Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q.1 (A) Attempt any THREE: **12M**

a) List and explain any two advantages and disadvantages of fiber optic communication.

Ans:

Advantages:- (Any 2) **2M**

- **High Bandwidth -** The higher the bandwidth, the greater the information carrying capacity. A higher bandwidth allows for higher data rates, more users and longer distances.
- **Easy Upgrades -** Fiber optic cable allows for easy future upgrades. Because a variety of transmissions can use fiber optics, it is only necessary to change the electronics. The cable can stay in place. No need to pull new cable in the future.
- **Low Attenuation -** This is a reduction of signal strength or loss of light power over the length of the fiber. Fiber optic cable usually has low attenuation characteristics which allow signals to travel over longer distances without reamplification. However, attenuation can be affected by extrinsic (environmental and physical bends), intrinsic (absorption and scattering) and wavelength. The longer the wavelength, the lower the attenuation.
- **EMI/RFI Immunity -** Since fiber optic cable transmits light instead of electrical current, immunity to electromagnetic and radio frequency interference provides better signal quality, ensuring low bit error rates and/or low noise on the system.
- **Security -** Again, since there is no electrical signal, fiber optic transmission is almost impossible to tap into without being detected.
- **Lightweight**- Fiber optic cable is smaller and lighter than copper cable allowing for easier installation, especially when conduit and/or raceway space is at a premium
- **Low Power Loss -** An optical fiber offers low power loss. This allows for longer transmission distances. In comparison to copper; in a network, the longest recommended copper distance is 100m while with fiber, it is 2000m.
- **Interference -** Fiber optic cables are immune to electromagnetic interference. It can also be run in electrically

noisy environments without concern as electrical noise will not affect fiber.

- **Size** - In comparison to copper, a fiber optic cable has nearly 4.5 times as much capacity as the wire cable has and a cross sectional area that is 30 times less.
- **Safety** - Since the fiber is a dielectric, it does not present a spark hazard.

Disadvantages of OFC: (Any 2) 2M

- **Cost** - Cables are expensive to install but last longer than copper cables.
- **Transmission** - transmission on optical fiber requires repeating at distance intervals.
- **Fragile** - Fibers can be broken or have transmission loses when wrapped around curves of only a few centimeters radius. However by encasing fibers in a plastic sheath, it is difficult to bend the cable into a small enough radius to break the fiber.
- **Protection** - Optical fibers require more protection around the cable compared to copper.
- **Affected by chemicals** - The glass can be affected by various chemicals including hydrogen gas (a problem in underwater cables.)
- **Opaqueness** - Despite extensive military use it is known that most fibers become opaque when exposed to radiation.

- **Requires special skills** - Optical fibers cannot be joined together as a easily as copper cable and requires additional training of personnel and expensive precision splicing and measurement equipment.
- Brittleness and small size makes it difficult to work with.
- Difficult to manufacture.
- Expensive tools and techniques are required.

b) Draw the schematic of fiber optic communication system and describe the function of LED and photodiode in it.

Ans*:*

Diagram: **2M**

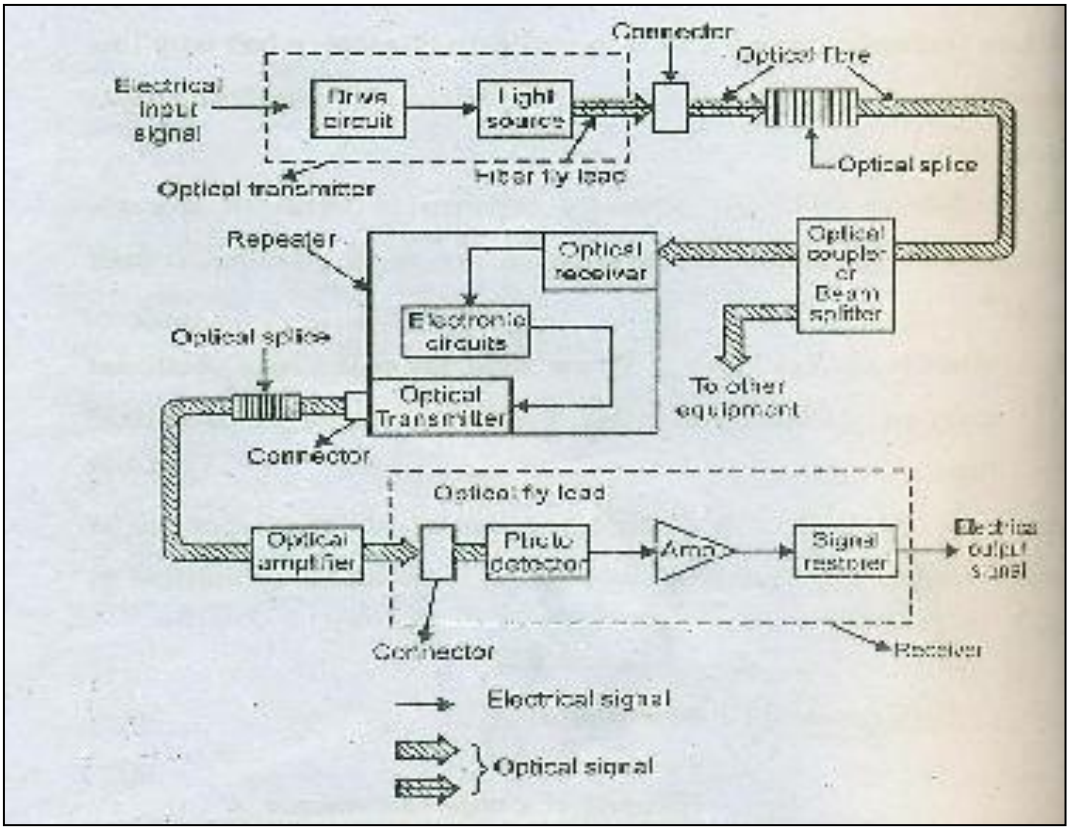


Fig. Schematic of fiber optic communication system

OR

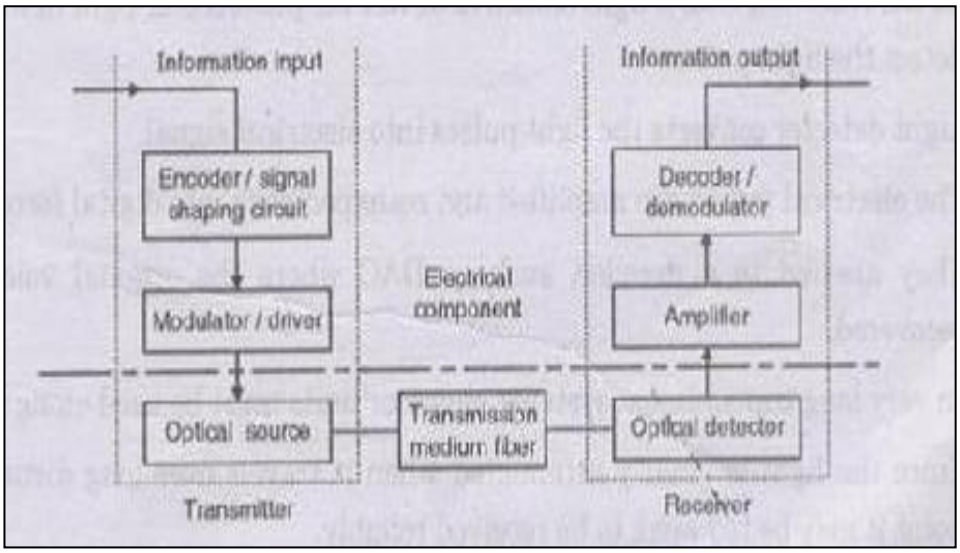


Fig. Schematic of fiber optic communication system

Optical Source (LED): **1M**

LED acts as light emitting source which is then transmitted into the fiber optic cable

- LED is used as light source at the transmitting end in optical fiber communication system. They are used in a low cost system and for short distance communication.
- Then digital pulses are used to drive a powerful light source off and on very rapidly. In low cost system for shorter distance communication LED is used.
- Color of light emitted depends on material used to construct LED.

.

Optical Detector (Photodiode) **1M**

Photodiode acts as light detector, on which light is incident from the fiber optic cable

- An optical detector is a transducer that converts an optical signal into an electrical signal. It does this by generating an electrical current proportional to the intensity of incident light.
- At the receiving end a light sensitive device/ light detector i.e. Photodiodes generally avalanche photo diode is used to detect light pulses.
- Light detector converts light pulses into electrical signal.

c) Draw well diagram of eye pattern of optical fiber. Define any two features in it.

Ans:

Diagram: **2M**

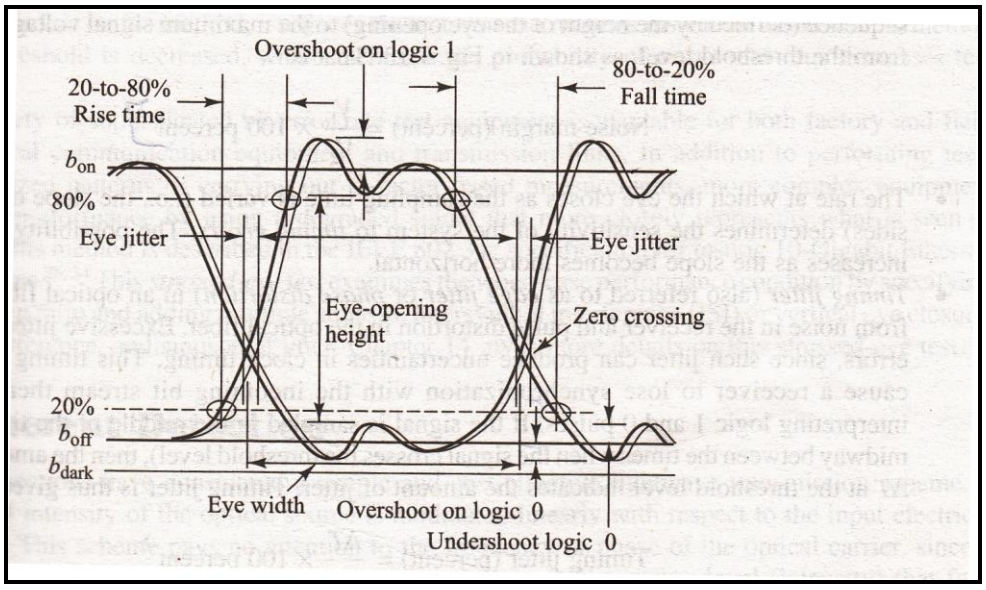
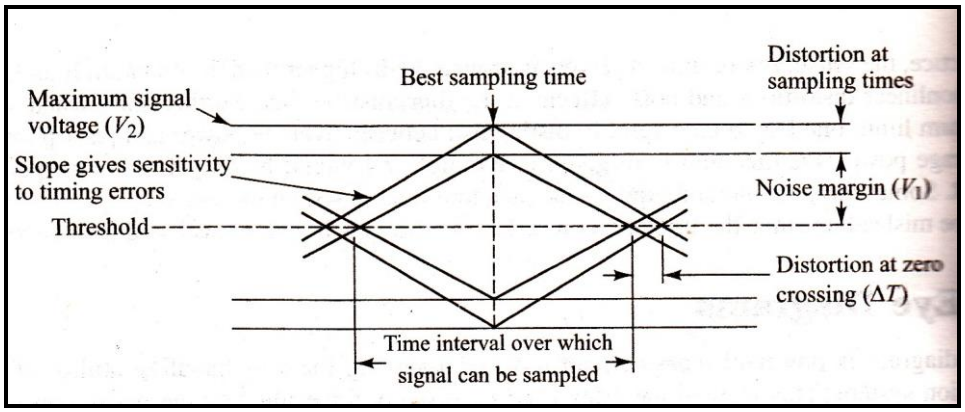


Fig: Eye pattern of optical fiber

OR



Features: (any two) **1M**

1**. Noise margin** is the percentage ratio of the peak signal voltage V1 for an alternating bit sequence to the maximum signal voltage width as measured from the threshold level , known as noise margin.

Formula: **1M**

Noise margin (percent) = V_1/ V_2 X 100 percent.

2. If the signal is sampled in the middle of the time interval, then the amount of distortion T at the threshold level integrates the amount of jitter called as **timing jitter.**

3. The width of the eye opening defines the time interval over which received signal can be sampled without error due to interference from adjacent pules known **as intersymbol interference**.

d) State function of mobile switching center and mobile base station.

Ans:

Mobile Switching Center: [any 4 function 2M]

MSC performs the following major functions:

- Call setup, supervision, and release
- Digit collection and translation
- Call routing
- Billing information collection
- Mobility management: Registration, location updating, inter-BSS and inter-MSC call handoffs
- Paging and alerting
- Management of radio resources during a call
- Echo cancellation
- Manage connections to BSS, other MSCs, and PSTN/ISDN
- Interrogation of appropriate registers (V/HLRs)

Mobile Base Station: [any 4 function 2M]

Functions performed by the Mobile Base Station:

- Radio resource control
- Frequency hopping and power control
- Handoff management
- Digital signal processing

(B)Attempt any ONE: 6M

a)State and explain Snell's law with neat diagram. How Total Internal Reflection does takes place in optical fiber? Explain with neat diagram.

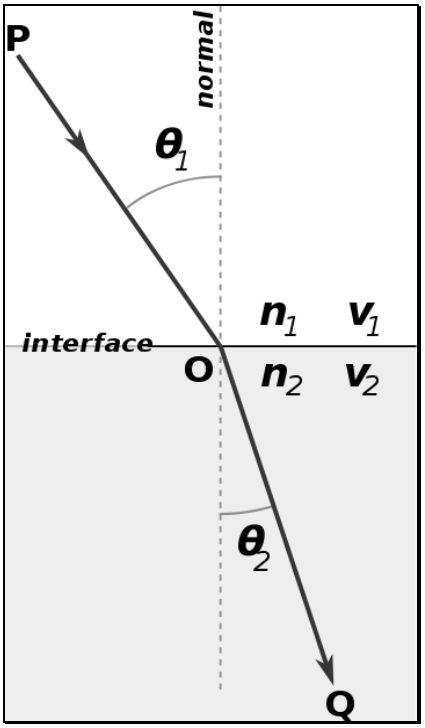
Ans:

Statement of Snell's Law: 1M

Snell's law states that the ratio of the sines of the angles of incidence and refraction is equivalent to the ratio of phase velocities in the two media, or equivalent to the reciprocal of the ratio of the indices of refraction:

$$\frac{\sin\theta_1}{\sin\theta_2} = \frac{v_1}{v_2} = \frac{n_2}{n_1}$$

Diagram: **1M**



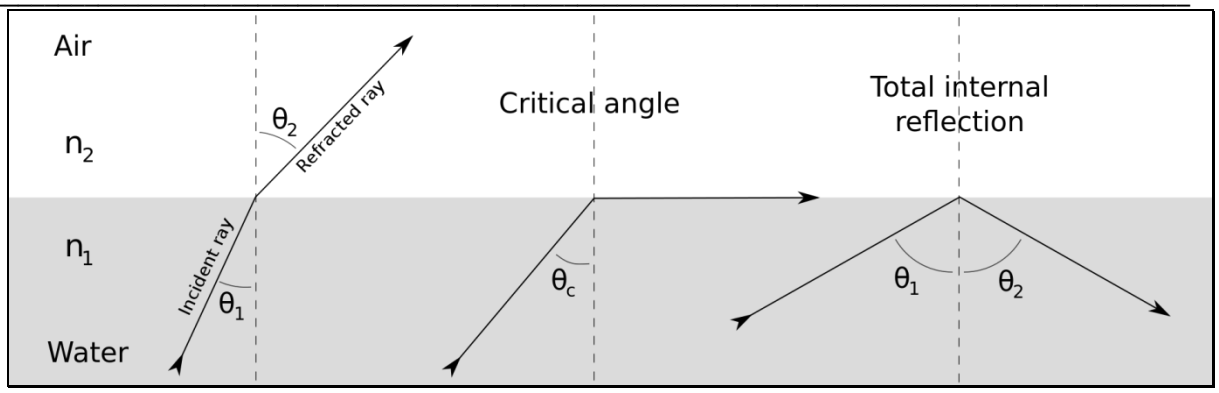
Explanation: **1M**

As light passes the border between media, depending upon the relative refractive indices of the two media, the light will either be refracted to a lesser angle, or a greater one. These angles are measured with respect to the *normal line* represented perpendicular to the boundary.

If a ray travels from a medium of lower refractive index into a medium of higher refractive index, it is bent toward the normal; if it travels from a medium of higher refractive index to a medium of lower index, it is bent away from the normal.

Total internal reflection: **1M**

Total internal reflection is a phenomenon that occurs when light travels from a more optically dense medium (or a medium with higher refractive index) to a less optically dense one (lower index), such as glass to air or water to air. When light travels from an optically dense medium to a less optically dense medium, the light refracts away from the normal. If the angle of incidence is gradually increased, one will notice that at a certain point, the refracted ray deviates so far away from the normal that it reflects rather than refracts. This results whenever the refracted angle predicted by Snell's Law becomes greater than 90 degrees.



2M

b) Explain paging system with neat diagram. What types of messages are sent?

Ans: diagram -2 M, explanation-2 M, Types of message 2 M

Diagram: **2M**

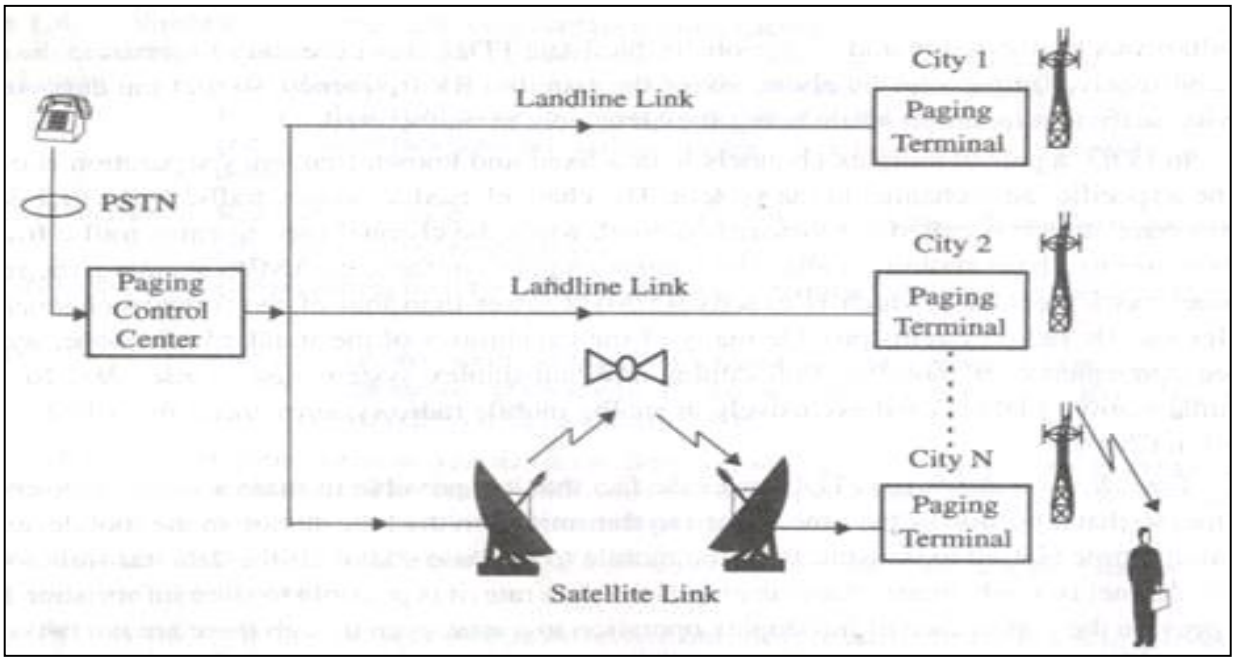


Fig. Paging System

Explanation: **2M**

- **Paging System** Sends brief messages to Subscribers
- Messages may be numeric message, alpha numeric message, voice message.
- In modern paging systems news headlines stock quotation , and faxes may be sent

- A message is sent to a paging subscriber via the paging system access number (usually a toll-free telephone number) with a telephone keypad or modem.
- Page is transmitted throughout the service area by BS on radio carrier
- Covers a limited range of 2-5 km, or may even be confined to within individual buildings , wide area paging system can provide worldwide coverage
- Wide area paging system consist of a network of telephone lines many base station transmitters and a large radio tower that simultaneously broadcast a page from each base station

Types of messages are sent as following: **2M**

1) Numeric message (containing numbers).

2) Alphanumeric message (containing numbers and text)

3) News headlines, stock information etc.

Q.2Attempt any FOUR: **16M**

a) Explain OTDR with neat labeled diagram.

Ans:

Diagram: **2M**

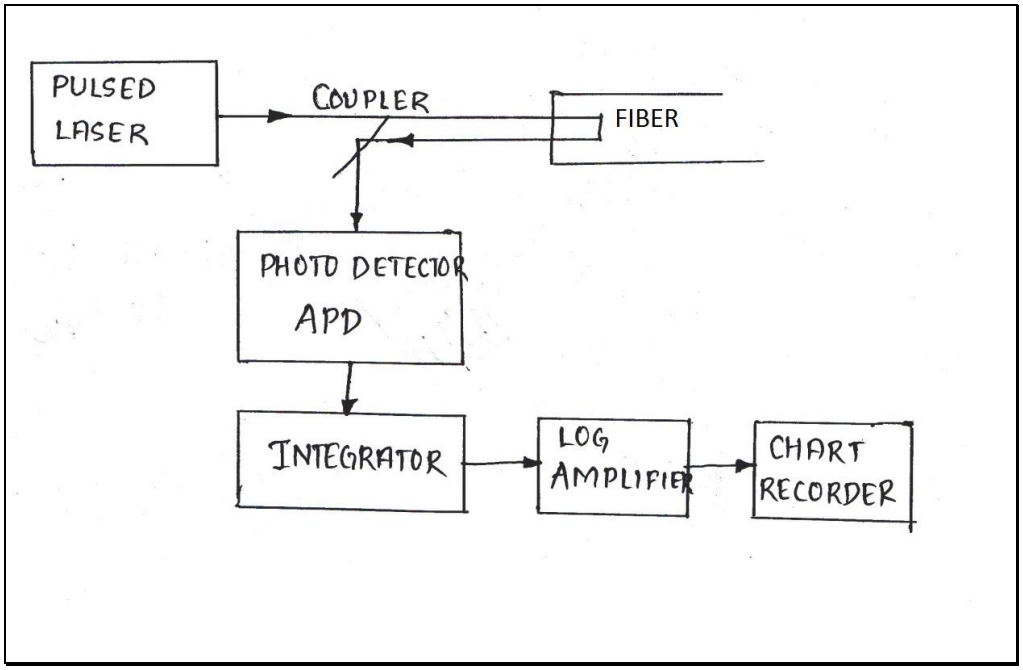


Fig. Block diagram of OTDR

Explanation: **2M**

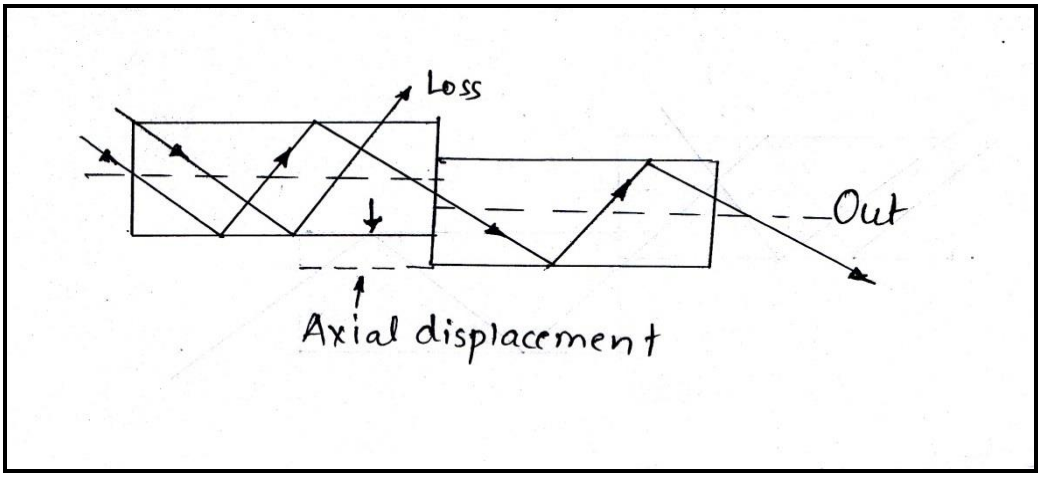
- OTDR is optical time domain reflectometer used for finding faults, splices and binds in fiber optic cables.
- OTDR consists of a light source and receiver, data acquisition and processing modules and an information storage unit for retaining data in external or internal memory disk and display.
- A light pulsed is launched into the fiber in forward direction from an injection laser using coupler or beam splitter.
- Beam splitter or coupler makes possible to couple the optical excitation power impulse into the tested fiber and to deviate the backscattered power to the optical receiver.
- The backscattered light is detected using an avalanche photodiode which drives integrator which is then fed to logarithmic amplifier and average measurements for successive points within the fibers are plotted as a chart recorder.

b) Give reason for the cause of the coupling. Absorption losses with neat diagram in optical fiber.

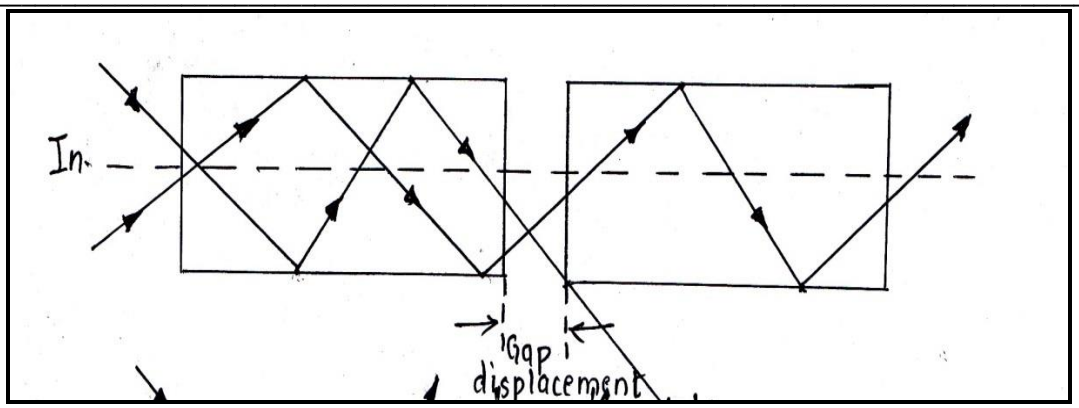
Ans:

Coupling losses in optical fiber are due to following reasons: **½ M each**

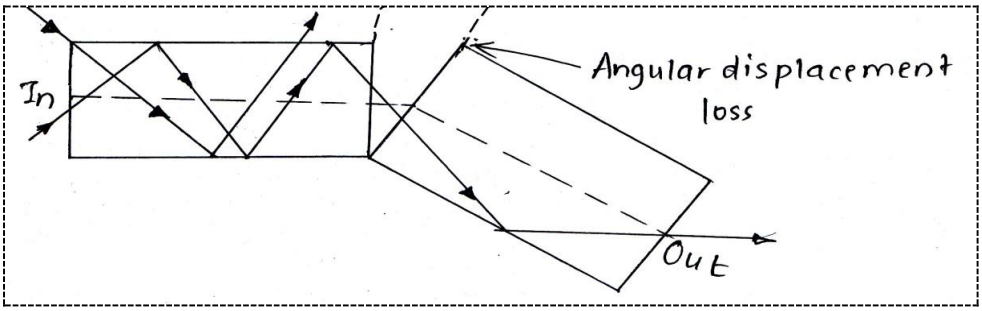
i) Lateral displacement of OFC (Optical fiber cable):



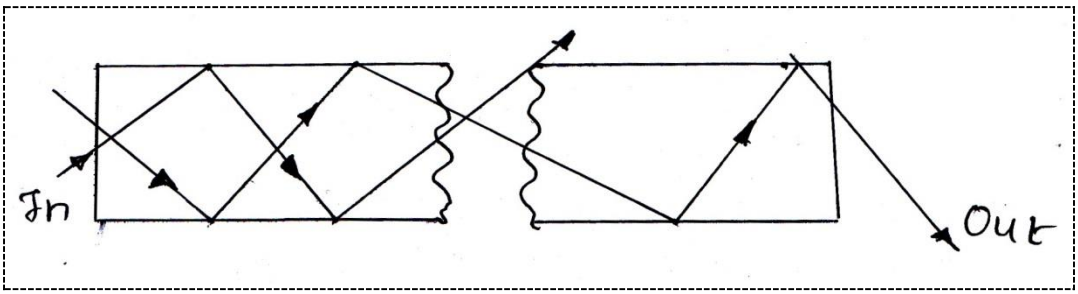
ii) Gap displacement of OFC:



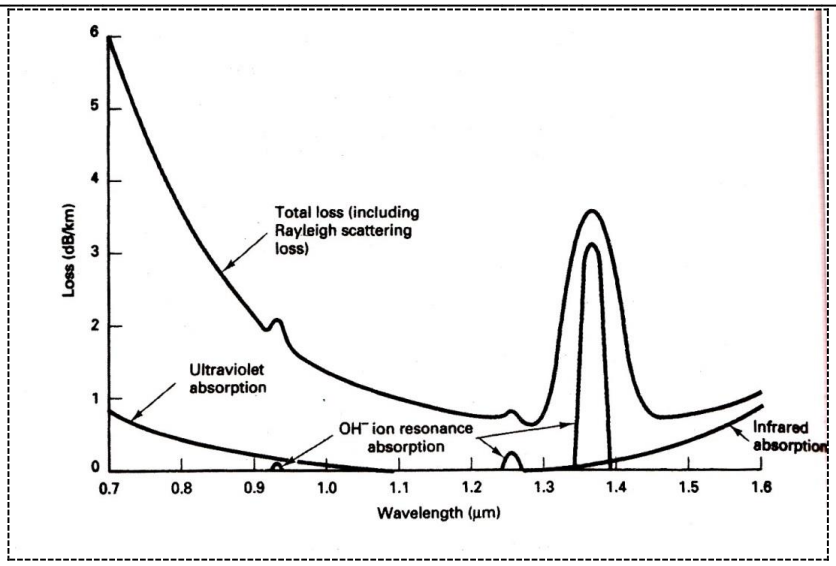
iii) Angular misalignment of OFC:



iv) Surface finish or Rough surface:



Absorption loss: **2M**



OR

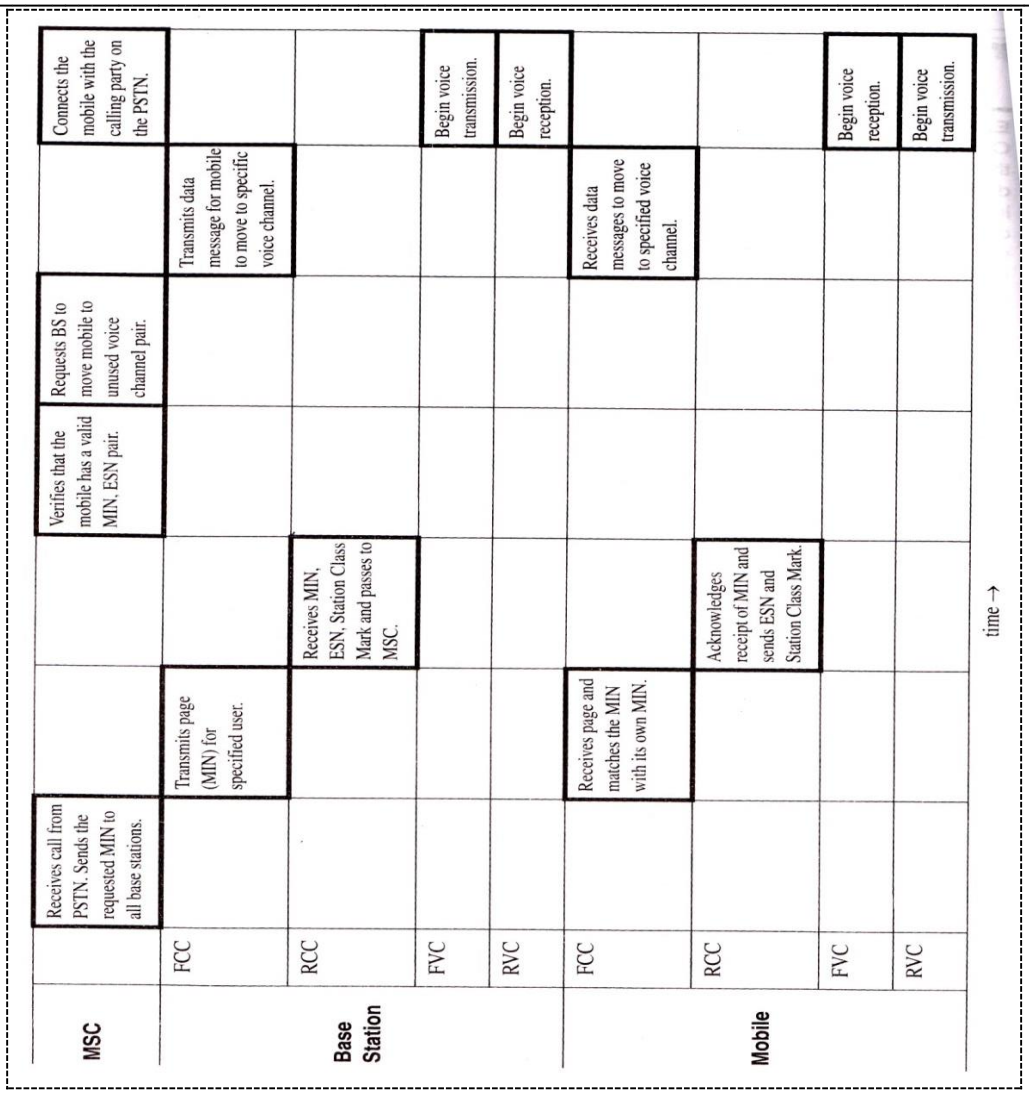
- Absorption losses in optical fiber occur due to the presence of imperfections in atomic structure of fiber material, due to some inherent intrinsic material properties and due to some extrinsic material properties.
- Absorption losses in optical fiber can be contributed due to ultraviolet absorption, infrared absorption and ion resonance absorption.

[NOTE: 2 Marks should be awarded if students draw diagram or if students write explanation of absorption losses]

c) Raju is calling his grandfather from landline phone to mobile phone to wish him for birthday. How does the call processing takes place on FCC, RCC, FVC, and RVC?

Ans: Raju is calling from landline to mobile, so call is initiated from landline subscriber to mobile user.

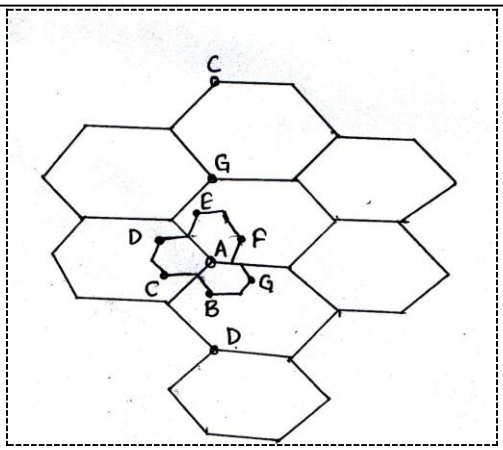
Diagram: **4M**



d) Explain with neat diagram how capacity is enhanced by cell splitting process.

Ans:

Diagram: **2M**



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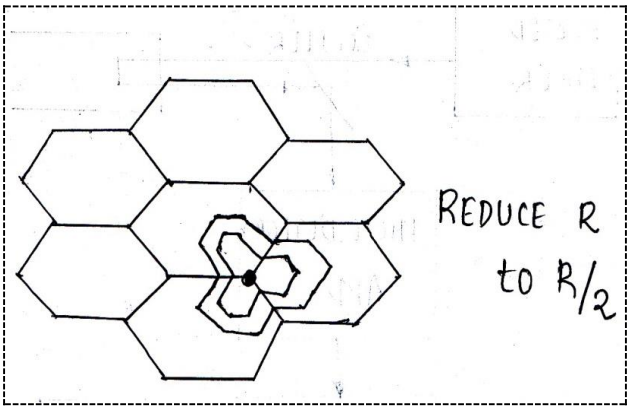


Explanation: **2M**

- Cell splitting in one technique of improving capacity and enhancing capacity of cell splitting of cellular system.
- It is process of **subdividing congested cell into small cell each** with its own base station which leads to reduction in antenna height and transmitted power.
- During all splitting if original cell radius is R then new cell will be with radius R/2 and for all new all transmitted power will be reduced.

$$\text{Pt new} = \frac{Pt\ old}{16} \quad \text{OR} \quad \text{Pt new} = \frac{Pt\ old}{n2}$$

- In all splitting large cells are replaced by smaller cells without upselling the channel allocation scheme.

e) Define numerical aperture and for a silica optical fiber having a refractive index of its core 1.50 and cladding refractive index of 1.47. Find (i) Critical angle (ii) Numerical aperture (iii) Acceptance angle

Ans:

Definition: **1M**

Light gathering capacity of fiber optic cable is called **numerical aperture.**

Given: n_1 (RI of core) = 1.50

n_2 (RI of clad) = 1.47

To find:-

i) θ_c = ?
ii) N_A =?
iii) θ_A (Acceptance angle) =?

Solution: (½ Mark – formula, ½ Mark – correct answer)

i) **Critical angle:**

$\theta_c = \text{Sin}^{-1}\left(\frac{n2}{n1}\right)$

$= \text{Sin}^{-1}\left(\frac{1.47}{1.50}\right)$

$= \text{Sin}^{-1}\ (0.98)$

θ_c = 78.52

ii) **N_A** = $\sqrt{n1^2 - n2^2}$

$= \sqrt{(1.50)^2 - (1.47)^2}$

$= \sqrt{2.25 - 2.16}$

= 0.09

N_A = 0.3

iii) **Acceptance angle:**

$\theta_A = \text{Sin}^{-1} N_A$

$= \text{Sin}^{-1}\ (0.3)$

θ_A = 17.45

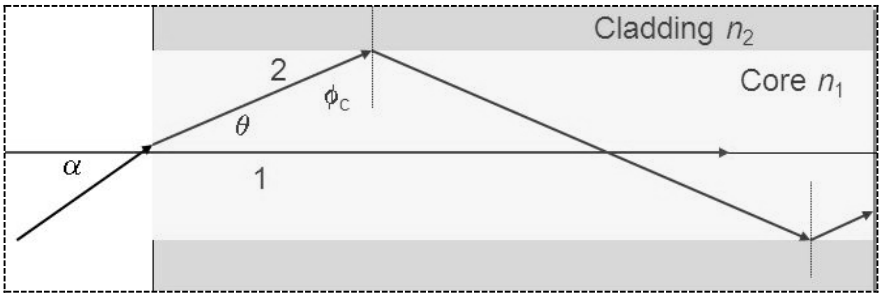
Q.3Attempt any TWO: 16M

a) Describe briefly intermodal and intra modal dispersion in optical with neat diagram.

Ans: (Intermodal dispersion-Explanation-2M, Diagram-2M

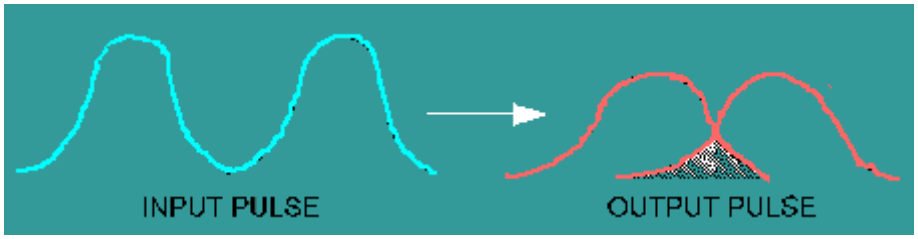
Intra modal dispersion-Explanation-2M, Diagram-2M)

Intermodal dispersion: 2M



- Lower order modes travel almost parallel to the centre line of the fiber cover the shortcut distance thus reaching the end of fiber soon.
- Higher order modes take longer route as they pass along the fiber and reach later.
- This dispersion is mainly in multimode fibers.
- It is pulse broadening due to propagation delay difference between modes within multimode fiber.

Intra modal dispersion: 2M



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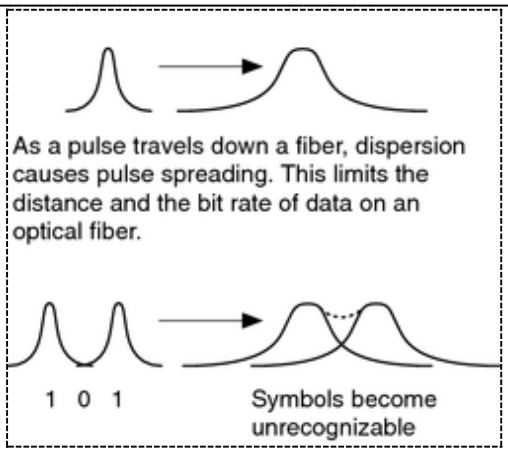


2M

- It is pulse spreading which is within a single mode.
- It is due to material dispersion and waveguide dispersion.
- Material dispersion is due to variation in refractive index of core because of which pulse spreading occurs even when different wavelength follows same path.
- Wavelength dispersion due to practically as 80% optical power is confined to core & rest 20% Optical power is lost into clad.

b) Draw neat diagram of transmitter unit of mobile phone. Explain operation of APC in it. What are the frequencies used by transmitter unit?

Ans:

Diagram: **4M**

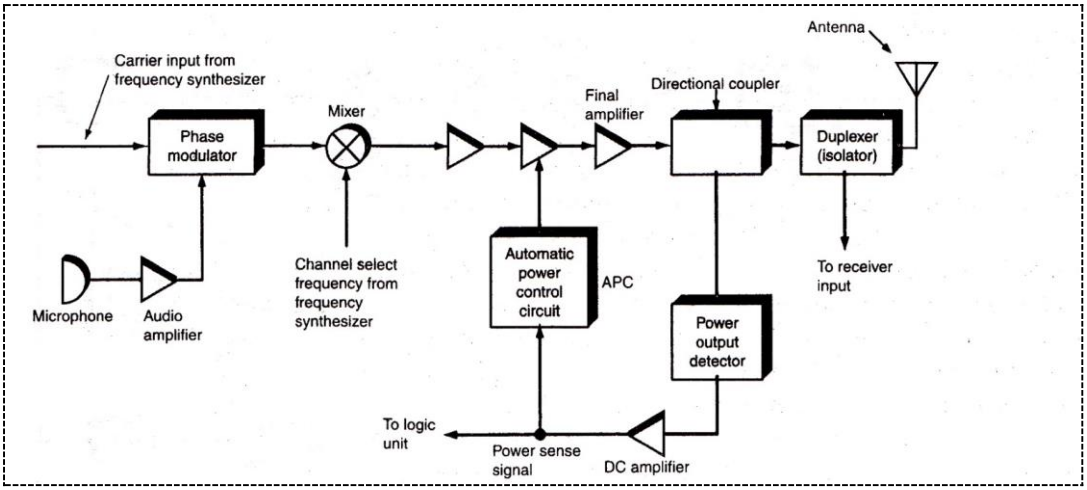


Fig. of transmitter unit of mobile phone

- **Operation of automatic power control:-** **2M**
  - The output power of high power transmitter is controlled by the cell rate and MTSO.
  - Control signal picked up by receiver are sent to automatic power control circuit which the transmitter to one of 8 power output levels.
  - APC permits optimum all site reception with minimal power 4dB from 0dB.
  - APC does this by controlling the supply voltage to one of the controlling power amplifier stage.

- **Frequency range used by transmitter unit:** **2M**
  - (825 to 845) MHz

[NOTE: Marks can be awarded if student write transmitter unit frequency of any system GSM, IS95 etc.]

c) Explain frequency planning in wireless communication system with neat diagram. Draw reuse pattern for cluster size 7 and 12. Also explain how co-channels cells are located.

Ans: **Explanation:** **2M**

- The design process of selecting and allocating channel groups for all of the cellular base stations within a system is called **frequency reuse of frequency planning.**
- From the diagram each 7 cells forms a cluster and each cell is assigned unique set of frequency A, B, C, D, E, F and G.
- The cells with same set of frequency is called co-channel cell.

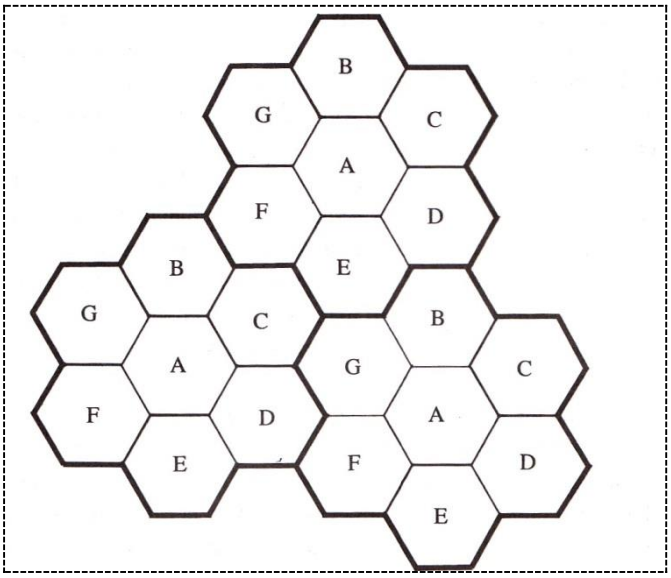


Fig. Frequency planning in wireless communication system

Diagram of cluster size-each1M, **2M**

7 cells

12 cells

Co-channel cell location: **1M**

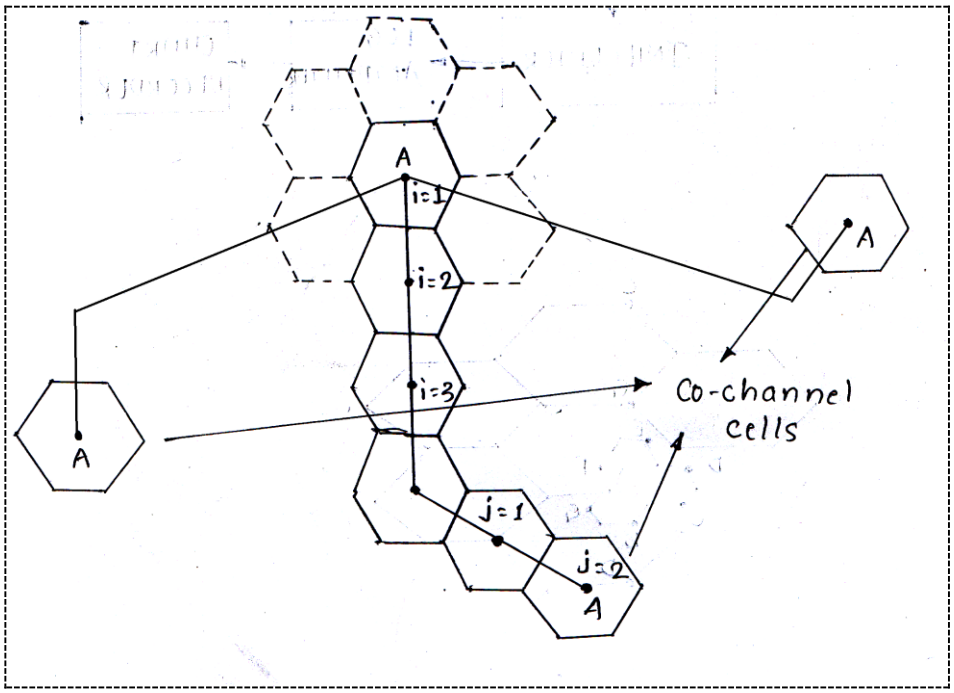
To locate the nearest co-channel:-

- Consider equation $N = i^2 + ij + j^2$
  Where, N= is No of cells per cluster

  j = are non-negative integer let I =3 & j=2

- Move cell along any side of hexagon.
- Turn 60^0 counter clockwise and move j cell.

Method of locating co-channel cells: - **1M**



Q.4 (A) Attempt any THREE: **12 M**

a) Describe co-channel interference. How does co-channel interference becomes a serious concern in the design of cellular system?

Ans:

Diagram -2 Mark,
Co-channel interference -1 Mark,
How does co-channel interference becomes a serious concern -1 Mark

Diagram:

2M

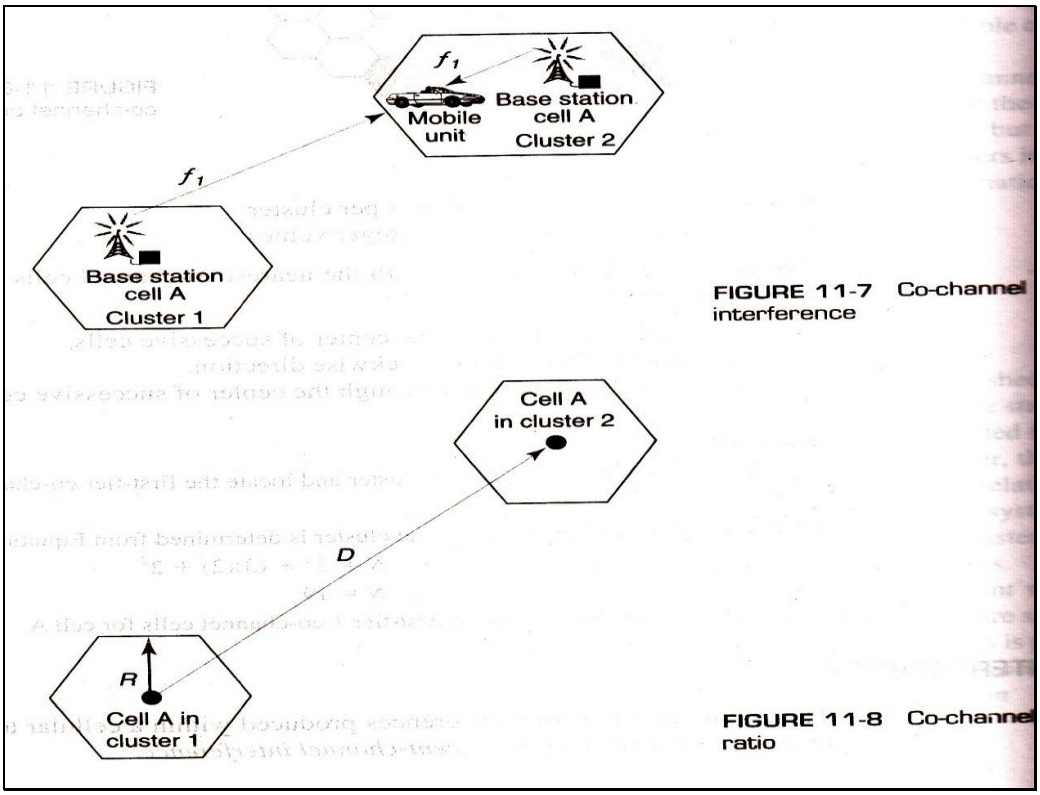


FIGURE 11-7 Co-channel interference

FIGURE 11-8 Co-channel ratio

Fig. Co-channel interference

Co-channel interference:

1M

- When frequency reuse is implemented, several cells within a given coverage area use the same set of frequencies. Two cells using the same set of frequencies are called co-channel cells, and the interference between them is called co-channel interference.

- Unlike thermal noise, co-channel interference cannot be reduced by simply increasing transmit power because increasing the transmit power in one cell increases the likelihood of that cell's transmissions interfering with another cell's transmission. To reduce co-channel interference, a certain minimum distance must separate co-channels.

Co-channel interference becomes a serious concern in the design of cellular system **1M**

- Signal to power ratio is reduced
- Reception capacity will be reduced
- Coverage area will be reduced.

b) State features of IMT 2000(any four).

Ans: (Any four, each feature 1 Mark)

- Common spectrum worldwide (1.8-2.2 GHz band)
- Multiple radio environments (cellular, cordless, satellite, LANs)
- Wide range of telecommunications services (voice, data, multimedia, and internet)
- Flexible radio bearers for increased spectrum efficiency
- Data rates up to 2 Mb/s (phase 1)—for indoor environments
- Maximum use of IN capabilities (for service provision and transport)
- Global seamless roaming
- Enhanced security and performance
- Integration of satellite and terrestrial systems
- High level of flexibility
- Cost-effectiveness in all operating environments
- Commonalty of design worldwide
- Operation within the designated MT-2000 frequency bands

c) With neat sketch explain the working principle of Avalanche photodiode.

Ans: Avalanche photodiode are used to obtain the large gain, i.e large output because conventional photodiodes and PIN photodiodes obtain the limited gain.

Diagram: **2M**

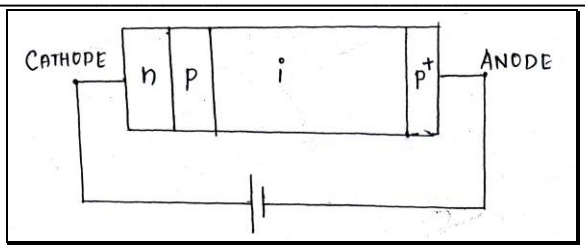


Fig. Avalanche photodiode

Or

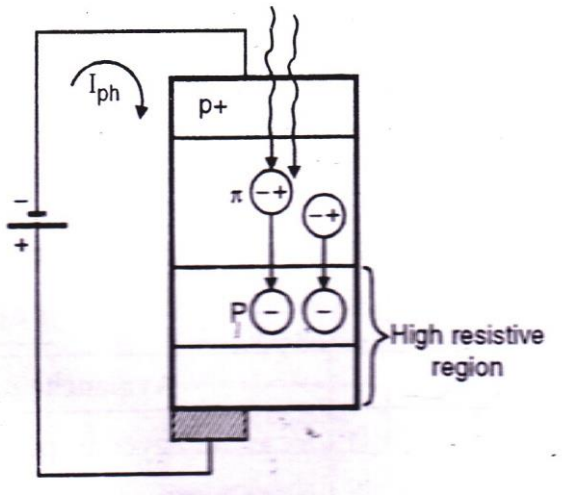


Fig. Avalanche photodiode

Working: **2M**

- Light enters the diode & absorbed by the P^+ material.
- This causes high electric field intensity developed across the i-p-n junction.
- This provides reverse biased & causes impact ionization.
- During ionization carrier can gain sufficient energy to ionize other electrons.
- This process is continues like an avalanche.
- It is effectively equivalent to an internal gain or carrier multiplication.
- APD's are more sensitive than PIN diodes.
- And requires less additional amplification.

d) With neat diagram explain working of edge emitter LED.

Ans:

Diagram: **2M**

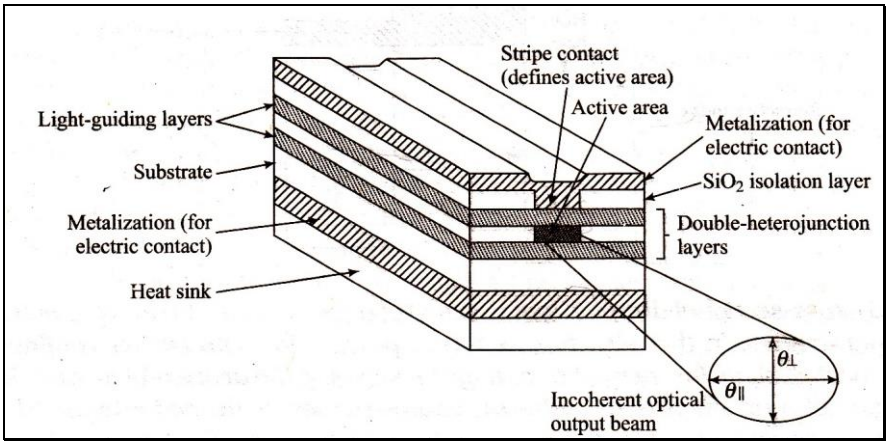
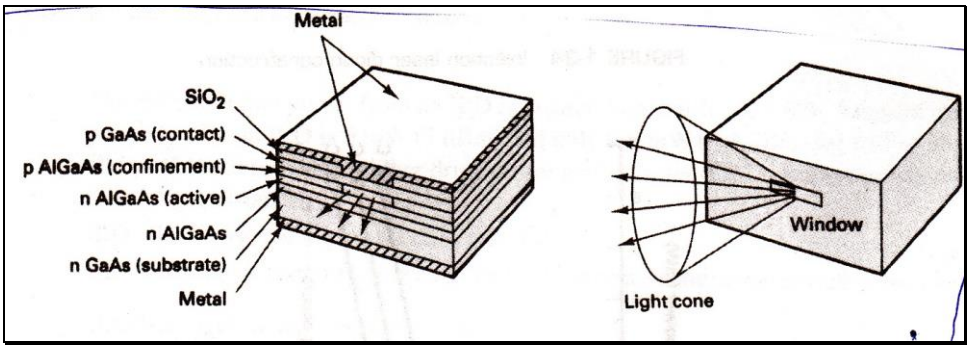
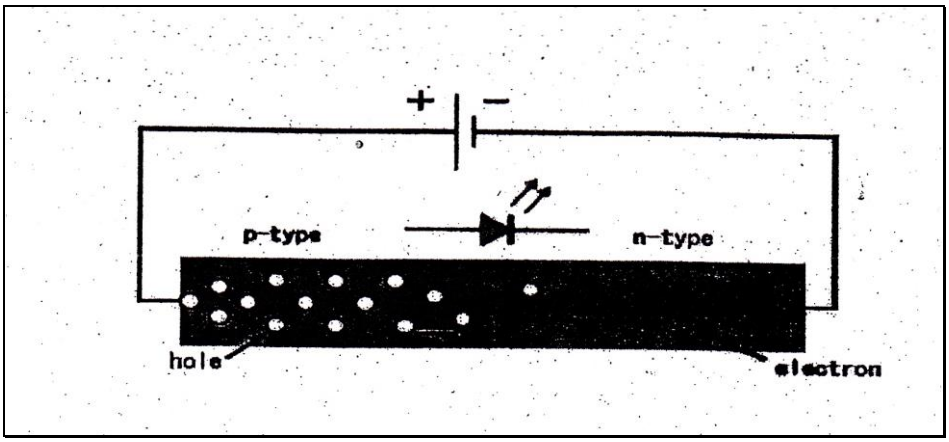


Fig. Working of edge emitter LED

OR



OR



Working: **2M**

- Here an N type layer is grown on a P type substrate by a diffusion process. Then a thin P type later is grown on the N type layer. The metal connections to both the layers anode and cathode terminals.
- The light energy is released at the junction, where the recombination of electrons with holes takes place.
- An LED is forward biased; the electrons and holes move towards the junction and recombination takes place. After recombination the electrons, lying in the valence band of N region, falls into the holes lying in the valence band of the P region.
- The difference of energy between the conduction band and valence band is radiated in the form of light energy.
- The LED's emit different colors of light such as red, green, yellow etc. the color of the emitted light depends upon the type of semiconductor used for e.g
    1. Gallium arsenide emits infrared radiations.
    2. Gallium phosphide emits red or green light.
    3. Gallium nitrite emits blue light.
- There is a large variety of LED's available in the market. They are available in different shapes and sizes. But are more commonly used in cylindrical shape.

(B) Attempt any ONE: **6M**

a) Draw GSM architecture and explain function of any three blocks in it.

Ans:

Diagram: **3M**

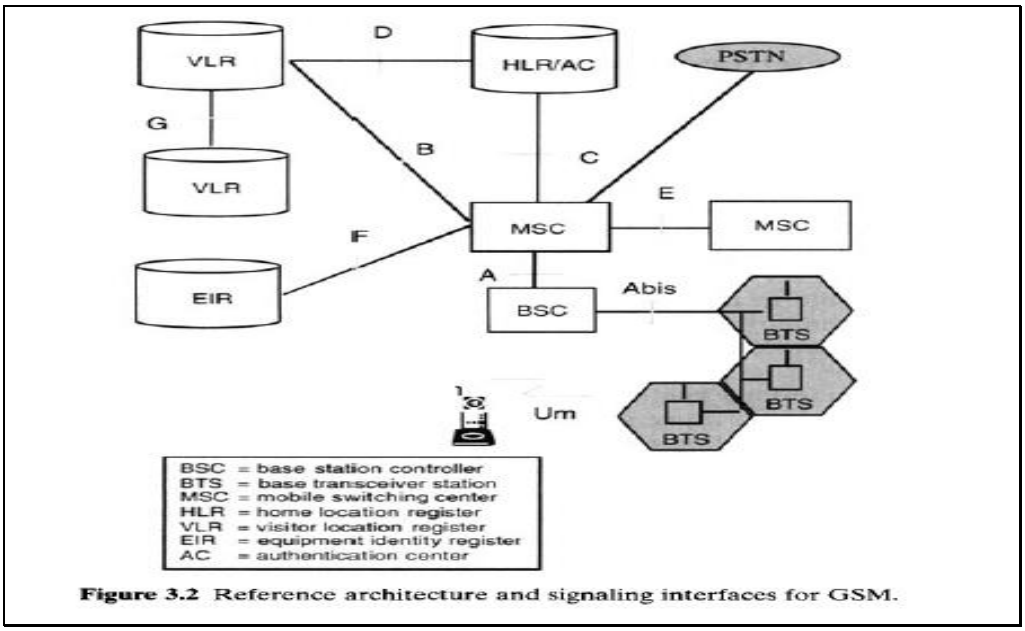


Figure 3.2 Reference architecture and signaling interfaces for GSM.

OR

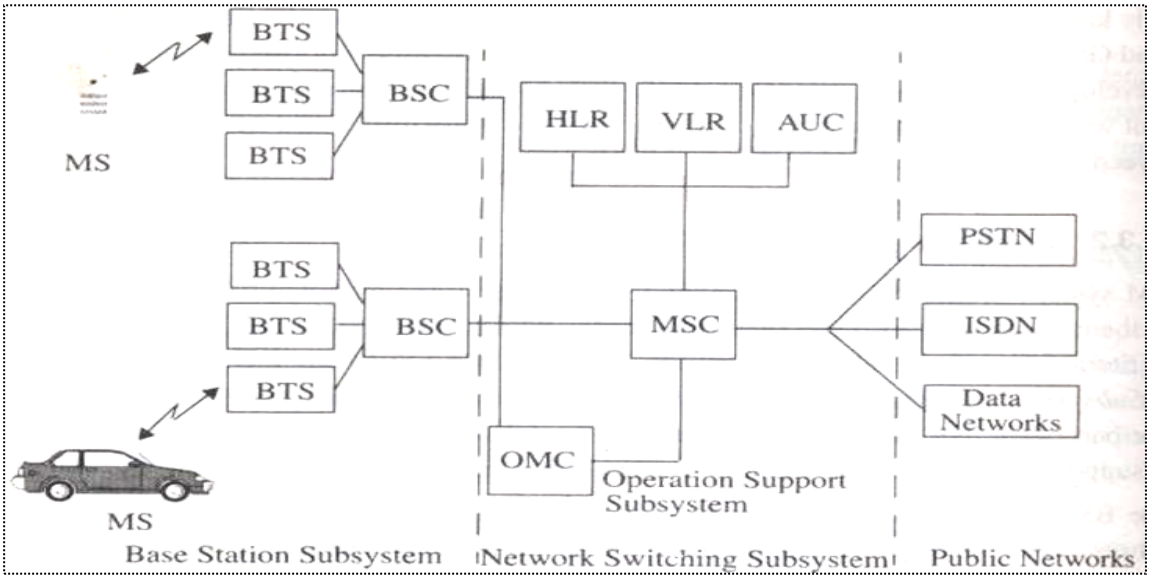
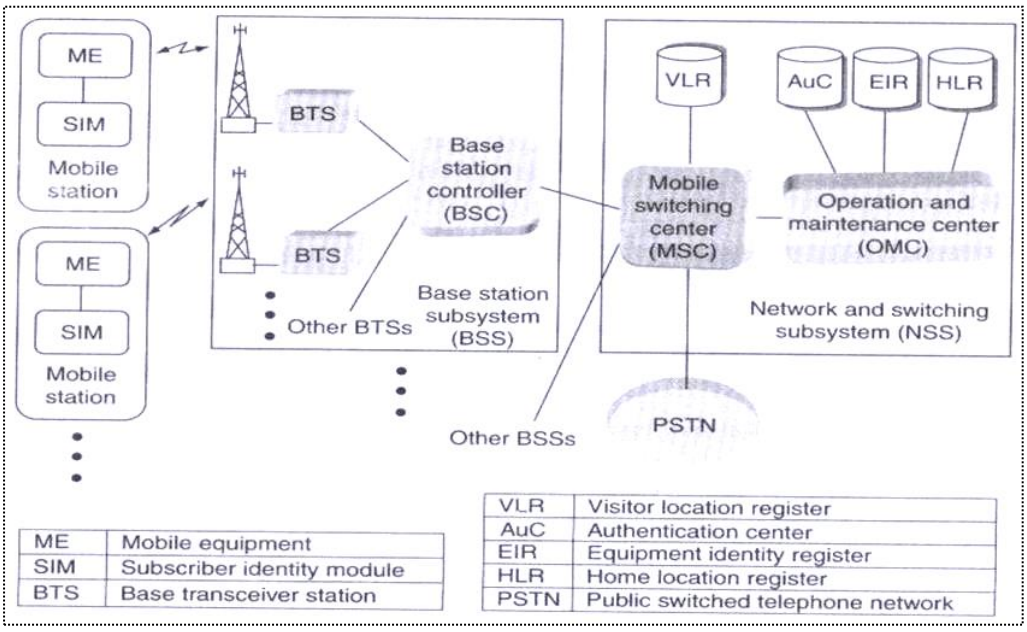


Fig. GSM architecture

OR



[NOTE : stating two brief Function of any three block:] **1M each**

1. BSS :

• Radio resource control
• Frequency hopping and power control
• Handoff management
• Digital signal processing

2. Home Location Registers (HLR)

- Permanent database about mobile subscribers in a large service area (generally one per GSM network operator)
- Database contains subscriber & location information
- Database contains IMSI (International Mobile Subscriber Identity), prepaid/postpaid, roaming restrictions, supplementary services
- Each Subscriber assigned IMSI to identify home user

3. Visitor Location Registers (VLR)

- Temporary database which stores IMSI & customer information for each roaming subscriber visiting the coverage area of particular MSC.
- It updates whenever new MS enters its area, by HLR database. It controls the mobiles roaming in its area.

4. **MSC performs the following major functions:**

• Call setup, supervision, and release
• Digit collection and translation
• Call routing
• Billing information collection
• Mobility management: Registration, location updating ,inter-BSS and inter-MSC call handoffs
• Paging and alerting
• Management of radio resources during a call
• Echo cancellation
• Manage connections to BSS, other MSCs, and PSTN/ISDN
• Interrogation of appropriate registers (V/HLRs)

5. **Authentication Center AC).**

- **AC** associated **with the HLR**, the authentication center contains authentication parameters that are used on initial location registration, subsequent location updates, and on each call setup request from the MS.
- AC maintains the authentication **keys and algorithms**, and **provides the security triplets (RAND,SRES, and Kc)** to the VLR so that the user authentication and radio channel encryption procedures may be carried out within the visited network.
- The authentication center for GSM contains the **security modules** for the authentication keys (Ki) and the authentication and cipher key generation algorithms **A3 and A8,** respectively.

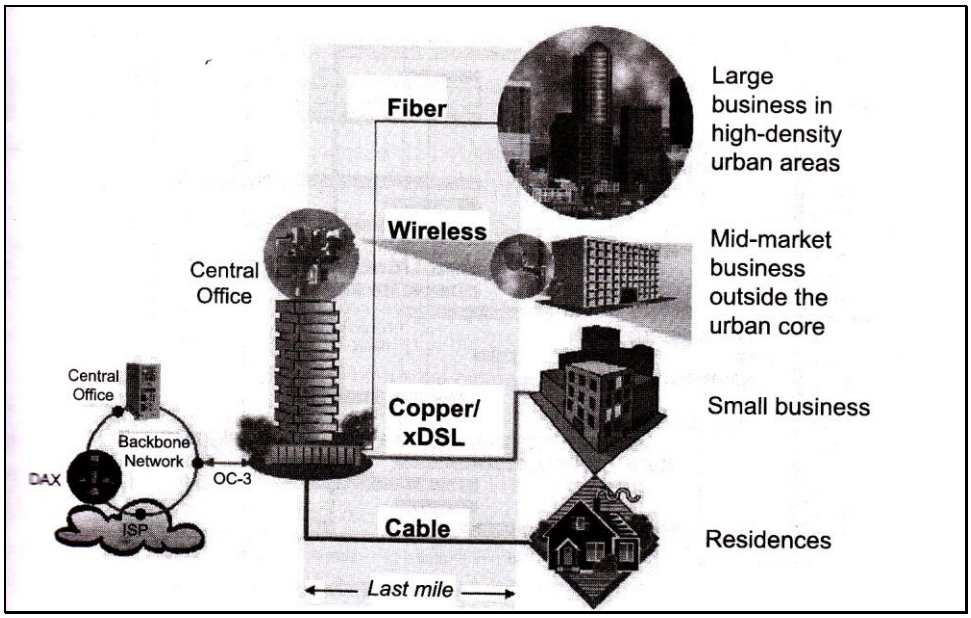
6. **Equipment Identity Register (EIR)**

- EIR maintains information to authenticate terminal equipment so that fraudulent, stolen, or nontype-approved terminals can be identified and denied service.
- The information is in the form of white, gray, and black lists that may be consulted by the network when it wishes to confirm the authenticity of the terminal requesting service.

b) With neat diagram explain wireless local loop setup.

Ans: (Diagram:-3 Mark, explanation -3marks)

Diagram: **3M**



Explanation: **3M**

- Fixed wireless equipment is extremely well suited for rapidly deploying a broadband connection.
- Modern fixed wireless systems are usually assigned microwave or millimeter radio frequency in the 28 GHz band and higher which is greater than 10 times the carrier frequency of 3G terrestrial cellular telephone network.
- At higher frequencies i.e., in GHz, wavelengths are extremely small, which in turn allows very high gain directional antennas to be fabricated in small physical form factor.
- The used high gain antennas have spatial filter properties which reject multipath signals that arrive from directions other than the desire light-of-sight (LOS) and supports transmission of very wide bandwidth signals without distortion.
- Microwave wireless links are used to create WLL.
- Benefit of WLL is that, once wireless equipment is paid for there are no additional costs for transport between central office (CO) and customer premise equipment (CPE).

Q5) Attempt any TWO: **16M**

a) Describe any eight features of 3GWCDMA cellular system.

Ans: (any 8 points) **8M**

Features of 3G WCDMA cellular system:-

1. **3GWCDMA** -UMTS evolved under European telecommunication standard institute (ETSI) in 1996.
2. **3GWCDMA** -UMTS was submitted by ETSI to ITU's IMT-2000 body in 1998 for consideration as a world standard.
3. It assures backward compatibility with 2G GSM, IS-136 and PDC TDMA technologies as well as all 2.5 G technologies.
4. UMTS network structure and bit level packaging of GSM data is retained by **3GWCDMA**
5. Additional capacity and bandwidth is provided by a new CDMA air interface.
6. The 3G W-CDMA air interface std has been assigned for "always-on" packet based wireless n/w and connected to the internet, anytime, anywhere.
7. **3GWCDMA** supports packet data rates upto 2.048 Mbps per user (if user is stationary)
8. W-CDMA supports:-Public and private network feature, As well as video conferencing and Virtual name entertainment. (VHE)
9. W-CDMA Requires:-Minimum spectrum allocation of 5MHz.
10. Complete change out of the RF equipment at each station to provide backward compatibility and interoperability for all GSM, IS-136/PDC, GPRS and EDGE equipment

b) Compare WCDMA with CDMA 2000 on the basis of following parameters:

- **i) Multiple access technique**
- **ii) Chip rate**
- **iii) Modulation scheme**
- **iv) Frame length**
- **v) Pilot structure**
- **vi) Spreading modulation**
- **vii) Scrambling codes**
- **viii) Channelization code**

Ans:

(1 mark- each point)

Parameter	**WCDMA**	**CDMA2000**
Multiple access tech	DS-CDMA	CDMA and TDMA
Chip rate	4.096 MHz	3.6864 MHz

Modulation scheme	BPSK	FW-QPSK, RV-BPSK
Frame length	10 ms	20 ms(also 5, 30,40)
Pilot structure	TDM dedicated pilot	CDM common pilot/ auxiliary pilot
Spreading modulation	Complex(OQPSK)	Complex(OQPSK)
Scrambling codes	S2 or long 38400 gold	Long code sequence
Channelization code	Orthogonal Variable Spreading Factor	Walsh code

c) Define and explain hand-off process in mobile system with neat diagram. List types of handoff and explain any one in brief.

Ans: **[**Define and explain hand-off process- 2M
Diagram. Of hand-off process - 2M
List types of handoff - 2M
Explain any one in brief. - 2M]

Define and explain hand-off process **2M**

Definition:

Transfer of call on different radio channels when subscriber move from one cell area to another is called **handoff or handover.**

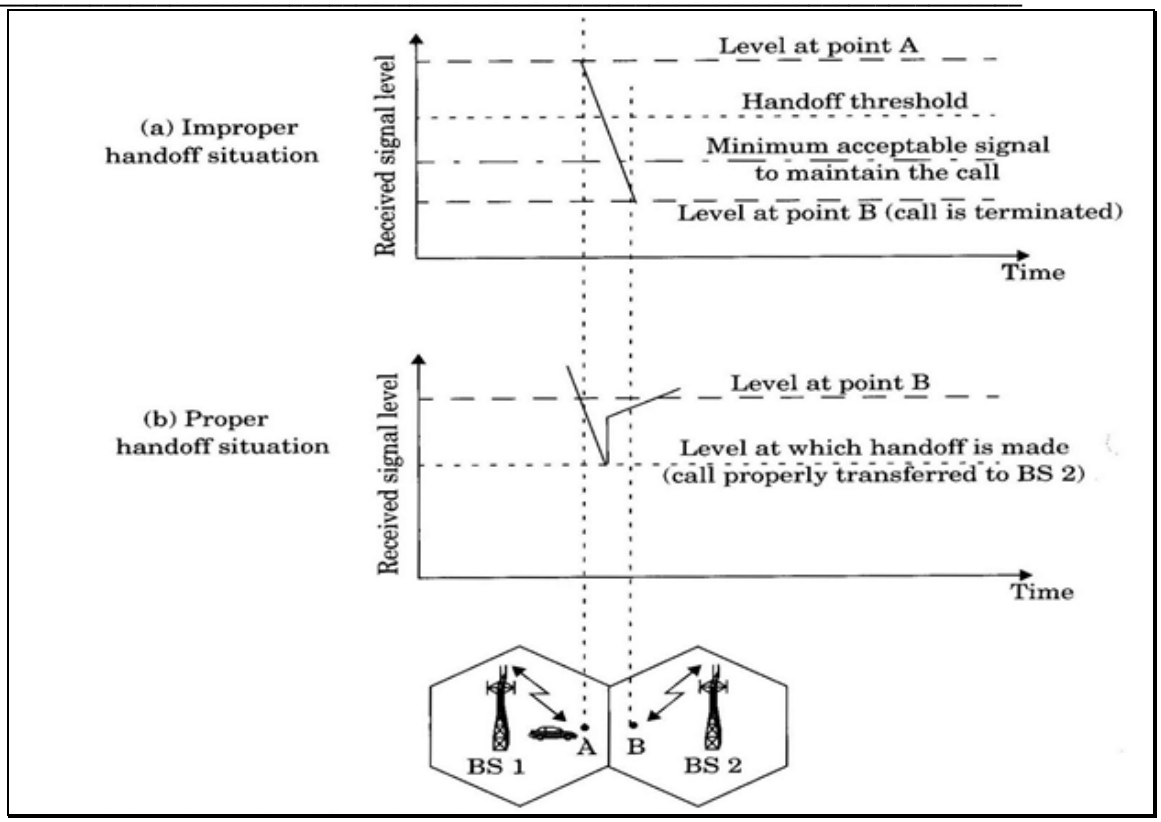
OR

Definition:

When a mobile moves into a different cell while a conversation is in progress, the MSC automatically transfers the call to a new channel belonging to the new base station. This process of transferring call to a new base station is called as Hand off.

From the diagam if the received signal strength falls **below the minimum** acceptable level the **call will terminated** as shown in fig a where as in fig b if the received signal strength **falls below level at point** B the handoff should be made immediately so that call is **properly transferred to BS2**

Diagram. Of hand-off process **2M**



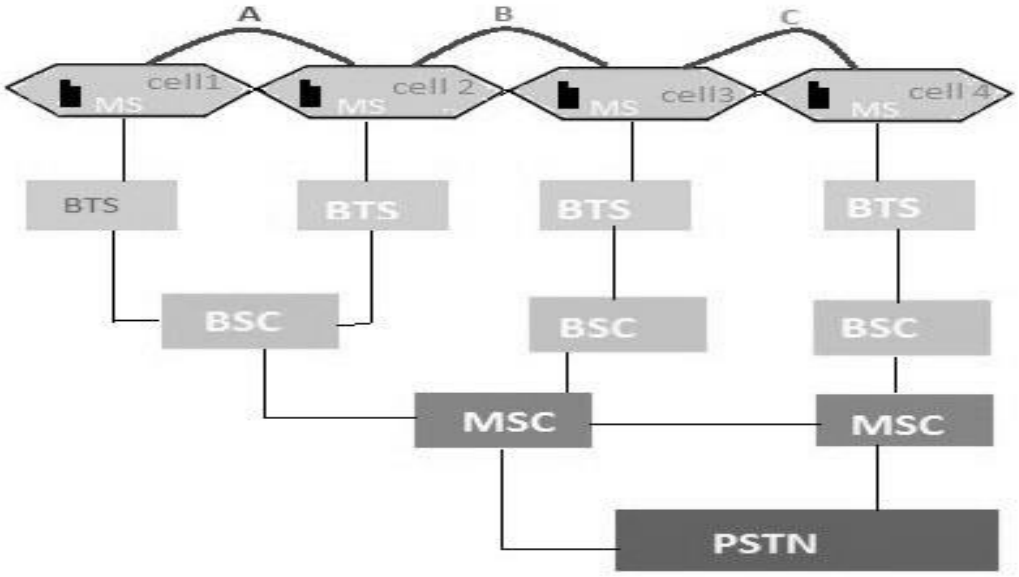
Types of Handoff: **2M**

- Intersystem Hand off (Intersystem BSC, Intersystem MSC,Intra BSC handoff)
- Hard Hand off
- Soft Handoff
- Mobile Assisted Hand off
- Intersystem Hand off
- Delayed Handoff (Two level Hand off)
- Queued handoff

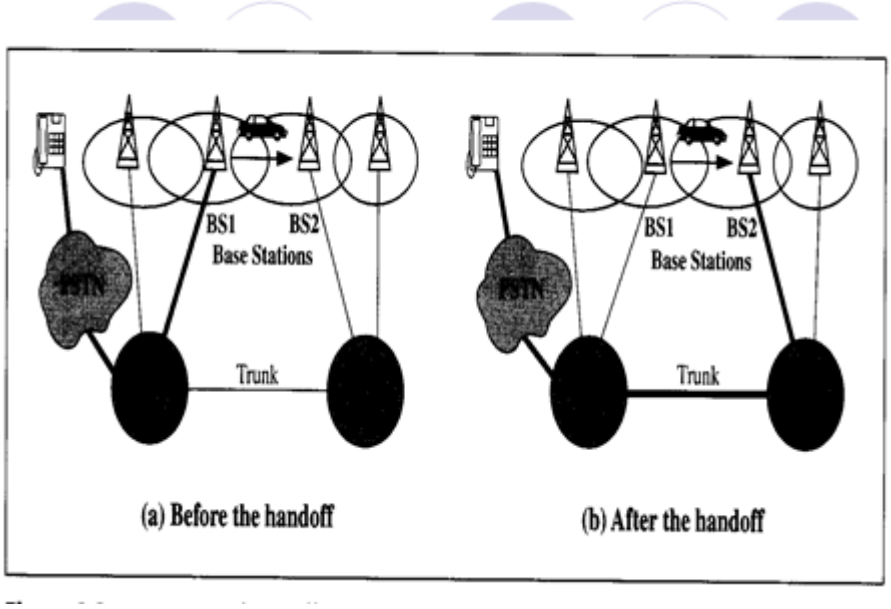
Explain any one in brief. **2M**

1. **Intersystem Hand off** (Intersystem BSC, Intersystem MSC,Intra BSC handoff:

- In intersystem handoff, the new and old BSs are connected to two different MSCs.
- We trace the intersystem handoff procedure of **IS-41**, where network-controlled handoff (NCHO) is assumed.
- In this figure, a communicating mobile user moves out of the BS served by MSC A and enters the area covered by MSC B.



OR



2. MAHO:

In today's 2G systems, handoff decisions are mobile assisted.

- In mobile assisted handoff (MAHO) every mobile station measures the received power from surrounding base stations and continually reports the results of these measurements to the serving base station.
- A handoff is initiated, when the power received from the base station of a neighboring cell begins to exceed the power received from the current base station by a certain level or for a certain period of time.
- In MAHO method call handed over between base stations is much faster than first generation analog systems .As handoff measurements are made by each mobile .MSC no longer constantly monitors signal

strengths. MAHO is particularly suited for microcellular environments where handoffs are more frequent. During the course of a call, if a mobile moves from one cellular system to a different cellular system controlled by a different MSC, an intersystem handoff becomes necessary.

- An MSC engages in an intersystem handoff when a mobile signal becomes weak in a given cell and the MSC cannot find another cell within its system to which it can transfer the call in progress.

3. Hard handover:

- The definition of a hard handover or handoff is one where an existing connection must be broken before the new one is established. One example of hard handover is when frequencies are changed.
- As the mobile will normally only be able to transmit on one frequency at a time, the connection must be broken before it can move to the new channel where the connection is re-established.
- This is often termed and inter-frequency hard handover. While this is the most common form of hard handoff, it is not the only one. It is also possible to have intra-frequency hard handovers where the frequency channel remains the same.
- Although there is generally a short break in transmission, this is normally short enough not to be noticed by the user.

4. Soft handover:

- This is a form of handover or handoff where it is not necessary to break the connection. This is called soft handover or soft handoff, and it is defined as a handover where a new connection is established before the old one is released.
- In UMTS most of the handovers that are performed are intra-frequency soft handovers
- Soft handoff is also called as Mobile Directed Handoff as they are directed by the mobile telephones. Soft handoff is the ability to select between the instantaneous received signals from different base stations.
- Here the channel in the source cell is retained and used for a while in parallel with the channel in the target cell. In this the connection to the target is established before the connection to the source is broken, hence this is called *"make-before-break".*
- The interval, during which the two connections are used in parallel, may be brief or substantial because of this the soft handoff is perceived by the network engineers as state of the call.

5. Queuing of Handoff:

- Queuing is a way of delaying handoff.
- The MSC queues the handoff requests instead of denying access if the candidate BS is busy.
- The probability of a successful handoff can be improved by queuing handoff requests at the cost of increased new call blocking probability and a decrease in the ratio of carried-to-admitted traffic since new calls are not assigned a channel until all the handoff requests in the queue are served.

6. Delayed Hand off:

- When a base station wants to handover the call to the base station of new cell where the subscriber enters, the base station will accept it and takes call control.

- This smooth handover is possible only if the new cell is free to take it. If the cell is not free, the handoff is delayed.
- This is called as delayed handoff.

This type of hand off is also called as two level hand off.

[NOTE- marks should be awarded if students explain any other handoff which is listed above]

Q6) Attempt any FOUR: 16M

a) List tele-services and data services in CDMA one system.
Ans:

Telephone Services: (any two) 2M

- Short message service (SMS):
- MMS
- Slotted paging:
- Over-the-air activation (OTA):
- Enhanced mobile ***station identities****:*
- Standard mobile telephone
- Mobile-originated
- Base-originated traffic.
- emergency calling
- Fax
- Videotext
- Tele text,

Data services: (any two) 2M

- Transparent, non-transparent data transmission
- Full duplex
- Synchronous, asynchronous package data.
- Packet data
- Asynchronous data and group 3 fax

b) List any four radio parameter with values of IS-95.
Ans: (any 4 parameters 4 marks)
Radio Aspects for IS-95:

An increase in bandwidth efficiency can be achieved either by selecting a **modulation technique like DQPSK or GMSK (used in GSM).**

- The IS-95 CDMA cellular system employs **direct sequence spread spectrum method**.
- In the IS-95 CDMA cellular systems the **chip rate is about 1.23 MHz;**

Each IS-95 channel occupies **1.25 MHZ of spectrum on each one way link.**

- A set of ten 1.25 MHz bandwidth CDMA channels can be used by each operator if the entire allocation is converted to CDMA.
- IS-95 uses different modulation and spreading technique for the forward and reverse link.
- Frequency and Channel Specification:
- **Reverse link frequency**: 824-849 MHZ.
- **Forward link frequency**: 869-894 MHZ.
- A **forward and reverse channel pair is separated** by 45 MHZ for cellular band operation.
- The **maximum user data rate** is 9.6 kb/s.
- Frequencies used- 800 MHz or 1900 MHz
- Channel bandwidth – Total 12 MHz
- Voice codec -8 kbps or 13 kbps
- SMS service up to -120 characters
- Type of radio interface- CDMA
- Type of handoff- soft

c) Draw and explain architecture of UMTS.

Ans:

Diagram: **2M**

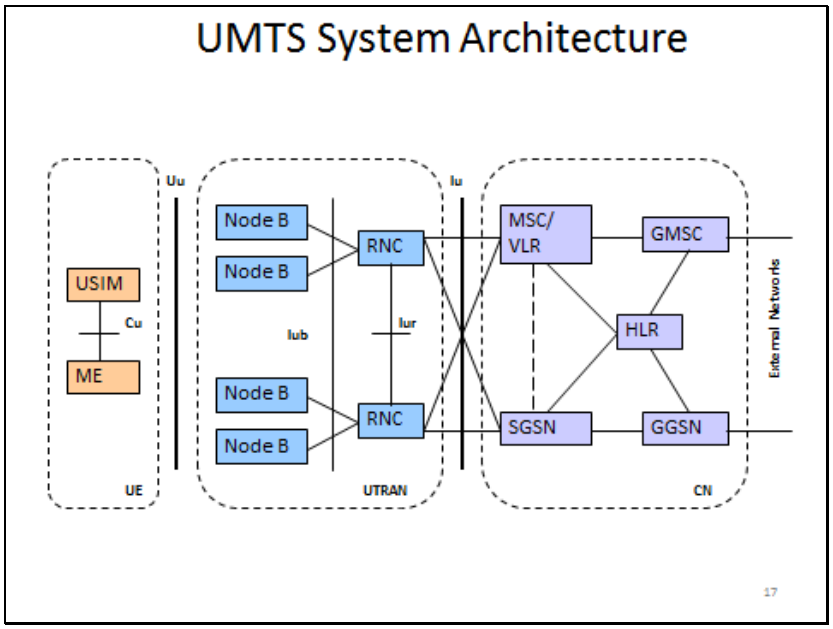


Fig. Architecture of UMTS

Explanation: **2M**

- A UMTS network consist of three interacting domains; Core Network (CN), UMTS Terrestrial Radio Access Network (UTRAN) and User Equipment (UE). The main function of the core network is to provide switching, routing and transit for user traffic. Core network also contains the databases and network management

functions.

The basic Core Network architecture for UMTS is based on GSM network with GPRS. All equipment has to be modified for UMTS operation and services. The UTRAN provides the air interface access method for User Equipment. Base Station is referred as Node-B and control equipment for Node-B's is called Radio Network Controller (RNC).

- It is necessary for a network to know the approximate location in order to be able to page user equipment. Here is the list of system areas from largest to smallest.
  UMTS systems (including satellite)
  Public Land Mobile Network (PLMN)
  MSC/VLR or SGSN
  Location Area
  Routing Area (PS domain)
- UTRAN Registration Area (PS domain)
- Cell
- Sub cell

d) Explain authentication process in GSM with neat diagram.

Ans:

Diagram: **2M**

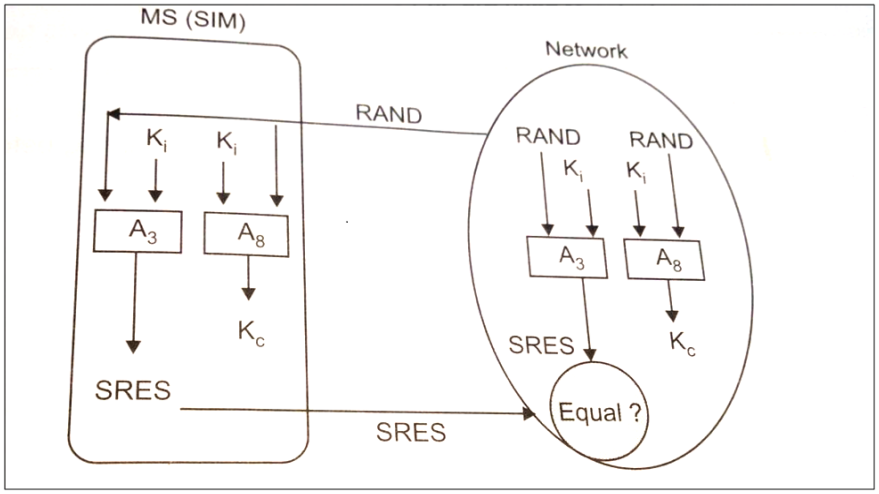


Fig. GSM authentication process in GSM

OR

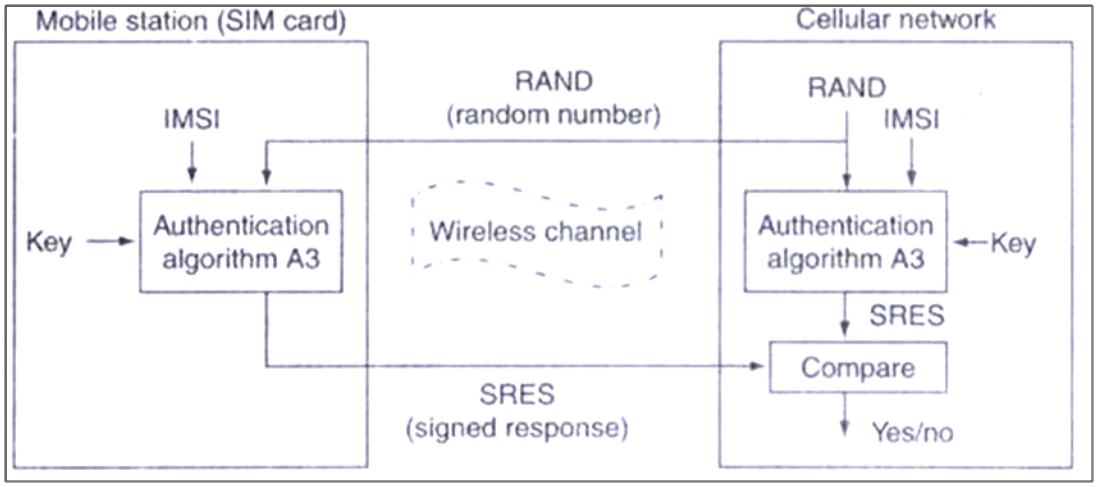


Fig. GSM

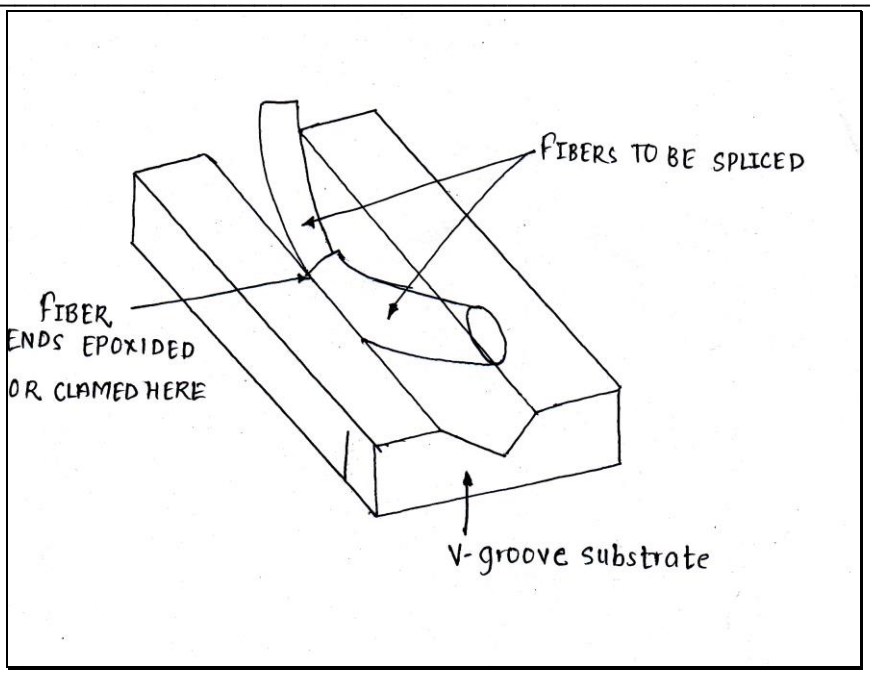
Explanation: **2M**

- Authentication refers to process by which station confirms the identity of mobile station.
- It protects GSM network against unauthorized access. T
- he Authentication Centre is responsible for all security aspects.
- The AUC generates the Ki"s associates them with IMSI and provides for each IMSI a set of triplets consisting of **RAND (Random Number), SERS (signed Response), Kc (Cipher key)**
- Authentication center first authenticate the subscriber mobile station and only then MSC provides service.
- At MS- SIM contains the entire authentication data along with A3 and A8 algorithm and signed response is generated using this.
- At network side signed response is generated using same algorithm and random number and if both the signed response matches then mobile phone authenticated.

e) Explain V groove and fusion splicing with neat diagram.

Ans:

Diagram: **2M**



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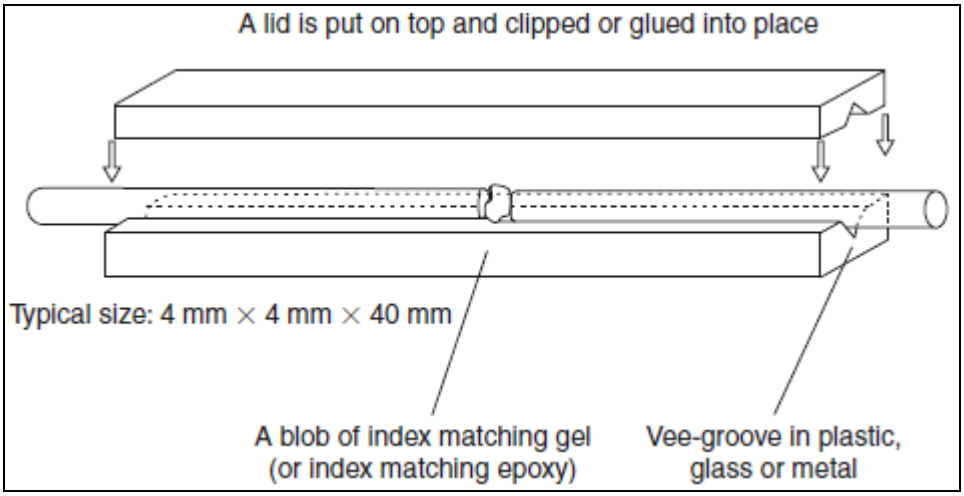
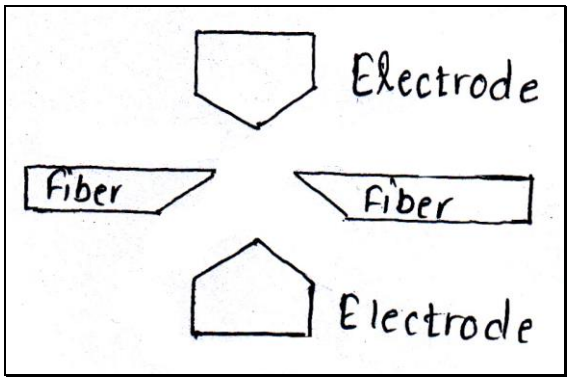


Explanation: **2M**

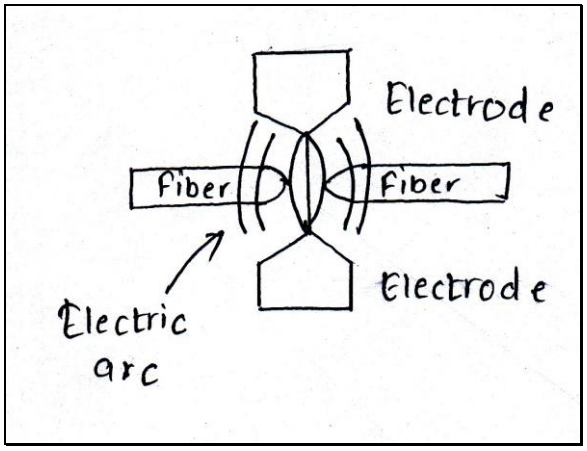
- In V-groove splice:-
  - The prepared fiber ends are first buttered “V” shaped groove.
  - Bonded together with and adhesive.
  - “V” shaped channel is either a grooved silicon plastic, ceramic or metal substrate.
  - It produces splice losses of around 0.1dB.

Fusion splicing techniques:

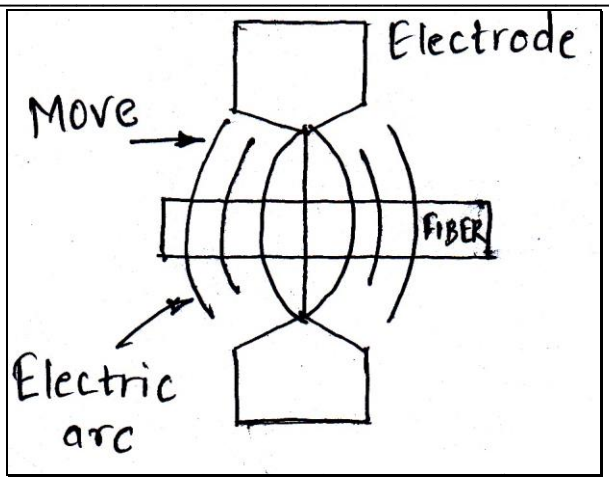
1. **Initial setting:**



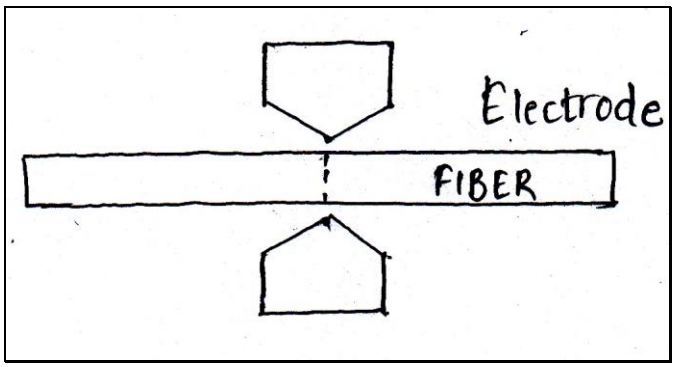
2. **Arrangement of smooth surface by prefusion:**



3. **Pressed together:**



4. Accomplishment of splice:



Explanation:

- Fusion splices are made by thermally bonding together fiber end.
- The fiber ends are prealigned and buttered together in order to achieve good continuity of the transmission medium at the junction point. This is done by grooved fiber holder or microscope with micro manipulator. The butt joint is then heated with an electric or a laser and hence bonded together.
- It (this method) provides very low splices losses
    - Consistent.
    - Easily controlled heat with adaptability for use under field conditions.