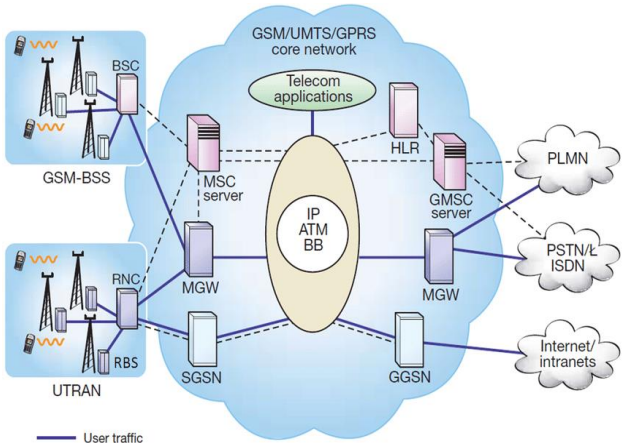
RQF LEVEL 5



TRADE NETWOKING

MODULE CODE: NEWTF501

TEACHER'S GUIDE

Module name: TELECOMMUNICATION FUNDAMENTALS

Table of content

Table of Contents

Acronyms

AAI : Accredited Advisor in Insurance.

ADM: add/drop multiplexer

ADM: Adaptive Delta Modulation

AINS : Associate In General Insurance.

AM: Amplitude modulation

ARM : Associate in Risk Management.

ASK: Amplitude Shift Keying

AWM: appliance wiring material

AWM: Arctic Warfare Magnum

CAD: Computer Aided Design

CAM: Computer Aided Manifacturing

CIC : Certified Insurance Counselor.

CRM : Certified Risk Manager.

DEMUX: Demultiplexing

DLC: digital loop carrier

DM: device management

DM: Delta Modulation

DPCM: Differential pulse-code modulation

DPCM: differential pulse-code modulation

DSP: Digital signal processing

EDD: Electronic Documentation Distribution

EDI: Electronic Data Interchange

ESD: Electrostatic Sensitive Device

FDM: Frequency Division Multiplexing

FM: Frequency Modulation

FM: Frequency Modulation

FSK: Frequency Shift Keying

GPS: Global Positioning System

HTTP: Hyper-Text Transfer Protocol

IMAP: Internet Message Access Protocol

MAC: Media Access Control

MDA: Mail Delivery Agent or Message Delivery Agent

MSA: Message Submission Agent (MSA) or Mail Submission Agent

MUX: multiplexer

OOK: On/Off Keying

PAM: Pulse-amplitude modulation

PAM: Pulse amplitude modulation

PCM: Pulse Code Modulation

PCM: Pulse-code modulation

PLC: Power Line Communication

PLCS : Personal Lines Coverage Specialist

PM: Phase modulation

POP: Post Office Protocol

PSK: Phase Shift Keying

PSTN: Public Switched Telephone Network

RFID: Radio Frequency IDentification

S/PDIE:

SMTP: Simple Mail Transfer Protocol

TDM: Time-division multiplexing

VOIP: Voice Over internet protocol

WDM: Wavelength Division Multiplexing

Introduction

This module is intended to the learner pursuing TVET certificate V in networking, at the end of this module the learner will be able to determine telecommunication fundamental principles, Apply signals formatting and Data communications and Apply Modulation/Demodulation and Multiplexing/ Demultiplexing Techniques, it serves as prerequisite to other modules whereby learner will apply it under non directive supervision.

Module Code and Title : NEWTF501/TELECOMMUNICATION FUNDAMENTALS

Learning Units:

1. Determine telecommunication fundamentals principals

2. Apply signal formatting and data communication

3. Apply modulation/demodulation and multiplexing/de-multiplexing techniques

Learning Unit 1: Determine Telecommunication Fundamental Principles.

STRUCTURE OF LEARNING UNIT 1

Learning outcomes:

1.1. Describe telecommunication
1.2. technology Apply building Blocks of telecommunication systems
1.3. Describe telecommunication principles for network design

Learning outcome 1.1: Describe telecommunication technology

Duration: 5hrs

Learning outcome 1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Define correctly telecommunication

2. Describe Effectively Evolution of telecommunication.

2. Describe correctly Communication techniques.

Resources		
Equipment	**Tools**	**Materials**
- Books - Hand-out notes -Computer -Projector	- Simulator Software	- Internet - Video aide
Advance preparation: .Prepare tools material and equipment to be used		

Indicative content 1.1.1: Evolution of telecommunication.

Definition of Telecommunication:

Telecommunication is the transmission of signs, signals, messages, words, writings, images and sounds or information of any nature by wire, radio, optical or electromagnetic systems.

Telecommunications is the science of communicating over a long distance using telephone or radio technology. ... Telephony is focused on voice communications.

- **Electronic transmission of signals for communications**
    - Telephone: A telephone, or phone, is a telecommunications device that permits two or more users to conduct a conversation when they are too far apart to be heard directly.

- Radio: Radio is the technology of using radio waves to carry information, such as sound and images, by systematically modulating properties of electromagnetic energy waves transmitted through space, such as their amplitude, frequency, phase, or pulse width.
- Television: A ***television*** (also known as a TV) is a machine with a screen. ***Televisions*** receive broadcasting signals and turn them into pictures and sound.


Theoretical learning Activity

✓ Group discussion on evolution of telecommunications

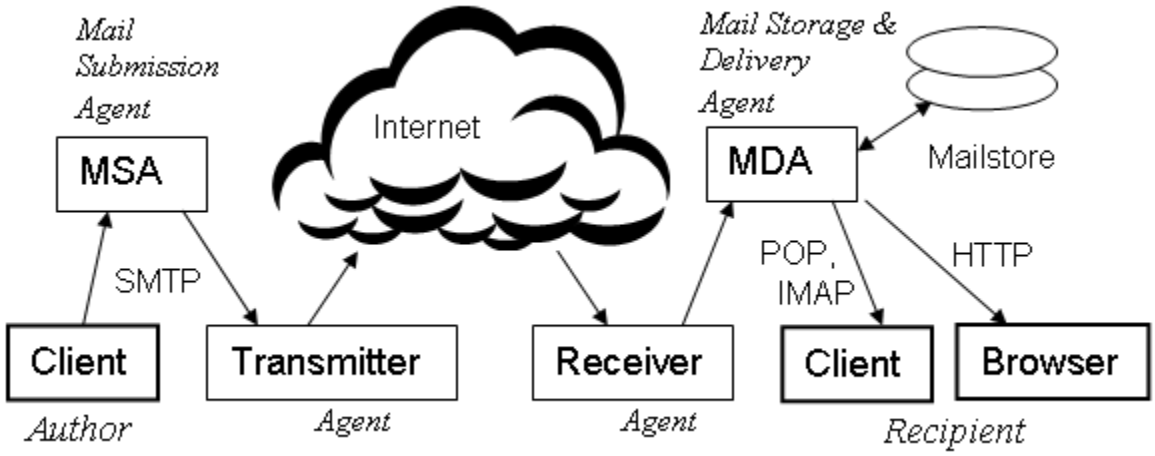

Points to Remember (Take home message)

Definition of: -Telecommunication -Telephone -Television -Radio


Indicative content 1.1 2: Communication techniques

- ✓ Telegraphy: Telegraphy is the long-distance transmission of textual or symbolic messages without the physical exchange of an object bearing the message.
- ✓ Telephone: A telephone, or phone, is a telecommunications device that permits two or more users to conduct a conversation when they are too far apart to be heard directly.

- ✓ Telemetry: **Telemetry** is an automated communications process by which measurements and other data are collected at remote or inaccessible points and transmitted to receiving equipment for monitoring.
- ✓ Telex: A **telex** is a machine that transmits and receives **telex** messages. Countable noun. A **telex** is a message that you send or that has been received and printed by **telex**.
- ✓ Radio: Radio is the technology of using radio waves to carry information, such as sound and images, by systematically modulating properties of electromagnetic energy waves transmitted through space, such as their amplitude, frequency, phase, or pulse width
- ✓ Facsimile: is a copy or reproduction of an old book, manuscript, map, art print, or other item of historical value that is as true to the original source as possible.
- ✓ TV:A ***television*** (also known as a TV) is a machine with a screen. ***Televisions*** receive broadcasting signals and turn them into pictures and sound.
- ✓ Email system: The **email system** is the network of computers handling electronic **mail** (**email**) on the Internet. This **system** includes user machines running programs that compose, send, retrieve, and view messages, and agent machines that are part of the **mail** handling **system**.



MSA: Message Submission Agent (***MSA***) or ***Mail*** Submission Agent

MDA: Mail Delivery Agent or Message Delivery Agent

SMTP: Simple Mail Transfer Protocol

POP: Post Office Protocol

IMAP: Internet Message Access Protocol

HTTP: HyperText Transfer Protocol

Theoretical learning Activity

- ✓ Brainstorming on Building block layout of telecommunication systems

Points to Remember (Take home message)

- Different Communication techniques

Learning outcome 1.1 formative assessment

Q1. TRUE or FALSE /5mks

A. Telecommunications is the science of communicating over a long distance using telephone or radio technology. ... Telephony is focused on voice communications.
B. Radio is the technology of using radio waves to carry information, such as sound and picture, by systematically modulating properties of electromagnetic energy waves transmitted through space, such as their amplitude, frequency, phase, or pulse width.
C. A *television* (also known as a TV) *Televisions* receive broadcasting signals and turn them into image and sound.
D. telephone switch is a U.S. telephone company central office telephone exchange used to interconnect local exchange carrier offices for short distance communications in the private switched telephone network.
E. Local office is an office in a locality to which subscriber home and business lines are connected on what is called a local loop

Q2. Match the following statement for matching them please use column A /5mks

column A	column B	column C
1-	1. Receiver	i. is a copy or reproduction of an old book
2-	2. *transmitter*	ii. *Mail* Submission Agent
3-	3. Facsimile	iii. is the long-distance transmission of textual or symbolic messages without the physical exchange of an object bearing

			the message
4-	4. *MSA*	iv.	**IS** in electronics, any of various devices that accept signals, such as radio waves, and convert them (frequently with amplification) into a useful form.
5-	5. Telegraphy	v.	is an electronic device which produces radio waves with an antenna
		vi.	is a material substance (solid, liquid, gas, or plasma) that can propagate energy waves

ANSWER SHEET

Q1. A. TRUE

B. FALSE

C. FALSE

D. FALSE

E. TRUE

Q2. 1-IV

2-V

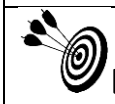
3- I

4- II

5- III

Learning outcome 1.2 : Apply building Blocks of telecommunication systems

Duration: 5hrs



Learning outcome 1.2 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Identify correctly Basic elements of telecommunication devices
2. Describe correctly Building block layout of telecommunication network

Resources		
Equipment	**Tools**	**Materials**
- Books - Hand-out notes -Transmitter - Receiver - Computer - Projector	- Simulator Software - Video aids	- Internet - Transmission medium
Advance preparation: Prepare the workplace prepare tools and equipments		

Theoretical learning Activity

Group discussion on telecommunication devices

Points to Remember (Take home message)

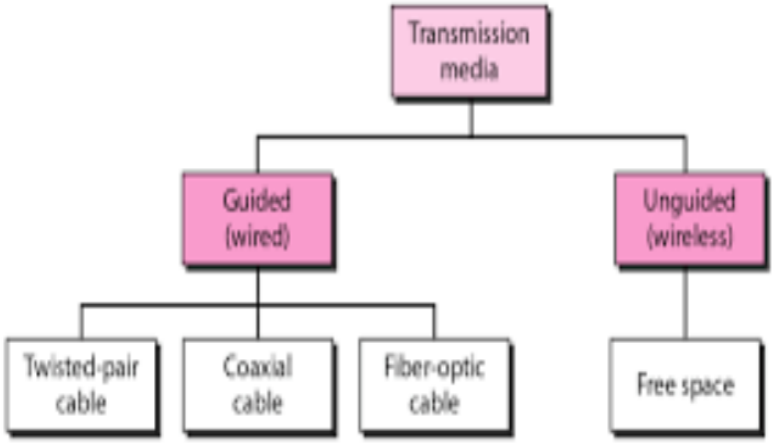
Basic elements of telecommunication devices
- Transmitter
-Transmission medium
- Receiver

Indicative content 1.2.1: Basic elements of telecommunication devices

Telecommunications devices (equipment): Are hardware which are used for the purposes of telecommunications.

Elements of telecommunication devices

- ✓ Transmitter: a ***transmitter*** or radio ***transmitter*** is an electronic device which produces radio waves with an antenna
- ✓ Transmission medium: A **transmission medium** is a material substance (solid, liquid, gas, or plasma) that can propagate energy waves. For example, the **transmission medium** for sounds is usually a gas, but solids and liquids may also act as a **transmission medium** for sound.



- ✓ Receiver: **IS** in electronics, any of various devices that accept signals, such as radio waves, and convert them (frequently with amplification) into a useful form. Examples are telephone receivers, which transform electrical impulses into audio signals, and radio or television receivers, which accept electromagnetic waves and convert them into sound or television pictures.

Indicative content 1.2.2: Building block layout

- ✓ Lines: fixed **lines** are called point-to-point communication because it is between one transmitter and one receiver.
- ✓ Local office: is an **office** in a locality to which subscriber home and business lines are connected on what is called a **local** loop.
- ✓ Central office: A **central office, in telecommunications**, is a building to which subscriber home and business lines are connected on a local loop.
- ✓ Line vs. trunk: **Trunk lines** are used for connecting a private branch exchange (PBX) to a telephone service provider.
- ✓ Tandem switches: A class-4, or **tande**  **m**, telephone **switch** is a U.S. telephone company central office telephone exchange used to interconnect local exchange carrier offices for long distance communications in the public switched telephone network.

Practical learning Activity

Practical exercises on Building block layout

Demonstration by video/ picture

Points to Remember (Take home message)

- Building telecommunication block layout

Learning Outcome 1.3: Describe telecommunication principles

Duration:10hrs

Learning outcome 1.3 objectives:

By the end of the learning outcome, the trainees will be able to:

1.Differentiate clearly network devices

2. Identify correctly Industrial Telecommunications media

3. Identify Network and distributed computing

4. Describe Types of telecommunication systems

5. Describe Categories of telecommunications

6. Describe General telecommunication principles

7. Describe Categories of telecommunications

Resources

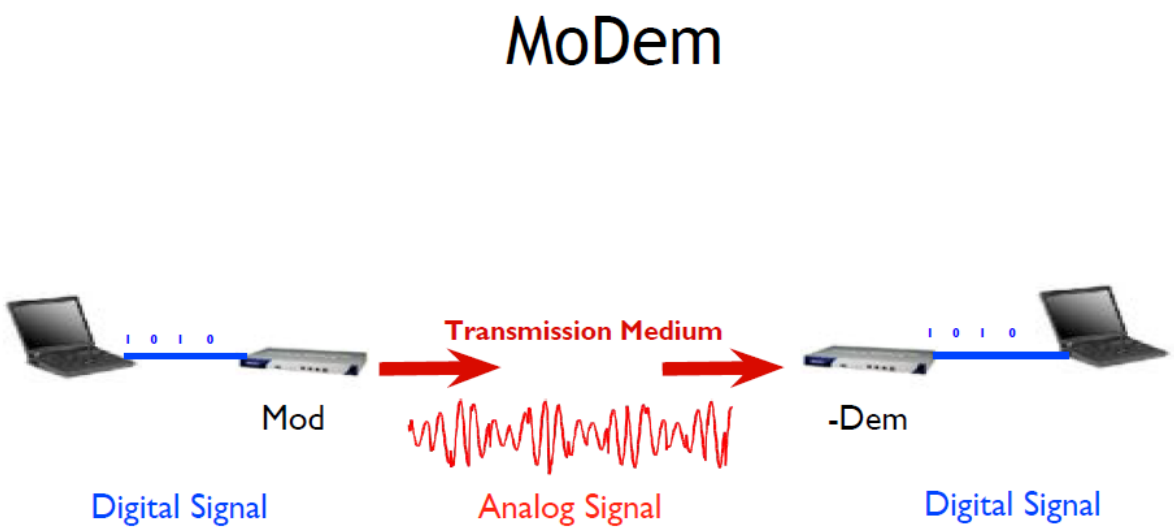
Equipment	Tools	Materials
--Books - Hand-out notes - Hubs - Rack mount - Switches - Repeaters - Bridges - Gateways - Router - Wireless access point - Cable modem - DSL modem - Network adapter	- Video aide - Firewall - Simulator Software	- Internet

Advance preparation:

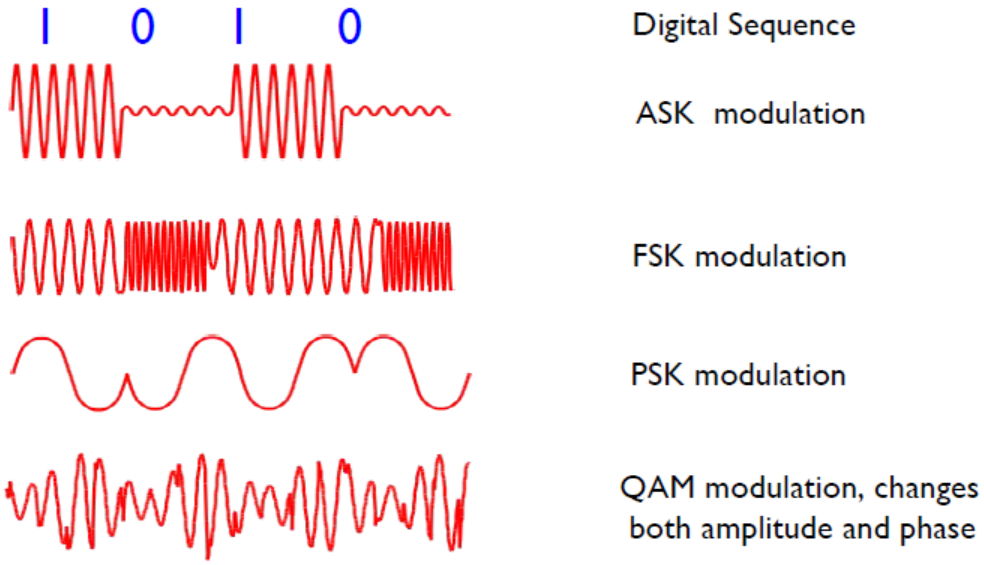
.Prepare tools and equipment to be used

Indicative content 1.3.1: Network devices

- ✓ Modems
  - Modulates and demodulates signals: A modulator is a device that performs **modulation**. A demodulator (sometimes detector or demod) is a device that performs **demodulation**, the inverse of **modulation**. A modem (from modulator–demodulator) can perform both operations.



Comparison of modulation techniques



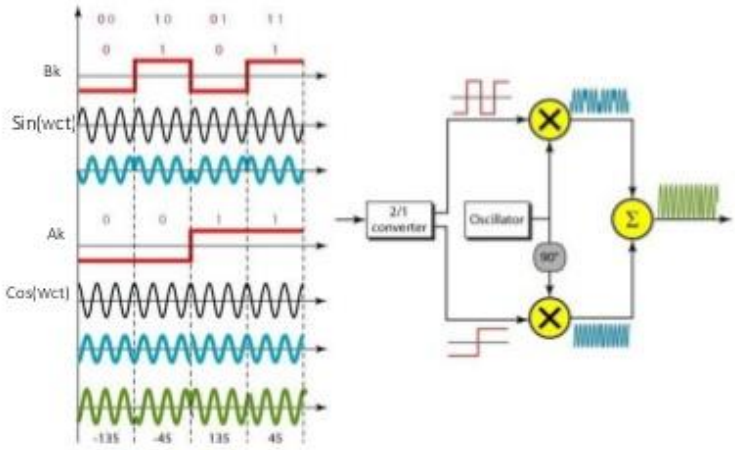
ASK: Amplitude-shift keying (**ASK**) is a form of amplitude **modulation** that represents digital data as variations in the amplitude of a carrier wave. In an **ASK** system, the binary symbol 1 is represented by transmitting a fixed-amplitude carrier wave and fixed frequency for a bit duration of T seconds.

FSK: Frequency-shift keying (**FSK**) is the frequency **modulation** system in which digital information is transmitted through the discrete frequency change of a carrier wave.

PSK: Phase-shift keying (**PSK**) is a digital **modulation** process which conveys data by changing (**modulating**) the phase of a constant frequency reference signal (the carrier wave).

QAM: **QAM** (**Quadrature Amplitude Modulation**) is a method of combining two amplitude-**modulated** (AM) signals into a single channel, thereby doubling the effective bandwidth. **QAM** is used with pulse amplitude **modulation** (PAM) in digital systems, especially in wireless applications.

BLOCK DIAGRAM OF QAM MODULATION



- Cable modem: A **cable modem** is a peripheral device used to connect to the Internet. It operates over coax **cable** TV lines and provides high-speed Internet access. Since **cable modems** offer an always-on connection and fast data transfer rates, they are considered broadband devices.
- Provide Internet access over a cable television: **Cable Internet connection** is a form of broadband **access**. **Through** use of a **cable** modem, users can **access** the **Internet over cable TV** lines. **Cable** modems can **provide** extremely fast **access** to the **Internet**.

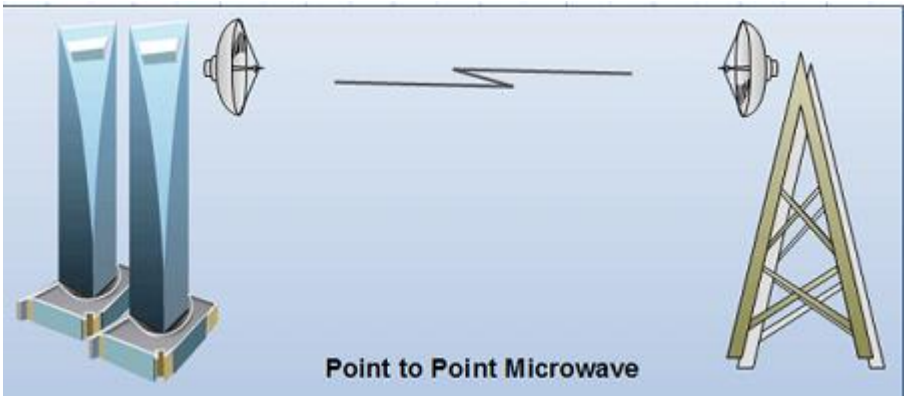
✓ DSL modem: A **digital subscriber line** (**DSL**) **modem** is a device used to connect a computer or router to a telephone line which provides the digital subscriber line service for connectivity to the Internet, which is often called *DSL broadband*.

✓ Network adapter: A network interface controller is a computer hardware component that connects a computer to a computer network.

- Network control Devices
  - ✓ Hubs: A **hub**, also called a **network hub**, is a common connection point for devices in a **network**. **Hubs** are devices commonly used to connect segments of a LAN. The **hub** contains multiple ports.
  - ✓ Switches: is a computer networking device that connects devices together on a computer network by using packet switching to receive, process, and forward data to the destination device.
  - ✓ Repeaters: a **repeater** is an electronic device that receives a signal and retransmits it. Repeaters are used to extend transmissions so that the signal can cover longer distances or be received on the other side of an obstruction.
  - ✓ Bridges: A ***network bridge*** is a computer ***networking*** device that creates a single aggregate ***network*** from multiple communication ***networks*** or ***network*** segments.

- ✓ Gateways: A **gateway** is a piece of networking hardware used in telecommunications for telecommunications networks that allows data to flow from one discrete network to another.
- ✓ Router: A ***router*** is a networking device that forwards data packets between computer networks.
- ✓ Wireless access point: is a networking hardware device that allows other Wi-Fi devices to connect to a wired network.
- ✓ Firewall: In computing, a firewall is a network security system that monitors and controls incoming and outgoing network traffic based on predetermined security rules.

- Industrial Telecommunications media
  - ✓ Microwave transmission: A **microwave** link is a communications system that uses a beam of radio waves in the **microwave** frequency range to transmit video, audio, or data between two locations, which can be from just a few feet or meters to several miles or kilometers apart
    - ➢ Microwave transmission is the transmission of information by microwave radio waves.



  - ✓ Communication satellite: A communications satellite is an ***artificial*** satellite that relays and amplifies radio telecommunications signals via a transponder; it creates a communication channel between a source transmitter and a receiver at ***different*** locations on Earth.
- Industrial hardware: **Telecommunications** equipment manufacturers refer to firms that manufacture **hardware** and devices related to **telecommunications** such as modems, circuit-switches systems, routers and base transceiver stations.
- Common line designations

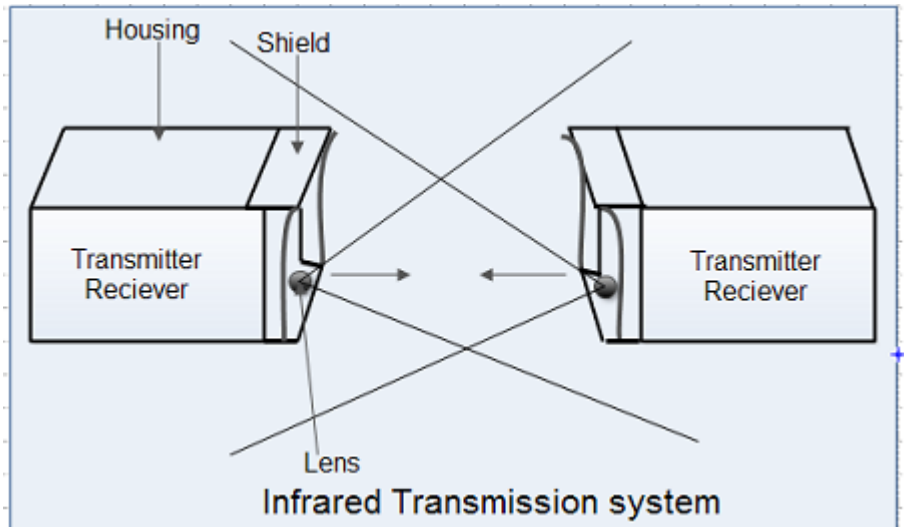
Most Common Designations

1. **CIC** - Certified Insurance Counselor.
2. **CRM** - Certified Risk Manager.
3. ARM - Associate in Risk Management.
4. **AINS** - Associate In General Insurance.
5. **AAI** - Accredited Advisor in Insurance.
6. **PLCS** - Personal Lines Coverage Specialist

- Global position systems
  - ✓ Satellites communication: ***Satellite communication***, in telecommunications, the use of artificial satellites to provide communication links between various points on Earth.
  - ✓ Using GPS receiver and network of 24 satellites: The Global Positioning System (**GPS**) is a **satellite**-based navigation system made up of a **network of 24 satellites** placed into orbit **by** the U.S. Department of Defense. **GPS** was originally intended for military applications, but in the 1980s, the government made the system available for civilian **use**.

Indicative content 1.3.3: Wireless Fidelity and WiMax

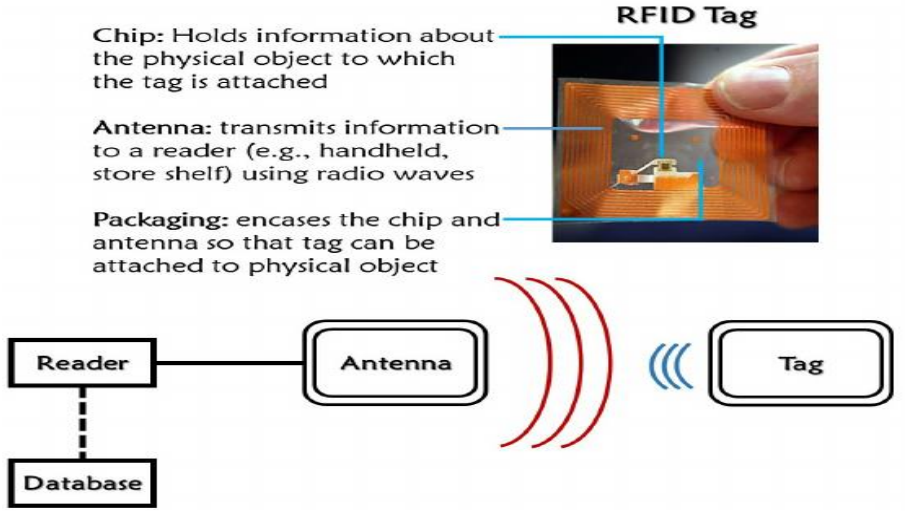
- ✓ Wi-Fi: **Wi-Fi** is the name of a popular wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections.
- ✓ Bluetooth: Bluetooth is a wireless technology standard for exchanging data over short distances using short-wavelength UHF (ultra-high frequency) radio waves in the ISM(industrial, scientific and medical) band from 2.400 to 2.485 GHz from fixed and mobile devices, and building personal area networks.
- ✓ Infrared Transmission: **Infrared transmission** refers to energy in the region of the electromagnetic radiation spectrum at wavelengths longer than those of visible light, but shorter than those of radio waves. Correspondingly, **infrared** frequencies are higher than those of microwaves, but lower than those of visible light.



Infrared Transmission system

- ✓ Radio Frequency Identification (RFID): **Radio-frequency identification** (**RFID**) uses electromagnetic fields to automatically **identify** and track tags attached to objects. The

tags contain electronically-stored information. Passive tags collect energy from a nearby **RFID** reader's interrogating **radio waves**.



Theoretical learning Activity

Further research on internet.

Points to Remember (Take home message)

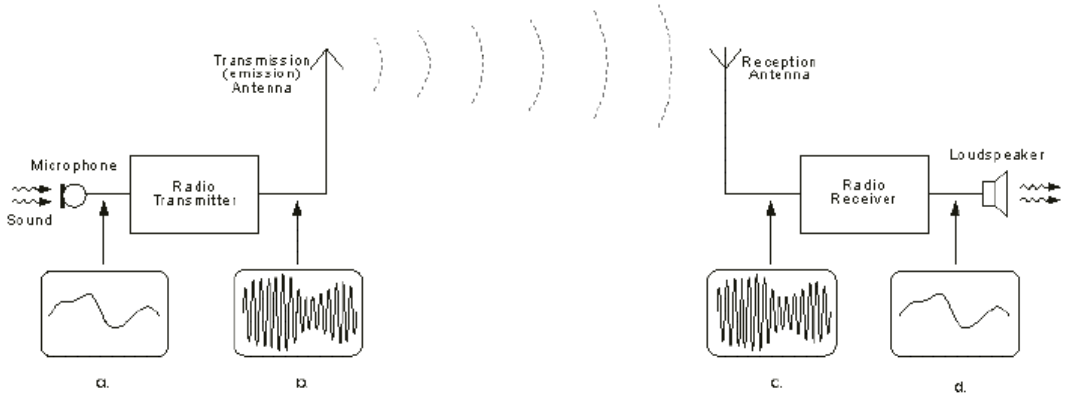
Wireless Fidelity and WiMax

Indicative content 1.3.4 : Network and distributed computing

- ✓ Computer networking concepts
  - Nodes: A **node** can be a computer or some other device, such as a printer. Every **node** has a unique **network** address, sometimes called a Data Link Control (DLC) address or Media Access Control (MAC) address.
  - Workstation: A workstation is a special computer designed for technical or scientific applications.

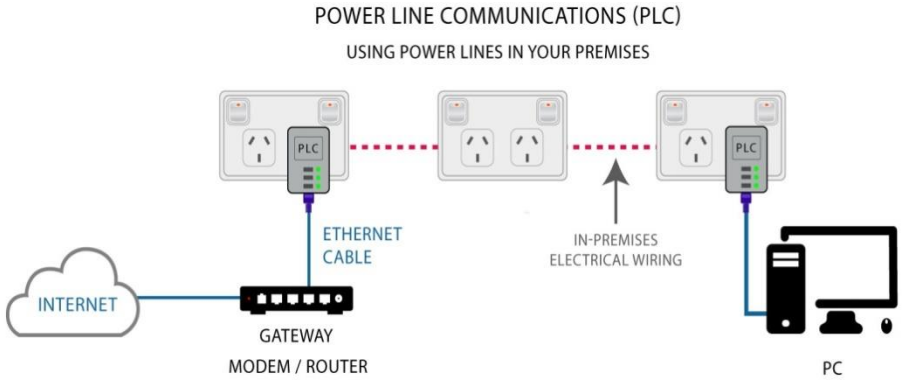
- Local recourses: ***Local resources*** are any information sources on a Superfund site that are available to you or citizens in the community.
- Network recourses: **Network resources** refer to forms of data, information and hardware devices that can be accessed by a group of computers through the use of a shared connection. These types of **resources** are also known as shared **resources**. They are important in work environments where collaboration is essential to success.
- Distributed computing: **Distributed computing** is a field of **computer** science that studies **distributed systems**. A **distributed system** is a **system** whose components are located on different networked **computers**, which communicate and coordinate their actions by passing messages to one another.

- Types of telecommunication systems
  - ✓ Radio communication system: A ***radio communication system*** sends signals by radio.

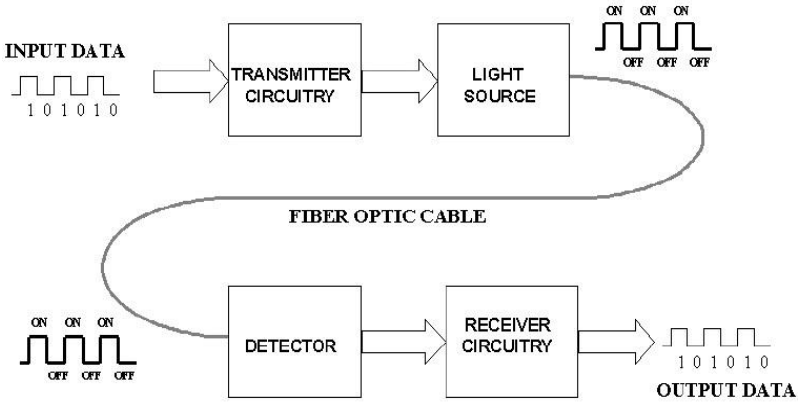


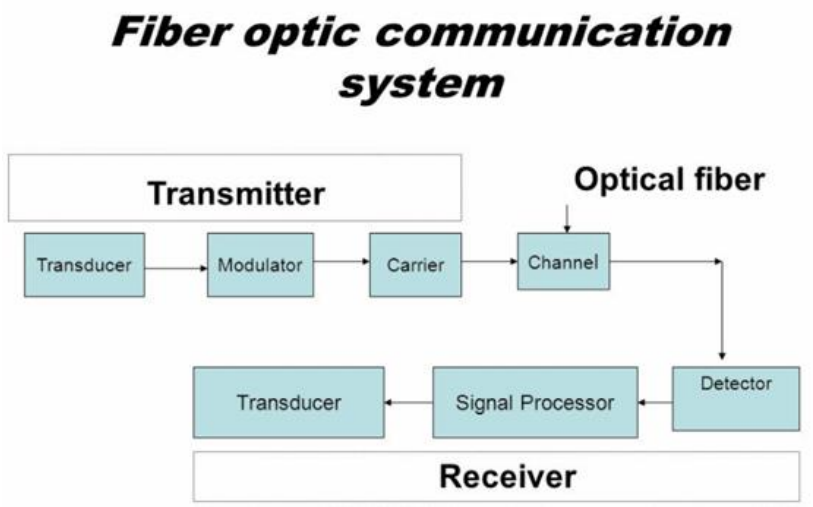
    - ➢ Radio communication system is the transmission of signals by modulation of electromagnetic waves with frequencies below those of visible light.

  - ✓ Power line communication: **Power Line Communication** (PLC) is a **communication** technology that enables sending data over existing **power cables**.



  - ✓ Optical communication systems: ***Optical communication*** is any type of ***communication*** in which light is used to carry the signal to the remote end, instead of electrical current. ***Optical communication*** relies on ***optical*** fibers to carry signals to their destinations.





Theoretical learning Activity

- ✓ Group discussion network devices

Points to Remember (Take home message)

- Computer networking concepts
- Types of telecommunication systems

Indicative content 1.3.5: **Categories of telecommunications**

- ✓ Data Communications: **Data communications** refers to the **transmission** of this **digital data** between two or more computers and a computer network or **data** network is a telecommunications network that allows computers to exchange **data**.
- ✓ Voice communications: Telephony or **voice telecommunications** refers to the **communication** of sound over a distance using wire or wireless telephones and related technology. **Voice communications**, which involves the transfer of sounds—especially the human **voice**—through telephone systems.
- ✓ Video Communication: ***Video communication*** refers to the transmission of information via live video streaming or through video sharing.

- General telecommunication principles
  - ✓ A transmitter that takes information and converts it to a signal
  - ✓ A transmission medium, also called the physical channel that carries the signals.
  - ✓ A receiver that takes the signal from channel and converts it back into usable information


Theoretical learning Activity

- ✓ Further research on internet.


Points to Remember (Take home message)

Categories of telecommunications


Learning outcome 1.3 : formative assessment

Q1. TRUE or FALSE **/5mks**

F. A modulator is a device that performs modulation

G. Amplitude-shift keying is a form of amplitude modulation that represents analog data as variations in the frequency of a carrier wave.

H. Quadrature Amplitude Modulation is a method of combining two frequency-modulated (FM) signals into a single channel, thereby doubling the effective bandwidth.

I. A digital subscriber line (DSL) modem is a device used to connect a computer or router to a telephone line which provides the digital subscriber line service for connectivity to the Internet

J. Wi-Fi: Wi-Fi is the name of a popular wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections.

Q2. Match the following statement for matching them please use column A **/5mks**

column A	column B	column C	
1-	6. Gateways	i.	A network interface controller is a computer hardware component that connects a computer to a computer network.
2-	7. *Chip*	ii.	is a piece of networking hardware used in telecommunications for telecommunications networks that allows data to flow from one discrete network to another.
3-	8. Network adapter:	iii.	Holds information about the physical object to which the tag is attached.
4-	9. Workstation	iv.	is the transmission of signals by modulation of electromagnetic waves with frequencies below those of visible light.
5-	10. Radio communication system	v.	is an electronic device which produces radio waves with an antenna
		vi.	is a special computer designed for technical or scientific applications.

Q3. Circle only for the best answers **/10mks**

A. those are the Categories of telecommunications expert one (which one)
i. Data Communications
ii. Voice communications
iii. Video Communication
iv. Optical communication
v. No above

B. This is the Types of telecommunication systems expert one (which one)
i. Radio communication system
ii. Power line communication
iii. Data Communications
iv. All above
v. No above

C. Choose the Computer networking concepts
i. Nodes
ii. Network recourses
iii. ARM
iv. Bluetooth
v. Distributed computing

D. Choose Network control Devices among the following
i. Repeaters
ii. Gateways
iii. Network adapter
iv. DSL modem
v. Cable modem

E. Choose Network devices in telecommunication among the following

i. Modems
ii. ASK
iii. Provide Internet access over a cable television:
iv. Switches
v. Hubs
vi. Radio

Q4. Which stand for: **/10 mks**

a. ASK: ……..
b. FSK: ……
c. PLC: ……..
d. QAM: ……
e. DSL: ……..
f. Modem: ……
g. TV: ……
h. GPS: ……
i. RFID: ……..
j. MAC: ……..

ANSWER SHEET

Q1. A. TRUE B. FALSE C. FALSE D. TRUE E. TRUE

Q2. 1-II 2- III 3- I 4- VI 5- IV

Q3. A. IV

B. III

C. I.II.V

D. I,II,V

E. I,III

Q4. Which stand for:

a. ASK: Amplitude Shift Keying
b. FSK: Frequency Shift Keying
c. PLC: Power Line Communication
d. QAM: Quadrature Amplitude Modulation
e. DSL: Digital Subscriber Line
f. Modem: Modulator Demodulator
g. TV: Television
h. GPS: Global Position System
i. RFID: Radio Frequency identification
j. MAC: Media Access Control

. Explain the following network devices:

a. Hubs: **ANS**

A hub, also called a network hub, is a common connection point for devices in a network. Hubs are devices commonly used to connect segments of a LAN. The hub contains multiple ports. /1 mark

b. Switches : **ANS /1 mark**

Is a computer networking device **that connects devices together on a** computer network **by using** packet switching **to receive, process, and forward data to the destination device.**

c. Bridges

ANS: A *network bridge* is a computer *networking* device that creates a single aggregate *network* from multiple communication *networks* or *network* segments. /1 mark

d. Router

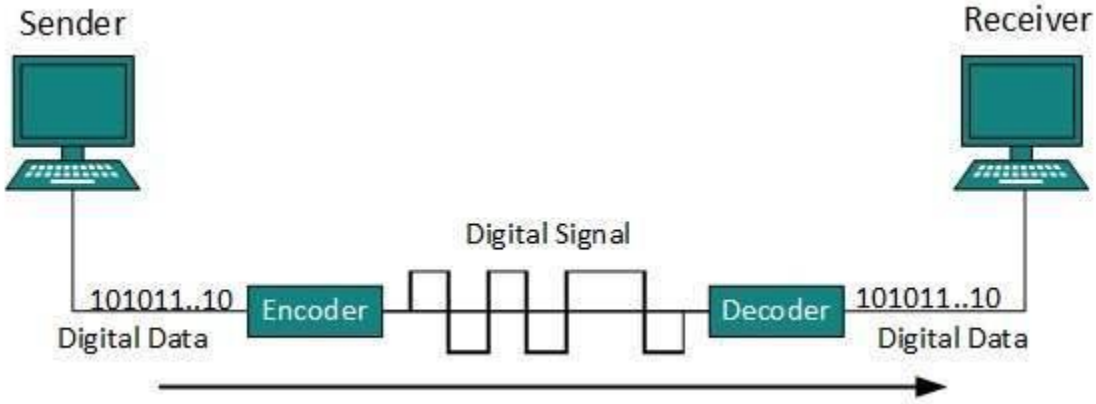
ANS: A *router* is a networking device that forwards data packets between computer networks. /1 mark

Q5. Describe in details MODEM.

ANS:

Modulates and demodulates signals**: A modulator is a device that performs modulation. A demodulator (sometimes detector or demod) is a device that performs demodulation, the inverse of modulation. A modem (from modulator–demodulator) can perform both operations. /1 mark**

Learning Unit 2: Apply Signal Formatting and Data Communications



STRUCTURE OF LEARNING UNIT 2

Learning outcomes:

2.1. Describe effectively telecommunication applications in computer network

2.2. Describe correctly PSTN concepts in telecommunication

2.3. Apply effectively number systems, digital arithmetic and logic gates in telecommunication

Learning outcome 2.1 Describe telecommunication applications

Duration: 20hrs

Learning outcome 2.1 : objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe correctly the Telecommunication application.
2. Define where Telecommunication is applicable
3. Mension the benefits of telecommunication application

Resources

Equipment	Tools	Materials
-Books - Hand-out notes -Computer -Projector	- Simulator Software	- Internet - Video aide

Advance preparation:

Workplace preparation

Prepare material to be used

Indicative content 2.1.1: Telecommunication applications

- ✓ Linking personal computers to mainframe computers: Any product that allows you to **connect personal computers**, CAD/CAM (**CAD**/**CAM** stands for computer-aided design & computer-aided manufacturing.) graphics workstations, word processing systems, or intelligent terminals to a host **mainframe computer** for accessing information can be a micro-**mainframe link**. The **link** products can be hardware, software or a combination of the two.
- ✓ Voice mail: A **voicemail** system (also known as **voice** message or **voice** bank) is a computer-based system that allows users and subscribers to exchange personal **voice** message.

- ➢ ***Voice mail*** is Electronic system for recording oral messages sent by telephone.

- ➢ Voicemail is a method of storing voice messages electronically for later retrieval by intended recipients. Callers leave short messages that are stored on digital media (or, in some older systems, on analog recording tape).

- ➢ Originally, voicemail was developed for telephony as a means to prevent missed calls, and also to facilitate call screening. In recent years, voicemail has become integrated with the Internet, allowing users to receive incoming messages on traditional computers as well as on tablets and mobile phones.

- ➢ Microsoft Exchange is a popular platform for voicemail with desktop and notebook computers. Users can play their voicemail messages either as audio (MP3) or as text. In order to play a voicemail or read it as text, the user simply clicks on an inbox item, just as would be done with an ordinary e-mail message.

- ✓ Electronic mail (e-mail): is an internet Service that allows people who have an e-mail address (accounts) to send and receive electronic letters.
- ✓ Electronic software distribution: ESD is the distribution of software or data to users electronically.
    - ➢ ESD is a system for selling software over a network. ESD system provide secure communications that customers use to download and pay for software. ESD systems can also allow users to use software for trial period before purchasing.
- ✓ Electronic documentation distribution: EDD is the sending of invoices or statements to a customer using e-mail and the internet

- EDD is the process of sending documents electronically. EDD en compasses all document types from invoices (e-invoicing), bills (e-billing) to legal documents, instructions or any other kind of document imaginable.

- ✓ Telecommunicating: is the process of telecommunication
- ✓ Electronic data interchange (EDI): is the electronic interchange of business information using a standardized format. EDI is a process which allows one company to send information to another company electronically rather than paper.
- ✓ Video conferencing: **Videoconferencing** (or **video conference**) means to conduct a **conference** between two or more participants at different sites by using computer networks to transmit audio and **video** data.

  - **Video conferencing** is a technology that allows users in different locations to hold face-to-face meetings without having to move to a single location together. **Uses** for **video conferencing** include holding routine meetings, negotiating business deals, and interviewing job candidates.

Among the most common and major types of video conference systems are: telepresence, integrated, desktop, service-based and codec.

1. Telepresence Video Conferencing System

Telepresence is designed to host a meeting as closely as possible. Even if the participants are not in the same room physically, the set-up is done in a way easily. Large screens are used and cameras are positioned at eye level. The result is a videoconference set-up that appears as if all the participants are sitting in the same room and around the same table.

2. Integrated Video Conferencing System

Integrated video conferencing systems are designed generally for group video conferencing where there's a centralized location for the equipment. It include both the hardware and codec. All the main camera, displays and other peripheral videos are mounted in the main conference location. Integrated video conferencing systems are typically ideal for boardroom and classroom conferences.

3. Desktop Video Conferencing System

As an important one of types of video conferencing systems, desktop video conferencing system is very popular with people on-the-go and typical office workers. Within this option there are two choices available: a software client on your desktop or a hardware codec that doubles as your computer monitor. By using this type of set-up, the video conferencing system is brought right into your personal computer while still pulling off a full-motion conference.

4. Service-based Video Conferencing System

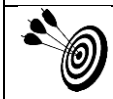
For serviced-based systems, the provider, which often is a telecom carrier, handles majority of the control when it comes to the network set-up. This means less work on your end. You just pay for the solution and

your provider manages it for you making more convenient especially if you don't want to bother with the technicalities.

5. Codec

This alternative is the most like a room-based video conferencing framework in that it utilizes an outside display, camera and microphone, which is the same as does a framework for your meeting room. It is the best decision for someone who will utilize a whiteboard in his or her office who need to collaborate with a physical protest or some else in the room or who likes to stroll about the space while on a call. The space amongst you and the codec enables the flexibility to utilize the space in your office.

Duration: …….hrs



Learning out come 2.1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Identify telecommunication applications.
2. Describe telecommunication applications
3. Differentiate where telecommunication applications are applied

Resources

Equipment	Tools	Materials
- Books -Computer -Projector	- Video aide - Hand-out notes	-Internet - Simulator Software

Advance preparation:

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Learning outcome 1 formative assessment

Learning outcome 2.2 Describe PSTN concepts

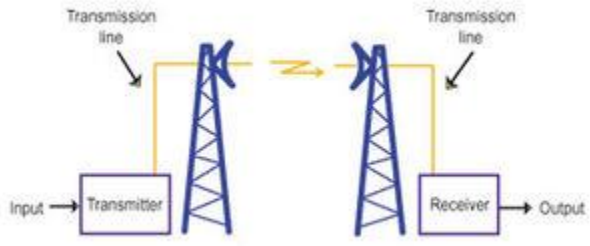
- PSTN definition(Public Switched Telephone Network)
  - ✓ Public circuit switched telephone networks: The public switched telephone network is the aggregate of the world's circuit-switched telephone networks that are operated by national, regional, or local telephone operators, providing infrastructure and services for public telecommunication.
    - ➢ Function of PSTN

    A PSTN lets users make landline telephone calls to one another. A PSTN is made up of **switches** at centralized points on a network that function as nodes to enable communication between two points on the network. A call is placed after being routed through multiple **switches**.

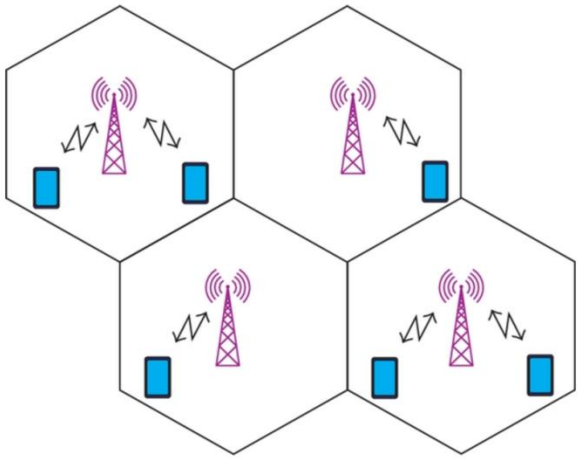
    - ➢ The difference between PSTN and VoIP
      Public Switched Telephone Network (**PSTN**), on the other hand, uses circuit-switched telephony **between** two points for the duration of a call. It is the traditional telephone system that carries analog voice data via copper wires. **VoIP** uses the internet to connect but **PSTN** uses a landline.
    - ➢ The use of PSTN
      PSTN uses an old technology whereby circuit-switched copper phone lines are **used** to transmit analogue voice data. It is the basic service that you have at home and in a small business. As a dedicated service, a **PSTN** line cannot be **used** for any other purpose while a call is being made.
  - ✓ Telephone lines: **Telephone lines** are used to deliver landline **telephone** service and Digital subscriber **line** (DSL) **phone** cable service to the

premises. **Telephone** overhead **lines** are connected to the public switched **telephone** network.

- ✓ Fiber optic cables: A **fiber optic cable** consists of a bundle of glass threads, each of which is capable of transmitting messages modulated onto light waves.
- ✓ Microwaves transmission links: A **microwave link** is a communications system that uses a beam of **radio waves** in the **microwave** frequency range to transmit information between two fixed locations on the earth.



- ✓ Cellular networks: A **cellular network** or **mobile network** is a communication **network** where the last link is wireless.



- ✓ Communication satellite: A communications satellite is a type of ***artificial*** satellite that is placed in Earth's orbit for the purpose of sending and receiving communication data between a source and destination.
- ✓ Understand telephone cables: Most ***telephone wires*** are one or more twisted pairs of copper ***wire***.

Learning outcome 2.3 Apply number systems, digital arithmetic and logic gates

Duration: …….hrs

Learning out come 2.3 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Apply numerical representation
2. Identify Advantages and applications of digital techniques
3. Describe Systems of numeration.
4. Apply Conversion between number systems

Resources

Equipment	Tools	Materials
- Books - Hand-out notes -Computer -projector	- Simulator Software	- Internet - Video aide

Advance preparation:

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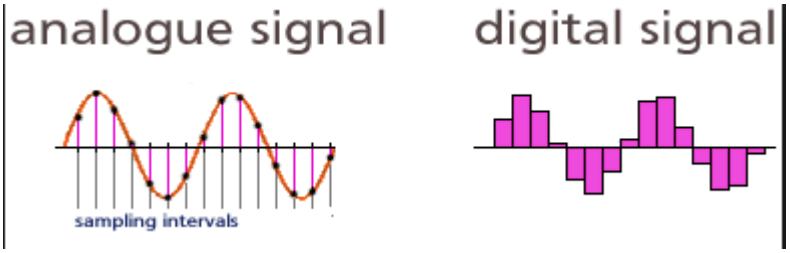
Indicative content 2.3.1: Numerical representation

- ✓ Analog representation: An analog signal is any continuous signal for which the time-varying feature of the signal is a representation of some other time varying quantity, i.e., analogous to another time varying signal.
- ✓ Digital representation: **Digital Representation** of Information. **Digital** encoding of information means the data is stored in discrete units -- effectively numbers -- and it is contrasted with analog encoding which uses a physical quantity, e.g. charge, varying over a continuous range. **Digital** is better.



Theoretical learning Activity

- ✓ **……** (example: ask trainees to brainstorm about……. within groups)
- ✓ **……**
- ✓ **……**

Practical learning Activity

- ✓ **……** (Example: Trainees in pair perform ……)

Points to Remember (Take home message)

Indicative content 2.3.2: Advantages and applications of digital techniques

Advantages of Digital Techniques

- Reduction in cost of hardware.
- High speed.
- High Reliability.
- Design is easy.
- Result can be reproduced easily.

  Application of Digital Techniques

  Applications of DSP include audio signal processing, audio compression, **digital** image processing, video compression and speech processing

  - ✓ Example of a system in which analogue circuit is used: An analog synthesizer is a synthesizer that uses analog circuits and analog computer techniques to generate **sound** electronically. The analog television **encodes** television and transports the picture and **sound** information as an analogue signal, that is, by varying the amplitude and/or frequencies of the broadcast signal.
  - ✓ A system using digital and analogue methods:

Analog Communication	Digital Communication
Transmitted modulated signal is analog in nature.	Transmitted signal is digital i.e. train of digital pulses.
Amplitude, frequency or phase variations in the transmitted signal represent the information or message.	Amplitude, width or position of the transmitted pulses is constant. The message is transmitted in the form of code words.
Noise immunity is poor for AM, but improved for FM and PM.	Noise immunity is excellent.
It is not possible to separate out noise and signal. Therefore, repeaters cannot be used.	It is possible to separate signal from noise. Therefore, repeaters can be used.
Coding is not possible.	Coding techniques can be used to detect and correct the errors.
Bandwidth required is lower than that for the digital modulation method.	Due to higher bit rates, higher channel bandwidth is required.
FDM is used for multiplexing.	TDM is used for multiplexing.
Not suitable for transmission of secret information in military applications.	Due to coding techniques, it is suitable for military applications.
Analog modulation systems are AM, FM, PM, PAM, AWM, etc.	Digital modulation systems are PCM, DM, ADM, DPCM, etc.

DM: Delta Modulation
ADM: Adaptive Delta Modulation
DPCM: differential pulse-code modulation
PCM: Pulse-code modulation
FDM: Frequency Division Multiplexing
FM: Frequency Modulation
PM: Phase modulation
AM: Amplitude modulation
PAM: *Pulse amplitude modulation*
AWM: Arctic Warfare Magnum
TDM: Time-division multiplexing


Theoretical learning Activity

- ✓ Group discussion numerical representation
- ✓ Further research on internet.


Points to Remember (Take home message)

- Example of a system in which analogue circuit is used
- A system using digital and analogue methods

Indicative content 2.3.3 : Systems of numeration

- ✓ Decimal numeration system: it's the all number's from 0 up to 9 it means that we have 10 numbers which composed by: $(0,1,2,3,4,5,6,7,8,9)_{10}$
- ✓ Binary numeration system: it's the digital number that composed of 0 and 1 it means that we have only 2 numbers $(0,1)_2$
- ✓ Octal number system: it's the all number's from 0 up to 7 it means that we have 7 numbers which composed by: $(0,1,2,3,4,5,6,7)_8$
- ✓ Hexadecimal number system: it's the all number's from 0 up to 15 it means that we have 7 numbers which composed by: $(0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F)_{16}$ for the Hexadecimal number system it's we

use numbers and letters, represented by this format
A=10,B=11,C=12,D=13,E=14,F=15

Theoretical learning Activity

- ✓ Group discussion numerical representation

Practical learning Activity

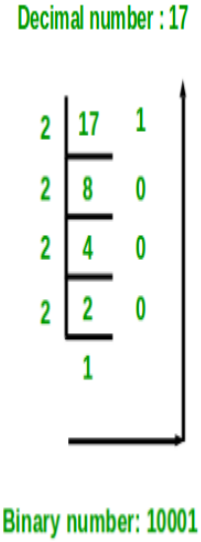
Practical exercises on Conversion between numbers and Logic gates

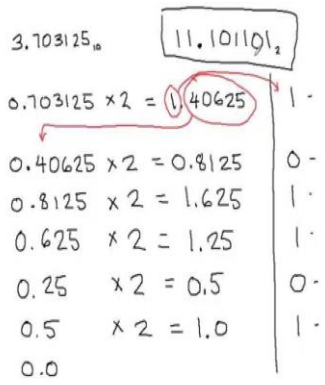
Points to Remember (Take home message)

- Decimal numeration system
- Binary numeration system
- Octal number system
- Hexadecimal number system

Indicative content 2.3.4: Conversion between number systems

Decimal to binary conversion





✓ Decimal to octal conversion

Decimal = 415

Division	Quotient	Remainder
415/8	51	7
51/8	6	3
6/8	0	6

Octal = 637

Decimal Numbers to Octal

$0.342_{10} = ?_8$

$0.342 \times 8 = 2.736 \quad (.2_8)$

$0.736 \times 8 = 5.888 \quad (.25_8)$

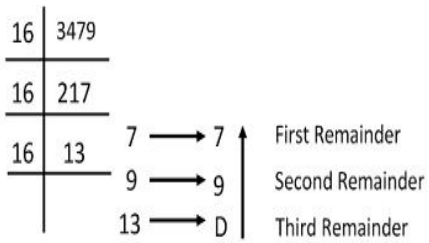
$0.888 \times 8 = 7.104 \quad (.257_8)$

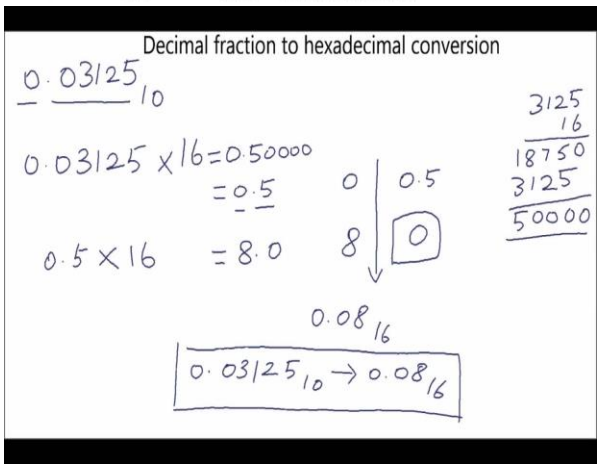
$0.104 \times 8 = 0.832 \quad (.2570_8)$

$0.342_{10} \approx 0.2570_8$ it's an approximation

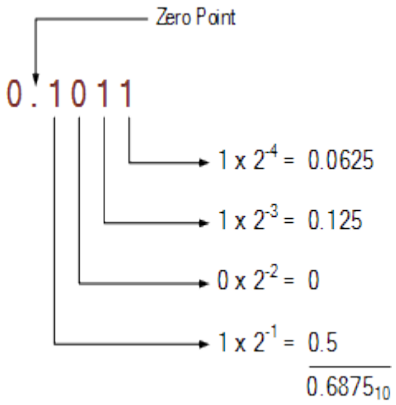
Take the integer part of every multiplication to form the binary number. You can go on many more multiplications to improve the accuracy of the conversion.

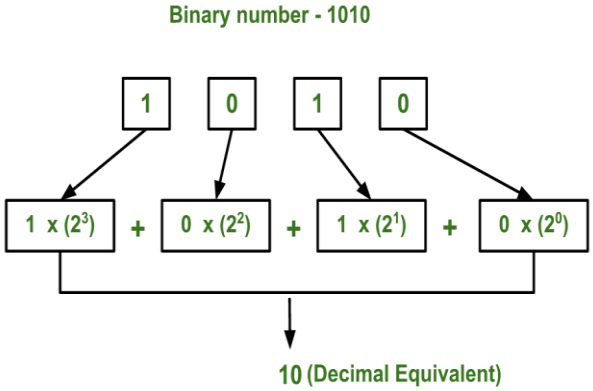
✓ Decimal to hexadecimal conversion





✓ Binary to Decimal conversion





✓ Binary to octal conversion

Binary to Octal Conversion

Convert the binary number 111110011001_2 to its octal equivalent.

1. ***Separate the digits of a given binary number into groups from right to left side, each containing 4 bits.***

   111 110 011 001

2. ***Find the equivalent octal number for each group.***

   111 110 011 001

   7 6 3 1

3. ***Write the all group's octal numbers together, maintaining the group order provides the equivalent octal number for the given binary.***

   7631

Result

$$111110011001_2 = 7631_8$$

✓ Binary hexadecimal conversion

Number	0	1	2	3	4	5	6	7
Binary	0000	0001	0010	0011	0100	0101	0110	0111
Hexadecimal	0	1	2	3	4	5	6	7

Number	8	9	10	11	12	13	14	15
Binary	1000	1001	1010	1011	1100	1101	1110	1111
Hexadecimal	8	9	A	B	C	D	E	F

✓ Octal to binary conversion

Octal	Binary
0	000
1	001
2	010
3	011
4	100
5	101
6	110
7	111

✓ Octal to decimal conversion

Octal to Decimal Conversion

Find the equivalent decimal number for octal 143_8

Place values	8^2	8^1	8^0
Octal	1	4	3
Conversion	$1x8^2$	$4x8^1$	$3x8^0$
Decimal	64	+ 32	+ 3

99

✓ Hexadecimal to binary conversion

Binary to Hexadecimal Conversion

$(1101011.00101)_2$

1101011.00101

01101011.00101000

Binary	Hexadecimal
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	A
1011	B
1100	C
1101	D
1110	E
1111	

✓ Hexadecimal to decimal conversion

Digit	5	4	D	2
Place value	16^1	16^0	16^{-1}	16^{-2}

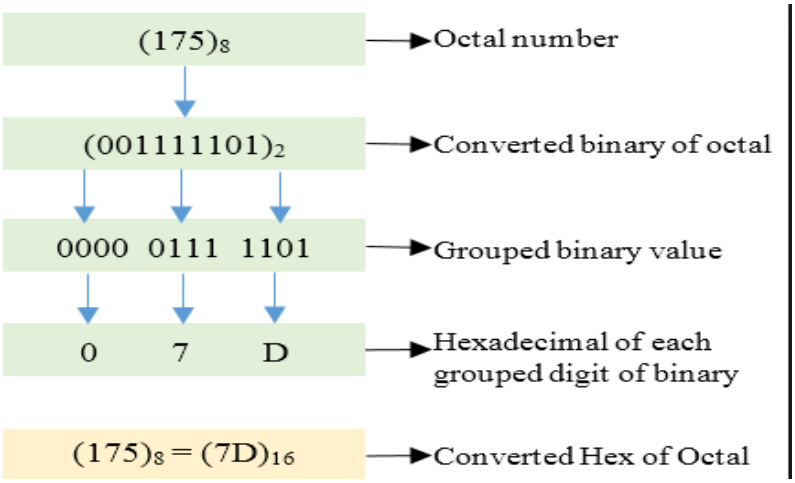
$$54.D2_{16}$$
$$= 5 \cdot 16^1 + 4 \cdot 16^0 + D \cdot 16^{-1} + 2 \cdot 16^{-2}$$
$$= 5 \cdot 16^1 + 4 \cdot 16^0 + 13 \cdot 16^{-1} + 2 \cdot 16^{-2}$$
$$= 80 + 4 + 0.8125 + 0.0078125$$
$$= 84.8203125$$

$4F7A_{16}$

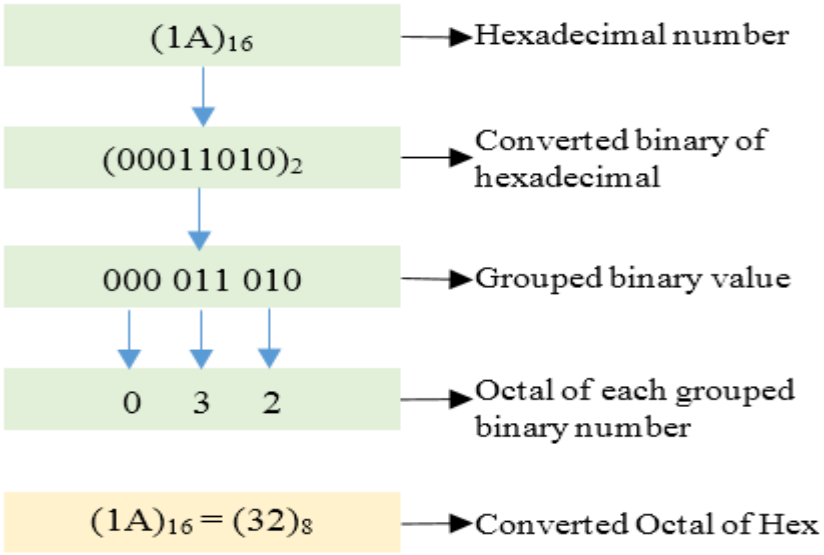
A	$10 \times 16^0 = 10 \times 1$	$= 10$
7	$7 \times 16^1 = 7 \times 16$	$= 112$
F	$15 \times 16^2 = 15 \times 256$	$= 3840$
4	$4 \times 16^3 = 4 \times 4096$	$= 16384$
		20346_{10}

✓ Octal to hexadecimal number and vice versa

➢ Octal to hexadecimal number



- Hexadecimal to octal number

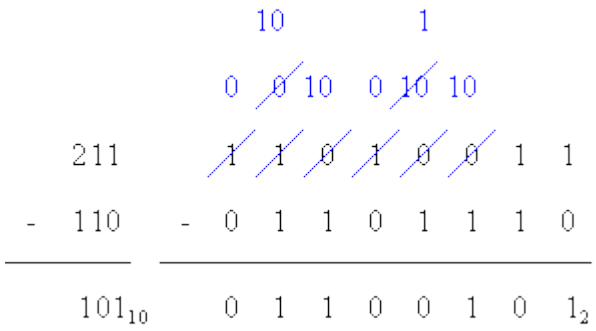


- ✓ Positive binary arithmetic

	Addition	Subtraction	Multiplication	Division
i)	0 + 0 = 0	0 – 0 = 0	0 x 0 = 0	0 /1 = 0
ii)	0 + 1 = 1	1 – 0 = 1	0 x 1 = 0	1 / 1 = 1
iii)	1 + 0 = 1	1 – 1 = 0	1 x 0 = 0	0 / 0 = not allowed (not valid)
iv)	1 + 1 =10	1-0 = 10 – 1 (with borrow 1) = 1	1 x 1 = 1	1 / 0 = not allowed (not valid)

- Binary addition and subtraction (Boolean postulates)

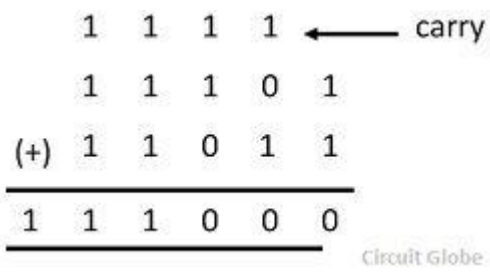
➢ Binary Subtraction

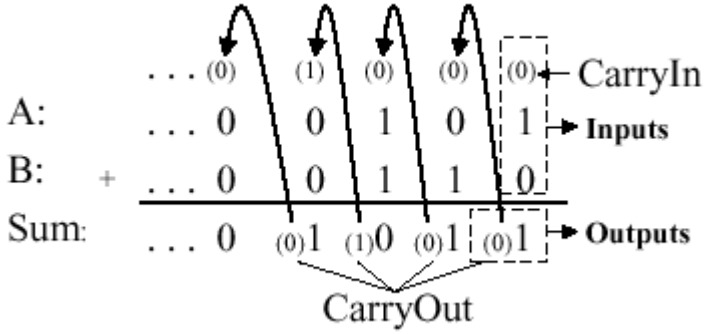


➢ Binary Addition

Binary Addition - Examples

101	5		00011010 +	26
+ 101	+ 5		00001100	12
1010	10		00100110	38





- Binary multiplication and division

Multiplication

```
    1011   Multiplicand (11 dec)
  x 1101   Multiplier    (13 dec)
  ------
    1011   Partial products
   0000    Note: if multiplier bit is 1 copy
  1011     multiplicand (place value)
 1011      otherwise zero
 --------
10001111   Product (143 dec)
```

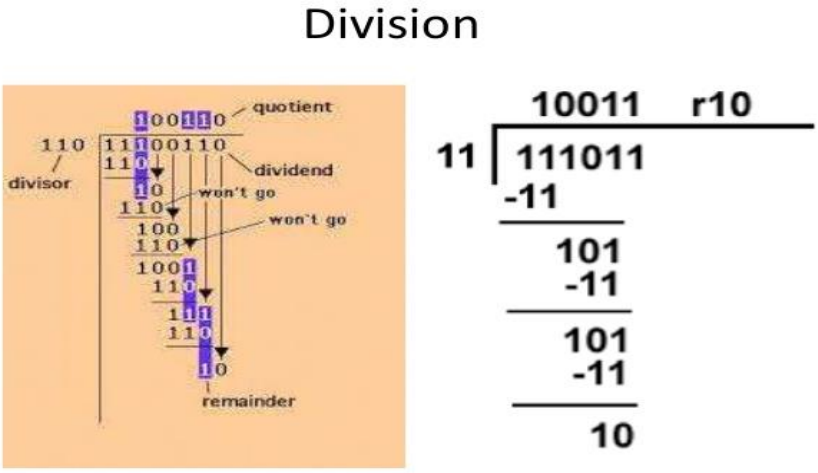
Note: need double length result

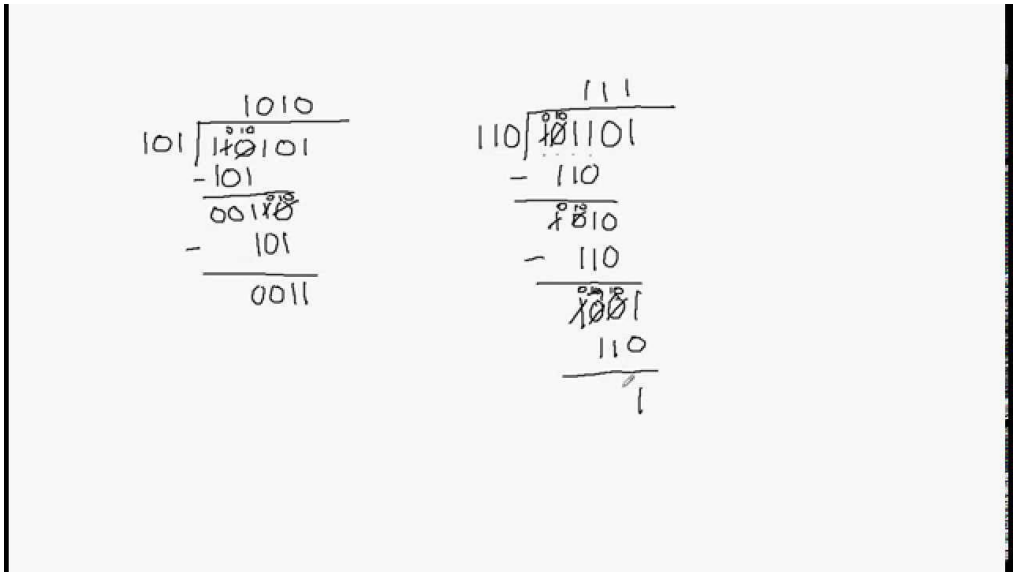
Example:

0011010 x 001100 = 100111000

$$
\begin{array}{rl}
0\,0\,1\,1\,0\,1\,0 & = 26_{10} \\
\times\, 0\,0\,0\,1\,1\,0\,0 & = 12_{10} \\
\hline
0\,0\,0\,0\,0\,0\,0 & \\
0\,0\,0\,0\,0\,0\,0 & \\
0\,0\,1\,1\,0\,1\,0 & \\
0\,0\,1\,1\,0\,1\,0 & \\
\hline
0\,1\,0\,0\,1\,1\,1\,0\,0\,0 & = 312_{10}
\end{array}
$$

Division

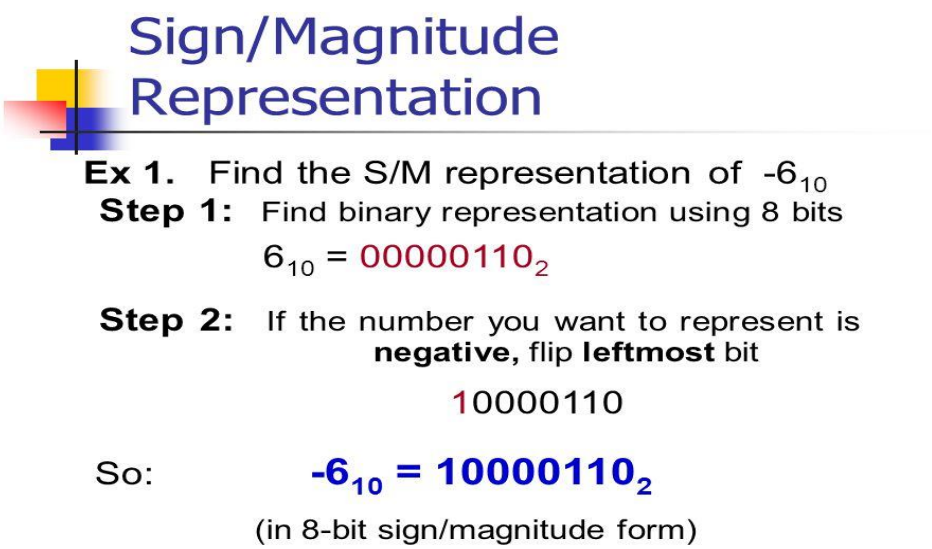




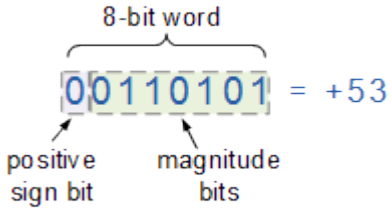
- ✓ Signed binary numbers

- Sign-Magnitude form

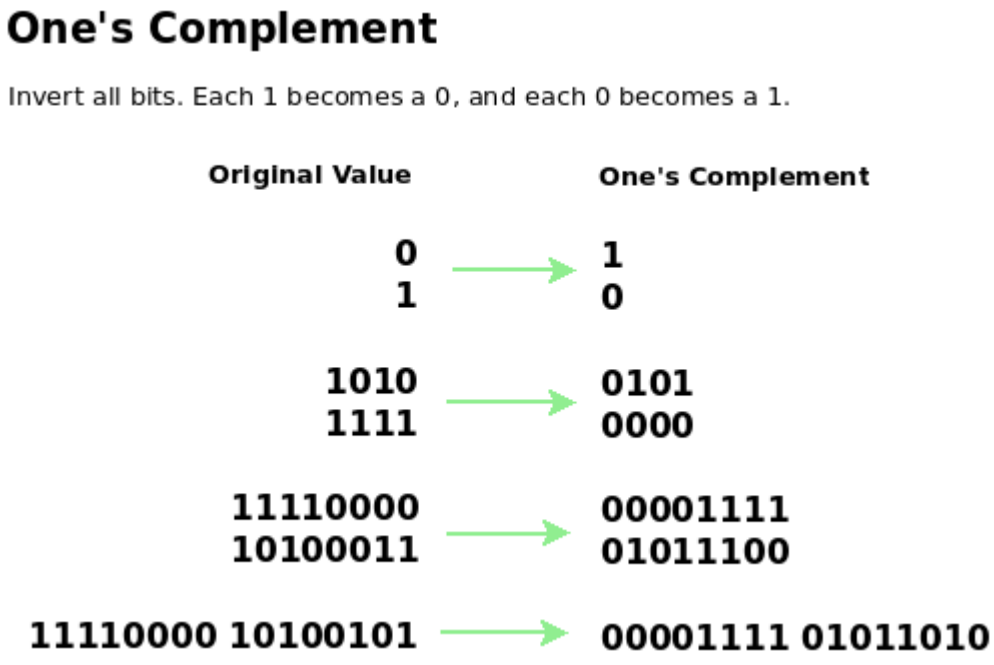
  For negative sign



  For Positive sign



- One's and two's complement form



Two's complement…

Negative numbers Are represented using a 2's complement form

- To obtain the 2's complement of a number:
  - Complement the bits
  - Add one to the result

Example1 : Find the 2's complement of the following 8 bit number

```
  00101001
  11010110 ..... First, invert the bits
+ 00000001 ..... Then, add 1
= 11010111
```

The 2's complement of 00101001 is **11010111**

Two's Complement Representation

Ex 3, **Step 3**: Add one to complemented value

```
(complemented) ->   10101111
(add one)      ->  +        1
                    ---------
                    10110000
```

So: $-80_{10} = 10110000_2$
(in 8-bit 2's complement form)

Theoretical learning Activity

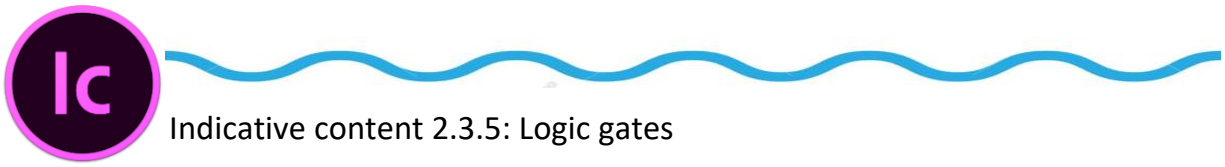
- ✓ **……** (example: ask trainees to brainstorm about……. within groups)
- ✓ **…….**
- ✓ **…….**

Practical learning Activity

Practical exercises to individual learner

Points to Remember (Take home message)

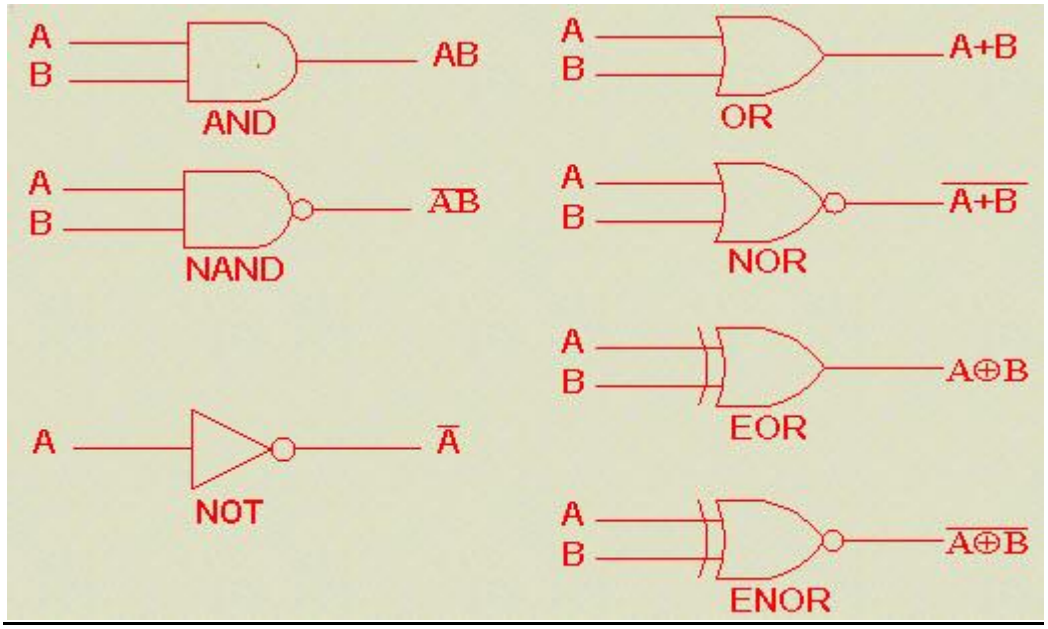
Converting decimal number to binary number Conversion binary number to decimal number One's compliments Two's compliments Operations



Indicative content 2.3.5: Logic gates

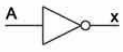
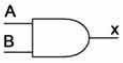
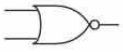
- ✓ Positive and negative logic designation
  - Truth table
  - The OR Gate
  - The AND Gate
  - The NOT Gate
  - The NOR Gate
  - The NAND Gate
  - The EXLUSIVE-OR Gate (EXOR), XOR
  - The EXLUSIVE-NOR Gate (EXNOR), XNOR

ALL SYMBOLS USED IN LOGICAL GATES



TRUTH TABLE OF ALL LOGICAL GATES

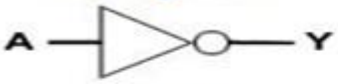
Logic Gates

Name	NOT	AND	NAND	OR	NOR	XOR	XNOR
Alg. Expr.	$\overline{A}$	AB	$\overline{AB}$	$A+B$	$\overline{A+B}$	$A \oplus B$	$\overline{A \oplus B}$
Symbol							
Truth Table	A | X 0 | 1 1 | 0	B A | X 0 0 | 0 0 1 | 0 1 0 | 0 1 1 | 1	B A | X 0 0 | 1 0 1 | 1 1 0 | 1 1 1 | 0	B A | X 0 0 | 0 0 1 | 1 1 0 | 1 1 1 | 1	B A | X 0 0 | 1 0 1 | 0 1 0 | 0 1 1 | 0	B A | X 0 0 | 0 0 1 | 1 1 0 | 1 1 1 | 0	B A | X 0 0 | 1 0 1 | 0 1 0 | 0 1 1 | 1

Logic Gate Examples

KEY: Input = A and B -- Output = Y

Not gate



If A = 0 then Y = 1
If A = 1 then Y = 0

Or gate

If A = 0 and B = 0 then Y = 0
If A = 1 and B = 0 then Y = 1
If A = 0 and B = 1 then Y = 1
If A = 1 and B = 1 then Y = 1

And gate

If A = 0 and B = 0 then Y = 0
If A = 0 and B = 1 then Y = 0
If A = 1 and B = 0 then Y = 0
If A = 1 and B = 1 then Y = 1

Nand gate

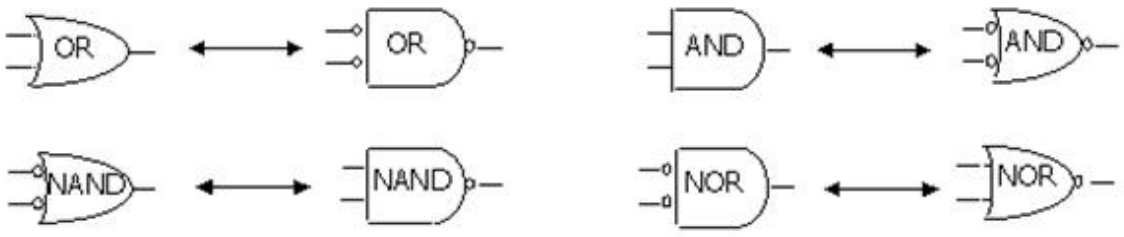
If A = 0 and B = 0 then Y = 1
If A = 0 and B = 1 then Y = 1
If A = 1 and B = 0 then Y = 1
If A = 1 and B = 1 then Y = 0

Nor gate

If A = 0 and B = 0 then Y = 1
If A = 0 and B = 1 then Y = 0
If A = 1 and B = 0 then Y = 0
If A = 1 and B = 1 then Y = 0

Two-level logic using NAND and NOR gates

- NAND-NAND and NOR-NOR networks
  - de Morgan's law: $(A + B)' = A' \cdot B'$ $(A \cdot B)' = A' + B'$
  - written differently: $A + B = (A' \cdot B')'$ $(A \cdot B) = (A' + B')'$
- In other words —
  - OR is the same as NAND with complemented inputs
  - AND is the same as NOR with complemented inputs
  - NAND is the same as OR with complemented inputs
  - NOR is the same as AND with complemented inputs

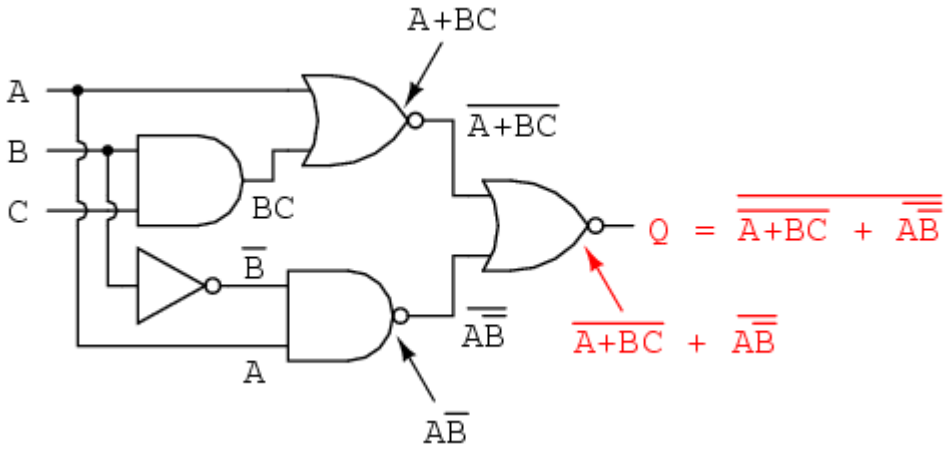


Basic Boolean algebra laws

	AND	OR
Commutative	$A \cdot B = B \cdot A$	$A + B = B + A$
Associative	$(A \cdot B) \cdot C = A \cdot (B \cdot C)$	$(A + B) + C = A + (B + C)$
Distributive	$A \cdot (B + C) = A \cdot B + A \cdot C$	$A + (B \cdot C) = (A + B)(A + C)$
De Morgan's Theorem	$(A \cdot B)' = A' + B'$	$(A + B)' = A' \cdot B'$
	$(A \cdot B \cdot C)' = A' + B' + C'$	$(A + B + C)' = A' \cdot B' \cdot C'$
	$(A \cdot B \cdot C \cdot \ldots.)' = A' + B' + C' + \cdots$	$(A + B + C + \cdots)' = A' \cdot B' \cdot C' \cdot \ldots.$
	$A \cdot 0 = 0$	$A + 0 = A$
	$A \cdot 1 = A$	$A + 1 = 1$
	$A \cdot A = A$	$A + A = A$
	$A \cdot A' = 0$	$A + A' = 1$
	$A \cdot (A + B) = A$	$A + (A \cdot B) = A$
	$A \cdot (A' + B) = A \cdot B$	$A + (A' \cdot B) = A + B$
	$A \cdot B + A \cdot B' = A$	$(A + B)(A + B') = A$
	$(A')' = A$	$0' = 1$

	AND Form	OR Form
Commutative Law	A . B = B . A	A + B = B + A
Associate Law	(A . B) . C = A . (B . C)	(A + B) + C = A + (B + C)
Distributive Law	(A+B)+ C = (A+C).(B+C)	(A + B) . C = (A . C) + (B . C)
Identity Law	A . 1 = A	A + 0 = A
Zero and One Law	A . 0 = 0	A + 1 = 1
Inverse Law	A . A' = 0	A + A' = 1
Idempotent Law	A . A = A	A + A = A
Absorption Law	A(A+B) = A	A + A.B = A A + A'B = A+B
DeMorgan's Law	(A . B)' = (A)' + (B)'	(A+ B)' = (A)' . (B)'
Double Complement Law	$\overline{\overline{x}} = x$	

2- and 3-variable Boolean Algebra Theorems		
Commutative Laws	(1a) (1b)	x+y=y+x x•y=y•x
Associative Laws	(2a) (2b)	x+(y+z)=(x+y)+z x•(y•z)=(x•y)•z
Distributive Laws	(3a) (3b)	x+(y•z)=(x+y)•(x+z) x•(y+z)=(x•y)+(x•z)
Unity	(4a) (4b)	(x•y)+(x'•y)=y (x+y)•(x'+y)=y
Absorption	(5a) (5b)	x+(x•y)=x x•(x+y)=x
	(6a) (6b)	x+(x'•y)=x+y x•(x'+y)=x•y
DeMorgan's		(x+y)'=x'•y' (xy)'=x'+y'



Boolean (or Switching) Algebra

Name	AND form	OR form
Identity law	$1A = A$	$0 + A = A$
Null law	$0A = 0$	$1 + A = 1$
Idempotent law	$AA = A$	$A + A = A$
Inverse law	$A\overline{A} = 0$	$A + \overline{A} = 1$
Commutative law	$AB = BA$	$A + B = B + A$
Associative law	$(AB)C = A(BC)$	$(A + B) + C = A + (B + C)$
Distributive law	$A + BC = (A + B)(A + C)$	$A(B + C) = AB + AC$
Absorption law	$A(A + B) = A$	$A + AB = A$
De Morgan's law	$\overline{AB} = \overline{A} + \overline{B}$	$\overline{A + B} = \overline{A}\,\overline{B}$

Some identities of Boolean algebra.

Theoretical learning Activity

- ✓ **……** (example: ask trainees to brainstorm about……. within groups)
- ✓ **…….**
- ✓ **…….**


Practical learning Activity

- ✓ **……** (Example: Trainees in pair perform ……)


Points to Remember (Take home message)


Learning outcome 3.2 : formative assessment

Written assessment

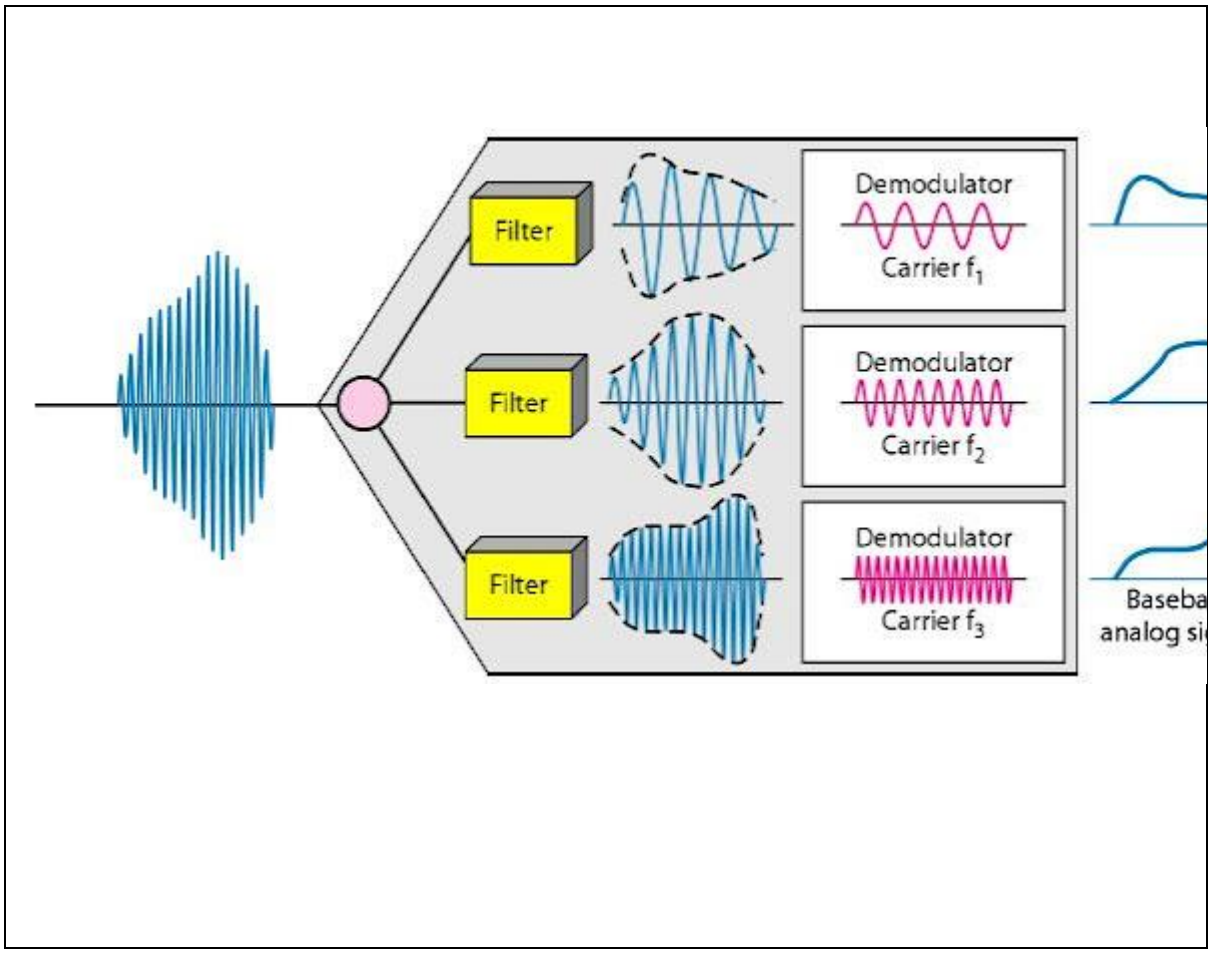
- Assessment tools
  - ✓ True or false questions
  - ✓ Multiple choice
  - ✓ Open ended questions
  - ✓ Case studies

Please mix different assessment tools for triangulation and relevancy of assessment

Practical assessment

- Assessment tools
  - ✓ Assay
  - ✓ Task to be performed
  - ✓ Observation checklist

Learning Unit 3: Apply Modulation/Demodulation Multiplexing/ De-multiplexing and Signals Processing Techniques



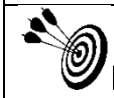
STRUCTURE OF LEARNING UNIT 3

Learning outcomes:

3.1: Describe transmission media **3.2:** Apply modulation &demodulation techniques **3.3:** Apply multiplexing and de-multiplexing techniques

Learning outcome 3.1 Describe transmission media

Duration: …….hrs



Learning outcome 3.1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Identify Transmission Mode
2. Identify Transmission media

2. Define transmission media

3. Classify transmission media

Resources

Equipment	Tools	Materials
-Books - Hand-out notes -	- Simulator Software - Network Tool box - Fiber Tool box	-Cables - Internet - Video aide

Advance preparation:

Workplace preparation

Tools,equipment,material preparation

Indicative content 3.1.1: Transmission media

- **Transmission Mode**

There are three modes of transmission namely: simplex, half duplex, and full duplex. Transmission mode defines the direction of flow of signal between two connected devices.

The primary difference between three modes of transmission is that:

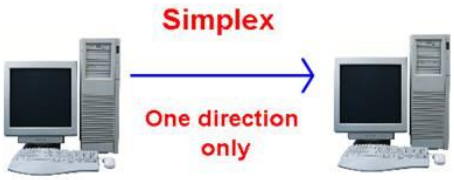
in a simplex mode of transmission the communication is unidirectional or one-way whereas,

in the half duplex mode of transmission the communication is two-directional, but the channel is interchangeably used by the both the connected devices.

On the other hand, in the full duplex mode of transmission, the communication is bi-directional or two-way, and the channel is used by both the connected devices simultaneously.

- **Simplex:** In Communication Networks, Communication can take place in one direction (Data flows in single direction.) connected to such a circuit are either a send only or receive only device.

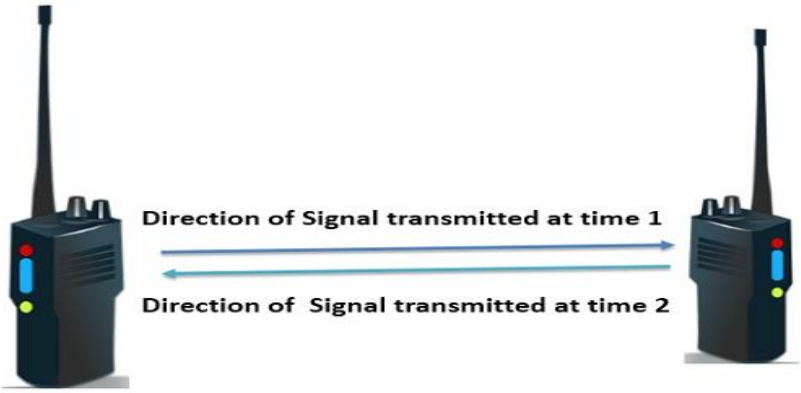
Examples of Simplex mode: A Communication between a computer and a keyboard involves simplex duplex transmission. A television broadcast is an example of simplex duplex transmission.

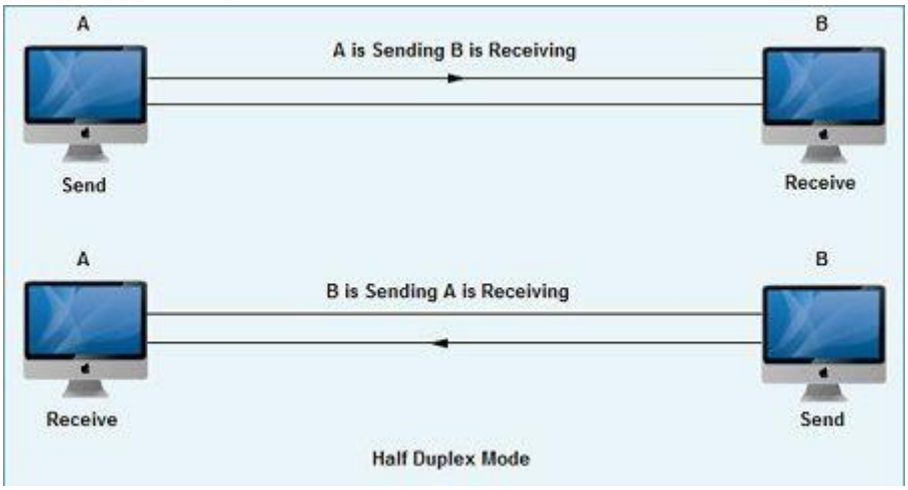


- **Half Duplex:** A half duplex system can transmit data in both directions, but only in one direction at a time that mean half duplex modes support two-way traffic but in only one direction at a time. Both the connected devices can transmit and receive but not simultaneously. When one device is sending the other can only receive and vice-versa. Data is transmitted in one direction at a time, **for example**. a walkie-talkie.

Example of half duplex mode: A walkie-talkie operates in half duplex mode. It can only send or receive a transmission at any given time. It cannot do both at the same time.

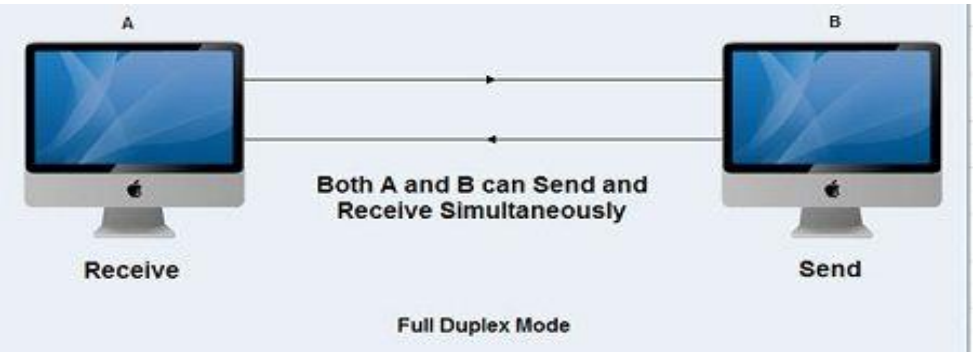
- ❖ As shown in fig. computer A sends information to computer B. At the end of transmission, computer B sends information to computer A. Computer A cannot send any information to computer B, while computer B is transmitting data.





- **Full Duplex:** A full duplex system can transmit data simultaneously in both directions on transmission path. Full-duplex method is used to transmit the data over a serial communication link. Two wires needed to send data over a serial communication link layer. Full-duplex transmission, the channel capacity is shared by both communicating devices at all times.

Example of Full duplex mode: Telephone networks operate in full duplex mode when two persons talk on telephone line, both can listen and speak simultaneously.



Comparison Chart

Basis for Comparison	Simplex	Half Duplex	Full Duplex
Direction of Communication	Unidirectional	Two-directional, one at a time	Two-directional, simultaneously
Send / Receive	Sender can only send data.	Sender can send and receive data, but one a time.	Sender can send and receive data simultaneously.
Performance	Least performing mode of transmission.	Better than Simplex	Most performing mode of transmission.
Example	Keyboard, monitor, Radio braoadcasting & TV braodcasting	Walkie-talkie	Telephone

Simplex

In a simplex transmission mode, the communication between sender and receiver occurs only in one direction. The sender can only send the data and the receiver can only receive the data. The receiver cannot reply to the sender.

Simplex is like a one-way road in which the traffic travels only in one direction, no vehicle from the opposite direction is allowed to enter.

For example, the keyboard can only send the input to the monitor and the monitor can only receive the input and display it on the screen. The monitor cannot reply nor send any feedback to the keyboard.

Half Duplex

The communication between sender and receiver occurs in both the directions in a half duplex transmission but, one at a time. The sender and receiver both can send and receive the information but, only one is allowed to send at a time. Half duplex is still considered a one-way road, in which a vehicle traveling in the opposite direction of the traffic has to wait till the road is empty.

For example, in walkie-talkies, the speaker at both ends can speak but they have to speak one by one. Both cannot speak simultaneously.

Full Duplex

In a full duplex transmission mode, the communication between sender and receiver can occur simultaneously. The sender and receiver can both transmit and receive at the same time. The full duplex transmission mode is like a two-way road in which traffic can flow in both directions at the same time.

For example, in a telephone, two people communicate, and both are free to speak and listen at the same time.

Key Differences between the Three Transmission Modes

In a simplex mode, signal is sent in one direction. In a half duplex mode, signal is sent in both directions, but one at a time. In a full duplex mode, signal is sent in both directions at the same time.

In a simplex mode, only one device can transmit the signal. In a half duplex mode, both devices can transmit the signal, but one at a time. In a full duplex mode, both devices can transmit the signal at the same time.

Full duplex performs better than half duplex and half duplex performs better than simplex.

- Transmission media
  - ✓ **Copper wires (Twisted pair and Coaxial cable): Copper** is the electrical **conductor** in many categories of electrical **wiring**. **Copper wire** is **used in** power generation, power transmission, power distribution, telecommunications, electronics circuitry, and countless types of electrical equipment.
  - ➢ **Twisted pair:** Twisted-pair cable is a type of cabling that is used for telephone communications and most modern Ethernet networks.

- **Coaxial cable:** Coaxial cable is used as a transmission line for **radio frequency signals**. Its applications include feedlines connecting **radio transmitters** and receivers with their antennas, computer network (Internet) connections, digital **audio** (**S/PDIF**), and distributing cable **television** signals.
- ✓ **Fiber optic:** A fiber optic cable is a network cable that contains strands of glass fibers inside an insulated casing. They're designed for long distance, very high-performance data networking, and telecommunications.
- ✓ **Radio (micro wave):** Microwave is a line-of-sight wireless communication technology that uses high frequency beams of radio waves to provide high speed wireless connections that can send and receive voice, video, and data information.

- ✓ Identification of transmission media
- ✓ Classification of transmission media.
- ✓ Application of transmission media


Theoretical learning Activity

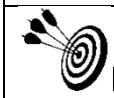
- ✓ Group discussion transmission media
- ✓ Demonstration by video/ picture


Points to Remember (Take home message)

- Transmission Mode
- Transmission media

Learning outcome 3.2: Apply modulation & demodulation techniques

 **Duration:5 hrs**

 Learning outcome 3.2 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Differentiate Modulation & demodulation Techniques
2. Describe Analog modulation
3. Describe Digital modulation
4. Describe Optical modulation

 **Resources**

Equipment	Tools	Materials
- Books - Hand-out notes - Modems -Computer -Projector	- Simulator Software	-Internet - Video aide

 **Advance preparation:**

.Prepare materials and equipment

Indicative content 3.2.1 : Modulation & demodulation Techniques

- Modulation & demodulation Techniques
  - ✓ **Analog modulation:** **Analog modulation** refers to the process of transferring an **analog** baseband (low frequency) signal, like an audio or TV signal over a higher frequency signal such as a radio frequency band.

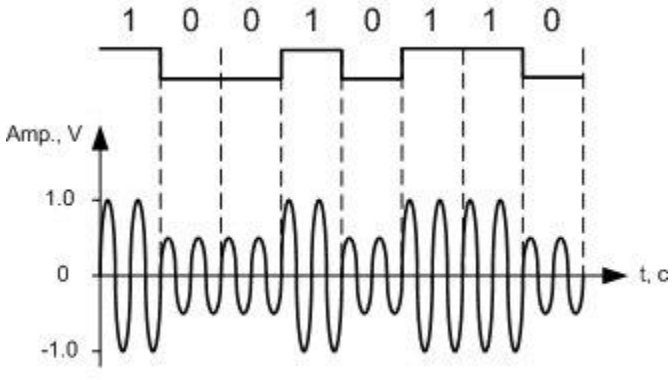
    There are Three Types of Analog Modulation
    - Amplitude Modulation (AM): Amplitude modulation is a modulation technique used in electronic communication, most commonly for transmitting information via a radio carrier wave.
    - Frequency Modulation (FM): In analog **frequency modulation**, such as **FM** radio broadcasting of an audio signal representing voice or music, the instantaneous **frequency** deviation, the difference between the **frequency** of the carrier and its center **frequency**, is proportional to the **modulating** signal.

      Where do we use AM and FM?

      AM is used for video signals for example TV. Ranges from 535 to 1705 kHz.

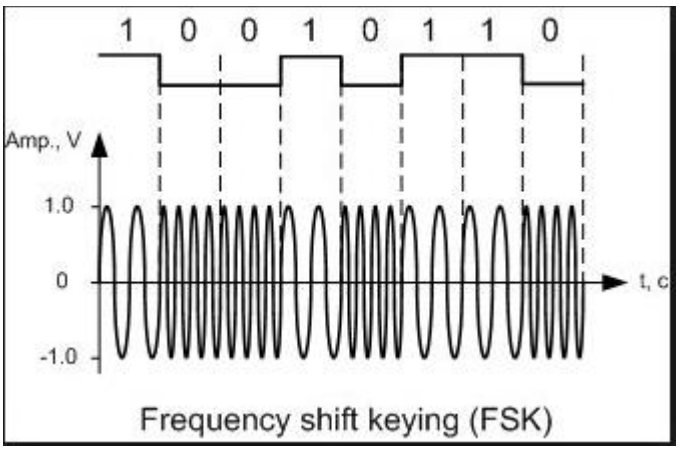
      FM is used for audio signals for example Radio. Ranges from 88 to 108 MHz.
    - Phase Modulation (PM): **Phase modulation** (**PM**) is a **modulation** pattern for conditioning communication signals for transmission. It encodes a message signal as variations in the instantaneous **phase** of a carrier wave. **Phase modulation** is one of the two principal forms of angle **modulation**, together with frequency **modulation**.
  - ✓ **Digital modulation:** DM stands for **Digital Modulation** and is a generic name for **modulation** techniques that uses discrete signals to modulate a carrier wave.

    There are Three Types of Digital Modulation
    - Amplitude Shift Keying (ASK): is a form of amplitude modulation that represents digital data as variations in the amplitude of a carrier wave.
      - ➢ ***Amplitude Shift Keying*** (***ASK***) is a type of Amplitude Modulation which represents the binary data in the form of variations in the amplitude of a signal.



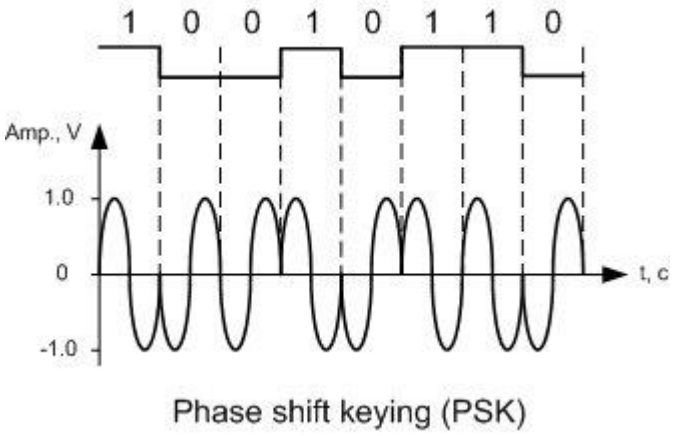
Amplitude shift keying (ASK)

- Frequency Shift Keying (FSK): **Frequency Shift Keying**. **Frequency Shift Keying**(**FSK**) is the digital modulation technique in which the **frequency** of the carrier signal varies according to the digital signal changes. ... The output of a **FSK** modulated wave is high in **frequency** for a binary High input and is low in **frequency** for a binary Low input.



- Phase Shift Keying (PSK): ***Phase-shift keying*** (***PSK***) is a method of digital communication in which the ***phase*** of a transmitted signal is varied to convey information.

  - Phase-shift keying is a digital modulation process which conveys data by changing the phase of a constant frequency reference signal.

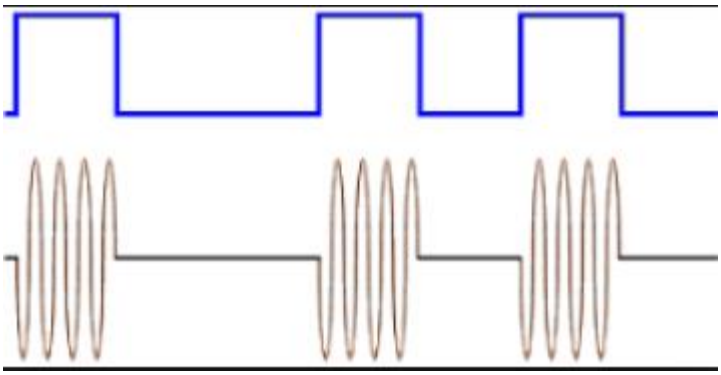


The difference between FM & FSK:

FSK and FM are similar. **FSK** is used for digital data where there is discrete shifting from one frequency to another in accordance with the logic state being transmitted. ... **FM** is used for

analog data and can have a continuous range of frequencies (within limits) output for a continuous analog signal (also within limits).

- ✓ **Optical modulation:** ***Optical modulation*** allows one to control an optical wave or to encode information on a carrier optical
- ✓ **ON/OF Keying (OOK): OOK modulation** (On/Off Key) is the special case of ASK (Amplitude Shift Key) **modulation** where no carrier is present during the transmission of a zero. FSK **modulation** (Frequency Shift Key) is commonly believed to perform better in the presence of interfering signals.



Base Station?

Base station is a radio receiver/transmitter that serves as the hub of the local wireless network, and may also be the gateway between a wired network and the wireless network.

- ✓ Definition of modulation
- ✓ Definition of demodulation
- ✓ Types of modulation
  - Analog and digital modulation
- ✓ Types of analog modulation
- ✓ Types of digital modulation
- ✓ Digital modulation Amplitude Shift Keying(ASK) Frequency Shift Keying(FSK) Phase Shift Keying(PSK)
- ✓ Optical modulation ON/OF Keying (OOK)

Theoretical learning Activity

- ✓ **……** (example: ask trainees to brainstorm about……. within groups)
- ✓ **…….**
- ✓ **…….**

Practical learning Activity

- ✓ **……** (Example: Trainees in pair perform ……)

Points to Remember (Take home message)

- Modulation & demodulation Techniques

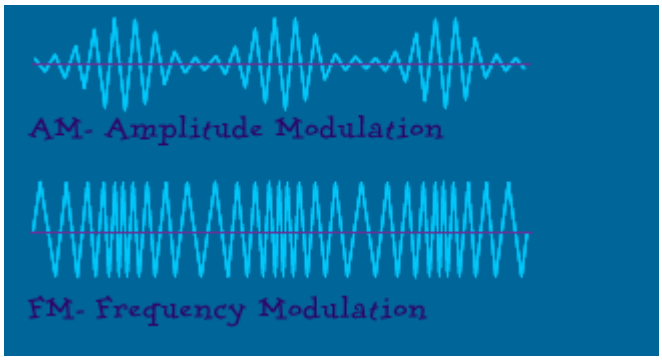
Learning outcome 3.2. : formative assessment

Written assessment

What is the difference between amplitude and frequency modulation?

ANS:

FM vs AM: What's the difference?



FM radio works the same way that AM radio works.

The difference is in how the carrier wave is modulated, or altered. With:

- **AM radio, the amplitude, or overall strength, of the signal is varied to incorporate the sound information. /2.5marks**
- **FM, the frequency (the number of times each second that the current changes direction) of the carrier signal is varied. /2.5marks**

- **FM signals have a great advantage over AM signals. /2.5marks**

- **Both signals are susceptible to slight changes in amplitude. With an AM broadcast, these changes result in static. With an FM broadcast, slight changes in amplitude don't matter -- since the audio signal is conveyed through changes in frequency, the FM receiver can just ignore changes in amplitude. The result: no static at all. /2.5marks**

Q15. Discus the difference between analog communication and digital communication.
1marks for each answer

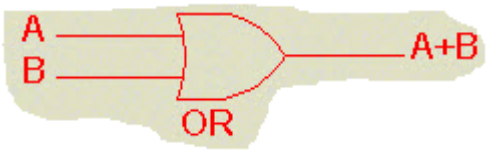
ANS:

Analog Communication	Digital Communication
Transmitted modulated signal is analog in nature.	Transmitted signal is digital i.e. train of digital pulses.
Amplitude, frequency or phase variations in the transmitted signal represent the information or message.	Amplitude, width or position of the transmitted pulses is constant. The message is transmitted in the form of code words.
Noise immunity is poor for AM, but improved for FM and PM.	Noise immunity is excellent.
It is not possible to separate out noise and signal. Therefore, repeaters cannot be used.	It is possible to separate signal from noise. Therefore, repeaters can be used.
Coding is not possible.	Coding techniques can be used to detect and correct the errors.
Bandwidth required is lower than that for the digital modulation method.	Due to higher bit rates, higher channel bandwidth is required.
FDM is used for multiplexing.	TDM is used for multiplexing.
Not suitable for transmission of secret information in military applications.	Due to coding techniques, it is suitable for military applications.
Analog modulation systems are AM, FM, PM, PAM, AWM, etc.	Digital modulation systems are PCM, DM, ADM, DPCM, etc.

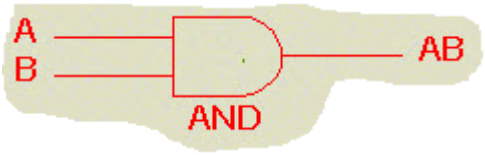
Q16. Draw the logical gates and truth table of the following: /**15marks**

ANS:

a) The or Gate

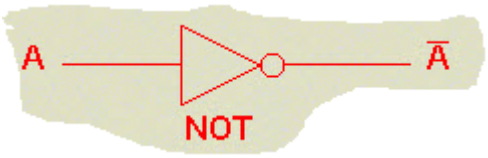


ANS: the AND Gate



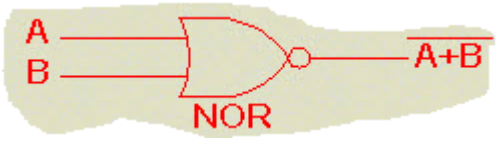
b) The NOT Gate

ANS:



c) The NOR Gate

ANS:



d) The NAND Gate

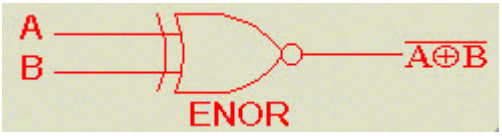
ANS:

e) The EXLUSIVE-OR Gate (EXOR), XOR

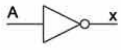
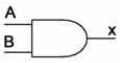
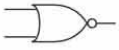
ANS: the XOR GATE

f) The EXLUSIVE-NOR Gate (EXNOR), XNOR

ANS:



Logic Gates

Name	NOT	AND	NAND	OR	NOR	XOR	XNOR
Alg. Expr.	$\overline{A}$	AB	$\overline{AB}$	$A+B$	$\overline{A+B}$	$A \oplus B$	$\overline{A \oplus B}$
Symbol							
Truth Table	A X 0 1 1 0	B A X 0 0 0 0 1 0 1 0 0 1 1 1	B A X 0 0 1 0 1 1 1 0 1 1 1 0	B A X 0 0 0 0 1 1 1 0 1 1 1 1	B A X 0 0 1 0 1 0 1 0 0 1 1 0	B A X 0 0 0 0 1 1 1 0 1 1 1 0	B A X 0 0 1 0 1 0 1 0 0 1 1 1

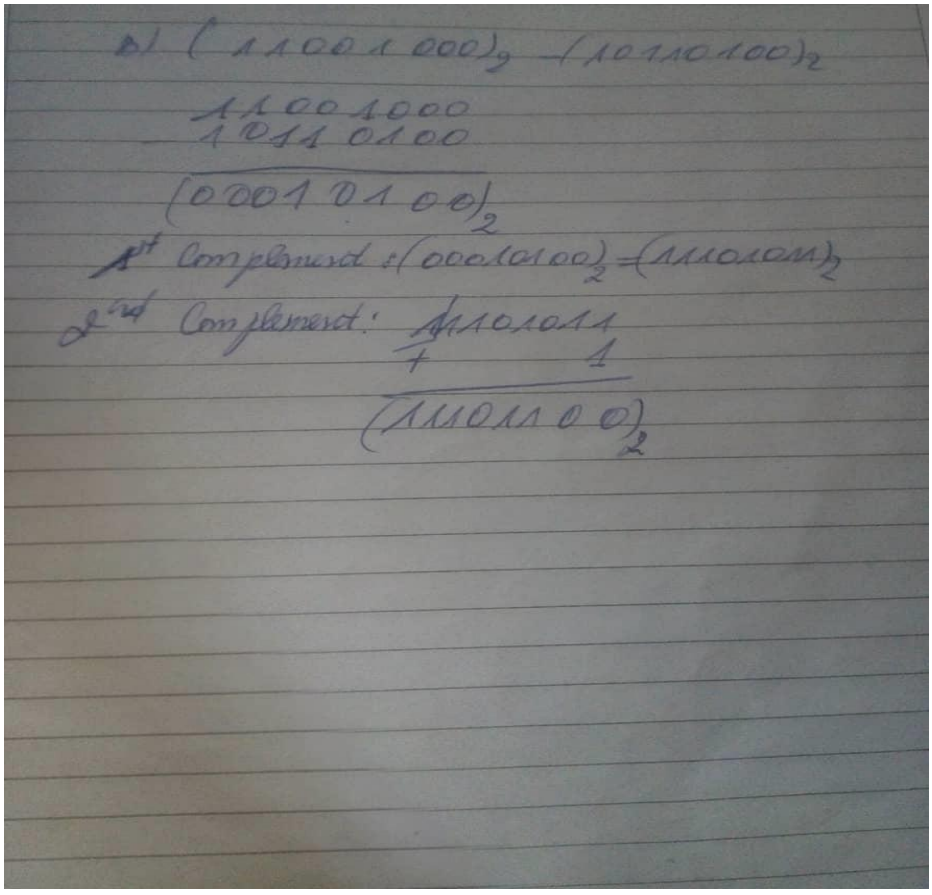
17. a) Give five examples of the circuits / system where only digital information is used. /**10 marks**

b) Using 2nd compliment method, perform the following binary operation $(11001000)_2$ _ $(10110100)_2$ **/5marks**

ANSWER: a)

1. **Decoder /2marks**
2. **Encoder /2marks**
3. **Multiplexer /2marks**
4. **DE multiplexer /2marks**
5. **Integrated circuit**

b) /**5MARKS**


d) $(11001000)_2 - (10110100)_2$
11001000
10110100
$(00010100)_2$
1st Complement: $(00010100)_2 = (11101011)_2$
2nd Complement: 11101011 + 1
$(11101100)_2$

Learning outcome 3.3: Apply multiplexing and de-multiplexing techniques

Duration: 10 hrs

Learning outcome 3.3 : objectives:

By the end of the learning outcome, the trainees will be able to:

1. Identify Multiplexing & De-multiplexing.
2. Describe multiplexing & De-multiplexing.
3. Apply multiplexing & De-multiplexing

Resources

Equipment	Tools	Materials
- Books - Hand-out notes - Digital and analog Multiplexers	- Simulator Software - Video aide	- Internet

Advance preparation:

.Prepare Digital and analog Multiplexers

Multiplexing and **Demultiplexing**. **Multiplexing** is the process in which multiple Data Streams, coming from different Sources, are combined and Transmitted over a Single Data Channel or Data Stream.

- **MULTIPLEXING TECHNIQUES**

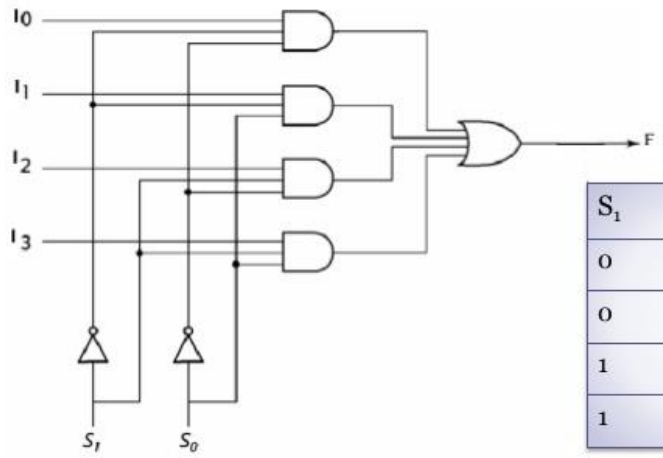
What Is multiplexing?

Multiplexing (Muxing) is a term used in the field of communications and computer networking. It generally refers to the process and technique of transmitting multiple analog or digital input signals or data streams over a single channel.

Multiplexing is the set of techniques that allows the simultaneous transmission of multiple signals across a single data link.

- In a multiplexed system, n lines share the bandwidth of one link.
- Multiplexer (MUX) combines the lines into single stream (many-to-one).
- At the receiving end, that stream is fed into demultiplexer (DEMUX), which separates the stream back into its components transmission (one-to-many)

4-to-1 Multiplexer

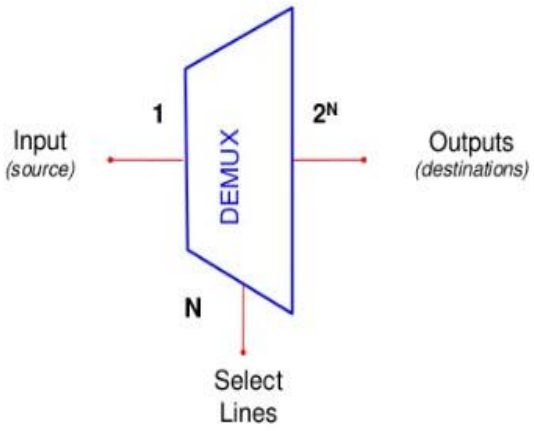


S_1	S_0	F
0	0	I0
0	1	I1
1	0	I2
1	1	I3

DEMULTIPLEXING TECHNIQUES

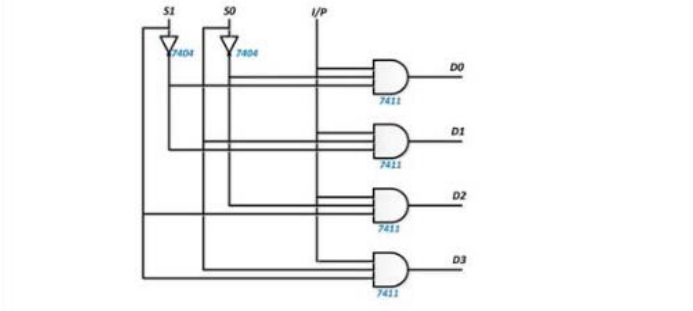
What Is De-multiplexing?

De-multiplexing (Demuxing) is a term relative to multiplexing. It is the reverse of the multiplexing process. De-multiplex is a process reconverting a signal containing multiple analog or digital signal streams back into the original separate and unrelated signals.



Input	Select Lines	Output Lines
I	S_1 S_0	D_0 D_1 D_2 D_3
I	0 0	1 0 0 0
I	0 1	0 1 0 0
I	1 0	0 0 1 0
I	1 1	0 0 0 1

DE-MULTIPLEXER



Bool Expression

Y3 = (((D * S1) * S0))

Y2 = (((D * S1) * ~S0))

Y1 = (((D * ~S1) * S0))

Y0 = (((D * ~S1) * ~S0))

Truth Table

S1	S0	D	Y3	Y2	Y1	Y0
0	0	0	0	0	0	0
0	0	1	0	0	0	1
0	1	0	0	0	0	0
0	1	1	0	0	1	0
1	0	0	0	0	0	0
1	0	1	0	1	0	0
1	1	0	0	0	0	0
1	1	1	1	0	0	0

- ✓ Frequency Division Multiplexing (FDM): Frequency Division Multiplexing (FDM) is a networking technique in which multiple data signals are combined for simultaneous transmission via a shared communication medium.
- ✓ Time Division Multiplexing (TDM):is a technique of multiplexing, where the users are allowed the total available bandwidth on time sharing basis
    - Synchronous vs. statistical: Difference Between Synchronous TDM and Statistical TDM. In Synchronous TDM data flow of each input connection is divided into units and each input occupies one output time slot. In Statistical TDM slots are allotted dynamically. i.e. input line is given slots in output frame if and only if it has data to send
- ✓ Wavelength Division Multiplexing (WDM):WDM is a technique in fiber optic transmission that enables the use of multiple light wavelengths (or colors) to

send data over the same medium. Two or more colors of light can travel on one fiber and several signals can be transmitted in an optical waveguide at differing wavelengths

- Wavelength Division Multiplexing increases fiber capacity by combining (mux) and separating (demux) multiple input channels over a single fiber output.
- In fiber-optic communications, wavelength-division multiplexing is a technology which multiplexes a number of optical carrier signals onto a single optical fiber by using different wavelengths of laser light

✓ Code Division Multiplexing (CDM): Code division multiplexing (CDM) is a networking technique in which multiple data signals are combined for simultaneous transmission over a common frequency band. When CDM is used to allow multiple users to share a single communications channel, the technology is called code division multiple access (CDMA).


Theoretical learning Activity

✓ Group discussion about Multiplexing and De-multiplexing techniques


Practical learning Activity

Demonstration by video/ picture


Points to Remember (Take home message)

✓ Frequency division multiplexing (FDM)
✓ Time division multiplexing (TDM) Synchronous vs. statistical
✓ Wavelength division.

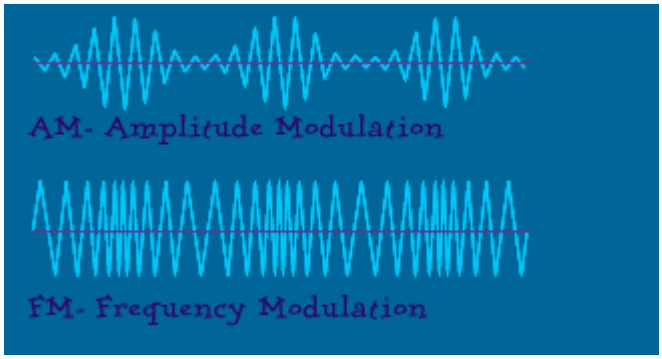
Learning outcome 1 formative assessment

Written assessment

. What is the difference between amplitude and frequency modulation?

ANS:

FM vs AM: What's the difference?



Q1. Choose the best answers. **/15MKS**

i. Which is called as on-off keying?
   a) Amplitude shift keying
   b) Uni-polar PAM
   c) Amplitude shift keying & Uni-polar PAM
   d) None of the mentioned

ii. QAM uses _____ as the dimensions.
   a) In phase
   b) Quadrature
   c) In phase & Quadrature
   d) None of the mentioned

iii. Which system uses QAM?
   a) Digital microwave relay
   b) Dial up modem
   c) Digital microwave relay & Dial up modem
   d) None of the mentioned

iv. Modulation is done in……
   a) Transmitter
   b) Radio receiver
   c) Between transmitter and receiver
   d) None of the above

v. In amplitude modulation, bandwidth is …… the audio signal frequency
   a) Thrice
   b) Four times

c) Twice
d) None of the above

vi. In amplitude modulation, the …… of carrier is varied according to the strength of the signal.
a) Amplitude
b) Frequency
c) Phase
d) None of the above

vii. Demodulation is done in ……
a) Receiving antenna
b) Transmitter
c) Radio receiver
d) Transmitting antenna

viii. In radio transmission, the medium of transmission is …….
a) Space
b) An antenna
c) Cable
d) None of the above

ix. In TV transmission, picture signal is …… modulated
a) Frequency
b) Phase
c) Amplitude
d) None of the above

x. The letters AVC stand for ……..
a) Audio voltage control
b) Abrupt voltage control
c) Automatic volume control
d) Automatic voltage control

xi. When the modulating signal controls the frequency of the carrier, we get…….
a) Phase modulation
b) Amplitude modulation
c) Frequency modulation
d) May be any one of the above

xii. The diode detector in an AM radio receiver is usually found …….
a) Before the first RF stage
b) After the first RF stage
c) After several stages of amplification
d) None of the above

xiii. In TV transmission, sound signal is …… modulated
a) Amplitude
b) Frequency
c) Phase
d) None of the above

xiv. In an AM wave, the majority of the power is in …….

a) Lower sideband
b) Upper sideband
c) Carrier
d) None of the above

xv. The Frequency range in Frequency Modulation is from:
a) 85khz-106khz
b) 88khz-107khz
c) 88MHZ-108MHZ
d) 88KHZ-108 KHZ
e) 535KHZ-1605KHZ

Practical assessment

Simplify the following question by using *Karnaugh map*/5MS

a. (1,2,4,6,7,8,9,A,C,D,F)/2MKS	b. (1,3,5,7,9,11,14,15,17,21,24,28.31) by using Overlay code /3MKS

FINAL SUMMATIVE ASSESSMENT OF TELECOMMUNICATION FUNDEMENTAL

INSTRUCTION:

This paper is composed of two(2) Sections as follow:

Section I: Attempt all the eight (8) questions

Section II: Attempt any six (6) questions out of eight (8)

Section I: Attempt all the eight (8) questions
40 marks

Q1. Match the following terms to the letter correspondingly /5mks

Column A	Column B	Column C
1⟶	1. Radio-frequency identification (RFID)	A. is a networking hardware device that allows other WiFi devices to connect to a wired network.
2⟶	2. A *radio communication system*	B. is a wireless technology standard for exchanging data over short distances using short-wavelength UHF (ultra-high frequency) radio waves

3⟶	3. Wireless access point	C. is uses electromagnetic fields to automatically identify and track tags attached to objects.
4⟶	4. Bluetooth	D. is a special computer designed for technical or scientific applications.
5⟶	5. A workstation	E. is sends signals by radio.

Q2. TRUE or FALSE /5mks

A. **Telecommunication** is the transmission of signs, signals, messages, words, writings, images and sounds or information of any nature by wire, radio, optical or electromagnetic systems.

B. A telephone, or phone, is a telecommunications device that permits two or more users to conduct a conversation when they aren't too far apart to be heard directly.

C. *Televisions* receive broadcasting signals and turn them into pictures and sound.

D. A modem is modulator–demodulator that can perform both operations.

E. A network interface controller is a computer hardware component that connects a computer to a computer network

Q3. Simplify the following question by using *Karnaugh map*/5MS

c. (1,2,4,6,7,8,9,A,C,D,F)/2MKS	d. (1,3,5,7,9,11,14,15,17,21,24,28.31) by using Overlay code /3MKS

Q4. Match the following terms to the letter correspondingly **/5mks**

Column A	Column B	Column C
1⟶	1. **OOK modulation** (On/Off Key)	A. is the electrical **conductor** in many categories of electrical **wiring**.
2⟶	2. *Optical modulation*	B. refers to the process of transferring an **analog** baseband (low frequency) signal, like an audio or TV signal over a higher frequency signal such as a radio frequency band.
3⟶	3. **Digital Modulation**	C. is a generic name for **modulation** techniques that uses discrete signals to modulate a carrier wave.
4⟶	4. **Analog modulation**	D. allows one to control an optical wave or to encode information on a carrier optical
5⟶	5. **Copper**	E. is the special case of ASK (Amplitude Shift Key) **modulation** where no carrier is present during the transmission of a zero.

Q5. Mention and explain briefly the different ways of transmission electronic signals for an effective communication process. **/5mks**

Answer:

Q6. a) What is a communication channel? **/1mks**

Answer:

b) Differentiate a receiver from a transmitter. **/4mks**

Answer:

Q7. a) What does MODEM stand for? **/2mks**

b) Give the relationship between cable modem and DSL modem. **/3mks**

Answer:

Q8. a) What does GPS stand for? **/1mks :**

b) Mention the uses of GPS and Explain why we need the network of 24 satellites in GPS communication. **/4mks**

Answer:

Section II: Attempt any six (6) questions out of eight (8) 60 marks

1. a) Differentiate Amplitude Modulation from Frequency Modulation techniques. **/8mks**

   Answer:

   b) Mention the range of operating frequencies for each of the above techniques in (a). **/2mks**

   Answer:

2. Convert the following expressions from the given bases to the recommended ones: $(1111100011)_2 = (?)_8 = (?)_{16} = (?)_{10} = (?)_{BCD}$ **/10mks**

   Answer:

3. a) Mention and explain the three (3) types of telecommunications. **/6mks**

   Answer:

   b) Mention any four (4) telecommunication applications. **/4mks**

   Answer:

4. a) Explain the acronym "PSTN" **/2mks**

   b) How does PSTN function? **/8mks**

   Answer:

5. Using truth tables, explain in detail how the following logic gates function: **/10mks**
   a) NOT gate
   b) AND gate
   c) OR gate

d) NAND gate
e) NOR gate

6. a) Explain the following digital modulation techniques **/6mks**
   i. FSK:
   ii. ASK:
   iii. PSK:

   b) Give at least two types of: **/4mks**

   i. Twisted pair cables:
   ii. Coaxial cables:

7. a) What is communication satellite? **/2mks**

   b) Mention the two (2) types of communication satellite. **/2mks**
   c) Give and explain any three (3) network control devices used in telecommunications system. **/6mks**

8. a) Give four (4) examples of the circuits/systems where only digital information is used. **/4mks**

   b) Using 2nd compliment method, perform the following binary operation: $(110001000)_2$-$(10110100)_2$ **/6mks**

   Answer:

Reference books:

1. T. S. Rappaport, Wireless Communications: Principles and Practice, 2nd ed.Singapore: Pearson Education, Inc., 2002.
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5. Tony Wakefield, Dave McNally, David Bowler, Alan Mayne, Introduction to mobile communications, AuerbachPublicationsTaylor& Francis Group; (2007).
6. Krzysztof Wesolowski, “Mobile Communication Systems”, John Wiley & Sons, Ltd; 4th edition 2002.
7. Jochen H. Schiller, Mobile Communications, Second Edition, Pearson Education Limited 2003