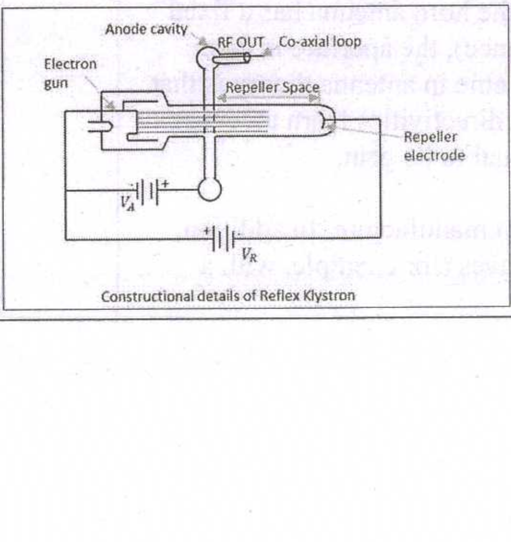
SCHEME OF EVALUATION
(SCORING INDICATOR)

REVISION : 15
COURSE : COMMUNICATION SYSTEMS
COURSE CODE : 6042

SCORING INDICATOR

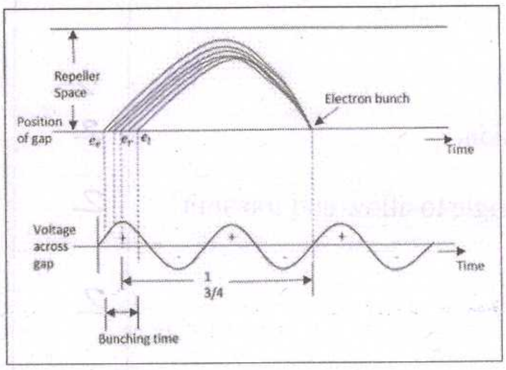
QST NO:	SCORING INDICATOR	SPLIT UP SCORE	SUB TOTAL	TOTAL
I	PART A			
1	Rectangular,circular,slab type etc	2		
2	Weather forecasting , Navigation, Astronomy, Satellite television	2		
3	Numerical Aperture is defined as the maximum acceptance angle to allow and transmit light by an optical fiber.	2		
4	• higher efficiency ,the quality and flexibility of service • greater access to modern apps and services • improved networking capabilities	2		
5	Connectivity for SMBs WiMAX Backhaul , Broadband for Developing Countries	2		10
	PART B			
III 1	**Construction of Reflex Klystron** The electron gun emits the electron beam, which passes through the gap in the anode cavity. These electrons travel towards the Repeller electrode, which is at high negative potential. Due to the high negative field, the electrons repel back to the anode cavity. In their return journey, the electrons give more energy to the gap and these oscillations are sustained. The constructional details of this reflex klystron is as shown in the following figure.	Expln 3 Dgm 3	6	



Constructional details of Reflex Klystron

It is assumed that oscillations already exist in the tube and they are sustained by its operation. The electrons while passing through the anode cavity, gain some velocity.

Operation of Reflex Klystron The operation of Reflex Klystron is understood by some assumptions. The electron beam is accelerated towards the anode cavity.Let us assume that a reference electron $\mathbf{e_r}$ crosses the anode cavity but has no extra velocity and it repels back after reaching the Repeller electrode, with the same velocity. Another electron, let's say $\mathbf{e_e}$ which has started earlier than this reference electron, reaches the Repeller first, but returns slowly, reaching at the same time as the reference electron.We have another electron, the late electron $\mathbf{e_l}$, which starts later than both $\mathbf{e_r}$ and $\mathbf{e_e}$, however, it moves with greater velocity while returning back, reaching at the same time as er and ee.Now, these three electrons, namely $\mathbf{e_r}$, $\mathbf{e_e}$ and $\mathbf{e_l}$ reach the gap at the same time, forming an **electron bunch**. This travel time is called as **transit time**, which should have an optimum value. The following figure illustrates this.



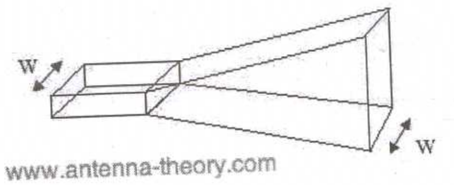
2 **Horn antennas** are very popular at UHF (300 MHz-3 GHz) and higher frequencies (I've heard of horn antennas operating as high as 140 GHz). Horn antennas often have a directional radiation pattern with a high antenna gain, which can range up to 25 dB in some cases, with 10-20 dB being typical. Horn antennas have a wide impedance bandwidth, implying that the input impedance is slowly varying over a wide frequency range (which also implies low values for S11 or VSWR). The bandwidth for practical horn antennas can be on the order of 20:1 (for instance, operating from 1 GHz-20 GHz), with a 10:1 bandwidth not being uncommon.

The gain of horn antennas often increases (and the beamwidth decreases) as the frequency of operation is increased. This is because the size of the horn aperture is always measured in wavelengths; at higher frequencies the horn antenna is "electrically larger"; this is because a higher frequency has a smaller wavelength. Since the horn antenna has a fixed physical size (say a square aperture of 20 cm across, for instance), the aperture is more wavelengths across at higher frequencies. And, a recurring theme in antenna theory is that larger antennas (in terms of wavelengths in size) have higher directivities.Horn antennas have very little loss, so the directivity of a horn is roughly equal to its gain.

Horn antennas are somewhat intuitive and relatively simple to manufacture. In addition, acoustic horn antennas are also used in transmitting sound waves (for example, with a

<table>
<tr><td></td><td>megaphone). Horn antennas are also often used to feed a dish antenna, or as a "standard gain" antenna in measurements.

Popular versions of the horn antenna include the E-plane horn, shown in Figure 1. This horn antenna is flared in the E-plane, giving the name. The horizontal dimension is



constant

Figure 1. E-plane horn antenna.</td><td>[illegible]</td><td>6</td></tr>
<tr><td>3</td><td><table><tr><td>FDMA stand for frequency division multiple access.
The FDMA (frequency division multiple access) is not required synchronization.
It has less power efficiency.
It requires high carrier frequency stability.
It has divide frequency band into disjoint subband.
Its Entire band of frequencies is divided into multiple RF channels/carriers. Each carrier is allocated to different users.
It has continuous transmission scheme.
It used in GSM and PDC.</td><td>TDMA stand for time division multiple acce
It is required synchronization.
It has more power efficiency.
The high carrier frequency is not necessary.
It has divided the time into non overlapping
slot.
Its entire bandwidth is shared among differe
subscribers at fixed predetermined or dynamically assigned time intervals/slots.
It discontinuous transmission scheme.
It is used in advanced mobile phone systems (AMPS).</td></tr></table></td><td>3+3</td><td>6</td></tr>
<tr><td>4</td><td>A GPS navigation device, GPS receiver, or simply GPS is a device that is capable of receiving information from <u>GPS satellites</u> and then to calculate the device's geographical position. Using suitable software, the device may display the position on a map, and it may offer directions. The <u>Global Positioning System</u> (GPS) is a <u>global navigation satellite system</u> (GNSS) made up of a network of a minimum of 24, but currently <u>30, satellites</u> placed into orbit by the <u>U.S. Department of Defense</u>.[1]

The GPS was originally developed for use by the United States military, but in the 1980s, the United States government allowed the system to be used for civilian purposes. Though the GPS satellite data is free and works anywhere in the world, the GPS device and the associated software must be bought or rented.

A GPS device can retrieve from the GPS system location and time information in all weather conditions, anywhere on or near the Earth. A GPS reception requires an unobstructed line of sight to four or more GPS satellites,[2] and is subject to poor satellite signal conditions.</td><td>3+3</td><td>6</td></tr>
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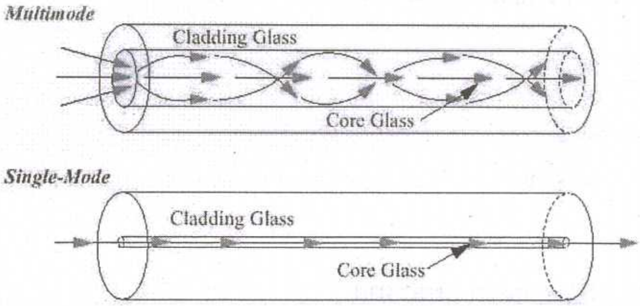
5

Understanding The Difference Between Single-mode and Multimode Fiber

There are so many cable options available the one might wonder where to start. This article will set you on the right path in the decision process. Let's begin by focusing on single



mode and.

3+3 6

Multimode Multimode optical fiber cable has a larger diametrical core that permits multiple modes of light to pass through at a given time. This characteristic allows the number of light reflections created as the light passes through the core to increase, creating the ability for more data to pass through at any given time. The attenuation rate and high dispersion of this fiber reduce the signal quality over long distances. Multimode optical fiber is commonly used short distances, audio/video applications, and Local Area Networks (LANs). From core to cladding, the diameter ratio is 50 microns to 125 microns and 62.5 microns to 125 microns.**Single Mode** Single mode optical fiber cable a small diametrical core that allows one mode of light to pass through at a given time. Because of this, the light reflections created as light passes through the core decreases, reducing attenuation and enabling the ability for the light signal to travel further. Single mode optical fiber would be ideal for long distances that require more bandwidth such as telecommunications companies, cable television providers, and colleges and universities. From core to cladding, the diameter ratio is 9 microns to 125 microns.

6 Comparison chart

	3G	4G
Introduction (from Wikipedia)	3G, the 3rd generation of wireless mobile telecommunications tech, offers faster internet speed than 2G and 2.5G GPRS networks. 3G networks comply with the IMT-2000 specifications; uses include voice telephony, mobile TV, video calls and web access.	4G is the 4th generation of broadband cellular network technology, succeeding 3G. A 4 system must provide capabilitie defined by ITU in IMT Advanc 4G applications include mobile access, IP telephony, gaming, H and video conferencing.

Data Throughput	Up to 3.1Mbps with an average speed range between 0.5 to 1.5 Mbps	Practically speaking, 2 to 12 Mbps (Telstra in Australia claims up to 40 Mbps) but potential estimated at a range of 100 to 300 Mbps.
Peak Upload Rate	5 Mbps	500 Mbps
Switching Technique	packet switching	packet switching, message switching
Peak Download Rate	100 Mbps	1 Gbps
Network Architecture	Wide Area Cell Based	Integration of wireless LAN and Wide area.
Frequency Band	1.8 – 2.5 GHz	2 – 8 GHz
Services And Applications	CDMA 2000, UMTS, EDGE etc	Wimax2 and LTE-Advance
Forward error correction (FEC)	3G uses Turbo codes for error correction.	Concatenated codes are used for error corrections in 4G.

3+3 6

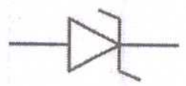
7 An avalanche diode is a special type of semiconductor device designed to operate in reverse breakdown region. Avalanche diodes are used as relief valves (a type of valve used to control the pressure in a system) to protect electrical systems from excess voltages. Avalanche diodes are generally made from silicon or other semiconductor materials. The construction of avalanche diode is similar to zener diode but the doping level in avalanche diode differs from zener diode. Expl.

Zener diodes are heavily doped. Therefore, the width of depletion region in zener diode is very thin. Because of this thin depletion layer or region, reverse breakdown occurs at lower voltages in zener diode. (3)

On the other hand, avalanche diodes are lightly doped. Therefore, the width of depletion layer in avalanche diode is very wide compared to the zener diode. Because of this wide depletion region, reverse breakdown occurs at higher voltages in avalanche diode. The breakdown voltage of avalanche diode is carefully set by controlling the doping level during manufacture.

Symbol of avalanche diode

The symbol of avalanche and zener diode is same. Avalanche diode consists of two terminals: anode and cathode. The symbol of avalanche diode is shown in below figure.



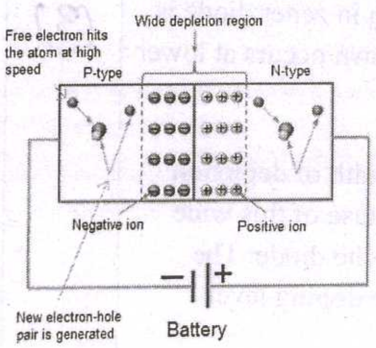
The symbol of avalanche diode is similar to the normal diode but with the bend edges on the vertical bar.

How avalanche diode works?

A normal p-n junction diode allows electric current only in forward direction whereas an avalanche diode allows electric current in both forward and reverse directions. However, avalanche diode is specifically designed to operate in reverse biased condition.

Avalanche diode allows electric current in reverse direction when reverse bias voltage exceeds the breakdown voltage. The point or voltage at which electric current increases suddenly is called breakdown voltage.

When the reverse bias voltage applied to the avalanche diode exceeds the breakdown voltage, a junction breakdown occurs. This junction breakdown is called avalanche breakdown. When forward bias voltage is applied to the avalanche diode, it works like a normal p-n junction diode by allowing electric current through it. When reverse bias voltage is applied to the avalanche diode, the free electrons (majority carriers) in the n-type semiconductor and the holes (majority carriers) in the p-type semiconductor are moved away from the junction. As a result, the width of depletion region increases. Therefore, the majority carriers will not carry electric current. However, the minority carriers (free electrons in p-type and holes in n-type) experience a repulsive force from external voltage.



diu
3
6

(6)

As a result, the minority carriers flow from p-type to n-type and n-type to p-type by carrying the electric current. However, electric current carried by minority carriers is very small. This small electric current carried by minority carriers is called reverse leakage current.

If the reverse bias voltage applied to the avalanche diode is further increased, the minority carriers (free electrons or holes) will gain large amount of energy and accelerated to greater velocities.

The free electrons moving at high speed will collide with the atoms and transfer their energy to the valence electrons.

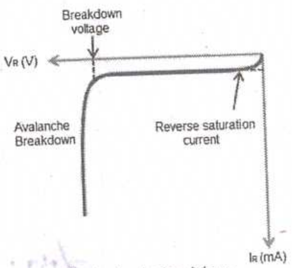


Fig: Avalanche breakdown

PART C

IIIa The TWT is an elongated vacuum tube with an electron gun (a heated cathode that emits electrons) at one end. A voltage applied across the cathode and anode accelerates the electrons towards the far end of the tube, and an external magnetic field around the tube focuses the electrons into a beam. At the other end of the tube the electrons strike the "collector", which returns them to the circuit.

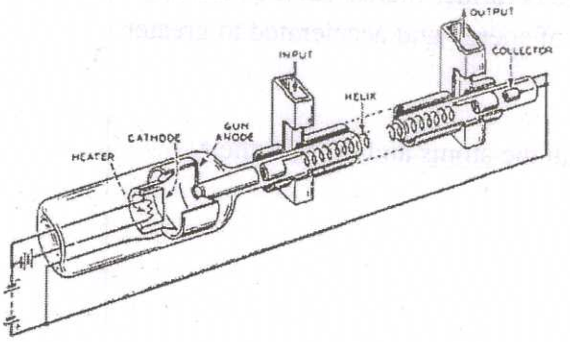
Wrapped around the inside of the tube, just outside the beam path, is a helix of wire, typically oxygen-free copper. The RF signal to be amplified is fed into the helix at a point near the emitter end of the tube. The signal is normally fed into the helix via a waveguide or electromagnetic coil placed at one end, forming a one-way signal path, a directional coupler.

By controlling the accelerating voltage, the speed of the electrons flowing down the tube is set to be similar to the speed of the RF signal running down the helix. The signal in the wire causes a magnetic field to be induced in the center of the helix, where the electrons are flowing. Depending on the phase of the signal, the electrons will either be sped up or slowed down as they pass the windings. This causes the electron beam to "bunch up", known technically as "velocity modulation". The resulting pattern of electron density in the beam is an analog of the original RF signal.

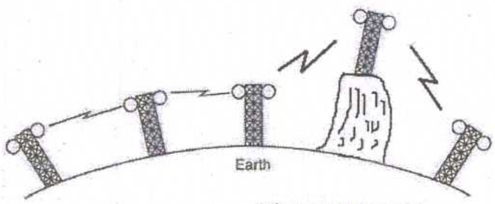
Because the beam is passing the helix as it travels, and that signal varies, it causes

Explain (3) 8

induction in the helix, amplifying the original signal. By the time it reaches the other end of the tube, this process has had time to deposit considerable energy back into the helix. A second directional coupler, positioned near the collector, receives an amplified version of the input signal from the far end of the RF circuit. Attenuators placed along the RF circuit prevent the reflected wave from traveling back to the cathode.



b)



Microwave Repeater

The figure-2 depicts series of repeaters used to extend range of **microwave** communication. The classic example is microwave relay stations used by telephone companiesfor long distance communication.

Here functions of all the repeaters is same as mentioned above. A whole string of repeater stations can relay signals for larger distances. Typically, such relay stations are located at 20 to 60 miles apart. They are placed at high altitude to achieve reliable communication over long distances.

Iva)

The block diagram shows the equipment of a microwave transmitter station on earth.

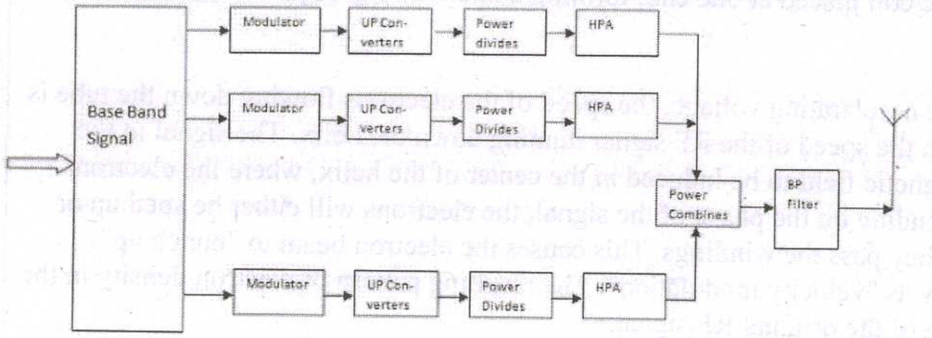


Figure: Microwave Transmitter

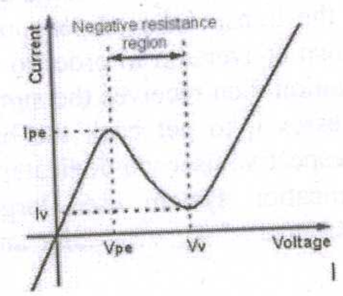
Block Diagram of Microwave Transmitter

The signal to be transmitter must be at uplink frequency. The converter multiply the signal frequency to uplink frequency after it is encoded and modulated properly.

After upconverting the frequency, it is applied to power dividers. The output of power divider goes to high power amplifier. Normally travelling wave tube amplifiers or multicavity klystron amplifiers are used. These tubes require good amount of cooling.

Here the modulation is performed at 70 MHz intermediate frequency and is then upconverted to a uplink frequency of 6 GHz. The output of several high power amplifiers are combined in a power combining amplifier and the output then passes through band pass filter and circulators. Frequency stability and power control are necessary to avoid interferences. The manufacturing is high and it increases as transmitted power increases.

b) **VI characteristics of Tunnel diode: The IV characteristics of the tunnel diode is**

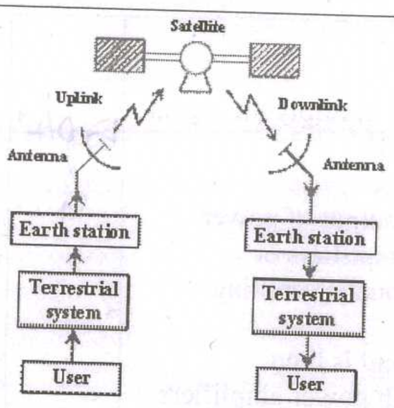


shown below

tunnel diode VI characteristics For small forward voltages owing to high carrier concentrations in tunnel diode and due to tunneling effect the forward resistance will be very small. As voltage increase she current also increases till the current reaches Peak current. If the voltage applied to tunnel diode is increased beyond the peak voltage the current will start decreasing. This is negative resistance region. It prevails till valley point. At valley point the current through the diode will be minimum. Beyond valley point the tunnel diode acts as normal diode. In reverse biased condition also Tunnel diode is an excellent conductor due to its high doping concentrations. Due to Tunneling, when the value of forward voltage is low value of forward current generated will be high. It can operate in forward biased as well as in reverse biased. Due to high doping, it can operate in reverse biased. Due to the reduction in barrier potential, the value of reverse breakdown voltage also reduces. It reaches a value of zero. Due to this small reverse voltage leads to diode breakdown. Hence, this creates negative resistance region.

Expl. 4 8 fig 3. 7 Expl. 4 15

Va)



The term Satellite communication is very frequently used, but what is satellite communication? It is simply the communication of the satellite in space with large number of earth stations on the ground. Users are the ones who generate baseband signals, which is processed at the earth station and then transmitted to the satellite through dish antennas. Now the user is connected to the earth station via some telephone switch or some dedicated link. The satellite receives the uplink frequency and the transponder present inside the satellite does the processing function and frequency down conversion in order to transmit the downlink signal at different frequency. The earth station then receives the signal from the satellite through parabolic dish antenna and processes it to get back the baseband signal. This baseband signal is then transmitted to the respective user via dedicated link or other terrestrial system. Previously satellite communication system used large sized parabolic antennas with diameters around 30 meters because of the very faint and weak signals received.

b) geostationary satellite

A geostationary satellite is an earth-orbiting satellite, placed at an altitude of approximately 35,800 kilometers (22,300 miles) directly over the equator, that revolves in the same direction the earth rotates (west to east). At this altitude, one orbit takes 24 hours, the same length of time as the earth requires to rotate once on its axis. The term geostationary comes from the fact that such a satellite appears nearly stationary in the sky as seen by a ground-based observer. BGAN, the new global mobile communications network, uses geostationary satellites.

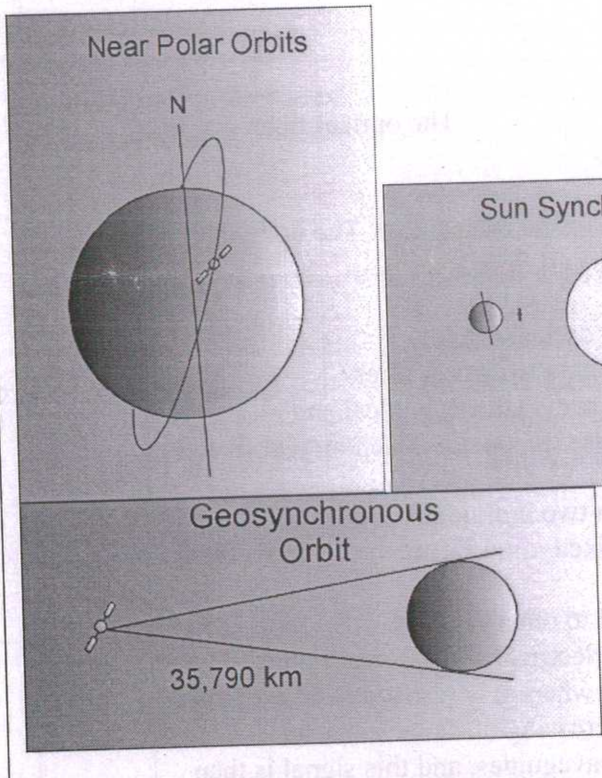
VIa

Definition: The DTH technology enables a broadcasting company to directly beam the signal to your TV set through a receiver that is installed in the house. There is no need for a separate cable connection.

Description: In India, direct-to-home (DTH) Broadcasting Service refers to the distribution of multi channel TV programmes in Ku Band by using a satellite system by providing TV signals direct to subscribers' premises. For DTH connection the broadcasting company provides a set that comprises the dish and a receiving set. The company beams an encrypted signal that only the set installed in your household can receive and enable viewing.

Direct to home technology refers to the satellite television broadcasting process which is actually intended for home reception. This technology is originally referred to as **direct broadcast satellite (DBS)** technology. The technology was developed for competing with the local cable TV distribution services by providing higher quality satellite signals with more number of channels. In short, DTH refers to the reception of satellite signals on a TV with a personal dish in an individual home. The satellites that are used for this purpose is geostationary satellites. The satellites compress the signals digitally, encrypt them and then are beamed from high powered geostationary satellites. They are received by dishes that are given to the DTH consumers by DTH providers. Though DBS and DTH present the same services to the consumers, there are some differences in the technical specifications. While DBS is used for transmitting signals from satellites at a particular frequency band [the band differs in each country], DTH is used for transmitting signals over a wide range of frequencies [normal frequencies including the KU and KA band].

b)



VIIa

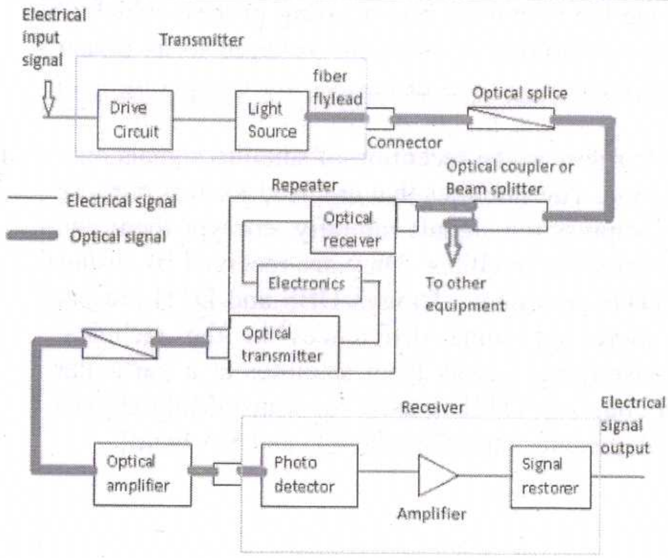


Figure 1

- The optical fiber consists of three main elements: 4

1. Transmitter: An electric signal is applied to the optical transmitter. The optical transmitter consists of driver circuit, light source and fiber flylead.
    - Driver circuit drives the light source.
    - Light source converts electrical signal to optical signal.
    - Fiber flylead is used to connect optical signal to optical fiber.
2. Transmission channel: It consists of a cable that provides mechanical and environmental protection to the optical fibers contained inside. Each optical fiber acts as an individual channel. 8
    - Optical splice is used to permanently join two individual optical fibers.
    - Optical connector is for temporary non-fixed joints between two individual optical fibers. 4
    - Optical coupler or splitter provides signal to other devices.
    - Repeater converts the optical signal into electrical signal using optical receiver and passes it to electronic circuit where it is reshaped and amplified as it gets attenuated and distorted with increasing distance because of scattering, absorption and dispersion in waveguides, and this signal is then again converted into optical signal by the optical transmitter.
3. Receiver: Optical signal is applied to the optical receiver. It consists of photo detector, amplifier and signal restorer.
    - Photo detector converts the optical signal to electrical signal.
    - Signal restorers and amplifiers are used to improve signal to noise ratio of the signal as there are chances of noise to be introduced in the signal due to the use of photo detectors.

- For short distance communication only main elements are required.

Source- LED Fiber- Multimode step index fiber Detector- PIN detector

- For long distance communication along with the main elements there is need for couplers, beam splitters, repeaters, optical amplifiers.

Source- LASER diode Fiber- single mode fiber Detector- Avalanche photo diode (APD)

b) **Definition:** The diode in which the intrinsic layer of high resistivity is sandwiched between the P and N-region of semiconductor material such type of diode is known as the PIN diode. The high resistive layer of the intrinsic region provides the large electric field between the P and N-region. The electric field induces because of the movement of the holes and the electrons. The direction of the electric field is from n-region to p-region.

The symbolic representation of the PIN diode is shown in the figure below. The anode and cathode are the two terminal of the PIN diode. The anode is the positive terminal and cathode represent their negative terminals. 4

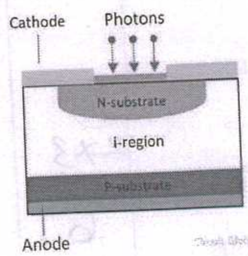
The diode consists the P-region and N-region which is separated by the intrinsic semiconductor material. In P-region the hole is the majority charge carrier while in n-region the electron is the majority charge carrier. The intrinsic region has no free charge carrier. It acts as an insulator between n and the p-type region. The i-region has the high resistance which obstructs the flow of electrons to pass through it.

PIN Diode

3 7 15

Working of PIN Diode

The working of the PIN diode is similar to the ordinary diode. When the diode is unbiased, their charge carrier will diffuse. The word diffusion means the charge carriers of the depletion region try to move to their region. The process of diffusion occurs continue until the charges become equilibrium in the depletion region.

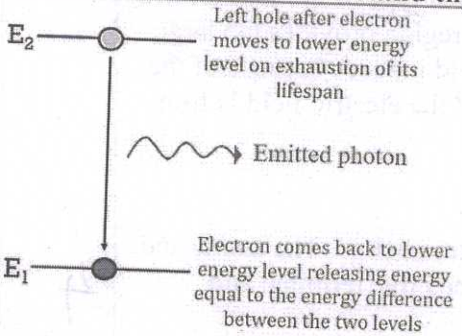


Let the N and I-layer make the depletion region. The diffusion of the hole and electron across the region generates the depletion layer across the NI-region. The thin depletion layer induces across n-region, and thick depletion region of opposite polarity induces across the I-region.

viiia

Definition: A semiconductor device that generates coherent light of high intensity is known as laser diode. **LASER** is an abbreviation for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation. **Stimulated emission** is the basis of working of a laser diode. 3

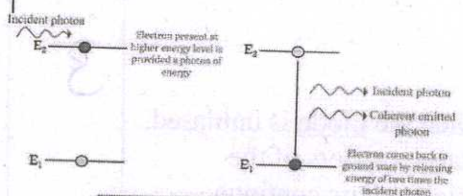
Moving further now understand the process of spontaneous emission.



3 9

Process of spontaneous emission

Due to absorption, the atom is present in the energy level E_2. So, as the lifespan of the atom expires it now comes back to ground level from the higher energy level. On coming back to ground level the atom emits the energy difference of the two energy levels i.e., $E_2 - E_1$. This energy is emitted by the atom in the form of electromagnetic wave, generating a photon of energy. This process is termed spontaneous emission.This radiation emission phenomenon is usually seen in optoelectronic devices such as LED. Let us now understand the process of stimulated emission 3



Process of stimulated emission

b)

The Advantages

Fiber-optic systems have a large number of advantages over copper wire cables. Among the most important are the following:

- Because fiber-optic cables are both lighter and smaller in diameter than copper lines, they can be more easily produced and installed.
- Fiber-optic systems use significantly less energy than copper lines and are thus immune to many dangers associated with the electrical current used in copper lines.
- Fiber-optic communication systems can be used to transmit more information than copper cables and are well-suited for use with digital communications.

2×3 6 6 15

electromagnetic interference and produce no interference when operating.

- Finally, fiber-optic lines are less expensive than copper cables, which can drastically reduce the cost of installing new lines or maintaining older ones.

IXa

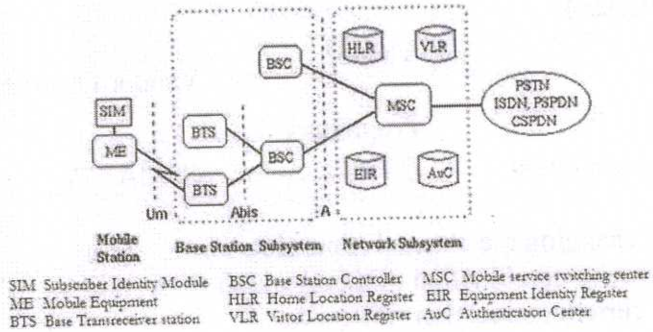
GSM network architecture elements

The GSM network architecture as defined in the GSM specifications can be grouped into four main areas: 5

- Network and Switching Subsystem (NSS)
- Base-Station Subsystem (BSS)
- Mobile station (MS)
- Operation and Support Subsystem (OSS)

The different elements of the GSM network operate together and the user is not aware of the different entities within the system. 10

A basic diagram of the overall system architecture for 2G GSM with these four major 5



elements is shown below:

b)

Comparison Table

Freature	WiMax (802.16a)	Wi-Fi (802.11b)	Wi-Fi (802.11a/g)
Primary Application	Broadband Wireless Access	Wireless LAN	Wireless LAN
Frequency Band	Licensed/Unlicensed 2 G to 11 GHz	2.4 GHz ISM	2.4 GHz ISM (g) 5 GHz U-NII (a)
Channel Bandwidth	Adjustable 1.25 M to 20 MHz	25 MHz	20 MHz
Half/Full Duplex	Full	Half	Half

Radio Technology	OFDM (256-channels)	Direct Sequence Spread Spectrum	OFDM (64-channels)
Bandwidth Efficiency	<=5 bps/Hz	<=0.44 bps/Hz	<=2.7 bps/Hz
Modulation	BPSK, QPSK, 16-, 64-, 256-QAM	QPSK	BPSK, QPSK, 16-, 64-QAM
FEC	Convolutional Code Reed-Solomon	None	Convolutional Code
Encryption	Mandatory- 3DES Optional- AES	Optional- RC4 (AES in 802.11i)	Optional- RC4 (AES in 802.11i)
Mobility	Mobile WiMax (802.16e)	In development	In development
Mesh	Yes	Vendor Proprietary	Vendor Proprietary
Access Protocol	Request/Grant	CSMA/CA	CSMA/CA

5 5 15

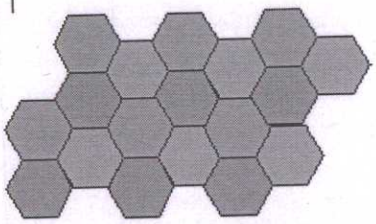
Xa Handoff is a process of changing the channel (time slot, spreading code, frequency or combination of them) which are associated with the current connection while a ca ll is in progress [1].

The handoff process is initiated by issuing of the handoff request. When the power received by the MS from BS of neighbouring cell exceeds the power received from the BS of the current cell by a certain amount, this is known as the h andoff threshold and this is a fixed value. For successful handoff, handoff request must be grabted by a channel before the power received by the MS reaches the receiver's threshold. The area where the ratio of received power levels from the current and th e target BS's is between

5

In the cellular concept, frequencies allocated to the service are re-used in a regular pattern of areas, called 'cells', each covered by one base station. In mobile-telephone nets these cells are usually hexagonal. In radio broadcasting, a similar concept has been developed based on rhombic cells.

To ensure that the mutual interference between users remains below a harmful level, adjacent cells use different frequencies. In fact, a set of C different frequencies $\{f_1, ..., f_C\}$ are used for each cluster of C adjacent cells. Cluster patterns and the corresponding frequencies are re-used in a regular pattern over the entire service area. 4 9



b)

i)Bluetooth is an open wireless technology standard for transmitting fixed and mobile electronic device data over short distances. Bluetooth was introduced in 1994 as a wireless substitute for RS-232 cables.

Bluetooth communicates with a variety of electronic devices and creates personal networks operating within the unlicensed 2.4 GHz band. Operating range is based on device class. A variety of digital devices use Bluetooth, including MP3 players, mobile and peripheral devices and personal computers. 3

ii)RFID (radio frequency identification) is a form of wireless communication that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency portion of the electromagnetic spectrum to uniquely identify an object, animal or person. An RFID system consists of three components: a scanning antenna and transceiver (often combined into one reader, also known as an interrogator) and a transponder, the RFID tag. An RFID tag consists of a microchip, memory and antenna. 6

The RFID reader is a network-connected device that can be permanently attached or portable. It uses radio frequency waves to transmit signals that activate the tag. Once activated, the tag sends a wave back to the antenna, where it is translated into data.

Types of RFID tags

There are two main types of RFID tags: active RFID and passive RFID. An active RFID tag has its own power source, often a battery. A passive RFID tag, on the other hand, does not require batteries; rather it receives its power from the reading antenna, whose electromagnetic wave induces a current in the RFID tag's antenna. There are also semi-passive RFID tags, meaning a battery runs the circuitry while communication is powered by the RFID reader. 3 15 based on rhombic cells.

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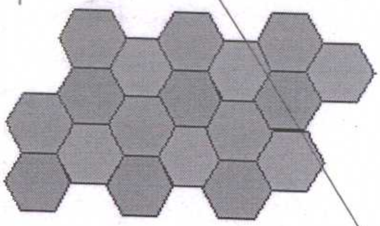

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