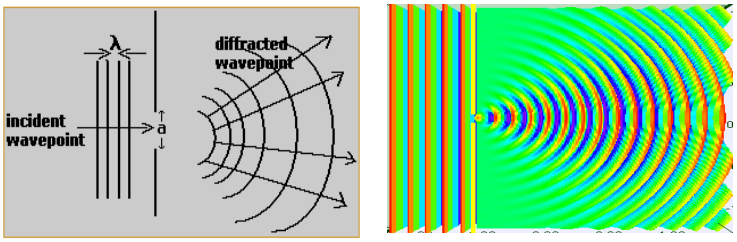
MODEL ANSWER

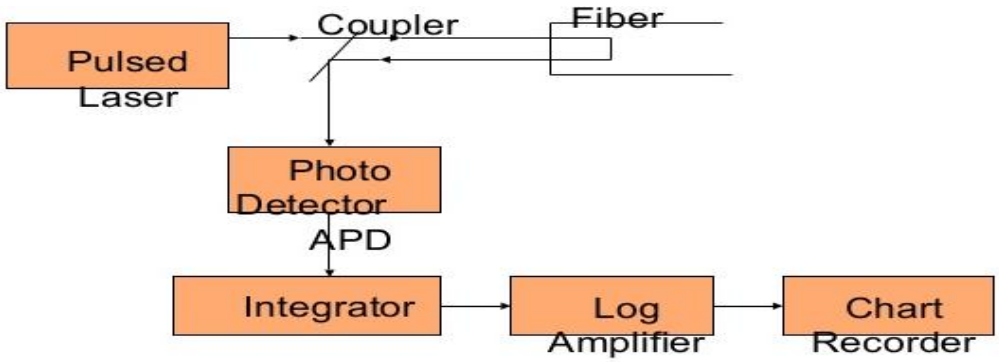
SUMMER– 17 EXAMINATION

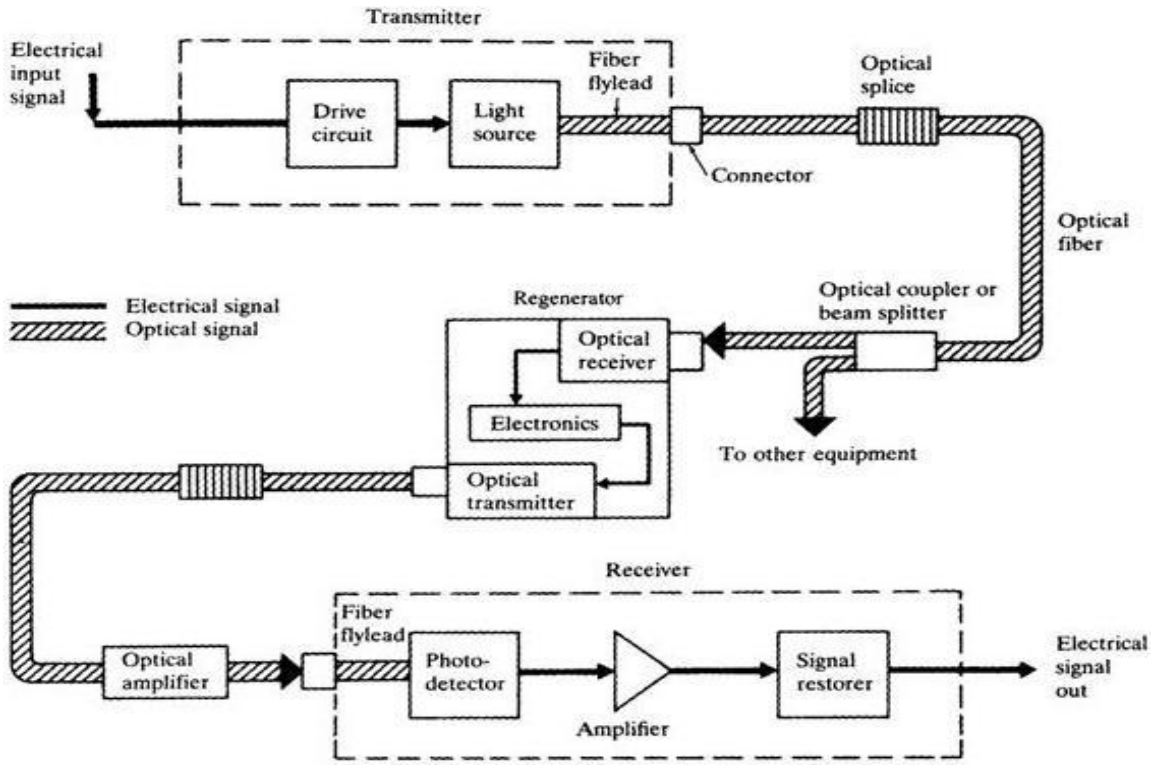
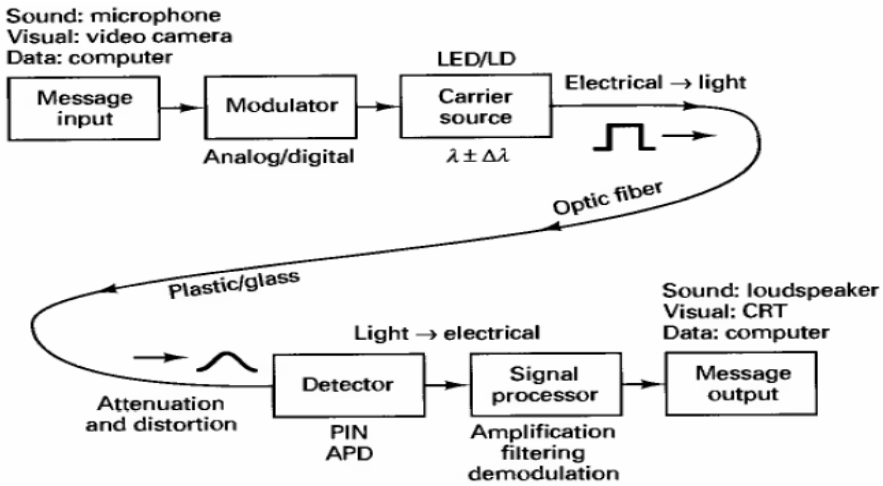
Subject Title: optical fibre and mobile communication Subject Code: 17669

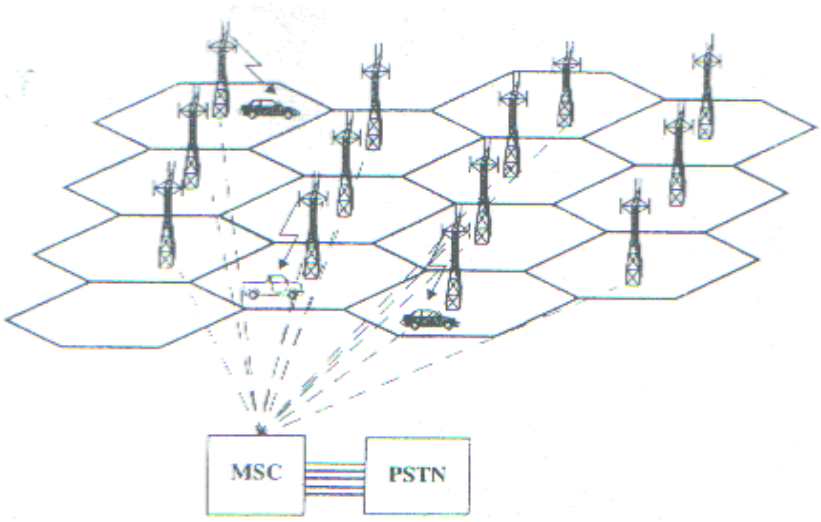
Important Instructions to examiners:

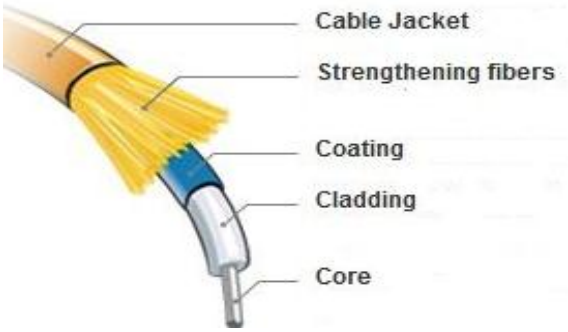
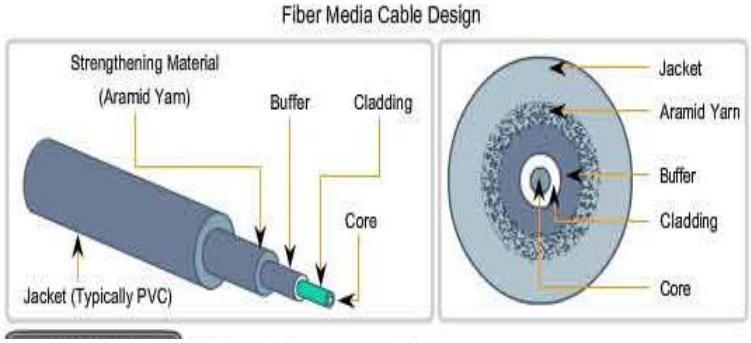
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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 anyequivalent 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. No.	Sub Q.N.	Answer	Marking Scheme
Q.1	(A)	**Attempt any THREE :**	**12-Total Marks**
	(a)	**Define the following terms -** **(i) Refraction** **(ii) Diffraction** **(iii) Reflection** **(iv) Scattering**	**4M**
	Ans:	**(i)Refraction:** Refraction is the bending of a wave when it enters a medium where its speed is different or when light changes its medium. **(ii) Diffraction: Diffraction** is defined as a process by which light waves break up into dark and light bands or into the colors of the spectrum. **OR** Diffraction is the slight bending of light as it passes around the edge of an object. **OR**  **(iii) Reflection:** Bouncing back of a light ray after hitting any surface is known as reflection. **(iv) Scattering:**	**[each definition 1M]**

		Light scattering is the deflection of a ray from a straight path. **OR** Light scattering is a form of scattering in which light is the form of propagating energy which is scattered.	
	(b)	**State the functions of following in cellular system** **(i) Visitors Location Register** **(ii) Equipment Identity Register**	**4M**
	Ans:	**(i)Visitors Location Register:** 1. Is temporary data store, and generally there is one VLR per MSC. 2. it stores information about the mobile subscribers who are currently in the service area covered by the MSC/VLR. 3. It stores information about locally activated features such as call forward on busy. **(ii) Equipment Identity Register:** 1. EIR maintains information to authenticate terminal equipment so that fraudulent, stolen, or nontype-approved terminals can be identified and denied service. 2. 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.	**[function of VLR-2M,** **EIR-2M]**
	(c)	**How does optical time domain reflectometer detects faults in optical fiber?**	**4M**
	Ans:	**Block diagram of Optical time domain reflectometer:**  **Explanation:** I)OTDR is optical time domain reflect meter used for finding faults, splices and binds in fiber optic cables. ii) 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. iii) A light pulsed is launched into the fiber in forward direction from an injection laser using coupler or beam splitter. iv) 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. v) The backscattered light is detected using an avalanche photodiode which drives integrator which is then fed to logarithmic amplifier and average measurements for	**[Block dig - 2M, explanation -2M]**

		successive points within the fibers are plotted as a chart recorder.	
	(d)	**State basic function of optical detector and optical source. Draw neat diagram of optical communication system.**	**4M**
	Ans:	**Optical detector:** It converts light signal into electrical signal. **Optical source.:** It converts electrical signal into light signal. **Block Diagram of optical communication system:**  **OR** **Block Diagram of optical communication system:**  	**(Function of optical detector =1M ,optical source-1M , diagram of foc =2M)**

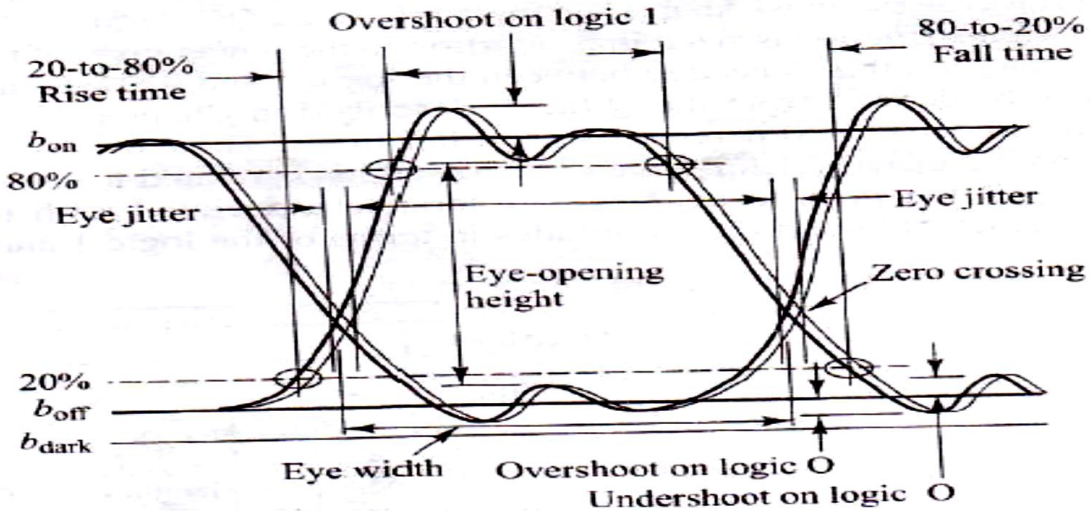
(B)	**Attempt any ONE :**	**6M**
(a)	**Explain cellular telephone system with neat diagram.**	**6M**
Ans:	**Block diagram cellular telephone system:** 	**3M**
	Explanation:- It provides a wireless connection to the PSTN for any user location within the radio range of the system This system accommodates a large no. of users over a large geographical area called as 'cell' so that same radio channels may be reused by another base station located some distance away. It consists of : 1. Mobile station 2. Base station 3. Mobile Switching Center (MSC) or Mobile Telephone Switching Office (MTSO) 4. Forward voice channel (FVC) :- for voice transmission from the BS to MS. 5. Reverse voice channel (RVC) :- voice transmission from MS to BS. 6. Forward control channels (FCC) and reverse control channels (RCC) :- are responsible for initiating mobile calls. Control channels are often called "setup channels" are only involved in the setting up a call and moving it to an unused voice channel. **7.** Control channels transmits and receives data messages that are monitored by mobiles when they do not have a call in progress.	**3M**
(b)	**Draw labelled structure of fiber optic cable and compare fiber optic cable with copper cable on basis of :** **(i) Security** **(ii) Interference** **(iii) Bandwidth** **(iv) Installation**	**6M**

	Ans:	**Labeled structure of fiber optic cable:**  **OR**  **(i)Security** – As is there is no electrical signal, fiber optic transmission is almost impossible to tap into without being detected so it is more secure than copper cable **(ii) Interference-** Fibre optic cables are immune to electromagnetic interference. It can also be run in electrically noisy environments without concern as electrical noise will not affect fibre. **(iii) Bandwidth**-fiber optics have high bandwidth as compared to coaxial, so the greater the information carrying capacity. A higher bandwidth allows for higher data rates, more users and longer distances transmission. **(iv) Installation: -**Fibre optic cable installation requires skilled technicians as compared to copper cable**.**	**(Labelled structure of fiber optic cable-2M compare fiber optic cable-4M)**
Q 2		**Attempt any FOUR :**	**16M**
	(a)	**Draw simplified eye pattern in optical fiber communication and define the following:** **(i) noise margin** **(ii) time jitter**	**4M**
	Ans:	**(i)Noise margin:** It is the percentage ratio of peak signal voltage V1 for an alternating bit sequence to the maximum signal voltage V2 as measured from the threshold level. It is given as (Noise margin%)=V1/V2 *100 percent	**[Diagram of eye pattern-2M, noise margin-1M, time jitter-1M]**

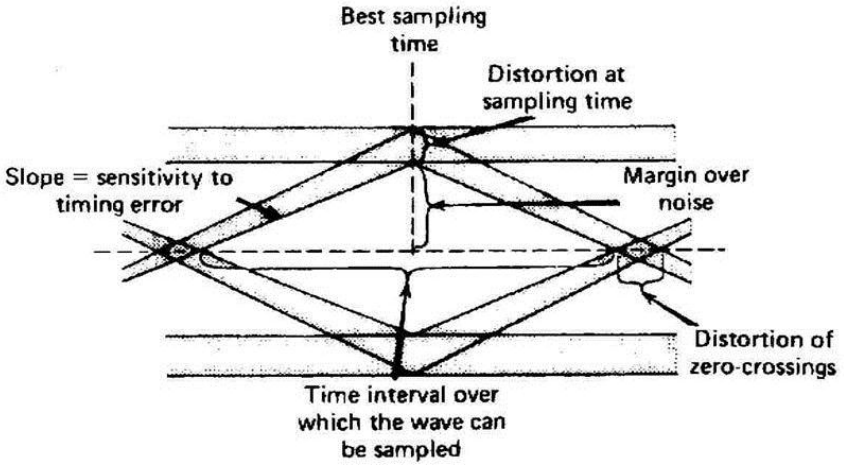
(ii) Time jitter:

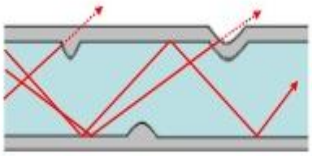
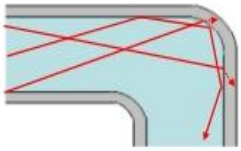
Timing jitter-in an optical fiber system arises from noise in the receiver and pulsr distortion in the optical fiber .

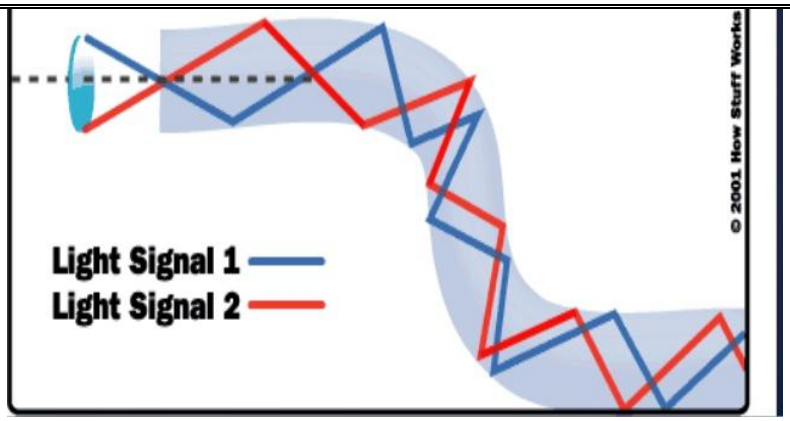
It is given as (Timing jitter %)=ΔT/Tb *100 percent



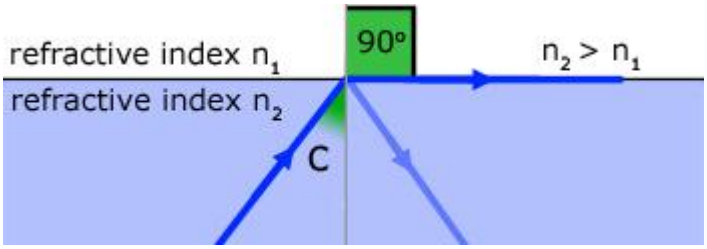
Or



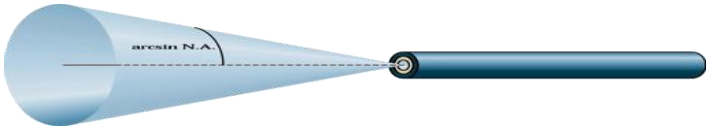
	(b)	**Why does bending losses occurs in fiber. Explain different type of bending losses with neat diagram.**	**4M**
	Ans:	Bending losses occurs in fiber due to fiber curve. **Microbending-** Microbending losses are due to microscopic fiber deformation in the core-cladding interface caused by induced pressure on the glass.  **Macrobending-** Macrobending losses are due to physical bends in the fiber that are large in relation to fiber diameter. 	**(Why does bending losses:1M Macro bending:1.5 M Micro bending:1.5 M)**
	(c)	**With the neat diagram, explain following terms :** **(i) Total internal reflection** **(ii) Critical angle** **(iii) Numerical aperture** **(iii) Acceptance cone**	**4M**
	Ans:	**i) Total internal reflection:** When a ray of light travels from a denser to a rarer medium such that the angle of incidence is greater than the critical angle,the ray reflects back into the same medium this phenomena is called total internal reflection.	**(Each definition 1M)**



(ii) **Critical angle:**It is that angle of incidence at which angle of refraction becomes 90 degree**.**



(iii) Numerical aperture- Light gathering capacity of fiber is called numerical aperture

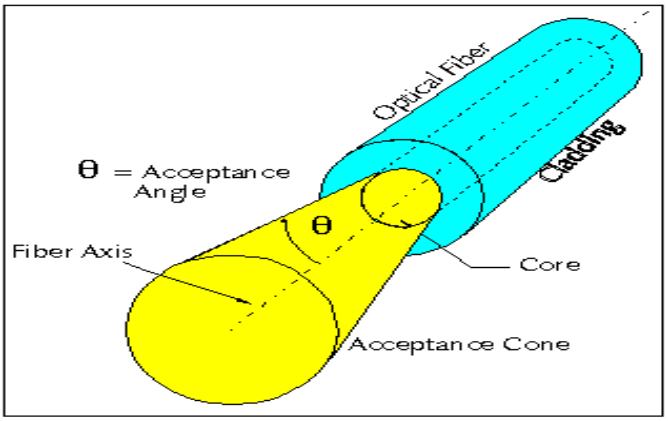


(iv)Acceptance angle :

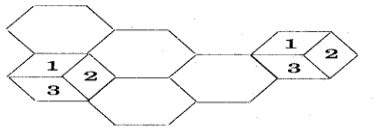
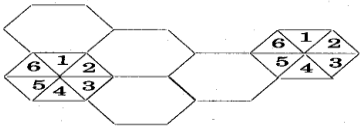
It is the maximum **angle** of a ray (against the **fiber** axis) hitting the **fiber** core which allows the incident light to be guided by the core.

(iii) Acceptance cone:

The acceptance cone is derived by rotating the Acceptance Angle about the fiber axis.



acceptance cone

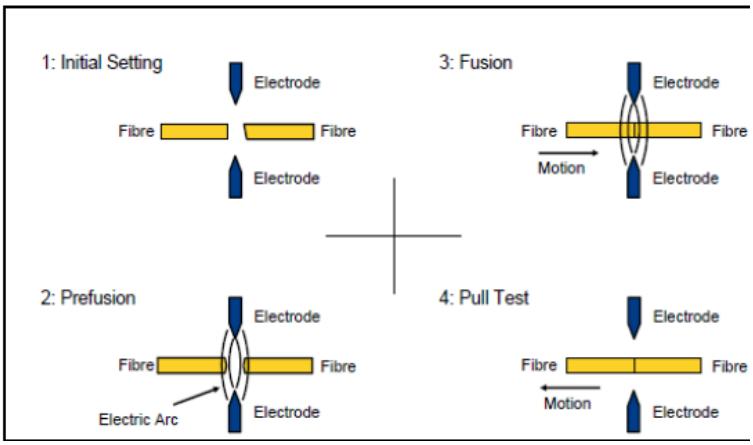
(d)	**Explain sectoring technique used in cellular system for improvement of cell coverage.**	**4M**
Ans:	• Sectoring is method of increasing the channel capacity of cellular system. In this method directional antennas are used to decrease the co channel and adjacent channel interference and reuse the frequency within the cell. • Instead of using a single omnidirectional antenna (in case of cell splitting), sectoring uses several directional antennas each covering a small area (called a sector) of the cell. • Usually, cells are divided into six 60degree sectors or three 120 DEGREE sector.  (a)  (b) a) When a three sector configuration is used, three antennas are installed in each 120degree sector. b) In these antennas, one is used for transmission and two for reception. c) The process of using two receiving antenna is known as diversity. d) It enhances the reception by providing more antennas. e) Usually both the receive antennas are placed on the same tower, one at 30 meter height and other at 50 meter height.	**Cell Sectoring: [Diagram 2M, Explanation 2M]**
(e)	**If refractive index of fused quartz clad = 1.46,refractive index of core = 1.5,angle of incidence = 30^0 . Find (i) angle of refraction, (ii) angle of acceptance.**	**4M**

	Ans:	R.I of clad = 1.46 R.I of core = 1.5 angle of incidence = 30° Find : angle of , refraction, angle of acceptance solution : $\eta_1 = 1.5$ $\eta_2 = 1.46$ $\eta_1 \sin\theta_1 = \eta_2 \sin\theta_2$ $\frac{1.5}{1.46} \sin 30 = \sin\theta_2$ $\sin\theta_2 = \frac{1.5}{1.46} \times 0.5$ $\sin\theta_2 = 0.5136$ $\boxed{\theta_2 = 30.91}$ angle of refraction ii) angle of acceptance $\theta_{in(max)} = \sin^{-1}\sqrt{\eta_1^2 - \eta_2^2}$ $= \sin^{-1}\sqrt{(1.5)^2 - (1.46)^2}$ $= \sin^{-1}\sqrt{2.25 - 2.13}$ $= \sin^{-1}\sqrt{0.12}$ $= \sin^{-1}(0.346)$ $= 20.26$	**(Angle of refraction-2M, Angle of acceptanc-2M)**
Q. 3		**Attempt any TWO :**	**16**
	(a)	**Define fiber joint. State different types of fiber joint. Explain prefusion splicing method.**	**8M**
	Ans:	Fiber joint is defind as point where two fibers are joint together to allow a light signal to propogate from one fiber into the next continuing fiber with as little loss as possible. **<u>Different types of fiber joint-</u>** • Permanet or fixed joint -uses fiber splice,mechanical strength and low lossses • Terminating or Non-fixed joint -uses FOC connector.	**2M** **2M**

Prefusion splicing method-

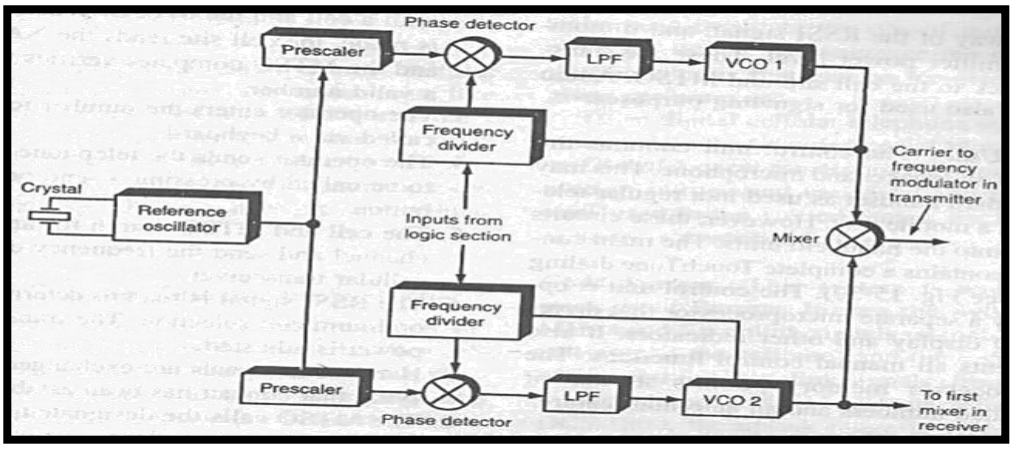
i) Pre-fusion splicing:

4M



- Fusion splice are made by thermally bonding together the prepared fibers end.
- The prepared fibers ends are pre-aligned and butted together in order to achieve good continuity.
- The butt joint is then heated with an electric arc or a laser and hence bonded together
- It provides very low splice losses.
- For good joint they have to be properly positioned and aligned.

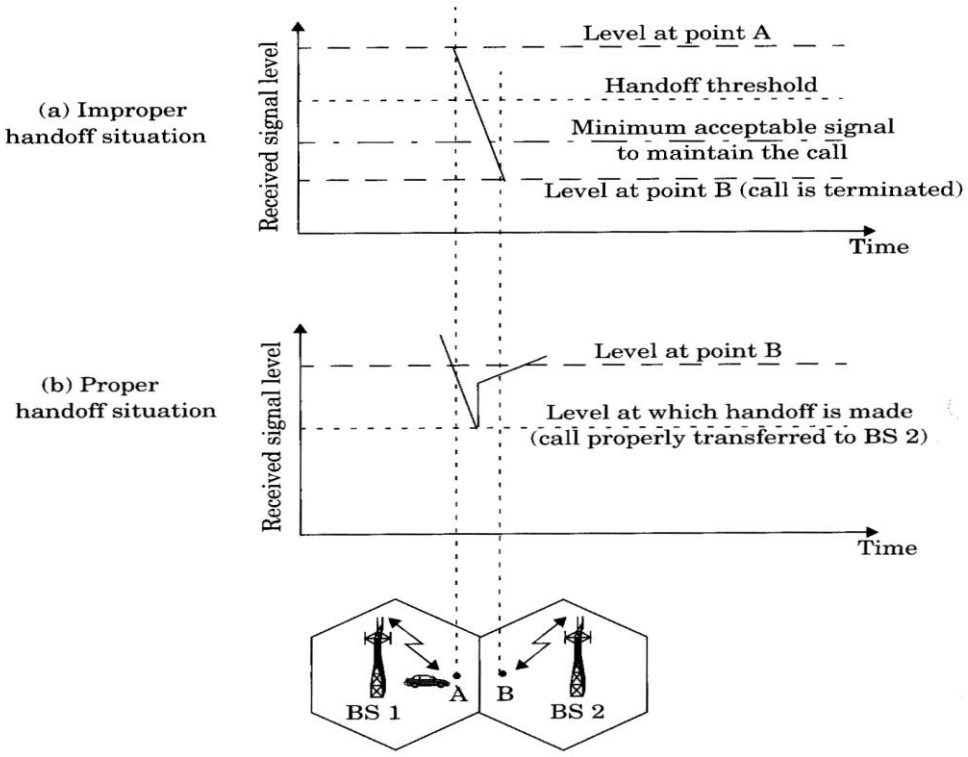
b)	**Define frequency synthesizer. Draw block diagram of frequency synthesizer used in mobile and state its operation.**	**8M**
Ans:	A frequency synthesizer is an electronic system for generating any of a range of frequencies from a single fixed timebase or oscillator used for transmitter and recevier.	**(Frequency synthesizer - -2M, block diagram of frequency synthesizer - 3M operation- 3M.)**

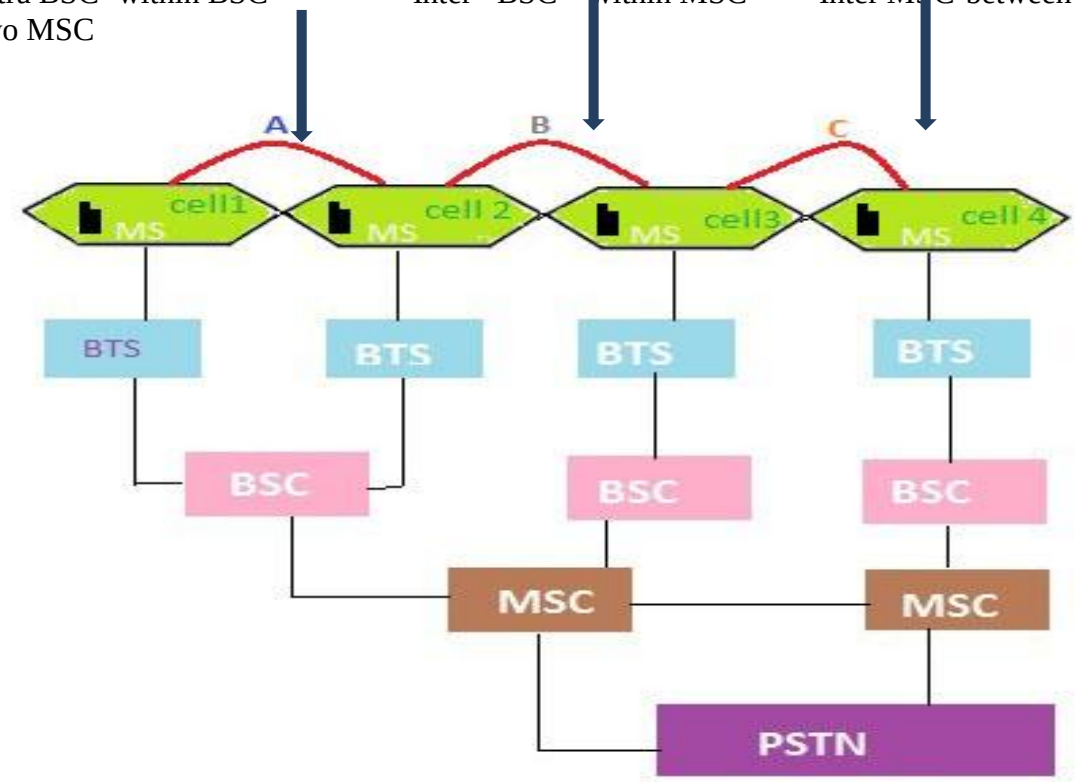
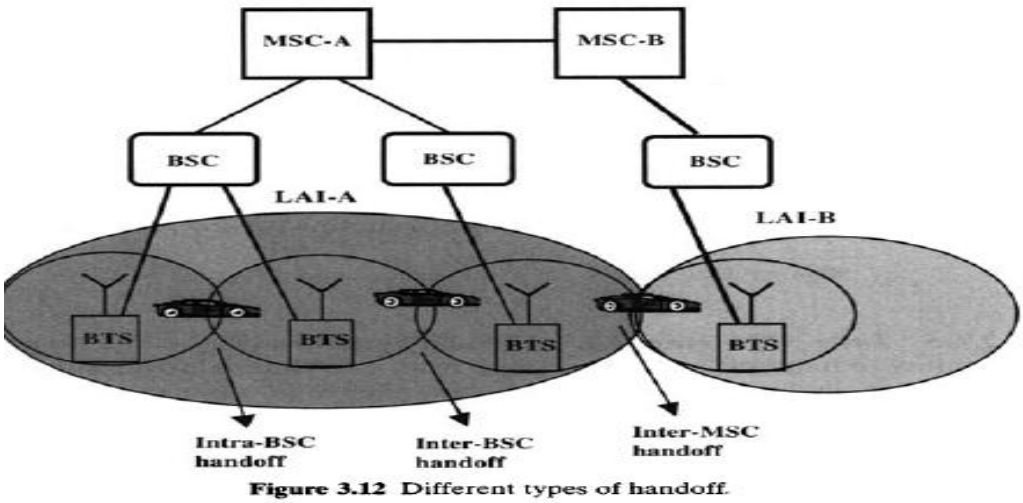


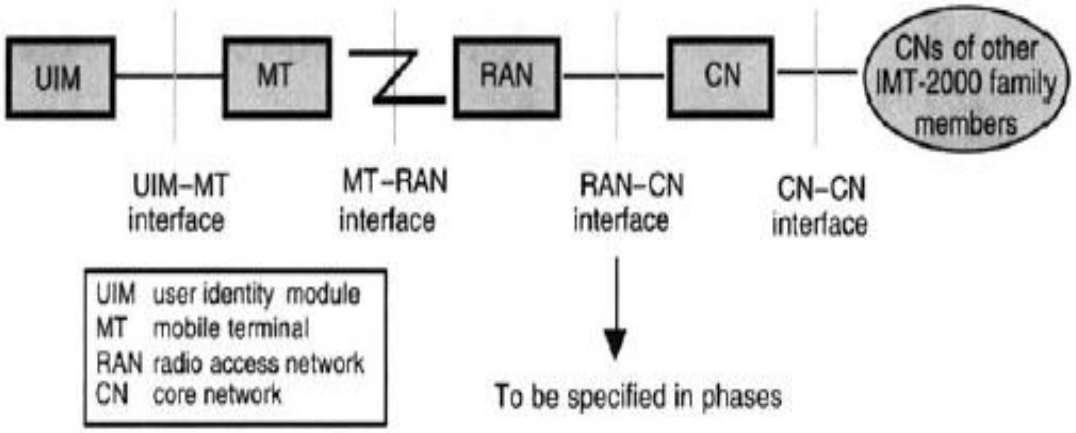
Operation of frequency synthesizer.

- It uses PLL and mixer.
- Crystal oscillator provides reference for the PLLs.
- One PLL incorporates a VCO2 whose o/p freq is used as the local oscillator for

	first mixer in recevier. • This signal is mixed with o/p of VCO1 to derive the transmitter o/p freq. • In cellular mobile freq division ratio is done by MTSO via cell site. • When Mobile unit gets or send call ,MTSO computer selects unused channels It then transmits a digitally coded signal to the recevier containing the freq division ratios for transmitter and recevier PLLs,this sets transmit and recevie freq.	
c)	**Draw diagram of :** **(i) Proper & improper situation of handoff** **(ii) Intersystem handoff**	**8M**
Ans:	**(i) Proper & improper situation of handoff**	**4M**



		(ii) <u>Intersystem handoff:</u> Intra BSC- within BSC Inter –BSC—within MSC Inter MSC-between two MSC  **<u>OR</u>**  **Figure 3.12** Different types of handoff.	**4M**
Q. 4	**(A)**	**Attempt any THREE :**	**12**
	(a)	**Draw well labelled architecture of IMT2000.**	**4M**
	Ans:		**(Architectur**



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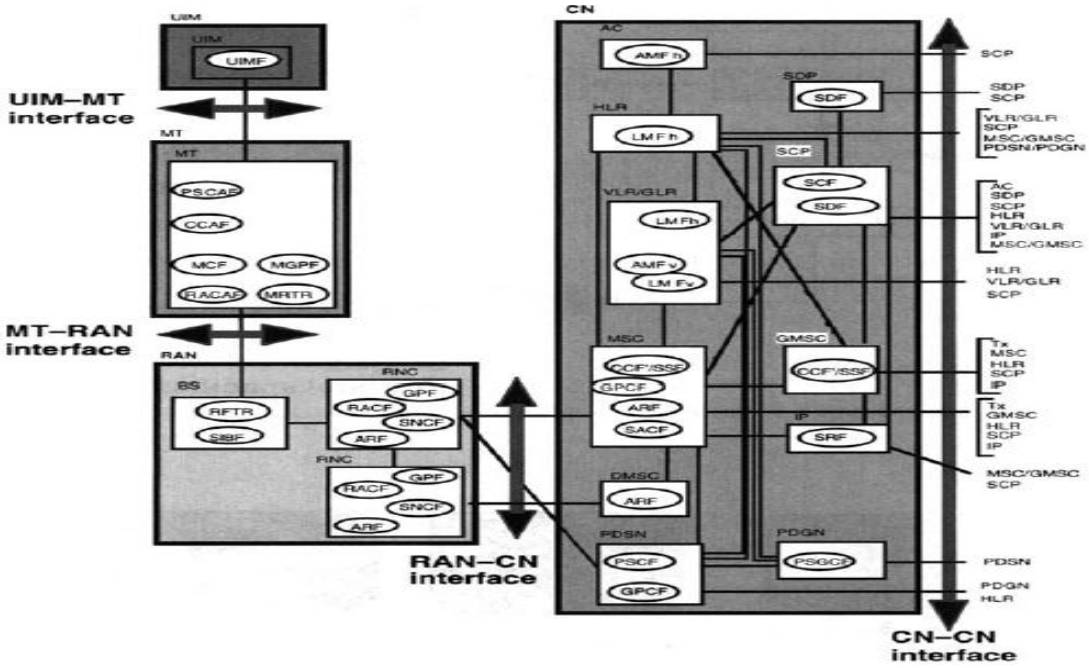
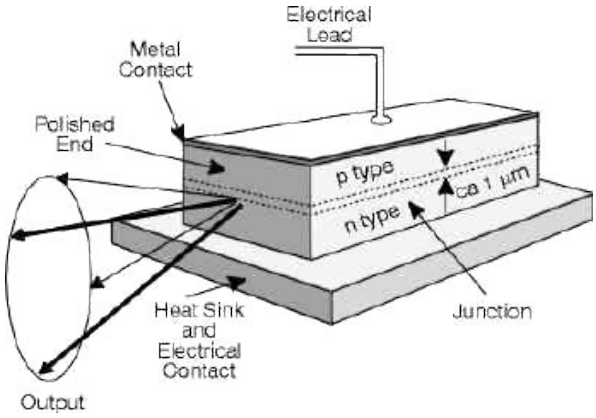
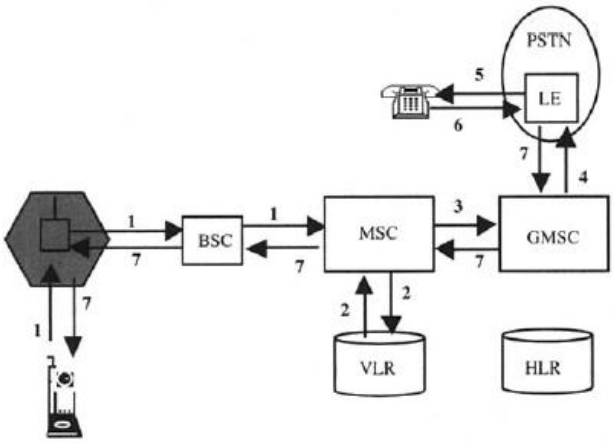
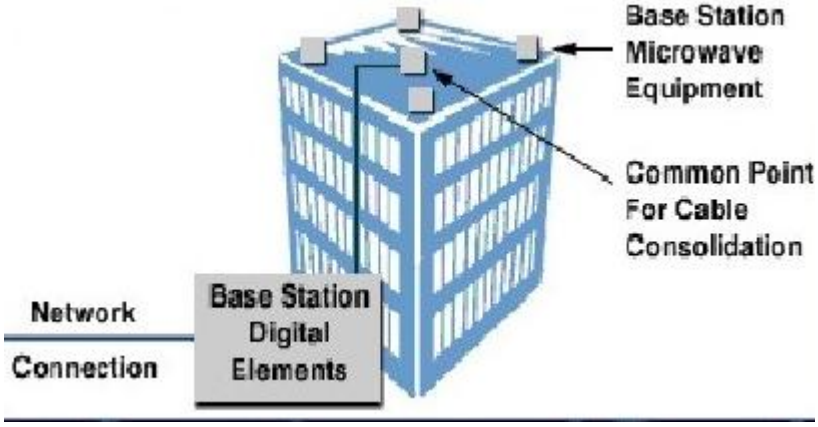


			e of IMT2000-4M)
	(b)	**List and explain any four characteristics of good optical detector.**	**4M**
	Ans:	**Characteristics of good optical detector** • Light Sensitivity-The minimum optical power of light detector can receive and still produce a usable electrical output signal. • Responsivity -the ratio of the output current of a photodiode to the input optical power. • Dark current-The leakage current that flows through a photo diode with no light input.	**(Any four characteristics-1 M each)**

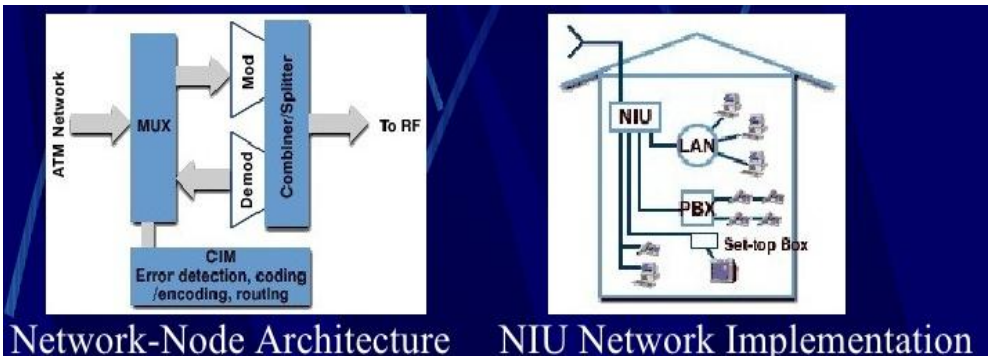
		• Transient time-The time optical detector takes a light induced carrier to travel across the depletion region of semi-conductor • Spectral response – the range of wavelength to which optical detector may respond.	
	(c)	**Explain working of Injection laser diode as optical source.**	**4M**
	Ans:	Diagram:[any other diagram showing laser concept should also be considered]  • Laser consists of 3 layers and polished end for reflection . • The light emitted bounces back and forth called as lasing effect . • The active region of the laser diode is in the intrinsic (I) region lasers use the double-heterostructure implementation, where the carriers and the photons are confined in order to maximize their chances for recombination and light generation. • Laser works on stimulated and spontaneous emission . process of emission	**(Diagram - 2M,explanation -2M)**
	(d)	**State two advantages and two disadvantages of the following :** **(i) Fixed Channel Assignment Strategy** **(ii) Dynamic Channel Assignment Strategy**	**4M**
	Ans:	**<u>Advantage of Fixed Channel Assignment Strategy:</u>** • Each cell is allocated a predetermined set of voice channel. • Each call have new channel . **<u>Disadvantage of Fixed Channel Assignment Strategy:</u>** • Any new call attempt can only be served by the unused channels • The call will be *blocked* if all channels in that cell are occupied **<u>Advantage of Dynamic channel assignment:</u>** • Reduces call blocking (that is to say, it increases the trunking capacity), • Minimize interference & maximize use of capacity **<u>Disadvantage of Dynamic Channel Assignment Strategy:</u>**	**(Each advantages and disadvantage-½M)**

		1]Increases storage & computational load of MSC 2]Requires **real-time** data from entire network related to: i) channel occupancy ii) traffic distribution iii) Radio Signal Strength Indications (RSSI's) from **all** channels 3] Dynamic Channel Assignment Strategy	
	(B)	**Attempt any ONE :**	**6M**
	(a)	**Explain call flow sequence for mobile call origination in GSM system.**	**6M**
	Ans:	1. The MS sends the dialed number indicating service requested to the MSC (via BSS). 2. The MSC checks from the VLR if the MS is allowed the requested service. If so, MSC asks the BSS to allocate necessary resources for the call. 3. If the call is allowed, the MSC routes the call to GMSC. 4. The GMSC routes the call to the Local Exchange of called user. 5. The LE alerts (applies ringing) the called terminal. 6. Answer back (ring back tone) from the called terminal to LE 7. Answer back signal is routed back to the MS through the serving MSC which also completes the speech path to the MS. **call flow sequence for mobile call origination call flow sequence for mobile call**  Call flow sequence for mobile call origination	**(Diagram-3M,explanation -3M)**
	(b)	**Draw architecture of Local Multipoint Distribution Services (LMDS) and explain its operation. State any two applications of LMDS.**	**6M**
	Ans:	**Architecture of Local Multipoint Distribution Services (LMDS) –**	**(Architecture of LMDS) -2M, Operation-2M, Any Two**



applications of LMDS- 2M)

OR



Operation of LMDS:

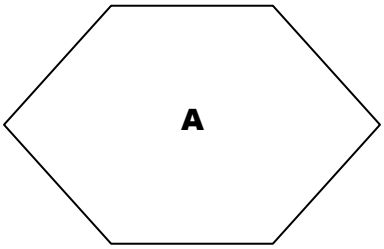
It consists of Network operations centure (NOC),Fiber based infrastructures,Base station and Customer Premise Equipment 1) Network-Node Equipment,2)Radio Frequency Equipment,3)Network Interace Equipment

- It is high speed dedicated links between high density node in a network
- LMDS uses low powered high frequency signals over short distance.
- LMDS is are cellular because they send these high frequency signals over line of sight distance.

Any two applications of LMDS.

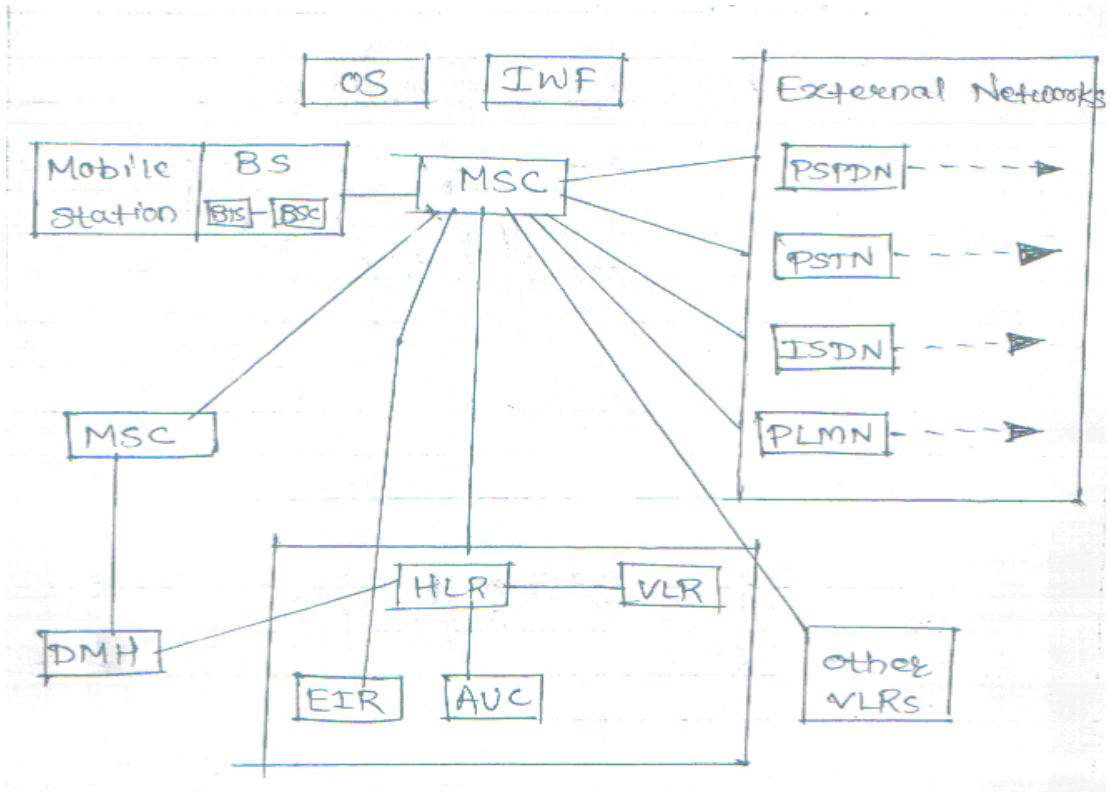
- Wireless LAN
- It offers wide range of one way and two way voice and data service tramission capabilities with a very large capacity ,better than what many current services offer.
- Asynchronous transfer Mode(ATM) can be transport among others, voice, data and even video.
- The Broadband Wireless Local Loop(B-WLL)

Q.5		**Attempt any TWO :**	**16**
	(a)	**(a)Define :**	**8M**

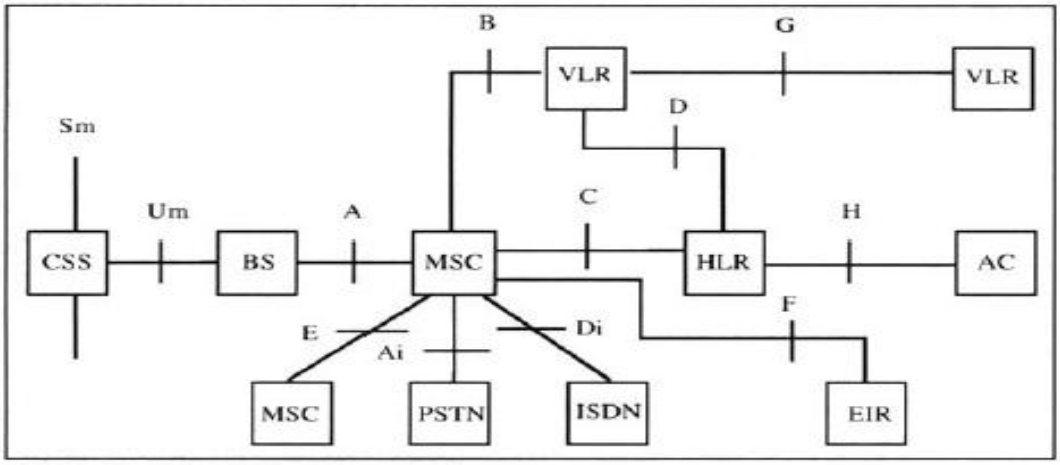
		(i) Cell **(ii) Co-channel cell** **(iii) Co-channel reuse ratio** **(iv) Cell splitting** **State the procedure of locating co-channel cell and draw co-channel on any two sides of given cell**  	
	Ans:	**(i) <u>Cell</u>-** Small geographical area under the coverage of cellular system is called cell. **ii) <u>Co-channel cell-</u>** There are several cells that use the same set of frequencies. These cells wih same set of frequency is are called co-channel cells . **iii) <u>Co-channel reuse ratio</u>-**It is the ratio of D/R where D is distance between the co-channel cells and R is the radius of the cell. **iv) <u>Cell splitting-</u>**subdividing a congested cell into smaller cells. co-channel on any two sides of given cell • Co-channel neighbors of a particular cell, • Assume i &j are non negative integer with values ex, *i=3* and *j=2*.  **<u>Procedure of locating co-channel cell:</u>** • Move i cells through the center of successive cells.	**(Each definition - 1M, procedure of locating co-channel cell-2M, co-channel location on any two sides-2M)**

		• turn 60degree in a clockwise direction • move j cells forward through the center of successive cells	
	(b)	**State any four features of the following :** **(i) GPRS for 2.5 G GSM** **(ii) EDGE for 2.5 G GSM**	**8M**
	Ans:	**i)<u>GPRS for 2.5 G GSM</u>** • General packet Radio services (GPRS) is packet based data network. • GPRS is well suited for non-real time internet usage including retrieval of email, faxes and asymmetric web browsing. • GPRS supports multi user network sharing of individual radio channels and time slots. • GPRS supports more user than HSCSD but in a bursty manner . • GPRS standards provides a packet network on dedicated GSM or IS-136 radio channel. • GPRS retains the original modulation formats specified in original 2G TDMA standards but uses completely redefined air interface in order to better handle packet data access • GPRS subscribers are automatically instructed to tune to dedicated GPRS radio channel • In GPRS individual users is able to achieve data rate as much as 171.2kpbs • Implementation of GPRS requires the GSM operator to install new routers and internet gateway at the base station and new software. • GPRS is most popular new packet data solution for 2G TDMA based technologies. • The dedicated peak 21.4 kpbs per channel data rate specified by GPRS works well with both GSM and IS136. **<u>ii) EDGE for 2.5G GSM:</u>** a) Enhanced data rates for GSM (as Global) Evolution advanced upgrade to the GMS standard. b) It requires the addition of new hardware and software at existing base station. c) EDGE introduces new digital modulation format 8 – PSK (octal phase shift keying) when it is used in addition to GSM's standard GMSK. d) EDGE allows for a different air interface format known as multiple modulation and coding scheme with varying degrees of errors control protection. e) Coverage range is smaller in EDGE than in HSDRC or GPRS. f) EDGE is also called as Enhanced GPRS. g) In EDGE each MCS (Multiple modulation and system) state may use either GMSK (low data rate) or 8-PSK (high data rate) or 8-PSK (high data rate) modulation for network access depending on the instantaneous demands of network and the operation.	**(Any four feature of GPRS-4M,EDGE-4M)**
	(c)	**List any 8 air interface parameters of WCDMA.**	**8M**
	Ans:	**<u>WCDMA Air Interface, Main Parameters-</u>**	**(Each parame-1M)**

Multiple Access Method	DS-CDMA
Duplexing Method	FDD/TDD
Base Station Synchronization	Asychronous Operation
Channel Separation	5MHz
Chip Rate	3.84 Mcps multiple carrier pers ec
Frame Length	10 ms
Service Multiplexing	Multiple Services with different QoS Requirements Multiplexed on one Connection
Multirate Concept	Variable Spreading Factor and Multicode
Detection	Coherent, using Pilot Symbols or Common Pilot
Multiuser Detection, Smart Antennas	Supported by Standard, Optional in Implementation

Q.6		**Attempt any FOUR :**	**16M**
	(a)	**Draw labelled architecture if IS-95 and state function of any two block.**	**4M**
	Ans:		**(Architecture of IS-95 -2M function of any two block-1M each)**

OR



CSS	cellular subscriber station
BS	base station
MSC	mobile switching center
HLR	home location register
VLR	visitor location register
EIR	equipment identity register
AC	authentication center

When mobile phone unit user calls tries to gain access to service from the network. The BSC is the control and management system for one or more BTS's.

a) The BSC exchanges the messages with both the BTS and MSC.

b) The MSC is an automatic system that interfaces the user traffic from wireless network with the wire line network or other wireless networks. MSC provides radio contact to a call.

c) Mobile station communicates with BSS for radio resources which in turn communicate with MSC for necessary channels.

d) When a roaming MS enters a new service area covered by the MSC, information is stored in VLR.

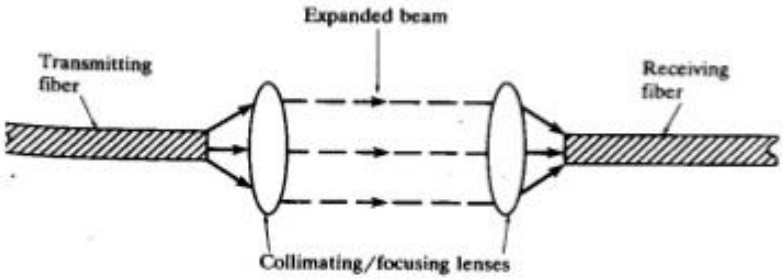
e) HLR maintains all subscriber-related information.

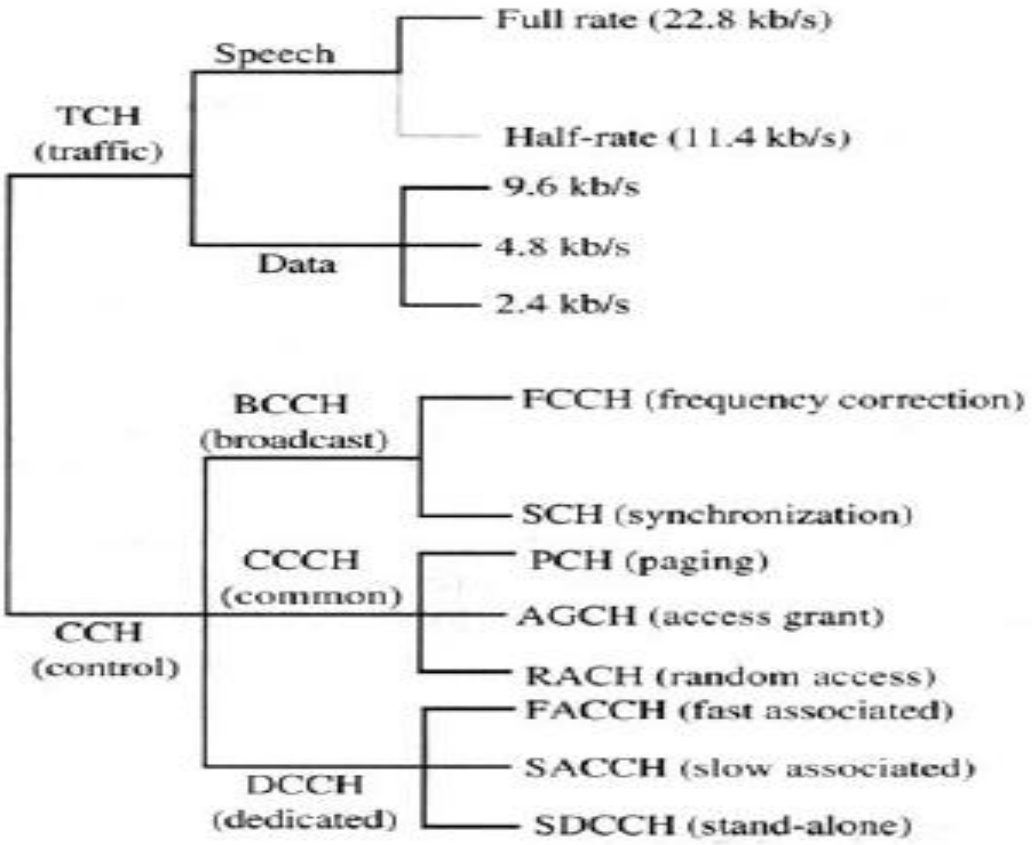
f) Data Message Handler (DMH) for collects the billing data.

g) Authentication Centre (AUC):The AUC manages the authentication associated with individual subscriber.

h) Inter working Function (IWF):The IWF enables the MSC to communicate with other networks. (PSTN), (ISDN), (PLMN) and Public Switched Packet Data Network (PSPDN).

(b)	**State two different properties of fiber joint. Explain expanded beam connector.**	**4M**
Ans:	**Properties of fiber joint-** • Good mechanical strength • Signal should travel through joint with low loss. • Capable to withstand moderate to low pulling and bending test. • Must terminate light process as much as possible .	**(Any two properties-2M, Diagram-1M, Explaination-1M)**

		Expanded beam connector- **Diagram:**  **Explaination:** It employs lenses is equal to local strength .Distance between fiber to lense is equal to local strength. separation of the fiber ends take place within connector. Connector is less dependant on central alignment. Optical processing elements such as beam splitter and switches can be easily inserted into expanded beam between the fiber ends**.**	
	(c)	**List the function of following :** **(i) UMTS Subscriber Identity Module(USIM)** **(ii) Radio Network Controller(RNC).**	**4M**
	Ans:	**(i) UMTS Subscriber Identity Module(USIM):** User Services Identity Module.: In a security context, this module is responsible for performing UMTS subscriber and network authentication and key agreement. It should also be capable of performing GSM authentication and key agreement to enable the subscriber to roam easily into a GSM Radio Access Network. (ii) **Radio Network Controller(RNC).** The RNC shall support the UMTS mechanism for data confidentiality of user and signaling data. **Note:marks can be awarded if function of USIM is written as that of GSM SIM and function of RNC is written as that of BSS of GSM**	**Function of (USIM)-2M,Radio Network Controller(RNC).-2M**
	(d)	**Draw diagram showing all the logical channels of GSM and state type of modulation used in GSM.**	**4M**

	Ans:	 **Figure 3.5** Logical channel structure in GSM. **Type of modulation** used in GSM=GMSK	**(Diagram showing all the logical channels of GSM-3M ,Type of modulation used in GSM-1M)**
	(e)	**State any four features of 3G-TD-SCDMA.**	**4M**
	Ans:	**<u>3G -TD-SCDMA:</u>** 1. It is Time Division Synchronous CDMA 2. Proposed by China Wireless Telecommunication Standards group (CWTS) 3. Uses Time Division Duplex (TDD) 4. Synchronous ⇒ All base station clocks are synchronized 5. TD-SCDMA is a 3GPP standard that combines an advanced TDMA/TDD system with an adaptive CDMA component operating in a synchronous mode. 6. TD-SCDMA is based on spread spectrum technology	**(Each features - 1M,Any Four)**