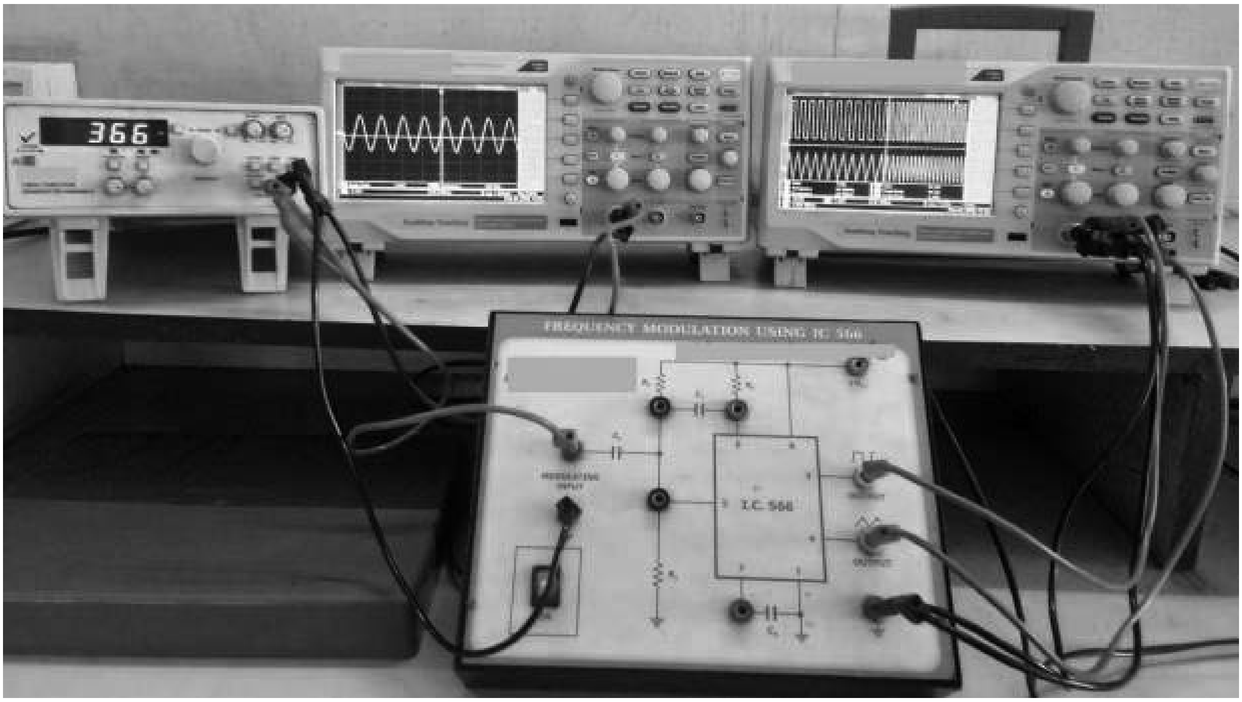

Fig 10.4: Experimental set up of FM generation using IC 566

b) Actual Experimental set up used in laboratory

(Student should draw Experimental set up used in their laboratory)

IX Resources required

Sr. No.	Instrument /Components	Specification	Quantity	Remarks
1.	FM demodulator trainer kit	Modulating signal- 0-5KHz Carrier signal 100KHz	1	
2.	Function generator	0.01Hz to 1MHz, 10V p-p output.	1	If modulating and carrier signal generator is built in trainer kit then there is no need of function generator.
3.	CRO	25MHz,dual scope	2	Either we can use CRO or DSO to interpret waveform.
	DSO	Bandwidth 30MHz – 200MHz Analog channels 2-4	2	
4.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement	

X Precautions

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.

XI Procedure

1. Make the connections as shown in figure 10.4.
2. Before applying modulating signal check the output of IC 566 and measure the frequency fc.
3. Apply the fixed modulating frequency fm from function generator 1KHz
4. Vary the modulating voltage V_m keeping modulating frequency fm constant.
5. Note down the t_{max} and find the f_{min}.
6. Vary the modulating frequency fm keeping the modulating voltage V_m constant.
7. Note down the t_{max} and find the f_{min}.
8. Calculate Δf and modulation index using formula
   $\Delta f = f_c - f_{min}$
   $m = \Delta f / f_m$
9. Draw the waveform of FM of graph paper.

XII Resources used (with major specifications)

Sr. No.	**Equipment's /Components**	**Specification**	**Quantity**
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

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XIV Precautions followed

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XV Observations and Calculations:

Table 1: Calculation of modulation index of FM.

Vary amplitude V_m and keep the modulating frequency (f_m) constant.

f_m = ... Hz

Sr.No	Modulating signal amplitude(v_m)	t_{max}(ms)	$f_{min}=1/t_{max}$ KHz	$\Delta f = f_c - f_{min}$ KHz	Modulation Index $m = \Delta f / f_m$
1					
2					
3					
4					

Table 2: Calculation of modulation index of FM.

Vary frequency fm and keep the modulating voltage (V_m) constant.

V_m = ...volts

Sr.No	Modulating signal frequency(f_m) in Hz	t_{max}(ms)	$f_{min}=1/t_{max}$ KHz	$\Delta f = f_c - f_{min}$ KHz	Modulation Index $m = \Delta f / f_m$
1					
2					
3					
4					

Calculations:

t_{max}=------------------ ms

f_{min}=------------------------------ ms

$\Delta f = fc - f_{min}$=------------------ KHz

$m = \Delta f / f_m$=

XVI Results

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XVII Interpretation of results

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XVIII Conclusions

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XIX Practical related Questions

Note: Below few sample questions are given for the reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Which pin is used for output in IC 566?
2. What is the effect in the value of $t_{max.}$ Keeping f_m constant and varying Vm.
3. For IC 566, fill the following table for modulating and carrier inputs as given in the procedure.

Pin. No	Type of wave	amplitude	frequency
1			
2			
3			
4			
5			
6			
7			
8			

[Space for Answers]

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XX References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=lkLEjqNyaZ8
2. https://www.youtube.com/watch?v=7Yi62Z_kDw8
3. https://www.youtube.com/watch?v=UHtlZe3stEQ&t=12s

XXI Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the trainer kit	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …………………………
2. …………………………
3. …………………………
4. …………………………

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Scale

X-axis -

Y-axis -

Practical No.11: Demodulation of FM Using IC 564/IC 565

I Practical Significance

Frequency demodulator, also called frequency discriminator, is a circuit, which converts instantaneous frequency variations to linear voltage changes. PLL FM demodulators using IC 565 are found in many types of radio equipment ranging from broadcast receivers to high performance communications equipment. In this practical students will understand the concept of FM demodulation using IC 565.

II Relevant Program Outcomes (Pos)

1. **Basic knowledge**: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
2. **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
4. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
5. **Individual and team work**: Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry-identified Competency: **'*Maintain Basic Electronic Communication Systems*'**

1. Select proper range of voltage, frequency of modulating, carrier signals.
2. Use CRO/DSO to measure the voltage and frequency.

IV Relevant Course Outcome(s)

Maintain transmitter and receiver circuits of AM and FM.

V Practical Outcome

Use IC 564 / IC 565 for FM demodulation and trace its input and output waveforms.

VI Relevant Affective domain related Outcome(s)

1. Handle components and equipment carefully.
2. Select instruments of required range.

VII Minimum Theoretical Background

Phase locked loops are widely employed in radio, telecommunications, computers and other electronic applications. They can be used to demodulate a signal, recover a signal from a noisy communication channel.

An IC565 PLL is used for FM demodulation. It contain voltage controlled oscillator which produces the frequency, which is proportional to the voltage applied to it. The frequency of oscillation is determined by resistance and capacitance at pin 8 and 9.

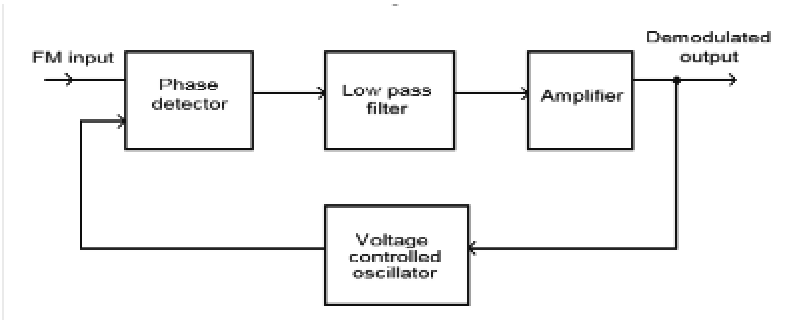

Fig 11.1 PLL block diagram

The block diagram for Phase locked loop demodulator is shown in fig 11.1. The phase detector which is basically balance modulator, produce an average output voltage that is a linear function of the phase difference between the two input signals. The frequency component is selected by the low pass filter which also remove much of the noise. The filtered signal is amplified through amplifier and pass as a control voltage to the VCO where it result in frequency modulation of the VCO frequency. When the loop is in lock the VCO frequency follows or track the incoming frequency. For example when the instantaneous frequency increases. The control voltage will cause the VCO frequency to increase. The pin diagram of IC 565 is shown in Fig 11.2.

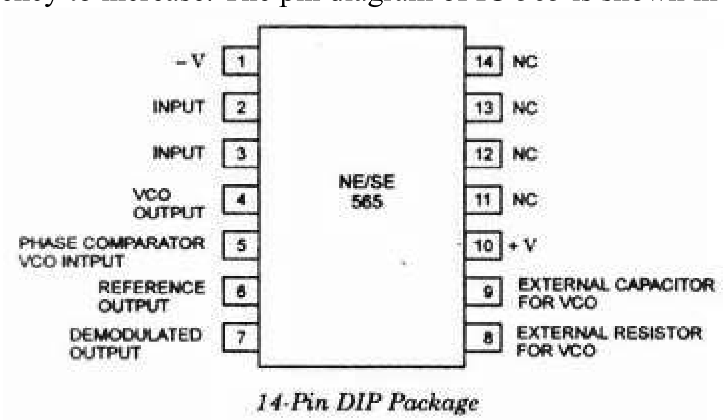

Fig 11.2 IC 565 Pin diagram

VIII Practical Circuit diagram:

a) Sample Circuit diagram(Fig11.3, Fig11.4)/Experimental set up(Fig 11.5)

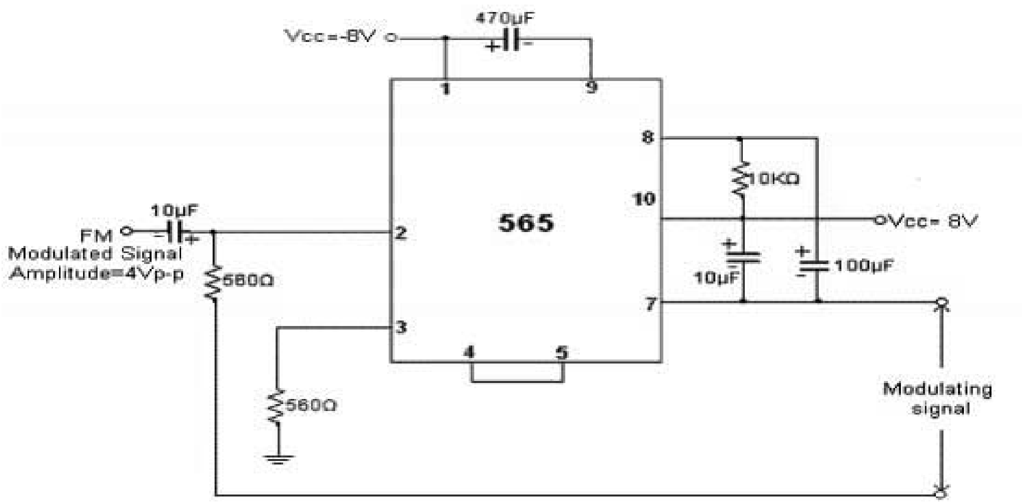

Fig 11.3: FM Demodulation circuit diagram using IC 565

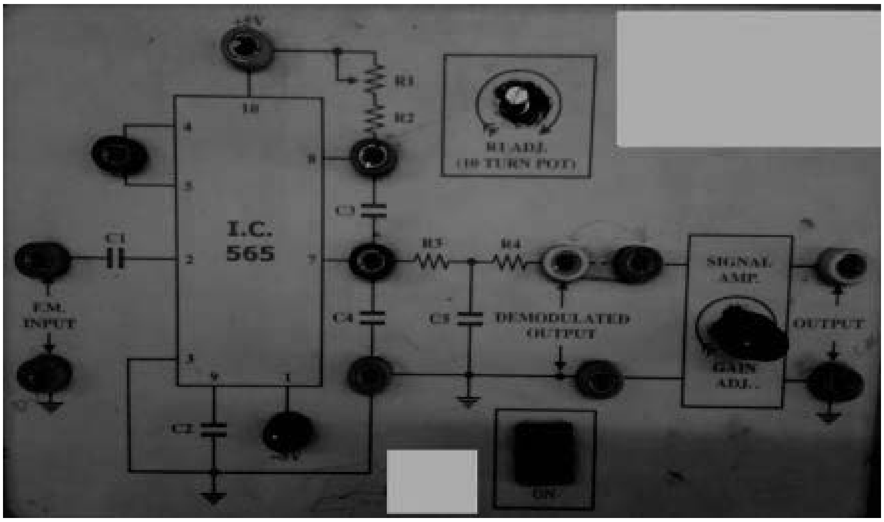

Fig 11.4: FM Demodulation trainer kit using IC 565

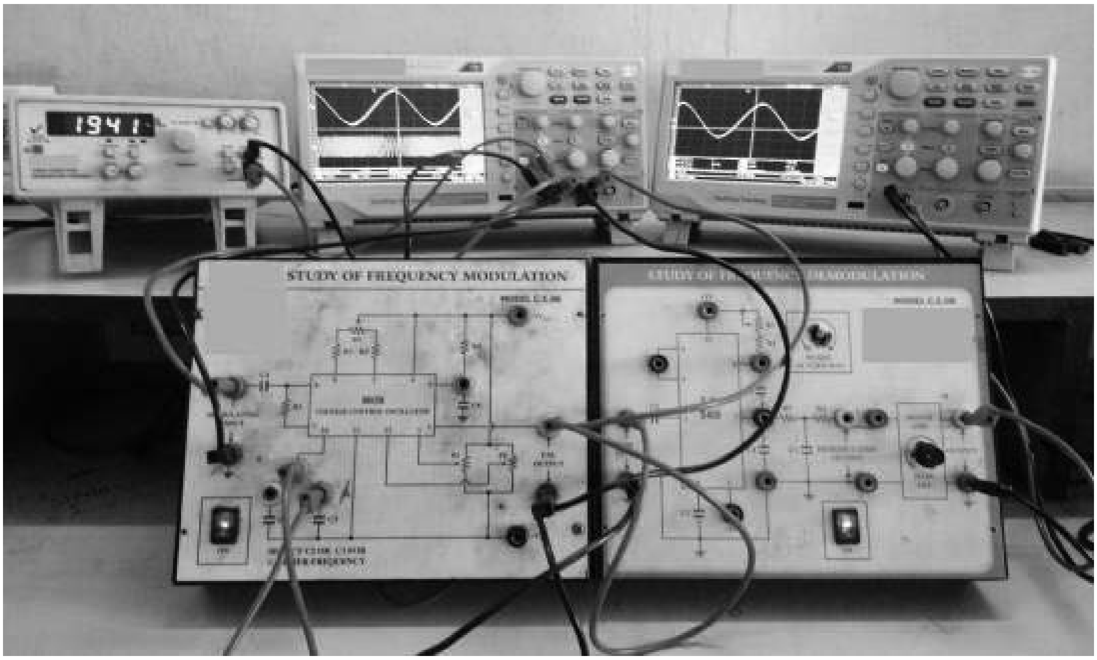

Fig 11.5: FM Demodulation experimental set up using IC 565

b) Actual experimental set up used in laboratory
(Student should draw experimental set up used in their laboratory)

IX Resources required

Sr. No.	Instrument /Components	Specification	Quantity	Remarks
1.	FM Modulator Kit	Using IC 8038	1	
2.	FM Demododulator Kit	Using PLL IC 564/565	1	
3.	Function generator	0.01Hz to 1MHz , 10V p-p output.	1	If modulating and carrier signal generator is built in trainer kit then there is no need of function generator.
4.	CRO	25 MHz ,dual scope	2	Either we can use CRO or DSO to interpret waveform
	DSO	Bandwidth 30 MHz – 200 MHz Analog channels 2-4	2	
5.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement	

X Precautions to be Followed

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the experiment adjust proper volt/div and times/div selection on CRO/DSO.
3. Connect kit and CRO correct polarities as shown in the diagram.

XI Procedure

1. Make the connections as shown in figure 11.5.
2. Before applying modulating signal check the output of IC 8038 and measure frequency fc.
3. Apply the modulating signal fmin from function generator.
4. Vary the amplitude of modulating signal Vm in each step.
5. Note down the t_{max} and find the f_{min}.
6. Calculate Δf and modulation index using formula
7. Apply FM modulated signal at the input of IC 565.
8. Connect the output to CRO and observe waveform of IC 565 circuit and record the result in observation table
9. Draw the waveform of Demodulated signal.

XII Resources Used

Sr. No.	Equipment's /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Table 1: Modulation index of FM signal and observation of demodulated signal

Modulating signal frequency (fm) =
Carrier frequency(fc) =

Sr.No.	Modulating signal voltage Vm	t_{max}	$f_{min}=1/t_{max}$ KHz	$\Delta f = fc - f_{min}$ KHz	Modulation Index $m = \Delta f / f_m$	Demodulated signal frequency (fm) in KHz
1.						
2.						
3.						
4.						
5.						

Calculations:

1. t_{max}=----------------- ms
2. $f_{min=}$------------------------------- ms
3. $\Delta f = fc - f_{min}$=------------------ KHz
4. $m = \Delta f / f_{m=}$
5. Demodulated signal frequency fm in KHz=

XVI Results

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XVII Interpretation of results

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XVIII Conclusions

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XIX Practical related Questions

Note: Below few sample questions are given for the reference. Teachers <u>must design</u> more such questions so as to ensure the achievement of identified CO.

1. List any two applications of phase locked loop.
2. Why limiter is not used before ratio detector**.**
3. For IC 565, fill the following table for modulating and carrier inputs as given in the procedure.

Pin. No	Type of wave	amplitude	frequency
1			
2			
3			
4			
5			
6			
7			
8			

[Space for Answers]

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XX References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=8wdpKBaP-HU
2. https://www.youtube.com/watch?v=Xl-k8unW9sk&t=9s
3. https://www.youtube.com/watch?v=GuIqNa5-JMs

XXI Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the trainer kit	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …………………………
2. …………………………
3. …………………………
4. …………………………

Marks Obtained			Dated signature of Teacher
Process Related(15)	Product Related(10)	Total (25)	

Scale

X-axis -

Y-axis -

Practical No. 12: Measurement of Wave Propagation Parameters Using Simulation Software

I. Practical Significance

The layers of the ionosphere have specific effects on the propagation of radio waves and for that various parameters of the layer must be studied. This practical will help the students to calculate the value of various parameters of ionosphere layer. One of the simulations code is given. Student can use any other software tool.

II Relevant Program Outcomes (Pos)

1. **Basic knowledge**: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
2. **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
4. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
5. **Individual and team work**: Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency '**Maintain Basic Electronic Communication Systems'.**

1. Use basic simulation tools.
2. Interpret the output.

IV Relevant Course Outcomes

Use relevant media for transmission and reception of signals.

V Practical Outcome

Use any simulation software to measure

1. MUF for the given critical frequency and incident angle.
2. Radio horizon for given height of transmitting and receiving antenna

VI Relevant Affective domain unrelated Outcome(s)

1. Select proper programming environment.
2. Follow ethical practices

VII Minimum Theoretical Background

Once Radio signal has been radiated by the antenna, it will travel or propagate through space and will reach the receiving antenna. The three basic path that radio signal can take through space are the **ground wave, the sky wave and the space wave**.

Ground waves

The ground or surface waves leaves the antenna and remains close to the earth. See fig 12.1. The ground wave will actually follow curvature of the earth and travel distances beyond the horizon. Ground wave propagation is strongest in the range 30 KHz to 3MHz**.**

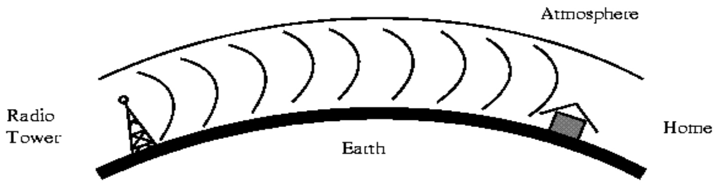


Fig 12.1 Ground wave propagation

Sky wave propagation

In sky wave propagation, the transmitted signal travels in to the upper atmosphere, and then it is bent or reflected back from there to earth. This bending or reflection of the signal takes place due to the presence of a layer called as ionosphere. The various layers of the ionosphere have specific effects on the propagation of radio waves .Principle of sky wave propagation is illustrated in figure12.2.

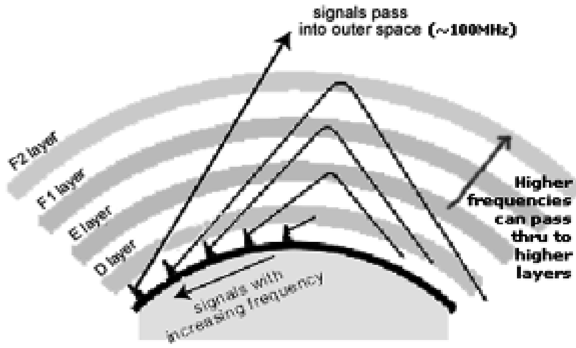


Fig 12.2 Sky wave propagation

The some terminologies related to ionosphere and sky wave propagation are explained here.

1. **Virtual height-** The effective height of a layer of ionized gas in the atmosphere by which radio waves are reflected around the earth's curvature.

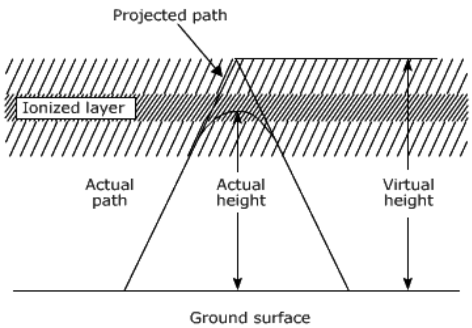


Fig 12.3 Sky wave propagation

2. **Critical frequency-** The critical frequency of layer is defined as the maximum frequency that is returned back to the earth by that layer, when the wave is incident at angle 90 degree (normal) to it. Its value in practice ranges from 5 to12MHz for the F2 layer

3. **Maximal usable frequency (MUF)**- It is that maximum frequency of radio waves which when sent at some angle towards ionosphere, gets reflected and returns to the surface of the earth. Normal values of MUF may range from 8 to 35MHz., but unusual solar activity they may rise to as 50MHz.

$$\text{MUF} = \frac{\text{critical frequency}}{\cos\theta}$$

$$\text{MUF} = f_c * \sec\theta$$

4. **Skip Distance**-The skip distance is defined as the shortest distance from transmitter measured along the surface of earth at which a sky wave of fixed frequency returns back to the earth

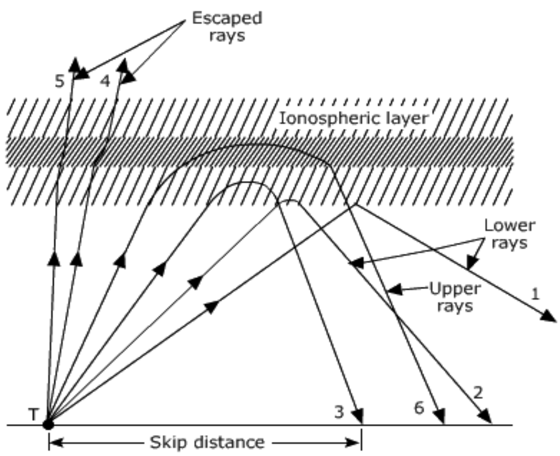


Fig 12.4: Skip Distance

Space wave propagation

Space wave travels in a straight line directly from the transmitting antenna to the receiving antenna. They do not refracted, nor do follow the curvature of the earth. The optical horizon is the farthest point which can be seen by the transmitting antenna and the radio horizon is slightly greater than the optical horizon.

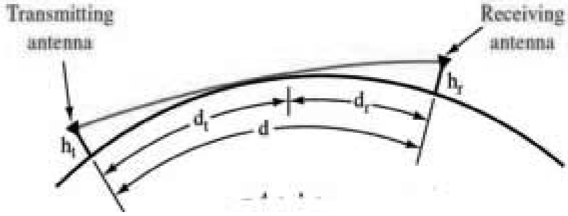


Fig.12.5: Radio Horizon for Space Wave

The radio horizon of an antenna is given, with approximation by the formula

$$d_t=4\sqrt{ht}$$

Where, dt=distance from transmitting antenna in, km

ht=distance from transmitting antenna above ground wave, in m

dr=distance from transmitting antenna in, km

hr=distance from transmitting antenna above ground wave, in m

The total distance will be given by empirical formula,

$$d=d_r + d_t=4\sqrt{ht} +4\sqrt{hr}$$

VIII Sample MATLAB code:

a) Sample MATLAB code to calculate Maximum usable frequency (MUF) of the layer if critical frequency and angle of incidence given.

```
clc;
clear all;
close all'
fc=input('enter the critical frequency of the layer');
theta =input('enter the angle of incidence');
MUF=fc/cos(theta*pi/180) ;
disp('maximum usable frequency of the layer is');
disp(MUF)
```

b) Sample MATLAB code to calculate radio horizon if transmitting antenna and receiving antenna height is given.

```
clc;
clear all;
close all;
ht=input('enetr the height of transmitting antenna in meter');
hr=input('enter height of receiving antenna meter');
d=4*sqrt(ht)+4*sqrt(hr);
disp('Radio horizon for space wave in Kilometers is');
disp(d);
```

c) Actual code used in laboratory

IX Resources required

Sr. No.	Instrument /Components	Specification	Quantity	Remarks
1	Computer	Latest Processor	1	
2	Simulation Software	Lab view/ MATLAB /SCILAB/P Spice /HS Spice / Multisim/ Proteus or any other relevant open source software	2	

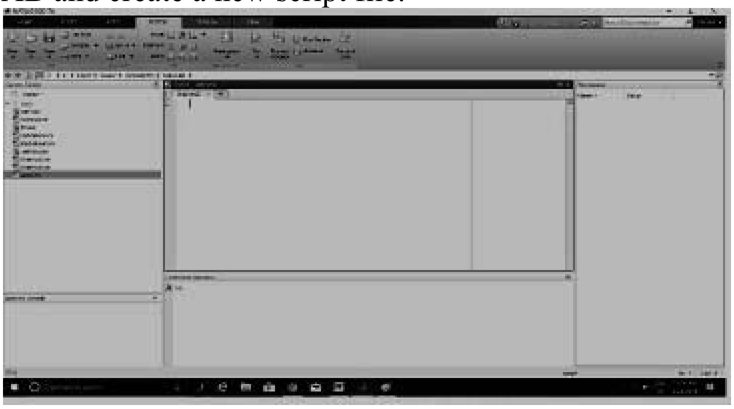
X Precautions

1. Ensure proper earthing to the computer system.
2. Ensure compatibility of computer system with software.
3. Ensure proper installation of simulation software.

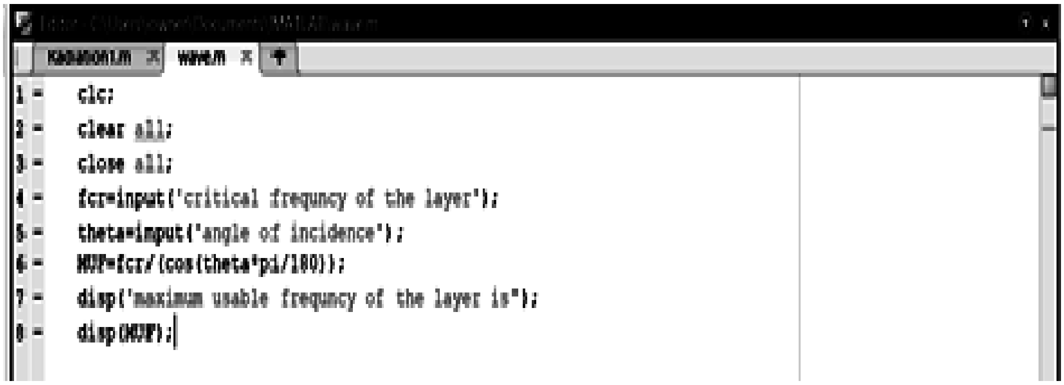
XI Procedure

To calculate Maximum Usable Frequency:

1. Open MATLAB and create a new script file.



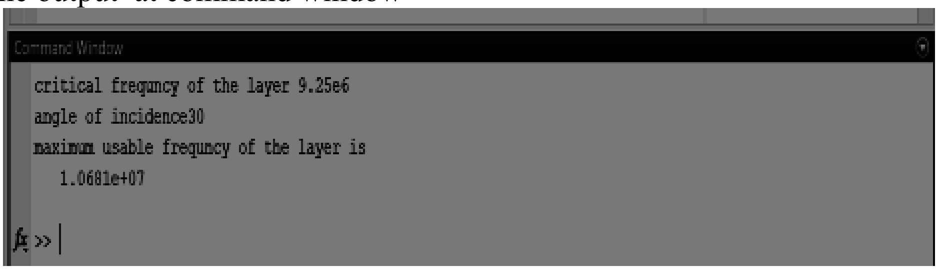
2. Write the code to calculate MUF the file.



3.Run the program using run option.

4.Input the values of critical frequency and angle of incidence

5.Get the output at command window

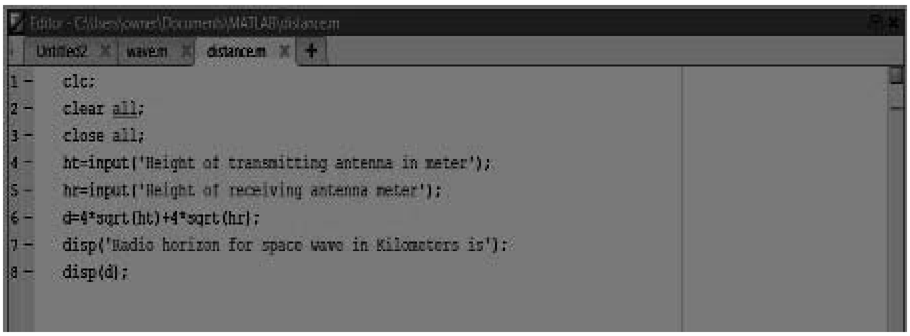


6. Note down values in observation table no.1.

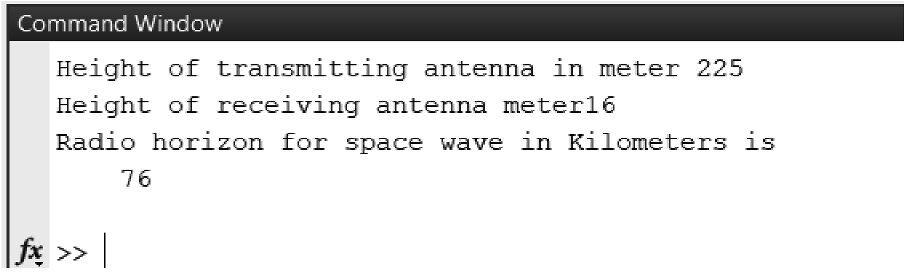
7. Repeat the step3,4, 5 for different values of critical frequency and angle of incidence.

<u>To calculate Radio horizon:</u>

1. Open MATLAB and create a new script file.
2. Write the code to calculate radio horizon the file.



3. Run the program using run option.
4. Input the values of height of transmitting and receiving antenna and Get the output at command window



5. Note down values in observation table no.2.
6. Repeat the step 3,4,5 for different values of height of transmitting and receiving antenna

XII Resources used (with major specifications)

S. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
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XIII Actual procedure followed

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XIV Precautions followed

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XV Observations and Calculations

Table 1: Calculation of MUF

Sr. no.	Critical frequency(fc) (Hz)	Angle of incidence(θ)	$\text{MUF} = \frac{\text{critical frequency}}{\cos\theta}$ (Hz.)
1			

2			
3			
4			

Table.2: Calculation of Radio horizon

Sr.No.	Transmitting Antenna Height(ht) (m)	Receiving Antenna Height(hr) (m)	$d=d_r+d_t=4\sqrt{ht}+4\sqrt{hr}$ (Km)
1			
2			
3			
4			
5			

Sample Calculation:

i. Critical frequency(fc)=…………..Hz

ii. Angle of incidence(θ)=…………..

$$MUF = \frac{\text{critical frequency}}{\cos\theta}$$

=…………Hz

iii. Transmitting Antenna Height(ht)=………….m

iv. Receiving Antenna Height(hr)=……………m

$$d=d_r+d_t=4\sqrt{ht}+4\sqrt{hr}$$

Radio horizon(d) =……………. Km

XVI Results

Maximum usable frequency of the layer (MUF)=…………………..Hz.
Radio horizon for the space wave is(d)=………………………………Km.

XVII Interpretation of results

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XVIII Conclusions & Recommendation

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XIX Practical related Questions

1. Write down the function used in software code to take input from the user.
2. If the critical frequency is 10 KHz in sky wave propagation. what is the best critical frequency to use assuming 30^o of radiation angle
3. A microwave-transmitting antenna is 550 ft. high. The receiving antenna is 200 ft. high. The minimum transmission distance is……
4. Which software is used for the performance? State its version. Is the simulation software used a freeware or licensed?
5. Which command or instruction is used to display its output?

[Space for Answers]

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XX References / Suggestions for further Reading

1. https://www.mathworks.com/campaigns/products/trials.html
2. https://en.wikipedia.org/wiki/Critical_frequency
3. https://www.scribd.com/document/338944473/30-Solved-Problems-on-Wave-Propagation
4. https://electrosome.com/am-generation-simulink/

XXI Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of simulation software	10 %
2	Building of diagram	20 %
3	Measuring values from PC Screen	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Correctness of output	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …………………………
2. …………………………
3. …………………………
4. …………………………

Marks Obtained			**Dated signature of Teacher**
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 13: Radiation Pattern of Dipole Antenna

I Practical Significance

Antennas are a fundamental component of modern communications systems The radiation pattern of the antenna is of principle concern when establishing contact between signal source and its target. Implementing this lab assignment, students will examine the radiation patterns of Dipole antenna by hands on field testing. This allows student to see visually how the most common types of real-world antenna designs function.

II Relevant Program Outcomes (POs)

1. **Basic knowledge**: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
2. **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
4. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
5. **Individual and team work**: Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency **'*Maintain Basic Electronic Communication Systems*'**:

1. Use test and measuring equipment: Field strength meter
2. Interpret the radiation pattern

IV Relevant Course Outcome(s)

Use relevant type of antenna for various applications.

V Practical Outcome

Use field meter to plot the radiation pattern of the given dipole antenna.

VI Relevant Affective domain related Outcome(s)

1. Follow safe practices
2. Demonstrate working as a team member

VII Minimum Theoretical Background

An antenna is metallic structure often wire or collection of wires used to convert high frequency current in to electromagnetic waves and vice versa.

Types of antenna

1. Resonant Antenna
2. Non resonant antennas (Directional antennas)

Different parameters of antenna are

1. Directive Gain
2. Power Gain
3. Radiation Pattern
4. Radiation Resistance

Dipole Antenna-

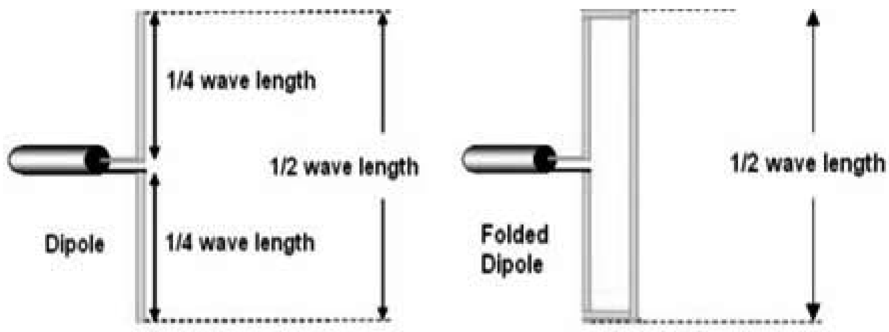

Fig13.1: Dipole antenna

The dipole antennas have lengths of □/2, □ , 3□/..etc multiples of □/2, which corresponds to resonant transmission line, hence the dipole antenna is called as resonant antenna. The length of □/2 is dependent on the frequency at which it is supposed to operate.

Radiation pattern

A graph or diagram which tells us about the manner in which an antenna radiates power in different direction is known as the radiation pattern of an antenna.

The radiation of dipole antenna is maximum at right angles to the dipole and zero along the axis of antenna. The radiation pattern cross section as shown in fig.13.2 of eight with its axis right angle to antenna.

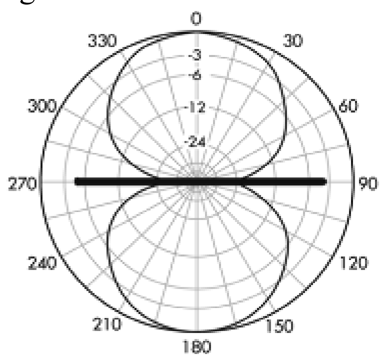

Fig13.2: Radiation pattern of dipole antenna

VIII Circuit diagram:

a) Sample experimental set up(Fig 13.3)

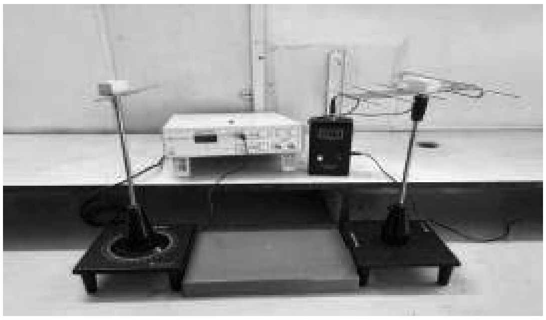

Fig13.3: Sample experimental set up

b) Actual Experimental Set up used in laboratory

IX Resources required

Sr. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Set up of dipole antenna	Vertical polarization broadband 87.5 108 MHz 2.5 db gain directional pattern stainless steel	1	
2.	Field strength meter	Frequency Coverage: 5 MHz to 1000 MHz IF Bandwidth: 15 KHz (6 pole) and 150 KHz	1	

X Precautions to be Followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that connection is as per set up
4. Ensure proper settings of field meter before use.

XI Procedure

1. Make connections as per practical set-up
2. Switch on the power supply
3. Connect output of antenna to field strength meter. Adjust channel selector switch.
4. Rotate antenna in steps of 30^0 and measure field strength.
5. Tabulate the observation.
6. Plot the directional pattern of antenna on attached polar paper according to the readings in observation.

XII Resources Used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations and Calculations

Table 1: Measurement of field strength w.r.t rotation angle

Angle of rotation (□)	Received signal strength(dB)
0°	
30°	
60°	
90°	
120°	
150°	
180°	

210°	
240°	
270°	
300°	
330°	
360°	

XV Results

For dipole antenna, the radiation pattern is figure of……………………………..

XVI Interpretation of results

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XVII Conclusions

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XVIII Practical related Questions

1. What type of radiation pattern dipole antenna produce?
2. What is the signal strength of antenna at 30^0degree?
3. At which angle signal strength is zero?
4. Stick the picture of antenna used in your laboratory.

[Space for Answers]

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XIX References / Suggestions for further Reading

1. en.wikipedia.org/wiki/Radiation_pattern
2. www.tutorialspoint.com/antenna_theory/antenna_theory_radiation_pattern.htm
3. www.allaboutcircuits.com/technical-articles/antenna-basics-field-radiation-patterns-permittivity-direc

XX Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ………………………...
2. …………………………
3. …………………………
4. …………………………

Marks Obtained			**Dated signature of Teacher**
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 14: Radiation Pattern of Yagi-Uda Antenna

I Practical Significance

Antennas are a fundamental component of modern communications systems. The radiation pattern of the antenna is of principle concern when establishing contact between signal source and its target. Implementing this lab assignment, students will examine the radiation patterns of Yagi-Uda antenna by hands on field testing. This allows student to visualize how the most common types of real-world antenna designs function.

II Relevant Program Outcomes (POs)

1. **Basic knowledge**: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
2. **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
4. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
5. **Individual and team work**: Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency '**Maintain Basic Electronic Communication Systems'.**

1. Use test and measuring equipment: Field strength meter.
2. Interpret the radiation pattern.

IV Relevant Course Outcomes

Use relevant type of antenna for various applications.

V Practical Outcome

Use field meter to plot the radiation pattern of given Yagi-Uda antenna.

VI Relevant Affective domain unrelated Outcome(s)

1. Follow safe practices
2. Demonstrate working as a team member

VII Minimum Theoretical Background

A Yagi–Uda antenna consists of dipole antenna (driven element) and one or more "parasitic elements" which are not connected to the transmitter or receiver called reflector and directors. The reflector element is slightly longer than the driven dipole, whereas the directors are a little shorter.

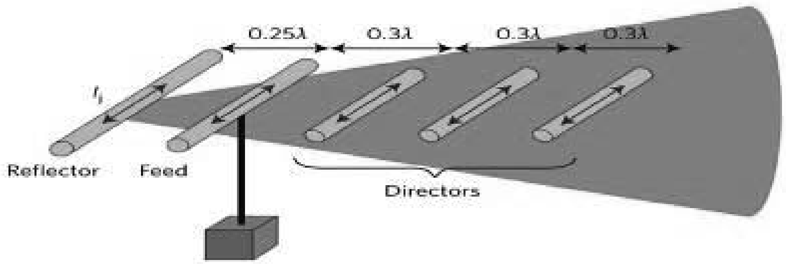


Fig14.1: Yagi –Uda Antenna

Radiation pattern of the Yagi-Uda antenna is shown in figure14.2 which shows that the Yagi-Uda is a directional antenna. The radiation pattern of the dipole is figure of eight. But it is modified by the parasitic elements i.e. reflectors and directors.

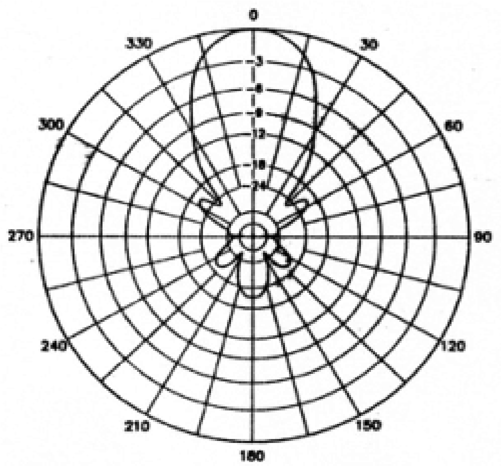
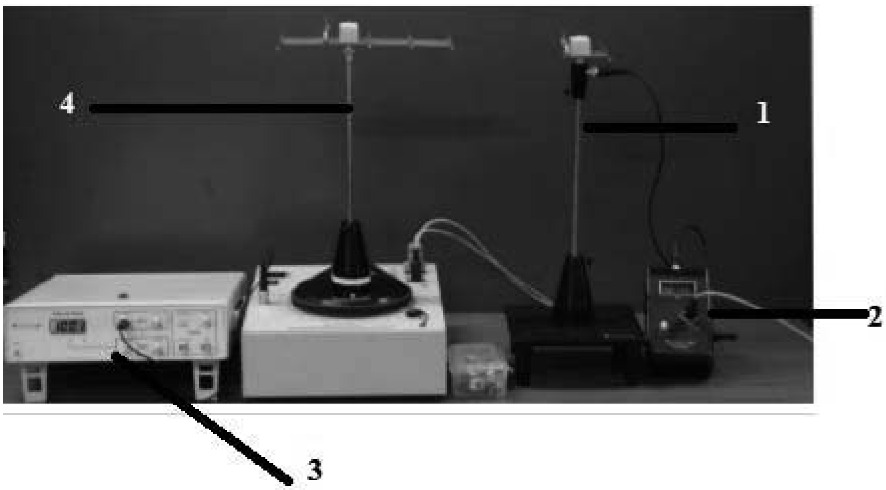


Fig14.2: Radiation Pattern of Yagi-Uda Antenna

VIII Practical Experimental set up :

a) Sample Experimental set up(Fig 14.3)



1-Reciever antenna; 2- Field strength meter; 3-frequency generator; r4- Transmitter antenna

Fig 14.3: Set up to measure radiation pattern of Antenna

b) Actual Circuit used in laboratory

IX Resources required

Sr. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Setup of Yagi-Uda antenna	Vertical polarization broadband 87.5 108MHz 2.5 db gain directional pattern stainless steel	1	
2.	Field strength meter	Frequency Coverage: 5 MHz to 1000 MHz IF Bandwidth: 15 KHz (6 pole) and 150 KHz	1	

X Precautions

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure that connection is as per set up.
4. Ensure proper settings of field meter before use

XI Procedure

1. Make connection as per practical set up
2. Switch on the power supply
3. Connect output of antenna to field strength meter
4. Rotate antenna in steps of 30^0 and measure field strength
5. Tabulate the observation
6. Plot the directional pattern on attached polar paper according to the reading in observation

XII Resources used (with major specifications)

Sr. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

…………………………………………………………………………………………
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XIV Precautions followed

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XV Observations and Calculations

Table 1: Measurement field strength w.r.t rotation angle

Angle of rotation (□)	Received signal strength(dB)
0°	
30°	
60°	
90°	
120°	
150°	
180°	
210°	
240°	
270°	
300°	
330°	
360°	

XVI Results

For Yagi-Uda antenna, the radiation pattern is figure of ……………………………..

XVII Interpretation of results

…………………………………………………………………………………………
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XVIII Conclusions & Recommendation

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XIX Practical related Questions

1. Why Yagi-Uda antenna is not used for microwave frequency?
2. Can antenna function as filter? if yes justify.
3. Can antenna function as transducer? if yes justify.
4. State antenna functions.
5. Name the element used to increase strength of Yagi uda antenna.
6. What is the difference between director and reflector of of Yagi –Uda antenna?
7. State applications of Yagi-Uda Antenna.

[Space for Answers]

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XX References / Suggestions for further Reading

1. en.wikipedia.org/wiki/Radiation pattern
2. www.tutorialspoint.com/antenna_theory/antenna_theory_radiation_pattern.htm
3. https://www.indiamart.com/proddetail/antenna-trainer-kit-15461184912.html
4. www.allaboutcircuits.com/technical-articles/antenna-basics-field-radiation-patterns-permittivity-direc

XXI Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the instruments	10 %
2	Identification of transmitter/receiver antenna	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Correctness of output	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …………………………
2. …………………………
3. …………………………
4. …………………………

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No.15: Radiation pattern of given antenna using simulation software

I Practical Significance

Antenna radiation patterns or plots show quick antenna response. This practical will help the students to plot radiation pattern using software tool. Different antenna exhibit different radiation pattern, which helps in studying the performance of the antenna.

II Relevant Program Outcomes (POs)

1. **Basic knowledge**: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics and Telecommunication engineering problems.
2. **Discipline knowledge**: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunication engineering problems.
4. **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.
5. **Individual and team work**: Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency '**Maintain Basic Electronic Communication Systems'.**

1. Use basic simulation tools.
2. Interpret the output.

IV Relevant Course Outcomes

Use relevant type of antenna for various applications.

V Practical Outcome

Use any simulation software to plot radiation pattern of the given type of antenna.

VI Relevant Affective domain unrelated Outcome(s)

1. Select proper programming environment.
2. Follow ethical practices

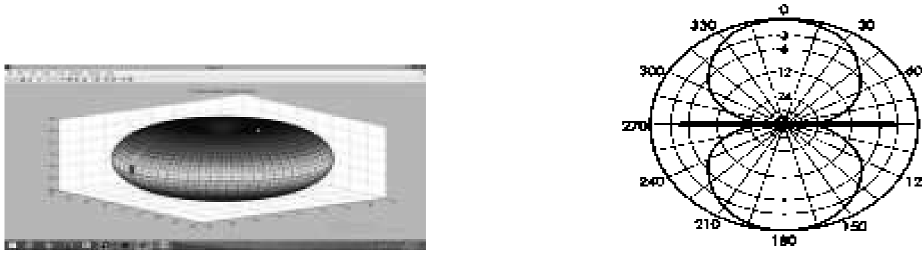
VII Minimum Theoretical Background

Radiation pattern of antenna-

A graph or diagram which tells us about the manner in which an antenna radiates power in different directions is known as the radiation pattern of antenna. It is plot of field strength in V/m verses angle θ.

Radiation pattern is

1. The radiation pattern is plotted on the polar coordinate
2. The field strength is measured at the same fixed distance by rotating the antenna through various angles.



(a) (b)

Fig 15.1: Dipole antenna (a) 3D Radiation pattern (b) 2D Radiation pattern

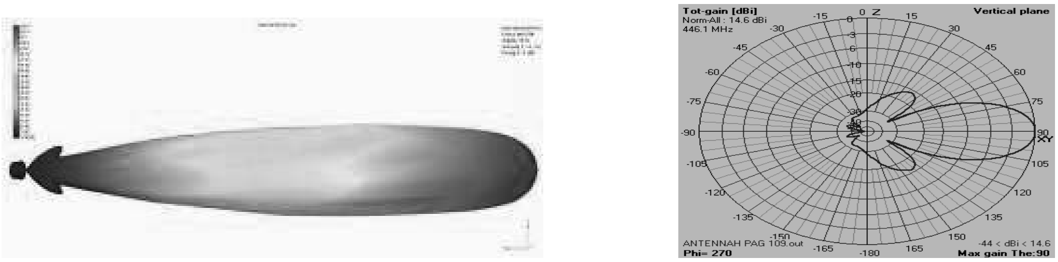


Fig 15.2: Yagi - Uda Antenna (a) 3D Radiation pattern (b) 2D Radiation pattern

VIII Practical Diagram:

a) Sample MATLAB code for radiation pattern of Dipole antenna

```
%All the parameters are entered in the M-File
clear all;
theta=[0:0.12:2*pi];
phi=[0:0.12:2*pi];
l_lamda1=1/100;
I0=1;
n=120*pi;
U1=( n*( I0^2 )*( ( cos(l_lamda1*cos(theta-(pi/2))/2)-cos(l_lamda1/2) )./ sin(theta-
(pi/2)) ).^2 )/(8*(pi)^2);
U1_1=10*log10(U1);
min1=min(U1_1);
U=U1_1-min1;
U(1,1)=0;
for n=1:length(phi)
theta(n,:)=theta(1,:);
end
phi=phi';
for m=1:length(phi)
phi(:,m)=phi(:,1);
end
for k=1:length(U)
U(k,:)=U(1,:);
end
E[x,y,z]=sph2cart(phi,theta,U);
surf(x,y,z)
colormap(copper)
title('Radition Pattern for Dipole Antenna (length=1.5lamda)')
```

```
xlabel('x-axis--->')
ylabel('y-axis--->')
zlabel('z-axis--->')
```

c) Actual simulation code for radiation pattern of Dipole antenna

IX Resources required

Sr. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Computer	Latest Processor	1	
2.	Simulation Software	Lab view/ MATLAB /SCILAB/P Spice /HS Spice / Multisim/ Proteus or any other relevant open source software	1	

X Precautions

1. Ensure proper earthing to the computer system.
2. Ensure compatibility of computer system with software.
3. Ensure proper installation of simulation software

XI Procedure

1. Start MATLAB and open new m-file.
2. Type sample MATLAB code for Dipole antenna in file.
3. Save and run file.
4. Observe 3D –radiation pattern on figure window.

5. Save the result.
6. Open Antenna toolbox
7. Get MATLAB code for Yagi-Uda antenna.
8. Run the code and save the result

XII Resources used (with major specifications)

Sr. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

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XIV Precautions followed

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XV Observations

Paste the radiation pattern of antenna

XVI Results

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XVII Interpretation of results

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XVIII Conclusions & Recommendation

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XIX Practical related Questions

1. What is meant by directional antenna?
2. Describe radiation pattern of Dipole antenna observed.
3. Describe radiation pattern of Yagi-Uda antenna observed.
4. Write names of the other software can be used to plot radiation pattern.
5. Define isotropic antenna .Draw its radiation pattern.

[Space for Answers]

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XX References / Suggestions for further Reading

1. http://www.youtube.com/watch?v=fGf_ng7qljI
2. http://www.circuitsgallery.com/2012/05/matlab-code-for-amplitude-modulation-am.html
3. https://electrosome.com/am-generation-simulink/

XXI Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of simulation software	10 %
2	Building of diagram	20 %
3	Measuring values from PC Screen	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Correctness of ouput	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …………………………
2. …………………………
3. …………………………
4. …………………………

Marks Obtained			Dated signature of Teacher
Process Related(15)	Product Related(10)	Total (25)	

List Of Laboratory Manuals Developed by MSBTE

First Semester:

1	Fundamentals of ICT	22001
2	English	22101
3	English Work Book	22101
4	Basic Science (Chemistry)	22102
5	Basic Science (Physics)	22102

Second Semester:

1	Bussiness Communication Using Computers	22009
2	Computer Peripherals & Hardware Maintenace	22013
3	Web Page Design with HTML	22014
4	Applied Science (Chemistry)	22202
5	Applied Science (Physics)	22202
6	Applied Machines	22203
7	Basic Surveying	22205
8	Applied Science (Chemistry)	22211
9	Applied Science (Physics)	22211
10	Fundamental of Electrical Engineering	22212
11	Elements of Electronics	22213
12	Elements of Electrical Engineering	22215
13	Basic Electronics	22216
14	'C' programming Language	22218
15	Basic Electronics	22225
16	Programming in "C"	22226
17	Fundamentals of Chemical Engineering	22231

Third Semester:

1	Applied Multimedia Techniques	22024
2	Advanced Serveying	22301
3	Highway Engineering	22302
4	Mechanics of Structures	22303
5	Building Construction	22304
6	Concrete Technology	22305
7	Strength Of Materials	22306
8	Automobile Engines	22308
9	Automobile Transmission System	22309
10	Mechanical Operations	22313
11	Technology Of Inorganic Chemicals	22314
12	Object Oriented Programming Using C++	22316
13	Data Structure Using 'C'	22317
14	Computer Graphics	22318
15	Database Management System	22319
16	Digital Techniques	22320
17	Principles Of Database	22321
18	Digital Techniques & Microprocessor	22323
19	Electrical Circuits	22324
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22	Electrical Materials & Wiring Practice	22328
23	Applied Electronics	22329
24	Electrical Circuits & Networks	22330
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26	Principles Of Electronics Communication	22334
27	Thermal Engineering	22337
28	Engineering Matrology	22342
29	Mechanical Engineering Materials	22343
30	Theory Of Machines	22344

Fourth Semester:

1	Hydraulics	22401
2	Geo Technical Engineering	22404
3	Chemical Process Instrumentation & Control	22407
4	Fluid Flow Operation	22409
5	Technology Of Organic Chemicals	22410
6	Java Programming	22412
7	GUI Application Development Using VB.net	22034
8	Microprocessor	22415
9	Database Managment	22416
10	Electric Motors And Transformers	22418
11	Industrial Measurements	22420
12	Digital Electronics And Microcontroller Applications	22421
13	Linear Integrated Circuits	22423
14	Microcontroller & Applications	22426
15	Basic Power Electronics	22427
16	Digital Communication Systems	22428
17	Mechanical Engineering Measurments	22443
18	Fluid Mechanics and Machinery	22445
19	Fundamentals Of Mechatronics	22048

Fifth Semester:

1	Design of Steel and RCC Structures	22502
2	Public Health Engineering	22504
3	Heat Transfer Operation	22510
4	Environmental Technology	22511
5	Operating Systems	22516
6	Advanced Java Programming	22517
7	Software Testing	22518
8	Control Systems and PLC's	22531
9	Embedded Systems	22532
10	Mobile and Wireless Communication	22533
11	Industrial Machines	22523
12	Switchgear and Protection	22524
13	Energy Conservation and Audit	22525
14	Power Engineering and Refrigeration	22562
15	Solid Modeling and Additive Manufacturing	22053
16	Guidelines & Assessment Manual for Micro Projects & Industrial Training	22057

Sixth Semester:

1	Solid Modeling	17063
2	Highway Engineering	17602
3	Contracts & Accounts	17603
4	Design of R.C.C. Structures	17604
5	Industrial Fluid Power	17608
6	Design of Machine Elements	17610
7	Automotive Electrical and Electronic Systems	17617
8	Vehicle Systems Maintenance	17618
9	Software Testing	17624
10	Advanced Java Programming	17625
11	Mobile Computing	17632
12	System Programing	17634
13	Testing & Maintenance of Electrical Equipments	17637
14	Power Electronics	17638
15	Illumination Engineering	17639
16	Power System Operation & Control	17643
17	Environmental Technology	17646
18	Mass Transfer Operation	17648
19	Advanced Communication System	17656
20	Mobile Communication	17657
21	Embedded System	17658
22	Process Control System	17663
23	Industrial Automation	17664
24	Industrial Drives	17667
25	Video Engineering	17668
26	Optical Fiber & Mobile Communication	17669
27	Therapeutic Equipment	17671
28	Intensive Care Equipment	17672
29	Medical Imaging Equipment	17673

Pharmacy Lab Manual

First Year:

1	Pharmaceutics - I	0805
2	Pharmaceutical Chemistry - I	0806
3	Pharmacognosy	0807
4	Biochemistry and Clinical Pathology	0808
5	Human Anatomy and Physiology	0809

Second Year:

1	Pharmaceutics - II	0811
2	Pharmaceutical Chemistry - II	0812
3	Pharmacology & Toxicology	0813
4	Hospital and Clinical Pharmacy	0816

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