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Second Year Degree Course In

E&TC / ELECTRONICS ENGINEERING (Sem - II)

ANALOG COMMUNICATIONS

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NIRALI PRAKASHAN

ADVANCEMENT OF KNOWLEDGE

A TEXT BOOK OF

ANALOG COMMUNICATION

FOR

SEMESTER – II

SECOND YEAR DEGREE COURSE IN ELECTRONICS/ ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Strictly According to New Revised Credit System Syllabus of Savitribai Phule Pune University

(w.e.f June 2016)

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PREFACE

It gives me great pleasure in publishing this text book on "**Analog Communication**" for the students of Second Year Degree Course in Electronics/Electronics and telecommunication Engineering. This book is strictly written according to **New Revised Credit System Syllabus** of Savitribai Phule Pune University (2015 Pattern).

As per the policy of the University, Engineering Syllabi is revised every five years. Last revision was in the year 2012. New revision is coming little earlier, as university has introduced **Online System of Examination** from year 2012.

As per the **New Credit System**, the **Online Examinations** Phase-I will be conducted based on First & Second Units and Phase II on Third & Fourth Units. The **Online** examinations will have objective types of questions with multiple choices. End Sem. Theory Examination will be based on all the six units and that will be conducted in traditional way and the Theory Course will have 4 credits.

This book provides an introduction to the theory on **Analog Communication**. The concepts of Analog Communication are presented with **Numbers of Examples**, are also given to test the understanding of the students.

Unit 1 provides the Concept of AM Transmission

Unit 2 provides the Concepts of AM Receiver

Unit 3 provides the Concepts of FM Transmission

Unit 4 provides the Concepts of FM Receiver

Unit 5 provides the Concepts of Noise

Unit 6 provides the Concepts of Pulse Analog Modulation.

Main feature of this book is, **Complete Coverage** of the New Credit System Syllabus with large number of **Worked (Solved) Examples and Exercises.**

I have given Separate Book of Multiple Choice Questions (MCQ's) which will be very useful to the students especially for Online Examinations.

I take this opportunity to express our sincere thanks to Shri. Dineshbhai Furia, Shri. Jignesh Furia, Mrs. Nirali Verma and Shri. M. P. Munde and entire team of Nirali Prakashan namely Mrs. Deepali Lachake (Co-ordinator), who really have taken keen interest and untiring efforts in publishing this text.

The advice and suggestions of our esteemed readers to improve the text are most welcomed, and will be highly appreciated.

Pune **Author**

SYLLABUS

Unit I : AM Transmission (08 Hrs)

Base band & Carrier communication, Generation of AM (DSBFC) and its spectrum, Power relations applied to sinusoidal signals, DSBSC – multiplier modulator, Nonlinear generation, switching modulator, Ring modulator & its spectrum, Modulation Index. SSBSC, ISB & VSB, their generation methods & Comparison, Block Diagram of AM Transmitter and Broadcast technical standards.

Unit II : AM Reception (8 Hrs)

Block diagram of TRF AM Receivers, Super Heterodyne Receiver, Dual Conversion Super heterodyne Receiver, Concept of Series & Parallel resonant circuits for Bandwidth & Selectivity. Performance Characteristics: Sensitivity, Selectivity, Fidelity, Image Frequency Rejection and IFRR. Tracking, Mixers. AM Detection: Rectifier detection, Envelope detection; Demodulation of DSBSC: Synchronous detection; Demodulation of SSBSC: Envelope detection

Unit III : FM Transmission (8 Hrs)

Instantaneous frequency, Concept of Angle modulation, frequency spectrum& Eigen Values, Narrow band & wide band FM, Modulation index, Bandwidth, Phase Modulation, Bessel's Function and its mathematical analysis, Generation of FM (Direct & Indirect Method), FM stereo Transmitter, Two way FM Radio Transmitter, Comparison of FM and PM.

Unit IV : FM Reception (6 Hrs)

Block diagram of FM Receiver, FM Stereo Receiver , Two way FM Radio Receiver, FM detection using Phase lock loop(PLL) ,Slope detector, Balanced Slope detector etc.

Unit V : Noise (6 Hrs)

Sources of Noise, Types of Noise, White Noise, Thermal noise, shot noise, partition noise, Low frequency or flicker noise, burst noise, avalanche noise, Signal to Noise Ratio, SNR of tandem connection, Noise Figure, Noise Temperature, Friss formula for Noise Figure, Noise Bandwidth, Behavior of Baseband systems and Amplitude modulated systems i.e.DSBSC and SSBSC in presence of noise.

Unit VI : Pulse Analog Modulation (6 Hrs)

Band limited & time limited signals, Narrowband signals and systems, Sampling theorem in time domain, Nyquist criteria, Types of sampling- ideal, natural, flat top, Aliasing & Aperture effect. PAM PWM & PPM. Introduction to Pulse Code Modulation.

CONTENTS

Unit I – AM Transmission

Unit II – AM Reception

Unit III – FM Transmission

Unit IV – FM Reception

Unit V – Nosie

UNIT - I

Chapter 1
AM TRANSMISSION

1.1 BASEBAND AND CARRIER COMMUNICATION

The Electronics field can be roughly categorized into three major areas :

1. Computers
2. Communication
3. Control

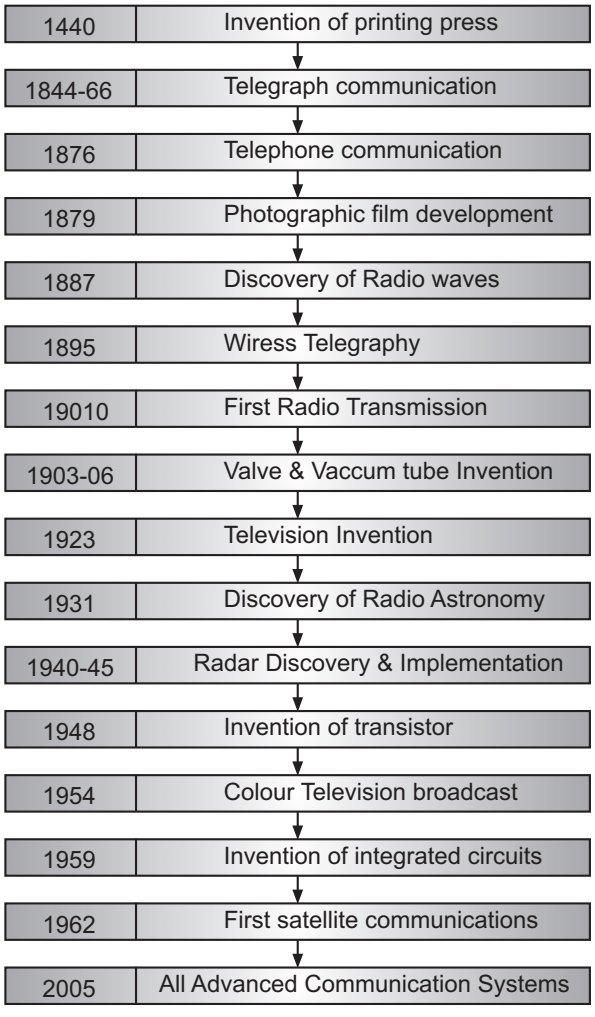


Fig. 1.1 : Evolution of the Human Race's Communication Techniques

The computer field is the latest of the three, while communication field is the oldest one. The field of communication is related with electronic equipments used for the transfer of information like voice, video, digital data between two or more points.

Communication is the transfer of meaningful information from one location (the sender, source, originator or transmitter) to other location (the destination or receiver). This definition is a basic one that only requires that the term information be defined to complete its meaning. Also, you can define the communication as the basic process of information exchange between transmitter and receiver. Most communication in the past has been done between one human and another. The communication systems in the past used two broad techniques - visual and aural. The evolution of people's ability to use these techniques is summarized in Fig. 1.1.

1.1.1 The Elements of a Communication System

The block diagram of the simplest possible electronic communication system is as shown in Fig. 1.2.

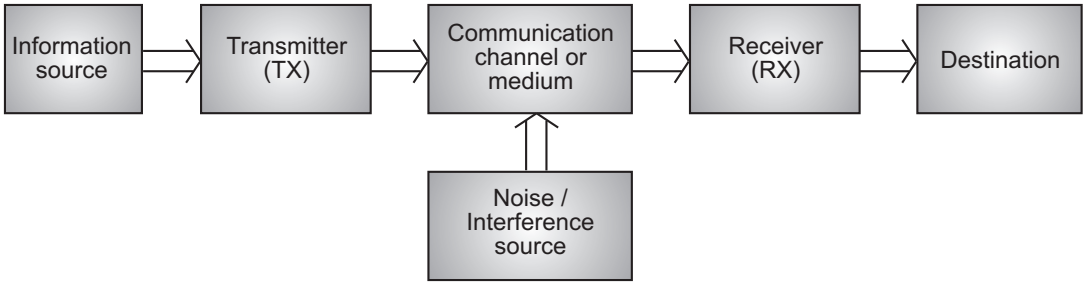


Fig. 1.2 : Block diagram of basic communication system

As seen from the Fig. 1.2, the basic components of a communication system are, transmitter, a communication channel or medium and a receiver. Unwanted noise is inherently present in the channel. The components of a communication system are as follows :

- Information
- Transmitter
- Medium or Communication Channel
- Unwanted Noise
- Receiver

Information or Input Signal :

The communication systems have been developed for communicating or transferring or exchanging information from one location to other. The information can be as follows :

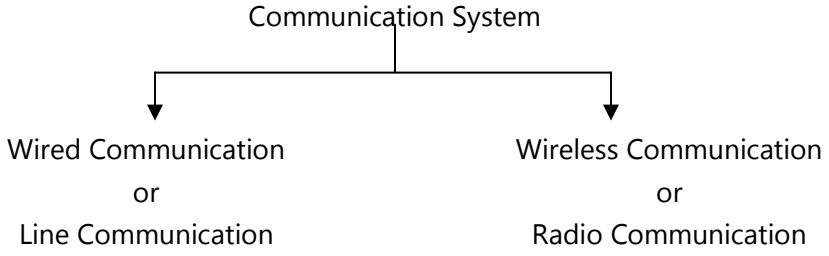
- human voice
- music
- picture or video signal
- data from computer
- or combinations of the above

Transmitter (T_x) :

Most of the times message coming from information source is not suitable for immediate transmission. The task of transmitter block is to convert the electrical equivalent of the information to a suitable form. Transmitter consists of electronic circuits such as amplifier, oscillator and power amplifier for signal conditioning to cover the large range.

Communication Channel or Medium :

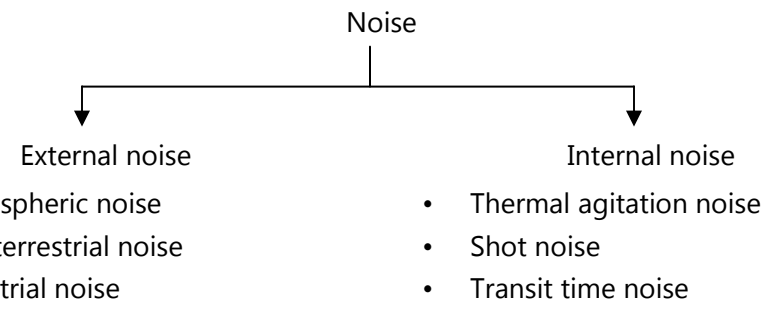
Depending on the type of communication medium, two types of communication systems will be available, they are as follows :



The wired communication medium can be conducting wires, cables and optical fibers. The wireless communication medium can be free space.

1. **Wired Communication :** Wired communication systems use the communication mediums like the simple wires, cables or optical fibers. The examples of wired communication are telegraph system, telephone system, fax system, cable T.V. system, Internet lines like leased lines, ISDN (Inter Services Digital Network) lines etc. This wired medium cannot be used for the communication over long distances because of the requirement of actual physical connection from one point of one location to other point of other location.
2. **Wireless Communication :** Radio communication is the broad general term applied to any form of wireless communication between two locations. Wireless communication doesn't require any physical wire between transmitter (Tx) and receiver (Rx), instead the signal is sent through air or free space via. transmitter antenna and received by receiver antenna. Transmitter antenna radiates the signal in electromagnetic waveform and received in the same form. For long distance communication like intercontinent communication, Earth to Satellite, Earth to Moon, Earth to Planet etc., radio communication is widely used.

Noise : Noise is random, unwanted electrical signal energy which gets added to the transmitted signal via medium in electronic communication system. It is very much difficult to separate the added noise from the transmitted signal. Also, receiver adds its own noise. So overall signal quality degrades, hence degradeing the overall performance of communication system. There are several ways of classifying noise. It may be subdivided according to type, source, effect or relation to the receiver, depending on circumstances. It is most convenient here to divide noise into two broad groups as follows :



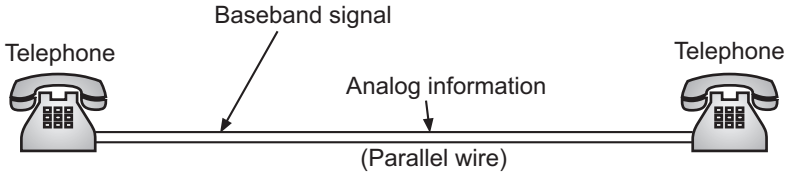
Atmospheric noise is caused by lightening discharges in thunderstorms and other natural electrical disturbances occurring in the atmosphere. Extraterrestrial noise includes solar noise, cosmic noise etc. Industrial noise is concerned with the sources such as automobile and aircraft ignition, electric dc/ac motors and switching gear, high voltage transmission line leakage etc. Thermal noise is due to thermal agitation in resistive component of system. Shot noise is due to random variations in the arrival of electrons (or holes) at the output electrode of amplifying device. Transit time noise is added due to the circuit operation above VHF (Very High Frequency). Even though noise cannot be completely eliminated, its effect can be minimized by using various noise reduction methods.

Receiver : The reception is exact opposite process of transmission. The received signal is processed by the various circuits like pre-amplifier, mixer, oscillator, detector, demodulator, driver amplifier and power amplifier.

Thus, we have studied the basic electronic communication system and its components. Further the electronic communication systems can be categorized as Analog communication systems and Digital communication systems. In Analog communication system, the continuous varying signal such as sine wave is used. For example, audio and video signal which is the output of microphone and video camera respectively. The data output from computer is digital data representing the alphabets, characters, numerical etc. which is being transmitted by digital communication system by either wired or wireless medium.

1.1.2 Baseband Signal Transmission and Bandwidth Requirement

Regardless of whether the original information signals are analog or digital, they are all referred to as baseband signals. Following are the examples of the baseband signal transmission given in Fig. 1.3 (a), (b), (c), (d).



(a) Voice as analog baseband signal

Analog Communication

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