MODEL ANSWER

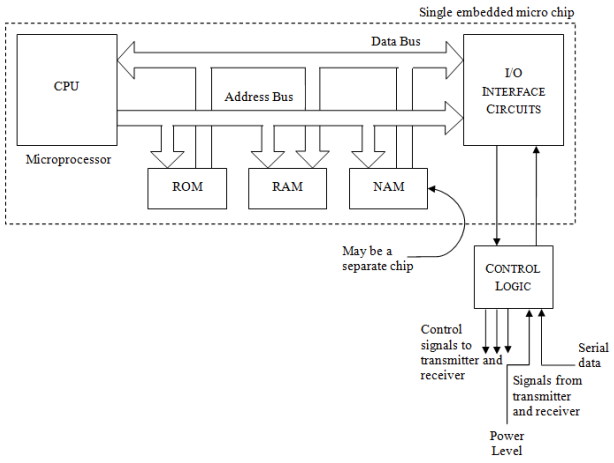
SUMMER– 19 EXAMINATION

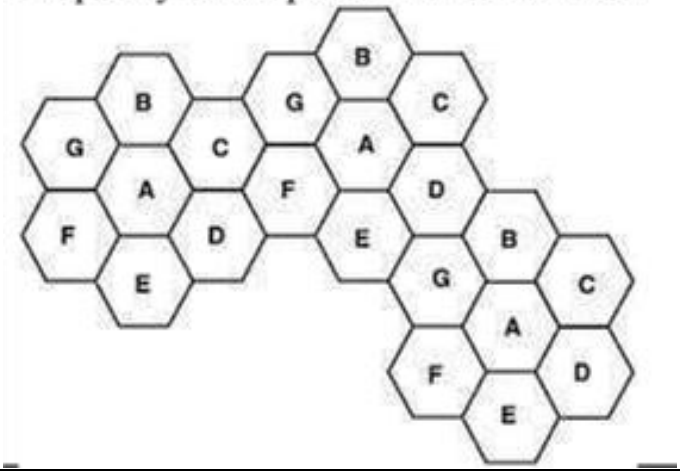
Subject Title: Mobile Communication Subject Code: 17657

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 of the following:**	**12- Total Marks**
	i)	**Define the following terms with respect to mobile communication:** **1) Base station** **2) Mobile switching Centre** **3) Forward Channel** **4) Control Channel**	**4M**
	Ans:	**Base Station:** It is a fixed station in a mobile radio system used for radio communication with mobile stations. Base stations are located at the center or on the edge of a coverage region and consist of radio channels and transmitter and receiver antennas mounted on a tower. **Mobile Switching center:** Also called a Mobile Telephone Switching Office (MTSO) is a switching center which coordinates the routing of calls in a large service area. In a cellular radio system, the MSC connects the cellular base stations and the mobiles to the PSTN (Public Switched Telephone Network, PSTN, is a global telecommunications network which connects conventional landline telephone switching centers, called central offices, with MSCs	**1M Each**

		throughout the world). **Forward Channel:** It is a radio channel used for transmission of information from the base station to the mobile. **Control Channel:** It is a radio channel used for transmission of call setup, call request, call initiation and other beacon or control purposes.	
	ii)	**List out the following specification for GPRS standard:** **1) Channel Bandwidth** **2) Modulation technique** **3) Data Rate** **4) Backward compatibility**	**4M**
	Ans:	**1. Channel Bandwidth**- 200KHZ **2. Modulation technique**- GMSK and 8 PSK **3. Data Rate**- 171.2kbps **4. Backward compatibility**- GSM	**1M Each**
	iii)	**Draw the block diagram of logic unit in mobile handset and explain it.**	**4M**
	Ans:	**(Diagram=2M, Explanation=2M)**  • It is made up of an embedded microprocessor with both ROM & RAM plus additional circuitry used for interpreting signals from MTSO and cell site & generating control signal for the transmitter & receiver. • A cellular radio contain a programmable read only memory chip called " Number Assignment Module (NAM)". The NAM contains the Mobile Identification Number	

	(MIN), which is the telephone number assigned to the unit. The NAM PROM is 'burned' when the Cellular Radio is purchased & the MIN is assigned. • This chip allows the radio to identify itself when a call is initiated or when the radio is interrogated by the MTSO. • All cellular mobile radios are fully under control of the MTSO through the cell site. The MTSO sends a serial data stream at 10 kbps through the cell site to the radio to control the transmitter & receiver frequency & transmitter power. • The MTSO monitors the received cell signal strength at the cellular radio by way of RSSI signal & it monitors the transmitter power level. These are transmitted back to the cell site & MTSO. Audio tones are also used for signaling purpose.	
iv)	**Describe the concept of "frequency reuse" used in cellular system. Define cluster. Draw frequency reuse pattern for cluster size 7.**	**4M**
Ans:	**(Concept=1M, Define=1M, Diagram=2M)** **Frequecy reuse:** • Base stations in adjacent cells are assigned channel group which contains completely different channels than neighboring cell. • By limiting coverage area to within the boundaries of cell, the same group of channels may be used to cover different cells that are separated from one another by distance large enough to keep interference level within tolerable limits. • The design process of selecting and allocating channel groups for all the cellular base station within a system is called frequency reuse or frequency planning. • Frequency reuse is important as the spectrum allocated for cellular transmission is limited and demand is increasing rapidly. **Cluster:** The Number of cells which collectively use the complete set of available frequency is called CLUSTER. Frequency Reuse pattern for cluster size 7  	
b)	**Attempt any ONE of the following:**	**6- Total Mark**
(i)	**Illustrate with the help of neat timing diagram, the process of cell initiation from mobile**	**6M**

handset to a landline phone (PSTN)

Ans: **(Diagram = 6M OR Explanation = 6M)**

MSC			Receives call initiation request from base station & verifies that the mobile has a valid MIN, ESN pair.	Instructs FCC of originating base station to move mobile to a pair of voice channels.		Connects the mobile with the called party on the PSTN.	
BASE STATION	FCC				page for called mobile, instructing the mobile to move to voice channel.		
	RCC	Receives call initiation request and MIN,ESN,Station Class Mark.					
	FVC						Begin voice transmission
	RVC						Begin Voice reception
MOBILE	FCC				Receives page & matches the MIN with its own MIN. Receives instruction to move to voice channel.		
	RCC	Sends a call initiation request along with subscribe MIN & number of called party					
	FVC						Begin Voice reception
	RVC						Begin voice transmission

Timing diagram illustrating how a call initiated by mobile is established

OR

A call initiation request is sent on the reverse control channel (RCC).Mobile unit transmits its telephone number (MIN), Electronic Serial Number (ESN), Station Class Mark (SCM) which indicates power level and telephone number of called party. The cell BS receives this information and sends it to MSC. The MSC validates the request, makes connection to called party through the PSTN.MSC instructs BS and mobile user to move to an unused voice channel pair to allow the conversation to begin.

OR When a mobile originates a call, a call initiation request is sent on the reverse control channel. With this request the mobile unit transmits its telephone number (MIN), Electronic Serial Number (ESN) and the telephone number of the called party. The base station receives the MIN, ESN of called party along with Station Class Mark (SCM) which indicates what is the maximum transmitting power level. The received details are forwarded to MSC. The MSC validates the request by checking the MIN, ESN etc. in its records. After validation, MSC instructs the originating Base station to move mobile to a unused pair of voice channels (FORWARD & REVERSE VOICE CHANNEL). The called party telephone number, is then

broadcast as paging message over all forward control channel throughout the cellular system (If the called number is another mobile phone) . The mobile receives the Paging message sent by base station which it monitors, and matches the received MIN with its own MIN. With MIN the called mobile phone number receives the instruction of moving itself to unused pair of voice channel. And then it makes connection to the called party. This connection is made with the called party through the PSTN, if the called party number is a landline telephone.

(ii) **Compare IS 95 standard with GSM standard with respect to the following points:** **6M**

1) **Frequency band**
2) **Multiple access**
3) **Modulation technique**
4) **Channel bandwidth**
5) **No of voice channel**
6) **SMS length.**

Ans: **(Each Parameter = 1M)**

Parameter	**GSM**	**IS-95**
Frequency band	890-915 MHz 935-960MHz	800 or 1900 MHz
Multiple access	TDMA	CDMA
Modulation technique	GMSK	QPSK /BPSK
Channel bandwidth	200KHz	1250KHz or 1.25MHz
No of voice channel	8 per channel	64 per channel
SMS length.	160	120

Q 2 **Attempt any FOUR of the following :** **16- Total Marks**

a) **State four features of Bluetooth.** **4M**

Ans: **Features of Bluetooth(any 4):** **Each 1M**

1. Each Bluetooth device has the capability of sharing all of its features with other Bluetooth devices in the surrounding area.
2. Bluetooth-enabled computer, sharing all the features, such as the Internet.
3. Bluetooth devices can communicate at ranges of up to 10 meters (Class B)
4. Bluetooth devices do not need to be in direct sight of each other.
5. Frequency – 2.4 GHz
6. Maximum Transmission rate is less than 1 Mbps

b) **Illustrate the operation of Radio paging system and state its drawback.** **4M**

Ans:
- Paging system are communication systems that sends brief (short) message to subscriber. Depending on the type of service, the message may be either a **numeric message, an alphanumeric message or a voice message.** **3M**

- Paging systems are typically used to notify a subscriber of the need to call a particular telephone number or travel to know location to receive further instructions.

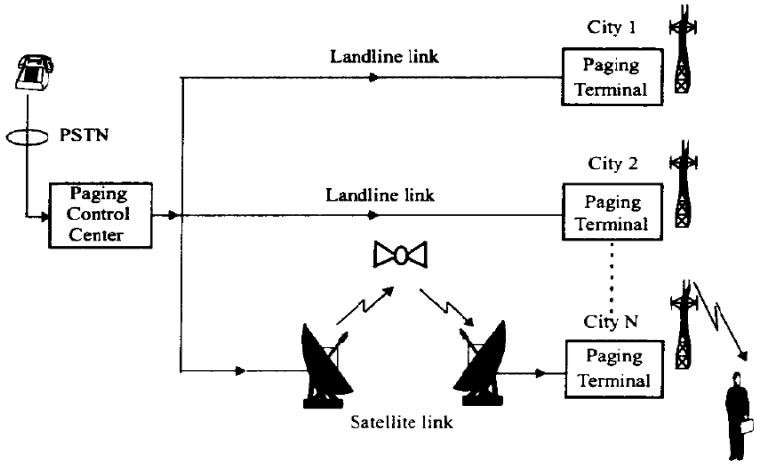


Figure: Paging System

- In modern paging system, news headlines, stock quotation & faxes may be sent. A message is sent to a paging subscriber via the **"Paging System Access Number"** with a telephone keypad or modem.
- The issued (transmitted) message is called **PAGE.** The paging system then transmits the page throughout the service area using base station which broadcast the page on a radio carrier.
- Paging systems are vary widely in their complexity & coverage area. while simple paging systems may cover a limited range of 2km to 5km, or may even be confined within individual buildings, wide area paging systems can provide worldwide coverage.
- Though paging receivers are simple & inexpensive, the transmission system required is quite sophisticated. Wide area paging systems consists of a network of telephone lines, many base station transmitter, and large radio tower that simultaneously broadcast a page from each base station [THIS IS CALLED SIMULCAST].
- Simulcast transmitter may be located within the same service area or in different cities or countries. Paging systems are designed to provide reliable communication to subscriber wherever they are.

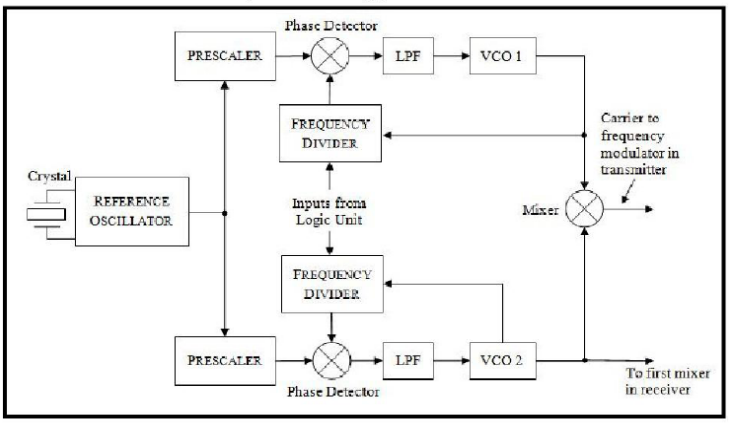
Drawbacks (Any 2) (Any other relevant drawbacks can be considered) **1M**

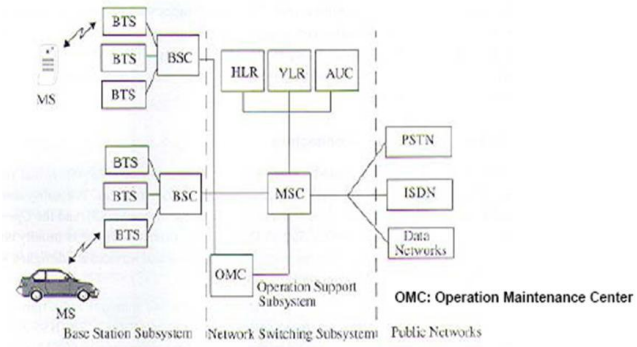
- Large transmitter power
- Low data rates
- The transmission system required is quite sophisticated

c)	**Define the term adjacent channel interference. State methods to reduce it.**	**4M**
Ans:	**(Define = 2M, Methods to reduce interference = 2M)** **Adjacent channel interference:** Interference resulting from signals which are close in frequency to the desired signal is called adjacent channel interference. Adjacent channel interference results from imperfect receiver filters which allow nearby frequencies to leak in to pass band. It is serious problem can be a particularly serious if an adjacent channel user is transmitting	

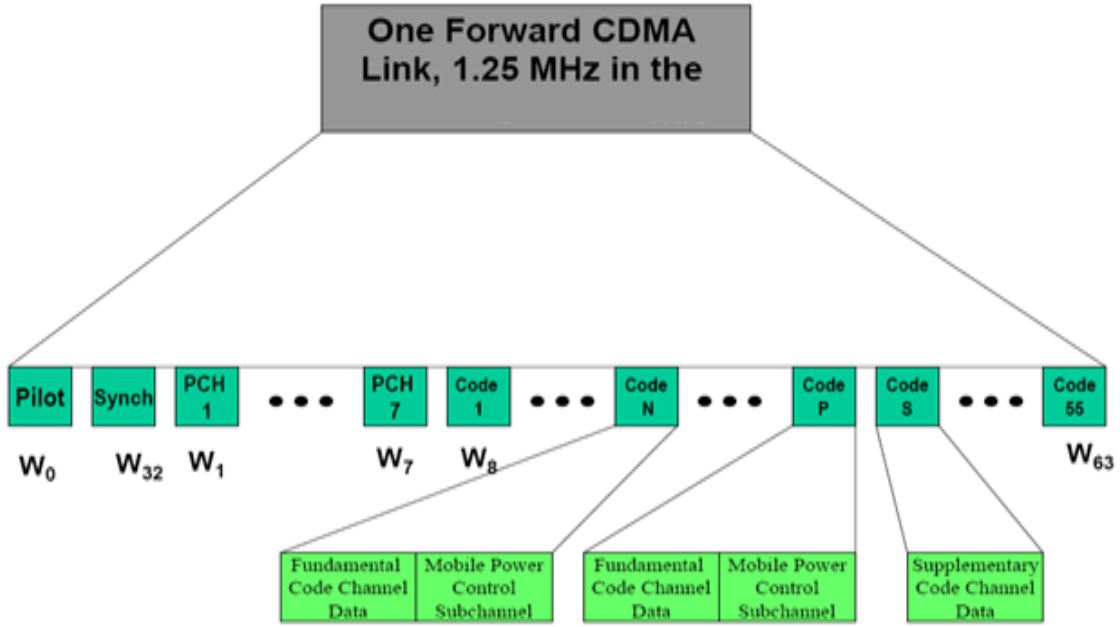
		very close range to a subscribers receiver, while receiver attempts to receive a BS on the desired channel this is referred to as near far effect **To reduce the interference:** The adjacent channel interference can be reduced by 1) Careful filtering 2) Careful channel assignment. • There should be adequate frequency separation between the spectrums of the adjacent channels in a cell • If the frequency reuse factor is large or cluster size is small the adjacent channel at the base station will be too close to each other in the frequency domain and this will increase the interference.	
	d)	**State the various services offered by GSM Standard. Describe these services in detail.**	**4M**
	Ans:	**(State = 1M, Describing = 3M)** The three services offered by GSM systems are; 1. Telephone services 2. Bearer services 3. Supplementary ISDN services **Telephone Services:** • Teleservices include • Standard mobile telephone • Mobile-originated • Base-originated traffic. • emergency calling • Fax • Videotext • Tele text, • SMS • MMS. **Bearer services:** The data services include the communication between computers and packet switched traffic. These services are limited to the first three layers of the OSI reference model. Data may be transmitted using either a Transparent Mode or Non-Transparent Mode. **Transparent Mode:-**Where GSM provides standard channel coding for user data **Non-Transparent Mode: -** Where GSM offers special coding efficiencies based on the particular data interface. **Supplementary ISDN services:** • This service are digital in nature and include	

		• Call diversion • Caller line ID • Closed user group • Call barring • Call waiting • Call hold • Connected line ID • Multiparty (Teleconferencing) • Call charge advice • This service also include the Short Messaging Service (SMS) which allow GSM subscriber and BS to transmit alphanumeric pages of limited length (160 -7 ASCII characters) while simultaneously carrying normal voice traffic.	
	e)	**List the follwing specification of IS 136 standard:** **(i) Frequncy spectrum** **(ii) Channel bandwidth** **(iii) Data Rate** **(iv) Modulation technique**	**4M**
	Ans:	**1)** Frequency Spectrum :Uplink 800 MHz,1500MHz Downlink 869-894MHz **2)** Channel Bandwidth :30KHz **3)** Data Rate :24,300 symbols per second. **4)** Modulation Technique : π/4 DQPSK	**1M Each**
	f)	**List various 3G standards and state any four features of third generation (3G) standard systems.**	**4M**
	Ans:	**(Each Feature= ½M, Each 3G standard =½M)** **Various 3G standards are:** (1) W-CDMA (2) IMT 2000 (3) CDMA 2000 (4) TDSCDMA **Features of Third generation (3G) standard system:** • Multi-megabit internet access. • Voice activated cells. • Unparalleled network capacity. • Ubiquitous " always on" access. • Communications using voice over internet protocol.	
Q.3		**Attempt any FOUR of the following :**	**16-Total Marks**
	a)	**State the Vision Of IMT 2000 (any four points).**	**4M**

	Ans:	1.Common Spectrum worldwide(1.8-2.2 GHz band) 2.Multiple radio environments (cellular,cordless,satellite,LANs) 3.Wide range of telecommunication services(voice,data,multimedia,internet) 4.Flexible radio bearers for increased spectrum efficiency. 5.Data rate up to 2 Mbps(phase 1)-for indoor environments 6.Maximum use of IN capabilities (for service provision and transport) 7.Global seamless roaming 8.Enhanced security and performance 9.Integration of satellite and terrestrial systems.	**Any 4 Each 1M**
	b)	**List the following parameters of 3G TD SCDMA System:** **(i) Data rate** **(ii) Bandwidth** **(iii) Multiple access** **(iv) Backward compatibility.**	**4M**
	Ans:	**(i) Data rate:-**Packet data rates up to 384 Kbps **(ii) Bandwidth:-**1.6 MHz **(iii) Multiple access:-**Time Division Synchronous Code Division Multiple Access Technology **(iv) Backward compatibility:-**GSM	**Each 1M**
	c)	**Draw the labeled diagram of frequency synthesizer? How many signals are obtained from frequency synthesizer? Why their frequency should be different?**	**4M**
	Ans:	**Diagram:**  **Figure: Block diagram of Frequency synthesizer of mobile unit** **Explanation:** • Frequency synthesizer uses many techniques to generate signal. • **Following signals are obtained from frequency synthesizer:** **1.** Frequency multiplication signal **2.** Frequency division signature **3.** Direct digital synthesis signal **4.** Frequency mixing signal **5.** Phase-locked loop signal to generate its frequencies.	**2M** **1M** **1M**

	• If the output frequency drifts, the phase error signal will increase, driving the frequency in opposite direction so as to reduce the error. Thus output is locked to frequency at other input. • For this reason their frequency should be different in frequency synthesizer.	
d)	**Draw GSM system architecture and explain function of HLR and OMC units.**	**4M**
Ans:	**Diagram:**  Fig. GSM system architecture **Home Location Register (HLR):** This database contains all the administrative information about each subscriber along with their last known location. In this way, the GSM network is able to route calls to the relevant base station for the MS.When a user switches on their phone, the phone registers with the network and from this it is possible to determine which BTS it communicates with so that incoming calls can be routed appropriately. Even when the phone is not active (but switched on) it re-registers periodically to ensure that the network (HLR) is aware of its latest position. There is one HLR per network, although it may be distributed across various sub-centres to for operational reasons. **Operation maintenance center (OMC):** Network operation and maintenance functions, subscription, management including charging and billing and also mobile equipment management. The OMC also has provision for adjusting all base station parameter and billing procedure as well as providing system operators with the ability to determine the performance and integrity of all equipments in the system.	**2M** **1M** **1M**
e)	**State and explain various services of SS7.**	**4M**
Ans:	**SS7 SERVICES** **a) Touchstar** It is also known as CLASS. It is a group of switch Controlled Services that provides its users with certain call management capabilities. It provides services such as call return, call forwarding, repeat dialing, call block, call tracing & caller ID. **b) 800 services** : It was introduced by bell System to provide toll-free access to the calling party to the services & database which is offered by private parties. Cost associated with the processing of calls is paid by the service subscriber.800 Service is offered under two plans : **a) 800-NXX plan :**	**4M**

		The first 6 digits of an 800 call are used to select the interexchange carrier (IXC). **b) 800 database plan :** The call is looked up in the database to determine the appropriate carrier & routing information. **c) Alternate Billing Service & Line Information Database (ADB/LIDB)** These services use the CCS network to enable the calling party to bill a call to a personal number (third party number, calling card, or collect etc.) from any number **d) Performance of SS7** **1)** Performance of signaling network is studied by connection set-up time (response time) or the end-to-end Signaling information transfer time. The delays in the signaling point (SP) and the STP depend on the specific hardware configuration & switching software implementation. **2) Congestion control in SS7 networks :** With the increase in subscribers it is important to avoid congestion in the signaling network under heavy traffic conditions.SS7 networking protocols provide several congestion control schemes, allowing traffic to avoid failed links & nodes.	
Q.4	**a)**	**Attempt any THREE of the Following :**	**12- Total Marks**
	(i)	**List down the features of HSCSD 2.5 G with respect to:** **1) Channel Bandwidth** **2) Duplexing method** **3) Data rate** **4) Backward compatibility.**	**4M**
	Ans:	**1) Channel Bandwidth:** 200 KHz **2) Duplexing method:** FDD **3) Data rate:** Data rate up to 57.6 Kbps **4) Backward compatibility:** Backward compatible to GSM	**Each 1M**
	(ii)	**State any four features of UMTS.**	**4M**
	Ans:	**Features of UMTS:** 1)Frequency spectrum: Uplink 1920-1980 MHz Downlink 2110-2170 MHz 2) Channel Bandwidth:5 MHz 3) chip rate:3.84 Mbps 4) Duplexing Technique: FDD and TDD modes 5) Modulation scheme: Direct sequence CDMA with QPSK 6) Frame length:10 ms frame with 15 time slots 7) Coding technique: Orthogonal variable spreading factor(OVSF) 8) Service type: Multi-rate and multi-service	**Any 4 Each 1M**
	(iii)	**Draw forward channel structure of IS-95. Write function of each channel type.**	**4M**
	Ans:	**Diagram:**	**2M**



Explanation:

Forward channel is a communication channel used for transmission of information from BS to mobile station.
Pilot channel: This channel allows a MS to acquire timing for forward CDMA channel. It provides a phase reference for coherence demodulation. It provides each mobile with an answer for signal strength comparison between BS for determining when to handoff.

Synchronization channel: The synchronization channel broadcasts synchronization message to the MS. The sync channel message parameters are System Identification (SID) and Network Identification (NID)

Paging Channel: The paging channel is used to send control information and paging messages from BS to the mobile and paging messages from BS to the mobile.
Forward Traffic channel: Information on the forward traffic channel includes the primary traffic (voice and data) secondary traffic (data) and signaling.

2M

(iv) **Compare GSM standard with N-AMPS standard with respect to.**

1) **Generation**
2) **Channel bandwidth**
3) **Analog/Digital**
4) **Data rate.**

4M

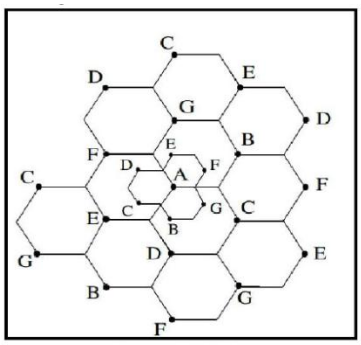
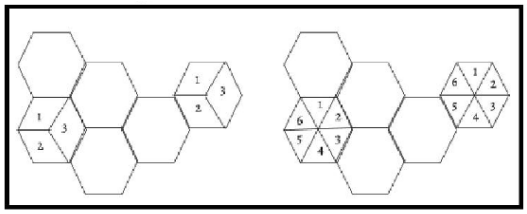
Ans:

Parameter	GSM	N-AMPS
Generation	Second Generation	First Generation
Channel bandwidth	200 KHz	10KHz
Analog/Digital	Digital Technology	Analog Technology
Data rate	270.833 Kbps	10 Kbps

Each 1M

b) **Attempt any ONE of the following:** **6M**

(i) **State different techniques used in cellular system to improve coverage and capacity of** **6M**

		cellular system. **Describe any one in detail with diagram. State how it increases system capacity.**	
	Ans:	**(Techniques = 2M, Diagram =2M, Explanation = 2M)** **Techniques for improving capacity:** Cell splitting Cell sectoring Microcell-zone concept Repeaters for Range Extension Frequency Reuse **Cell splitting** is the process of subdividing congested cell into smaller cells, each with its own base station and a corresponding reduction in antenna height and transmitter power. **Cell splitting** increases capacity of a cellular system since its increases the number of times that channels are reused.  Figure: Cell Splitting **OR** **Cell sectoring** increases SIR using directional antennas, then capacity improvement is achieved by reducing the number of cells in a cluster, thus increasing frequency reuse. Often wireless operator needs to provide dedicated coverage for hard-to-reach areas. Such as within buildings, or in valleys or tunnels. Radio transmitters, known as **—repeaters** are often used to provide such range (coverage) extension capabilities.  Figure: Cell Sectoring (120° & 60°) **OR** **Microcell-zone concept:**	

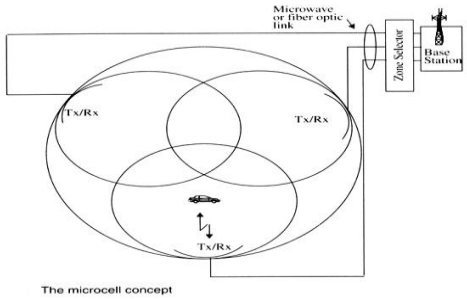
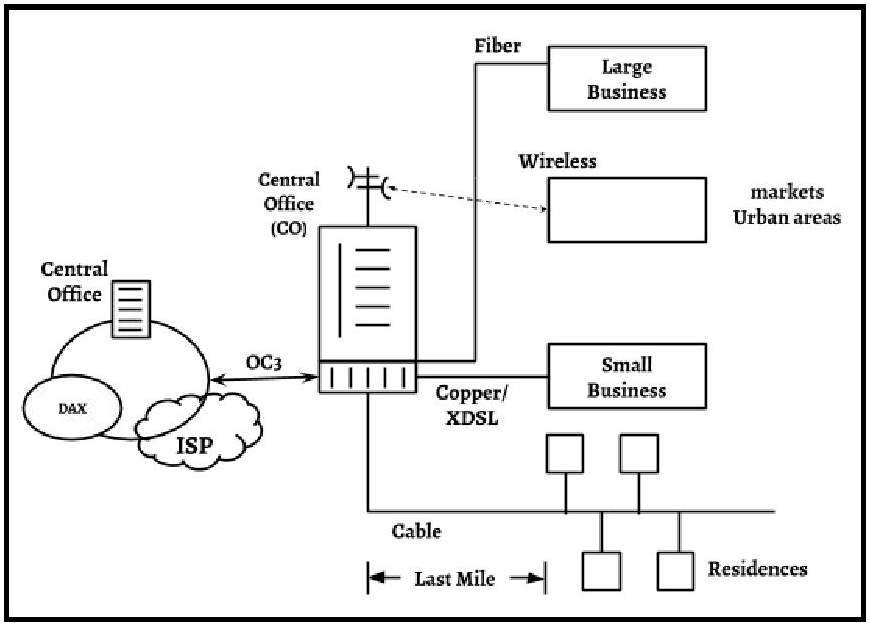


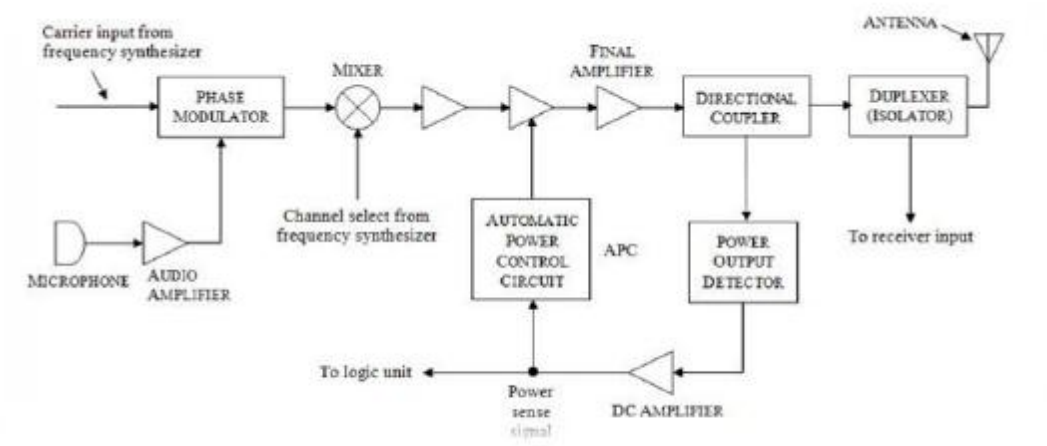
Figure The microcell concept

The problem associated with sectoring technique is the increase in number of handoffs. This puts an additional load on the switching and control link elements of the mobile system. A solution to this problem is microcell concept. In this scheme, all the three or more zone sites represents as Tx/ Rx are connected to the same base station and share the same radio equipment. The transmission media used for connecting the zones to the base station are coaxial cable, fiber optics cable or a microwave link. So each cell consists of a base station and multiple zones. A mobile travelling within a cell, is served by the zone that has the strongest signal of all. The antennas in zones are placed at the outer edges of the cell and any base station channel can be assigned to any zone by the base station. As a mobile travels from one zone to the other within a cell, it uses the same channel . This will avoid hand-off. The base station will just switch the channel to the appropriate zone sit. Thus a given channel is being used only in a particular zone in which the mobile is travelling. So the base station radiation is localized. This will reduce interference. The channels are distributed in time and space by all the zones are also reused in the co- channels cells. The microcell concept is very useful along highways or in the busy urban areas.

(ii)	**What is meant by Hand-off? List different types of Hand-off. Explain any three in detail.**	**6M**
Ans:	**Definition of Hand-off:** 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 procedure is called handoff.	**1M**
	Different types of Hand off: 1)Hard Handoff 2)Soft Handoff 3)Mobile assisted Handoff 4)Intersystem Handoff 5)Delayed Handoff 6)Queued Handoff 7)Intra system Handoff 8)Network controlled Handoff(NCHO) 9)Mobile Assisted Handoff(MAHO)	**2M**
	Hard Handoff: 1.The definition of a hard handover or handoff is one where an existing connection must be broken before the new one is established. 2.Hard handoff allocate different frequency of user. 3.In hard handoff a handset always communicates with one BS at any given time. 4.Hard Handoff is typically used in TDMA and FDMA systems. 5.Hard handoff is not very complicated.	**Any 3 Each 1M**

		Soft Handoff: 1.Soft handoff is defined as a handover where a new connection is established before the old one is released. 2.Soft handoff allocate same frequency. 3.In soft handoff a handset may connect up to three or four radio links at the same time. 4.Soft handoff used in CDMA and some TDMA systems. 5.Soft handoff is more complicated than hard handoff. **Delayed Handoff:** 1.A Delayed handoff is a two hand off level algorithm. It provides more opportunity for a successful handoff. 2.The MTSO always handles the handoff first and the originating calls second. If no neighboring cells are available after the second handoff level is reached, the call continues until the signal strength drops below the threshold level then the call is dropped. 3.Lower handoffs help in handling call processing more adequately. 4.It makes the handoff occur at the proper location and eliminates possible interference in the system. **Queued Handoff:** 1.Queued handoff is more effective than two threshold level handoffs. 2.The MTSO will queue the requests of handoff calls instead of rejecting them if the new cell sites are busy. 3.With Queuing of originating calls only, the probability of blocking is reduced. 4.It is effective when implementing a simple queue for handoff calls which reduces call drops.	
Q.5		**Solve any FOUR of the following :**	**16- Total Marks**
	a)	**Draw neat block diagram of wireless local loop (WLL) network and state its importance.**	**4M**
	Ans:	**Block Diagram:**  	**3M**

		WLL is Wireless Local Loop. The importance of WLL is that only once the charges has to be paid for wireless equipment, after that there is no additional costs involved. WLL can greatly improve telecommunication facility and services in an expensive way. It provides 1. High bandwidth 2. Faster deployment 3. Lower deployment costs 4. Lower network maintenance, management and operating cost	**1M**
	b)	**List and describe any four key features of IS-95 CDMA system.**	**4M**
	Ans:	1) **Diversity**- The cellular system are having tendency to multipath fading and diversity methods of some are required to mitigate the effect of fading. @ Type of diversity in CDMA is: **a) Time diversity:** Provided by symbol interleaving, error detection & correction coding **b) Frequency diversity:** provided by 1.25MHz **c) Space (path) diversity:** Multipath signals accepted by Receiver 2) **Power control:** For the CDMA system to work efficiently the RF power in the system need to be controlled. All the transmission from mobile must receive at base station receiver at approximately the same strength (within 1dB). To maximize the no. of users sharing a cell, only minimum RF power required for reliable communication. 3) **Soft handoff** -The soft handoff in a CDMA system results from system capability to simultaneously deliver signal to mobile through more than one cell. 4) **System capacity** - Key parameters that determine capacity of CDMA are as follow: **a)** Processing gain ratio of spreading code information data rate (W/R). **b)** Ratio of energy per bit to noise power (Eb / No) **c)** Voice activity factor 5) **Soft capacity**- CDMA based on spread spectrum concept are designed to tolerate some level of interference, with their overall capacity limited by how well this mutual interference call be controlled. This is important when call might be dropped during handoff. 6) **Quality of service** – By using RAKE receivers and other improved signal processing techniques. Each mobile station selects the three strongest multipath signals and coherently combines them to produce an enhanced signal. 7) **Economics** - CDMA is cost effective technology that require fewer cell site and no costly frequency reuse pattern. The average power transmitted by CDMA mobile station average 6 to7 mW, which is lower than required by FM and TDMA phones.	**List - 1M** **Four Key Feature 3M**
	c)	**Draw neat block diagram of transmitter unit of mobile handset. State function of APC loop and duplexer unit.**	**4M**
	Ans:	**Block Diagram:**	



2M

Function of APC circuit:

The APC circuit can introduce power attenuation in steps of 4 dB to 28 dB. This is done by controlling supply voltage to one of intermediate power amplifier stages. It also helps to minimize the interference from other stations in same adjacent cells.

1M

Function of Duplexer Circuit:

The Transmitter output is fed to duplexer circuit or isolator that allows the transmitter and receiver to share the same antenna.

Avoids high transmitted power to reach the receiver. Hence protects the receiver from high transmitted power.

1M

	d)	**Describe the concept of Ad-hoc mobile communication for 4G.**	**4M**
	Ans:	**(Note: Explanation 4M Diagram Optional . If Diagram Drawn, Diagram - 1M,Explaination -3M)** Mobile ad hoc networks (MANETs) are envisioned to become key components in the 4G architecture, and ad hoc networking capabilities are expected to become an important part of overall next-generation wireless network functionalities. In general, mobile ad hoc networks are formed dynamically by an autonomous system of mobile nodes that are connected via wireless links without using an existing network infrastructure or centralized administration. The nodes are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. Such a network may operate in a standalone fashion, or may be connected to the larger Internet. Mobile ad hoc networks are infrastructure less networks since they do not require any fixed infrastructure such as a base station for their operation. In general, routes between nodes in an ad hoc network may include multiple hops and, hence, it is appropriate to call such networks "multihop wireless ad hoc networks."	

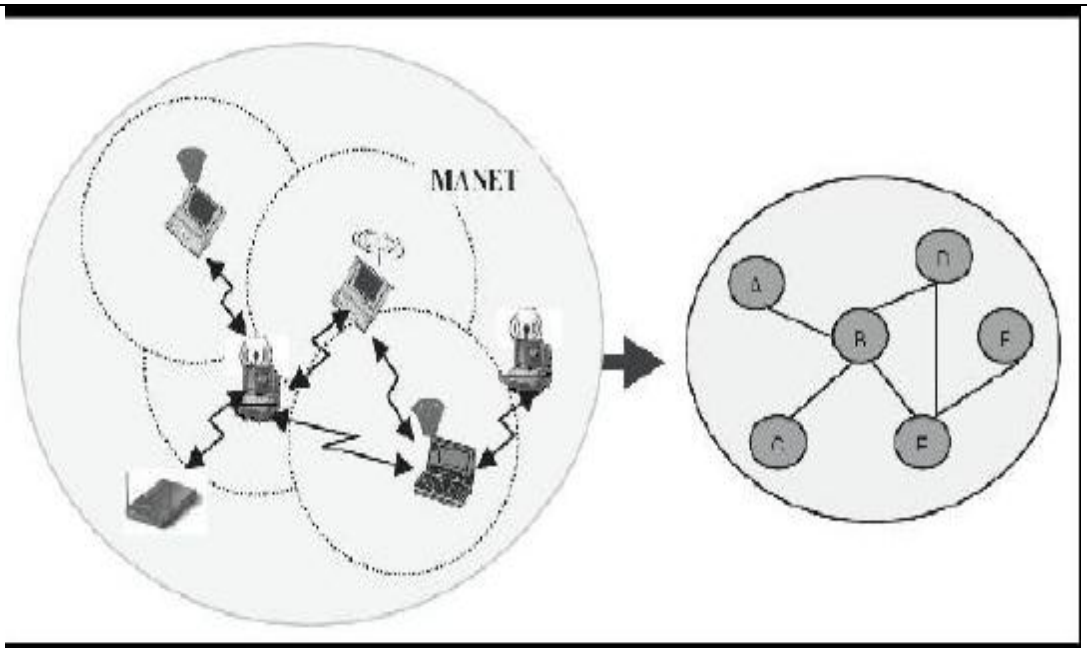
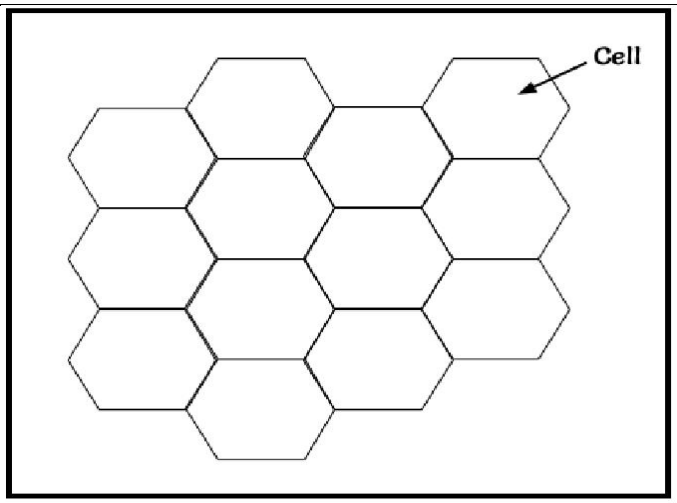
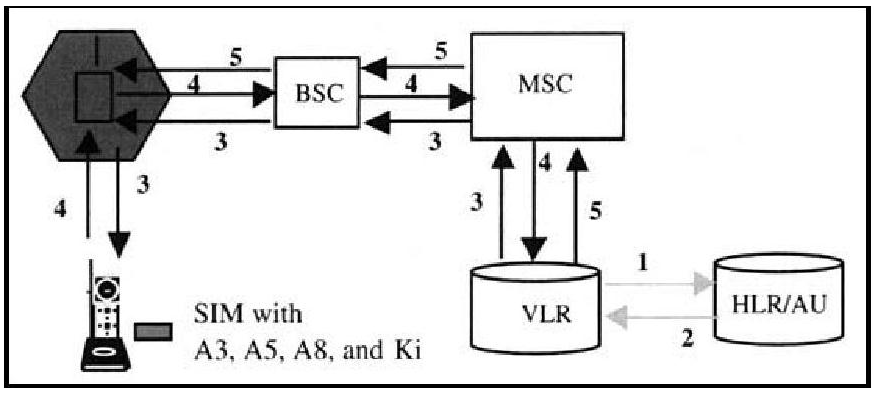


Figure: Mobile ad hoc network.

Figure shows an example mobile ad hoc network and its communication topology. As shown in Figure, an ad hoc network might consist of several home-computing devices, including notebooks, handheld PCs, and so on. Each node will be able to communicate directly with other nodes that reside within its transmission range.
For communicating with nodes that reside beyond this range, the node needs to use intermediate nodes to relay messages hop by hop.

e)	**Draw basic cellular system. State the advantages of cellular system and define frequency reuse ratio.**	**4M**
Ans:		**1M**
	Advantages of Cellular System: The cellular system divides a large geographic area into cells with diameters from 2 to 50 km, each of which is allocated a number of RF channels. Transmitter in each adjacent cell operate on different frequencies to avoid interference. However, transmit power & antenna height in each cell are relatively low, cells that are sufficiently far apart can reuse the same set of frequencies without causing co-channel interference.	**2M**

		As the demand for cellular mobile service grows, additional cells can accommodate the traffic. Figure given below illustrates an idealized view of a cellular mobile system, where cells are depicted as perfect HEXAGON. **Frequency Reuse :** The Design process of selecting and allocating channels groups for all of the cellular base station within a system is called Frequency Reuse or Frequency Planning.	**1M**
	f)	**Explain authentication process in GSM system with the help of neat Figure.**	**4M**
	Ans:	**Diagram:**  **Explanation:** **1.** At terminal location update, VLR sends IMSI to the HLR. **2.** HLR returns security triplets (RAND, SRES, Kc) to the VLR. **3.** For authentication and ciphering the VLR sends RAND to the MS. **4.** Using stored A3 algorithm and secret key Ki stored in the SIM, and RAND provided by the VLR, the MS calculates the SRES and returns it to the VLR. Using the A8 algorithm and Ki, the MS also calculates the cipher key Ke. **5.** If the SRES returned by the MS matches with the stored SRES in the VLR, the VLR sends the cipher key Kc to the BTS which uses Kc for ciphering the radio path (downlink). The MS uses its Kc to cipher the radio path (uplink) using encryption algorithm As **OR**	**2M** **2M**

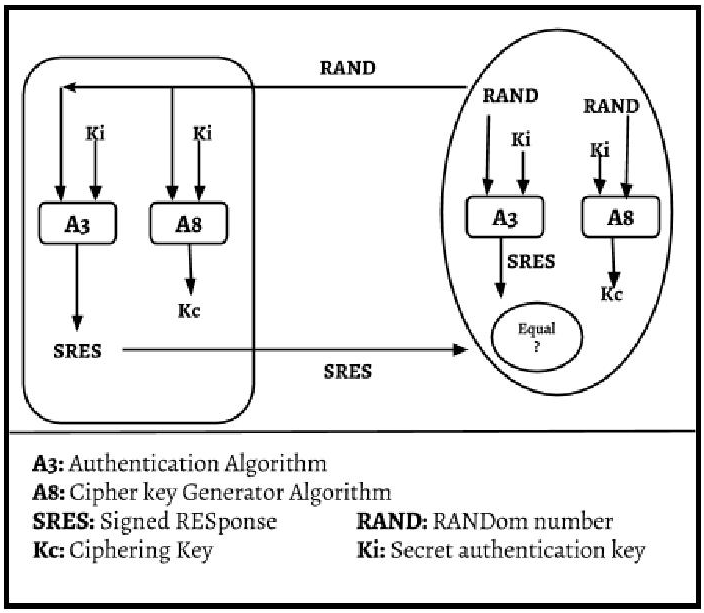
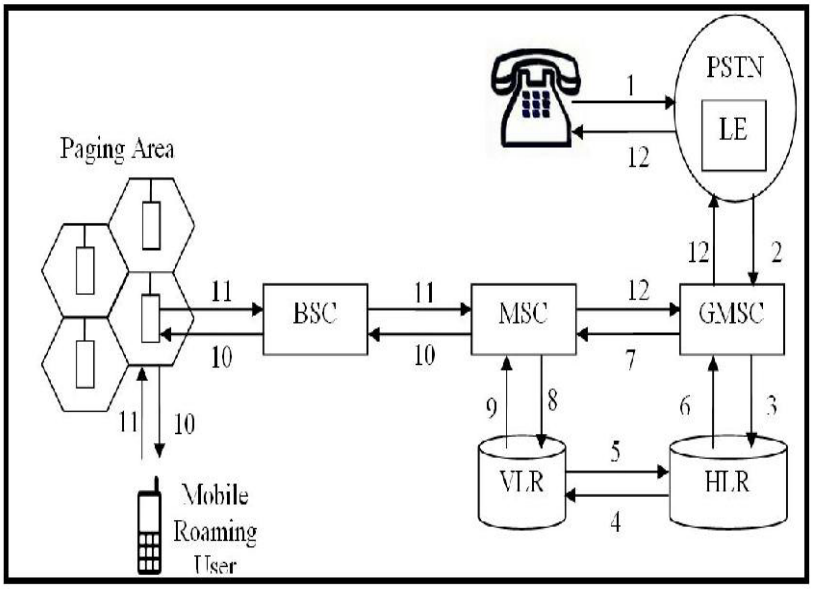


Fig shows the general authentication process.

- At the time of service provisioning the IMSI, the individual subscriber authentication key (Ki), the authentication algorithm (A3), the cipher key generation algorithm (A8), and the encryption algorithm (A5) is unique and needs to be used across all GSM network operators.
- The authentication center is responsible for all security aspects. And its function is closely linked with HLR.
- The AUC (Authentication Center) generates the Kis, associates them with IMSIs, and provides for each IMSI to set of triplets consisting of RAND (random number), SRES (signed response), and Kc (ciphering key).
- The HLR then provides the appropriate VLR with this set, and it is the VLR that carries out the authentication check and provides the appropriate ciphering key (Kc) to BTS for encryption/decryption of the radio path.
- It is also possible for the new VLR to receive unused triplets from old VLR at location update. Further, the serving VLR can request additional triplets from HLR/AC if the current set is depleted below a certain threshold.
- The network operator has option of invoking the procedure at one or more of the following instances: initial registration, location update, and call origination/termination.

Q.6		**Attempt any FOUR of the following :**	**16- Total Marks**
	a)	**Describe the process of mobile terminated call (Incoming call) in GSM with neat call flow sequence diagram.**	**4M**
	Ans:	**Sequence Diagram:**	**2M**



2M

Explanation:

1) The PSTN user dials the MSISDN of the called user in GSM.
2) The LE routes the call to the GMSC of the called GSM user.
3) The GMSC uses the dialed MSISDN to determine the serving HLR for the GSM user and interrogates it to obtain the required routing number.
4) The HLR requests the current serving VLR for the called MS for a MSRN(MS
5) roaming number so that the call can be routed to the correct MSC.
6) The VLR passes the MSRN to the HLR.
7) The HLR passes the MSRN to the GMSC.
8) Using the MSRN, the GMSC routes the call to the serving MSC.
9) The MSC interrogates the VLR for the current location area identity (LAI) for the MS. The VLR provides the current location for the MS.
10) The MSC pages MS via the appropriate BSS. The MS responds to the page and sets up the necessary signaling links.
11) When the BSS has established the necessary radio links, the MSC is informed an the call is delivered to the MS.
12) When the MS answers the call, the connection is completed to the calling PSTN user.

b) **State importance of the following terms:**

(i) Blockage
(ii) Call drops
(iii) Word error rate
(iv) Voice quality.

4M

Ans: **(i) Blockage : There are two kinds of blockage:**

1. Set-up channel blockage
2. Voice-channel blockage.

Each 1M

1. Set-up Channel Blockage: Information regarding set-up channel blockage cannot be obtained at the cell site because the mobile unit will be searching for the busy/idle bit of a forward set-up channel in order to set up its call. If the busy bit does not change after 10 call attempts in 1s, a busy tone is generated, and no mobile transmit takes place. In another case the mobile transmit takes place as soon as the idle bit is shown. The set-up channel blockage should be at least less than half of the specified blockage (usually 0.02) in the mobile cellular

system.

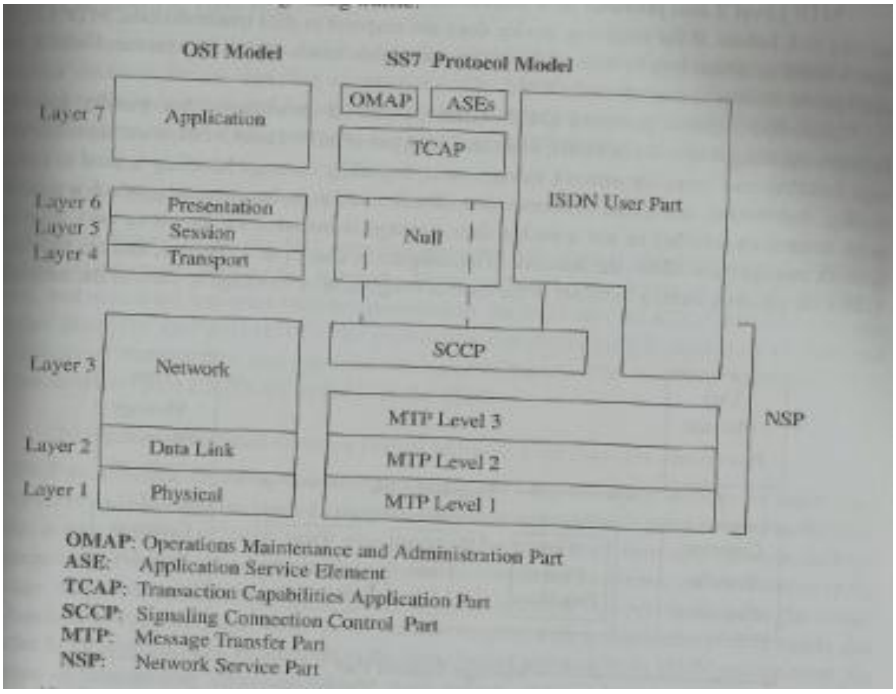
2. Voice-channel Blockage: Voice-channel blockage can be evaluated at the cell site. When all calls come in, some are refused for service because there are no available voice channels.

(ii) Call Drops (Dropped-call Rate): Call drops are defined as calls dropped for any reason after the voice channel has been assigned. Sometimes call drops due to weak signals are called lost calls.

(iii) Word error rate (WER): It is defined as a metric for performance of a speech recognition or machine translation system.
OR The WER is a valuable tool for comparing different systems as well as for evaluating improvements within one system.

(iv) Voice Quality: The voice quality of a channel can be tested by using the signal-to-noise-plus-distortion ratio (SINAD) to evaluate voice quality.

c)	**Draw SS7 protocol architecture and explain working of different levels of SS7.**	**4M**
Ans:	**Diagram:**	**2M**



The SS7 architecture is shown in figure. SS7 is based on a four-level protocol layer architecture.

I.NETWORK SERVICE Part (NSP) oF SS7: The NSP provides ISDN nodes with a highly reliable and efficient means of exchanging traffic using connectionless services.

MESSAGE TRANSFER Part (MTP) oF SS7:

The function of MTP is to ensure that signaling traffic can be transferred and delivered reliably between the end-users and the network. MTP is provided at three levels.

1.Signaling Data Link Functions (MTP Level 1):

Level 2M

- This level provides an interface to the actual physical channel over which communication takes place.
- Physical channels may include copper wire, twisted pair, fiber, mobile radio or satellite link. This level uses 64 kbps transmission.

2.Signaling Link Function (MTP Level 2):

- It provides a reliable link for the transfer of traffic between two directly connected signaling points. Variable packet messages, called message signal units (MSUs) are defined in MTP level 2.
- MTP level 2 also provides flow control data between two signaling points as a means of sensing link failure.

3.Signaling Network Function (MTP Level 3):

- It provides procedures that transfer messages between signaling nodes.
- **There are two types of MTP Level 3 functions:**
  1.Signaling message handling
  2. Signaling network management.

4.Signaling Message Handling:

- This is used to provide routing, distribution and traffic discrimination (discrimination is the process by which a signaling point determines whether or not a packet data message is intended for its user or not).

5.Signaling Network Management:

This allows the network to reconfigure in case of node failures and has provisions to allocate alternate routing facilities in case of congestion or blockage in parts of the network.

- **SIGNALING CONNECTION CONTROL Part (SCCP):** The SCCP provides enhancement to the addressing capabilities provided by the MTP. SCCP also provides the ability to address global title messages or non-billed numbers. Different classes of service provided by SCCP are:

II. SS7 User Part:

SS7 user part provides call control and management functions and call setup

capabilities to the network.

- The SS7 user part includes the following:

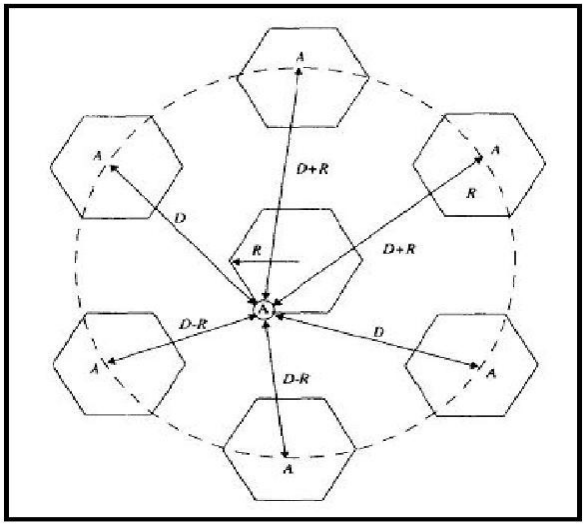
a) Integrated Services Digital Network User Part (ISUP):

The ISUP provides the signaling functions for carrier and supplementary services for voice, data and video in an ISDN environment.

ISUP uses the MTP for transfer of messages between different exchanges.

In addition to the basic bearer services in an ISDN environment, the facilities of user-to-user signaling, closed user group, calling line identification and call forwarding are provided.

b)Transaction Capabilities Application Part (TCAP):

		The TCAP part in SS7 refers to the application layer which invokes the services of the SCCP and the MTP in a hierarchical format. One application at a node is thus able to execute an application at another node and use these results. **c) Operation Maintenance and Administration Part (OMAP):** The OMAP functions include monitoring, coordination and control function to ensure that trouble-free communications are possible.	
	d)	**State any four features of 4G CDMA 2000.**	**4M**
	Ans:	**1)** Code division multiple access 2000 is the natural evolution of IS-95 (cdmaOne). **2)** It includes additional functionality that increases its spectral efficiency and data rate capability. **3)** Code division multiple access is a mobile digital radio technology where channels are defined with codes (PN sequences). **4)** CDMA permits many simultaneous transmitters on the same frequency channel. **5)** Since more phones can be served by fewer cell sites, CD MA-based standards have a significant economic advantage over TDMA or FDMA-based standards. The main CDMAz2000 standards are: CDMA2000 1xRTT,CDMA2000 1xEV and CDMAz2000 EV-DV. **(NOTE: If student attempted the question considering 3G CDMA 2000, give appropriate marks accordingly.)**	**Each 1M**
	e)	**Define the term co-channel interference. State cause and effect of co-channel interference on system capacity.**	**4M**
	Ans:	**(Defination -1M,Cause and effect -3M)**  **Definition:** Frequency reuse implies that in a given coverage area there is several cells that Use the same set of frequencies. These cells are called co-channel cells, and the Interference. Between signals from these cells is called co-channel interference.	

		Cause of co-channel interference: In Cellular mobile communication, frequency spectrum is divided into non-overlapping spectrum bands which are assigned to different cells .In cellular communications, a cell refers to the hexagonal/circular area around the base station antenna. However, after certain geographical distance, the frequency bands are re-used, i.e. the same spectrum bands are reassigned to other distant cells. The co-channel interference occurs due to Frequency reuse. Thus, besides the intended signal from within the cell, signals at the same frequencies (co-channel signals) arrive at the receiver from the undesired transmitters located (far away) in some other cells and lead to deterioration in receiver performance. **Effect of co-channel interference:** Co channel Interference plays an important role in determining the quality of service. QOS is measured by coverage, call blocking, call dropping, Audio quality. Audio quality is mainly affected by co channel Interference. The capacity of the channel is affected significantly by co channel Interference. Co channel Interference also decides the frequency reuse plan and link performance.	