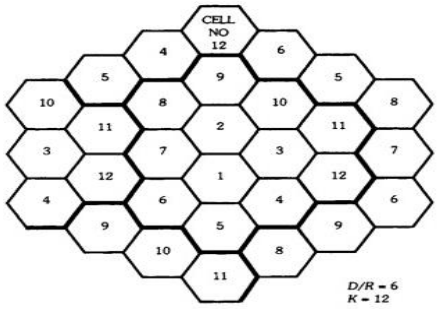
WINTER – 19EXAMINATION

Subject Name: Mobile Communication **Model Answer** 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 themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given moreImportance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in thefigure. 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 constantvalues 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 frequency reuse. Draw frequency reuse pattern for cluser size N= 12.**	**4M**
	Ans:	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.  	**Definition 1M** **Diagram 3M**
	(ii)	**List any four specification of GPRS 2.5G GSM standard**	**4M**
	Ans:	**Specifications of GPRS 2.5G GSM standard:** **1**)Packet Switching 2)Radio Frequency 1800 to 1900 MHz 3)TDMA,CDMA 4)Bandwidth-171-384 K Marks to be credited for any other relevant specification.	**Each 1Mark**
	(iii)	**Compare EDGE for 2.5G GSM with IS-95B 2.5g CDMA (Any four points)**	**4M**

Ans:

EDGE	IS95B
1. Channel Bandwidth is 200 KHZ	1. Channel bandwidth is 1.25 MHz
2. Edge stand for Enhanced data rate for GSM	2. Interim data solution for CDMA is called as IS 95B
3. Requires new Transceiver at base station. Also software upgrades to base station controller and base station.	3. Requires new software in base station controller.
4. EDGE introduces higher order 8PSK modulation which is used in addition to GSm 's standard GMSK modulation	4. IS 95B specifies Hard Hand Off procedure that allows subscriber unit to record different radio channels in the network without instructions from switch so that subscriber can tune to different base stations to maintain link quality.
5. All eight times slots of GSM radio channel are dedicated to a single user, a raw peak throughput data rate of 547.2 Kbps can be provided or 384 Kbps for a single dedicated user on single GSM channel.	5. IS 95 allows dedicated user to command up to eight different user walsh codes simultaneously and in parallel for instantaneous throughput of 115.2 Kbps per user(8*14.4.Kbps).

4M

(iv) Illustrate the operation of paging with neat block diagram. **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.

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 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.

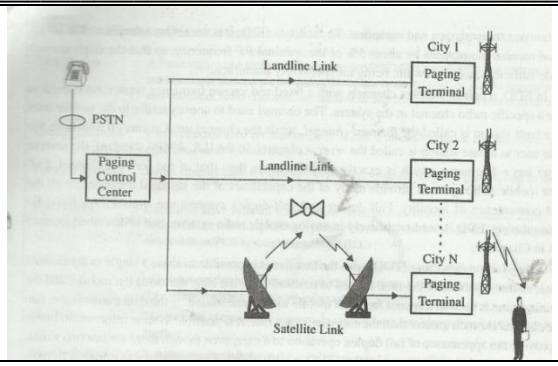
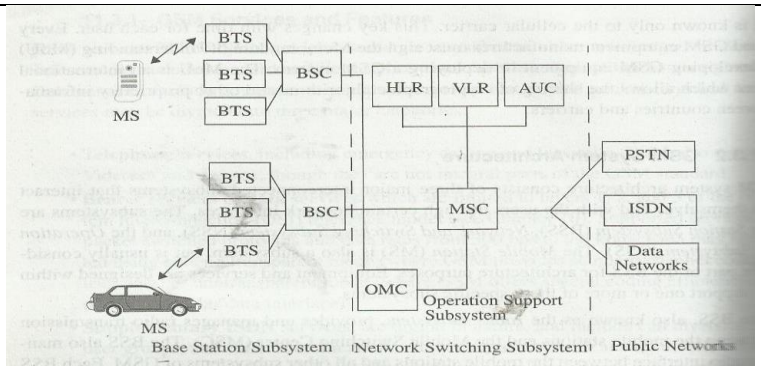
The issued (transmitted) message is called PAGE. The paging system then transmits the page throughout the service area using base station which broadcast the page on a radio carrier.

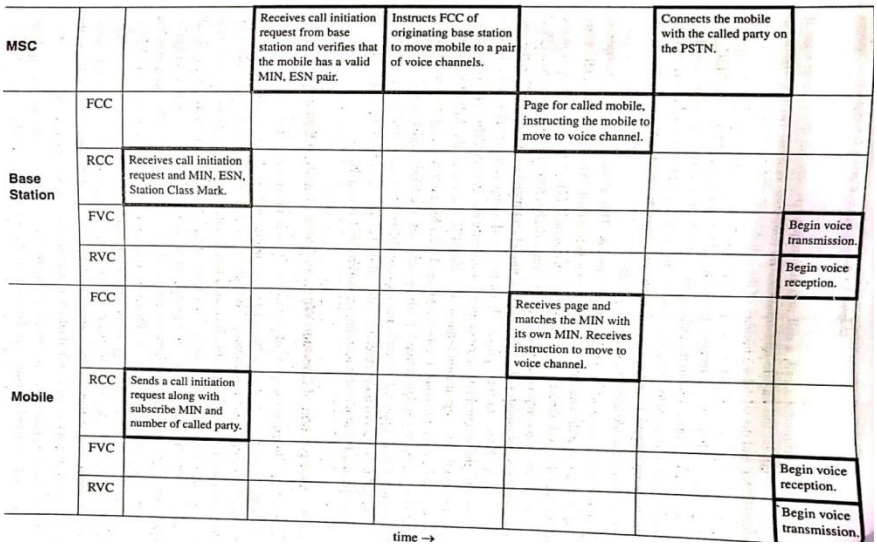
Paging systems are vary widely in their complexity & coverage area. while simple paging systems may cover a limited range of 2km to 5km, or may even be confined within individual buildings, wide area paging systems can provide worldwide coverage.

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.

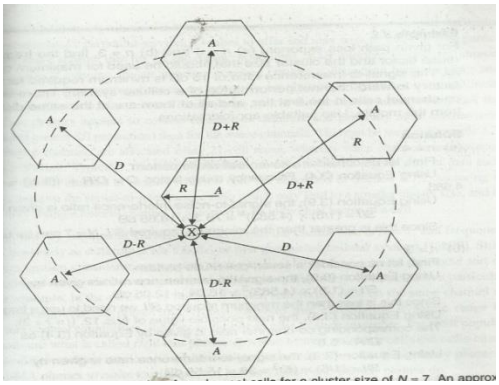
Simulcast transmitter may be located within the same service area or in different cities or countries. Paging systems are designed to provide reliable communication to subscriber wherever they are.

Explanation 2M

			**Block Diagram 2M**
	b)	**Attempt any ONE of the following:**	**6-Total Marks**
	(i)	**Draw the architecture of GSM and state the functions of BTS and BSC.**	**6M**
	Ans:		**Architec-ture 2M**
		Function Of BTS and BSC BTS functions: The BTS corresponds to the transceivers and antennas used in each cell of the network. A BTS is usually placed in the center of a cell. Its transmitting power defines the size of a cell. Each BTS has between 1 and 16 transceivers, depending on the density of users in the cell. Each BTS serves as a single cell. • Encoding, encrypting, multiplexing, modulating, and feeding the RF signals to the antenna • Transcoding and rate adaptation • Time and frequency synchronizing • Voice through full- or half-rate services • Decoding, decrypting, and equalizing received signals • Random access detection • Timing advances • Uplink channel measurements	**2M**
		BSC Functions: The BSC manages the radio resources for one or more BTSs. It handles radio channel setup, frequency hopping, and handovers. The BSC is the connection between the mobile and the MSC. The BSC also translates the 13 Kbps voice channel used over the radio link to the standard 64 Kbps channel used by the Public Switched Telephone Network (PSDN) or ISDN. It assigns and releases frequencies and time slots for the MS. The BSC also handles intercell handover. It controls the power transmission of the BSS and MS in its area. The function of the BSC is to allocate the necessary time slots between the BTS and the MSC. It is a switching device that handles the radio resources. • Control of frequency hopping	**2M**

		• Performing traffic concentration to reduce the number of lines from the MSC • Providing an interface to the Operations and Maintenance Center for the BSS • Reallocation of frequencies among BTSs • Time and frequency synchronization • Power management • Time-delay measurements of received signals from the MS	
	(ii)	**Describe the process of cell initiations from mobile handset to the landline unit (PSTN) with neat timing diagram.**	**6M**
	Ans:	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 the maximum transmitting power level is. 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 toa unused pair of voice channels (FORWARD & REVERSE VOICECHANNEL). The called party telephone number, is then broadcast as paging message overall 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.  	**Explanation 3M** **Diagram 3M**

Q.2		**Attempt any <u>FOUR</u> of the following:**	**12M**
	a)	**Describe the effect of co-channel interference in cellular system. How it affect the system capacity?**	**4M**

	Ans:	• 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 • In Cellular mobile communication, frequency spectrum is divided into non-overlapping • spectrum bands which are assigned to different cells .I • n 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 on System capacity:** • 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.**  	**Explanation 3M** **Effect 1M** **Diagram Optional**
	b)	**Compare 3G-TD-SCDMA with 3G-CDMA-2000in terms of** **(i) Data rates** **(ii) Bandwidth** **(iii)Spectrum utilization** **(iv)Antenna**	**4M**

Ans:

	3G-TD-SCDMA	3G-CDMA-200
Data rates	1.971Mbps	2 Mbps
Bandwidth	1.6 MHz	1.25 MHz
Spectrum utilization	Spectrum spreading mode DS SF=1/2/4/8/16 Spectrum Efficiency 25Erl./MHz	>Need paired spectrum one for UL and the other for DL
Antenna	Smart antenna technology is incorporated into the base station	Advanced Antenna system is used.

4M

c) State any four features of UMTS.(W-CDMA) **4M**

Ans: **Specifications of UMTS are:** **1mark each**

1. It is more robust for multipath delays.
2. It provides higher immunity towards frequency selective fading.
3. It has very high packet data rates of 2.048Mbps.
4. It has very high channel bandwidth of 5 MHz
5. It has backward compatibility with the GSM systems.
6. It has high frame structure of 16 slots per frame.
7. It gives signals of higher voice and data quality and also small bit-error rates.
8. It has a common world-wide spectrum band.
9. It can operate in multiple radio environments such as cellular, cordless, satellite, LAN etc.
10. It has a wide range of telecommunication services such as voice, data, multimedia, Internet etc.
11. It has global seamless connectivity (roaming).

d) Compare GPRS standard with IS-95B standard w.r.t. **4M**

(i) Data rate
(ii) Number of voice channel
(iii)Channel bandwidth
(iv)Backward compatibility

Ans:

		GPRS	IS95B	4M
(i)	**Data rate**	New GPRS handset works on GPRS networks at 171.2 Kbps,96.1 Kbps on GSM networks with dual phone	New Handset will work on IS95B at 64 Kbps and IS95 S at 14.4 Kbps.	
(ii)	**Number of voice channel**	8 per carrier	64	
(iii)	**Channel bandwidth**	200KHz	1.25MHz	
(iv)	**Backward compatibility**	GPRS architecture works on the same procedure like GSM network, but, has additional entities that allow packet data transmission. New terminals will be backward compatible with GSM for voice calls.	Provides Backward Compatibility with IS95 A & IS 95 B.	

e) State any four features of bluetooth. **4M**

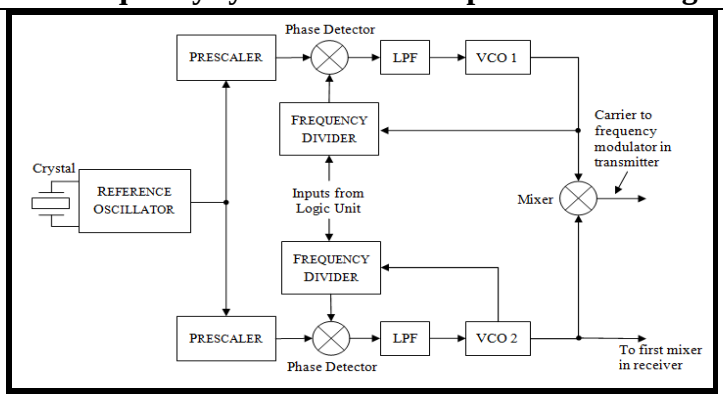
Ans: **Each 1M**

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 Mbp

f) Compare between Hard handoff and soft handoff.(Any four points) **4M**

Ans:

Hard handoff	Soft handoff	4M
1.The definition of a hard handover or handoff is one where an existing connection must be broken before the New one is established.	1.Soft handoff is defined as a handover where a new connection is established before the old one is released	
2. Hard handoffs allocate different frequency of user.	2.Soft handoff allocate Same frequency.	
3.In hard handoff a handset always Communicates with one BS at any given time.	3.In soft handoff a handset may connect up to three or four radio links at the same Time.	
4. Hard Handoff is typically used in TDMA and FDMA systems.	4.Soft handoff used in CDMA and some TDMA systems	
5. Hard handoff is not very complicated.	5.Soft handoff is more complicated than Hard handoff.	
6.Hard handoff is noticeable	6. Soft handoff is not noticeable.	

Q.3		Attempt any FOUR of the following:	16M
	a)	**Draw block diagram of frequency synthesizer and explain its working.**	4M
	Ans:	 • It **uses standard Phase Lock Loop (PLL)** circuit & a mixer. A crystal controlled oscillator provides the reference for the PLL. • One PLL incorporates a voltage controlled oscillator (NO.2) whose output frequency is used as a local oscillator for the first mixer in receiver. This signal is mixed with the output of a second PLL, VCO to drive the transmitter output frequency. • As in other PLL circuit, the output VCO frequency is determined by the frequency division ratio of the divider in the feedback path between the VCO & phase detector. • In cellular radio, this frequency division ratio is applied by the MTSO via the cell site. When a mobile unit indicates or is to receive a call, the MTSO computer selects an unused channel. • It then transmits a digitally coded signal to the receiver containing the frequency division ratio for the transmitter & receiver PLLs. This sets the transmitter & receiver channel frequencies.	**2M Diagram** **2M Explanation**
	b)	**Compare GSM system with IS-95 standard w.r.t.** **(i) Data rates** **(ii) Handoff used** **(iii) Channel Bandwidth** **(iv) Modulation used**	4M
	Ans:		**1M Each For Point**

PARAMETER	GSM	IS-95
Data Rate	9.6 kbps	14.4 Kbps
Handoff used	HARD	SOFT
Channel Bandwidth	200KHZ	1.23MHZ
Modulation used	GMSK	QPSK/BPSK

	c)	**Describe the concept of cell splitting using suitable diagram.**	4M
	Ans:	**(Note: any other relevant diagram can be considered.)** • Cell splitting is the process of subdividing a congested cell into smaller cells, each with its own base station and a corresponding reduction in antenna height and transmitter power. • Cell splitting increases the capacity of a cellular system since it increases the number of times that channels are reused. By defining new cells which have a smaller radius than the original cells and by installing these smaller cells (called microcells) between the existing cells, capacity increases due to the additional number of channels per unit area.	**2M Explanation**

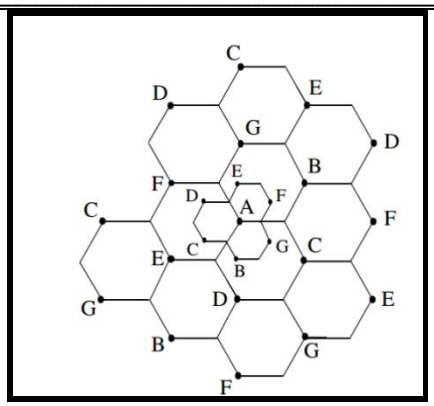


Figure: Cell Splitting

- Imagine if every cell in Figure were reduced in such a way that the radius of every cell was cut in half. In order to cover the entire service area with smaller cells, approximately four times as many cells would be required. This can be easily shown by considering a circle with radius R.
- The area covered by such a circle is four times as large as the area covered by a circle with radius R/2. The increased number of cells would increase the number of clusters over the coverage region, which in turn would increase the number of channels, and thus capacity, in the coverage area.
- Cell splitting allows a system to grow by replacing large cells with smaller cells, while not upsetting the channel allocation scheme required to maintain the minimum co-channel reuse ratio Q between co-channel cells.

2M Diagram

d) Illustrate operation of WLL with suitable diagram. **4M**

Ans:

- WLL stands for Wireless Local Loop. Microwave wireless links can be used to create a wireless local loop such as shown in figure below.

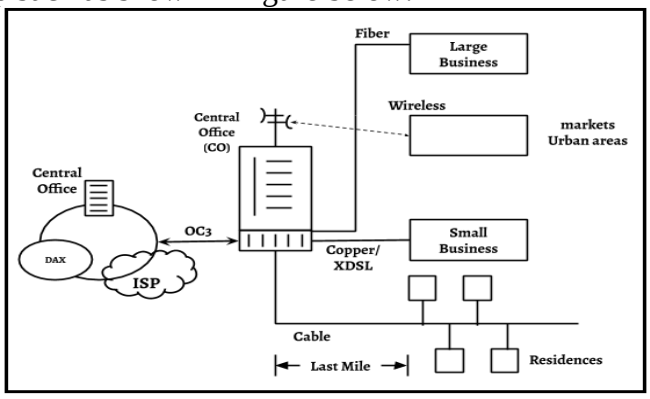


Figure: Wireless Local Loop

- Local Loop is a network that resides between the central office (CO) and the individual homes and business in close proximity to the central office (CO) as shown in figure above.
- In most developed countries, copper or optical fiber cable already has been installed to residence and business. One more advantage of WLL is that we have to pay only once for that wireless equipment, after there is no additional costs involved.
- System WLL is based on Cellular, satellite, microcellular The WLL can greatly improve the telecommunication facilities and services in an inexpensive way.

2M Diagram

2M Explanation

e) State various services offered by SS7. **4M**

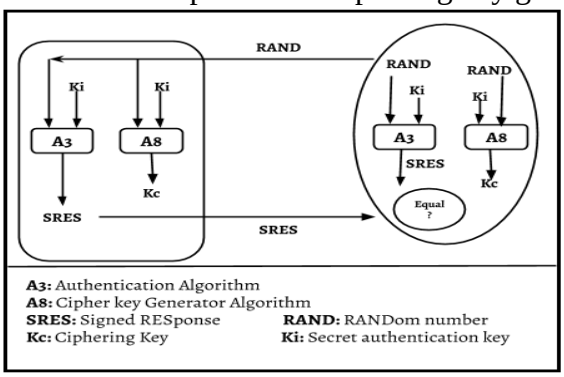
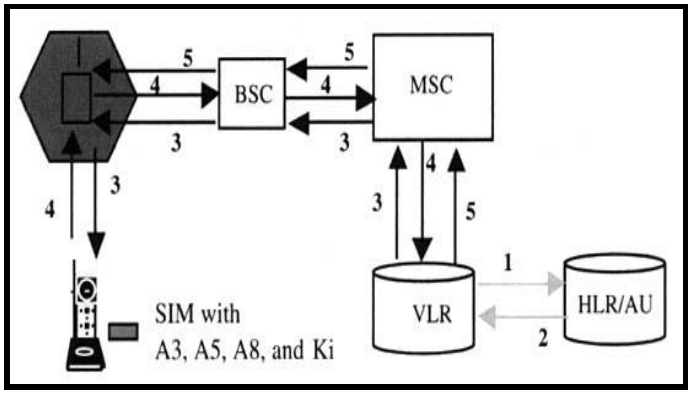
Ans:

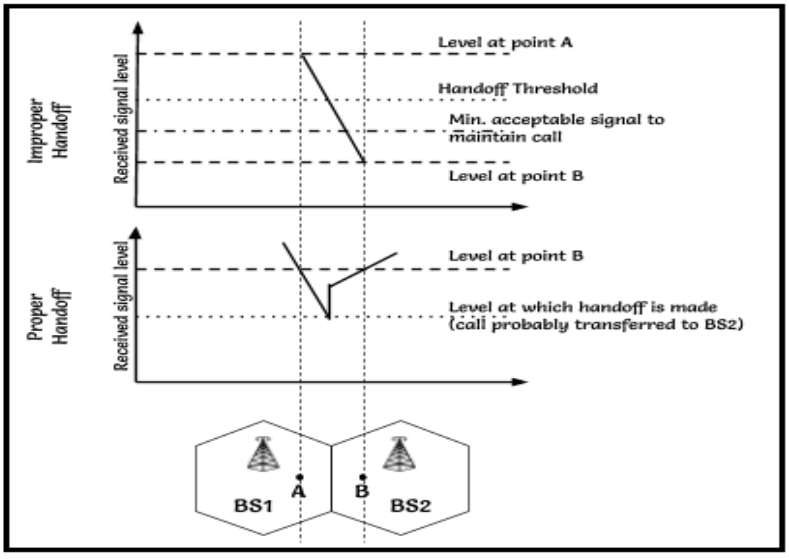
SS7 Services:

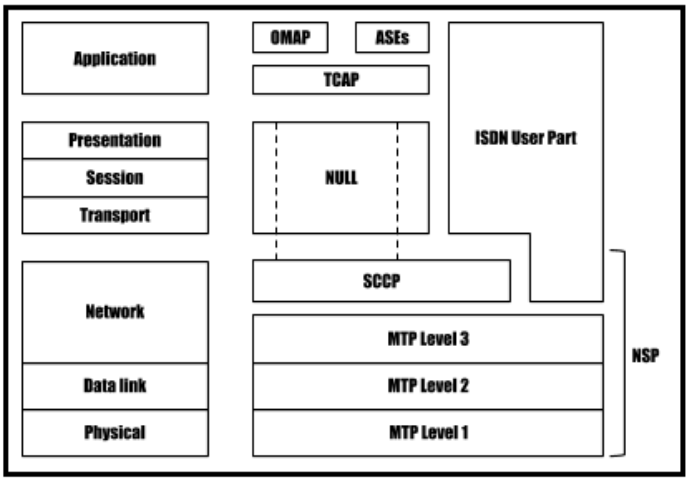
1. **Touchstar**
2. **800 Services**
3. **Alternate Billing Service and Line Information Database (ADB/LIDB)**

2M Listing

		• **Touchstar:** o This kind of service is also known as CLASS and is a group of switch-controlled services that provide its users with certain call management capabilities. o Services such as call return, call forwarding, repeat dialing, call block, call tracing and caller ID are provided. • **800 Services:** o These services were introduced by Bell Systems to provide toll-free access to the calling party and to the services and database which is offered by the private parties. o The costs associated with the processing of the calls are paid by the service subscriber. o The service is offered in two plans known as the 800-NXX plan and the 800 database plan. o In the 800-NXX plan the first six digits of an 800 call are used to select the interexchange carrier (IXC). o In the 800 database plan, the call is looked up in a database to determine the appropriate carrier and routing information. • **Alternate Billing Service and Line Information Database (ADB/LIDB):** o These services use the common channel signaling (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.	**1M Explanation**
Q.4	**a)**	**Attempt any <u>THREE</u> of the following :**	**12M**
	(i)	**List the features of IMT-2000(Any four)**	**4M**
	Ans:	• Common spectrum worldwide (1.8-2.2 GHz band) • Multiple radio environments (cellular, cordless, satellite, LANs) • Wide range of telecommunications services (voice, data, multimedia, 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	**Any 4 Features (1m Each)**
	(ii)	**Explain Authentication process in GSM with suitable diagram.**	**4M**
	Ans:	• 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 Ki's, 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.	**2M Explanation**

		• Fig shows the general authentication process an ciphering key generation in GSM.  **Figure: General Authentication process** **OR**  **Figure: Authentication.** 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 Kc. 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 A5.	**2M Diagram**
	(iii)	**List features of HSCSD 2.5G w.r.t** **(1) Channel Bandwidth** **(2) Duplexing method** **(3) Data rates** **(4) Backward compability**	**4M**
	Ans:	**Channel Bandwidth:** 200Khz **Duplexing method:** FDD **Data rate:** 14.4Kbps/ 57.6Kbps **Backward Compatibility:** GSM	**1M each**
	(iv)	**State any two advantages and disadvantages of sectoring in cellular system.**	**4M**
	Ans:	**(Note: Any other relevant point can be considered.)** **Advantages: (Any 2)** 1. Improves System capacity 2. Co-channel Interference can be reduced. **Disadvantages: (Any 2)**	**1M each point**

		1. The number of handoffs will increase. **2.** Hardware requirement will increase.	
	b)	**Attempt any ONE of the following:**	**6M**
	(i)	**Define handoff. List the types of handoff used in cellular system. Explain two level handoff with suitable diagram.**	**6M**
	Ans:	• **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 procedure is called **handoff**. • The handoffs are of following types: o Hard Handoff o Soft Handoff o Queued Handoff o Delayed Handoff o Intersystem Handoff o Intrasystem Handoff o Network controlled Handoff (NCHO) o Mobile Assisted Handoff (MAHO) • Figure shows the case where a handoff is not made and the signal drops below the minimum acceptable level to keep the channel active. This dropped call event can happen when there is an excessive delay by the MSC in assigning a handoff or when the threshold Δ is set too small for the handoff time in the system. • Excessive delays may occur during high traffic conditions due to computational loading at the MSC or due to the fact that no channels are available on any of the nearby base stations (thus forcing the MSC to wait until a channel in a nearby cell becomes free). • In deciding when to handoff, it is important to ensure that the drop in the measured signal level is not due to momentary fading and that the mobile is actually moving away from the serving base station. • The time over which a call may be maintained within a cell, without handoff, is called **DWELL TIME**. The dwell time of a particular user is governed by number of factors including propagation, interference, distance between the subcarrier & the base station & other time varying effects.  **Figure: Handoff Process**	**1M Definition** **2M List** **1M diagram** **2M explanation**

	(ii)	**Explain the working of different levels of SS7 protocol architecture with neat sketch.**	**6M**
	Ans:	The SS7 architecture is shown in figure. SS7 is based on a four-level protocol layer architecture.  FIGURE: SS7 PROTOCOL 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):** • 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: signaling message handling and 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 it's 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	**3M diagram** **3M Explanation**

network.

II. 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:
  - **Class 0**: Basic connectionless.
  - **Class 1**: Sequenced connectionless.
  - **Class 2**: Basic connection-oriented.
  - **Class 3**: Flow control connection oriented.
  - **Class 4**: Error recovery and flow control connection oriented.

III. 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):

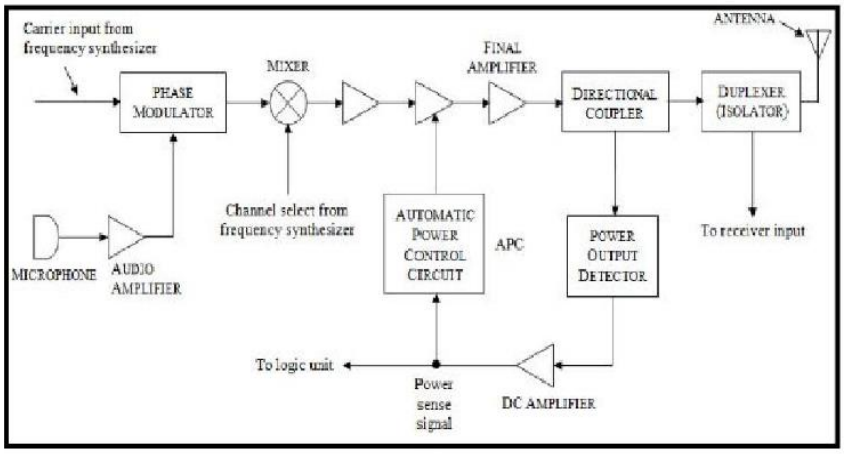
- The ISUP provides the signaling functions for carrier and supplementary services for voice, data and video in an ISDN environment.
- ISUP uses the MTP for transfer of messages between different exchanges.
- In addition to the basic bearer services in an ISDN environment, the facilities of user-to-user 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.

Q.5		**Attempt any FOUR of the following:**	**16M**
	a)	**Draw the block diagram of transmitter unit of mobile handset and state its functions.**	**4M**
	Ans:	 **Figure: Block diagram of transmitter of mobile unit** It is a low power FM unit operating in the frequency range of 824 to 849 MHz. The Carrier is obtained from frequency synthesizer and is applied to phase Modulator along with the amplified voice signal.	**2M for Diagram & 2M for Explanation**

Modulator o/p converted using a mixer to final transmitter frequency.
Mixer o/p is applied to Class C amplifier.
The final amplifier stage is to designed to supply 3W to antenna.
The automatic power control circuit controls the o/p power of the transmitter automatically, with the help of power o/p detector & DC amplifier.
Transmitter o/p is fed to duplexer. Carrier i/p for the phase modulator & the local oscillator frequency signal for mixer are produced by frequency synthesizer.
Transmitter o/p power is controlled by cell site & MTSO.
Receiver picks up the special control signals & sends to APC that sets transmitter o/p power level.

b) Compare GSM standard with N-AMPS standard w.r.t. following points — **4M**

(i) Channel Bandwidth
(ii) Frequency Band used
(iii) Type of modulation
(iv) Multiple access method

Ans: — **1M each for correct comparison point**

Sr. No	Feature/ Standard	GSM	N-AMPS
1	Channel Bandwidth	200 KHz	10 KHz
2	Frequency band used	1.85- 1.99 GHz	824 -894 MHz
3	Type of Modulation	GMSK	FM
4	Multiple access method	TDMA	FDMA

c) Draw the block diagram of forward CDMA channel modulation process and explain it in detail. — **4M**

Ans: — **2M for Diagram & 2M for Explanation**

The forward channel modulation process is as follows:

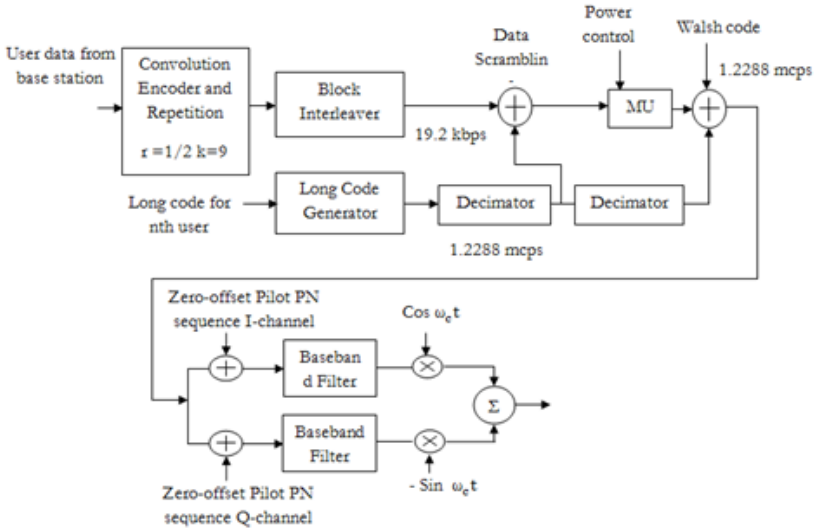


Fig: Forward CDMA channel modulation process

A. Convolution encoder and repetition:

- Speech coded voice or user data is encoded using ½ rate convolution encoder with constraint length 9.
- The speech coder exploits gaps and pauses in speech and reduces its output from 9600

bps to 1200 bps during silent period.

- Whenever the user data rate is less than 9600 bps each bit is repeated to maintain a constant symbol rate of 19.2 kbps.

B. Block interleaver:

- It makes data block of 20 ms in a random way i.e. consecutive bits are not in a same block.
- It maps the data bits in a 24 by 16 matrix and then transmit it column wise.
- This procedure is helpful in recovering the data back if a block is lost during channel transmission.

C. Long PN sequence:

- In forward CDMA channel Direct Sequence is used for data scrambling.
- Long PN sequence is user specific code of period $_2{}^{42}-1$ chips.
- PN sequence is generated from a 42 bit code also called as the public mask.
- Public mask is specified as- M41 through M32 is set to 1100011000 and M31 through M0 is set to mobile station ESN bits. ESN= (E31, E30, E29, E28, ... , E1, E0), permuted ESN= (E0, E31, E22, E13, E14, E26, E17, E8, ... , E18, E9)

D. Data scrambler:

- It is performed after block interleaver. The 1.2288 MHz PN sequence is applied to decimator which keeps only the first chip out of every 64 consecutive PN chips.
- The data rate from the decimator is 19.2 ksps. The data scrambling is performed by modulo-2 addition of the interleaver output with the decimator output symbol.

E. Power control subchannel:

- Power control measures are sent by base station every 1.25ms. Power control commands are sent to raise or lower its transmission power in 1 db steps.
- If the received signal is low 0 is sent over power control sub channel instructing the mobile station to increase its mean output power level. If mobile's power level is high 1 is sent to indicate that the mobile station should decrease the power level.

F. Orthogonal covering:

- Orthogonal scrambling is performed following the data scrambling on the forward link.
- Each traffic channel is transmitted on the forward CDMA channel is spread with a Walsh function at fixed rate of 1.2288 Mcps.
- The Walsh functions consist of 64 binary sequences each of length 64 which are completely orthogonal to each other and provide orthogonal channelization.

After orthogonal covering Quadrature modulation is performed.

	d)	**Describe the operation of Local Multipoint Distribution Service (LMDS) with suitable diagram.**	**4M**
	Ans:	LMDS is one of the new proposed services and applications. It is in the early stages of commercialization. In 1998, 1200MHz of the unused spectrum in the 27-31GHz band was auctioned by the US government to support LMDS. Similar auctioned were held worldwide. Various spectrums were allotted for the LMDS. Most of these allocations share the frequencies with the teledesic band approved by the ITU for broadband satellite systems. The teledesic band was originally established for the Motorola iridium system.	

LMDS is a fixed wireless system. The table given shows the total spectrum bandwidth of various wireless systems in the US. It shows that the BW of 1300MHz has been allotted for LMDS.

The 1300MHz bandwidth of LMDS is sufficient to provide more than 200TV channels or 65000 full duplex voice channels.

The US LMDS band is 27.5 - 28.35 GHz, 29.1 – 29.25 GHz and 31.075 – 31.225 GHz.

However LMDS has its own drawbacks. LMDS is a brand new, and an unproven system. The equipment required for LMDS are millimeter wave equipment which are costly.

The most important application of LMDS is the Local Exchange Carrier (LEC) network. It is shown in the figure.

In this network the LEC uses a very wide bandwidth ATM (asynchronous transfer mode) or SONET (synchronous optical network) backbone switch.

Such a switch can connect hundreds of megabits per second traffic to the internet, PSTN, or to its own private network.

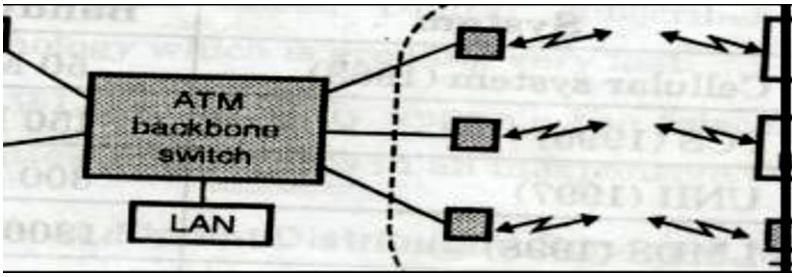
The LMDS thus provides wireless broadband connectivity to the customers without using the cables.

Difficulties:

The most important problem for LMDS of WLL is that of line of sight (LOS). If the antennas can be seen, then only the transmission is successful.

The other problem is that rain, snow and hail can create large changes in the channel gain between the transmitter and receiver.

Diagram:



OR

LMDS: Local multi-point distribution system.

It is a broadband wireless point to multipoint communication system that provides reliable digital two-way voice, data and Internet services. The term "Local" indicates that the signals range limit. "Multipoint" indicates a broadcast signal from the subscribers, the term "distribution" defines the wide range of data that can be transmitted, data ranging anywhere from voice, or video to Internet and video traffic.

It provides high capacity point to multipoint data access that is less investment intensive.

Advantages:

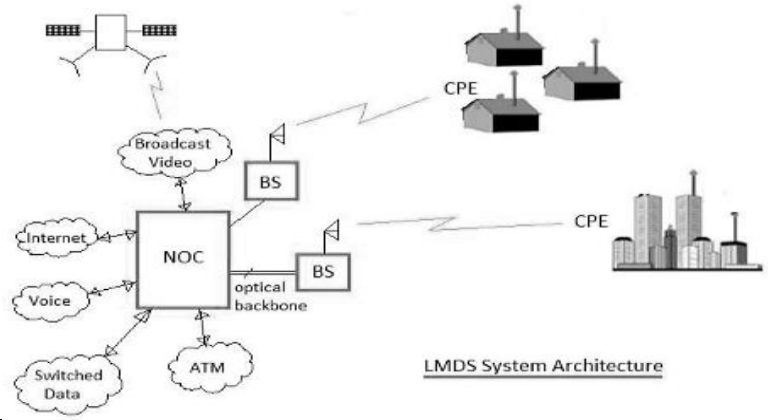
- Lower entry and deployment cost.
- Ease and speed of deployment.
- Fast realization of revenue.
- Uses low powered high frequency (25-31 GHz) signals over a short distance.

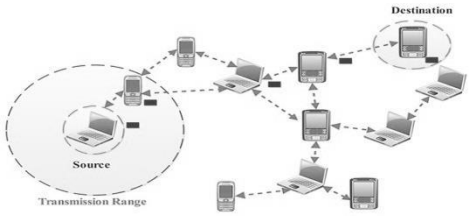
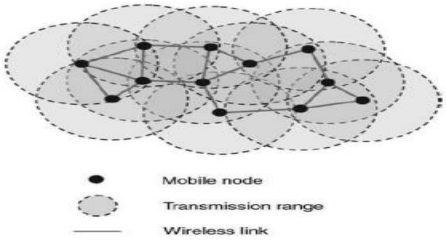
Four parts in LMDS are:

1. NOC (network operation center).
2. Fiber based infrastructure.
3. Base station.

4. Customer premise equipment.

Diagram:



	e)	**Explain mobile ad-hoc network (MANET) with suitable diagram.**	**4M**
	Ans:	**Definition of MANET:** MANET is defined as is a type of ad hoc network that can change locations and configure itself on the fly. Because MANETS are mobile, they use wireless connections to connect to various networks. It is an autonomous system of mobile host connected by wireless link. In cellular network communication between two mobile hosts (MH) completely rely on the wired backbone and fixed base station but in MANET no such infrastructure exists and network topology may dynamically change in an unpredictable manner since nodes are free to move. Change in topology made known to other nodes so that outdated topology information can be updated or removed. Ad-hoc network are basically peer to peer multi-hop mobile wireless network, where information packets are transmitted in store and forward manner from source to arbitrary destination.  **MANET** The following diagram represents MANET topology:  **MANET topology**	**Dig-2M,** **explain ation-2M**

Characteristics/Features of MANET:

It is an infrastructure less IP based network of mobile and wireless machine nodes connected with the radio. In operation, the nodes of a MANET do not have a centralized administration mechanism. It is known for its routable network properties where each node acts as a "Router" to forward the traffic to other specified node in the network.

Characteristics of MANET:

In MANET, each node act as both host and router. Thus it autonomous in behavior.

Multi-hop radio relaying- When a source node and destination node are out of the radio range, the MANETs are capable of multi-hop routing.

Distributed nature of operation for security, routing and host configuration. A centralized firewall is absent here.

The nodes can join or leave the network anytime, making the network topology dynamic in nature.

Mobile nodes are characterized with less memory, power and light weight features.

The reliability, efficiency, stability and capacity of wireless links are often inferior when compared with wired links. This shows the fluctuating link bandwidth of wireless links.

Mobile and spontaneous behavior which demands minimum human intervention to configure the network.

All nodes have identical features with similar responsibilities and capabilities and hence it forms a completely symmetric environment.

High user density and large level of user mobility.

Nodal connectivity is intermittent.

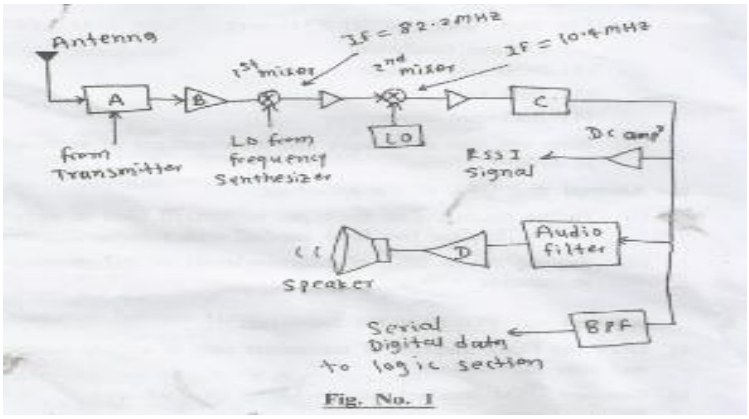
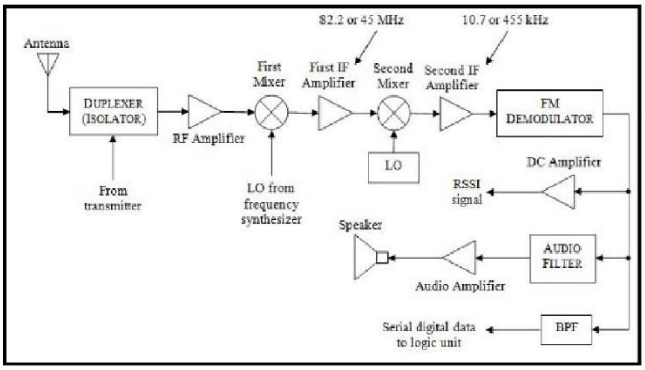
Applications of MANET:

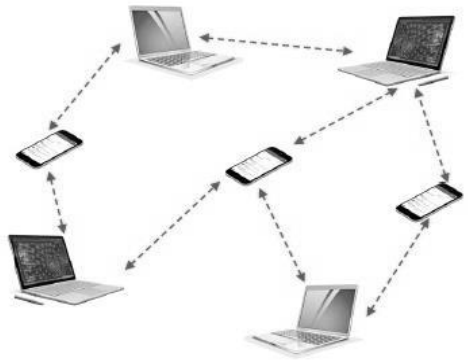
With the increase of portable devices as well as progress in wireless communication, adhoc networking is gaining importance with the increasing number of widespread applications in the Commercial, Military and Private sectors. Mobile Ad-Hoc Networks allow users to access and exchange information regardless of their geographic position or proximity to infrastructure. All nodes in MANETs are mobile and their connections are dynamic. MANETs do not require a fixed infrastructure. This offers an advantageous decentralized character to the network. The applications of MANET as follows: ---

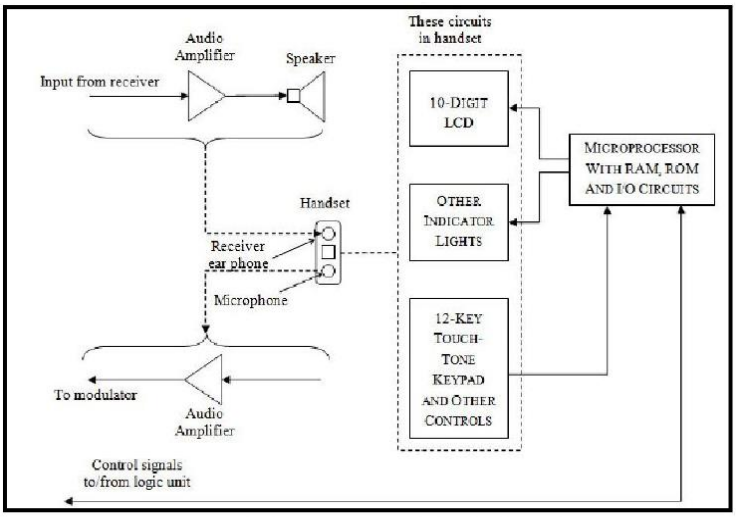
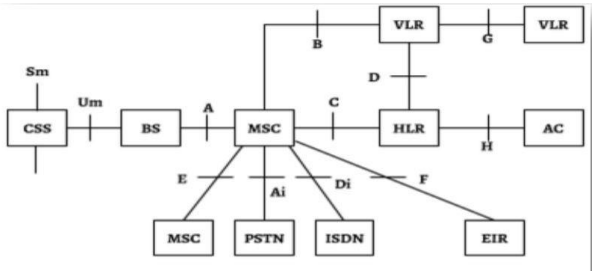
Military Sector: Military equipment now routinely contains some sort of computer equipment. Ad- hoc networking would allow the military to take advantage of commonplace network technology to maintain an information network between the soldiers, vehicles, and military information headquarters. The basic techniques of ad hoc network came from this field

Crisis –management Application: Ad hoc can be used in emergency rescue operations for disaster relief efforts, e.g. in fire, flood, or earthquake. This may be because all of the equipment was destroyed, or perhaps because the region is too remote. Rescuers must be able to communicate in order to make the best use of their energy, but also to maintain safety. By automatically establishing a data network with the communications equipment that the rescuers are already carrying, their job made easier. Other commercial scenarios include e.g. ship-to-ship ad hoc mobile communication, law enforcement, etc.

Low Level: Appropriate low level application might be in home networks where devices can communicate directly to exchange information. Similarly in other civilian environments like taxicab, sports stadium, boat and small aircraft, mobile ad hoc communications will have many

		applications. **Data Networks**: A commercial application for MANETs includes ubiquitous computing. By allowing computers to forward data for others, data networks may be extended far beyond the usual reach of installed infrastructure. Networks may be made more widely available and easier to use. **Vehicular Area Network:** Ad-hoc network is useful in forming network among different vehicles on the road and can propagate information like accidents, congestion. It is also helpful in determining nearby facilities such as gas station, restaurants, hospitals and other facilities. **Personal Area network**: PAN is short range, localized network where nodes are associated with a given person. These nodes could be attached to someone' cellphone laptop and television and so on.	
	f)	**State any four advantages of microcell zone concept.**	**4M**
	Ans:	**(Note: 1M each for correct advantages Any 4)** **Advantages of Microcell zone concept are as follows:-** 1. It reduces the co-channel interference. 2. It improves signal quality. 3. It increases system capacity. 4. There is degradation in the truncking efficiency.	
Q.6		**Attempt any FOUR of the following:**	**16M**
	a)	**Identify the given block diagram and name the blocks A,B,C and D. State the functions of identified blocks (Refer Fig. No.1)**  Fig. No. 1	**4M**
	Ans:	**The given block diagram is of receiver of mobile unit:**  Figure: Block diagram of Receiver of mobile unit	**Diagram 2M**

		Block A is Duplexer (Isolator) Block B is RF Amplifier Block C is FM Demodulator Block D is Audio Amplifier **Block A –Duplexer-**The transmitter output is fed to a duplexer or isolator which allows the transmitter and receiver and receiver frequencies to share the same antenna. **Block B-RF Amplifier-**It boosts the level of received cell site signal. Block C-FM Demodulator-The signal amplified by second IF Amplifier is demodulated by FM demodulator to get the voice signal. **Block D-Audio Amplifier-**The demodulated voice signal is de-emphasized, filtered and amplified and then applied to the loud speaker for sound production.	**Expln 2M**
	b)	**List various key features of IS-95 CDMA system.**	**4M**
	Ans:	**(Note: 1M each for correct features of IS-95 CDMA (Any 4 correct features)** **Key features of IS-95 CDMA system:** 1. Diversity 2. Power Control 3. Soft handoff 4. IS-96 system capacity 5. soft capacity 6. Quality of service 7. Economics	
	c)	**Illustrate operation of wireless LAN in Ad-hoc mode with neat and labelled diagram.**	**4M**
	Ans:	An ad hoc network is one that is spontaneously formed when devices connect and communicate with each other. The term ad hoc is a Latin word that literally means "for this," implying improvised or impromptu. Ad hoc networks are mostly wireless local area networks (LANs). The devices communicate with each other directly instead of relying on a base station or access points as in wireless LANs for data transfer co-ordination. Each device participates in routing activity, by determining the route using the routing algorithm and forwarding data to other devices via this route.  Any other diagram showing wireless lan in adhoc mode to be considered.	**2M for Diagram & 2M for Explanation**
	d)	**Draw the block diagram and explain the operation of control unit in mobile.**	**4M**

	Ans:	**Block diagram of control unit of mobile unit:**  **Figure: Block diagram of Control unit of mobile unit** The control unit contains handset with speaker and microphone. It also contains a complete touch tone dialing circuit. It is operated by a separate microprocessor drives the LCD display and other indicator .It also implements all manual control functions .The microprocessor memory permits storage of often called numbers and an auto dial features .The demodulated signal coming from the receiver is amplified by an audio amplifier and applied to the loudspeaker whereas the electrical equivalent of voice signal is produced by the microphone & amplified by the audio amplifier. This signal acts as the modulating signal and applied to the modulator.	**2M for Diagram** **2M for Explanation**
	e)	**Draw system architecture of IS-95. Explain working of mobile switching center (MSC) and Home location register (HLR) in it.**	**4M**
	Ans:	**Diagram:**  CSS- Cellular Subscriber Station BS-Base station MSC- Mobile switching center HLR-Home location registers EIR-Equipment identity register VLR- Visiting location registers AC- Authentication center **Explanation :** **Home Location Register**: Permanent database about mobile subscribers in a large service area. Database contains subscriber & location information. Database contains prepaid/postpaid, roaming restrictions, supplementary services. **Mobile Switching Center:** It co-ordinates the activities of all the base stations and connects the entire cellular system to the PSTN. A typical MSC handles 100,000 cellular subscribers and 5,000 simultaneous conversations at a time, and accommodates all billing and system maintenance functions as well.	**2M for Diagram & 1M for each function**