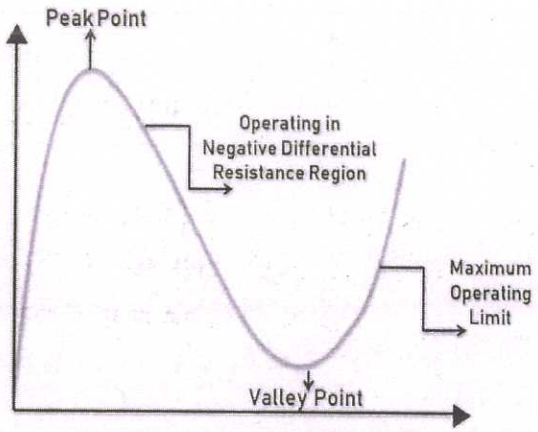
SCHEME OF VALUATION
Scoring Indicators

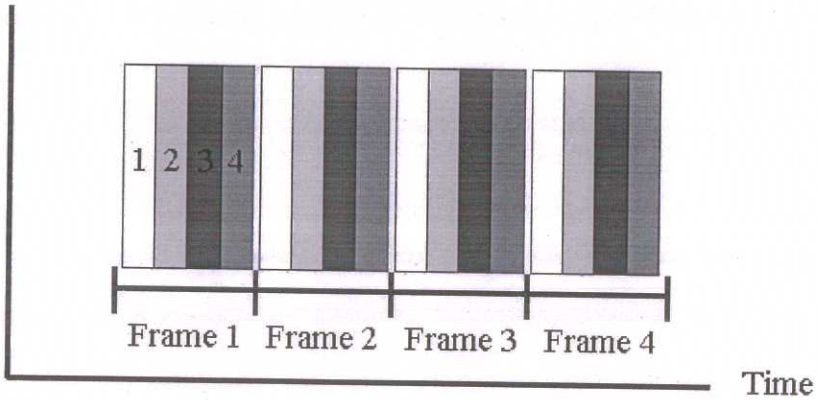
Revision: TED (15) | Course Code:6042

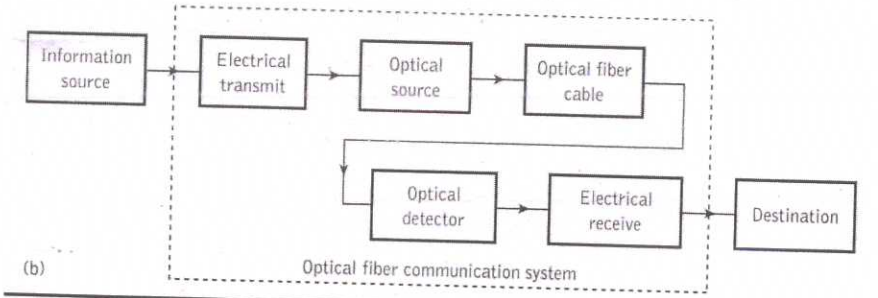
Course Title: COMMUNICATION SYSTEMS

Qn. No.	Scoring Indicators	Split up Score	Sub Total	Total
	PART A			
I.1	**Transit time** is basically **time** taken for movement or transition of electron from one electrode to another is known **transit time**. and the **effect** which is caused due to **transit time** is known as **transit time effect** For low frequencies transit time is negligible, but for high frequencies (microwave frequencies) it is comparable with the time period of signal. Simple words more the transit time. More will be the time taken by the device to give output for a given input. This results in fall in gain.	2	2	10
I. 2	Geosynchronous satellites orbit Earth above the equator with the same angular velocity as Earth.	2	2	
I. 3	LED, LASER	2	2	
I. 4	A high capacity land mobile system in which available frequency spectrum is partitioned into discrete channels which are assigned in groups to geographic cells covering a cellular **Geographic Service Area (GSA).** The discrete channels are capable of being reused in different cells within the service area. It is in the shape of hexogen	2	2	
I. 5	current  Characteristics of Gunn Diode voltage	2	2	

PART B

II. 1	**TWT**	**Klystron**	3*2	6	6
	1. The interaction of electron beam and RF field in the TWT is continuous over the entire length of the circuit.	2. The interaction occur only at the gaps of few resonant cavities			
	2. The wave in TWT is a propagating wave	2.The wave in klystron is not propagating wave			
	3.In the coupled-cavity TWT there is a coupling effect between the cavities.	3. Whereas each cavity in Klystron operates independently.			
II. 2	• TDMA: Time Division Multiple Access. • *TDMA is digital transmission technology that allows a number of users to access a single radio frequency channel without interference by allocating unique time slots to each user.* • Each user is allowed to transmit only within specified time intervals (Time slots). Different users transmit in different Time slots. • When user transmits, they occupy the whole frequency bandwidth. • TDMA divides each cellular channel into three time slots in order to increase the amount of data that can be carried. • In TDMA audio signals has been digitized divided into a number of milliseconds long packets. It allocates a single frequency channel for a short time and then moves to another channel.		6*1	6	6

	Frequency  			
II. 3	**1. Weather Forecasting:** Certain satellites are specifically designed to monitor the climatic conditions of earth. They continuously monitor the assigned areas of earth and predict the weather conditions of that region. This is done by taking images of earth from the satellite. These images are transferred using assigned radio frequency to the earth station. These satellites are exceptionally useful in predicting disasters like hurricanes, and monitor the changes in the Earth's vegetation, sea state, ocean color, and ice fields **2. Radio and TV Broadcast**: These dedicated satellites are responsible for making 100s of channels across the globe available for everyone. They are also responsible for broadcasting live matches, news, world -wide radio services. These satellites require a 30-40 cm sized dish to make these channels available globally. **3. Military Satellites:** These satellites are often used for gathering communications satellite used for military purposes, or as a military weapon. **4. Navigation Satellites**: The system allows for precise localization world-wide, and with some additional techniques, the precision is in the range of some meters. Ships and aircraft rely on GPS as an addition to traditional navigation systems. Many vehicles come with installed GPS receivers. **5. Global Telephone:** One of the first applications of satellites for communication was the establishment of international telephone backbones. Instead of using cables it was sometimes faster to launch a new satellite But, fibre optic cables are still replacing satellite communication across long distance as in fibre optic cable; light is used instead of radio	6*1	6	6

	frequency, hence making the communication much faster **6. Connecting Remote Areas:** Due to their geographical location many places all over the world do not have direct wired connection to the telephone network or the internet (e.g., researchers on Antarctica) .Here the satellite provides a complete coverage. **7. Global Mobile Communication:** The basic purpose of satellites for mobile communication is to extend the area of coverage. Cellular phone systems, such GSM (and their successors) do not cover all parts of a country. Areas that are not covered usually have low population where it is too expensive to install a base station. With the integration of satellite communication, however, the mobile phone can switch to satellites offering world-wide connectivity to a customer. Satellites cover a certain area on the earth. This area is termed as a footprint of that satellite. Within the footprint, communication with that satellite is possible for mobile users. (Any six points)			
II. 4	 • **Information source** - provides an electrical signal to a transmitter which drives an optical source to give modulation of the light wave carrier. • **optical source** - The optical source which provides the electrical–optical conversion may be either a semiconductor laser or light-emitting diode (LED) • **transmission medium** - optical fibre cable • **Receiver** - consists of an optical detector which drives a further electrical stage and hence provides demodulation of the optical carrier. Example: Photodiodes (p-n, p-i-n or avalanche) and, in some instances, phototransistors and photoconductors are utilized for the detection of the optical signal and the optical–electrical conversion. Optical carrier may be modulated using either analog or digital information	3+3 Figure carry 3 marks	6	6

II. 5	**1. Enormous potential bandwidth** • The optical carrier frequency in the range 10^{13} to 10^{16} Hz yields a far greater potential transmission bandwidth than metallic cable systems (i.e. coaxial cable bandwidth typically around 20 MHz over distances up to a maximum of 10 km). • By the year 2000, the typical bandwidth-length product for : 1) Optical fibre link - 5000 GHz km 2) coaxial cable - 100 MHz km. • Enhanced bandwidth utilization for an optical fibre can be achieved by **WDM** (wavelength division multiplexing) **2. Small size and weight** • Have very small diameters • Much lighter than corresponding copper cables • Useful in aircrafts, satellites and ships. **3. Electrical isolation** • Since optical fibres are fabricated from glass or plastic polymer, they are electrical insulators. • Do not exhibit earth loop • Ideally suited for communication in electrically hazardous environments as the fibres create no arcing or spark hazard. **4. Immunity to interference and crosstalk.** • Optical fibres are a dielectric waveguide - free from electromagnetic interference (EMI), radio-frequency interference (RFI) or switching transients giving electromagnetic pulses (EMPs). • unaffected by transmission through an electrically noisy environment • requires no shielding from EMI • not susceptible to lightning strikes • no crosstalk **5. Signal security** • Light from optical fibres does not radiate significantly • Any attempt to acquire a message signal transmitted may be detected • Useful for military, banking and general data transmission **6. Low transmission loss** • Losses as low as 0.15 dB km^{-1} • Extremely wide optical repeater or amplifier spacing's - This reduces	6*1	6	6

	both system cost and complexity **7. Ruggedness and flexibility** • May be manufactured with very high tensile strengths. • May also be bent to quite small radii or twisted without damage **8. System reliability and ease of maintenance** • Low-loss property of optical fibre cables which reduces the requirement for intermediate repeaters. Predicted lifetimes optical components is about 20 to 30 years (any 6 points)					
II. 6	Attribute	3G	4G	6*1	6	6
	Network Architecture	Wide area cell based	Hybrid-integration of wireless lan (WIFI), Bluetooth wid area			
	Frequency band	1.8 – 2.5 GHz	2 – 8 GHz			
	Peak Download Rate	100Mbps	1Gbps			
	Peak upload rate	5Mps	500Mps			
	Access	WCGMA/CDMA2000	MC-CDMA or OFDM			
	Switching	Packet Switching	Packet Switching, message Swicthing			
	Operational	2003	2010			
II. 7	Bluetooth wireless technology is a short range communications technology intended to replace the cables connecting portable unit and maintaining high levels of security. Bluetooth technology is based on Ad-hoc technology also know as Ad-hoc pico nets, which is a local area network with a very limited coverage Bluetooth specification details the entire protocol stack. Bluetooth employs radio frequency for communication. It makes use of frequency modulation			1*6	6	6

to generate radio waves in the ISM band.

The usage of Bluetooth has widely increased for its special services.

- Bluetooth offers a uniform structure for a wide range of devices to connect and communicate with each other.
- Bluetooth technology has achieved global acceptance such that any Bluetooth enable device , almost everywhere in the world , can be connected with Bluetooth enabled devices.
- Lower power consumption of Bluetooth.
- Bluetooth usage model includes cordless computer, intercom, cordless phone and mobile phones.

Spectrum

- Bluetooth technology operates in the unlicensed industrial , scientific and and medical (ISM) band at 2.4 to 2.485 GHZ.
- Using a spread spectrum hopping, full-duplex signal at a nominal rate of 1600 hop/sec.
- The 2.4 GHZ ISM band, available and unlicensed in most countries.

Range

Bluetooth operating range depends on the device

- Class 3 radios have a range of up to 1 meter or 3 feet
- Class 2 radios are most commonly found in mobile devices have a range of 10 meters or 30 feet
- Class 1 radios are used primarily in industrial use cases have a range of 100 meters or 300 feet.

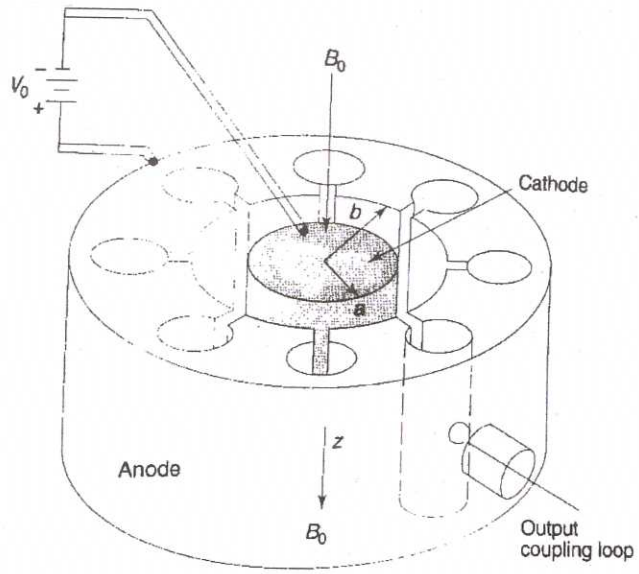
Data Rate

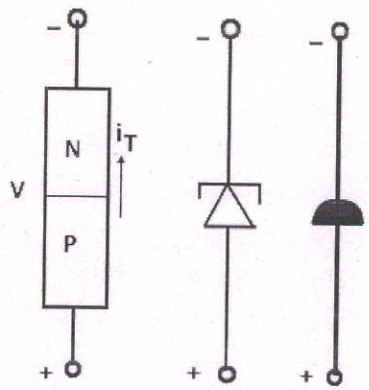
Bluetooth supports 1Mbps data rate for version 1.2 and 3Mbps data rate for Version 2.0

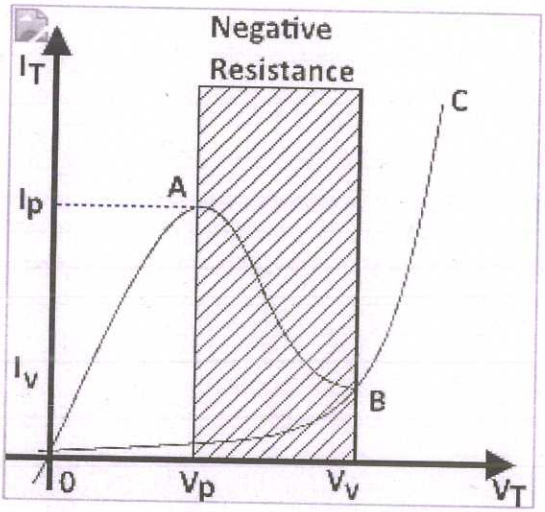
Advantages of Bluetooth :

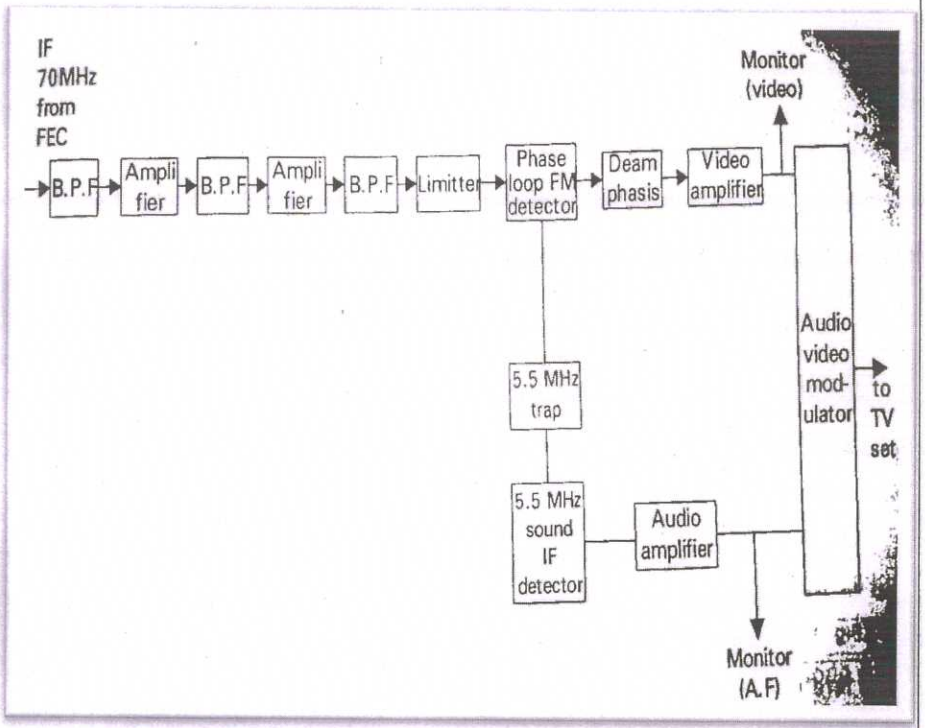
Following are the advantages of Bluetooth

- it creates connection immediately without any wire
- Connection establishment is very quick.
- It has low power consumption.
- It can pass through walls.

	• It has range better than Infrared communication. • It is used for voice and data transfer. **Disadvantages of Bluetooth** • One of the big disadvantages of Bluetooth is security: because it uses RF hence it can be penetrate through walls • Bandwidth is lower compare to WIFI • Battery usage is more compare to the condition when Bluetooth id powered off.			
	PART C			
III. a	**TRAVELLING WAVE MAGNETRON** • It consists of a cylindrical cathode of finite length and radius a at the centre surrounded by a cylindrical anode of radium b. • The radial electric field is established by dc voltage V_0 in between the cathode and anode • DC magnetic flux B_0 is maintained in positive z direction by means of permanent magnet or an electromagnet.  **Fig. 9.20** *Magnetron* **How does a magnetron make microwaves?** 1.There's a heated cathode (a solid metal rod) at the center of the magnetron. 2. A ring-shaped **anode** surrounds the cathode 3. If you switched on a simple magnetron like this, electrons would	3+5 Figure carry 3 marks	8	15

	move from the cathode to the anode in straight lines much like the electron beam in a TV set. But there are two added extra bits in a magnetron that change things completely. **4.** First, the anode has holes or slots cut into it called **cavities or resonant cavities.** Second, a powerful magnet is placed underneath the anode to generate a magnetic field along the length of the tube (parallel to the cathode and, in this diagram, going directly into the paper away from you) **5.** Now when the electrons try to move from cathode to anode, they are traveling through an electric field and a magnetic field at the same time. So, like any electrically charged particles moving in a magnetic field, they feel a force and follow a **curved path** instead of a straight one. **6.** The electrons passes energy to the cavities, the cavities resonate and emit **microwave radiation.** 7. The microwave radiation that the cavities produce is collected up and channeled by a kind of funnel called a **waveguide.**			
III. b	**Tunnel diode** • Tunnel diodes are fabricated by doping the semiconductor materials at very high doping level which result in narrow depletion region. • Germanium and gallium arsenide are used to fabricate tunnel diode because of high electron mobility and reasonable gap energy • It is also called Esaki diode. The very high doping level in tunnel diode result in thin depletion region  Figure 1: Tunnel Diode Symbols • Which result in to very high electric field in junction.	2+5 V-I characteristics carry 2 marks	7	

	• This very high electric field helps for tunneling of charge carriers through junction. • Characteristics of Gunn Diode(v- I chara) • Initially the tunneling Current starts to increase in Tunnel diode with the applied bias voltage due to quantum mechanical tunneling of electrons through narrow space charge region of the junction. • At a particular instant depletion region disappear, the current starts to decrease and this point is known as peak point. • After crossing peak point the current starts decreasing and this creates a negative differential resistance region in the Tunnel diode. And because of this negative differential resistance region, the diode acts as the oscillator  Figure 2: Tunnel Diode VI Characteristics			
IV. a	**Microwave Reciver** The first stage of the terminal station receiver is the front end coverter which is usually a double converter to convert the down link frequency signal of the order of Ghz into an intermediate frequency of 70Mhz. Now this intermediate frequency signal is first passed through a chain of bandpass filters and amplifier combinations to improve signal strength. Thus the IF signal is demodulated to get the orginal baseband signal. The FM used here is a phase-locked loop(PLL) type of FM demodulator. Now the signal is amplified after it is given to de-emphasis network. A 5.4 Mhz sound trap is provided in the circuit to get the sound IF . Now this sound IF is given to FM detector to get orginal audio signal.	3+5 Figure carry 3 marks	8	15



IV. b

HORN ANTENNA

- Wave guide also have the capability to radiate th energy into the space when it is suitably excited at one end opened out at the other end.
- This type of arrangement is known as Horn antennna.

Types of Horn Antennas:

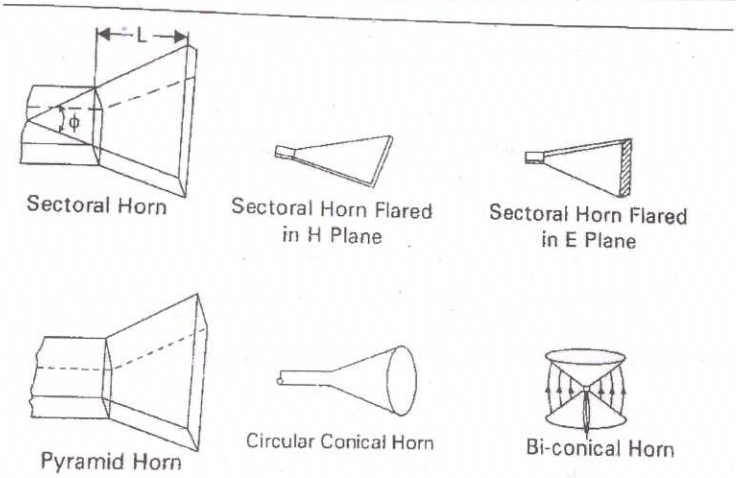
- Sectoral horn flared in H plane
- Sectoral horn flared in E plane
- Pyramidal Horn
- Circular or conical horn
- Bi-conical horn

- H plane horn is the horn which is flared out in horizontal direction
- E plane horn is also a sectoral horn which is flared out in vertical direction only
- Pyramidal horn is the horn which is flared out in both the directions

3+4

Figure carry 3 marks

7

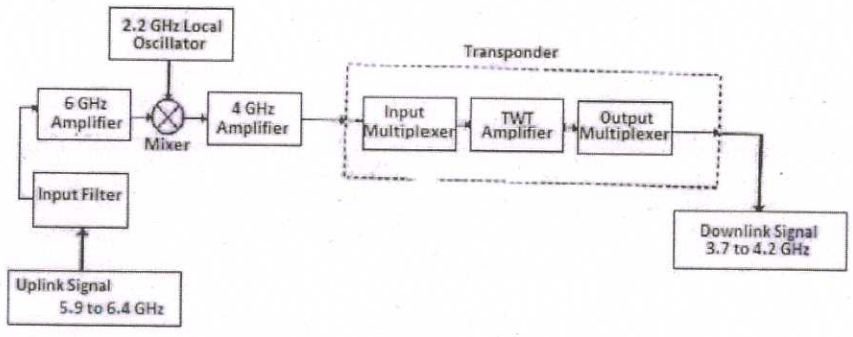


• s of Horns

Radiation from Horn Antenna(working)

- When a wave guide is suitably excited at one end and opened at the other end a small portion of the energy will be radiated.
- If the mouth of the waveguide is opened out, the drawback of mismatch can be avoided.
- Opening of wave guide results in an electro-magnetic spectrum.
- When wave guide is terminated by a horn, the impedance matching is easy.
- Hence all the energy is forward and will be radiated.
- The pyramidal horn and conical horn gives pencil like beams.
- Fan shaped beams result for sectoral horns.

V. a



Satellite Communication System Block Diagram

The uplink frequencies(5.9---6.4Ghz) are used for Transmission from the

3+5

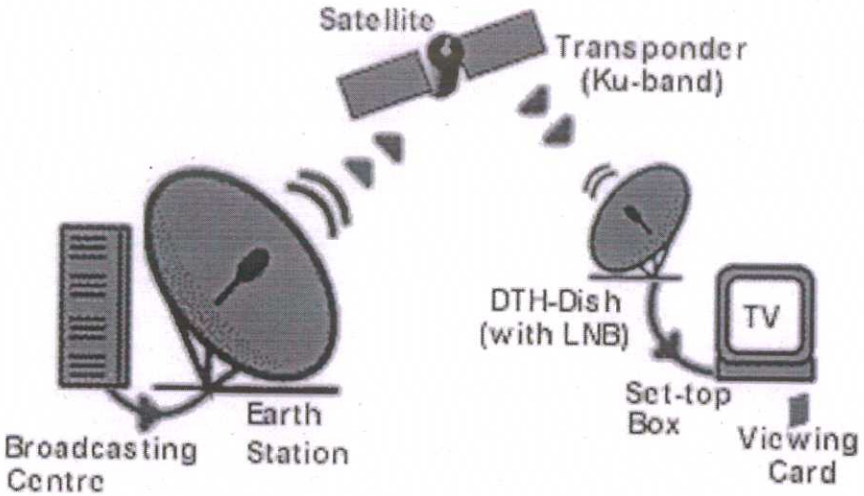
Figure carry 3 marks

8

15

<table>
<tr><td></td><td colspan="2">earth station to the satellite and down link frequencies(3.7—4.2Ghz)
The above frequencies are used for transmission from the satellite to the earth station, the uplink frequencies are converted to lower frequencies by the mixer and local Oscillator, the communication satellite acts as a repeater station it receives the signal, amplifiers it and then transmitted over a next frequencies to avoid interference between the uplink signal and downlink, the two way communication is established with the help of transponder, a com satellite has multi transponder per satellite has increased over the year , a satellite with 2 transponder can support a signal TV channel or 240 telephone lines,</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">V. b</td><td>Advantage</td><td>Disadvantage</td><td rowspan="2">1*7</td><td rowspan="2">7</td><td rowspan="2"></td></tr>
<tr><td>Advantages
• If channel is not used , it is in idle state
• Channel bandwidth is relatively narrow (30kHz).
• Simple hardware required.
• Efficient when number of stations is small and traffic is uniformly constant.
• No need for network timing.
• No restriction regarding the type of modulation.</td><td>• The presence of guard bands
• Requires right RF filtering to minimize adjacent channel interference.
• Maximum bit rate per channel is fixed. (bandwidth per channel is fixed)
• FDMA requires high-performing complex filters
• Less differ from analog system</td></tr>
<tr><td>VI. a</td><td colspan="2">To know the working of DTH better, take a look at the diagram below.For a DTH .
network to be transmitted and received, the following components are needed.
• Broadcasting Centre</td><td>3+6
Figure carry 3 marks</td><td>9</td><td>15</td></tr>
</table>

- Satellites
- Encoders
- Multiplexers
- Modulators
- DTH receivers



It must be noted the channels that are broadcasted from the broadcasting centre hare not created by the DTH providers. The DTH providers pay other companies like HBO, Sony MAX and so on for the right to broadcast their channel to the DTH consumers through satellite. Thus the DTH provider acts as a mediator r broker between the consumers and the programme channels.

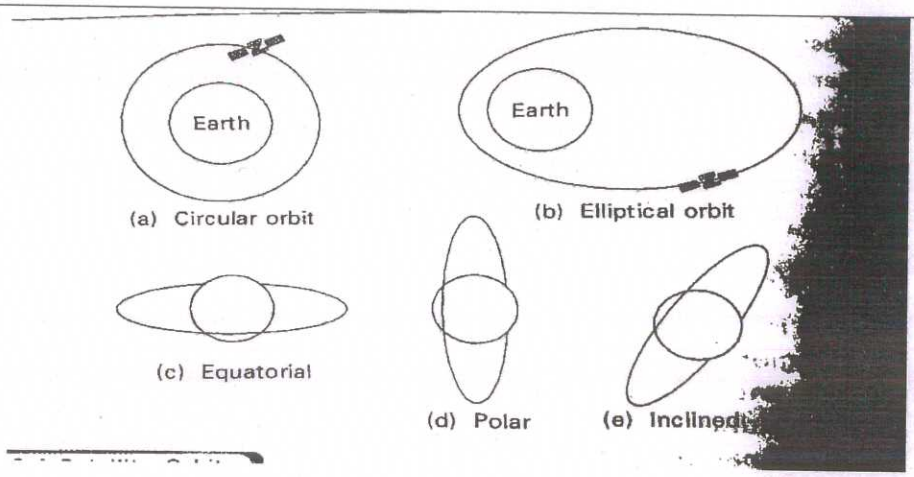
The broadcast centre is the main part of the whole system. It is from the broadcast station that the signals are sent to the satellites to be broadcasted. The broadcast station receives the signals from various program channels.

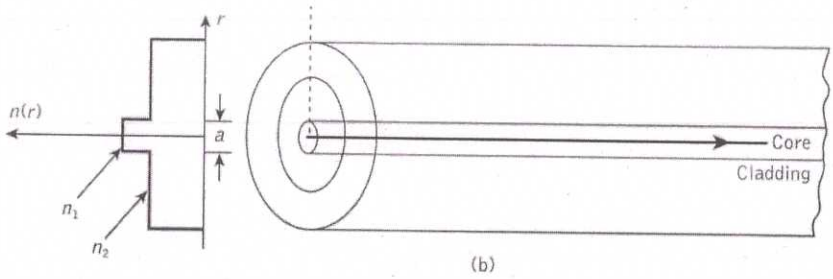
The satellite receives the signal from the broadcast centre and compresses the signals and makes them suitable for re-transmission to the ground.

The DTH providers give dish receivers for the viewers to receive the signal from the satellites. There may be one or multiple satellites that send the signals at the same time. The receiver receives the signal from them and is passed on to the Set Top Box [STB] receiver in the viewer's house.

The STB receiver changes the signal in a form suitable for our television and then passes it on to our TV.

	Advantage of DTH technology • The main advantage is that this technology is equally beneficial to everyone. As the process is wireless, the system can be used in all remote or urban areas. • High Quality audio and video which are cost effective due to absence of mediators. • Almost 4000 channels can be viewed along with 2000 radio channel thus the world's entire information including news and entertainment available to you at home. • With a single DTH service you will be able to use digital quality audio video and also high speed broadband.			
VI. b	A communication satellite can be launched in any of the following orbits. • Equatorial→ where the satellite orbits the Earth above the equator • Polar→ a satellite orbit that passes over Polar Regions, especially one whose plane contains the polar axis. • Inclined→ if the orbit exhibits an angle other than 0° to the equatorial plane • Circular→ For a circular orbit, the distance from the Earth remains the same at all times • Elliptical→ The elliptical orbit changes the distance to the Earth **The Combinations Used Are:** • Equatorial Circular • Equatorial Elliptical • Polar Circular • Polar Elliptical • Incline Circular • Inclined Elliptical Polar orbits are not used as majority of population will not cover. Equatorial orbits are commonly used orbits. AII INTELSAT satellites use equatorial orbits.	3+3 Figure carry 3 marks	6	



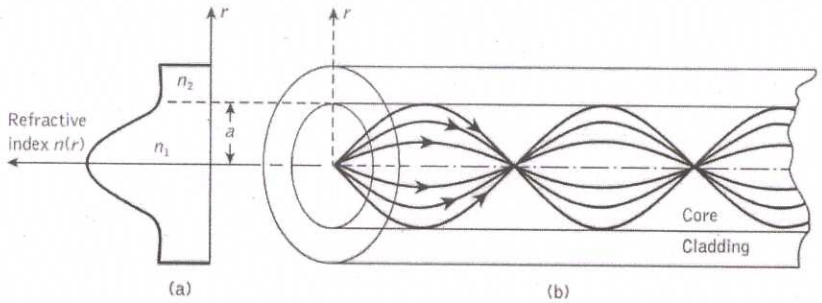
VII. a	**Single Mode Step-Index (SMSI) Fibres** As the name indicates, these optical fibres allow a single mode of data transmission.There is an abrupt change in the refractive index variation.here the core layer is made from dopped silica and the cladding layer from borosilicate. • Core diameter must be of the order of 2 to 10 μm • Allows the propagation of only one transverse electromagnetic mode (typically HE11)  (b) • Has the distinct advantage of low intermodal dispersion (broadening of transmitted light pulses), as only one mode is transmitted, whereas with multimode step index fibre considerable dispersion may occur due to the differing group velocities of the propagating modes. • Intermodal dispersion restricts the maximum bandwidth attainable with multimode step index fibres **GRADED INDEX(gi/grin) FIBRES** • Do not have a constant refractive index in the core. • Have a decreasing core index n(r) with radial distance from a maximum value of n1 at the axis to a constant value n2 (beyond the core radius 'a') in the cladding.	4+4 Figure carry 4 marks	8	15

- Also known as inhomogeneous core fibres.
- The refractive index profile may be defined as:

$$n(r) = \begin{cases} n1\sqrt{1-2\Delta\left(\frac{r}{a}\right)^{\alpha}} & r < a \quad \text{(core)} \\ n1\sqrt{1-2\Delta} = n2 & r \geq a \quad \text{(cladding)} \end{cases}$$

Δ =relative refractive index difference
α =profile parameter

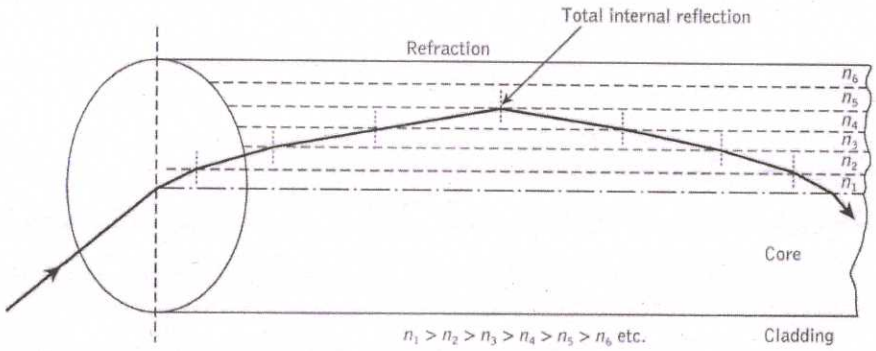
α = ∞ - Step index fiber
α = 2 - a parabolic profile
α = 1 - triangular profile



The refractive index profile and ray transmission in a **multimode graded index fibre**

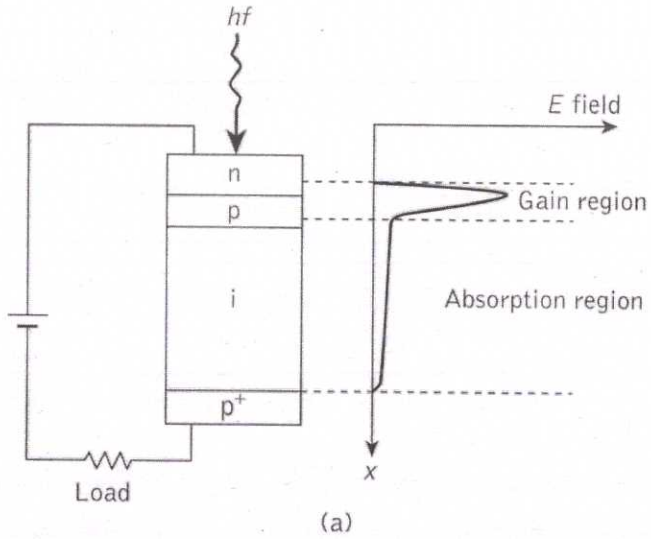
- Meridional rays shown appear to follow curved paths through the fiber core.
- The gradual decrease in refractive index from the center of the core creates many refractions of the rays.

As a result ray is gradually curved,until the conditions for total internal reflection are met, and the ray travels back towards the core axis, again being continuously refracted

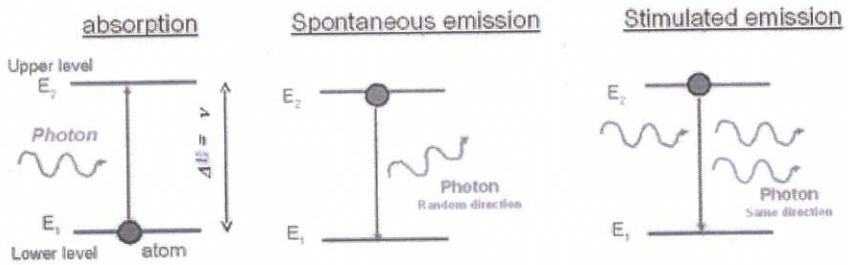


Multimode graded index fibres

- Multimode graded index fibres exhibit less intermodal dispersion than multimode step index fibres due to their refractive index profile.

	• The rays traveling close to the fibre axis have shorter paths when compared with rays which travel into the outer regions of the core. • Near axial rays are transmitted through a region of higher refractive index and therefore travel with a lower velocity. • This compensates for the shorter path lengths and reduces dispersion in the fiber. • Multimode graded index fibres with parabolic index profile cores have transmission bandwidths greater than multimode step index fibre bandwidths • They are not capable of the bandwidths attainable with single mode fibres. • Graded index fibres accept less light than corresponding step index fibres with the same relative refractive index difference			
VII. b	**AVALANCE PHOTODIODE (APD)** • An avalanche diode is a semiconductor device designed to work in the reverse breakdown region. • This has a more sophisticated structure than the p–i–n photodiode in order to create an extremely high electric field region  (a) **AVALANCHE EFFECT** • If we permit this avalanche effect in the diode very large current gain can be obtained. This is the principle used in the avalanche photodiode. • From the figure we find that the avalanche photodiode has a P-I-P-N structure. • The light enters the diode through the thin n-layer.	3+4 Figure carry 3 marks	7	

	• This n layer is heavily doped. • This forms an abrupt junction with a thin P-layer between it and the intrinsic layer. • It is across this junction most of the terminal voltage is developed. • This generates the required high filed intensity for a avalanche in its junction region. • The intrinsic layer distributes a part of the field deeper in to the n-region. • This catches and releases the deeper photo carrier, sweeping the electrons in the area of avalanche. • The P+-I junction is also at reverse bias. • A portion of the applied voltage is dropped across it. • Therefore it sweeps the holes from the I-layer. The voltage drop is determined by the extent to which this P+ layer is doped. **Advantages** • High gain • High sensitivity • Speed of operation is high **Disadvantages** • Requires high voltage power supply. • Poor temperature stability. • Expensive			
VIII. a	**PRINCIPLE OF LASER** Consider an atomic system possessing energy state E1 and E2.When radiation of energy E2-E1=hf passes through system following process will take place. 1. ABSORPTION:The incident radiation are absorbed by ground state(E1) atoms and get excited to E2	3+6 Figure Carry 3 marks	9	15



2.SPONTANEOUS EMISSION: Since atoms at E2 state is highly unstable. The atoms return to ground state(E2) by remitting radiation of frequency

These emitted photos are in random direction and phase so they cannot be amplified.

3.STIMULATED EMISSION: When one the spontaneously emitted photos stimulate atoms in the excited state(E2) to take a transition to ground state.

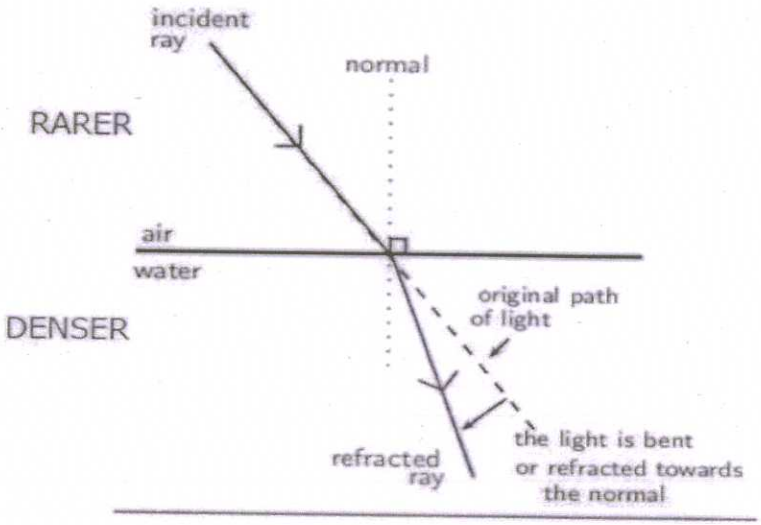
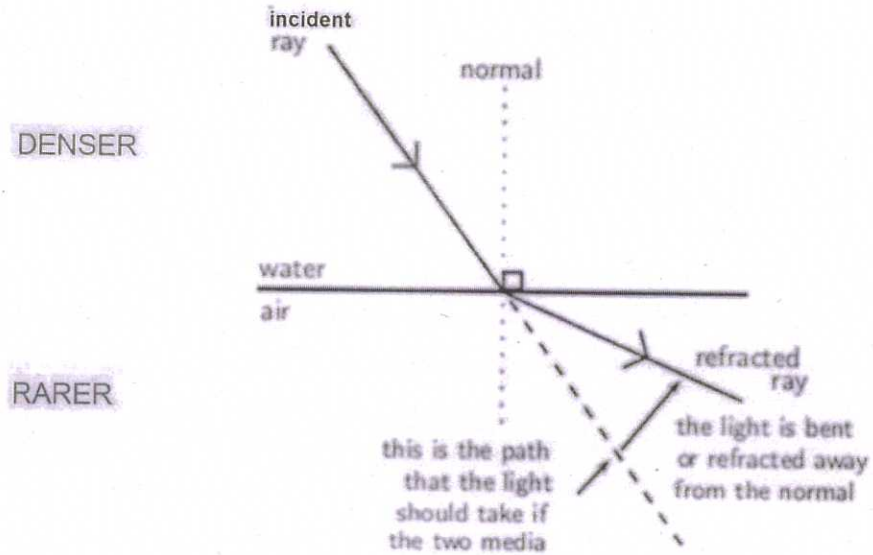
Two photos are emitted

All emitted photos have same phase and direction with that of stimulating photos.

Optical Amplification is possible here.

POPULATION INVERSION (PI):

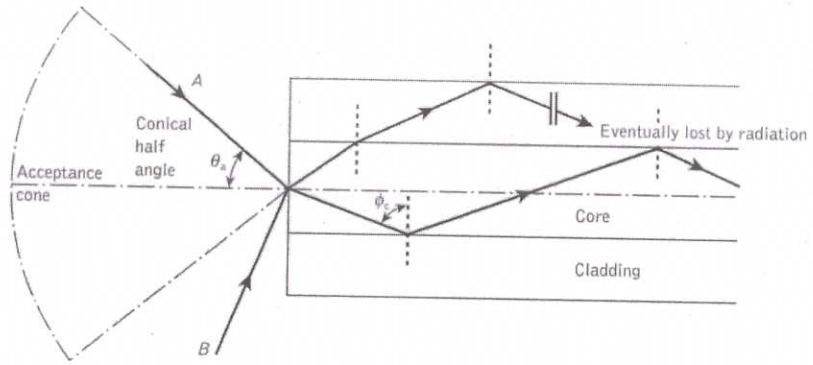
- At normal condition number of atoms in ground state is always greater than that of excited state.
- Absorption is greater than emission.
- In order to achieve laser action number of atoms at upper level E2 (excited state) is made much greater than that of lower energy level.
- This is called POPULATION INVERION.
- Once the population inversion is achieved Stimulated emission is greater that of absorption.
- In order to achieve population inversion, we require minimum 3 energy level and a pumping mechanism.

VIII. b	**i.REFRACTION** • When a ray is incident on the interface between two dielectrics of differing refractive indices, refraction occurs. It is the change in path of light as it goes from one medium to another. • Refractive index $\mu=\frac{C}{V}=\frac{vel.of\ light\ in\ vacuum}{vel.of\ light\ in\ medium}$ • A ray of light travels more slowly in an optically dense medium. When a ray of light travels from an optically rarer medium to a denser medium, it bends towards the normal  • When a ray of light travels from an optically denser medium to a rarer medium, it bends away from the normal.  	3*2	6	

ii)ACCEPTANCE ANGLE

- Rays with an angle of incidence (to the normal) greater than $\emptyset_c$ at the core-cladding interface are transmitted by total internal reflection.

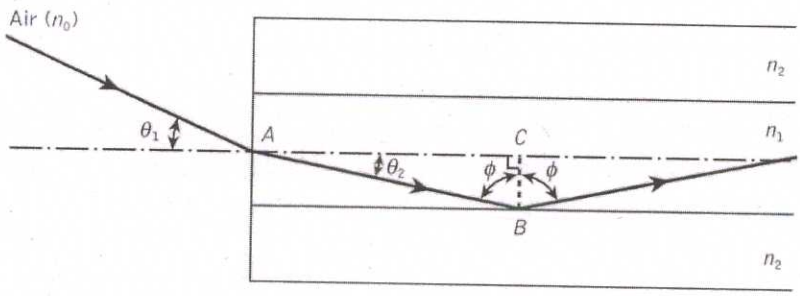
Not all rays entering the fibre core will continue to be propagated down its length



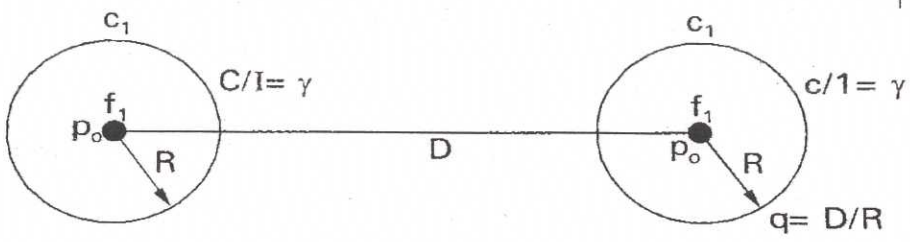
- Ray A is at an angle greater than the critical angle $\emptyset_c$ within the fibre at the core-cladding interface.
- This ray enters the fibre core at an angle θ_a to the fibre axis.
- Any rays which are incident into the fibre core at an angle greater than θ_a will be transmitted to the core-cladding interface at an angle less than $\emptyset_c$, and will not be totally internally reflected.
- For rays to be transmitted by total internal reflection within the fibre core they must be incident on the fibre core within an acceptance cone defined by the conical half angle θ_a.
- θ_a is the maximum angle to the axis at which light may enter the fibre in order to be propagated.

θ_a is known as the acceptance angle/maximum or total acceptance angle for the fibre

iii) NUMERICAL APERTURE



Numerical Aperature is defined as

	$NA = n_0 \sin \theta_a = (n_1^2 - n_2^2)^{\frac{1}{2}}$ $NA = n_1(2\Delta)^{\frac{1}{2}}$ • Relative refractive index difference Δ between the core and the cladding is defined as $\Delta = \frac{n_1^2 - n_2^2}{2n_1^2}$ $\simeq \frac{n_1 - n_2}{n_1}$ for $\Delta \ll 1$ • Δ n = n1 - n2 is referred to as the index difference • Δ n/n1 is referred to as the fractional index difference. • NA is a measure of the light-collecting ability of a fibre			
IX. a	**FREQUENCY REUSE** In this frequency reuse system, users in different cells may simultaneously use the same frequency channel. The frequency reuse system can increase the spectrum efficiency, but if the system is not properly designed, serious interference may occur. Interference due to the common use of the same channel is co-channel interference A particular radio channel, say F_1, used in one cell to call a call, says C_1, with a coverage radius R. The same radio frequency can be used in another cell with the same coverage radius at a distance D away.  **The ratio of D/R** **1. Frequency Reuse Schemes**: The frequency reuse concept can be used in the time domain and the space domain. Frequency reuse in the time domain results in the occupation of the same frequency in different time slots. It is called time division multiplexing (TDM). Frequency reuse in the space	1*8	8	15

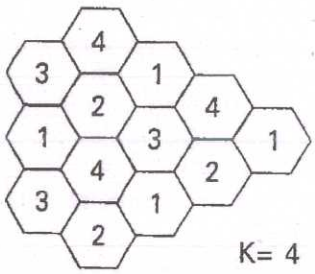
domain can be divided into two categories

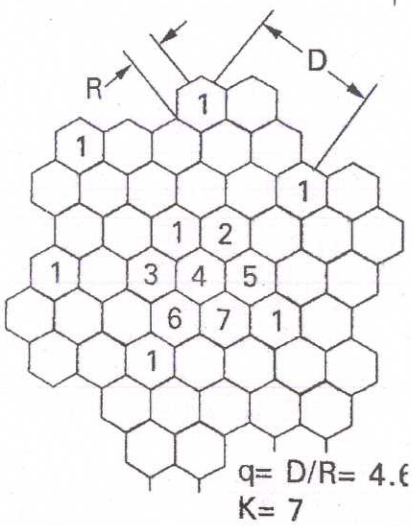
1. Same frequency assigned in two different geographic areas, such as AM or FM radio stations using the same frequency in different cities.
2. Same frequency repeatedly used in non-adjacent cells. Which is used in cellular systems .The total frequency spectrum allocation is divided into K frequency reuse patterns, as illustrated in Fig. for k 4, 7, 12 and 19.

Frequency Reuse Distance

The minimum distance which allows the same frequency to be reused will depend on many factors, such as the number of co-channel cells in the vicinity of the center cell, the type of geographic area, the antenna height, and the transmitted power at each cell site. The frequency reuse distance D can be determined from $D=R\sqrt{3K}$

Where K is frequency reuse pattern shown in Fig





HANDOFF

Cellular networks are composed of cells, each of which is capable of providing telecommunications services to subscribers roaming within them. Each cell can only serve up to a certain area and number of subscribers. Thus, when any of these two limits is reached, a **HANDOFF** ensues.

Reasons for **HANDOFF**

- If a subscriber moves out of the coverage area of a particular cell while entering another, a handoff takes place between the two cells. The cell that served the call prior to the handoff is relieved of its duties, which are then transferred to the second cell.
- A handoff may also be triggered when the number of subscribers using a

	particular cell has already reached the cell's maximum limit (capacity). Such a handoff is possible because the reach of the cell sites serving these cells can sometimes overlap. Thus, if a subscriber is within an overlapping area, the network may opt to transfer one subscriber's call to the cell involved in the overlap. **Handoffs** may be classified into two types: ***Hard Handoff***: There is a actual break in the connection while switching from one cell or base station to another. The switch takes place so quickly that it can hardly be noticed by the user. Because only one channel is needed to serve a system designed for hard handoffs.It is also sufficient for services that can allow slight delays, such as mobile broadband Internet. ***Soft Handoff***: Entails two connections to the cell phone from two different base stations. This ensures that no break ensues during the handoff. Naturally, it is more costly than a hard handoff			
IX. b	**RFID** • Radio Frequency identification (RFID) is the use of wireless non contact system that uses radio frequency electromagnetic fields to transfer data from a tag attached to an object , for purpose of automatic identification and tracking. • RFID is generic term that is used to describe that transmits the identity of an object or person wirelessly using radio waves. It is grouped under the broad category of automatic identification. • RFID tags used in many industries. • An RFID is attached to an automobile during production can be used to track its process through assembly line. • RFID card given to employees to access to locked areas of a building. **Components of RFID** This technology allows transmission of data without contact and line of	1*7	7	

sight from a data medium.

Basic system consists of three components.

- An antenna or coil
- A transceiver with decoder.
- A transponder (RF tag) electronically programmed with unique information.

Tags(chip+ antenna)

A RFID tag is an object that can be stuck on or incorporated into product, animal o a person for the purpose of identification using radio waves.

Working

- Radio frequency identification uses tags, or labels attached to the objects to be identified. Two way radio transmitter- receivers called interrogators or readers send a signal to tag and read its response.
- The reader generally transmits their observation to a computer system running RFID.
- The tags information is stored electronically in a nonvolatile memory.
- The RFID tag includes a small RF transmitter and receiver.
- An RFID reader transmits an encoded radio signal to interrogate the tag. The tag receives the message and responds with its identification information.
- RFID contain at least two parts: an integrated circuit for storing and processing information, modulating and demodulating a radio frequency signal.

Advantages

- The read only tag code data is 100% secure and cannot be changed or duplicated.
- No need for physical contact between the data carrier and communication devices. The tags can be used repeatedly, relatively low maintenance cost.
- Extremely low error rate.
- Long read range.

	• Bar code does not identify unique items but it can identify the item. **Disadvantages** • RFID systems are often more expensive than barcode systems. • RFID technology is harder to understand. • RFID tags are usually longer than barcode labels. • Tags are application specific.			
X. a	**GSM NETWORK ARCHITECTURE** GSM system architecture consists of three major subsystems that interact between themselves and with users through certain network interfaces. As shown in Fig GSM system consists of Base transceiver Station (BTS); Base Station Controller (BSC) and Mobile Switching MSC). **Mobile Station (MS) :** • Mobile stations are portable radio telephony units that can be used on any GSM system as vehicular and/or hand held terminals. • User Information is communicated with MS through a microphone and a speaker. • Mobile station has basically two elements First one is mobile equipment or handset. • Second element of mobile station is Subscriber Identity Module or 'SIM'. It is a smart card identifying specifications of user. **Base Station Subsystem:** Base station subsystem comprises a base station controller and one or more subtending base transceiver stations (BTS) • BSS perform a variety of functions ranging from radio resource control to digital signal processing. **Mobile Switching Centre** : It is a local ISDN switch with additional capabilities to support mobility management like terminal registration. location updating and handoff Typical functions of MSC includes call set up, call routing, billing	3+6 Figure carry 3 marks	9	15

information collection, Echo cancellation, paging and alerting and interrogation of appropriate registers.

MSC also provides to network specific information on status of mobile channels.

Register Component of NSS :

Network and switching subsystem is responsible for network operation

It consists of a number of software components namely VLR, HLR, EIR and AUC.

HLR : HLR is Home Location Register, represent centralized database that has permanent data fill about mobile subscribers.

- It stores subscriber address, service type current location, forwarding address, privacy keys etc.
- HLR is kept updated with current locations of all its mobile subscribers.
- Usually one HLR is put into use for each GSM network. HLR generally maintains following subscriber data on permanent bases.

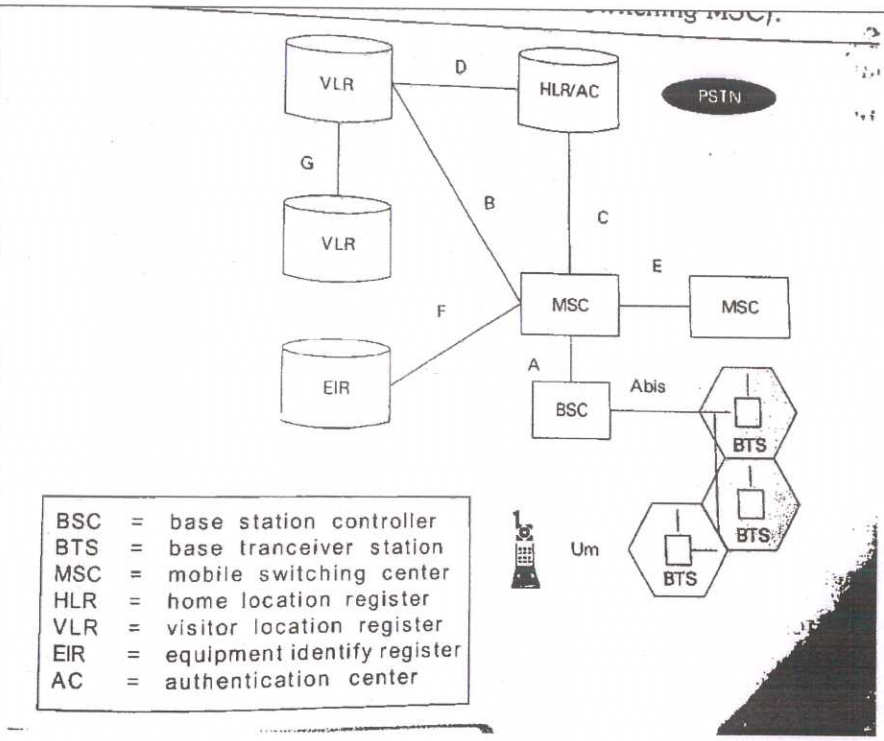
(a) International Mobile Subscriber Identify (IMSI)

VLR: VLR IS VISITOR Location Register and generally there is one VLR per MSC.

- Its primary function is to identify subscribers visiting inside coverage area of an MSC. \LR
- VLR also contains information about locally activated features such as call forward or busy.
- It also provides variety of information like features currently activated, temporary mobile station identity.

EIR : It is Equipment Identity Register.

- It is another database managing identification of mobile equipment against fault and theft.
- Equipment Identification Register maintains information in white, grey and black lists that may be consulted by the network in event of confirmation of authencity.

			
X. b	WI-MAX is one of the hottest broadband wireless technologies around today. Imax systems are exposed to deliver broadband access services to residential and enterprise customers in an economical way. • Loosely, WiMax is a standardized wireless version of Ethernet intended primarily as an alternative to wire technologies (such as Cable Modems, DSL and TlEl links) to provide broadband access to customer premises. • More strictly, WiMAX is an industry trade organization formed by leading communications, component, and equipment companies to promote and certify compatibility and interoperability of broadband wireless access equipment that conforms to the IEEE 802.16 and ETSI HIPERMAN standards. • WiMAX would operate similar to WiFi, but at higher speeds over greater distances and for a greater number of users. WiMAX has the ability to provide service even in areas that are difficult for wired infrastructure to reach and the ability to overcome the physical limitations of traditional wired infrastructure. • WiMAX was formed in April 2001, in anticipation of the publication of the original 10-66 GHz IEEE 802.16 specifications. WiMAX is to 802.16 as the WiFi Alliance is to 802.11.	1*6	6	

WiMAX is

- Acronym for Worldwide Interoperability for Microwave Access.
- Based on Wireless MAN technology.
- A wireless technology optimized for the delivery of IP centric services over a wide area.
- A scalable wireless platform for constructing alternative and complementary broadband networks.
- A certification that denotes interoperability of equipment built to the IEEE 802.16 or compatible standard. The IEEE 802.16 Working Group develops standards that address two types of usage models

1.A fixed usage model (IEEE 802.16-2004).

2.A portable usage model (IEEE 802.16e).

- WiMAX is expected to offer initially up to about 40 Mbps capacity per wireless channel for both fixed and portable applications, depending on the particular technical configuration chosen, enough to support hundreds of businesses with T-l speed connectivity and thousands of residences with DSL speed connectivity. WiMAX can support voice and video as well as Internet data.
- WiMAX could potentially be deployed in a variety of spectrum bands: 2.3GHz, 2.5GHz, 3.5GHz, and 5.8GHz