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**Department of Information and Communication Technology**

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**Course Title: Telecommunication Engineering**

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Assignment Name: Question and Answer on Unit 4 & Lecture 1,2.

Assignment No: 02

1. a) What is CCITT? Show telephone number structure? 4
- b) Draw the diagram of telecommunication including mobile, optical fibers cable, Satellite main switch centers? 6
- c) What are main types of signaling techniques? Show signaling technique division? 4

2. a) Define common channel signaling? Draw the diagrams of common channel signaling?
- b) What is PBX? What are the part of PBX? why we use it?

- c) Define subscriber loop system? Draw a figure of subscriber loop system?

3. a) How many telecommunication network basic topologies are there? Draw associated figure? Advantage and disadvantages? 6

- b) Compare between Satellite and Terrestrial communication? 5.

- c) Define Ensing and CCS? What are the relation between them? 4

and 4. a) Discuss about cellular mobile telephony? 2  
b) write short note on (i) 3G (ii) LTE (iii) 4G 2

5. a) what are the difference between, in-channel  
and common channel signaling? 6

b) what is cell? Write importance of DIR  
in cell geometry? 4

c) Draw cellular structure? 4

6. a) what is switch telephone networks (PSTN)?  
What are the telecommunication networks may  
be viewed as consisting of the following  
major system? 5

b) Small scale fading figure and explain? Advantages  
of Raming? 4

7. a) What is GSM? Why we use GSM? 5

b) Describe Call initiation?  
c) Why is sampling necessary? What are the  
problems in sampling? 4

8. a) Write short note on antenna and duty cycle  
b) Briefly describe the different parameters of antenna?  
c) Draw the block diagram of a PDM system?

Answer to the Question No: 1(a)

CCITT: Consultative Committee on International Telephone and Telegraph.

Now known as the ITU - International Telecommunications Union. The primary international body for developing co-operative standards for telecommunications equipment and systems.

Telephone number structure.

Country Code	National Number
1-3 digits	9-11 digits max
← 12 digit maximum →	

International telephone number.

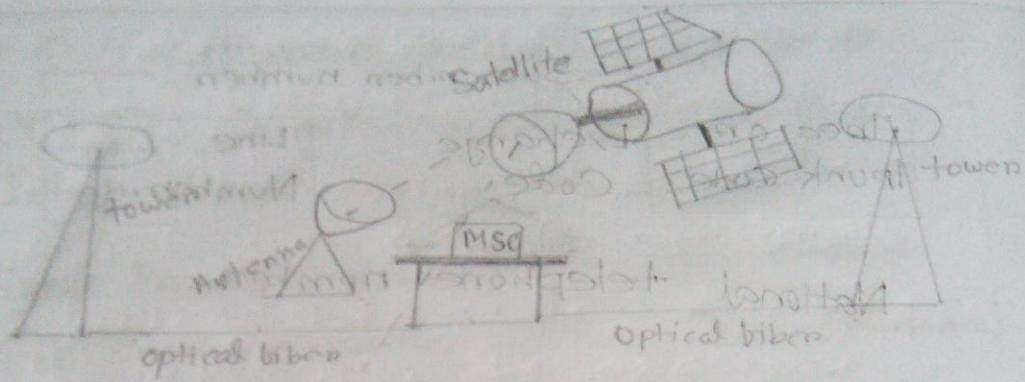
Subscribers number		
Area or trunk Code	Exchange Code	Line Number.

National telephone number.

### Answers to the Question No-1 (b)

Telecommunication: Telecommunication is the transmission of information by various types of technologies over wire, radio, optical or other electromagnetic system.

In the early day telecommunication used wire connection. That was region level, on national level. To convert it into international satellite then optical fiber system make a great contribution.



WLL architecture ext of coverage

Telecommunications: wireless  
for minimising distance between  
satellite and antenna to minimise latency  
of signal set to avoid channel  
disagreements or degradation of quality of service  
; latency

It is a local area network which consists of  
multiple nodes connected to a central node  
at various OT level towers or level  
towers next to hilltops & mountainous  
areas (infra) steps or some mountain

Answer to the Question No-1(c)

Signaling Techniques: Signaling is the exchange of information between involved points in the network that sets up controls, and terminates each telephone call.

Signaling techniques enable the circuit to function as a whole by interconnecting all varieties of switching system.

There are two main types of Signaling techniques:

1. In-Channel Signaling: In-Channel Signaling is also known as per-Trunk Signaling. This uses the same channel which carries users voice or data to pass control signals related to that call or connection. No additional transmission facilities are needed.

## 2. Common Channel Signaling:

Common Channel Signaling uses a separate channel for passing control signals for a group of trunks on information path. This signaling uses the speech or the data path for signalling.

Division of signaling techniques.

### Signalling

In-Channel	out Channel
D.C.	PCM
Low frequency	Associated Non-associated
voice frequency	band
	In-band Out-band

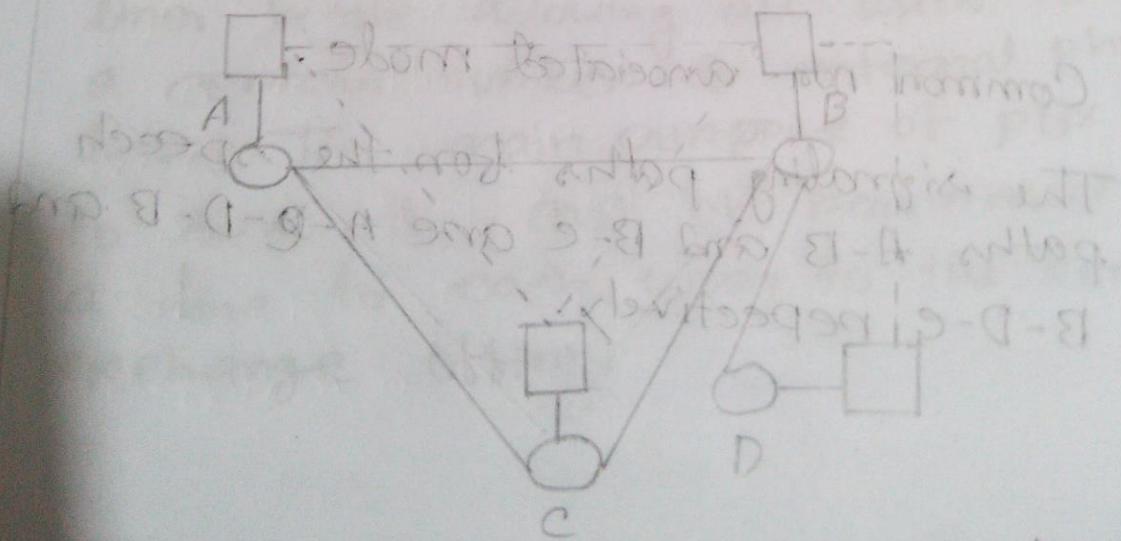
Answer to the Question No-2(a)

Common channel signaling: In telecommunication Common channel signaling or Common channel interface signaling, is the transmission of control information via a separate channel than that used for the message.

The signaling channel usually controls multiple message channel.

Common channel signaling implemented in two mode:

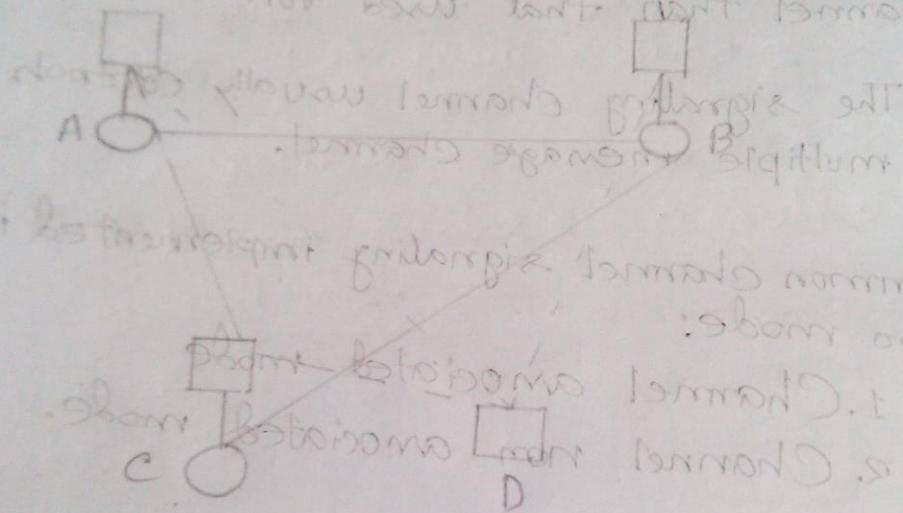
1. Channel associated mode
2. Channel non-associated mode.



Associated mode of common channel signaling.

The signaling path for the speech paths A-B, A-CB and B-D are A-B, A-e-B and B-D respectively.

• Prevent ent nod bow last right



Common non-associated mode.

The signaling paths for the speech paths A-B and B-e are A-D-B and B-D-e respectively.

Answer to the Question No- 2(b)

Private Branch Exchange (PBX): PBX or private branch exchange within an office or a building, in order to communicate within themselves.

It is a private exchange, which is a branch to the main exchange similar to a local loop connected to the main loop as a branch.

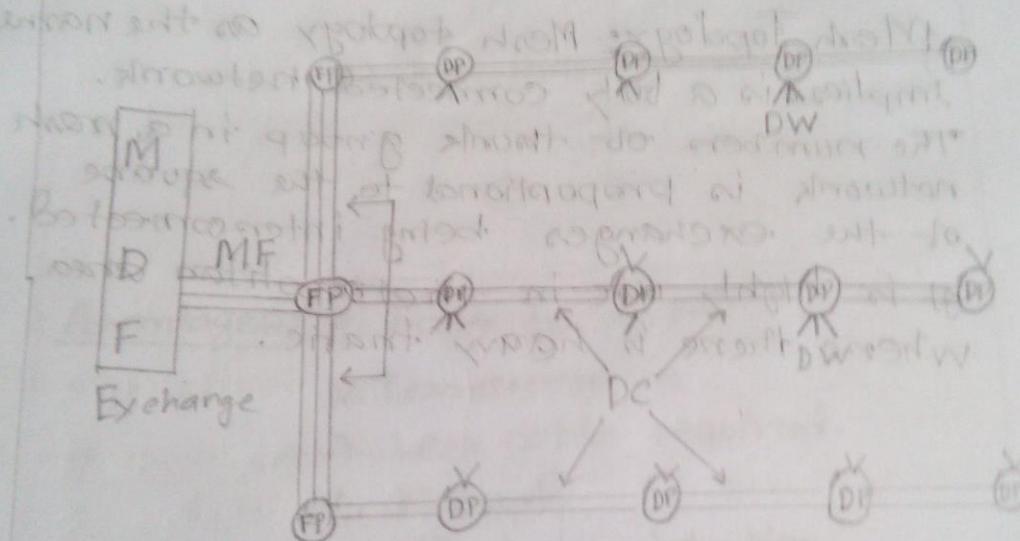
Private Branch Exchange is a telephone system within a local area that switches calls between those users on local lines while allowing all users to share a certain number of external phone lines. The main purpose of PBX is to save the cost of requirement for a line to each user to the central exchange office.

## The parts of a PBX

1. A telephone trunk that contains many lines which are terminated at PBX.
2. A computer that handles the incoming and outgoing calls of PBX along with switching between lines within the PBX.
3. The network of lines within the PBX.
4. A human operator console which is optional.

### Answer to the Question No= 2(e)

Subscriber Loop System: In a general telephone network, every subscriber has two dedicated lines connecting to the nearest switching exchange, which are called the loop lines of that subscriber.



MDF = main distribution frame DW = Drop wires

DP = Distribution point

DC = Distribution cable

MF = main feeder

BF = Branch feeder

FP = feeders point

Answer to the Question No- 3(a)

There are three basic topologies  
and they are:  
1. Mesh topology  
2. Star topology  
3. Hierarchical topology

Mesh Topology: Mesh topology as the name implies, is a fully connected network. The number of links in a mesh network is proportional to the square of the exchanges being interconnected. It is highly used in metropolitan area where there is heavy traffic.

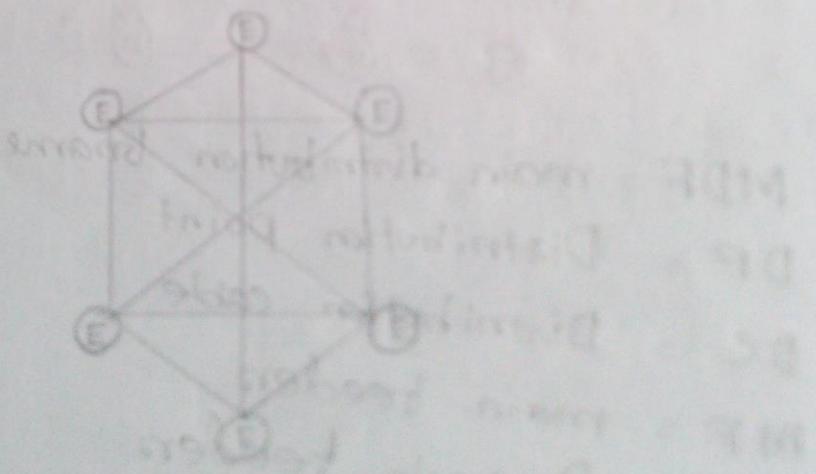
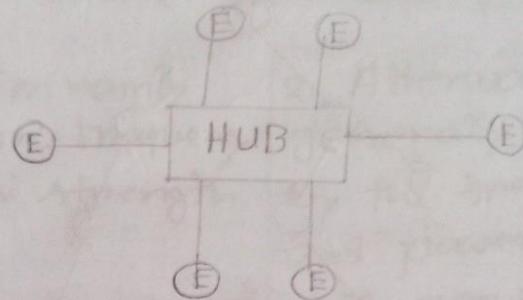


Fig: Mesh topology

Star topology: Star topology is connected in the shape of a star, which utilizes an intermediate exchange called a tandem exchange through which all others exchanges communicated.



Advantages: 1. Easy to install

2. Less expensive

3. Less cable required.

4. Robust

5. Early fault detection.

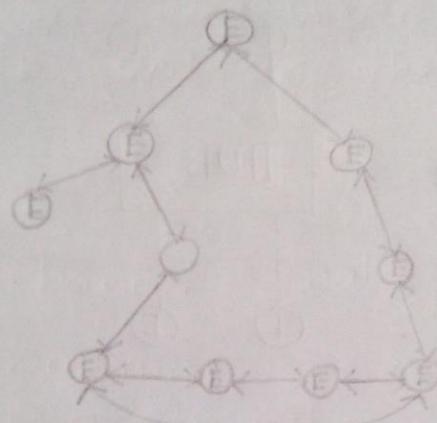
Disadvantages:

1. If hub down everything goes down.

2. More resources require.

3. Regular maintenance.

Hierarchical topology: A hierarchical network is a network with an additional networking device connected to the main networking device. Larger networks such as those of corporations or universities use it.



Matrix of cost of communication

Advantages:

1. No overflow traffic permitted.
2. Interactivity between any pair of exchanges is high.
3. Clear understanding of employee nodes.

Disadvantages:

1. Slow down decision making.
2. Delays in communication.

### Answer to the Question No-3(b)

Difference between or compare between satellite, and terrestrials communication.

#### Terrestrial Communication      Satellite Communication

- |   |   |
|---|---|
| 1. The frequency range<br>• 4 GHz to 6 GHz                                | 1. The frequency<br>range 11 GHz to 14 GHz                                |
| 2. Attenuation mainly<br>depends on frequency<br>and signal strength      | 2. Attenuation is<br>generally affected<br>by the frequency<br>and power. |
| 3. It requires bended<br>signals and line<br>of sight as physical<br>path | 3. It requires the<br>proper alignment<br>of earth station<br>antennas.   |
| 4. Relay towers are<br>used to extend the<br>signals                      | 4. Satellite are used<br>for the expansion<br>of signals.                 |
| 5. Short distance<br>system can be<br>in expensive                        | 5. Very expensive<br>for any distance.                                    |

Answer to the Question No-3(c)

Erlang: Erlang is the fundamental unit of telecommunication traffic used by voice system designers. The three resources on our web site and the software we often use are based around this unit and the teletraffic theory.

Common channel signaling (CCS): CCS is the transmission of control information via a separate channel than that used for the messages.

The relation between Erlang and CCS is 1 Erlang equal 36 CCS.

Answers to the Question No 4 (a)

Cellular Telephony: Cellular telephones or simply cell phones, are portable devices that may be used in motor vehicles or by pedestrians. Communicating by radio waves, they permit a significant degree of mobility within a defined serving region that may range in area from a few city blocks to hundreds of square kilometers.

### Development of Cellular System

In the United States, interconnection of mobile transmitters and receivers with the public switched telephone network began in 1946, with the introduction of mobile telephone service by the American Telephone & Telegraph Company.

Each base station antenna had to be located on a tall structure and had to transmit at high powers in order to provide coverage throughout the located on a tall structure and had to transmit entire service area.

Because in the IMTS system were motor - vehicle - based instruments that carried large storage, batteries,

### Airborne Cellular Systems

In addition to the terrestrial cellular phone system described above within decade the system was installed in more than 1700 aircraft with ground stations in the United States providing coverage over most of the United States and southern Canada.

### Satellite Based Telephone:

The inmarsat satellites are geostationary, remaining approximately 35,000 km above a single location on earth surface. Because of this high altitude, on Earth - based communication transceivers required high transmitting power, large communication on both in order to communicate with the satellite.

LEO satellite are not geostationary and therefore cannot provide constant coverage over specific areas on Earth. Nevertheless, by allowing radio communication with a mobile instrument to be handed off between..

Answer to the Question No: 4 (b)

Third Generation (3G): 3G, short for third generation, is the third generation of wireless mobile telecommunication technology. It is upgrade from 2G, and 2.5G GPRS network. 3G fasten internet speed. This is based on a set of standards used for mobile devices and mobile telecommunication service and networks that comply with the international mobile telecommunication specification by the International Telecommunication Union. 3G binds application in wireless voice telephone, mobile internet access, fixed wireless internet access, video call and mobile TV.

Long Term Evolution: LTE stands for Long term evolution and it was started as a project in 2004 by telecommunication body known as the third generation partnership project. System Architecture Evolution is the corresponding evolution of the GPRS core network evolution.

The term LTE is typically used to represent both LTE and SAE.

All LTE devices have to support multiple input and multiple output transmission which allow the base station to transmit several data streams over the same carrier simultaneously.

Works with GSM/EDGE/UMTS system existing 2G and 3G spectrum and new spectrum, supports handovers and roaming to existing mobile networks.

Fourth Generation (4G) : Fourth generation is the abbreviation of the fourth generation of cellular communication. The standard for 4G is set by the radio sector of the International Telecommunication Union, known as International Mobile Telecommunication Advanced.

An IMT-Advanced cellular system is expected to securely provide mobile service users with bandwidth higher than 100 Mbps, enough to support high quality streaming multimedia content. Existing 3G technologies often branded as pre-4G fall short of this bandwidth requirement. The majority of implementation brands as 4G do not comply with the full standard.

### Answers to the Question No-B(3)

Difference between in-channel and common channel signaling.

#### IN-Channel Signaling

1. Trunks are held up during signaling.
2. Interface between voice and control signal may occur.
3. Signalling is relatively slow.
4. It is difficult to change signal on add new signal.
5. Circuit continuity is assured when signal needed.

#### Common Channel Signaling

1. Trunks are not required.
2. Control channel is inaccessible to user.
3. Signal is much faster.
4. Flexible to change on add new signal.
5. Started or speech circuit not automatically assured.

### Answer to the Question No-5(b)

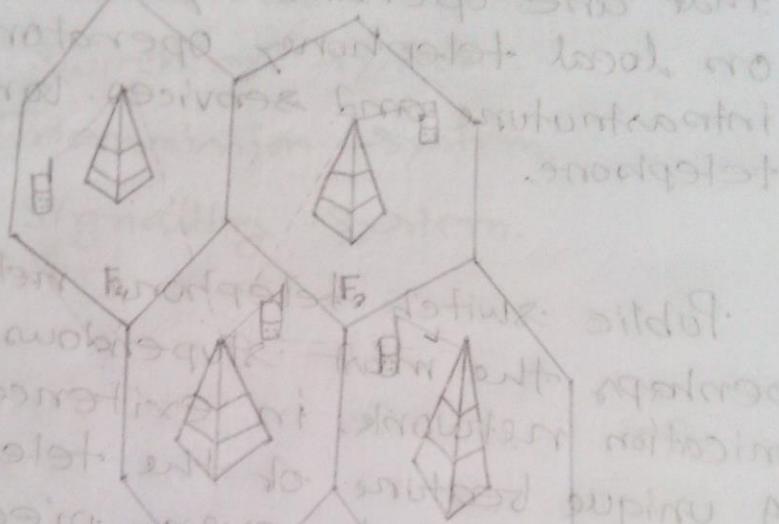
Cell: A cell is the geographic area that is covered by a single base station in a cellular network.

### Importance of D/R

- \* Detecting the distance.
- \* Give the area.
- \* Manufacturing of every piece of subscribers terminal within a region with the same set of channels.
- \* High value of D/R means less interference.
- \* Lower value of D/R means high interference.

Answer the Question No. 5(e)

Figure of a cellular system



at show when  $F_1$  and  $F_2$  are  
missed. work is done by  $F_1$  and  $F_2$ .  
robot moves from point  $E$  to point  $F$ .  
So.  $F_1$  does work.  $F_2$  does no work.  
work done by  $F_1$  is  $W_1 = F_1 \cdot d_1$   
and work done by  $F_2$  is  $W_2 = F_2 \cdot d_2$   
so total work done by both is  $W = W_1 + W_2$   
or  $W = F_1 \cdot d_1 + F_2 \cdot d_2$

Answer to the Question No-6(a)

PSTN: The public switch telephone network is the aggregate of the world circuit-switched telephone networks that are operated by national regional or local telephone operators providing infrastructure and services for public telephone.

Public switch telephone networks is perhaps the most stupendous telecommunication network, in existence today. A unique feature of the telephone networks is that every piece of equipment, technique or procedure which has evolved in the last 100 years from a number of different giant corporations, is capable of working with each other.

Any telecommunication network may be viewed as consisting of the following major systems:

1. Subscribers end instruments
2. Subscribers loop system
3. Switching system.
4. Transmission system.
5. Signalling system.

Answer to the Question No-6(b)

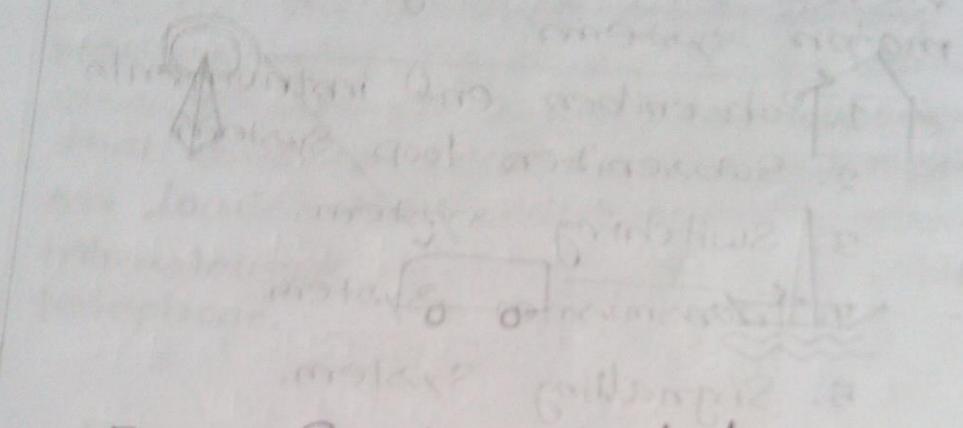


Figure: Small scale fading

- \* The signal may take different paths to the mobile customer.
- \* Reflections off moving objects cause a shift in frequency in the signal. Each path arriving at the mobile a various amplitudes and phase.
- \* Some paths arrive at the mobile at the same time. Other paths arrive much later due to a longer distance traveled.

Answer to the Question No-6(c)

Network Registration: Registration is the process of notifying the network that a phone is active on the system.

When a phone is switched on, it registers by signaling to the MSC via the base station on a set-up or control channel.

There are also some registration systems.

Periodic registration: Periodic registration is when the phone announces itself on a regular basis.

Forced Registration: Forced registration is when the phone monitors a control channel which provides information including the cell identification.

Roaming: Roaming is when a phone is outside its home area or local region.

- If the phone registers outside its home area, MSC contacts the phone's home area and confirms that the phone is OK.
- MSC then notifies home area of the phone's current location and provides instructions for routing incoming calls to the phone.

Answer to the Question No- 7(a)

### GSM Group Special Mobile (GSM):

- \* Originally, Groupe Special mobile until 1992, Then Global system for mobile communication
- \* European digital standard later brought to Canada by Microcell and later Rogem.
- \* In Europe, usually used in 800/900 MHz band.
- \* TDMA System, that 'hops' from one frequency channel to the next to avoid being in frequency selective fade for a long period of time.

We need GSM, because

- \* Improve spectrum efficiency.
- \* International roaming.
- \* Low cost mobile set.
- \* Base station.
- \* High quality speech.
- \* Support for new service.

Answer to question No- 7(b)

Call initiated from PSTN

- MSC receives call from PSTN
- sends requested MIN to all BS.
- BS transmits page to user.
- Mobile receives and confirms MIN match with electronic serial numbers.
- BS relay info to MSC.

- MSC verifies ESN/MIN pair.
- MSC tell BS to select used voice channel pair. BS selects voice channel pair and info to mobile to move to those channels.
- MSC connects with PSTN to begin call.

Call initiated from mobile.

- Mobile sends MIN and ESN
- BS passes to MSC
- MSC verifies ESN and MIN pair
- MSC tell BS to select used voice channel pair.
- BS selects voice channel pair. pages mobile and informs to moves to those channels.
- Mobile receives page verifies MIN and moves to specified channels.
- MSC connects PSTN with mobile (through BS)

Answer to the Question No. 7(c)

Sampling: The process of measuring the instantaneous values of continuous time signal in a discrete form.

Sampling is necessary, because

to convert the signal from continuous time to discrete time a process called sampling is used. The value of the signal is measured at certain interval in time.

If the signal contains high frequency component, we will need to sample at a higher rate to avoid losing information that is in the signal.

## Problems of Sampling

- \* Sampling Errors
- \* Lack of Sample representativeness
- \* Difficulty in estimation of sample size.
- \* Lack of knowledge about the sampling process.
- \* Lack of Resources.
- \* Lack of co-operation.
- \* Lack of existing appropriate sampling frames for large population.

### Answer to the Question - 8(a)

Antenna: An antenna is a transducer which converts electrical power into electromagnetic waves and vice versa. Antenna can also be termed as an Aerial. Plural of it is antenna or antennas. Now-a-days antennas have undergone many changes. In according with their size and shape.

In the field of communication systems, whenever the need for wireless communication arises, there occurs the necessity of an antenna.

An antenna has the capability of sending or receiving the electromagnetic waves for the sake of communication.

## Some common types of antenna.

- \* Wine Antenna
- \* Log periodic Antenna
- \* Aperture Antenna
- \* Microstrip Antenna
- \* Reflectors Antenna
- \* Lens Antenna
- \* Travelling Antenna
- \* Array Antenna.

Antenna polarization refers to the physical orientation of the electromagnetic wave radiated in a given direction. Polarization of an EM wave is a time varying direction and relative magnitude of the field vector.

### Answers to the Question No - 8(b)

Parameters of antenna

Radiation Patterns: A practical antenna cannot radiate energy in all directions with equal strength.

Radiation Intensity: The radiation intensity of an antenna is the power unit solid angle  $\Omega$  is represented by  $I$  and is independent of distance from the antenna.

Direction and Gating: Gating an antenna which radiates energy in all direction equally.

$$P_{\text{ang}} = P_{\text{rad}} \cdot \Omega \text{ or } \text{W/m}^2$$

## Radiation Efficiency and power Gain

All practical antenna will have ohmic losses as they are made up of conducting materials with finite conductivity.

$$\eta_r = P_{rad} / P_{in}$$

Input Impedance: we should take care to match the input impedance of the antenna to that of the input transmission line.

Effective length: The length of an imaginary linear antenna with uniform distributed current defined as the effective length of an antenna.

of an antenna given with a

Bandwidth: The bandwidth of antenna is defined as the range of frequencies over which the characteristic of the antenna are maintained to the specified value.

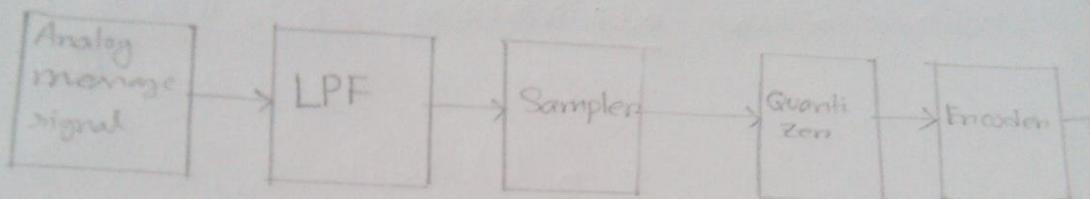
Effective Aperture: Generally

the term effective aperture or effective area is associated with the receiving antenna.

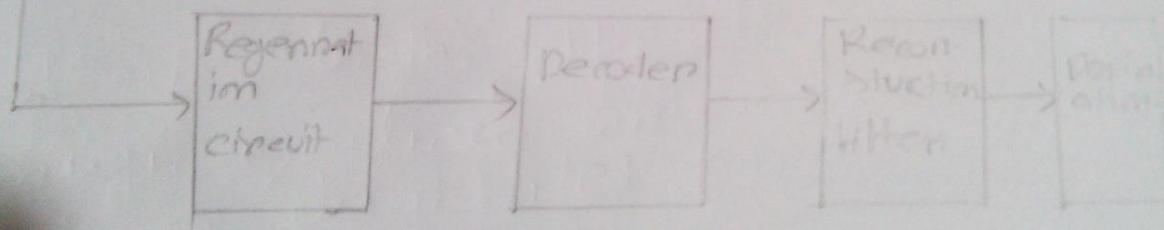
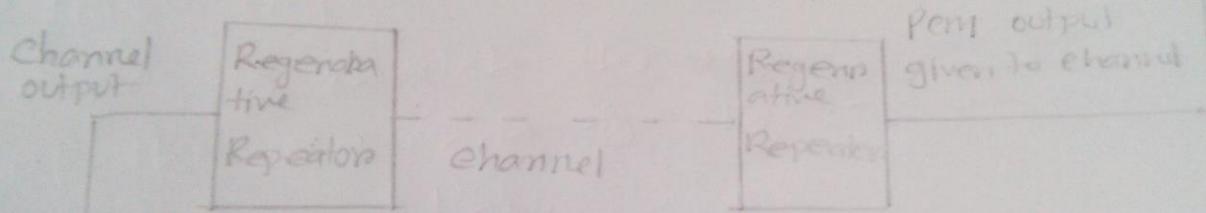
Antenna polarization: The antenna polarization refers to the physical orientation of the electromagnetic wave radiated in a given direction. Polarization of an EM wave is a time varying direction and relative magnitude of the electric field vector.

Answer to the Question No-8 (e)

Block diagram of PCM.



Transmitter Section



Receiver Section