Name : ______________________________

Roll No. : ________________ Year : 20___ 20___

Exam Seat No. : ______________________

SCHEME : K

LABORATORY MANUAL FOR
PRINCIPLES OF ELECTRONIC COMMUNICATION (313326)

ELECTRONICS ENGINEERING GROUP

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 challenging technological & 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 following

- Skill development in line with industry requirements
- Industry readiness and improved employability of Diploma holders
- Synergistic relationship with industry
- Collective and Cooperative development of all stake holders
- Technological interventions in societal development
- Access to uniform quality technical education

A Laboratory manual
for

Principles of Electronic Communication

(313326)

Semester – III

(DE/EJ/ET/EX/IE)

Maharashtra State
Board of Technical Education, Mumbai

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

Maharashtra State Board of Technical Education , Mumbai

(Autonomous) (ISO 9001:2015) (ISO/IEC 27001:2013)
4th Floor, Government Polytechnic Building, 49,
Kherwadi, Bandra (East), Mumbai- 400051.
(Printed on July 2024)

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

Certificate

This is to certify that Mr./Ms…………………….................................

Roll No.…………. of third Semester of Diploma in…..…………..

of Institute…….…………………………………………………….……

(Code : ………) has attained pre-defined practical outcomes (PROs) satisfactorily in course **Principles of Electronic Communication (313326)** for the academic year 20…... .to 20……. as prescribed in the curriculum.

Place: ……………..   Enrollment No. :……………..…….

Date: ……………..   Exam Seat No.: ………………

Course Teacher   **Head of department**   **Principal**

Seal of Institute

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 'K' Scheme curricula for engineering diploma programmes with outcome-based education as the focus and accordingly, a 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 realize that every minute of the laboratory time needs 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 course 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 "K’ 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 predetermined 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 the 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)

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

PO1: Basic and Discipline specific knowledge: Apply knowledge of basic mathematics, science `and engineering fundamentals and engineering specialization to solve the broad based Electronic Engineering group program problems.

PO2: Problem analysis: Identify and analyze well-defined Electronic Engineering group program problems using codified standard methods.

PO3: Design/ development of solutions: Design solutions for well-defined technical problems and assist with the design of Electronic Engineering group program systems components or processes to meet specified needs.

PO4: Engineering Tools, Experimentation and Testing: Apply modern Electronic Engineering group program tools and appropriate technique to conduct standard tests and measurements.

PO5: Engineering practices for society, sustainability and environment: Apply appropriate Electronic Engineering group program technology in context of society, sustainability, environment and ethical practices.

PO6: Project Management: Use Electronic Engineering group program management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.

PO7: Life-long learning: Ability to analyze individual needs and engage in updating in the context of Electronic Engineering group program technological changes.

List of Industry Relevant Skills

The following industry relevant skills of the identified competency "Maintain basic electronic communication system."are expected to be developed in the student by undertaking the laboratory work as given in 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.
5. Interpret propagation mode for specific radio frequency bands.

Practical-Course Outcome Matrix

COURSE LEVEL LEARNING OUTCOMES (COS)

1. CO1 – Select relevant frequency range/band for different communication modes.
2. CO2 – Maintain AM based communication system.
3. CO3 – Maintain FM based communication system.
4. CO4 – Identify Propagation mode for specified radio frequency bands.
5. CO5 – Identify relevant types of antenna for given frequency range/application.

Sr.No.	Title of the Practical	CO1	CO2	CO3	CO4	CO5
1	Demonstrate the simplex,half duplex and full duplex communication link using switches,wires and LEDs.	✓	-	-	-	-
2	Observe the different analog and digital signals on CRO and spectrum analyzer in time domain and frequency domain.	✓	-	-	-	-
3	Observe the AM modulated waveforms generated for different modulating frequencies.	-	- ✓	-	-	-
4	Generate AM wave and measure its modulation index for different values of modulating signal amplitude.	-	✓	-	-	-
5	Build and test the AM demodulator circuit.	-	✓	-	-	-
6	Display the AM modulator and demodulator signal using MATLAB simulink/SCILAB/relevant software for different modulating frequencies.	-	✓	-	-	-
7	Test the output of various stages/blocks of the AM receiver.	-	✓	-	-	-
8	Build and test FM signal using voltage controlled oscillator/IC 566 to measure frequency deviation and modulation index.	-	-	✓	-	-
9	Display FM signal using suitable simulation software such as MATLAB/SCILAB/relevant software.	-	-	✓	-	-
10	Demodulate the given FM signal using IC 564/565 and test the output from the given input waveforms.	-	-	✓	-	-
11	Test the output of various stages/blocks of the FM receiver.	-	-	✓	-	-
12	Use simulation software to measure MUF for the given critical frequency and incident angle.	-	-	-	✓	-
13	Test the performance of a given dipole antenna ,measure the field strength and plot the radiation pattern for different lengths of antenna.	-	-	-	-	✓

14	Test the performance of a given Yagi-Uda antenna.	-	-	-	-	✓
15	Use suitable simulation software to plot the radiation pattern of a given antenna.	-	-	-	-	✓

Guidelines to Teachers

1. Teacher should provide the guideline with demonstration of practical to the students with all features.
2. Teacher shall explain prior concepts to the students before starting of each practical.
3. Involve students in the performance of each experiment.
4. Teacher should ensure that the respective skills and competencies are developed in the students after the completion of the practical exercise.
5. Teachers should give opportunities to students for hands-on experience after the demonstration.
6. Teacher is expected to share the skills and competencies to be developed in the students.
7. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected of the students by the industry.
8. Finally give practical assignments and assess the performance of students based on tasks assigned to check whether it is as per the instructions.
9. Teacher is expected to refer complete curriculum document and follow guidelines for implementation
10. At the beginning of the practical which is based on the simulation, teacher should make the students acquainted with any simulation software environment.

Instructions for Students

1. Listen carefully to the lecture given by the teacher about course, curriculum, learning structure, skills to be developed.
2. Organize the work in the group and make a record of all observations.
3. Do the calculations and plot the graph wherever it is required in the practical
4. Students shall develop maintenance skills as expected by industries.
5. Student shall attempt to develop related hand-on skills and gain confidence.
6. Student shall develop the habits of evolving more ideas, innovations, skills etc. those included in scope of manual
7. Student should develop the habit to submit the practical on date and time.
8. Student should prepare well while submitting a write-up of exercise.

Content Page

List of Practicals and Progressive Assessment Sheet

9	Display FM signal using suitable simulation software such as MATLAB/SCILAB/relevant software.	70					
10*	Demodulate the given FM signal using IC 564/565 and test the output from the given input waveforms.	80					
11	Test the output of various stages/blocks of the FM receiver.	88					
12	Use simulation software to measure MUF for the given critical frequency and incident angle.	96					
13	Test the performance of a given dipole antenna ,measure the field strength and plot the radiation pattern for different length of antenna.	108					
14	Test the performance of a given Yagi-Uda antenna.	115					
15*	Use suitable simulation software to plot the radiation pattern of a given antenna.	121					
Total							

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

Practical No. 1:Demonstrate the simplex, half duplex and full duplex communication link using switches, wires and LEDs.

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 directions but not simultaneously. This practical is designed to explain how data flows in simplex and half duplex systems.

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

II. Industry /Employer Expected Outcomes

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

III. Course Level Learning Outcomes:

CO1 – Select relevant frequency range/band for different communication mode

IV. Laboratory Learning Outcomes

LLO 1.1- Test the output of simplex and duplex mode of communication

LLO 1.2- Determine the number of channels for simplex,half duplex and full duplex communication.

V. Relevant Affective domain unrelated Outcome(s)

1.Follow safe practices

2.Handle instruments carefully.

3.Follow ethical practices.

VI. Relevant Theoretical Background

A simplex communication link can transmit data only in one direction as shown in Figure 1.1 This happens because the communication channel is only used by the transmitter. Terminal A is the transmitter and terminal B is the receiver. Terminal A is sending data towards terminal B is only receiving data.

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

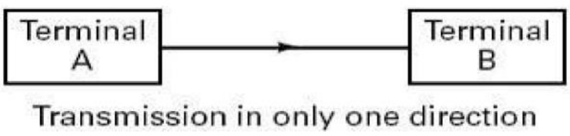


Fig 1.1:Simplex communication link

Half duplex communication link means that communication can takes place in either direction between two systems but only one at a time as shown in figure 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 the walky-talky system.

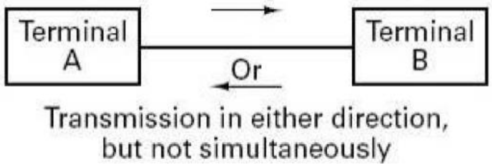


Fig 1.2: Half duplex communication link

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 1.3

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

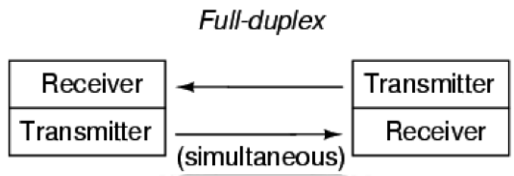
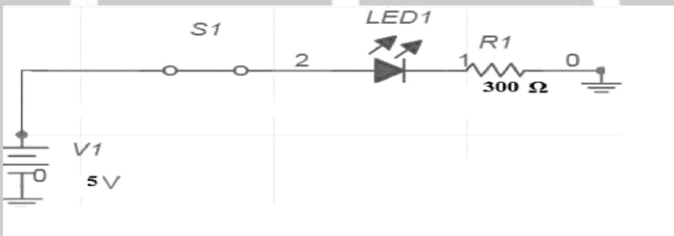


Fig 1.3:Full duplex communication link

VII. Actual Circuit diagram used in a laboratory with related equipment rating.

a. Suggestive Circuit diagram (Simplex communication):



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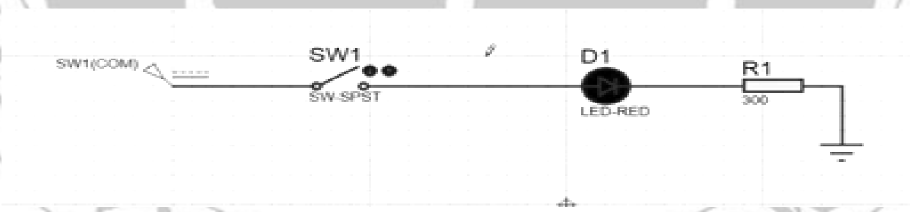
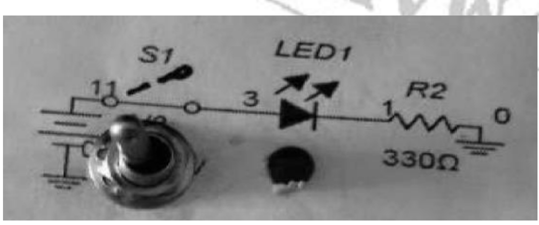


Fig 1.4 : Simplex communication using LED and switch

Layout of Laboratory (Simplex communication)



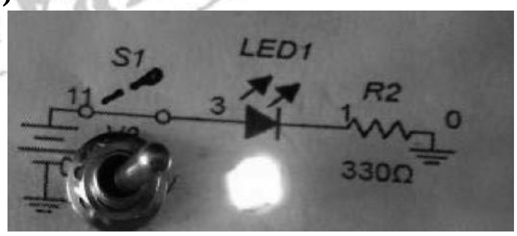
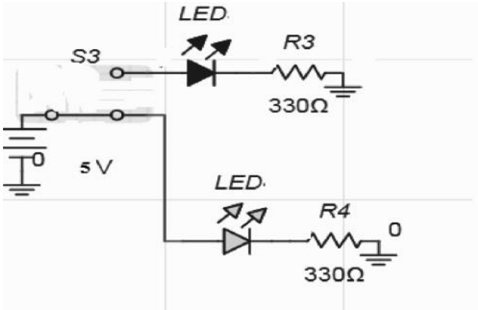


Fig 1.5 : When S_1 is open **When S_1 is Closed**

Circuit diagram (Half Duplex):



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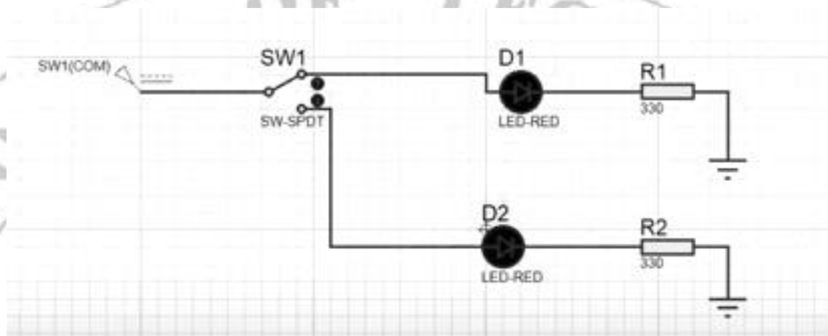
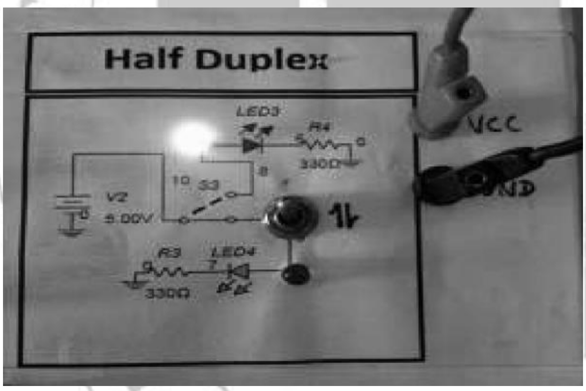


Fig 1.6: Half duplex

Layout of Laboratory (Half Duplex):



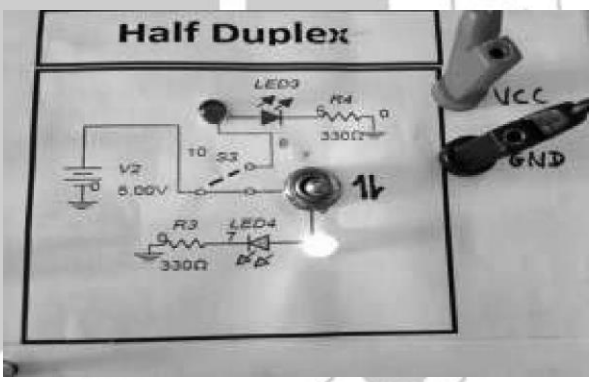
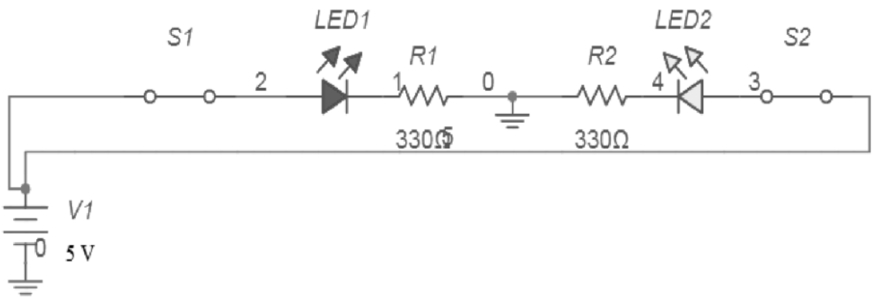


Fig 1.7:Half duplex in forward direction

Half duplex in reverse direction

Circuit diagram (Full Duplex):



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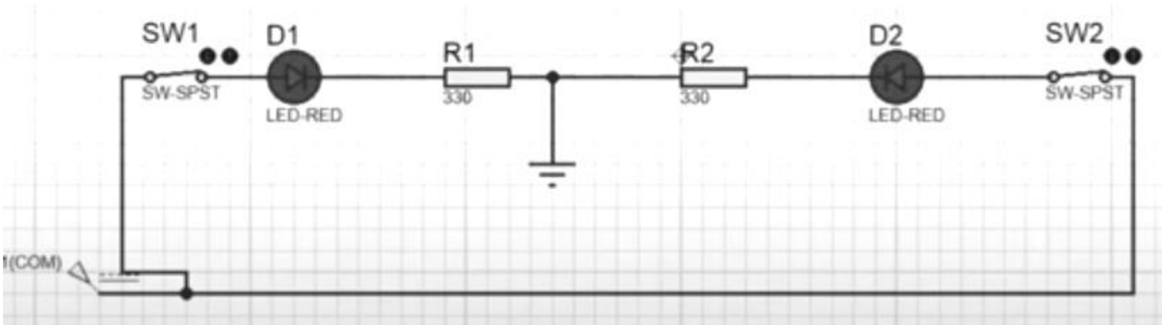

Fig 1.8: Full duplex

Layout of Laboratory (Full Duplex):

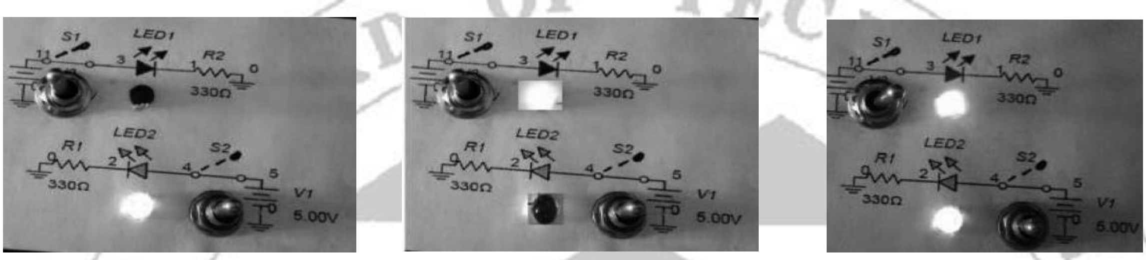

Fig 1.9:When S_2 is closed **When S_1 is closed** **When S_1 and S_2 is closed**

b. Actual setup diagram

VIII. Required Resources/apparatus/equipment with specifications

Sr. No.	Instrument/ Components	Specification	Quantity
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	3
3.	SPDT switch (Half Duplex)	SPDT switch	1
4.	LED	1.8V to 2.2 V	5
5.	Breadboard	5.5cm x 17cm	1
6.	Resistor	330Ω(0.5watts/0.25watts)	2
7.	Connecting wires	Single strand Teflon coating (0.6 mm diameter)	As per requirement

IX. 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 do not exceed the input voltage beyond the rated voltage of LED and Switch.

X. Procedure

Simplex

1. Connect the electrical circuit as shown in fig 1.4
2. Switch ON the power supply and set 5V
3. Close switch S1 and observe the LED status.Note it in table 1.1
4. Open switch S1 and observe the LED status.Note it in table 1.1

Half Duplex:

1. Connect the electrical circuit as shown in fig 1.6
2. switch ON the power supply and set 5V
3. During the first throw of switch S3.Observe LED3 and LED4. Note it in table 1.2
4. During the second throw of switch S3.Observe LED3 and LED4. Note it in table 1.2
5. At a time only one LED glows.

Full Duplex:

1. Connect the electrical circuit as shown in fig 1.8
2. Switch ON the power supply and set 5V
3. Close the switch S1 and open switch S2.Observe LED status. Note down in Table 1.3
4. Open the switch S1 and close switch S2 .Observe LED status. Note down in Table 1.3
5. Close the switch S1 and S2 .Observe LED status. Note down in Table 1.3
6. Open the switch S1 and S2 .Observe LED status. Note down in Table 1.3

XI. Resources used:

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

XII. Actual Procedure:

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XIII. Observation Table:

Table 1.1 : Simplex Communication Link

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

Table 1.2 : Half Duplex Communication Link

Sr. No.	Switch S3	LED Status(ON/OFF)	
		LED3	LED4
1	First Throw		
2	Second Throw		

Table 1.3 : Full Duplex Communication Link

Sr. No.	Switch S3	LED Status(ON/OFF)	
		LED1	LED2
1	S1 ON S2 OFF		
2	S1 OFF S2 ON		
3	S1 ON S2 ON		
4	S1 OFF S2 OFF		

XIV. Results

1. Table 1 signifies ________________ communication link that is simplex
2. Table 2 signifies ________________ communication link that is Half Duplex
3. S1 ON, S2 OFF: Given System will work as ____________ communication link.
4. S1 OFF, S2 ON: Given System will work as _____________ communication link
5. S1 ON, S2 ON: Given System will work as ______________ communication link

XV. Interpretation of Results

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XVI. Conclusions & Recommendation

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XVII. Practical Related Questions

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 for mobile communication?
4. Name the type of communication link that is used in FM radio.
5. State the basic difference between simplex and half duplex communication link?
6. Which type of communication link is used in cordless telephones?
7. Name the type of communication link used in a fax machine.

[Space for Answer]

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XVIII. 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

XIX. 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%**

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

Practical No. 2: Observe the different analog and Digital Signals on CRO and spectrum analyzer in time domain and frequency domain.

I. Practical Significance

In industries for manufacturing and maintenance of Electronic circuits,measurement/testing are prime requirements. The various parameters are to be tested with utmost accuracy and precision. For this purpose testing instruments like CRO, spectrum analyzer are used.

II. Industry/Employer Expected Outcome(s)

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

III. Course Level Learning Outcome(s)

CO1-Select the relevant frequency range/band for different communication modes.

IV. Laboratory Learning Outcome(s)

LLO 2.1-Test analog and digital signals on CRO and spectrum analyzer.

LLO 2.2 Observe the difference between time domain and frequency domain representation of a signal .

V. Relevant Affective Domain related outcome(s)

1. .Follow Safety Rules in the laboratory.
2. Handle instruments carefully.
3. Follow ethical practices.

VI. Relevant theoretical background

Analog Signal:

An analog signal is a smoothly and continuously varying voltage or current. Some typical analog signals are shown in Fig. 2.1. A sine wave is a single-frequency analog signal. Voice and video voltages are analog signals that vary in accordance with the sound or light variations that are analogous to the information being transmitted.

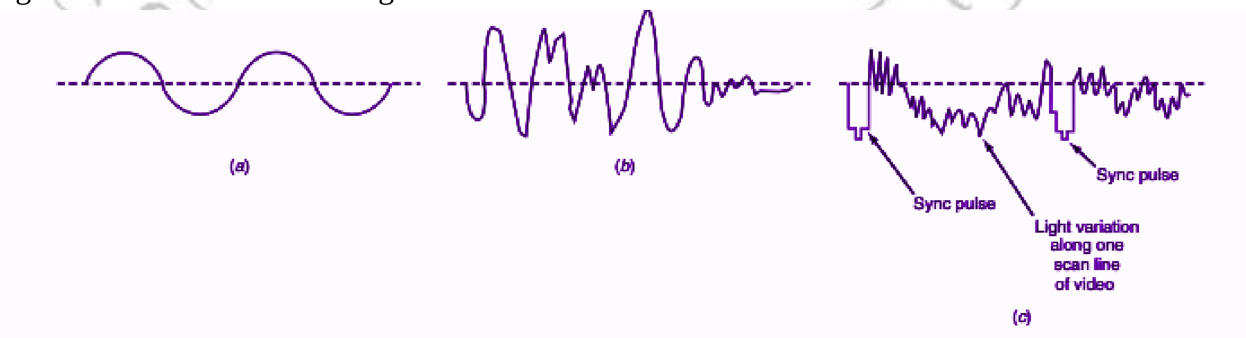

Fig 2.1 Analog signals. (a) Sine wave (b) Voice. (c) Video (TV) signal

Digital Signals:

Digital signals, in contrast to analog signals, do not vary continuously, but change in steps or in discrete increments. Most digital signals use binary or two-state codes. Some examples are shown in Fig.2.2

Data used in computers is also digital. Binary codes representing numbers, letters, and special symbols are transmitted serially by wire, radio, or optical medium. The most commonly used digital code in communications is the American Standard Code for Information Interchange (ASCII).

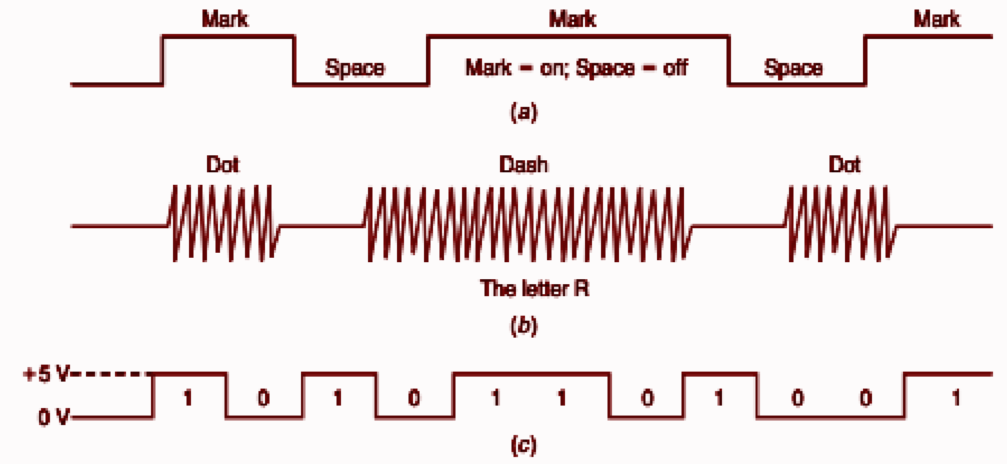

Fig 2.2 Digital signals. (a) Morse code. (b) Continuous-wave (CW) code. (c) Serial binary code.

Time Domain:

Most of the signals and waveforms are expressed in the time domain. That is, they are variations of voltage, current, or power with respect to time. In time-domain, waveform mathematical expressions contain the variable time t, indicating that they are a time-variant quantity.

Test instrument for displaying signals in the time domain is CRO.

Frequency Domain

Complex signals containing many sine and/or cosine components are expressed as sine or cosine wave amplitudes at different frequencies. Frequency domain is a plot of sine and/or cosine component amplitudes with respect to frequency.

Frequency domain plot can be made directly from the Fourier expression by simply using the frequencies of the fundamentals and harmonics and their amplitudes. The test instrument for producing a frequency-domain display is the spectrum analyzer. Time domain and Frequency-domain plots for some of the common non sinusoidal waves are also shown in Fig 2.3.

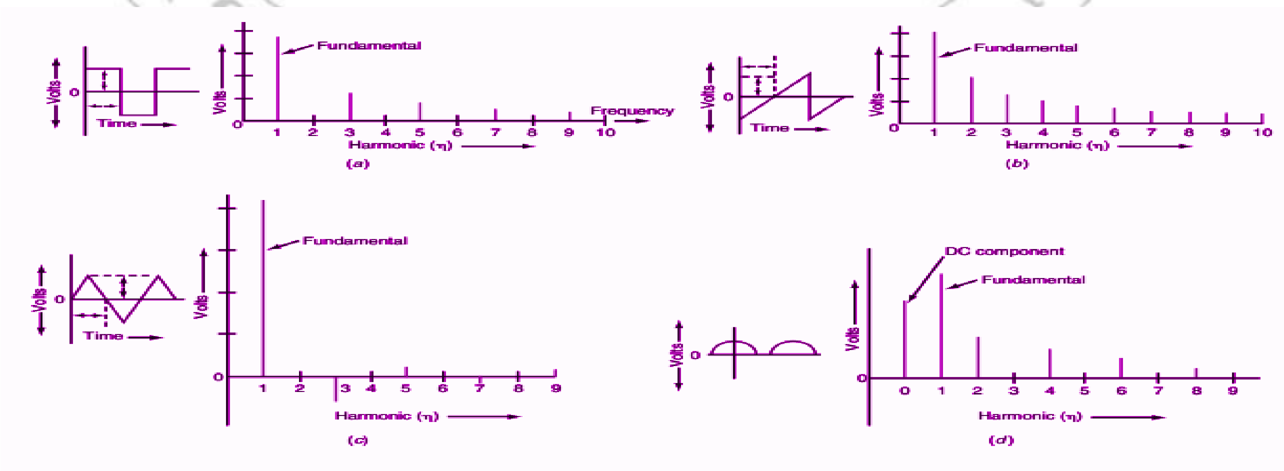

Fig 2.3 The frequency-domain plots of common non sinusoidal waves. (a) Square wave. (b) Sawtooth. (c)Triangular. (d) Half cosine wave.

VII. Actual Circuit diagram used in a laboratory with related equipment rating.

a. Suggestive Circuit diagram

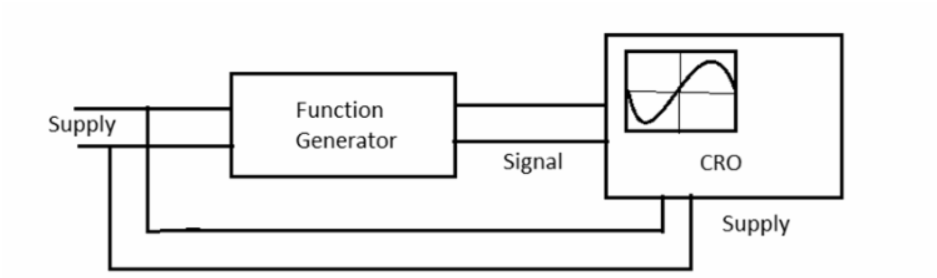

Fig 2.4 Time domain measurement Setup

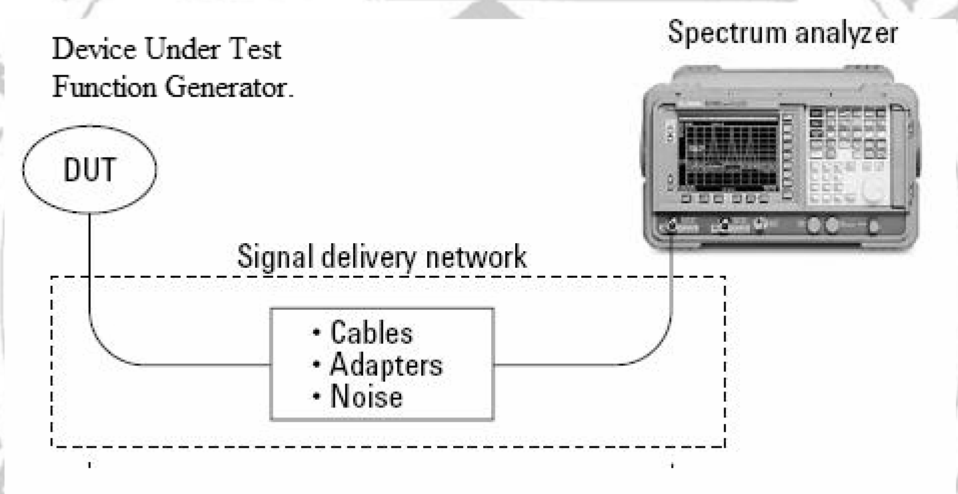

Fig 2.5 Frequency domain Measurement setup

b. Actual setup diagram

VIII. Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Specification	Quantity
1	CRO with probe	10 Hz-30 MHz	1
2	Function Generator	0.1Hz– 30 MHz	1
3	Spectrum Analyzer with probe	9KHz-7GHz.	1

IX. Precautions to be Followed:

1. Connect the function generator output to the CRO's channel using the CRO probe properly.
2. Connect the function generator output to the Spectrum analyzer properly.

X. Procedure

For Time Domain Measurement

1. Connect the function generator output to the CROs channel using CRO probe.
2. Adjust the volt per division and time per division CRO such that the waveform of the current or voltage can be observed properly.
3. Adjust the Peak-to-peak value voltage.
4. Measure and Note down the time period and peak value of a signal.

For Frequency Domain Measurement

1. Connect the function generator output to the Spectrum analyzer using a High-frequency probe.
2. Set spectrum analyzer on measurement mode..
3. Go to the Measurement setup and set it for amplitude and frequency measurement.
4. Measure and note down the amplitude and frequency of a signal.

XI. Resources Used

Sr. No.	Name of Resource	Specifications	Quantity
1			
2			
3			

XII. Actual Procedure

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XIII. Observation Table

a. Time Domain

Sr. No.	Type of Signal	Horizontal division of one cycle **(Dh) (division)**	Time per division **(t) sec/div**	Time period of signal **T=Dh x t (sec)**	Frequency of Signal **(f = 1/T) (Hz)**	Vertical division (Peak to Peak) **(Dv) (division)**	Voltage per division **(v) volts/ div**	Peak to Peak Amplitude of signal **(Vpp= Dv x v) (vols)**
1	Analog Signal							
2	Digital Signal							

b. Frequency Domain

Sr.no	**Type of Signal**	**Amplitude of signal (V)**	**Frequency of Signal (Hz)**
1	Analog signal		
2	Digital Signal		

XIV. Results

1. Amplitude of Analog Signal on CRO…………volts and frequency …………Hz
2. Amplitude of Digital Signal on CRO…………volts and Frequency …………Hz.
3. Amplitude of Analog Signal on Spectrum Analyzer…………dB and frequency …………Hz.
4. Amplitude of Digital Signal on Spectrum Analyzer …………dB and frequency …………Hz.

XV. Interpretation of results

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XVI. Conclusion and recommendation

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XVII. Practical related questions

1. State the Applications of CRO.
2. Write Applications of Spectrum Analyzer.
3. Calculate frequency of signal if horizontal division of one cycle is 1 div and time per division is 1ms/div.
4. Compare analog signal With Digital Signal.
5. Calculate Amplitude of signal if vertical division of signal is 2 div and volts per division is 1 volts/div..

[Space for Answers]

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XVIII. References/Suggestions for further reading

1. http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAE/exp1/index.html#
2. https://rfmw.em.keysight.com/spectrum-analyzer/

XIX. Suggested Assessment Scheme

	Performance Indicators	Weightage
	ProcessRelated:15 Marks	**60 %**
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring Value using suitable instrument	20%
4	working in teams	10%
	Product Related:10 Marks	**40%**
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
	Total(25 Marks)	**100 %**

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

Scale -

X-Axis -

Y-Axis -

Practical No. 3: Observe the AM modulated waveforms generated for different modulating frequencies.

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. Industry /Employer Expected Outcomes

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

III. Course Level Learning Outcomes:

CO2 – Maintain AM based communication system.

IV. Laboratory Learning Outcomes

LLO 3.1- Interpret the effect of change in modulating frequency on AM signal.

V. Relevant Affective Domain related Outcome(s)

1.Follow safe practices

2.Handle instruments carefully.

3.Follow ethical practices.

VI. Relevant 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 carrier is a high frequency signal. Figure 3.1 shows how AM signal is generated.

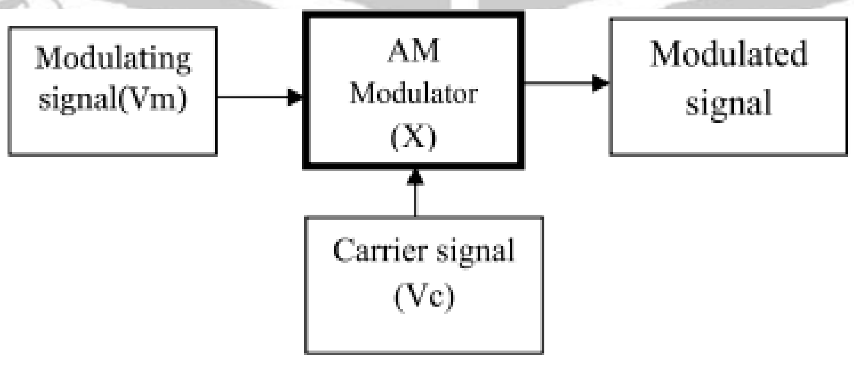


Fig 3.1:Generation of AM

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 fig 3.2

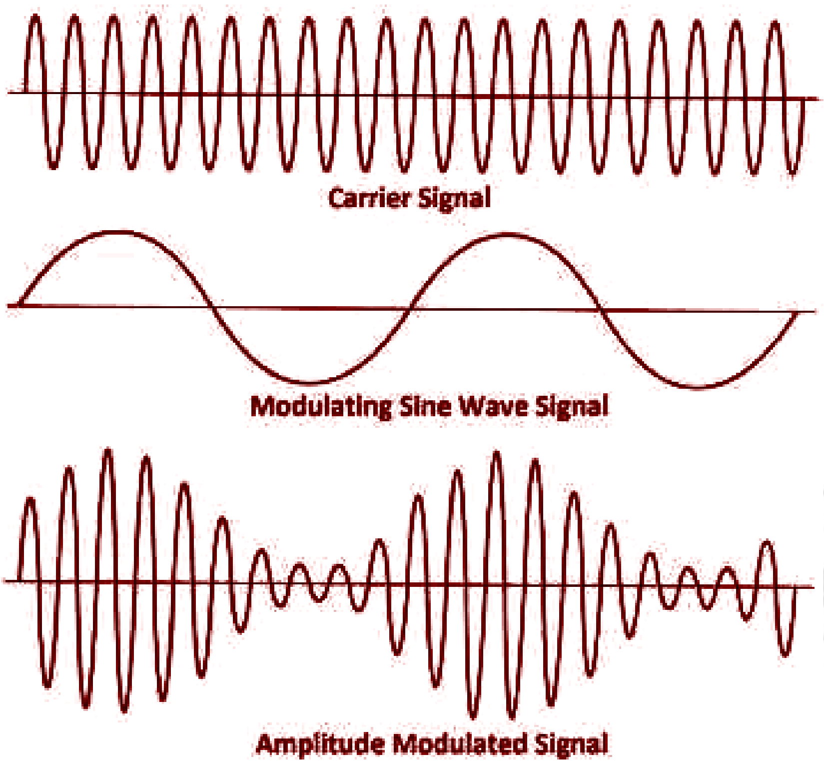


Fig 3.2:Waveform of AM modulation

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 non inverting integrator and other as an inverting integrator.The two amplifiers are connected in cascade to form a feedback.IC TL084 is a quad-opamp IC,requires both positive supply voltage (pin 4) and negative supply (pin 11) voltages.IC 3086 is the transistor array used as an input amplifier**.**

Pin Diagram of IC TL084

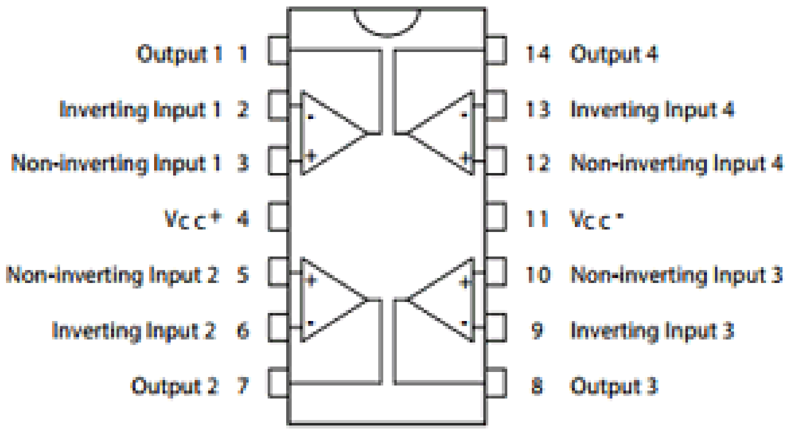


Fig 3.3:Pin Diagram of IC TL084(Op-Amp)

Pin Diagram of IC 3086

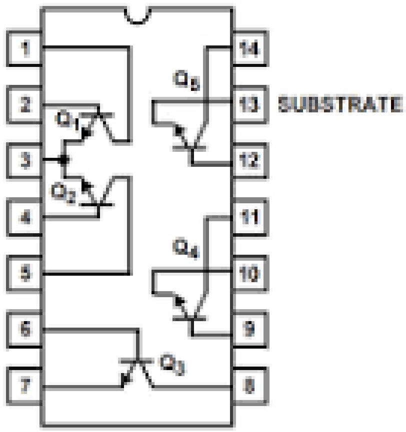


Fig 3.4:Pin Diagram of IC 3086
(General Purpose NPN Transistor Array)

VII. Actual Circuit diagram used in a laboratory with related equipment rating.

a. Sample Circuit diagram:

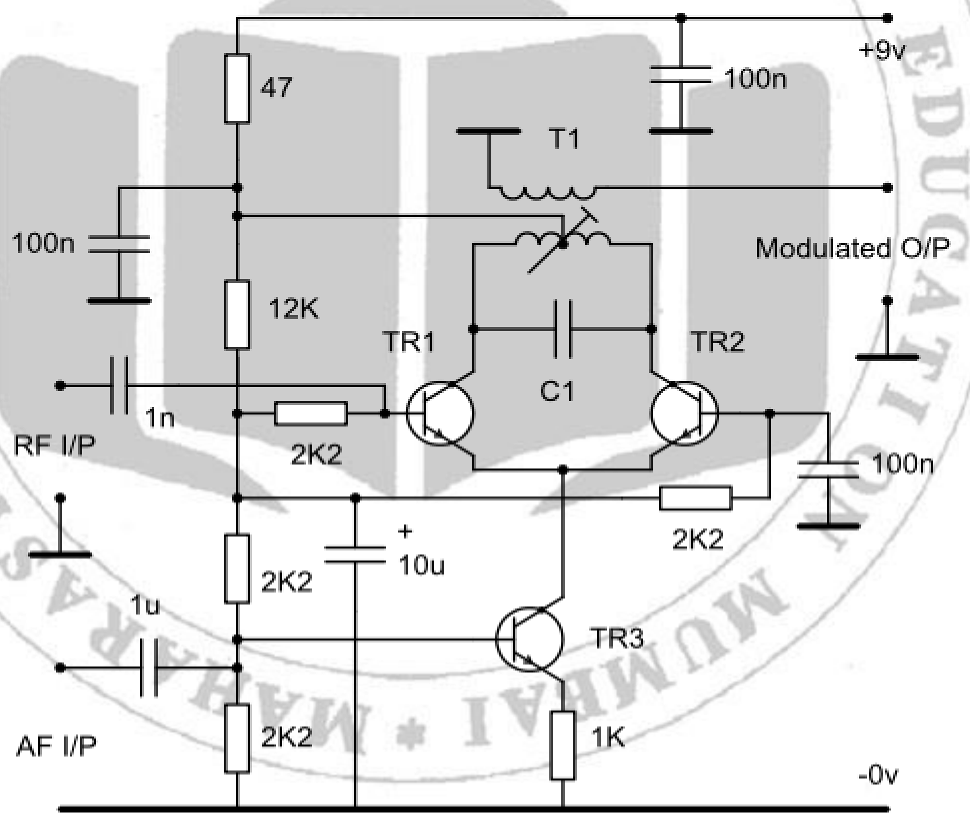
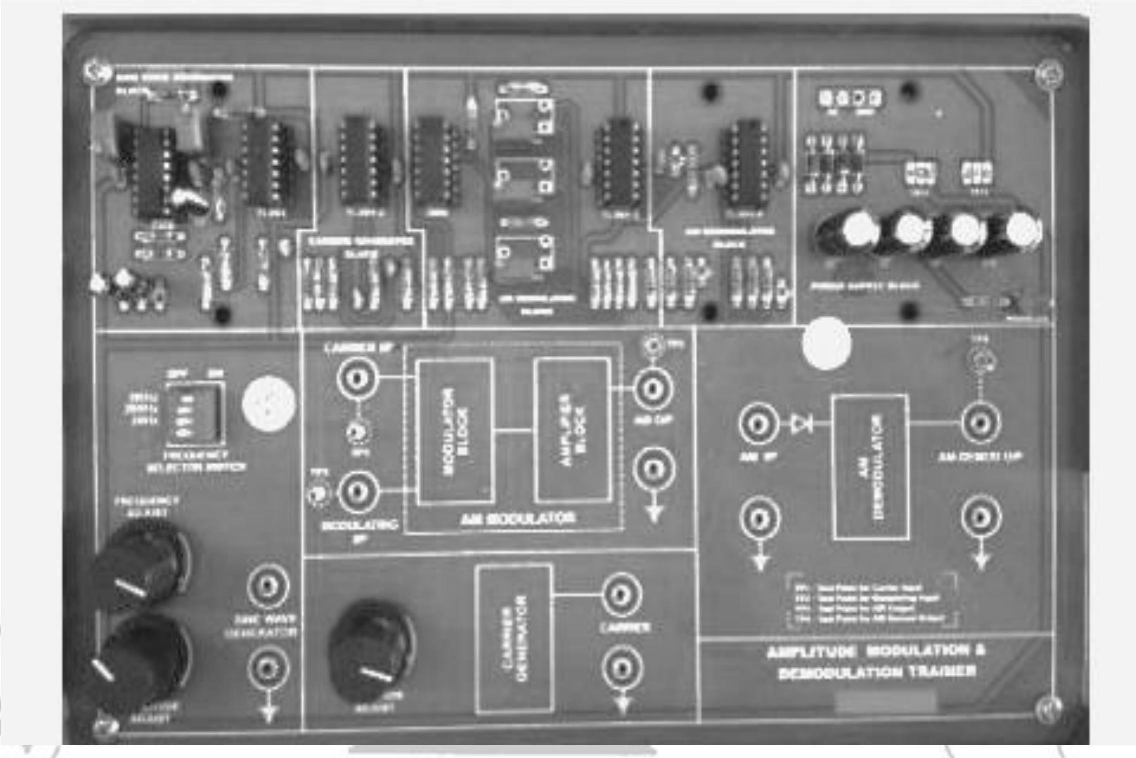


Figure 3.5 : AM modulation circuit diagram



OR

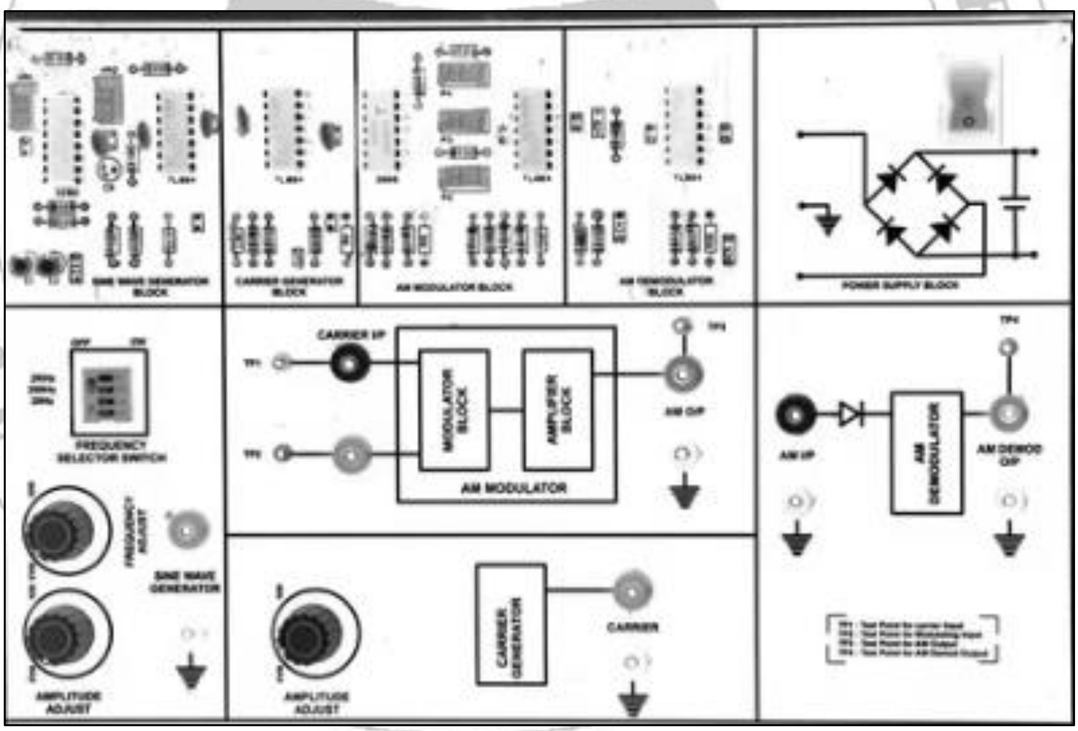


Fig 3.6:AM modulator trainer kit

Fig 3.7:Experimental setup of AM Modulator

b. Actual Experimental Setup used in Laboratory with related equipment rating

VIII. Resources Required/apparatus/Equipment with specifications

Sr. No.	Instrument/Components	Specification	Quantity
1.	AM Trainer kit	Modulating signal -0 to 2 KHz ,Carrier signal 100 KHz	1
2.	Function Generator	0.01 Hz to 1 MHz,10V p-p output	2
3.	CRO	25 MHz,dual scope	
	DSO	Bandwidth 30 MHz – 200 MHz Analog channels 2-4	1
4.	Connecting wires	Single strand Teflon coating (0.6 mm diameter)	As per requirement

IX. 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.

X. Procedure

1. Make connections as shown in fig 3.7
2. Switch on the power supply
3. Select sine wave of amplitude 1V p-p and frequency of 1KHz as a modulating signal from function generator-1 and give it as one of the inputs to the modulator.
4. Select sine wave of amplitude 2V p-p and 5KHz as a carrier signal from function generator-2 and give it as another of the input to the modulator.
5. Observe AM waveform on CRO
6. Change the frequency carrier in steps of 5 KHz and note down the reading in observation table 3.1
7. Draw the waveform of modulating signal,carrier signal and AM signal on graph paper for any one sample of observed value.

XI. Resources used

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

XII. Actual Procedure

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XIII. Observations Table

Table 3.1: Measurement of Vmax and Vmin

Sr. No.	Modulating Signal		Carrier Signal Frequency		Amplitude Modulated Signal	
	Amplitude(Vm) in Volts	Frequency(fm) in KHz	Amplitude (Vc) in Volts	Frequency (fc) in KHz	Vmax in Volts	Vmin in Volts
1	1V	1 KHz	2V	5 KHz		
2	1V	1 KHz	2V	10 KHz		
3	1V	1 KHz	2V	15 KHz		
4	1V	1 KHz	2V	20 KHz		
5	1V	1 KHz	2V	25 KHz		

Calculations

Modulating Signal:

Amplitude Vm Volts =

Frequency fm KHz =

Carrier Signal Frequency:

Amplitude Vc Volts =

Frequency1 fc KHz =

Frequency2 fc KHz =

Amplitude Modulated Signal:

Vmax Volts=

Vmin Volts=

XIV. Results

As carrier frequency is increased step by step the effect on Vmax and Vmin is --------- (Increases/decreases/no change)

XV. Interpretation of Results

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XVI. Conclusions & Recommendation

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XVII. Practical Related Questions

1. State the effect of carrier frequency variation on AM wave observed on CRO
2. Explain the need of modulation .
3. Modulation index for AM should be between 0 and 1. Justify the statement.
4. Keeping fc carrier frequency as 5KHz,change amplitude of carrier Vc and observe its effect on AM waveform
5. List applications of AM (Any Two)

[Space for Answer]

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XVIII. 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

XIX. 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%**

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

Scale -

X-Axis -

Y-Axis -

Practical No. 4 : Generate AM wave and measure its modulation index for different values of modulating signal amplitude

I. Practical Significance

The modulation index determines the strength and quality of the transmitted signal. The amplitude of the sideband and total power of the modulated wave depend on the modulation index.If the modulation index is small,then the power requirement for transmitting an AM signal is less, and Vice versa.In this practical, students will understand the concept of modulation index and its effect on the amplitude of the modulated wave.

II. Industry /Employer Expected Outcomes

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

III. Course Level Learning Outcomes:

CO2 – Maintain AM based communication system.

IV. Laboratory Learning Outcomes

LLO 4.1- Calculate modulation index 'm' from the observed AM waveform.

LLO 4.2- Interpret the effect of 'm'

V. Relevant Affective domain unrelated Outcome(s)

1.Handle components and equipment carefully.
2.Select instruments of required range.
3.Follow ethical practices.

VI. Relevant Theoretical Background

In communication, to transfer signal from one point to another efficiently many modulation techniques are used. Amplitude modulation is the pioneer technique used in communication to carrier message signal with help of high-frequency waves. If the amplitude of the high-frequency signal is simultaneously changed to that of the modulating signal, the process is termed as amplitude Modulation.

Modulation Index:

The ratio of maximum amplitude of the modulating signal to maximum amplitude a 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

$$m = \frac{Vm}{Vc}$$

Vm= maximum amplitude of the modulating signal

Vc= maximum amplitude of carrier signal

It can be seen from the resultant of AM waveform

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

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

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

Effect of modulation index " m " on AM waveform:

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

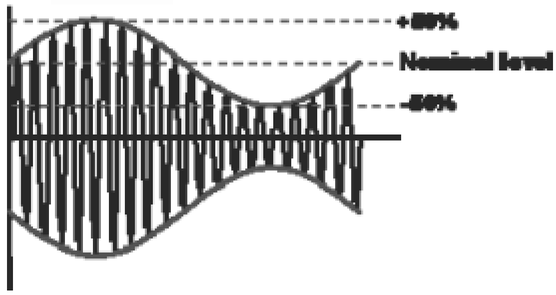


Fig. 4.1: m= 0.5

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

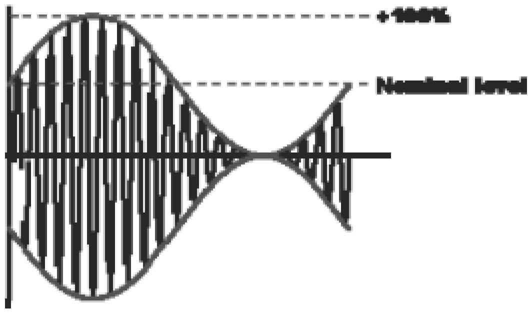


Fig. 4.2: m= 100

3. **Vm>Vc -----Over modulation**
   m>1

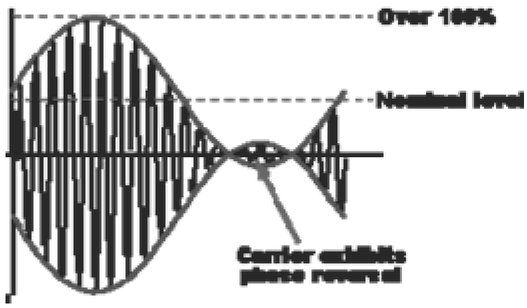


Fig. 4.3: m > 100

VII. Actual Circuit diagram used in a laboratory with related equipment rating.

a) Suggestive Circuit diagram

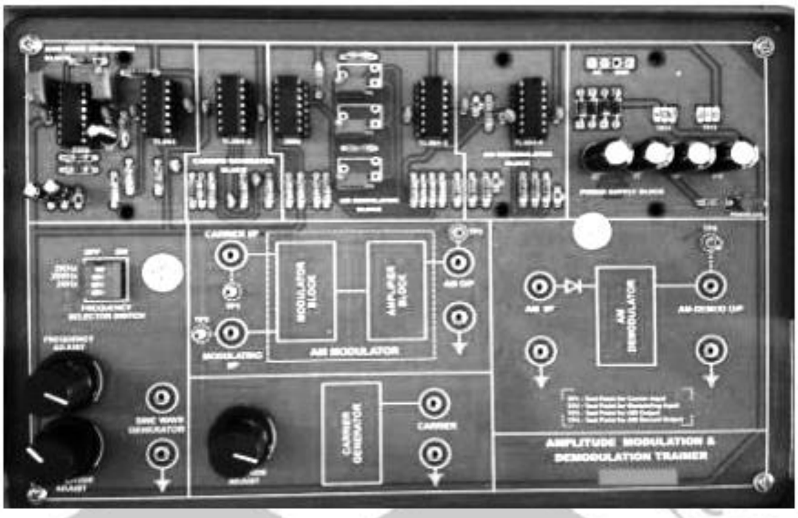
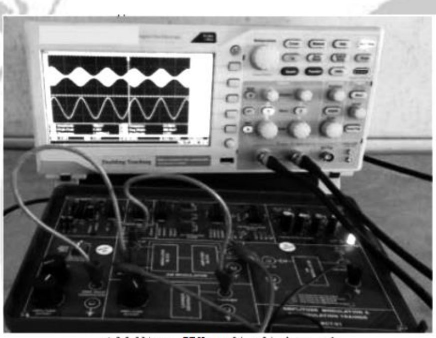


Fig 4.4:Trainer kit of AM wave



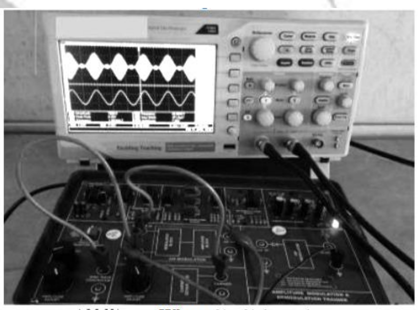


Fig 4.5: When m<1 **Fig 4.6 When m>1**

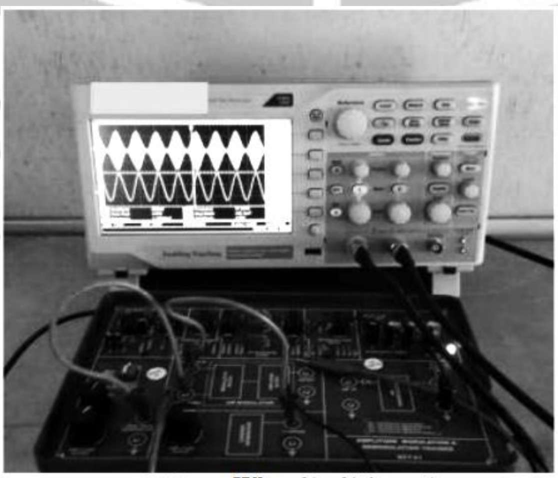


Fig 4.7: When m=1

(b) Actual Experimental Setup used in Laboratory with related equipment rating

VIII. Resources Required/apparatus/Equipment with specifications

Sr. No.	Instrument/Components	Specification	Quantity
1.	AM Trainer kit	Modulating signal -0 to 2 KHz ,Carrier signal 100 KHz	1
2.	Function Generator	0.01 Hz to 1 MHz,10V p-p output	2
3.	CRO	25 MHz, dual scope	1
	DSO	Bandwidth 30 MHz – 200 MHz Analog channels 2-4	
4.	Connecting wires	Single strand Teflon coating (0.6 mm diameter)	As per requirement

IX. 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 volts/div and times/div selection on CRO/DSO.

X. Procedure

1 For m < 1 as shown in fig 4.5 ,switch on the trainer kit and check the output of the carrier generator on an oscilloscope.
2 Select a sine wave of amplitude 1V p-p and frequency of 1 KHz as a modulating signal from the function generator and connect it to the AM modulator.
3 Select sine wave of amplitude 2V p-p and 50 KHz as a carrier signal from the function generator and connect it to the 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

Percentage Modulation = $\frac{Vmax - Vmin}{Vmax + Vmin}$ x 100

Modulation Index = $\frac{Vmax - Vmin}{Vmax + Vmin}$

XI. Resources used:

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

XII. Actual Procedure

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XIII. Observation Table

Carrier frequency :------------------- Hz

Carrier Amplitude:-------------------Volts

Modulating Frequency:------------- Hz

Sr No.	Amplitude of Modulating signal (V)	V_{max} (V)	V_{min} (V)	Percentage Modulation % m= $\frac{Vmax - Vmin}{Vmax + Vmin}$ x 100

Calculations

Percentage Modulation = $\frac{Vmax - Vmin}{Vmax + Vmin}$ x 100

Modulation Index = $\frac{Vmax - Vmin}{Vmax + Vmin}$

XIV. Results

If Vm < Vc then m=

If Vm = Vc then m=

If Vm > Vc then m=

XV. Interpretation of Results

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XVI. Conclusions & Recommendation

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XVII. Practical Related Questions

1. State different AM stations and their corresponding frequency range.
2. 2Vp-p carrier signal is modulated to depth of 60% Find the maximum amplitude of modulating signal
3. State the value of m for over modulation. also state the effect of over modulation in AM wave transmission.
4. Draw the AM waveform with Vmax and Vmin for m=0.8

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XVIII. References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=vddBNW18fgl
2. https://www.youtube.com/watch?v=vVrXYA4PJvs
3. https://kcgcollege.ac.in/Virtual-Lab/Electronics-and-Communication-Engineering/simulation.html

XIX. 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	Calculation of theoretical values	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%**

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

Scale -

X-Axis -

Y-Axis -

Practical No. 5: Build and test the AM demodulator circuit

I. Practical Significance

Demodulation is extracting 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. Industry /Employer Expected Outcomes

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

III. Course Level Learning Outcomes:

CO2 – Maintain AM based communication system.

IV. Laboratory Learning Outcomes

LLO 5.1- Observe the AM demodulated signal on DSO/CRO

LLO 5.2- Observe the AM demodulated signal on DSO/CRO

V. Relevant Affective domain unrelated Outcome(s)

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

VI. Relevant Theoretical Background

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

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

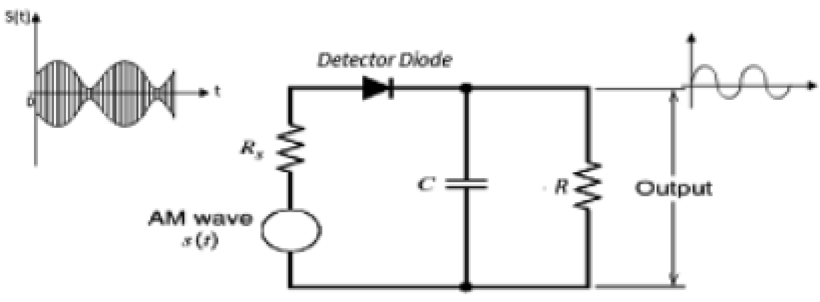


Fig 5.1:AM Demodulation circuit Diagram

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 simple diode

Filter: The filtering removes any unwanted high frequency elements in the demodulation process.

The AM demodulation process is shown in fig 5.2 below

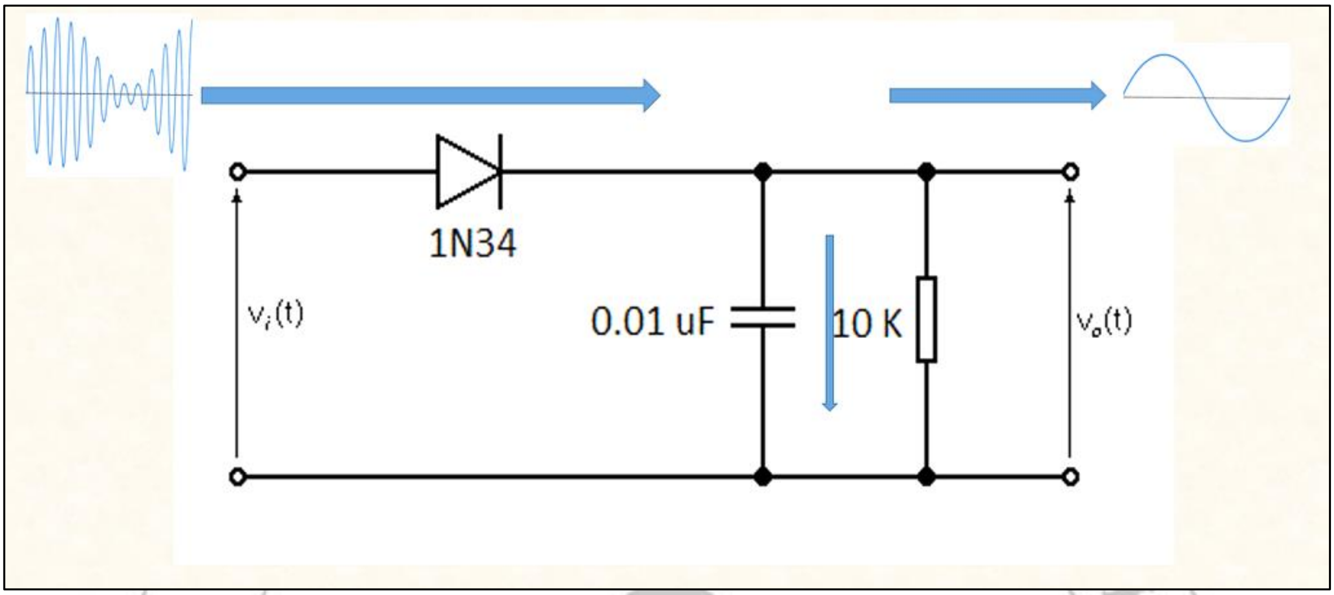


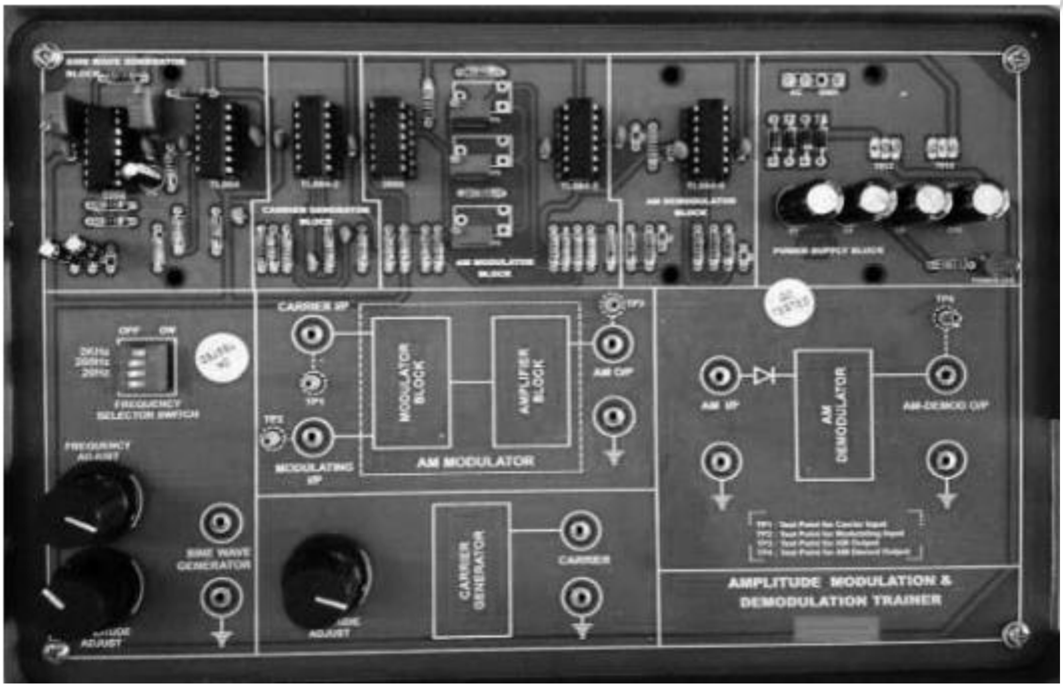
Fig 5.2:AM Demodulation

Diode Detector: This is the simplest form of AM demodulator or detector requiring just semiconductor (or other form) of diode along with a capacitor to remove the high frequency components as shown in fig 5.2

In experimental trainer kit as shown in fig 5.3 AM modulator circuit is made up of IC TL084 and IC 3086 and AM Demodulator is Diode detector method is made up of IC 565 using PLL (Fig 5.1)

VII. Actual Circuit diagram used in a laboratory with related equipment rating.

a) Sample Trainer kit used in laboratory



OR

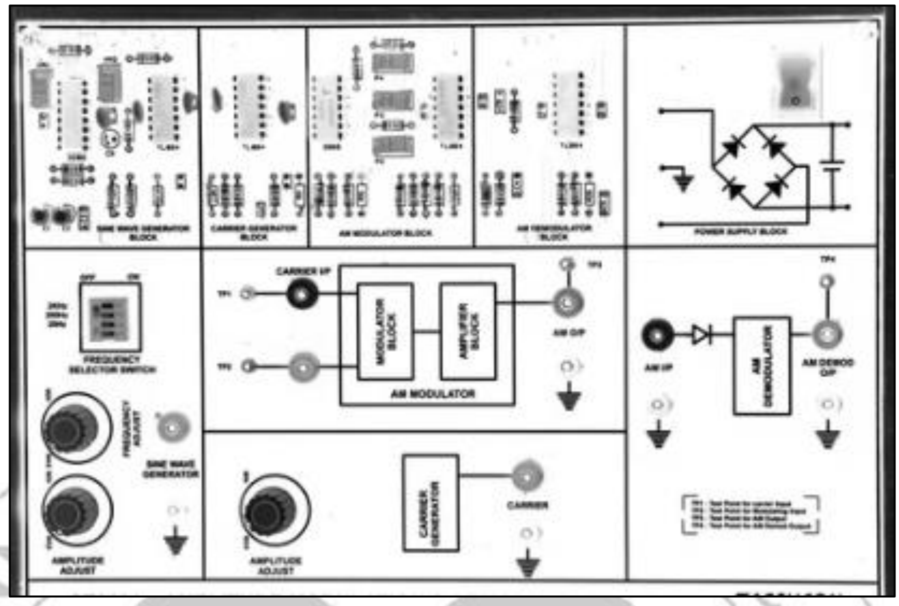


Figure 5.3:AM Demodulation Trainer kit

b) Sample Experimental setup

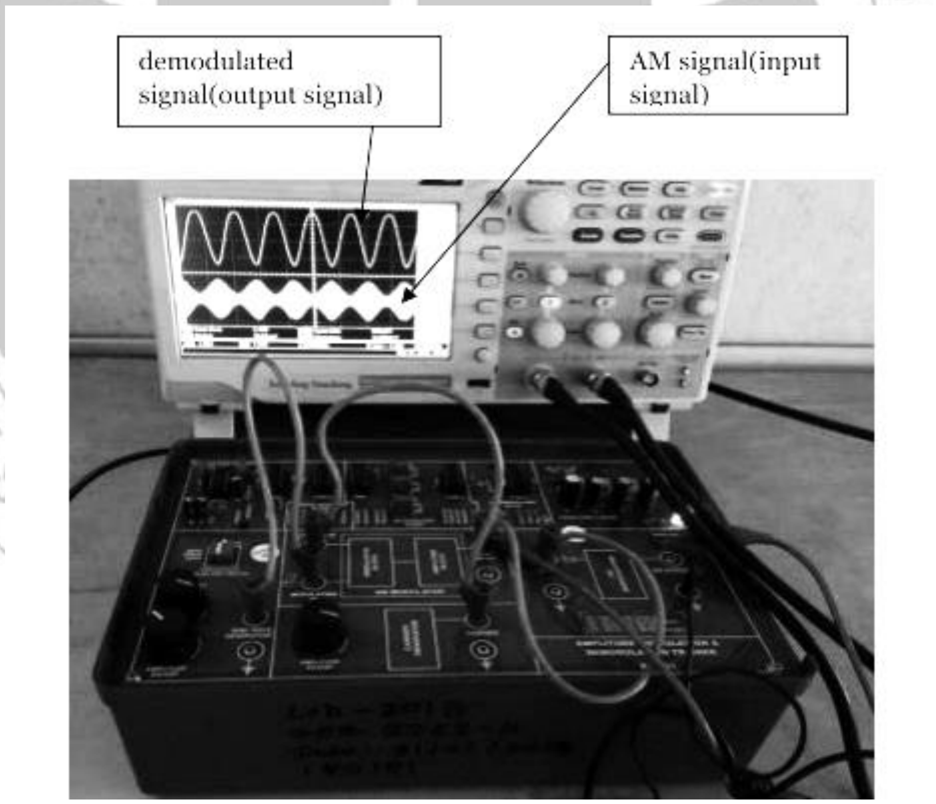


Fig 5.4:AM Demodulation

(c)Actual Experimental Setup used in Laboratory with related equipment rating

VIII. Resources Required/apparatus/Equipment with specifications

Sr. No.	Instrument/Components	Specifications	Quantity
1.	AM Demodulation trainer kit	Modulating signal-0 to 2 KHz Carrier signal 100 KHz	1
2.	Function Generator	0.01 Hz to 1 MHz 10V p-p output	1
3.	CRO	25 MHz Dual Scope	2
	DSO	Bandwidth 30 MHz – 200 MHz Analog Channels 2-4	2
4.	Connecting wires	Single strand Teflon coating (0.6 mm diameter)	As per requirement

IX. 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

X. Procedure

1. Connections are made on AM modulator and demodulator kit as shown in fig 5.4
2. Switch on the power supply
3. Apply sinusoidal signal of 1KHz frequency and amplitude 2V p-p as modulating signal.
4. Carrier signal of frequency 11 KHz and amplitude 15V p-p
5. Now slowly increase the amplitude of the modulating signal up to 7V and note down values of Vmax and Vmin
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.

XI. Resources used

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

XII. Actual Procedure

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XIII. Observation Table

Input AM signal frequency = ----------- 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 $= \frac{Vmax - Vmin}{Vmax + Vmin}$ x 100	Peak to Peak amplitude of detected output signal in volts	Frequency of demodulated output signal (Hz)
1					
2					
3					
4					

Calculations:

V_{max}=

V_{min}=

% m= $\frac{Vmax - Vmin}{Vmax + Vmin}$ x 100

Frequency of demodulated output signal (Hz)=

XIV. Results

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XV. Interpretation of Result

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XVI. Conclusions & Recommendation

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XVII. Practical Related Questions

1. List the different types of AM detectors?
2. Draw practical diode detector circuit used for AM detection
3. Give the diode number used for diode detection
4. State the role of diodes in the demodulation process

[Space for Answer]

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XVIII. 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

XIX. 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%**

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

Scale -

X-Axis -

Y-Axis -

Practical No. 6: Display the AM modulator and demodulator signal using MATLAB Simulink/SCILAB/relevant software for different modulating frequencies

I. Practical Significance

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

II. Industry /Employer Expected Outcomes

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

III. Course Level Learning Outcomes:

CO2 – Maintain AM based communication system.

IV. Laboratory Learning Outcomes

LLO 6.1- Observe the AM signal using simulation software

LLO 6.2- Interpret the demodulated AM signal using simulator software.

V. Relevant Affective domain unrelated Outcome(s)

1.Select proper programming environment

2.Follow ethical practices

VI. Relevant Theoretical Background

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

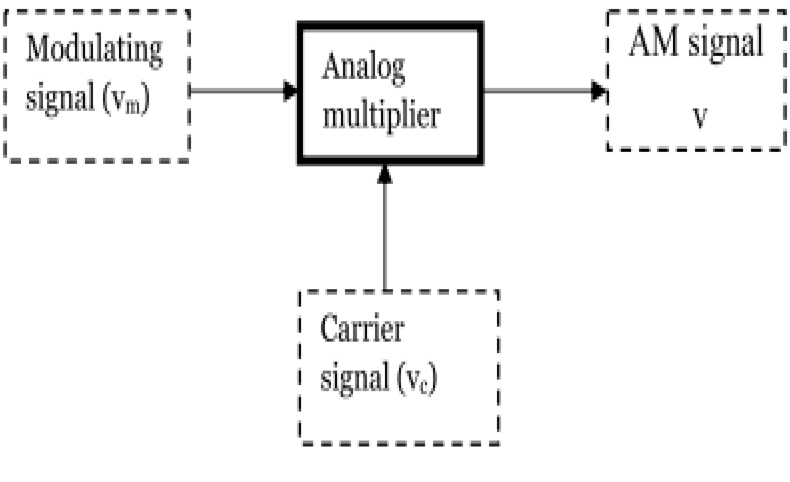

Fig 6.1: Block Diagram representation of generation of AM signal

The modulating signal mathematically represented by,

$$V_m = \mathbf{Vm \sin (2\pi fmt)}$$

Where,

V_m - Instantaneous amplitude of modulating signal.
Vm -Amplitude of modulating signal
fm -Modulating signal frequency

The Carrier signal mathematically represented by,

$$V_c = \mathbf{Vc \sin (2\pi fct)}$$

Where,

V_c--Instantaneous amplitude of carrier signal.
Vc -Amplitude of carrier signal,
fc -Carrier signal frequency

When,

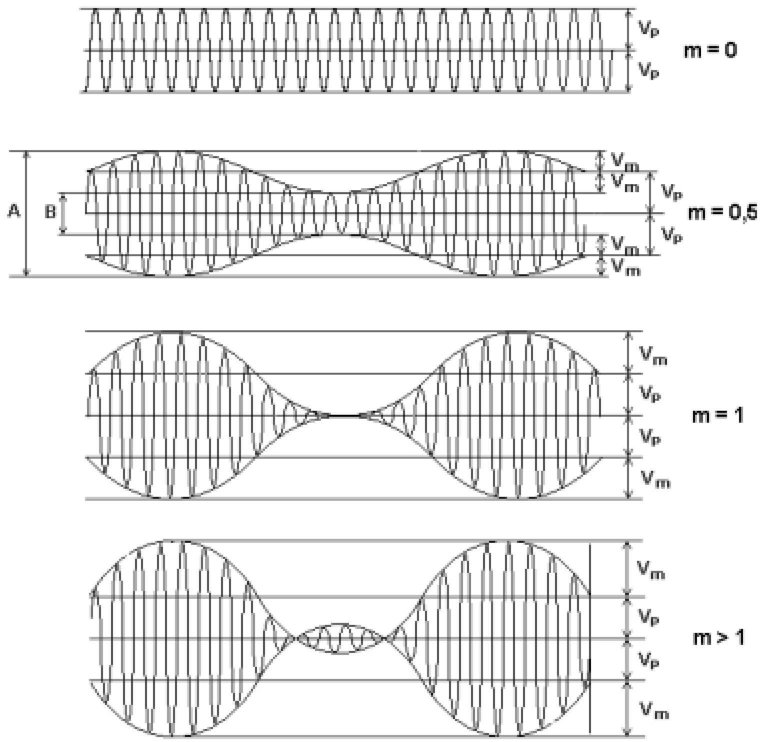

Fig 6.2:AM waveform

VII. Sample Simulation

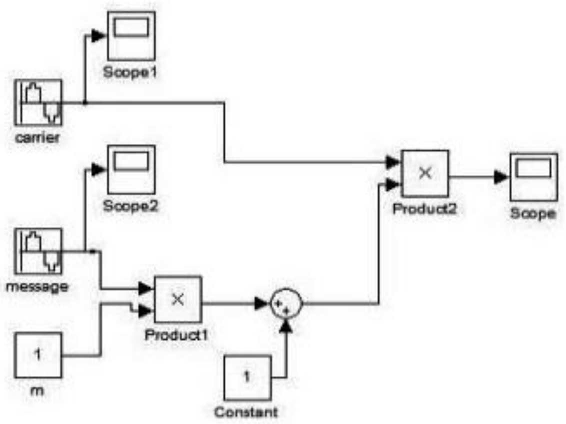

Fig 6.3:AM Generation using MATLAB simulink

OR

AM Generation using MATLAB code

```
clc;
clear all;
close all;
t=0:0.001:1;
set(0,'default line linewidth',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;
```

VIII. Required Resources/apparatus/equipment with specifications

Sr. No.	Instrument /Components	Specification	Quantity
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

IX. Precautions to be followed

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

X. 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 fig 6.1
4. Set the amplitude=0.5V and frequency 10 Hz of modulating signal
5. Set the amplitude=2V and frequency 1000 Hz of carrier signal
6. Observe the output AM signal on scope and measure Vmax and Vmin Save the result.
7. Now increase the amplitude of modulating signal and repeat step 6
8. Note the output in Table 6.1

XI. Resources used

Sr. No.	Instrument /Components	Specification	Quantity
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2.			
3.			
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XII. Actual Procedure

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XIII. Observations Table

Amplitude of Modulating Signal =----------- V

Amplitude of carrier signal=-------- V

Frequency of carrier signal=---------- Hz

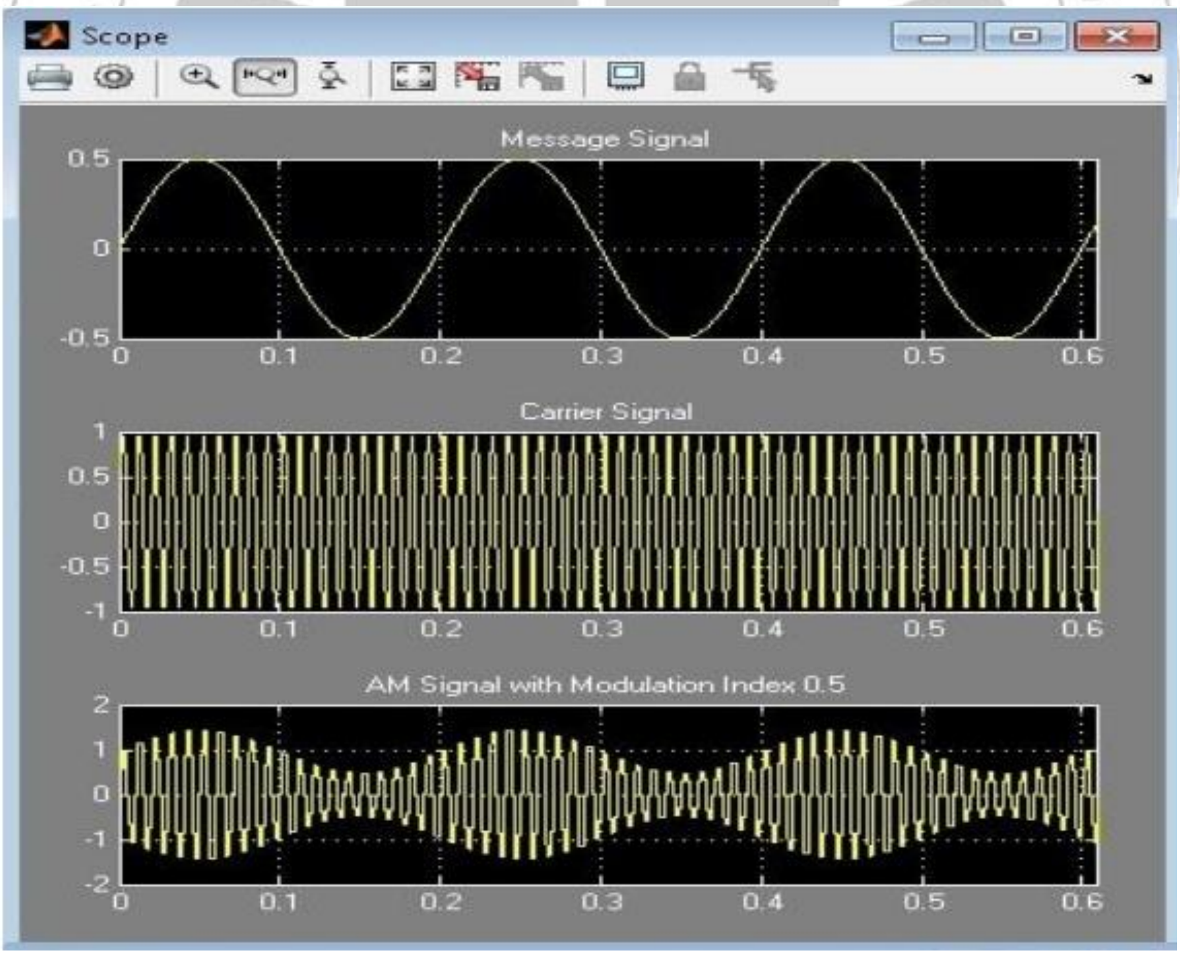
Keep frequency of modulating signal constant and vary amplitude

Frequency of modulating signal=--------- Hz

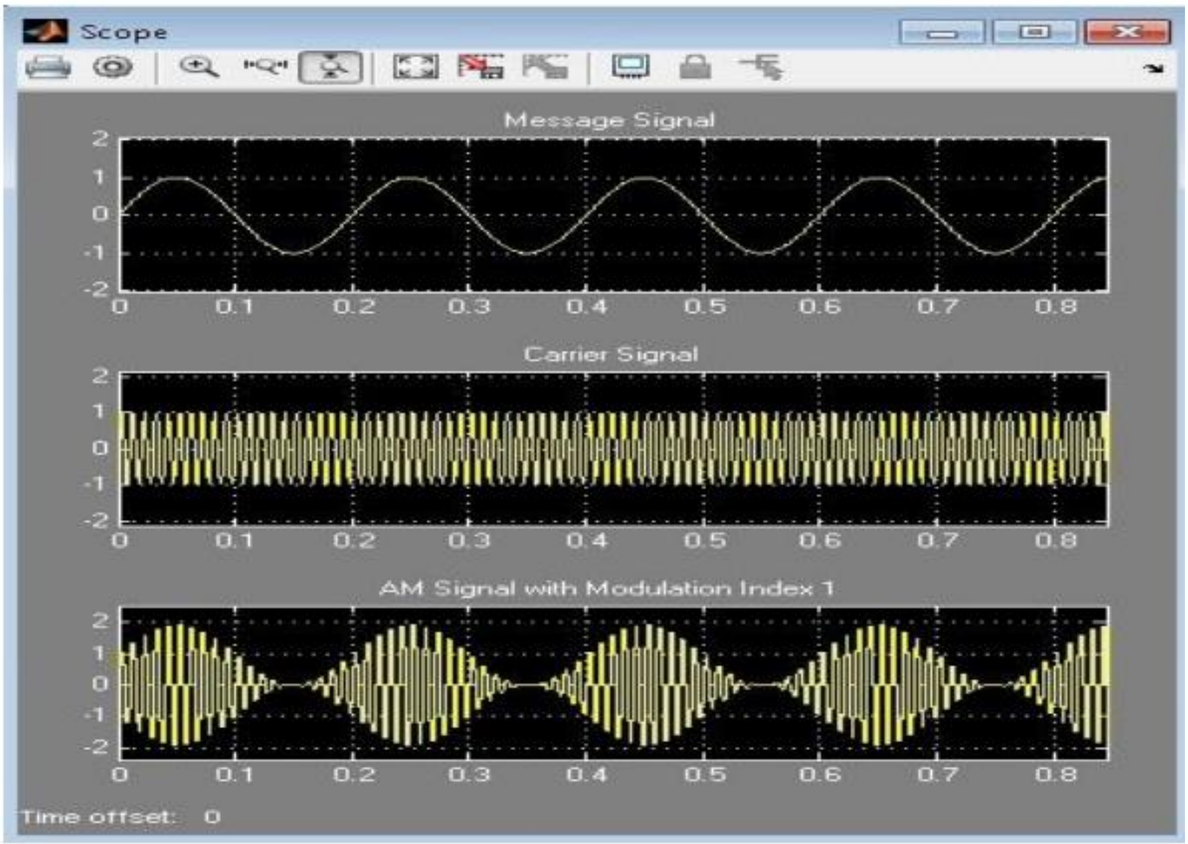
Table 6.1:Measurement of V_{max} and V_{min}

Sr No.	V_{max} (volts)	V_{min} (volts)
1		
2		
3		

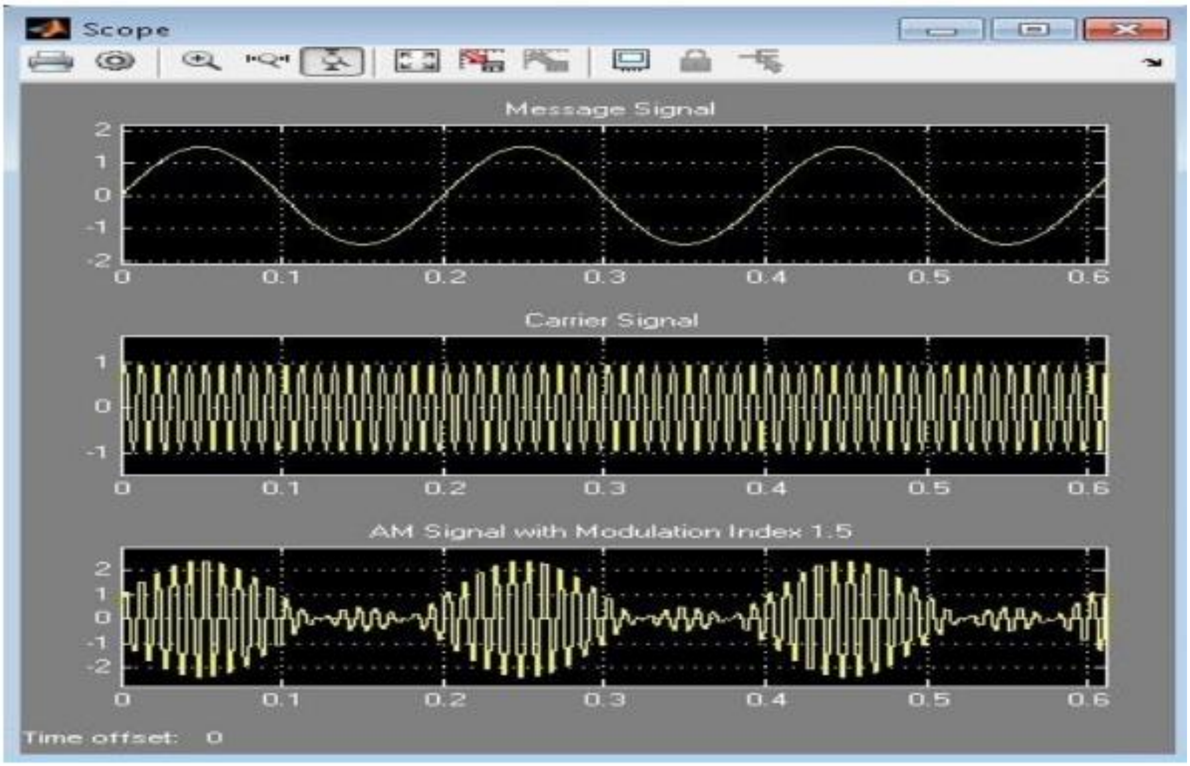
Sample MATLAB Simulation Output waveforms



(a)For m<1



(b)For m=1



(c)For m>1

Fig 6.4:MATLAB Simulation Output waveforms

Actual AM simulation output observed: (Students should paste AM output)

XIV. Results

Amplitude of modulating signal=---------------- V

V_{max}=---------------- V

V_{min}=------------------ V

As V_m increases V_{max}---------(decreases/increases) and V_{min} --------- (decreases/increases)

XV. Interpretation of Results

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XVI. Conclusions & Recommendation

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XVII. 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 modulating index is greater than 1
4. For m=70% adjust values of Vc and Vm note the corresponding values Vmax and Vmin on scope.Calculate “m”

[Space for Answer]

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XVIII. References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=Deg_hv5E8VQ
2. https://www.youtube.com/watch?v=fGf_ng7qljI
3. https://www.youtube.com/watch?v=7BlwG7BBm2k
4. https://www.youtube.com/watch?v=p-lfEoyKX2M

XIX. 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%**

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

Practical No.7: Test the output of various stages/blocks of the AM receiver

I. Practical Significance

AM superheterodyne receivers work on the super heterodyne principle. In them, the incoming signal voltage is combined with a signal generated in the receiver. The local oscillator voltage is normally converted into a signal of a low fixed frequency with the help of a mixer.

The signal at this intermediate frequency contains the same modulation as the original carrier, and it is now amplified and detected to reproduce the original modulating signal.

II. Industry /Employer Expected Outcomes

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

III. Course Level Learning Outcomes:

CO2 – Maintain AM-based communication system.

IV. Laboratory Learning Outcomes

LLO 7.1- Observe the waveforms and measure the voltages at various test points of AM receiver.

LLO 7.2- Troubleshoot various faults of the AM receiver, such as low volume and hum sound.

V. Relevant Affective domain unrelated Outcome(s)

1.Follow safe practices

2.Handle instruments carefully.

3.Follow ethical practices

VI. Relevant Theoretical Background

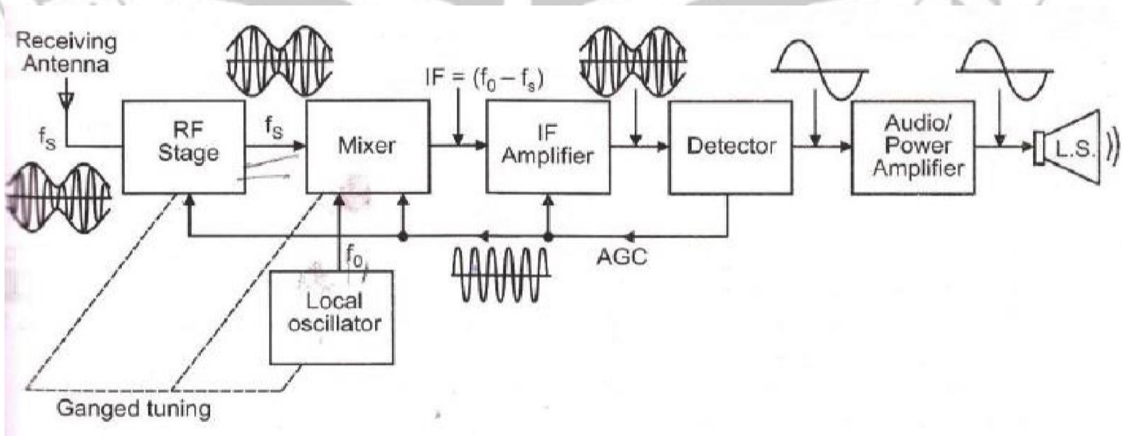

Fig 7.1:AM Super heterodyne Receiver

The problem in the TRF receiver are solved in this receiver by converting every selected RF−signal (station) to a fixed lower frequency called the "intermediate frequency (IF)".

This frequency contains the same modulation as the original carrier. The IF signal is then amplified and detected to get back the modulating signal. The intermediate frequency is lower than the lowest frequency that is to be received, 530 kHz. As the "IF" is lower than the lowest RF signal frequency, the possibility of oscillations and instability is minimized. Also the required value of Q for constant BW does not depend on the frequency of desired input signal, because the "IF" is constant and same to all the incoming RF signals. Thus the super heterodyne receiver solves all the problems associated with the TRF receiver.

The radio and TV receivers operate on the principle of super heterodyning. The block diagram of a superheterodyne radio receiver is shown in Figure.

Functions of each block-

Receiving antenna- AM receiver operates in frequency range of 540 KHz - 1640 KHz.

RF stage- Selects wanted signal and rejects all other signals and thus reduces the effect of noise.

Mixer- Receives signal from RF stage Fs and the local oscillator Fo, and are mixed to produce intermediate frequency signal IF which is given as:

$$IF = Fo - Fs$$

Ganged Tuning- To maintain a constant difference between the local oscillator and RF signal frequency, gang capacitors are used.

IF stage- The IF signal is amplified by the IF amplifier with enough gain.

Detector-Amplified signal is detected by the detector to get the original modulating signal. The detector also provides control signals to control the gain of the IF and RF stage called AGC.

AGC- Automatic gain control controls the gain of RF and IF amplifiers to maintain a constant output level at the speaker even though the signal strength at the antenna **varies.**

VII. Actual Circuit diagram used in a laboratory with related equipment rating.

a. Suggestive Circuit diagram

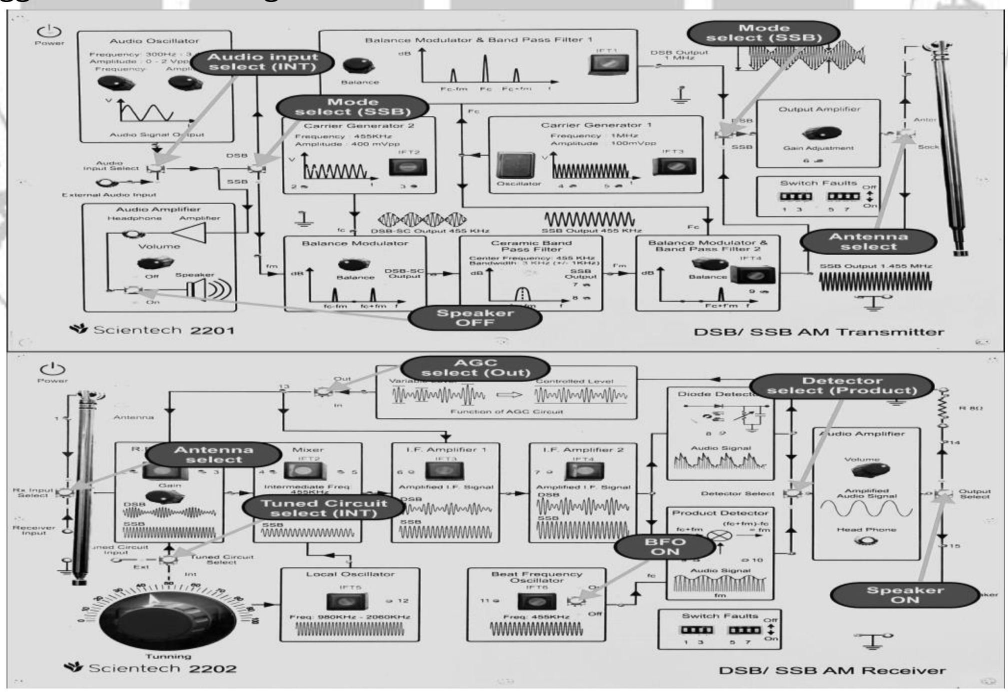

Figure 7.2 :AM Transmitter and Receiver Kit

b. Actual Setup diagram

VIII. Required Resources/apparatus/equipment with specifications

Sr. No.	Instrument/Components	Specification	Quantity
1.	AM Trainer kit for Modulation and Demodulation	Modulating signal -0 to 2 KHz ,Carrier signal 100 KHz	1
2.	Function Generator or RF Signal Generator	0.01 Hz to 1 MHz,10V p-p output frequency range 100 Khz to 150 Mhz fine frequency adjustment by calibrated dial built in audio frequency generator	2
3.	CRO	25 MHz, dual scope	1
	DSO	Bandwidth 30 MHz – 200 MHz Analog channels 2-4	
4.	Connecting wires	Single strand Teflon coating (0.6 mm diameter)	As per requirement
5	Digital Multimeter	3 1/2 digit display ,9999 counts digital multimeter measures: Vac, Vdc (1000 V max) ,Adc,Aac (10 A max) , Resistance (0 to 100 MΩ).	As per requirement

IX. 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.

X. Procedure

Double sideband AM Receiver:

1. Set the AM signal generator to 1MHz carrier signal, 1 KHz modulated signal (message signal), 60% modulation index and maximum power, set switch (SW) into detector mode.
2. Adjust the tuning for the receiver to 1MHz; you must hear the 1 KHz tone on the speaker.
3. Observe the waveform at the output of R.F. amplifier, then measure the frequency of this signal.
4. Observe the waveform at the output of the local oscillator, then measure the frequency of this signal.
5. Measure the frequencies present at the mixer and draw the output waveform.
6. Observe the waveform at the output of the IF amplifier first stage and measure the frequency of this signal.
7. Observe the waveform at the output of the IF amplifier second stage and measure the frequency of this signal.
8. Observe the waveform at the output of diode detector and measure the frequency of this signal
9. Observe the waveform at the output of audio amplifier l, and then measure the frequency.

XI. Resources used

Sr. No.	Instrument /Components	Specification	Quantity
1.			
2.			
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XII. Actual Procedure

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XIII. Observation Table

Sr.No.	Stages	Amplitude (V)	Frequency(Hz)	Waveform
1	RF mixer stage (RF Amplifier)			Draw the all waveforms on the graph paper
2	First IF Amplifier			
3	Second IF Amplifier			
4	Detector Stage			
5	Audio Amplifier			
6	Local Oscillator			

XIV. Results

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XV. Interpretation of Results

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XVI. Conclusions & Recommendation

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XVII. Practical Related Questions

1. Which type of receiving antenna is used in AM receivers?
2. State difference between audio amplifier and power amplifier
3. Draw and explain the AM receiver.
4. If the AM signal with carrier frequency is 1600 KHz and the message signal with 3.4 KHz. Calculated the local oscillator frequency and all frequency components output of the mixer if the intermediate frequency is 455 KHz

[Space for Answer]

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XVIII. References / Suggestions for further Reading

1.https://www.etti.unibw.de/labalive/index/amplitude-modulation/

2.https://www.etti.unibw.de/labalive/experiment/amtransmitterrecordaudiodemo/

XIX. Assessment Scheme

	Performance Indicators	Weightage
	Process Related (15 Marks)	**60%**
1	Handling of the experimental kit	10%
2	Identification of blocks/component on kit	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%**

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

Scale -
X-Axis -
Y-Axis -

Practical No. 8: Build and test FM signal using voltage controlled oscillator/IC 566 to measure frequency deviation and modulation index

I. Practical Significance

A voltage controlled oscillator is an electronic oscillator whose oscillation frequency is controlled by input voltage. Consequently a VCO can be used for frequency modulation 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.

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. Industry /Employer Expected Outcomes

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

III. Course Level Learning Outcomes:

CO3 – Maintain FM based communication system.

IV. Laboratory Learning Outcomes

LLO 8.1- Calculate modulation index 'm' from the observed FM wave.

LLO 8.2- Interpret the frequency deviation and modulation index of the FM signal.

V. Relevant Affective domain unrelated Outcome(s)

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

VI. Relevant Theoretical Background

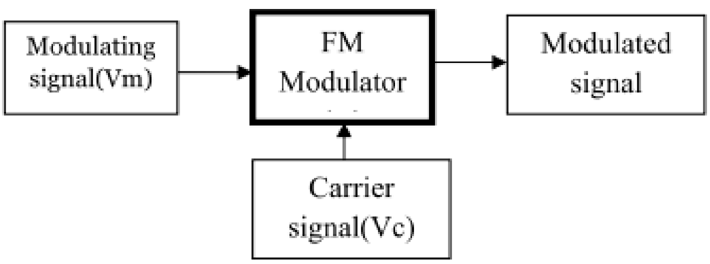


Fig 8.1: FM Generation

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 fig 8.1

In frequency modulation frequency of the carrier signal is varied in accordance with instantaneous amplitude of modulating signal keeping amplitude constant as shown in fig 8.2

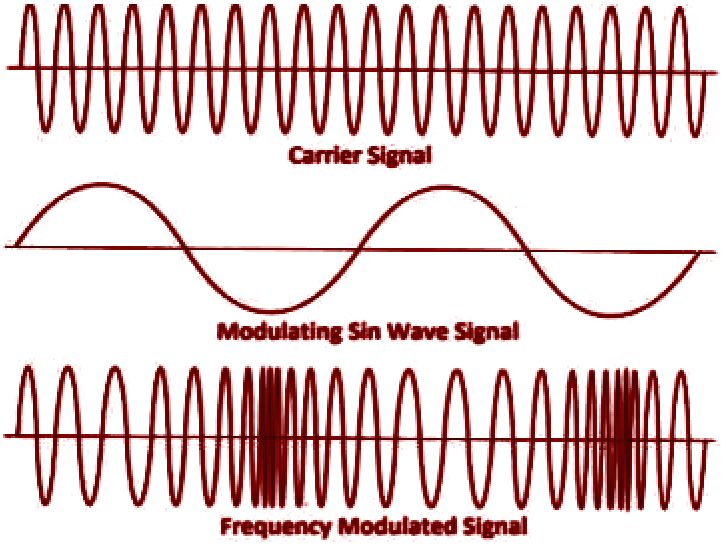


Fig 8.2:FM waveforms

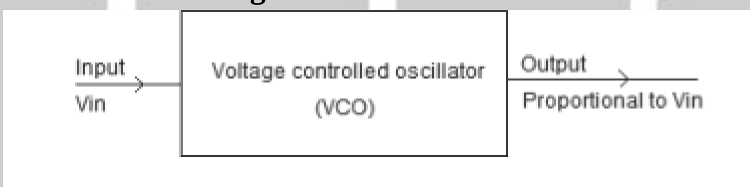
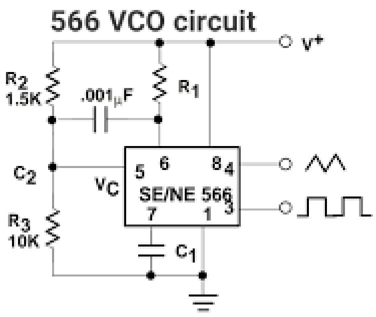


Fig 8.3:Voltage Controlled Oscillator

LM 566 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 LM 566 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 LM 566 is shown in figure.



OR

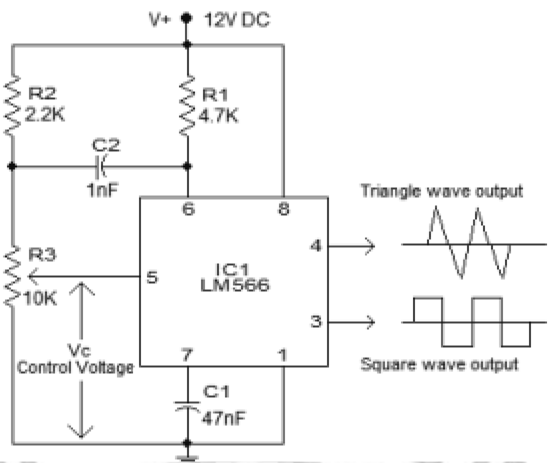


Fig 8.4: FM Modulator using IC 566

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.

VII. Actual Circuit diagram used in a laboratory with related equipment rating.

(a) Sample circuit diagram

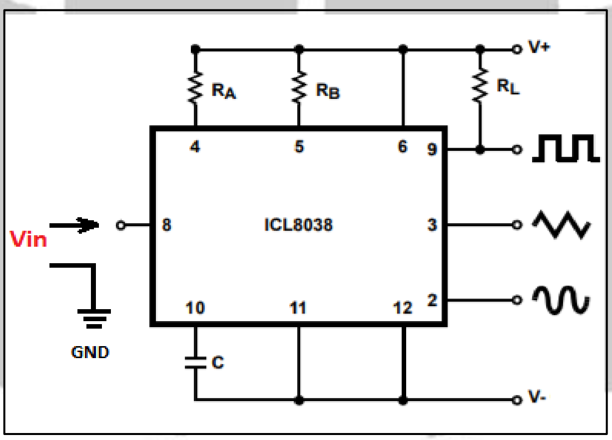


Fig 8.5:FM Modulation circuit Diagram using 8038

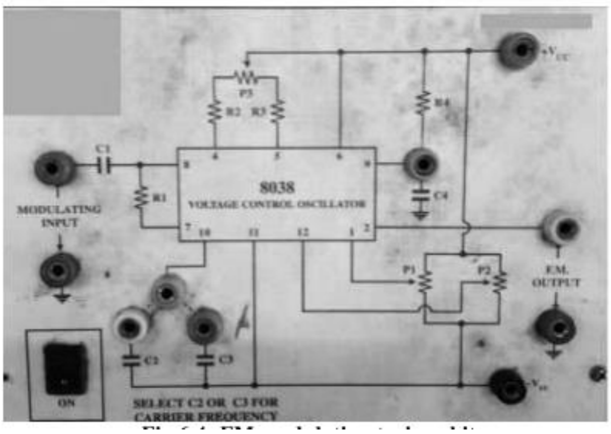


Fig 8.6:FM Modulation trainer kit

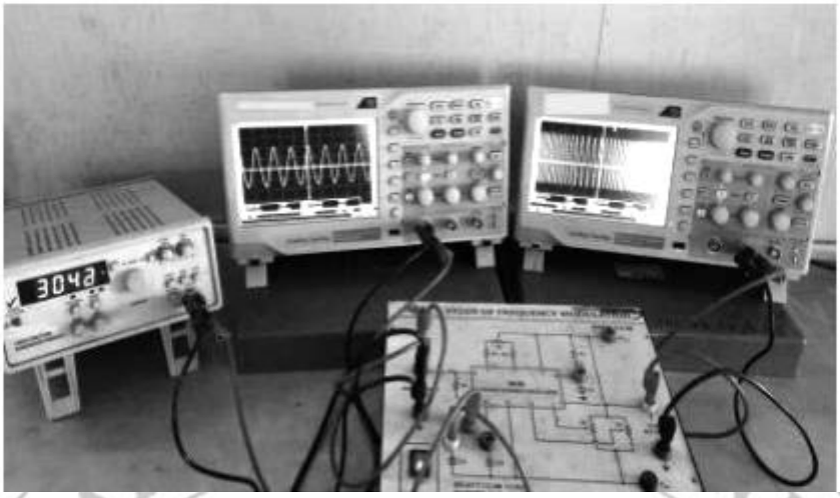


Fig 8.7:FM generation using VCO 8038

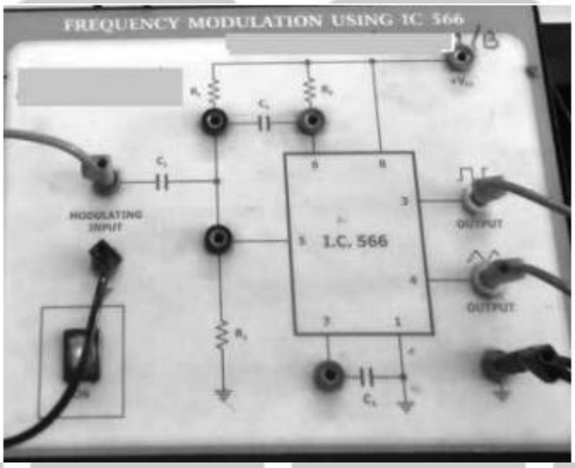


Fig 8.8:Circuit Diagram of FM Generation using IC 566

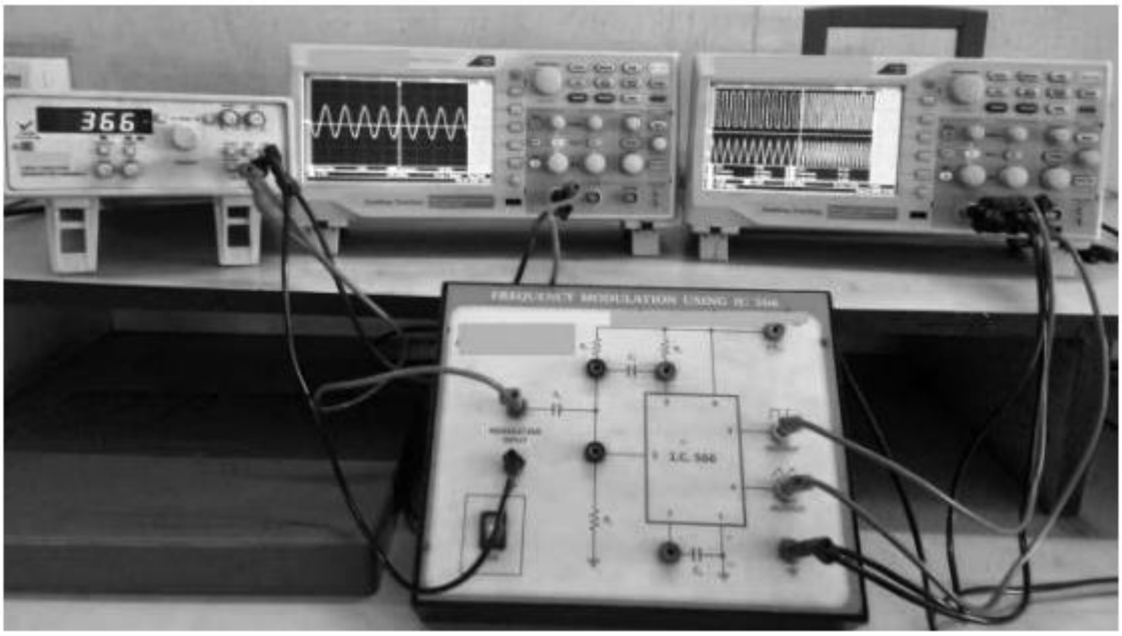


Fig 8.9: Experimental set up of FM Generation using IC 566

(b) Actual Experimental Setup used in Laboratory

VIII. Required Resources/apparatus/equipment with specifications

Sr. No.	Instrument /components	Specification	Quantity
1.	FM generation trainer kit using VCO 8038	Modulating signal 0 to 5 KHz carrier signal is 100 KHz	1
2.	Function Generator	0.01 Hz to 1 MHz 10V p-p output	1
3.	CRO	25 MHz,dual scope	2
	DSO	Bandwidth 30 MHz to 200 MHz Analog Channels 2-4	2
4	FM demodulator trainer kit	Modulating signal 0 to 5 KHz carrier signal is 100 KHz	1
5	Connecting wires	Single strand Teflon coating (0.6 mm diameter)	As per requirement

IX. 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.

X. Procedure

1. Make connections as shown in fig 8.7
2. Before applying modulating signal check the output of IC 8038 at pin no2 and measure frequency
3. Switch on the power supply
4. Connect the in-built carrier on the kit to the modulator
5. Apply modulating signal from function generator as input to trainer kit as well as to first channel of CRO as shown in fig 8.5
6. Connect CRO at FM output terminal second channel of CRO/DSO as shown in fig 8.7
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 frequency values of modulating signal keeping amplitude constant.

Write down the readings in observation table

9. Calculate frequency deviation =fc – fm
10. Draw the waveform of modulating signal, carrier signal and AM signal on graph paper.
11. Make the connections as shown in fig 8.9
12. Before applying modulating signal check the output of IC 566 and measure the frequency fc
13. Apply the fixed modulating frequency fm from function generator 1 KHz
14. Vary the modulating voltage Vm keeping modulating frequency fm constant.
15. Note down t_{max} and find f_{min}
16. Vary the modulating frequency fm keeping the modulating voltage Vm constant
17. Note down t_{max} and find f_{min}
18. Calculate frequency deviation and modulation index using formula

    Frequency Deviation=fc – f_{min}

    Modulation index=frequency deviation /fm

XI. Resources used

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

XII. Actual Procedure

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XIII. Observation Table

Table 8.1: Calculation of frequency deviation of FM

Vary Amplitude Vm and keep the modulating frequency constant

Fm= ____________ Hz

Sr No.	Modulating Signal Amplitude(Vm)	t_{max}	f_{min} (KHz)	Frequency Deviation=fc - f_{min}
1				
2				
3				
4				

Table 8. 2:Calculation of frequency deviation of FM

Vary frequency fm and keep the modulating voltage constant

Vm= ____________ V

Sr No.	Modulating Signal Frequency(fm)	t_{max}	f_{min} (KHz)	Frequency Deviation=fc - f_{min}
1				
2				
3				
4				

Calculations:

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

f_{min}= ---------------- KHz

Frequency Deviation = fc – f_{min} =------------ KHz

Table 8.3:Calculation of modulation index of FM

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

fm=--------- Hz

Sr No.	Modulating Signal Amplitude (Vm)	t_{max} (ms)	f_{min} (KHz)	Frequency Deviation= fc -f_{min}	Modulation Index=Frequency Deviation/fm
1					
2					
3					
4					

Table 8.4:Calculation of modulation index of FM

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

Vm=---------Volts

Sr No.	Modulating Signal Frequency (fm)	t_{max} (ms)	f_{min} (KHz)	Frequency Deviation= fc - f_{min}	Modulation Index=Frequency Deviation/fm
1					
2					
3					
4					

Calculations:

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

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

Frequency Deviation=fc – f_{min} =---------- KHz

Modulation Index=Frequency Deviation/fm=

XIV. Results

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XV. Interpretation of Results

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XVI. Conclusions & Recommendation

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XVII. Practical Related Questions

1. Write 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 4 applications of FM
4. Give frequency range for FM band
5. State the changes in FM when the frequency of the carrier signal is increased.
6. State the effect in the value of t_{max},keeping fm constant and varying Vm
7. For IC 566,fill the following table for modulating and carrier inputs as given in the procedure.

Pin No.	Type of wave	Amplitude	Frequency
3			
4			
5			
6			
7			

[Space for Answer]

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XVIII 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

XIX Assessment Scheme

	Performance Indicators	**Weightage**
	Process Related (15 Marks)	**60%**
1	Handling of the experimental kit	10%
2	Identification of blocks/components on kit	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%**

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

Scale -

X-Axis -

Y-Axis -

Practical No. 9: Display FM signal using simulation software such as MATLAB/SCILAB/ relevant 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. Industry /Employer Expected Outcomes

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

III. Course Level Learning Outcomes:

CO3 – Maintain FM based communication system.

IV. Laboratory Learning Outcomes

LLO 9.1- Interpret FM signal using simulation software.

LLO 9.2- Calculate modulation index and frequency deviation of FM signal.

V. Relevant Affective domain unrelated Outcome(s)

1.Select proper programming environment

2.Follow ethical practices

VI. Relevant Theoretical Background

The modulating signal is mathematically represented as,

$$Vm = Vm\cos(2*\Pi*fmt) \text{----------------} (1)$$

Where, Vm - Instantaneous amplitude of modulating signal.

Vm -Amplitude of modulating signal

fm -Modulating signal frequency

Carrier signal is mathematically represented as,

$$Vc = Vc\sin(2\Pi fct+\theta) \text{----------------} (2)$$

Where, Vc=- Instantaneous amplitude of carrier signal.

Vc -Amplitude of carrier signal

fc - Carrier signal frequency

FM wave is mathematically represented as,

$Vfm=Vc \sin [wct+(\delta/fm)\ \sin wmt]$

Where, $m=\delta/fm$=Modulation index of FM wave

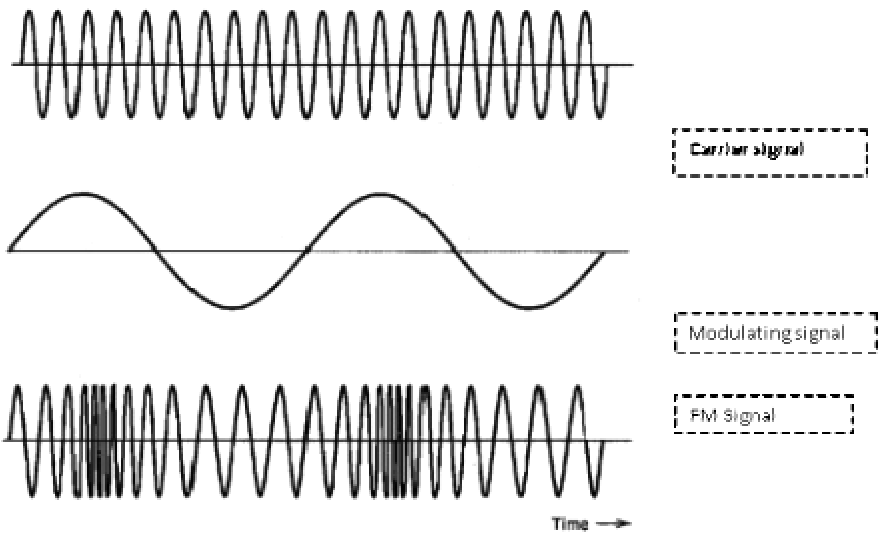

Fig 9.1:FM Waveform

VII. Sample Simulation Code

(a) FM Generation using MATLAB simulink

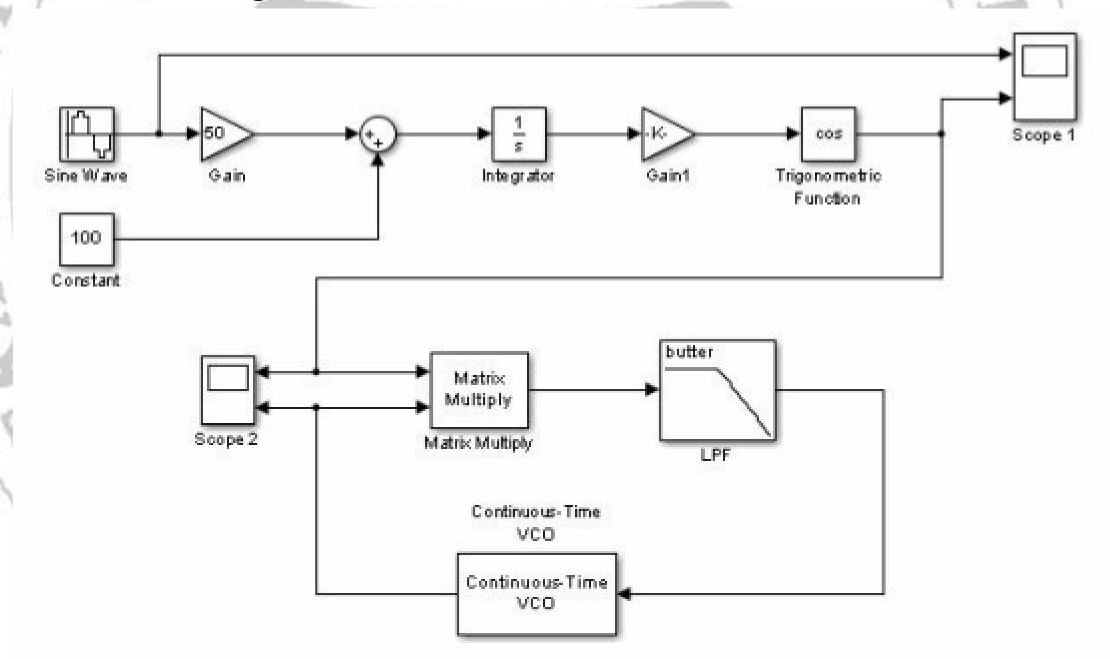

Fig 9.2:FM generation using MATLAB Simulink

OR

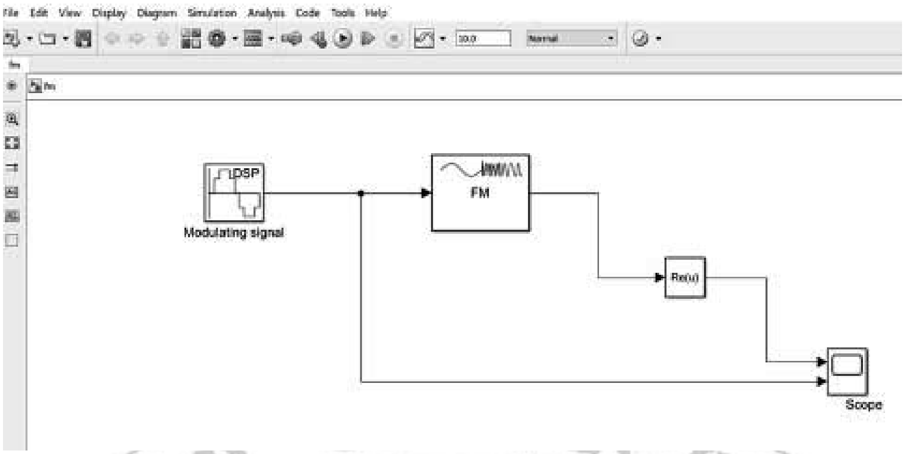

Fig 9.2:FM generation using MATLAB Simulink

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,l,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;
```

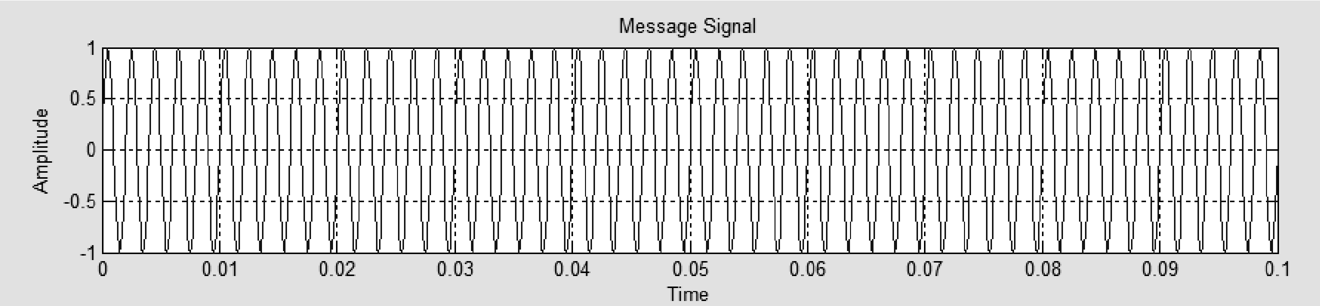

Fig 9.3:Sample MATLAB Simulation Output

OR

Sample Code for FM Generation using Scilab Code:

```
t=0:1/1000:1;   //declare time interval
Ac=9;  //amplitude of carrier signal
Am=4;  //amplitude of modulating signal
fc=100;  //carrier frequency
fm=50; //modulating frequency
//Carrier signal
Vc=Ac*cos(((2*%pi)*fc)*t);
//Modulating signal
Vm=Am*sin(((2*%pi)*fm)*t);
//Frequency modulation signal
m=2; //modulation index
Vfm=Ac*cos(((2*%pi)*fc)*t)+m*sin(((2*%pi)*fm)*t);
//plot signal
subplot (311);
plot(t,Vm)
title('Modulating Signal')
subplot (312);
plot(t,Vc);
title('Carrier Signal')
subplot(313);
plot(t,Vfm)
title('Frequency Modulaing signal')
```

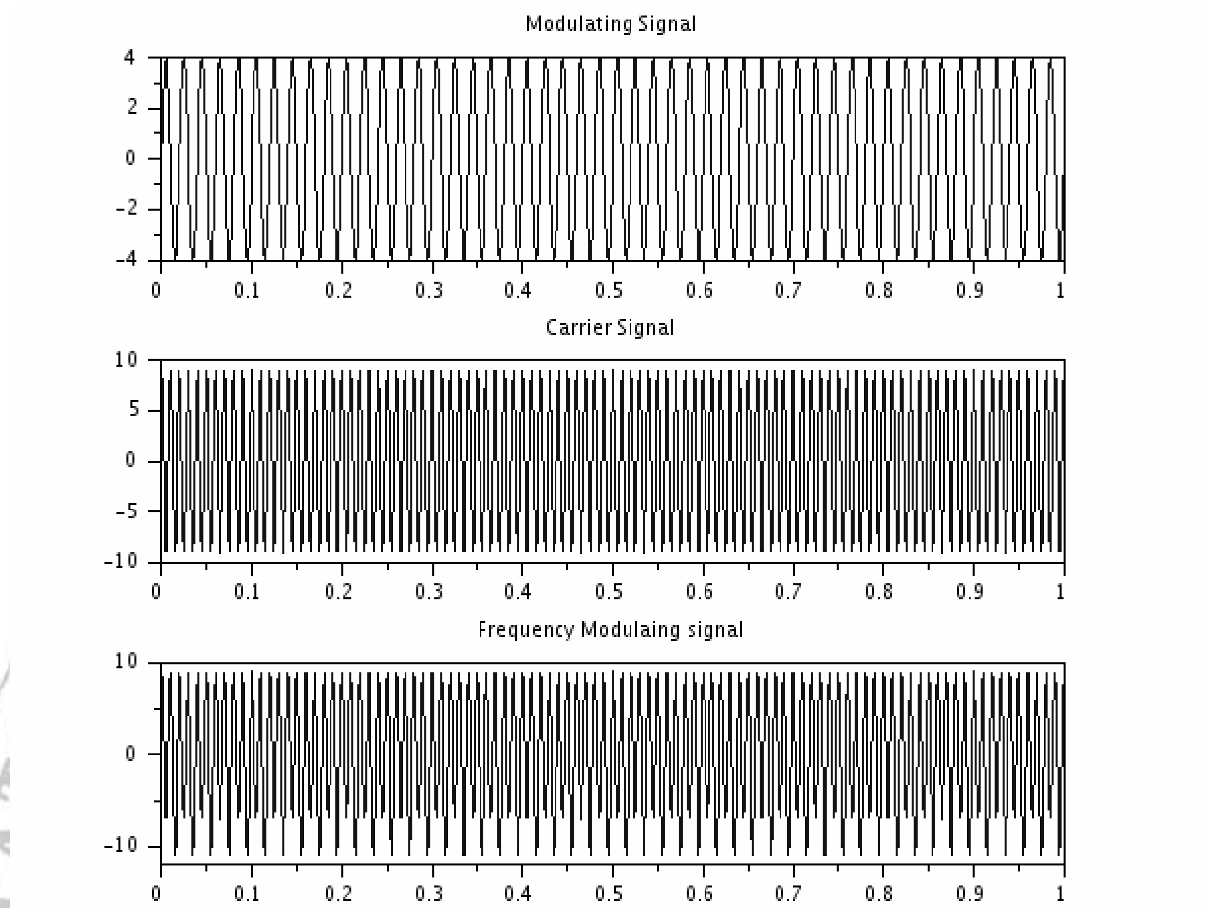

Fig 9.4:Sample Scilab Simulation Output

VIII. Required Resources/apparatus/equipment with specifications

Sr. No.	Instrument /Object	Specification	Quantity
1.	Computer	Latest Processor	1
2.	Simulation Software	Lab View/MATLAB/SCILAB/PSpice/HS Spice/Multisim/Proteus or any relevant open source simulation software	1

IX. Precautions to be followed

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

X. 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
4. Set the amplitude =1V and frequency of modulating signal 4 Hz
5. Set the frequency deviation =50 Hz for FM baseband modulator
6. Observe the output FM signal on scope and save the result.
7. Now increase the amplitude of modulating signal and repeat step 6

XI. Resources used

Sr. No.	Instrument /Components	Specification	Quantity
1.			
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XII. Actual Procedure

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XIII. Observations

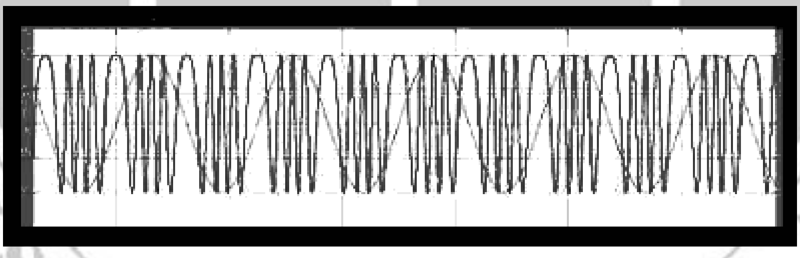
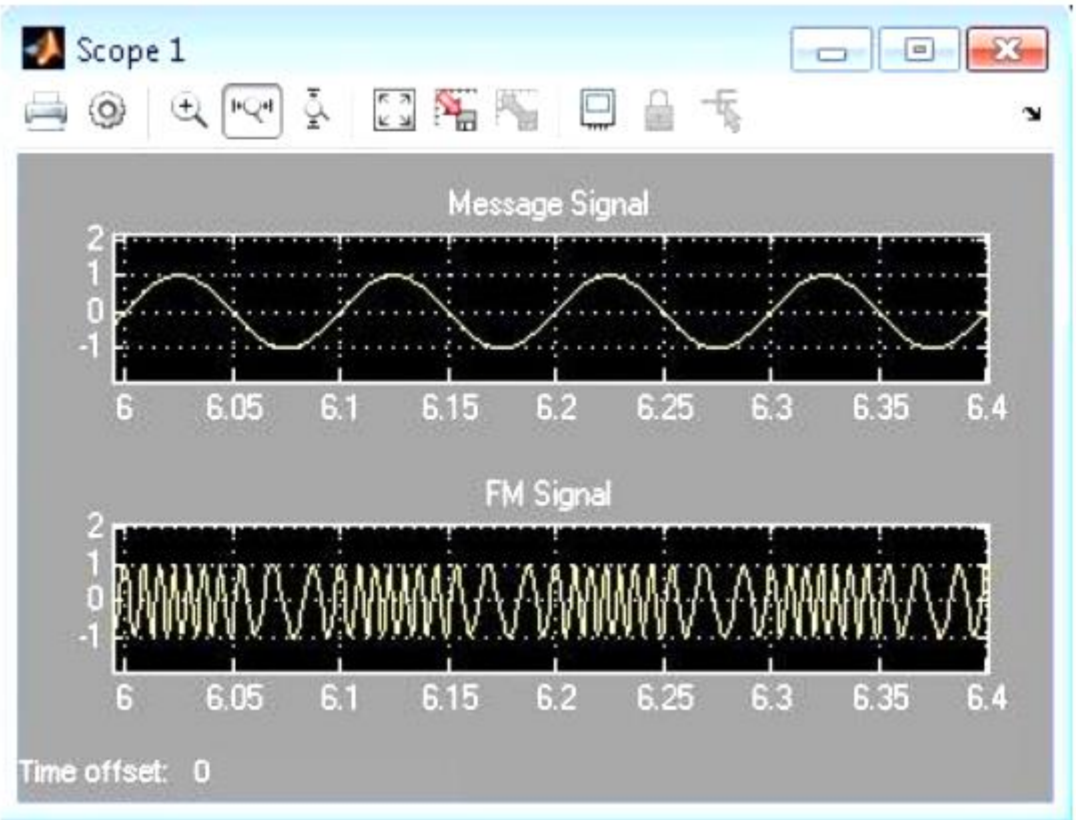
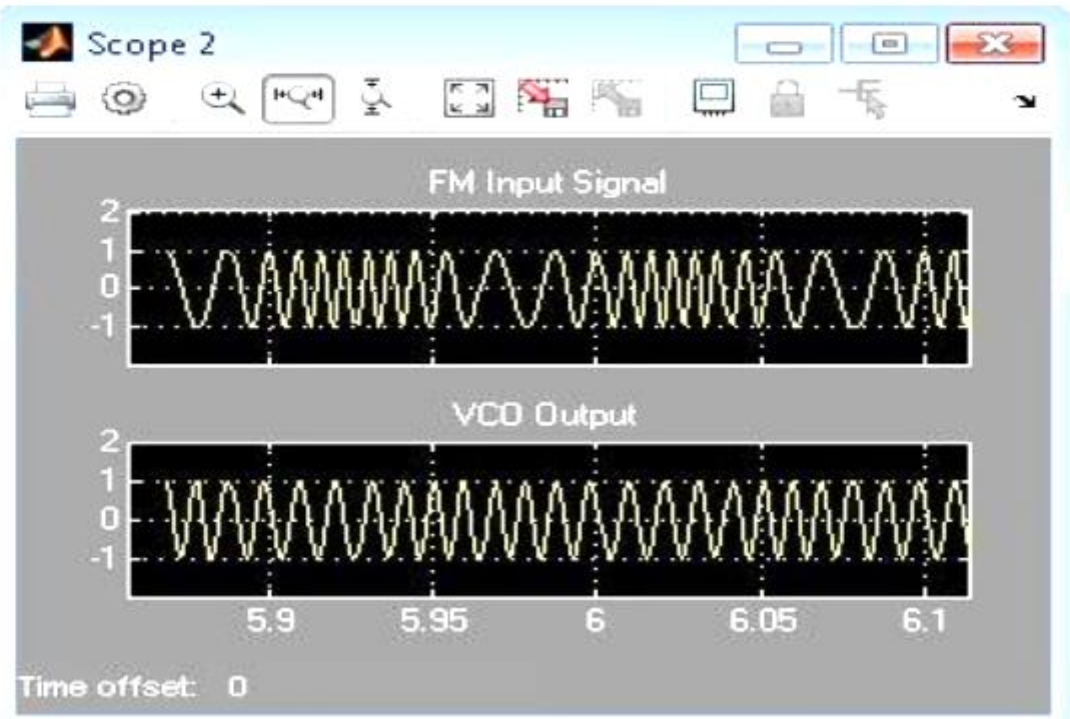


Fig 9.5 :FM observed signal on scope (for Vm=1V,fm=4 Hz and fc=50 Hz)

OR


Scope 1
Message Signal
2
1
0
-1
6
6.05
6.1
6.15
6.2
6.25
6.3
6.35
6.4
FM Signal
2
1
0
-1
6
6.05
6.1
6.15
6.2
6.25
6.3
6.35
6.4
Time offset: 0


Scope 2
FM Input Signal
2
1
0
-1
VCO Output
2
1
0
-1
5.9
5.95
6
6.05
6.1
Time offset: 0

Actual simulation output(FM Observed):
(Students should paste the FM waveform for different values of deviation)

XIV. Results

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XV. Interpretation of Results

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XVI. Conclusions & Recommendation

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XVII. Practical Related Questions

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. State the value of the modulation index of the observed FM waveform?
4. Draw frequency spectrum of FM
5. Calculate bandwidth for observed FM wave by Carson's rule

[Space for Answer]

XVIII. References / Suggestions for further Reading

1.https://www.circuitsgallery.com/2012/05/matlab-code-foramplitude-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 the simulation software	10%
2	Building of Program	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%**

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

Practical No. 10: Demodulate the given FM signal using IC 565 and test the output from the given input waveforms

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 communication equipment.

In this practical students will understand the concept of FM demodulation using IC 565

II. Industry /Employer Expected Outcomes

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

III. Course Level Learning Outcomes:

CO3 – Maintain FM based communication system.

IV. Laboratory Learning Outcomes

LLO 10.1- Build FM detector circuit using IC 565.

LLO 10.2- Observe the FM demodulated signal and draw the input and output waveforms.

V. Relevant Affective domain unrelated Outcome(s)

1.Handle components and equipment carefully.

2.Select instruments of required range.

3.Follow ethical practices.

VI. Relevant 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 IC 565 PLL is used for FM demodulation.It contains 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 pin 9.

The block diagram for phase locked demodulator is shown in fig 10.1.The phase detector which is basically balance modulator produce an average output voltage that is linear function of the phase difference between 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 VCO frequency to increase. The pin diagram of IC 565 is shown in fig.10.2

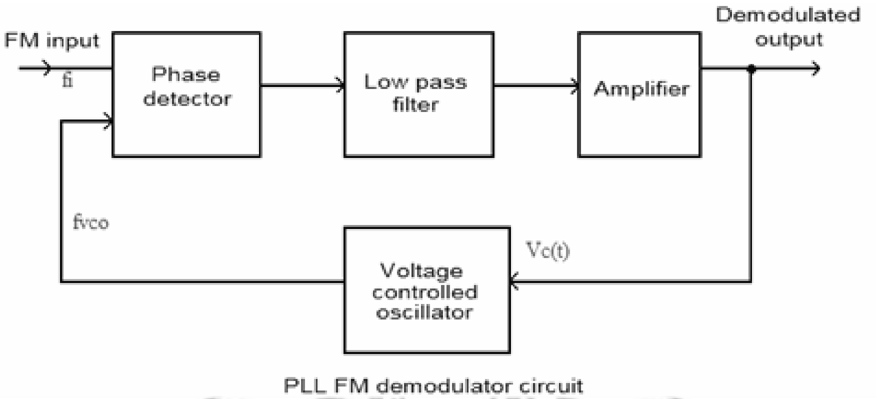

Fig 10.1:PLL Block Diagram

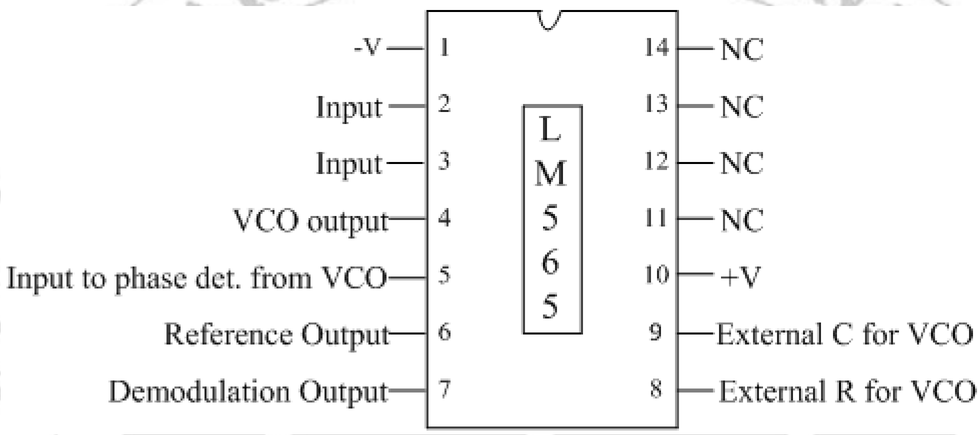

Fig 10.2: IC 565 Pin Diagram

VII. Actual Circuit diagram used in a laboratory with related equipment rating.

(a) Sample Circuit diagram

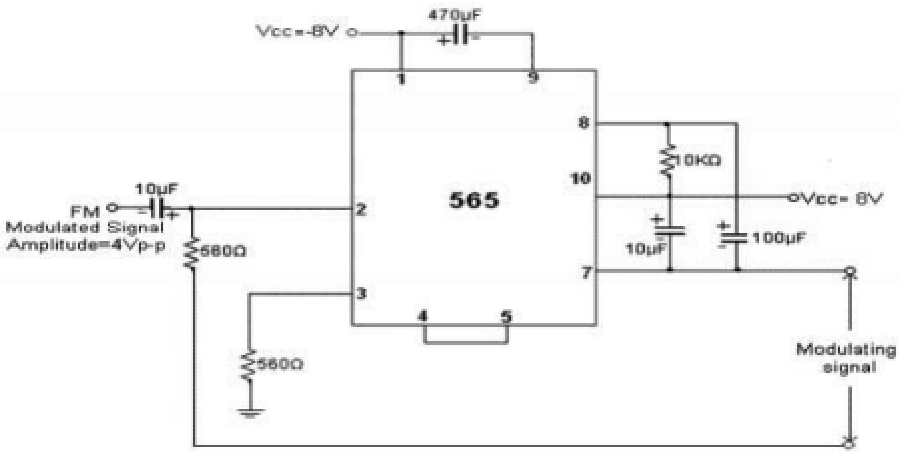

Fig 10.3 :FM Demodulation circuit diagram using IC 565

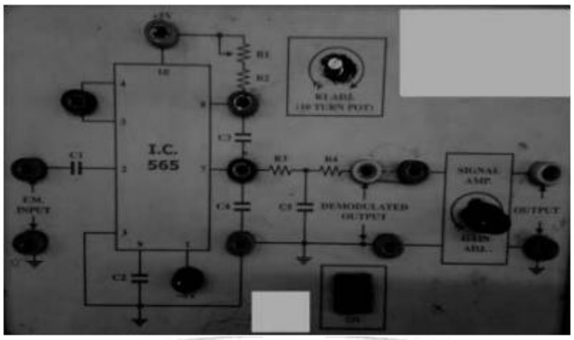

Fig 10.4:FM demodulation trainer kit using IC 565

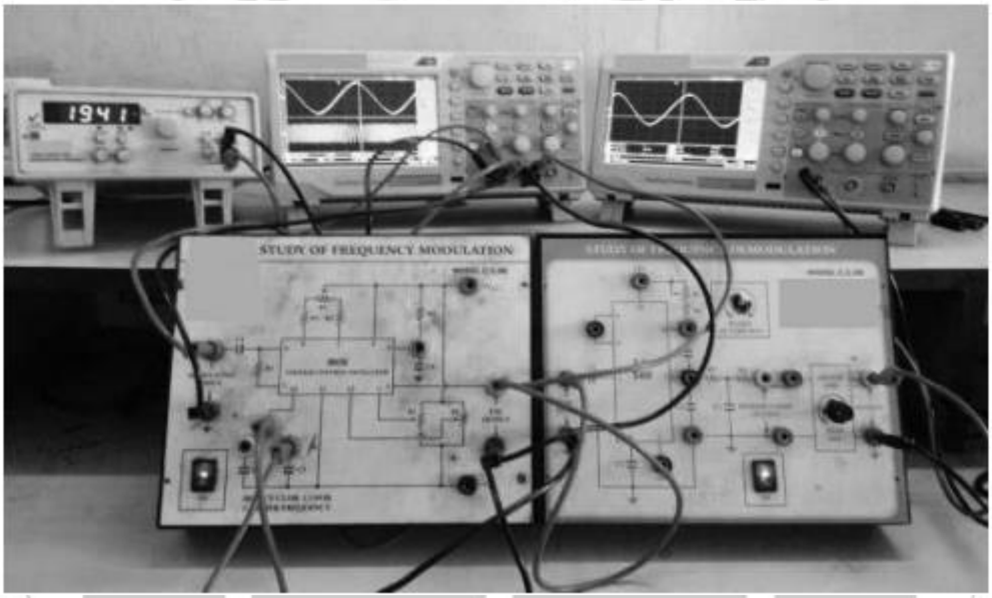

Fig 10.5:FM demodulation experimental setup using IC 565

(b) Actual Experimental Setup used in Laboratory

VIII. Required Resources/apparatus/equipment with specifications

Sr. No.	Instrument/Components	Specification	Quantity
1.	FM Modulator kit	Using IC 8038	1
2.	FM Demodulator kit	Using PLL IC 564/565	1
3.	Function Generator	0.01 Hz to 1 MHz,10 V p-p output	1
4.	CRO	25 MHz,dual scope	2
	DSO	Bandwidth 30 MHz – 200 MHz Analog Channels 2 - 4	2
6.	Connecting wires	Single strand Teflon coating (0.6 mm diameter)	As per requirement

IX. 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.

X. Procedure

1. Make the connections as shown in fig 10.5
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 tmax and find fmin
6. Calculate frequency deviation and modulation index using formula
7. Apply FM modulated signal at the input of IC 565
8. Connect the output to CRO and observe the waveform of IC 565 circuit and record the result in the observation table 10.1
9. Draw the waveform of a demodulated signal.

XI. Resources used

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

XII. Actual Procedure

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XIII. Observation Table

Table 10.1:Modulation index of FM signal and observation of demodulated signal

Modulating signal frequency=

Carrier Frequency=

Sr No.	Modulating signal Voltage Vm	tmax	fmin = 1/tmax KHz	Frequency Deviation (fc - fmin)	Modulation Index	Demodulated signal frequency in KHz
1						
2						
3						
4						
5						

Calculations:

tmax=

fmin=

Frequency Deviation=fc – fmin

m=Frequency Deviation / fm

Demodulated signal frequency=--------------- in KHz

XIV. Results

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XV. Interpretation of Results

XVI. Conclusions & Recommendation

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XVII. Practical Related Questions

1. List any two applications of phase locked loop
2. For IC 565 fill the following table for modulating and carrier inputs as given in the procedure.

Pin No.	Type of wave	Amplitude	Frequency
2			
4			
5			
6			
7			
8			
9			

[Space for Answer]

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XVIII. 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=GulqNa5-JMs

XIX. 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%**

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

Practical No. 11: Test the output of various stages/blocks of the FM receiver

I. Practical Significance

FM Radio Receiver has been calibrated with standard source of FM RF generator. It has been calibrated for FM generator signal for the carrier frequency range from 88 MHz to 108 MHz. The tuning coils are already tuned for the optimum output response and generally no need to re-tune until unless it is required. It has also been tuned to the locally available FM radio stations and found the satisfactory audio signal output response. The quality of the detected signals very much depends on the power level of the particular transmitting radio station in the vicinity of the experiment area. In case of low power, it is suggested to establish the experimental setup closer to the open environment.

II. Industry /Employer Expected Outcomes

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

III. Course Level Learning Outcomes:

CO3 – Maintain FM-based communication system.

IV. Laboratory Learning Outcomes

LLO 11.1- Observe the waveforms and measure the voltages at various test points FM receiver.

LLO 11.2- Troubleshoot various faults of FM receivers such as popping, hissing etc.

V. Relevant Affective domain unrelated Outcome(s)

1.Follow safe practices

2.Handle instruments carefully.

3.Follow ethical practices

VI. Relevant Theoretical Background

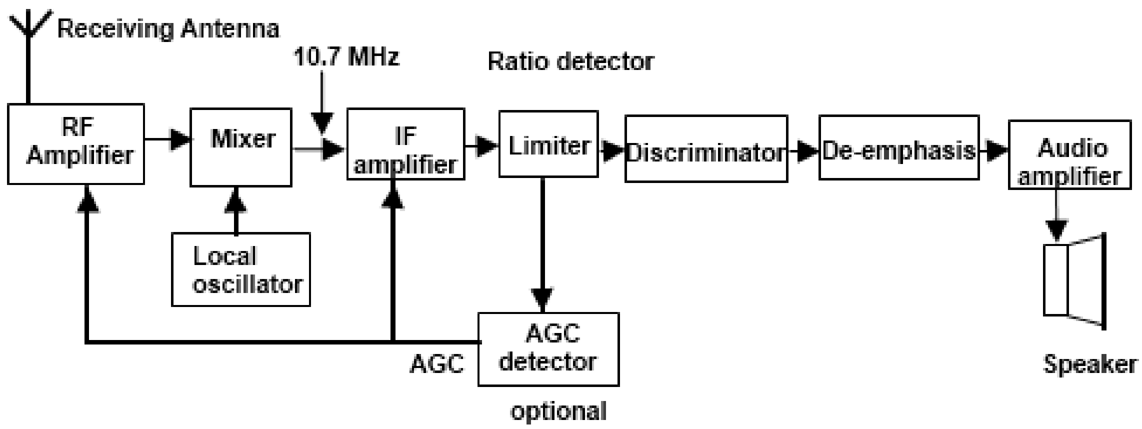

Fig 11.1: Block diagram of superheterodyne FM Receiver

Explanation:-

RF amplifier:

There are two important functions of RF amplifier:

- To increase the strength of weak RF signals.
- To reject image frequency signals. In FM broadcast the channel bandwidth is large as compared to AM broadcasts.

Hence the RF amplifier must be designed to handle large bandwidth.

Mixer Stage:

The function of frequency mixer is to heterodyne signal frequency fs and local oscillator frequency of. At the output, it produces the difference frequency known as intermediate frequency fi. The intermediate frequency used in FM receivers is higher than that in AM receivers. Its value is 12MHz (practical value of IF is 10.7MHz).

Local oscillator:

Since FM broadcast operates in VHF and UHF band, a separate local oscillator is used in FM receiver The local oscillator frequency fo is kept smaller than the signal frequency fs by an amount equal to the intermediate frequency fi
(fi = fs-fo).

IF amplifier:

Two or more stages of IF amplifiers are used to provide large gain to the receiver. This increases the sensitivity of a receiver. If amplifiers should be designed to handle large bandwidths.

Amplitude limiter:

The function of the amplitude limiter is to remove all amplitude variation of FM carrier voltage that may occur due to atmospheric disturbances. Use of amplitude limiter makes the system less noisy.

FM Discriminator or detector:

It separates modulating signals from frequency modulated carrier signals. Thus it produces an audio signal at its output.

Audio frequency voltage and power amplifier:

Audio amplifier increases the voltage and power level of an audio signal to a suitable level. In FM broadcast, the maximum modulating frequency is 15 kHz. Hence the audio amplifiers must have large bandwidth.

VII. Actual Circuit diagram used in a laboratory with related equipment rating.

a. Sample Circuit diagram / set up

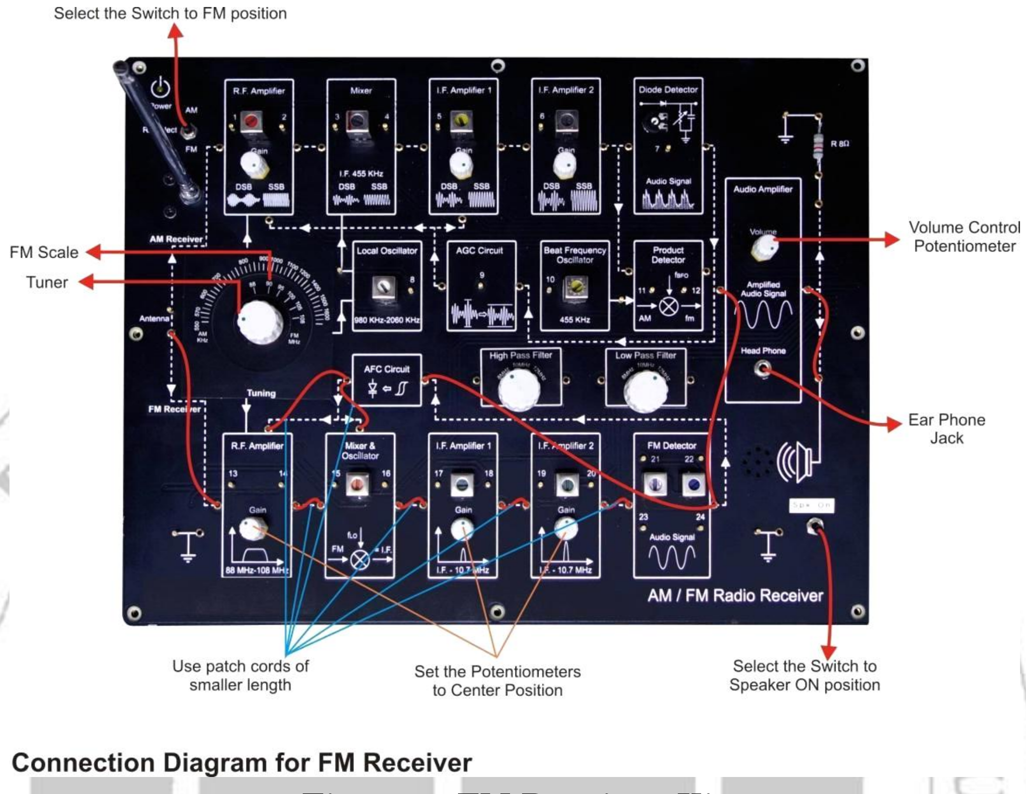

Fig 11.2 FM Receiver Kit

b. Actual circuit diagram /setup

VIII. Required Resources/apparatus/equipment with specifications

Sr. No.	Instrument/Components	Specification	Quantity
1.	FM Trainer kit for Modulation and Demodulation	Modulating signal -0 to 2 KHz ,Carrier signal 100 KHz	1
2.	Function Generator or RF Signal Generator	0.01 Hz to 1 MHz,10V p-p output frequency range 100 Khz to 150 Mhz fine frequency adjustment by calibrated dial built in audio frequency generator	2
3.	CRO	25 MHz,dual scope	1
	DSO	Bandwidth 30 MHz – 200 MHz Analog channels 2-4	
4.	Connecting wires	Single strand Teflon coating (0.6 mm diameter)	As per requirement
5	Digital Multimeter	3 1/2 digit display ,9999 counts digital multimeter measures: Vac, Vdc (1000V max) , Adc, Aac (10 A max) , Resistance (0 to 100 MΩ).	As per requirement

IX. 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 the proper volt/div and times/div selection on CRO/DSO.
3. Connect kit and CRO as shown in fig

X. Procedure

1. Set the Standard FM RF Source to generate FM output for carrier frequency of 90 Hz approximately and the amplitude of 120mVpp approximately.
2. Connect the FM output from Standard FM Source to the ‘Antenna’ input socket of the FM Radio Receiver.
3. Make the connections as per the connection diagram.
4. Set R.F. amplifier's gain and IF amplifier gain pot in center position.
5. Set Audio amplifier's volume pot in a fully counterclockwise position.
6. Set the Speaker switch in the ON position.
7. Turn on the power to the FM Radio Receiver
8. Adjust the volume pot so that the receiver's output can be clearly heard.
9. Check that the waveforms at the outputs of different stages of receiver as per the observation table.

XI. Resources used

S. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
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XII. Actual Procedure

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XIII. Observation Table

Sr.No.	Stage /Block	Amplitude of signal (in volts)	Waveform
1	RF Amplifier		Draw all waveforms on graph paper
2	Local Oscillator		
3	IF Amplifier		
4	FM Detector		
5	AF Power Amplifier		

XIV. Results

XV. Interpretation of Results

XVI. Conclusions & Recommendation

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XVII. Practical Related Questions

1. State function of limiter circuit used in FM receiver
2. Give the name of the antenna used in FM receivers
3. Draw and explain ratio detector circuit used in FM receivers.
4. State the role of local oscillator and IF amplifier used in FM receiver

[Space for Answer]

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XVIII. References / Suggestions for Further Reading

1. https://www.electronicsforu.com/electronics-projects/fm-radio-receiver-using-ic-ta-7640ap
2. https://www.etti.unibw.de/labalive/experiment/fmdemod/
3. https://www.tutorsglobe.com/homework-help/electrical-engineering/fault-in-fm-radio-receiver-71490.aspx

XIX. 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%**

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

Practical No. 12: Use simulation software to measure MUF for the given critical frequency and incident angle

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 the ionosphere layer. One of the simulation codes is given. Students can use any other software tool.

II. Industry /Employer Expected Outcomes

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

III. Course Level Learning Outcomes:

CO4 – Identify Propagation mode for specified radio frequency bands.

IV. Laboratory Learning Outcomes

LLO 12.1- Interpret the MUF for the given critical frequency.

V. Relevant Affective domain unrelated Outcome(s)

1.Select proper programming environment

2.Follow ethical practices

VI. Relevant Theoretical Background

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

Ground Waves:

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

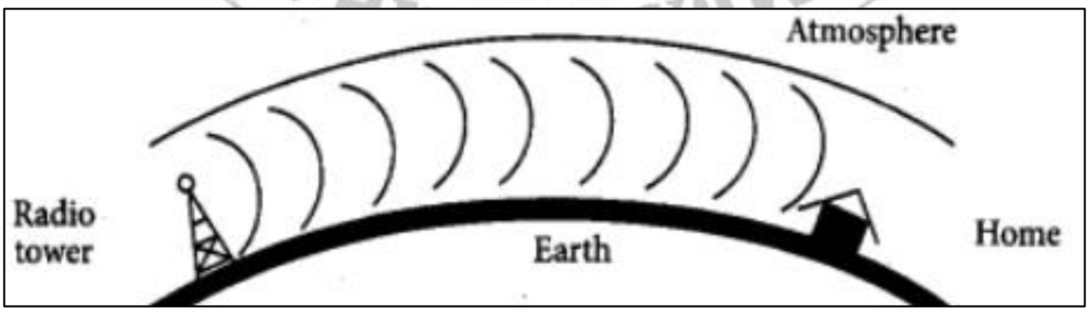


Fig 12.1: Ground wave propagation

Sky Wave Propagation:

In sky wave propagation the transmitted signal travels into 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 the ionosphere. The various layers of the ionosphere have specific effects on the propagation of radio waves. Principle of sky wave propagation is shown in fig.12.2

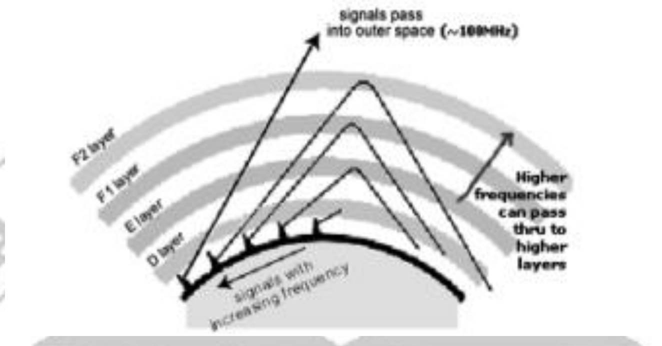


Fig 12.2:Sky Wave Propagation

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.

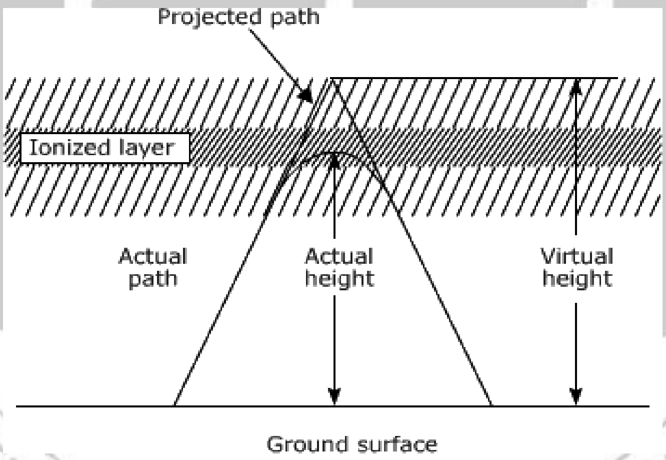


Fig 12.3: Virtual Height

2. **Critical Frequency:**

   The critical frequency of a 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 to 12 MHz for the F2 layer.

3. **Maximum Usable Frequency:**

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

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

4. **Skip Distance:**

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

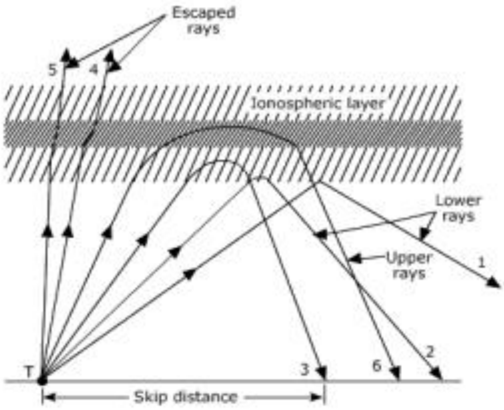


Fig 12.4: Skip Distance

Space Wave Propagation:

Space waves travel in a straight line directly from the transmitting antenna to the receiving antenna. They do not refract nor do they follow the curvature of 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.

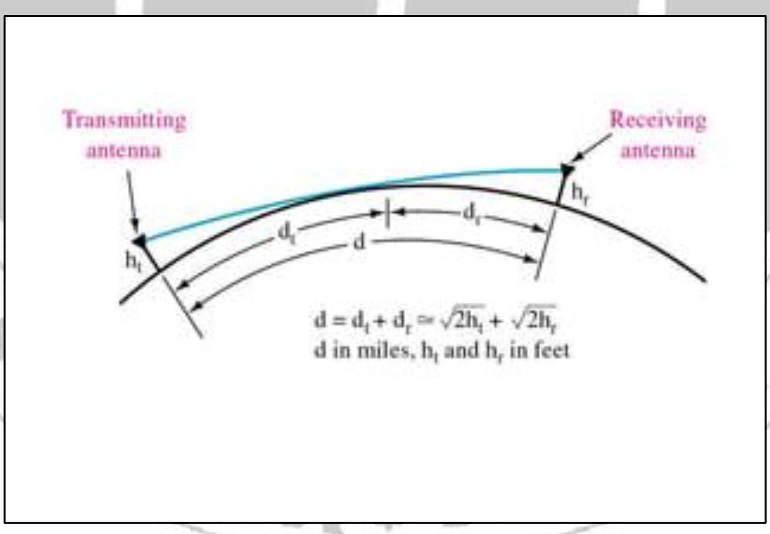


Fig 12.5: Radio Horizon for space wave

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

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

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 the empirical formula,
d=dr + dt = $4\sqrt{ht} + 4\sqrt{hr}$

VII. Sample Simulation Code

(a) Sample MATLAB code to calculate MUF of 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)
```

Program:To calculate MUF

```
clc;

clear all;

close all;

fc=input('critical frequency of the layer');

theta=input('angle of incidence');

muf=(fc/cos(theta*pi/180));

disp('maximum usable frequency of the layer is');

disp(muf);
```

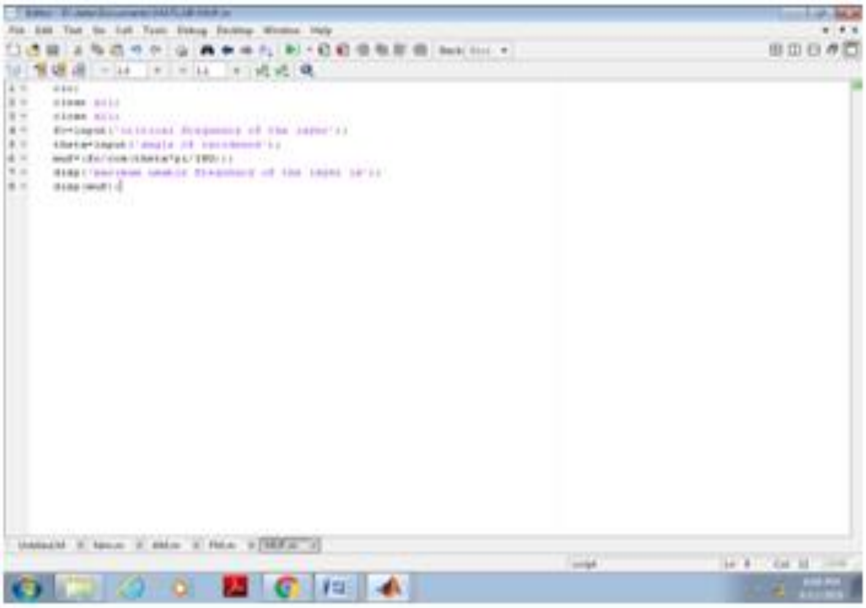


Fig 12.6: MATLAB Code to calculate MUF

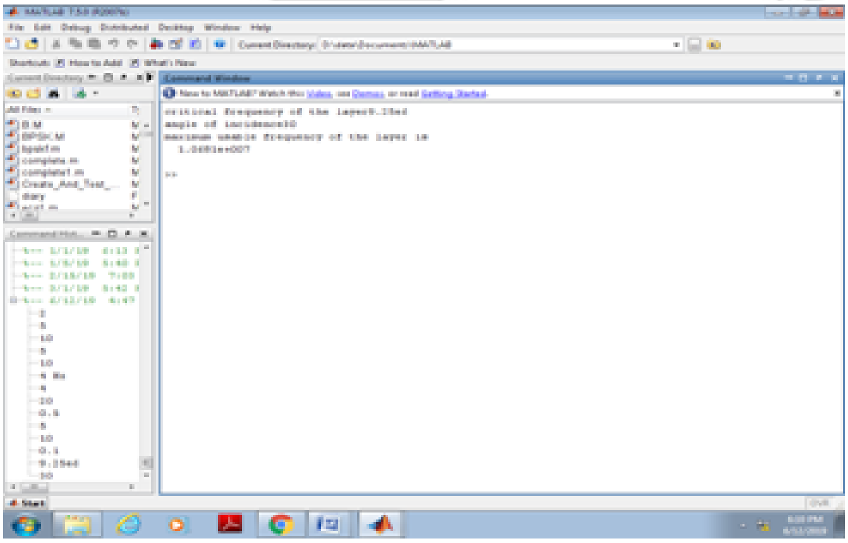


Fig 12.7: MATLAB Simulation Output

(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);
```

Program:To calculate Radio horizon

```
clc;

clear all;

close all;

ht=input('enter the height of transmitting antenna in meter');

hr=input('enter the height of receiving antenna in meter');

d=4*sqrt(ht)+4*sqrt(hr);

disp('Radio horizon for space wave in kilometers is');
disp(d);
```

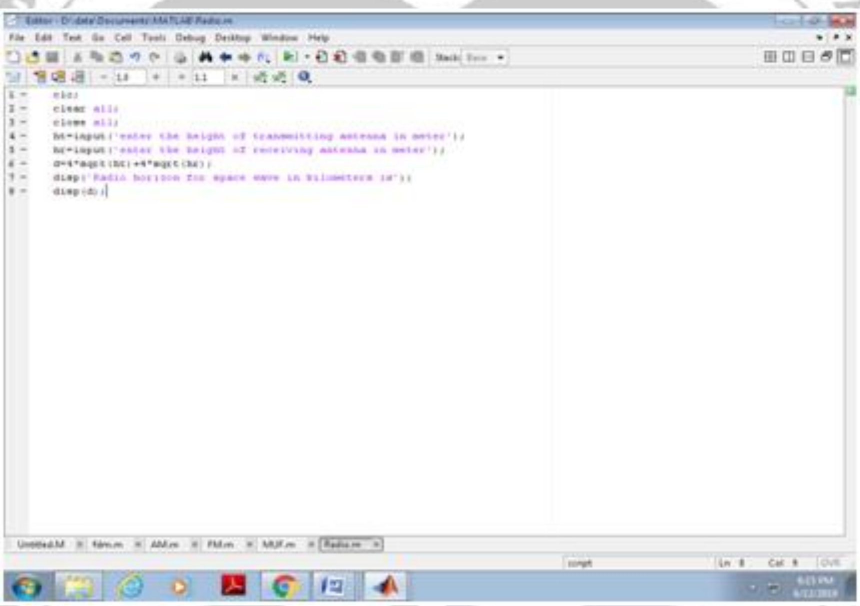


Fig 12.8: MATLAB Code to calculate Radio Horizon

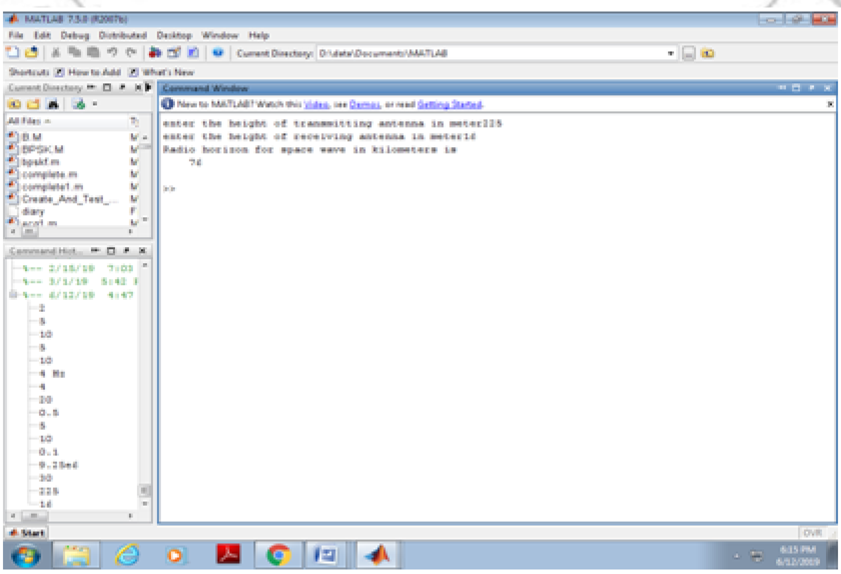


Fig 12.9: MATLAB Simulation Output

(c) Actual code used in laboratory

VIII. Required Resources/apparatus/equipment with specifications

Sr. No.	Instrument /Object	Specification	Quantity
1.	Computer	Latest Processor	1
2.	Simulation Software	LabView/MATLAB/SCILAB/P Spice/HS Spice/Multisim/Proteus or any relevant open source simulation software	1

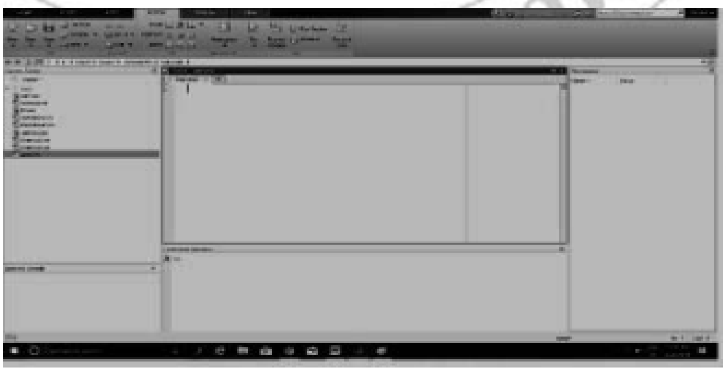
IX. Precautions to be followed

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

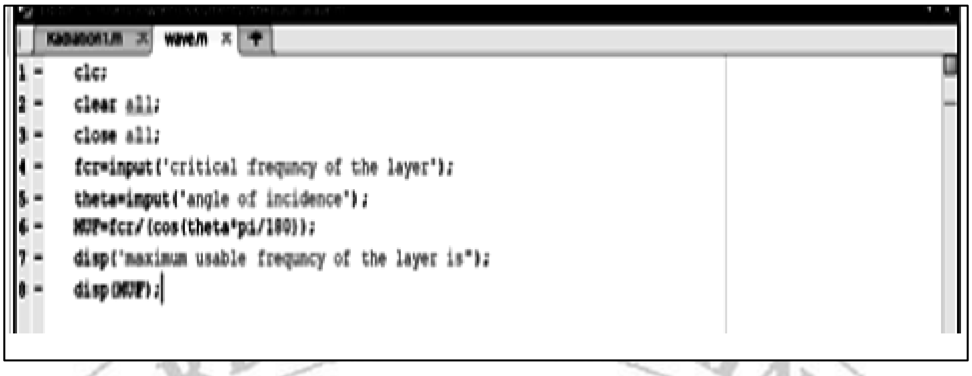
X. Procedure

Part I : To calculate Maximum Usable Frequency

1. Open MATLAB and create a new script file.

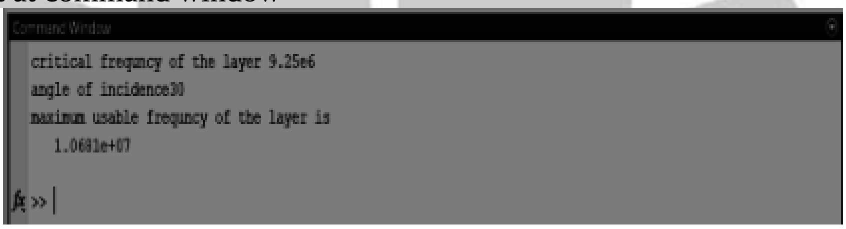


2. Write the code to calculate MUF the file



3. Run the program using the run option.
4. Input the values of critical frequency and angle of incidence.

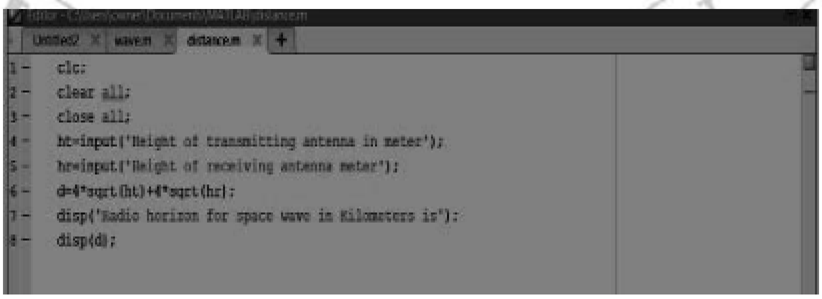
5. Get the output at command window



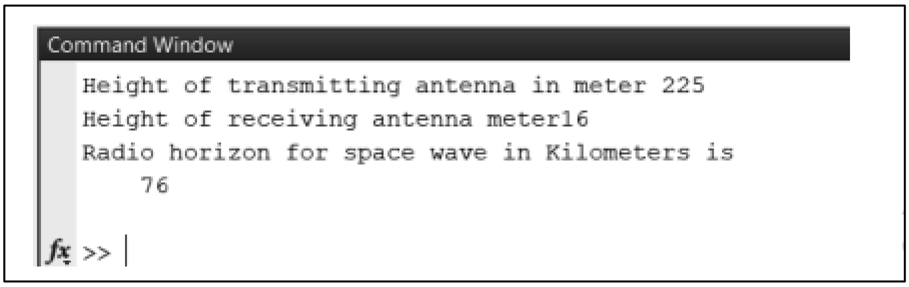
6. Note down values in observation table 12.1
7. Repeat the steps 3,4,5 for different values of critical frequency and angle of incidence.

Part II : To calculate radio Horizon

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 the command window.



5. Note down values in observation table 12.2
6. Repeat the steps 3,4,5 for different values of height of transmitting and receiving antenna.

XI. Resources used

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

XII. Actual Procedure

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XIII. Observations Table

Table 12.1: Calculation of MUF

Sr No.	Critical Frequency (Hz)	Angle of Incidence(θ)	MUF (Hz)

Table 12.2 : Calculation of Radio Horizon

Sr No.	Transmitting Antenna Height (m)	Receiving Antenna Height (m)	D (Km)

Sample Calculation:

i. Critical frequency(fc)=................. Hz

ii. Angle of incidence(θ)= ....

$$MUF = \frac{Critical\ frequency}{Cos\ \theta}$$

=............... Hz

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

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

$$d=dr + dt = 4\sqrt{ht} + 4\sqrt{hr}$$

Radio horizon(d) =...................... Km

XIV. Results

1. Maximum Usable Frequency (MUF) = ……………………….. Hz
2. Radio Horizon for the space wave (d) = ……………………….. Km

XV. Interpretation of Results

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XVI. Conclusions & Recommendation

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XVII. 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 3o degree 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. Give the name of the software used for the performance?State its version.Is the simulation software used freeware / open source or licensed?
5. State the command or instruction is used to display its output.

[Space for Answer]

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XVIII. 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/
4. https://electrosome.com/am-generation-simulink/

XIX. Assessment Scheme

Performance Indicators		Weightage
Process Related (15 Marks)		**60%**
1	Handling of the simulation software	10%
2	Building of Program	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%**

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

Practical No. 13: Test the performance of given dipole antenna, measure the field strength and plot the radiation pattern for different length of antenna

I. Practical Significance

Antennas are fundamental components of modern communication 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 students to see visually how the most common types of real world antenna designs function.

II. Industry /Employer Expected Outcomes

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

III. Course Level Learning Outcomes:

CO5 – Identify relevant types of antenna for given frequency range/application.

IV. Laboratory Learning Outcomes

LLO 13.1- Use RF source and field meter to measure the field strength of a given antenna.

LLO 13.2- Plot the radiation pattern of a given antenna.

V. Relevant Affective domain unrelated Outcome(s)

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

VI. Relevant Theoretical Background

An antenna is a metallic structure, often a wire or collection of wires used to convert high frequency current into 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-

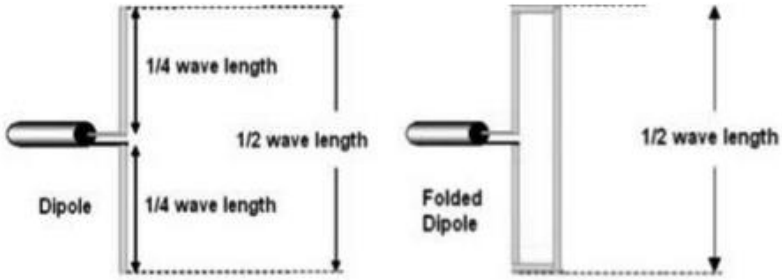

Fig 13.1: Dipole Antenna

The dipole antennas have lengths of λ/2,λ,3λ/2 etc. multiples of λ/2.which corresponds to resonant transmission line hence the dipole antenna is called resonant antenna. The length of λ/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 directions is known as the radiation pattern of the antenna.

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

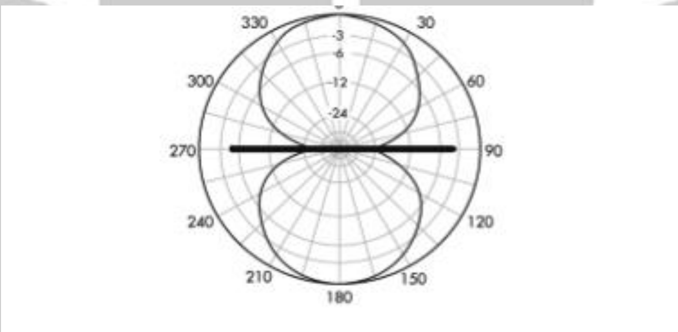

Fig 13.2: Radiation Pattern of Dipole Antenna

VII. Actual Circuit diagram used in a laboratory with related equipment rating.

(a) Sample Experimental Setup

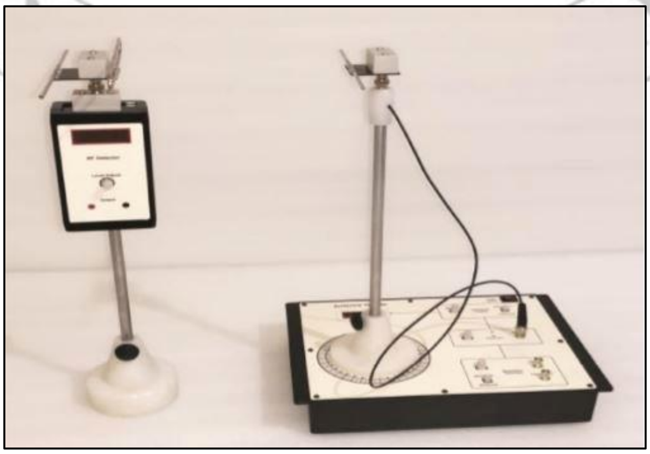

Fig 13.3 :Sample Experimental Setup

(b) Actual Experimental Setup used in Laboratory with related equipment rating

VIII. Required Resources/apparatus/equipment with specifications

Sr No.	Instrument/Components	Specifications	Quantity
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:5MHz to 1000 MHz IF Bandwidth:15 KHz (6 pole) and 150 KHz	1

IX. Precautions to be followed

1.Ensure proper earthling to the equipment
2.Ensure power switch is in off condition initially
3.Ensure proper calibration of the field meter.

X. Procedure

1.Make connection 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 degrees and measure field strength Tabulate the observation
5.Plot the directional pattern of antenna on attached polar paper according to the reading in observation 13.1

XI. Resources used

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

XII. Actual Procedure

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XIII. Observations Table

Table 13.1: Measurement of field strength w.r.t rotation angle

Angle of rotation in degree	Received signal strength in dB
0	
30	
60	
90	
120	
150	
180	
210	
240	
270	
300	
330	
360	

XIV. Results

For Dipole antenna, the radiation pattern is figure of ---------

XV. Interpretation of Results

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XVI. Conclusions & Recommendation

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XVII. Practical Related Questions

1. Dipole antenna produces _______type of radiation pattern
2. _______ is the signal strength of an antenna at 30 degrees?
3. At which angle signal strength is zero?
4. Stick the picture of antenna used in your laboratory
5. A dipole carries RMS current about 300A across the radiation resistance of 2Ω calculate the power radiated by the antenna (Hint: $P_{rad} = I^2 * R_{rad}$)
6. Calculate the length of transmitting antenna for radiating radio waves of 900MHz

[Space for Answer]

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XVIII. References / Suggestions for further Reading

1.en.wikipedia.org/wiki/Radiation_pattern
2.www.tutorialspoint.com/antenna_theory/antenna_theory_radiation_pattern.htm

XIX. 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%**

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

Scale -

X-Axis -

Y-Axis -

Practical No. 14: Test the performance of given Yagi - Uda antenna

I. Practical Significance

Antennas are a fundamental component of modern communication systems.

The radiation pattern of the antenna is of principle concern when establishing contact between signal source and its target. Implementing these lab assignments students will examine the radiation patterns of Dipole Antenna by hands-on field testing. This allows students to see visually how the most common types of real world antenna designs function.

II. Industry /Employer Expected Outcomes

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

III. Course Level Learning Outcomes:

CO5 – Identify relevant types of antenna for given frequency range/application.

IV. Laboratory Learning Outcomes

LLO 14.1- Use RF source and field meter to measure the field strength of a given yagi-uda antenna.

LLO 14.2- Plot the radiation pattern of yagi-uda antenna and interpret the beamwidth.

V. Relevant Affective domain unrelated Outcome(s)

1.Follow safe practices.

2.Handle instruments carefully.

3.Follow ethical practices

VI. Relevant Theoretical Background

A Yagi-Uda antenna consists of a 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.

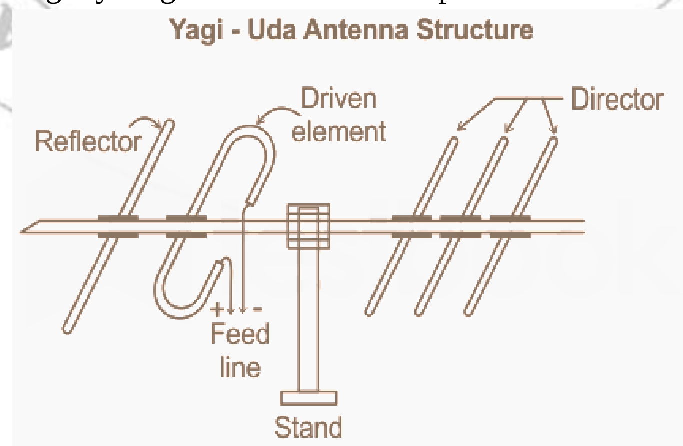

Fig 14.1:Yagi Uda Antenna

Radiation Pattern of the Yagi-Uda Antenna is shown in fig.14.2 which shows that Yagi-Uda is a directional antenna. The radiation pattern of the dipole is a figure of eight. But it is modified by the parasitic elements that are reflectors and directors.

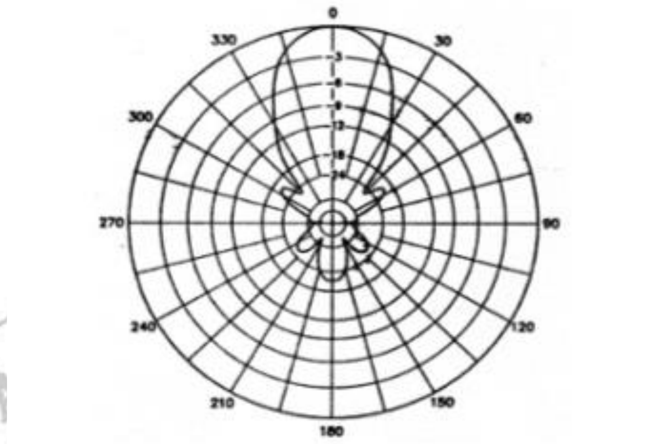

Fig 14.2: Radiation Pattern of Yagi Uda Antenna

VII. Actual Circuit diagram used in a laboratory with related equipment rating.

(a) Sample Experimental Setup:

Fig 14.3 :Sample Experimental Setup

(b) Actual Experimental Setup used in Laboratory

VIII. Required Resources/apparatus/equipment with specifications

Sr No.	Instrument/Components	Specifications	Quantity
1	Set-up of Yagi-Uda Antenna	Vertical polarization broadband 87.5 108 MHz,2.5 dB gain Directional pattern stainless steel	1
2	Field strength Meter	Frequency coverage:5MHz to 1000 MHz,IF Bandwidth:15 KHz (6 pole) and 150 KHz	1

IX. Precautions to be followed

1. Ensure proper earthling to the equipment
2. Ensure power switch is in off condition initially
3. Ensure proper settings of field meter before use

X. Procedure

1. Make connection as per practical set up
2. Switch ON the power supply
3. Connect the output of the antenna to field strength meter.
4. Rotate antenna in steps of 30 degrees and measure field strength
5. Tabulate the observation in observation table
6. Plot the directional pattern of antenna on attached polar paper according to the reading in observation 14.1

XI. Resources used

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

XII. Actual Procedure

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XIII. Observations Table

Table 14.1: Measurement of field strength w.r.t rotation angle

Angle of rotation in degree	Received signal strength in dB
0	
30	
60	
90	
120	
150	
180	
210	
240	
270	
300	
330	
360	

XIV. Results

For Yagi Uda Antenna ,the radiation pattern is figure of _______________

XV. Interpretation of Results

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XVI. Conclusions & Recommendation

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XVII. Practical Related Questions

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

[Space for Answer]

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XVIII. References / Suggestions for further Reading

1.en.wikipedia.org/wiki/Radiation_pattern
2.www.tutorialspoint.com/antenna_theory/antenna_theory_radiation_pattern.htm

XIX. 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	Interpretation of result	15%
6	Conclusions	05%
7	Practical related questions	15%
8	Submitting the journal in time	05%
	Total (25 Marks)	**100%**

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

Practical No. 15: Use simulation software to plot the radiation pattern of given antenna

I. Practical Significance

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

II. Industry /Employer Expected Outcomes

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

III. Course Level Learning Outcomes:

CO5 – Identify relevant types of antenna for given frequency range/application.

IV. Laboratory Learning Outcomes

LLO 15.1- Interpret the directivity and beam width from the radiation pattern of given antenna.

V. Relevant Affective domain related Outcome(s)

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

VI. Relevant 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 the antenna.It is a plot of field strength in V/m versus angle theta. The radiation pattern is plotted on the polar coordinate. The field strength is measured at the same fixed distance by rotating the antenna through various angles

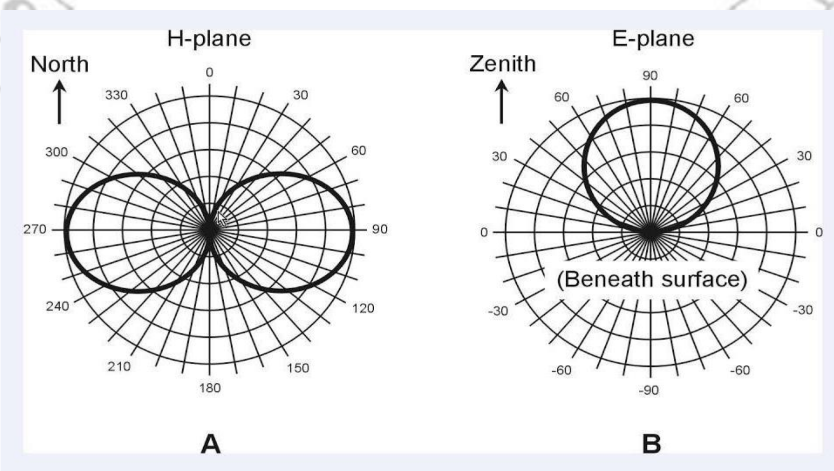

Fig 15.1:Radiation Pattern of Dipole Antenna

VII. Actual Simulation software used in a laboratory with related version/ Give /Suggest other code/simulation software tool which is free (For ex. Scilab) /

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—>')
```

OR

Sample simulation Scilab Code:

```
phi = linspace (0 ,2* %pi ,1000) ;
rad = abs (sin( phi ) );
k =1;
polarplot ( phi ,k * rad )
```

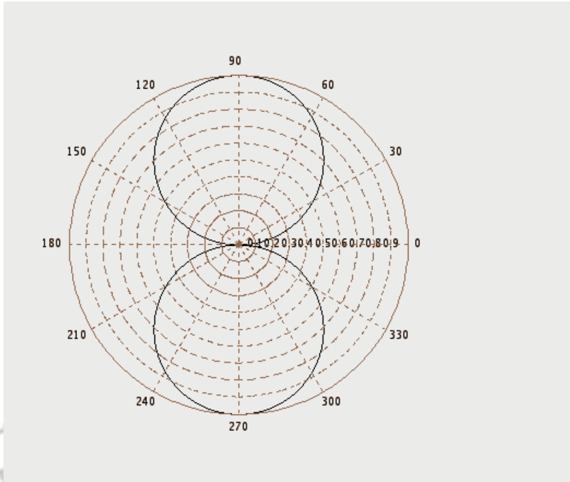

Fig 15.2:Scilab Simulation Output

Radiation pattern of dipole antenna using MATLAB Code

Sample Program:

```
while (1)

choice=menu({'Radiation pattern of half wavelength dipole (select your
choice)';'By antennatutorials.com'},'Three dimensional plot','Two dimensional
plot','exit')

if choice == 1

%radiation pattern of half wave dipole in three dimension

%By www.antennatutorials.com

clear all

clc

theta=linspace(0,pi,100);

 phi=linspace(0,2*pi,100);

 [theta, phi]=meshgrid(theta,phi);

 r=(sin(theta)).^3;

 x=r.*(sin(theta)).*cos(phi);

 y=r.*(sin(theta)).*sin(phi);

 z=r.*cos(theta);

 figure(1);

 mesh(x,y,z);

 xlabel('x axis');
```

```
 ylabel('y axis');

 zlabel('z axis');

 title('Radiation pattern of half wavelength dipole by
antennatutorials.com','color','b');

 text(-1,1,0.4,'antennatutorials.com');

 axis equal;

 grid on;

 elseif choice ==2

%radiation pattern of half wave dipole in two dimension

%By www.antennatutorials.com

clear all

clc

theta=linspace(0,2*pi,500);

r=abs((sin(theta)).^3);

x=r.*(sin(theta));

z=r.*cos(theta);

figure(2);

plot(x,z);

 xlabel('x axis');

 zlabel('z axis');

 title('Two dimensional Radiation pattern of half wavelength dipole by
antennatutorials.com','color','b');

 axis ([-1 1 -0.5 0.5]);

 zlabel('zaxis')

 ylabel('yaxis')

 legend(' at phi=90')

 grid on;

  text(-1,0.38,'antennatutorials.com');

elseif choice==3
```

```
break
end
end
```

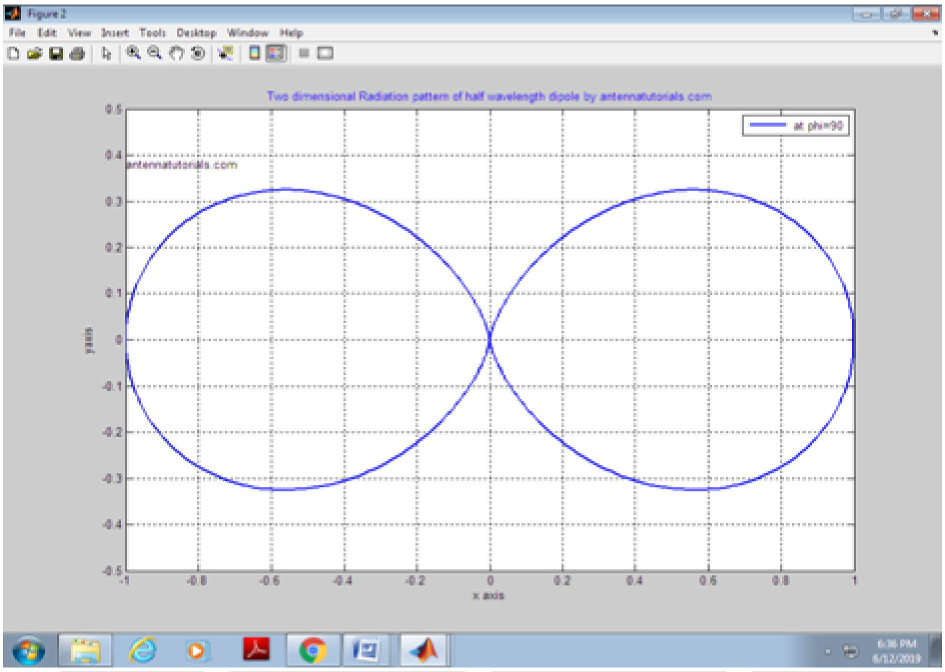

Fig 15.3:Scilab Simulation Output

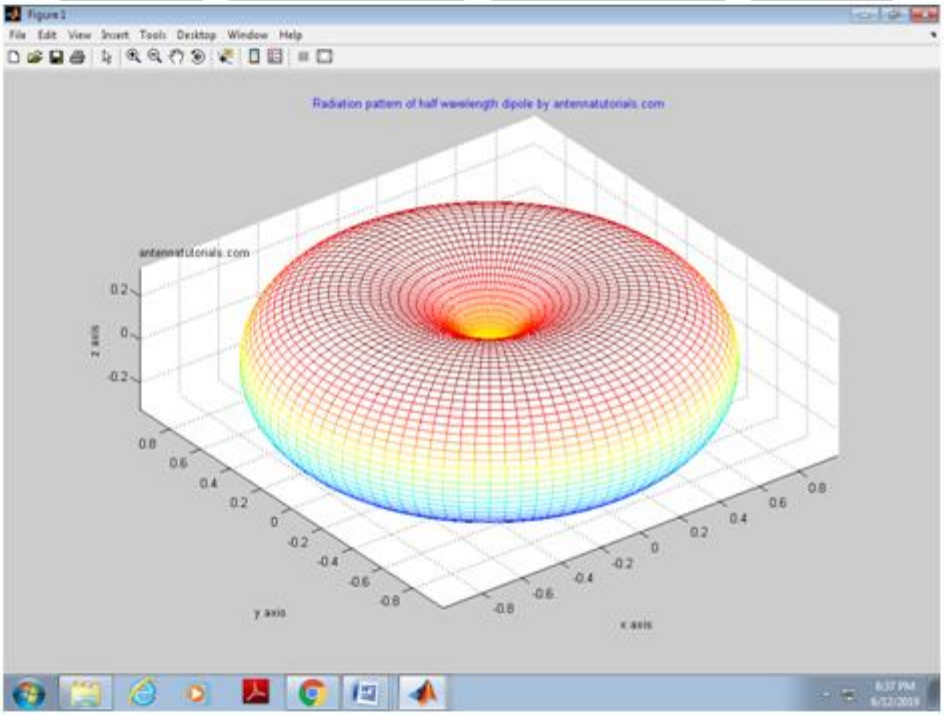

Fig 15.4: Scilab Simulation Output

(b) Actual Simulation Code:

VIII. Required Resources/apparatus/equipment/ softwares with specifications

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

IX. Precautions to be followed

(1) Ensure proper earthing to the equipment
(2) Ensure power switch is in off condition initially

X. Procedure

(1) Start MATLAB/SCILAB 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 tool
(7) Get MATLAB code for Yagi-Uda Antenna
(8) Run the code and save the result

XI. Resources used

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

XII. Actual Procedure :

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XIII. Observations :

Paste Radiation Pattern of Antenna

XIV. Results

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XV. Interpretation of Results

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XVI. Conclusions & Recommendation

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XVII. Practical Related Questions

1. State the function of directional antenna
2. Describe radiation pattern characteristics of observed dipole antenna
3. Describe radiation pattern characteristics of observed Yagi-Uda antenna.
4. Give names of other relevant simulation software can be used to plot radiation pattern
5. State the function of an isotropic antenna. Draw its radiation pattern.
6. State the types of antenna radiation patterns.

[Space for Answer]

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XVIII. 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-generaation-simulink/

XIX. Assessment Scheme

Performance Indicators		Weightage
Process Related (15 Marks)		**60%**
1	Handling of the simulation software	10 %
2	Building of diagram	20 %
3	Measuring value 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%**

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