

**CS8601****MOBILE COMPUTING**

L	T	P	C
3	0	0	3

**OBJECTIVES:**

- To understand the basic concepts of mobile computing.
- To learn the basics of mobile telecommunication system.
- To be familiar with the network layer protocols and Ad-Hoc networks.
- To know the basis of transport and application layer protocols.
- To gain knowledge about different mobile platforms and application development.

**UNIT I INTRODUCTION****9**

Introduction to Mobile Computing – Applications of Mobile Computing- Generations of Mobile Communication Technologies- Multiplexing – Spread spectrum -MAC Protocols – SDMA- TDMA- FDMA- CDMA.

**UNIT II MOBILE TELECOMMUNICATION SYSTEM****9**

Introduction to Cellular Systems – GSM – Services & Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Mobility Management – Security – GPRS- UMTS – Architecture – Handover – Security.

**UNIT III MOBILE NETWORK LAYER****9**

Mobile IP – DHCP – AdHoc– Proactive protocol-DSDV, Reactive Routing Protocols – DSR, AODV , Hybrid routing –ZRP, Multicast Routing- ODMRP, Vehicular Ad Hoc networks ( VANET) –MANET Vs VANET – Security.

**UNIT IV MOBILE TRANSPORT AND APPLICATION LAYER****9**

Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WML.

**UNIT V MOBILE PLATFORMS AND APPLICATIONS****9**

Mobile Device Operating Systems – Special Constraints & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – MCommerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

**TOTAL 45 PERIODS**

**OUTCOMES:**

At the end of the course, the students should be able to:

- Explain the basics of mobile telecommunication systems
- Illustrate the generations of telecommunication systems in wireless networks
- Determine the functionality of MAC, network layer and Identify a routing protocol for a given Ad hoc network
- Explain the functionality of Transport and Application layers
- Develop a mobile application using android/blackberry/ios/Windows SDK

**TEXT BOOKS:**

1. Jochen Schiller, —Mobile Communications, PHI, Second Edition, 2003.
2. Prasant Kumar Pattnaik, Rajib Mall, —Fundamentals of Mobile Computing, PHI Learning Pvt.Ltd, New Delhi – 2012

**REFERENCES**

1. Dharma Prakash Agarwal, Qing and An Zeng, “Introduction to Wireless and Mobile systems”, Thomson Asia Pvt Ltd, 2005.
2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, —Principles of Mobile Computing, Springer, 2003.
3. William.C.Y.Lee,—Mobile Cellular Telecommunications-Analog and Digital Systems, Second Edition, TataMcGraw Hill Edition ,2006.
4. C.K.Toth, —AdHoc Mobile Wireless Networks, First Edition, Pearson Education, 2002.
5. Android Developers : <http://developer.android.com/index.html>
6. Apple Developer : <https://developer.apple.com/>
7. Windows Phone DevCenter : <http://developer.windowsphone.com>
8. BlackBerry Developer : <http://developer.blackberry.com>

**OUTCOMES:**

**At the end of the course, the students will be able to**

<b>Course Outcome</b>	<b>Statement</b>
<b>CO1</b>	Explain the basics of Mobile Telecommunication Systems
<b>CO2</b>	Determine the functionality of MAC protocol
<b>CO3</b>	Illustrate the generations of telecommunication systems in wireless networks
<b>CO4</b>	Compare various routing protocols in Ad-hoc networks
<b>CO5</b>	Explain the functionality of Mobile Transport and Application Layers
<b>CO6</b>	Analyze the features of various Mobile Operating Systems.

**UNIT – I****INTRODUCTION**

**Introduction to Mobile Computing – Applications of Mobile Computing- Generations of Mobile Communication Technologies- Multiplexing – Spread spectrum -MAC Protocols – SDMA- TDMA- FDMA- CDMA.**

**PART – A****1. Define Mobile Computing. (R)**

Mobile Computing also called as Ubiquitous Computing or Nomadic Computing is described as the ability to compute remotely while on the move. It makes possible for people to access information from anywhere and at any time.

**Mobile Computing = Mobility + Computing**

**2. What do you mean by the terms Mobility and Computing? (U)**

**Mobility:** Provides the capability to change location while communicating to invoke computing services at some remote computers.

**Computing:** Capability to automatically carry out certain processing related to services invocation on a remote computer.

**3. Name the type of Mobility. (R)**

1. **User Mobility** - It refers to the capability to change location while communicating to invoke computing services at some remote computers. i.e. the user can be a mobile, and the services will follow him or her.
2. **Device Portability** – It refers to the movement of communication devices. i.e. Devices can be connected anytime, anywhere to the network.

**4. List out the advantages of Mobile Computing. (U) (May/June 2016)**

- (i) Location Flexibility
- (ii) User Mobility
- (iii) Device Portability
- (iv) Saves Time
- (v) Enhanced Productivity
- (vi) Entertainment

**5. Mention the disadvantages of Mobile Computing. (U)**

**What are the limitations of Mobile Computing? (U) (Nov/Dec 2016)**

- (i) Expensive

- (ii) Power Consumption
- (iii) Small Screen Display
- (iv) Slow Internet Speed
- (v) Risky to carry
- (vi) Security Concerns
- (vii) Communication depends upon network

**6. Compare Wired Networks and Mobile Networks. (AN)**

S.No	Wired Networks	Mobile Networks
1.	Users cannot get any information at any place (does not support mobility)	Users can get information at any place (Supports Mobility)
2.	Bandwidth is high	Bandwidth is low
3.	Low bandwidth variability	High bandwidth variability
4.	Listen on wire	Hidden Terminal problem
5.	Productivity is low	Productivity is high
6.	High Power Machines	Low Power machines
7.	High Resource machines	Low Resource machines
8.	Need physical access	Need proximity
9.	Low delay	Higher delay
10.	Connected Operations	Disconnected Operations

**7. Differentiate Mobile Computing and Wireless Networking. (AN) (April/May 2017)  
(Nov/Dec 2017)**

S.No	Mobile Computing	Wireless Networking
1.	It is a technology that access data through wireless network	It is a network that uses wireless data connections for connecting network nodes
2.	It denotes accessing information and remote computational services while on the move	It provides the basic communication infrastructure necessary for mobile computing
3.	It refers to computing devices that are not restricted to a desktop. Eg: Smart Phone, PDA, Laptop etc.,	It is a method of transferring information between a computing devices such as PDA & data sources without a physical connection
4.	It refers to a device performing computation that is not always connected to a central network	It refers to the data communication without the use of a landline. Eg. Cellular Telephone, Two way radio, Satellite, Wireless Connection.

**8. Name some of the Mobile Computing Devices. (R)**

- Mobile Phones

- Laptops
- PDA
- Notebook PCs

**9. Point out the problems faced by devices in Wireless Transmission? (U)**

1. Lower Bandwidth
2. Bandwidth Fluctuations
3. Host mobility
4. Intermittent disconnections
5. High bit error rate
6. Poor link reliability
7. Higher delay
8. Power consumption

**10. What are the classifications of Wireless Networks? (R)**

- i) Extension of Wired Networks: Uses fixed infrastructures such as base stations to provide single hop wireless communication (or) two-hop wireless communication.

Example: WLAN, Bluetooth

- ii) Adhoc Networks: It does not use any fixed infrastructure and it is based on multi-hop wireless communication.

Example: MANET, VANET.

**11. What are the applications of mobile computing? (Apr/May 2018) (U)**

- Emergency services
- Stock Broker
- Vehicles
- For Estate Agents
- In courts
- In companies
- Stock Information Collection/Control
- Credit Card Verification
- Taxi/Truck Dispatch
- Electronic Mail/Paging

**12. List out the characteristics of Mobile Computing. (R)**

- i. Ubiquity
- ii. Location Awareness
- iii. Adaptation
- iv. Broadcast
- v. Personalization

**13. Draw the structure of Mobile Computing Application. (R)**

Presentation (tier -1)
Application (tier -2)
Data tier (tier -3)

**14. Specify the functionalities of Application Tier. (R)**

- Responsible for making logical decisions and performing calculations.
- Moves and Process data between the presentation and data layers.

**15. What is the use of Data Tier? (R)**

- Responsible for providing the basic facilities of data storage, access and manipulation.
- Contains a database where the information is stored and retrieved.

**16. What are the advantages of cellular system?**

- High Capacity
- Less Transmission Power
- Local Interference only
- Robustness

**17. What is meant by multiplexing?**

Multiplexing is a mechanism which describes how several users can share a medium with minimum or no interference.

**18. List out the various multiplexing mechanisms.**

1. Space Division Multiplexing
2. Frequency Division Multiplexing
3. Time Division Multiplexing
4. Code Division Multiplexing

**19. Describe about MAC Protocol. (R)**

MAC Protocol is access control protocol which is responsible for regulating access to the shared channel when multiple nodes compete to access that channel. It is a sub layer of the data link layer protocol and it directly invokes the physical layer protocol.

**20. What are the Objectives of MAC Protocol? (U)**

- Maximization of the channel utilization
- Minimization of average latency of transmission

**21. What are the features / objectives of MAC protocols? NOV/DEC 2018**

It should implement some rules that help to enforce discipline when multiple nodes contend for a shared channel. It should help maximize the utilization of the channel. Channel allocation needs to be fair. No node should be discriminated against at any time and made to wait for an unduly long time for transmission. It should be capable of supporting several types of traffic having different maximum and average bit rates. It should be robust in the face of equipment failures and changing network conditions

**22. List out the properties required of MAC protocol. (R)**

- (i) It should implement some rules to enforce discipline when multiple nodes compete for a shared channel.
- (ii) It should help maximize the channel utilization.
- (iii) Channel allocation needs to be fair. No node should be discriminated against at any time and made wait for a long time for transmission.
- (iv) It should be capable of supporting several types of traffic having different bit rates.
- (v) It should be robust in the face of equipment failure and changing network conditions.

**23. What is the random assignment schemes that are used in MAC protocols. (NOV/DEC 2016), (APR/MAY 2017)**

- ALOHA Slotted
- ALOHA CSMA
- CSMA/CD
- CSMA/CA

**24. What is meant by Hidden Node and Exposed Node? (R)**

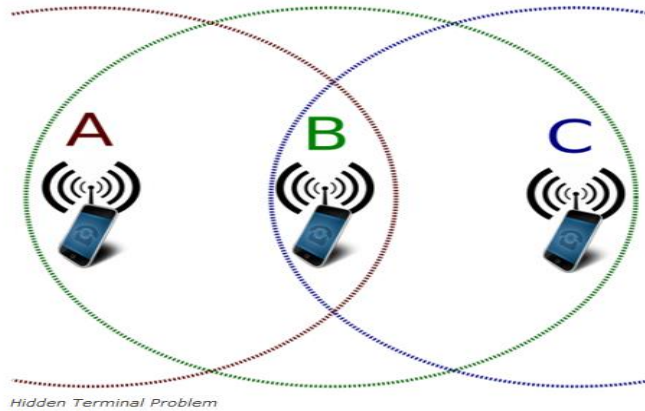
- **Hidden Node:** A hidden node is a node that does not hear the transmission that a node within its range is receiving and thus does not attempting to gain access.
- **Exposed Node:** An exposed node is a node that hears multiple disjoint sections of a network and never gets an opportunity to compete for transmission since it is always deferring to someone.

**25. Explain hidden and exposed terminal problem in infrastructure-less network. (U)**  
**(May/June 2016)( Apr/May 2017) (Nov/Dec 2017) (Nov/Dec 2018)**

**Hidden Terminal Problem:**

The Hidden Terminal Problem arises when at least three nodes (A, B and C) communicating.





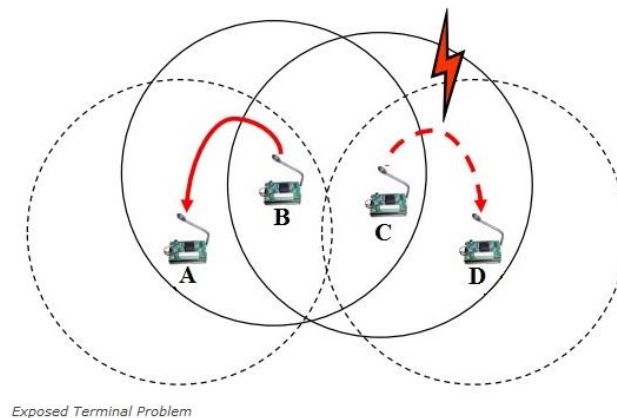
B is in the radio range of A, and B is also within the radio range of C. The nodes A and C are not in the radio range of each other. If both A and C start to transmit to B at the same time, the data received at B would get garbled. This situation arises because A and C are “hidden” from each other, because they are outside each other’s transmission range.

Note:- Hidden Terminal causes Collisions.

#### **Exposed Terminal Problem:**

Exposed Terminal Problem arises when all the three nodes are in the radio range of all nodes. Now B is transmitting to A, C wants to send to another terminal (not A or B) outside the range. C senses the carrier and detects that the carrier is busy, so C postpones the transmission until it detects the medium is free. But A is outside the radio range of C. This problem arises because “C is exposed to B”.

Note:- Exposed Terminal leads to inefficient spectrum usage and unnecessary transmission delays.



#### **26. What are the classifications of MAC Protocols? (R)**

Wireless MAC protocols are classified into

- SDMA
- FDMA

- TDMA
- CDMA

**27. Compare between CSMA / CD and CSMA / CA. (AN)**

S.No	CSMA / CD	CSMA / CA
1.	It takes effect after a collision	It takes effect before a collision
2.	It will not take steps to prevent transmission collision until it is taken place	It will take actions not to take place any collision
3.	It only minimizes the recovery time	It reduces the possibility of a collision
4.	Typically used in wired networks	Typically used in wireless networks & WLANs
5.	Standardized in IEEE 802.3	Standardized in IEEE 802.11

**28. What are the limitations / challenges of mobile computing? (NOV/DEC 2016) , (NOV/DEC2018)**

- Quality of connectivity
- Security concerns
- Power Consumption

**29. Spread spectrum is inherently secure than simple shift keying techniques. Justify this statement. (April/May 2021)**

Only the receiver having the exact same pseudo-random sequence and synchronous timing can de-spread and retrieve the original signal. Consequently, a spread spectrum system provides signal security that is not available to conventional analog wireless systems.

**PART – B**

1. Explain the characteristics of Mobile Computing. (U) (May/June 2016)
2. Explain the various applications of mobile computing. (8) (U)  
(Nov/Dec 2016) (April/May 2017)
3. Explain the structure of Mobile Computing Applications with neat sketch. (U)  
(May/June 2016)
4. Compare and Contrast the various Generations of Mobile Communication Technologies. (AN)
5. Explain in detail about the various multiplexing mechanisms. (U)
6. Explain hidden and exposed terminal problem in infrastructure-less network. (8)  
(U) (Nov/Dec 2017)

7. Briefly explain FDMA, CDMA, and TDMA. (R) (Nov/Dec 2011, May/June 12, May /June 2013, Nov/Dec 2013, May/June 2014, Nov/Dec2014)
8. Differentiate between FDMA, TDMA & CDMA. (AN) (Nov/Dec 2016)
9. Explain the structure, characteristics, Applications of mobile computing?(MAY/JUNE 2016), (NOV/DEC2016) , (APR/MAY 2017), (NOV/DEC 2017), (APR/MAY 2018)
10. Apply mobile computing to design taxi dispatcher and monitoring service. Explain the components in detail.( APR/MAY 2018)
11. What is CSMA? What are the categories of CSMA? Explain their working with advantage and disadvantage.(APR/MAY 2018)
12. Describe the various random assignment schemes used in MAC protocol (NOV/DEC 2018)
13. Discuss the various Reservation based schemes in MAC protocol (NOV/DEC 2018)
14. Explain the various components of an FHSS based communication system. (APR/MAY 2021)
15. Assume that two senders a and B want to send the data. CDma assigns 010011 as the key to a and 110101 as the key to B. a wants to send 1 and B wants to send 0. CDma codes 0 as  $-1$  and 1 as  $+1$ . Explain the steps involved in the process of sending and receiving. (APR/MAY 2021)
16. Explain how the slots are reserved by the base station based on the demand received from the mobile nodes using PRMA. (APR/MAY 2021)
17. Assume that three stations a, B and C are deployed as follows. B is within the transmission range of a and C and a and C are not within the transmission range. Explain how collisions are avoided using MACA protocol(APR/MAY 2021)

**UNIT – II****MOBILE TELECOMMUNICATION SYSTEM**

**Introduction to Cellular Systems – GSM – Services & Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Mobility Management – Security – GPRS- UMTS – Architecture – Handover – Security.**

**1. Define a cell. (R)**

In mobile communication, the coverage area is divided into smaller areas which are each served by its own base station. These smaller areas are called cells.

**2. Expand GSM, GPRS and UMTS. (R)**

GSM – Global System for Mobile Communication

GPRS – General Packet Radio Services

UMTS – Universal Mobile Telecommunication Systems

**3. What is meant by GSM? (R)**

Global System for Mobile Communication (GSM) is a wide area wireless communications system that uses digital radio transmission to provide voice, data and multimedia communication services. A GSM system coordinates the communication between a mobile telephones (Mobile Stations), base stations (Cell Sites) and switching systems.

**4. What is the important characteristic of GSM? (U)**

GSM provides data services in addition to voice services and it is compatible to 1G system.

**5. What is the use of GSM in mobile telecommunication? (U) (Nov/Dec 2011&12 ) (May/June 12)**

This system was soon named the Global System for Mobile communications (GSM), The primary goal of GSM was to provide a mobile phone system that allows users to roam and provides voice services compatible to ISDN and other PSTN systems.

**6. Specify the three different categories of services defined by GSM. (R)**

- Bearer services
- Tele services
- Supplementary services

**7. List out the different subsystems of GSM? (U) NOV/DEC 2018**

Radio sub system (RSS)

Network and switching subsystem (NSS)  
Operation subsystem (OSS).

**8. What is the use of emergency number? (U)**

Another service offered by GSM is the emergency number. This service is mandatory for all providers and free of charge. This connection also has the highest priority, possibly pre-empting other connections, and will automatically be set up with the closest emergency center.

**9. What is HLR? (U) (NOV/DEC 2018 )**

The home location register is a database used for mobile user information management. An HLR record consists of three types of information Mobile station information Location information Service information

**10. List the important supplementary services offered by GSM.(R)**

- User Identification
- Call Forwarding (or Redirection)
- Automatic call-back
- Conferencing with up to 7 participants

**11. Write about the supplementary services in GSM. (U) (Nov/Dec 2016)**

- GSM provides certain supplementary services in addition to the basic services.
- Important Services:
  - User Identification
  - Call Redirection
  - Forwarding of ongoing calls
  - Standard ISDN features
    - Closed User Groups
    - Multiparty Communication

**12. Name the Teleservices provided by GSM. (R) (April/May 2017)**

- Teleservices focuses on providing high quality digital voice transmission with the bandwidth of 3.1 KHz
- Voice related Teleservices:
  - Mobile Telephony
  - Emergency Number
  - Multi Numbering
- Non-Voice related Teleservices:
  - Short Message Service (SMS)
  - Enhanced Message Service (EMS)
  - Multimedia Message Service (MMS)

- Fax

**13. What is meant by SMS and EMS? (U)**

- A useful service for very simple message transfer is the short message service(SMS), which offers transmission of messages of up to 160 characters
- The successor of SMS, the Enhanced Message Service (EMS), offers a larger message size (e.g., 760 characters, concatenating several SMs), formatted text, and the transmission of animated pictures

**14. What are the sub systems available in GSM? (R)**

- Radio subsystem
- Network and switching subsystem
- Operation subsystem

**15. What is RSS? (R)**

RSS stands for Radio Sub System. It comprises of all radio specific entities.

**16. Name the entities of RSS. (R)**

1. Mobile Station (MS)
2. Base Station Subsystem (BSS)
3. Base Transceiver Station (BTS)
4. Base Station Controller (BSC)

**17. Classify the functions of HLR and VLR. (AN)**

Home Location Registers(HLR)	Visitor Location Registers(VLR)
HLR is a mobile operator database that includes details specific to each subscriber such as phone number, subscriber's IMSI, pre/postpaid, user's current location, billing details, phone status – parameters.	VLR is a temporary database that is updated whenever a new MS enters its area by roaming. The information is obtained from the corresponding HLR. i.e., VLR supports roaming functions for users outside the coverage area of their own HLR.
<u>Basic Parameters stored in the HLR:</u> <ul style="list-style-type: none"> <li>• Subscriber ID (IMSI and MSISDN)</li> <li>• Current Location of the user</li> <li>• Supplementary Services Subscriber to (Caller Tone, Missed Call Alert, Any Other Services etc.)</li> <li>• Subscriber Status (Registered or Deregistered)</li> </ul>	<u>The additional data stored in the VLR in telecom is listed below:</u> <ol style="list-style-type: none"> <li>1. Location Area Identity (LAI).</li> <li>2. Temporary Mobile Subscriber Identity (TMSI).</li> <li>3. Mobile Station Roaming Number (MSRN).</li> <li>4. Mobile status (busy/free/no answer)</li> </ol>

<ul style="list-style-type: none"> <li>• Authentication Key and AUC Functionality</li> <li>• Mobile Subscriber Roaming Number</li> </ul>	etc.).
--	--------

**18. List out the functions of OMC. (U)**

- Traffic Monitoring
- Subscribers
- Security Management
- Account Billing

**19. What are the two issues of GSM Mobility database? (U)**

- Fault Tolerance
- Database Overflow

**20. Define Handoff. What are its types? (R) (Nov/Dec2017)**

A handoff refers to the process of transferring an active call or data session from one cell in a cellular network to another or from one channel in a cell to another.

There are two main types soft handoff and hard handoff based on connection with the target resource.

**Hard handoff - *break before make***, in this type connection with the source channel/BTS/BSC is first broken before making connection with target channel/BTS/BSC.

**Soft handoff - *make before break***, in this type connection with the source channel/BTS/BSC is retained for some time before connection with the target channel/BTS/BSC is established. In this type user of cellular network will not experience any glitch and will continue to receive better service.

**21. What are the four types of handover available in GSM? (R)**

- Intra Cell Handover
- Inter Cell Intra BSC Handover
- Inter BSC Intra MSC Handover
- Inter MSC Handover

**22. List the 3 important features of GSM Security. (R) (May/June 2016)**

1. **Authentication** – used to protect the network against unauthorized use.
2. **Confidentiality** – Data on the radio path is encrypted between the Mobile Equipment (ME) and the BTS which protects user traffic and sensitive signaling data against eavesdropping.

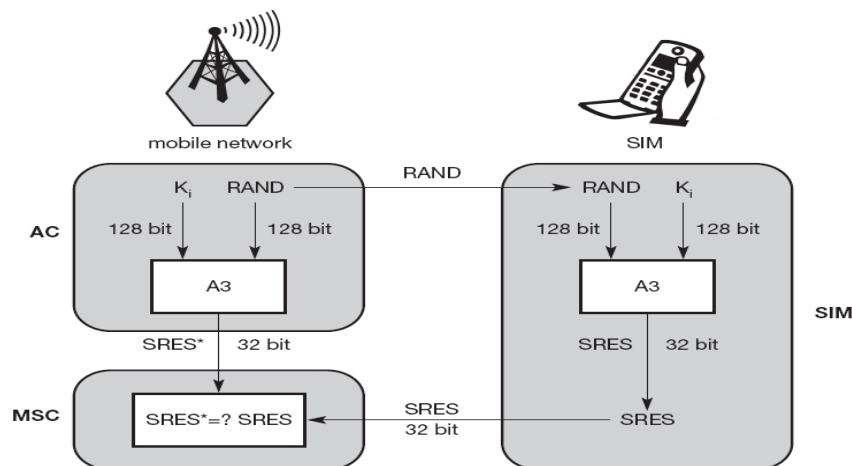
3. **Anonymity** – Anonymity is achieved by allocating Temporary Mobile Subscriber Identity (TMSI) instead of permanent identities to protect against tracking a user's location and obtaining information about a user's call log.

**23. What are the characteristics of GSM? (U)**

1. Communication
2. Total Mobility
3. World Wide Connectivity
4. High Capacity
5. High Transmission Quality
6. Security Functions
7. SIM Card Bounded Service

**24. Give the block diagram of GSM Authentication. (R)**

(May/June 2014)



**Figure**  
Subsc  
authen

**25. What is meant by GPRS? (R) ( May/June 12)**

GPRS (General Packet Radio Services) is a packet-oriented mobile data service on the GSM of 3G and 2G cellular communication systems. It is a non-voice, high-speed and useful packet-switching technology for GSM networks.

**26. List out the features of GPRS. (R)**

1. Speed
2. Immediacy
3. Packet Switched Resource Allocation (Spectrum Efficiency)
4. Flexible Channel Allocation
5. Traffic characteristics suitable for GPRS
6. Mobility
7. Localization



**27. Explain in what ways is GPRS better than GSM? (E)**

GSM uses a billing system based on the time of connection whereas GPRS uses a billing system based on the amount of transmitted data.

**28. What are the goals of GPRS? (U)**

1. Open Architecture
2. Consistent IP services
3. Same infrastructure for different air interfaces
4. Integrated telephony and Internet infrastructure
5. Service innovation independent of infrastructure

**29. What are the services offered by GPRS? (R) (Nov/Dec 2017)**

GPRS offers end-to-end packet-switched data transfer services which can be categorized into the following two types:

1. **Point-To-Point Service (PTP):** It is between two users and can either be connectionless or connection-oriented.
2. **Point-To-Multipoint Service (PTM):** It is a data transfer service from one user to multiple users.

**30. Point out the purpose of EIR in Mobile Computing. (U)**

Equipment Identity Register (EIR) is a database that used to track handsets using the IMEI. It helps to block calls from stolen, unauthorized, or defective mobiles.

**31 What are the information in SIM? (K) (APR/MAY 2018 )**

Card type, serial no., list of subscribed services Personal identity number Pin unlocking key, Authentication key

**32. What is the use of VOIP? (U) (May/June 2013)**

Voice over Internet protocol, a technology for making telephone calls over the Internet in which speech sounds are converted into binary.

**33. What is meant by roaming? (U)**

In wireless telecommunications, roaming is a general term referring to the extension of connectivity service in a location that is different from the home location where the service was registered. Roaming ensures that the wireless device is kept connected to the network, without losing the connection.

**34. What is the function of GGSN? (U) (May/June 2014)**

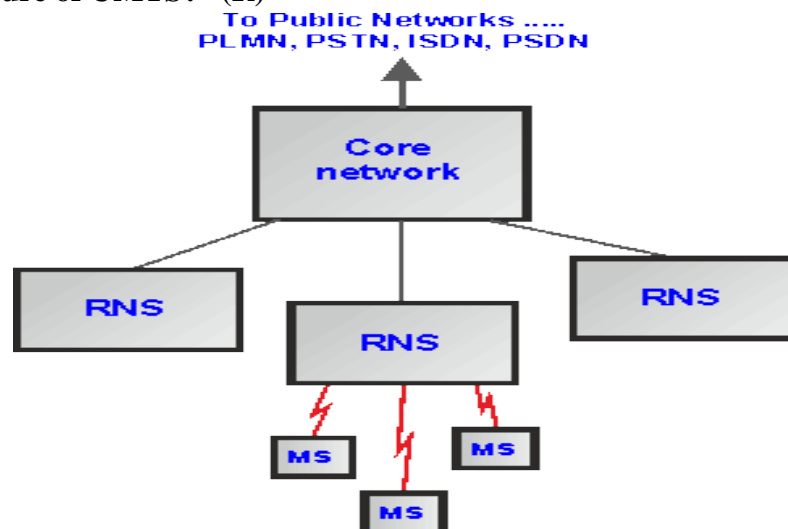
- The gateway GPRS support node (GGSN) is the interworking unit between the GPRS network and external packet data networks (PDN). This node contains routing information for GPRS users, performs address conversion, and tunnels data to a user via encapsulation.
- The GGSN is connected to external networks (e.g., IP or X.25) via the Gi interface and transfers packets to the SGSN via an IP-based GPRS backbone network (Gn interface).

**35. What is UMTS? (R)**

The Universal Mobile Telecommunications System (UMTS) is a 3G mobile communication system that provides a range of broadband services to wireless and mobile communications. The UMTS was developed mainly for countries with GSM networks.

**36. What are the main elements of UMTS? (R) (May/June 2016)**

1. User Equipment / Mobile Station (MS): is the name by which a cell phone is referred to.
2. Radio Network Subsystem (RNS): Equivalent of Base Station Subsystem (BSS) in GSM. It provides and manages the wireless interface for the overall network.
3. Core Network (CN): Equivalent of the Network Switching Subsystem (NSS) in GSM.

**37. Draw Architecture of UMTS? (R)****38. List out UMTS Problems. (AN)**

- Require more battery power
- Can handoff UMTS to GSM but not GSM to UMTS
- Initial poor coverage
- More expensive than GSM

**39. Which one of the following is correct ? i) GSM is a 2G and analog network ii) GSM is a 3G and digital network iii) GSM is a 4G and analog network iv) GSM is a 2G and digital network (April/May 2021)**

Answer is IV : GSM is a 2G network and digital network.

**PART-B**

1. Discuss about Cellular Systems. (U)
2. Explain GSM architecture and its services with neat diagram. (U) (Nov/Dec2011&12, May/June 12, May /June 2013, Nov/Dec 2013, May/June 2014, Nov/Dec2014, May/June 2016, April/May 2017, Nov/Dec 2017, Nov/Dec 2018)
3. Explain in detail about the handovers of GSM. (U) (Nov/Dec 2016)
4. Explain security service in GSM. (U) (December 2012, Nov/Dec 2013)
5. Explain GSM Authentication and Security. (U) (May/June 2016)
6. What are the functions of authentication and encryption in GSM? How is system security maintained? (8) (U) (Nov/Dec 2016)
7. Draw a neat diagram of GPRS and explain its protocol architecture and services. (U) (Nov/Dec 2011&12, May/June 12, May /June 2013, Nov/Dec 2013, May/June 2014, Nov/dec2014, May/June 2016, Nov/Dec 2016, April/May 2017)
8. Explain in detail about UMTS Architecture and its Services. (U) (May/June 2016) (Nov/Dec 2016) (Nov/Dec 2017)
9. Describe how the mobile cellular communication has evolved over the generation of technology. (AN)
10. Discuss the architecture of UMTS? MAY/JUNE 2016 , NOV/DEC 2017, APR/MAY2018
11. Explain about the various handover by GSM? NOV/DEC 2016, APR/MAY2018
12. Describe the function of HLR and VLR in call routing and roaming? NOV/DEC 2018
13. Explain the various components of radio subsystem of GSM networks. APR/MAY2021
14. Discuss the bearer services of GSM networks APR/MAY2021
15. Explain the GPRS architecture reference model with a neat diagram APR/MAY2021
16. Discuss the UTRA FDD mode with a neat diagram APR/MAY2021

**UNIT III****MOBILE NETWORK LAYER**

**Mobile IP – DHCP – AdHoc– Proactive protocol-DSDV, Reactive Routing Protocols – DSR, AODV , Hybrid routing –ZRP, Multicast Routing- ODMRP, Vehicular Ad Hoc networks ( VANET) –MANET Vs VANET – Security.**

**PART-A****1. Specify the goals of Mobile IP. (U)**

- Allows mobile hosts to stay connected to the internet regardless of their location and without changing their IP address.
- Enable packet transmission efficiently without any packet loss and disruptions in the presence of host and/or destination mobility.

**2. What are the main requirements needed for mobile IP? (R)**

- Compatibility
- Transparency
- Scalability and efficiency
- Security

**3. List out the various terminologies involved in Mobile IP. (R)**

- a) Mobile Node
- b) Home Network
- c) Home Address
- d) Foreign Agent
- e) Correspondent Node
- f) Care-of-Address
- g) Tunnel
- h) Foreign Network
- i) Home Agent

**4. Differentiate the functionalities of a foreign agent and home agent. (AN)****(Nov/Dec 2017)**

<b>Home Agent</b>	<b>Foreign Agent</b>
Router on a home network that intercepts datagrams destined for the mobile node and delivers them through the care-of-address.	Router on a mobile node's visited network that provides routing services to the mobile node while the mobile node is registered.

**5. Define COA. (R) (Nov/Dec 2016)**

It is an address that identifies the mobile node's current location. The packets sent to the Mobile Node are delivered to COA. COA is associated with the mobile node's Foreign Agent (FA).

**6. Define Tunneling. (U)**

Tunneling is the process of delivering the packet sent by the Home Agent (HA) to foreign agent (COA) and from COA to the mobile node via tunnel. Tunneling has two primary functions:

1. Encapsulation of data packet to reach the tunnel endpoint
2. Decapsulation when the packet is delivered at that endpoint.

**7. What is encapsulation in Mobile IP. (U)**

Encapsulation refers to arranging a packet header and data and putting it into the data part of a new packet. Thus the encapsulated packet will contain the new destination address as "Address of COA" and the new source address as "Address of HA".

**8. What are the two types of COA? (R)**

1. Foreign Agent COA: It is an IP address of Foreign Agent(FA).
2. Co-located COA: Temporary IP address that is assigned to MN.

**9. What is meant by Agent Discovery? (U)**

Agent Discovery is a process by which a mobile node determines its Foreign Agent (FA) during call establishment.

Two methods of Agent Discovery:

- (i) Agent Advertisement
- (ii) Agent Solicitation

**10. What is meant by Agent Advertisement? (U)**

Foreign agents and home agents advertise their presence periodically using special agent advertisement messages. An Agent Advertisement Message lists one or more COA and a flag indicating whether

**11. What is meant by Agent Solicitation? (U)**

Agent Solicitation is an Agent Discovery process which is used to search for a foreign agent. Agent Solicitation message is sent if a mobile node does not receive any COA.

**12. What are the mechanisms used for forwarding the packet? (U)**

- CN does not need to know anything about the MN's current location and sends the packet as usual to the IP address of MN

- The packet is not forwarded into the subnet as usual, but encapsulated and tunnelled to the COA
- The foreign agent now decapsulates the packet, i.e., removes the additional header, and forwards the original packet with CN as source and MN as destination to the MN

**13. What are the key mechanisms associated with Mobile IP? (R)**

1. Discovering the Care-of-Address
2. Registering the Care-of-Address
3. Tunneling to the Care-of-Address

**14. What do you mean by the term binding of mobile node? (U)**

The association of the home address of a mobile node with a Care-Of-Address (COA) is called binding of mobile node.

**15. What is DHCP? Mention the importance of DHCP in the context of mobile computing (R) (May/June 2016)(April/May 2021)**

DHCP (Dynamic Host Configuration Protocol) is a communication protocol that network administrators use to centrally manage and automate the network configuration of devices attaching to an Internet Protocol (IP) network.

**16. Define an Ad-hoc network? (R)**

The term implies spontaneous or impromptu construction. An ad hoc network is a network that is composed of individual devices communicating with each other directly. Instead of relying on a base station to coordinate the flow of messages to each node in the network, the individual network nodes forward packets to and from each other.

**17. What are the basic principles of Ad-hoc networking? (U)**

- Mobile device communicate in peer-to-peer fashion
- Self-organizing network without the need of fixed network infrastructure,,
- Multi-hop communication,,
- Decentralized, mobility-adaptive operation

**18. What are the MANET Design Issues? (K) NOV/DEC2018**

Below are important issues that are relevant to the design of suitable MANET protocols.

1.Network size and node density 2.Connectivity 3.Network topology 4.User traffic 5. Operational environment 6. Energy constraint

**19. What are the needs of ad hoc networks? (AN)**

- Ease of deployment
- Speed of deployment

- Decreased dependence on infrastructure

## 20. What are the advantages of ad hoc networks?(U)

The advantages of an ad hoc network include:

1. Separation from central network administration.
2. Self-configuring nodes are also routers.
3. Self-healing through continuous re-configuration.
4. Scalability incorporates the addition of more nodes.
5. Mobility allows ad hoc networks created on the fly in any situation where there are multiple wireless devices.
6. Flexible ad hoc can be temporarily setup at any time, in any place.
7. Lower getting - started costs due to decentralized administration.
8. The nodes in ad hoc network need not rely on any hardware and software. So, it can be connected and communicated quickly.

## 21. What are the key challenges in ad hoc networks? (U)

1. All network entities may be mobile  $\Rightarrow$  very dynamic topology
2. Network functions must have high degree of adaptability (mobility, outage)
3. No central entities  $\Rightarrow$  operation in completely distributed manner

## 22. What is meant by MANET? (R)

A mobile ad hoc network (MANET) is a continuously self-configuring, infrastructure-less network of mobile devices connected without wires. MANETs are established and maintained on the fly and work without the support of any form of fixed infrastructure such as base station or an access point.

## 23. Give the difference between cellular and ad-hoc networks. (AN)

S.No.	Cellular Networks	Ad-hoc Networks
1	Infrastructure Networks	Infrastructure-less Networks
2	Fixed, pre-located cell sites and base stations	No base station and rapid deployment
3	Static backbone network topology	Highly dynamic network topologies
4	Relatively caring environment and stable connectivity	Hostile environment and irregular connectivity
5	Detailed planning before base station can be installed	Ad-hoc networks automatically forms and adapts to changes
6	High setup costs	Cost-effective
7	Large setup time	Less setup time

**24. List out the characteristics of MANETs. (U) (May/June 2016)**

- 1) Lack of fixed infrastructure
- 2) Dynamic Topologies
- 3) Bandwidth constrained, variable capacity links
- 4) Energy Constrained Operation
- 5) Increased Vulnerability
- 6) Distributed peer-to-peer mode of operation
- 7) Multi-hop Routing
- 8) Autonomous Terminal
- 9) Lightweight Terminals
- 10) Shared Physical Medium

**25. Analyze the operational constraints (challenges) associated with MANET. (AN)**

1. Low Processing Capabilities & low bandwidth
2. Computational & Communication overhead
3. Mobility-induced route changes
4. Battery Constraints
5. Packet losses due to transmission errors
6. Security Threats
7. Dynamic Topology

**26. What are the advantages of MANETs? (U)**

- They provide access to information and services regardless of geographic position.
- Independence from central network administration
- Self-configuring network, nodes are also act as routers. Less expensive as compared to wired network.
- Scalable—accommodates the addition of more nodes.
- Improved Flexibility.
- Robust due to decentralize administration.
- The network can be set up at any place and time.

**27. What are the disadvantages of MANET? (U)**

1. Limited Resource
2. Limited Physical Security
3. Vulnerable to attacks. Lack of authorization facilitates
4. Variable network topology makes it hard to detect malicious nodes
5. Security protocols for wired network cannot work for adhoc network
6. Battery constraints
7. Frequent route changes leads to computational overhead



**28. List out some of the applications of MANETs. (U) (April/May 2017)**

Some of the typical applications include:

- 1) Communication among portable computers
- 2) Environmental Monitoring
- 3) Sensor Networks
- 4) Military Sector
- 5) Personal Area Network and Bluetooth
- 6) Emergency Applications

**29. Analyze and list out the various design issues associated with MANET. (AN)**

- 1) Network Size and Node Density
- 2) Connectivity
- 3) Network Topology
- 4) User Traffic
- 5) Operational Environment
- 6) Energy Constraints

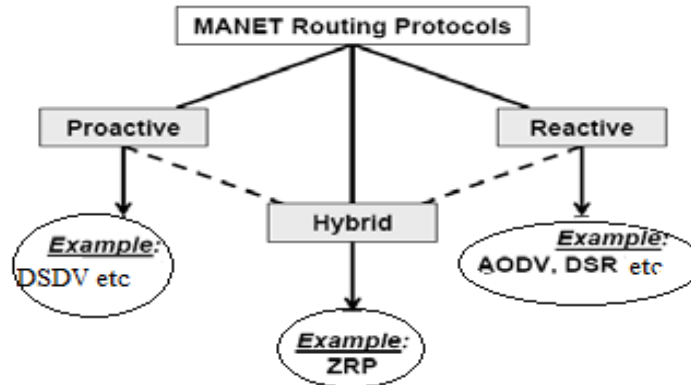
**30. What is meant by routing in ad hoc networks? (R)**

“Routing is the process of finding the best path between the source and the destination for forwarding packets in any store-and-forward network. Routing is the mechanism of forwarding packet towards its destination using most efficient path. Efficiency of the path is measured in various metrics like, Number of hops, traffic, security, etc. In Ad-hoc network each host node acts as specialized router itself.

**31. Differentiate between MANET routing strategies with routing strategies of traditional networks. (AN)**

S.NO	MANET routing strategies	Routing strategies of traditional networks
1	In MANET, each node acts as a router	In traditional network, ordinary nodes do not participate in routing the packets.
2	In MANET, the topology is dynamic because of the mobility of the nodes. Thus the routing table quickly becomes obsolete.	In traditional networks, the topology is static and the routing table is also constant during the data transmission.
3	IP address encapsulated in the subnet structure does not work because of the node mobility	Simple IP-based addressing scheme is deployed in wired network.

**32. Give the classification of MANET routing protocols. (AN)**



**33. Distinguish Proactive and Reactive protocols. (AN) (April/May 2017)**

	Reactive Protocol	Proactive Protocol
<b>Approach</b>	On-demand Routing Protocol.	Table-driven Routing Protocol.
<b>Route Discovery</b>	As Needed	Constantly discovers and maintain routes
<b>Overhead</b>	Low	High
<b>Route Discovery Latency</b>	High	Low
<b>Topology Change Detection</b>	Route Errors	Hellos
<b>Routing Method</b>	Link State Routing	Distance Routing
<b>Example</b>	DSR, AODV	DSDV

S.No.	Proactive Protocol	Reactive Protocol
1	Table-driven Routing Protocol.	On-demand Routing Protocol.
2	Each node has to maintain one or more table to maintain routing information.	Since the nodes do not maintain up-to-date routes to different destinations new routes are discovered only when required.
3	Generates control messages to keep the routing table consistent and up-to-date.	Uses flooding techniques to determine the route.
4	This protocol is designed for small networks and networks with less node mobility.	This protocol is designed to reduce large overheads in larger networks and networks with high mobility.
5	Example: DSDV	Example: DSR, AODV

**34. List the types of communication in MANET. (R)**

- **Unicast:** Message is sent to a single destination node
- **Multicast:** Message is sent to a selected subset of network nodes
- **Broadcast:** Broadcasting is a special case of multicasting. Message is sent to all the nodes in the network.

**35. What is multicasting? (R) (Nov/Dec 2016)**

Multicasting is the process of delivering a message to a group of destination nodes in a single transmission.

**36. Why traditional routing strategies cannot be deployed in a MANET? (AN)**

**Traditional Routing strategies cannot be deployed in a MANET. Because,**

- Every node is a router in a MANET, while most nodes in traditional wired networks do not route packets.
- Topologies are dynamic in MANET's due to mobile nodes, but are static in traditional networks.
- Routing in MANET's must consider both layer 3 and layer 2 information, while traditional protocols rely on layer 3 information only.
- There is limited physical security (therefore, Increased possibility of eavesdropping, spoofing, and denial-of-service attacks) in MANET's compared to traditional network.
- Different node characteristics make routing difficult.
- Rate of link failure/repair may be high when nodes move fast.

**37. Compare AODV and DSR protocols. (AN) (Nov/Dec 2017)**

Properties	AODV	DSR
<b>Loop-Free</b>	Yes	Yes
<b>Multiple Routes</b>	No	Yes
<b>Distributed</b>	Yes	Yes
<b>Reactive</b>	Yes	Yes
<b>Multicast</b>	Yes	No
<b>Periodic Broadcast</b>	Yes	No
<b>Route Discovery</b>	On Demand	On Demand

**38. Write the Important steps in the operation of DSDV? (K) NOV/DEC2018**

The important steps in the operation of DSDV are summarized below: 1. Each router (node) in the network collects route information from all its neighbours. 2. After gathering information, the node determines the shortest path to the destination based on the gathered information. 3. Based on the gathered information, a new routing table is generated. 4. The

router broadcasts this table to its neighbours. On receipt by neighbours, the neighbour nodes recompute their respective routing tables. 5. This process continues till the routing information becomes stable.

**39. Write short notes on VANET? (April/May 2021) (U)**

A Vehicular Adhoc Network (VANET) is a special type of MANET in which moving automobiles form the nodes of the network. i.e., vehicles are connected to each other through an adhoc formation that forms a wireless network.

**40. Mention the goals of VANET. (U)**

- Improve traffic safety and comfort of driving
- Minimize accidents, traffic intensity, locating vehicles
- Up-to-date traffic information
- Intersection collision warning
- Weather information

**41. What are the characteristics of VANETs? (U)**

- 1) High mobility of nodes
- 2) Rapidly changing network topology
- 3) Unbounded network size
- 4) Higher computational capacity
- 5) Time-sensitive data exchange
- 6) Potential support from infrastructure
- 7) Abundant Resources
- 8) Partitioned Network
- 9) Unlimited Transmission Power

**42. Mention the uses of VANET. (U)**

- 1) A VANET can help drivers to get advance information and warnings from a nearby environment via message exchanges.
- 2) A VANET can help disseminate geographical information to the driver as he continues to drive.
- 3) Drivers may have the opportunity to engage in other task.

**43. List out the applications of VANETs. (U)**

- 1) Safety oriented
  - a) Real-time traffic
  - b) Cooperative message transfer
  - c) Post-crash notification
  - d) Road hazard control notification

- e) Traffic vigilance
- 2) Commercial oriented
  - a) Remote vehicle personalization
  - b) Internet access
  - c) Digital map downloading
  - d) Real time video relay
  - e) Value-added advertisement
- 3) Convenience oriented
  - a) Route diversion
  - b) Electronic toll collection
  - c) Parking availability
- 4) Productive Applications
  - a) Environmental Benefits
  - b) Time Utilization
  - c) Fuel Saving

**44. Compare MANET Vs VANET. (AN) (May/June 2016) (Nov/Dec 2016) (Nov/dec 2018)**

S. No		<b>VANET – Vehicular Adhoc Network</b>	<b>MANE – Mobile Adhoc Network</b>
<b>1</b>	<b>Basic Idea</b>	It is a collection of nodes(vehicles) that communicate with each other over bandwidth constrained wireless links with certain road side infrastructure or base station	It is a collection nodes that communicate with each other over bandwidth constrained wireless links without any infrastructure support
<b>2</b>	<b>Production Cost</b>	Costly	Inexpensive
<b>3</b>	<b>Network Topology Change</b>	Frequent and very fast	Sluggish / Slow
<b>4</b>	<b>Mobility</b>	High	Low
<b>5</b>	<b>Density in Node</b>	Frequent variable and dense	Sparse
<b>6</b>	<b>Bandwidth</b>	1000 kbps	100 kbps
<b>7</b>	<b>Range</b>	Up to 600 m	Up to 100 m
<b>8</b>	<b>Node lifetime</b>	It is depend on vehicle life	It is depend on power

		time	source
<b>9</b>	<b>Reliability</b>	High	Medium
<b>10</b>	<b>Nodes moving Pattern</b>	Regular	Random

**PART – B**

1. Explain entities and terminology of Mobile IP. (R)
2. Describe the following terms in detail: (R)
  - i) Corresponding Node
  - ii) Care of Address
  - iii) Agent Discovery
  - iv) Tunneling and Encapsulation.
3. Discriminate in detail about traditional IP. How does it differ from Mobile IP? Why the traditional IP cannot be used in the mobile network. (E)
4. Demonstrate the working of Mobile IP with help of a diagram. (A)
5. With a neat diagram explain how packet delivery to and from a mobile node is transferred in Mobile IP. (U) (Apr/May 2017) (Nov/Dec 2017)
6. Explain in detail about the key mechanisms associated with Mobile IP. (U)  
(Nov/Dec 2016)
7. Express brief account of route optimization in Mobile IP. (U)
8. With a diagram explain DHCP and its protocol architecture. (R) (May/June 2016)
9. Explain IP-in-IP, Minimal IP and GRE encapsulation methods. (U) (May/June 2016)
10. What is Encapsulation? Explain in detail the various encapsulation techniques in Mobile IP. (U) (April/May 2017)
11. Explain the basic characteristics and applications of Mobile Ad hoc networks. (U)  
(May/June 2016)
12. Explain the various routing strategies in mobile ad-hoc networks. (U)
13. What are reactive and proactive protocols? Specify its advantages and disadvantages. (8)  
(U) (Nov/Dec 2016)
14. Explain DSR Routing Protocol in detail. (U) (May/June 2016)
15. Discuss route discovery and route maintenance mechanisms in DSR with illustration. List its merits and demerits. (A) (Nov/Dec 2017)
16. Explain the following: (U)
  - (i) DSDV routing protocol [Marks 8]
  - (ii) Ad-hoc DSR routing protocol [Marks 8]
17. Explain Dynamic Source Routing. (U) (May/June 2014)
18. Discuss and detail the differences between DSDV and DSR routing protocols. (AN)
19. Explain about Hybrid Routing protocols in MANETs. (U)
20. Demonstrate how multicast routing is carried out in ad-hoc networks. (8) (A)

**(Nov/Dec 2016)**

- 21.** Explain about characteristics and applications of MANET? **(MAY/JUNE 2016, APR/MAY2018)**
- 22.** Define VANET? Explain how does it differ from MANET? Explain any one application of VANET. **(AN)**
- 23.** Draw and explain the architecture of VANET. **(U) (May/June 2016)**
- 24.** Describe the architecture of VANET with the functionality of the components. Compare VANET with MANET. **(U) (Nov/Dec 2017)**
- 25.** Explain any two VANET routing protocol with an example. **(U) (April/May 2017)**
- 26.** Discuss about various schemes in VANET routing. **(AN)**
- 27.** Explain the various security attacks on VANET. **(U) (May/June 2016)**
- 28.** Explain how routing is done in MANET? Explain about DSR in detail and compare with DSDV ? **(MAY/JUNE2016,NOV/DEC2017,NOV/DEC2018)**
- 29.** What is VANET? Differentiate MANET and VANET? Architecture of VANET? **(MAY/JUNE 2016, NOV/DEC2017, APR/MAY2018)**
- 30.** Illustrate the process of route discovery ,route reply, data delivery and route caching using DSR. **(APR/MAY2018)**
- 31.** Explain DSR protocol with a sample topology. **(APR/MAY2021)**
- 31.** Discuss the suitability of DSR in terms of density of nodes, total number of nodes pattern of communication and end to end delay**(APR/MAY2021)**
- 32.** Explain ZRP with a sample topology**(APR/MAY2021)**
- 33.** Explain the reasons why a pure proactive or a pure reactive protocol is not suitable for certain scenarios with suitable examples**(APR/MAY2021)**

**UNIT IV****MOBILE TRANSPORT AND APPLICATION LAYER****Mobile TCP – WAP – Architecture – WDP – WTLS – WTP – WSP – WAE – WTA  
Architecture - WML****PART – A****1. Define TCP. (R)**

Transmission Control Protocol (TCP) is the standard transport layer protocol for applications that require guaranteed message delivery. It is a connection-Oriented protocol.

**2. Mention the layers involved in TCP/IP Protocol Suite. (R)**

1. Application Layer
2. Transport Layer
3. Internet Layer
4. Network Access Layer

**3. Name the protocols in Application Layer. (R)**

1. HTTP (HyperText Transfer Protocol)
2. FTP (File Transfer Protocol)
3. SMTP (Simple Mail Transfer Protocol)
4. SNMP (Simple Network Management Protocol)
5. DNS (Domain Name System)
6. TELNET

**4. Mention the Transport Layer Protocols. (R)**

1. TCP (Transmission Control Protocol)
2. UDP (User Datagram Protocol)

**5. List out the Internet Layer Protocols. (R)**

1. IGMP (Internet Group Management Protocol)
2. ICMP (Internet Control Message Protocol)
3. IP (Internet Protocol)
4. ARP (Address Resolution Protocol)
5. RARP (Reverse Address Resolution Protocol)

**6. To which layer does each of the following protocols belong to? What is their functionality? (a) RARP (b) DNS (R) (Nov/Dec 2017)**



- (a) **RARP:** It is a Network Layer protocol. RARP is used by IP to find the IP address based on the physical address of a computer.
- (b) **DNS:** It is an Application Layer protocol. It is a software service available on the internet that is responsible for translating domain names into IP address.

**7. What is the use of HTTP and FTP? (R)**

- **HTTP:**

- HTTP stands for HyperText Transfer Protocol
- HTTP takes care of the communication between a web server and a web browser.
- It is used for sending requests from a web client (a browser) to a web server, returning web content (web pages) from the server back to the client.

- **FTP:**

- FTP stands for File Transfer Protocol
- FTP takes care of file transmission between computers.

**8. What are the various mechanisms used to improve traditional TCP performance?**

1. Slow Start
2. Congestion Avoidance
3. Fast Retransmit / Fast Recovery

**9. List out indirect TCP advantages. (U) May/June 2013**

- I-TCP does not require any changes in the TCP protocol as used by the hosts in the fixed network or other hosts in a wireless network that do not use this optimization. All current optimizations for TCP still work between the foreign agent and the correspondent host.
- Due to the strict partitioning into two connections, transmission errors on the wireless link, i.e., lost packets cannot propagate into the fixed network

**10. Mention the disadvantage of I-TCP. (U)**

- The loss of the end-to-end semantics of TCP might cause problems if the foreign agent partitioning the TCP connection crashes.
- The foreign agent must be a trusted entity because the TCP connections end at this point. If users apply end-to-end encryption.

**11. What is meant by Snooping TCP? (R)**

- The main function of the enhancement is to buffer data close to the mobile host to perform fast local retransmission in case of packet loss.

- In this approach, the foreign agent buffers all packets with destination mobile host and additionally ‘snoops’ the packet flow in both directions to recognize acknowledgements

**12. List out advantage of M-TCP. (U)**

- It maintains the TCP end-to-end semantics. The SH does not send any ACK itself but forwards the ACKs from the MH.
- If the MH is disconnected, it avoids useless retransmissions, slow starts or breaking connections by simply shrinking the sender’s window to 0

**13. Define fast retransmit and fast recovery. (R)**

- The mechanisms of fast recovery/fast retransmit a host can use after receiving duplicate acknowledgements, thus concluding a packet loss without congestion.
- As soon as the mobile host registers at a new foreign agent using mobile IP, it starts sending duplicated

**14. Define time out freezing. (R) May/June 12 and May/June 2013 Nov/Dec 2014**

The MAC layer can inform the TCP layer of an upcoming loss of connection or that the current interruption is not caused by congestion. TCP can now stop sending and ‘freezes’ the current state of its congestion window and further timers

**15. Define Selective retransmission. (R) Nov / Dec 2012**

- If a single packet is lost, the sender has to retransmit everything starting from the lost packet (go-back-n retransmission). This obviously wastes bandwidth, not just in the case of a mobile network, but for any network (particularly those with a high path capacity, i.e., bandwidth delay- product
- The advantage of this approach is obvious: a sender retransmits only the lost packets

**16. List out disadvantage of M-TCP. (U)**

- As the SH does not act as proxy as in I-TCP, packet loss on the wireless link due to bit errors is propagated to the sender. M-TCP assumes low bit error rates, which is not always a valid assumption.
- A modified TCP on the wireless link not only requires modifications to the MH protocol software but also new network elements like the bandwidth manager

**17. What is WAP? (U)**

Wireless Application Protocol (WAP) is a protocol suite which enables global wireless communication across different wireless network technologies such as GSM, GPRS, UMTS etc.

**18. What is the objective of WAP? (U)**

The objective of WAP is to bring diverse internet content and other data services to digital cellular phones and other wireless, mobile terminals.

**19. List out the general features offered by WSP. (R)**

- Session Management
- Capability Negotiation
- Content Encoding

**20. What is WSP/B? List out the features offered by WSP/B. (U)**

Wireless Session Protocol / Browsing is a specification of WAP which comprises protocols and services most suited for browsing-type applications.

WSP/B offers the following features adapted to web browsing:

- HTTP/1.1 Functionality
- Exchange of session headers
- Push and Pull Data Transfer
- Asynchronous requests

**21. List the goals of Wireless Application Environment. (U)**

- Device and Network independent application environment
- For low band width wireless devices
- Considerations of slow links, limited memory, low computing power, small display, simple user interface
- Integrated Internet/WWW programming model
- High interoperability

**22. Mention the components of WAE. (R)**

- Architecture
- User Agents
- WML
- WMLScript
- WTA
- Proxy

**23. What is the function of a WAP gateway ? ( April/May 2021)**

A WAP gateway sits between mobile devices using the Wireless Application Protocol (WAP) and the World Wide Web, passing pages from one to the other much like a

**proxy.** This translates pages into a form suitable for the mobiles, for instance using the Wireless Markup Language (WML).

**24.** What are the possible reasons for the loss of packets in mobile networks ? ( **April/May 2021**)

Network congestion, as its name suggests, occurs when a network becomes congested with traffic and hits maximum capacity. Software Bugs. Software bugs are another common cause of packet loss

### **PART – B**

- 1.** Explain Indirect TCP. (U) (Nov /Dec 2011&12, May/June 12, May /June 2013, Nov/Dec2014)
- 2.** Short notes on Snooping and Mobile TCP. (U) (Nov /Dec 2011&12, May/June 12, May/June 2013, Nov/Dec 2013, May/June2014, Nov/Dec 2014)
- 3.** Discuss and compare the various mechanisms used to improve the TCP performance in mobile network. (AN) (May/June 2016) (Nov/Dec 2017)
- 4.** Explain in detail about WAP protocol Architecture. (U)
- 5.** Explain WML and WML Scripts. (U)
- 6.** Discuss about Wireless Telephony Application. (U)
- 7.** Discuss the limitations of traditional TCp in the context of mobile networks( **April/May 2021**)
- 8.** Explain end to end semantics of the transport layer. Discuss how end to end semantics. ( **April/May 2021**)
- 9.** Explain Wireless Datagram protocol (WDp) of Wap stack. ( **April/May 2021**)
- 10.** Write a Wml script that asks the user to enter his name and age. Write validation function(s) that ensure that name has only alphabets and age has only numeric ( **April/May 2021**)

**UNIT V****MOBILE PLATFORMS AND APPLICATIONS**

**SYLLABUS: Mobile Device Operating Systems – Special Constrains & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – MCommerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.**

**PART – A****1. What is meant by Mobile Operating System? (U)**

A mobile operating system, also called a mobile OS, is software that is specifically designed to run on mobile devices such as mobile phones, smartphones, PDAs, tablet computers and other handheld devices. Much like the Linux or Windows operating system controls your desktop or laptop computer, a mobile operating system is the software platform on top of which other programs can run on mobile devices.

**2. List out the features of Mobile Operating Systems. (U)**

1. Multitasking
2. Scheduling
3. Memory Allocation
4. File System Interface
5. Keypad Interface
6. I/O Interface
7. Protection and Security
8. Multimedia features

**3. Draw the architecture of Mobile OS. (R)**

Applications
OS Libraries
Device Operating System Base, Kernel
Low-Level Hardware, Manufacturer Device Drivers

**4. What are the special constraints and requirements of Mobile OS? (E)**  
**(April/May 2017) (Nov/Dec 2017)**

Design and capabilities of a Mobile OS (Operating System) is very different than a general purpose OS running on desktop machines:

- Mobile devices have constraints and restrictions on their physical characteristic such as screen size, memory, processing power and etc.
- Scarce availability of battery power
- Limited amount of computing and communication capabilities

**5. List out various Mobile Operating Systems.**

**Give four examples of Mobile OS.**

**(R) (May/June 2016)**

There are many mobile operating systems. The followings demonstrate the most important ones:

- Java ME Platform
- Palm OS
- Symbian OS
- Linux OS
- Windows Mobile OS
- BlackBerry OS
- iPhone OS
- Google Android Platform

**6. Define Android SDK. (R)**

Android SDK is a software development kit that enables developers to create applications for the Android platform. The Android SDK includes sample projects with source code, development tools, an emulator, and required libraries to build Android applications.

**7. What are the advantages and disadvantages of Android Mobile OS? (U)**

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Large number of devices using Android</li> <li>• Frequent Enhancement</li> <li>• Larger number of applications availability</li> <li>• Excellent UI</li> <li>• Multi-tasking</li> <li>• Free developer tools</li> <li>• No restrictions on applications</li> <li>• Phones are available from every service provider</li> <li>• Many devices can be unlocked with third-party applications</li> </ul>	<ul style="list-style-type: none"> <li>• Some device manufacturers add alternative UI front-ends which reduces OS consistency</li> <li>• Updates are controlled by device manufacturers and may be slow or non-existent</li> <li>• Applications are not validated</li> </ul>

**8. What are the advantages and disadvantages of Apple IOS? (U)**

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Excellent UI</li> </ul>	<ul style="list-style-type: none"> <li>• Closed architecture</li> </ul>

<ul style="list-style-type: none"> <li>• Larger number of applications availability</li> <li>• Apple validates applications</li> <li>• Consistent UI across devices</li> <li>• Frequent free OS updates</li> </ul>	<ul style="list-style-type: none"> <li>• Limited number of devices to choose from – all from apple</li> <li>• No multi-tasking for applications</li> <li>• Applications must be approved by Apple before being made available via the Marketplace</li> <li>• Can't be unlocked</li> </ul>
--	---

**9. What are the advantages and disadvantages of BlackBerry OS? (U) (Nov/Dec 2017)**

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Secure send and receive email using proprietary encryption</li> <li>• Multi-tasking</li> <li>• Phones available form most service providers</li> </ul>	<ul style="list-style-type: none"> <li>• Closed architecture</li> <li>• Limited number of devices to choose from – all from Research In Motion</li> <li>• Limited number of applications available</li> <li>• Application development is more complex and difficult than other Operating Systems</li> <li>• Applications tend to be more costly</li> </ul>

**10. What are the advantages and disadvantages of Windows Phone OS? (U)**

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Built in support for Windows Office documents</li> <li>• Multi-tasking</li> <li>• Phones available form most service providers</li> <li>• Excellent development tools, with free versions available to students</li> <li>• Updates available directly from Microsoft</li> </ul>	<ul style="list-style-type: none"> <li>• Closed architecture</li> <li>• Small number of applications available</li> <li>• Browser is a mix of IE7 and IE8 (a bit dated)</li> <li>• Applications must be approved by Microsoft before being</li> </ul>

**11. What is M-Commerce? (U) (May/June 2016)**

M-commerce (mobile commerce) is the buying and selling of goods, services or information by using Wireless handheld devices such as cellular telephone and personal digital assistants (PDAs). It is an important application of Mobile Computing. This includes purchases on Websites or apps, in-store or from vending machines; paying for

travel, events or bills; or redeeming a coupon... any type of commerce that is conducted using a mobile device.

**12. What are the characteristics of M-Commerce? (U)**

1. Fast Processing
2. Reduced Business Costs
3. Little Need for Maintenance

**13. List out the applications of M-Commerce. (R)**

M-Commerce applications broadly categorized into

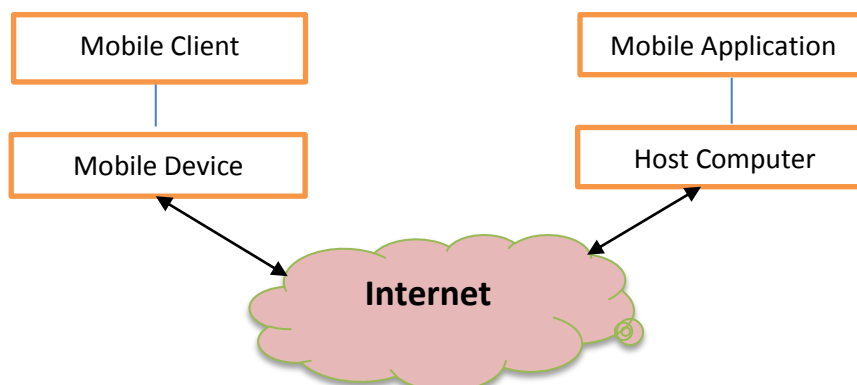
**1. Business-to-Consumer (B2C) Applications**

- (i) Advertising
- (ii) Comparison Shopping
- (iii) Information about a product
- (iv) Mobile Ticketing
- (v) Content Purchase and Delivery
- (vi) Loyalty and Payment Services
- (vii) Mobile Banking
- (viii) Catalogue Shopping
- (ix) Mobile Brokerage

**2. Business-to-Business (B2B) Applications**

- (i) Ordering and Delivery Conformation
- (ii) Stock Tracking and Control
- (iii) Supply Chain Management
- (iv) Mobile Inventory Management

**14. Draw the structure of Mobile Commerce. (R)**





**15. What are the features required for a mobile device to enable mobile commerce? (AN)**

To enable M-Commerce to be used widely, a mobile device should support the following features:

- i) Good internet connectivity
- ii) Ability to display rich content such as images
- iii) Have a good quality camera with auto focus
- iv) Screen should be able to properly display the bar codes
- v) Ability to read the RFID tags
- vi) MMS (Multimedia Message Service), SMS (Short Message Service)
- vii) Ability to communicate between the mobile device and the supporting network
- viii) Ability to scan bar codes
- ix) Ability to interact with the Point-of-Sale (PoS) terminals

**16. What are pros of M-Commerce? (U) (April/May 2017)**

1. For the business organizations, the benefits of using M-commerce include customer convenience, cost savings and new business opportunities.
2. For customers, M-commerce provides the flexibility of anytime, anywhere shopping using a lightweight device. Customers can save substantial time compared to visiting several stores to identify a right product at lowest price.
3. Cover wild distance: Mobile is the only technology which is now become necessary for any person in social and business life than computers. So, it is easy to reach users through mCommerce.
4. Consumer deals : As more users use mCommerce, there are lots of companies use mCommerce site to reach them by giving different and better deals in comparison of their competitor.
5. Savings : Companies try to reach to the consumer directly through mCommerce, so users have no need to go far to the store physically and at the end it saves user's time and money.
6. Easy to use : There is no need of skilled consumer. Buyers can have look thousands of items on their cell phones and there is no need of online checkout process.

**17. What are the cons of M-Commerce? (U) (April/May 2017)**

1. Smart phone limitation (Small Screen): Mobile has no big screen like desktop or laptops, so sometimes users tried to navigate more and more to choose just one item from thousands. It affects shopping rates.

2. **Habituate:** Every new technology has some problem at the starting phase. Here mCommerce is new application, so sometimes people avoid to change which are rapidly change. As they are habituate to buy products from eCommerce.
3. **The underlying network may impose several types of restrictions.** For example, the available bandwidth is restricted, international calls and SMS may be expensive. Therefore ubiquity of E-commerce is hard to achieve.
4. **Security:** unless a customer is extremely careful, he may fall to various types of frauds and may get billed for the items he did not purchase.
5. **Risk factor:** Each business has its own risk. Same Mobile commerce is the growing field and a lot of investment in this field is become risky. Because technology change day by day. Moreover, there less security in wireless network, so in data transfer hacking chances are more.
6. **Connectivity:** Mobile commerce needs high speed connectivity of 3G. Otherwise it is become hectic for user to go through entire product purchase process.

**18. Differentiate E-Commerce and M-Commerce. (AN) (Nov/Dec 2016)**

Basis for comparison	E-commerce	M-commerce
<b>Meaning</b>	Any kind of commercial transaction that is concluded, over the internet using electronic system is known as e-commerce.	M-commerce refers to the commercial activities which are transacted with the help of wireless computing devices such as cell phone or laptops.
<b>Which device is used?</b>	Computers and Laptops	Mobiles, tablets, PDA's, iPad etc.
<b>Developed</b>	In 1970's	In 1990's
<b>What is it?</b>	Superset	Subset
<b>Ease of carrying device</b>	No	Yes
<b>Use of internet</b>	Mandatory	Not mandatory
<b>Reach</b>	Narrow i.e. it is available only in those places where there is internet along with electricity.	Broad due to its Portability

**19. What is meant by M-Payment (Mobile Payment)? (U)**

A Mobile Payment (m-payment) may be defined as initiation, authorization and confirmation of a financial transaction using mobile devices like mobile phones, PDAs and other devices that connects to a mobile network for making payments.

**20. What are the characteristics/properties of Mobile Payment System? (U)**

1. Simplicity and Usability
2. Universality
3. Interoperability
4. Security, privacy and Trust
5. Cost
6. Speed / Swiftness
7. Cross border payments

**21. What are the different Mobile Payment System models? (R)**

There are three different models available for mobile payment solutions on the basis of payment:

1. Bank account based
2. Credit card based
3. Micro Payment

**22. Define POS. (R) (Nov/Dec 2016)**

A point of sale (POS) is the place where sales are made. On a macro level, a POS may be a mall, a market or a city. On a micro level, retailers consider a POS to be the area where a customer completes a transaction, such as a checkout counter. It is also known as a point of purchase.

**23. List out the various technologies used for M-Payment systems. (R)**

- a) SMS (Short Message Service)
- b) USSD (Unstructured Supplementary Services Delivery)
- c) WAP/GPRS
- d) Phone based applications (J2ME/BREW)
- e) SIM-based Application
- f) Near Field Communication (NFC)
- g) Dual Chip
- h) Mobile Wallet

**24. Who are the stakeholders of M-Payment systems? (AN)**

The mobile payment ecosystem involves the following types of stakeholders:

- Consumers
- Financial service providers (FSPs)

- Payment service providers (PSPs)
- In-service providers (merchants), including content providers
- Network service providers (NSPs)
- Device manufacturers
- Regulators
- Standardization and industry bodies
- Trusted service managers (TSMs)
- Application developers

**25. What are the advantages of M-Payment System? (U)**

- ✓ **Security:** Mobile payments are more secure than traditional credit or debit cards. The retailer's system never has direct access to the cardholder's account number, so current point-of-sale malware doesn't work against it.
- ✓ **Speed:** Most mobile payments are fast. Customers simply pass their mobile device over a near-field communication (NFC) reader connected to the POS system. Some systems require entering a password or PIN, but others are just scan-and-go.
- ✓ **Fewer cards to carry around:** Instead of a wallet full of credit cards, customers can simply carry an identification card and mobile device.
- ✓ **Not limited to POS stations:** Some retailers have already started experimenting with mobile payment kiosks mounted around the retail floor. Customers can avoid long lines and use their mobile devices to pay from anywhere.
- ✓ **Tested and proven overseas:** Consumers in Kenya, Japan, Hong Kong, and Taiwan have been using mobile payment technology for over a decade. Japanese consumers can use their cell phones to buy at vending machines, ticket booths, and 1.8 million retailers.

**26. List out the disadvantages of M-Payment System. (U)**

- **Cost:** In most cases, accepting mobile payments requires additional POS hardware. The NFC readers are not cheap, but because of upcoming changes to the credit card system that will start next year, your business will probably need to upgrade soon. The cost of an NFC reader included with the new hardware will probably be much less than current NFC readers.
- **Competing systems:** There are at least three major companies that offer mobile wallet services and dozens of smaller ones. Some systems require NFC readers, while others use bar codes displayed on the screen. A few retailers offer their branded mobile wallets that deduct funds from gift cards.
- **Mobile hardware incompatibility:** Not all systems work with all mobile hardware. Many older and low-end smartphones lack NFC capabilities.
- **Rewards:** Some mobile wallets don't give customers the same rewards as scanning their credit card would. For example, Google Wallet sets up a MasterCard debit account that

charges the customer's credit card on the back end. Suppose a customer has a branded rewards card that gives double points for shopping at the issuing retailer. They would not get a double reward since the card was charged by Google and not a retailer.

**27. What are the risks associated with M-Payment systems? (U)**

- Inability to adapt to mobile payments can put a company at a competitive disadvantage.
- New processes create new security vulnerabilities. Over-the-air provisioning of payment credentials and applications, for example, potentially creates new attack vectors for eavesdroppers to steal and misuse customer data.
- Attackers can steal and misuse data, leading to painful disclosures, adverse publicity, and fines.
- Failure to understand exactly where and how sensitive account data is stored and transmitted can prevent organizations from clearly defining and implementing data protection solutions.
- Rising transaction volumes can lead to performance bottlenecks as inefficient processing limits capacity and degrades the customer experience.
- Overly cumbersome and costly security schemes can hinder an organization's ability to adapt quickly to new opportunities or to scale its business processes to meet rising service demand.

**28. What are Special Constraints of Mobile O/S? APR/MAY 2017, NOV/DEC 2017, APR/MAY2018**

Limited memory Limited screen size Miniature keyboard Limited processing power Limited battery power Limited and fluctuating bandwidth of the wireless medium

**29. list the important features of the Windows mobile OS? NOV/DEC2018**

- The Graphics/Window/Event manager (GWE) component handles all input and output.
- Provides a virtual memory management.
- Supports security through the provision of a cryptographic library.
- Application development is similar to that in the Win32 environment.
- support true multitasking in the future versions of the Windows Phone operating system.

**30. List the pros & cons of M- commerce? APR/MAY 2017, APR/MAY 2018**

Providing a wider reach or Accessibility Reducing the transaction cost Ubiquity Personalization. Reducing time. Cons: Limited Speed Small Screen Size No standard for M-commerce Technology constraints of devices

**31. What are the features of BlackBerry OS? NOV/DEC2018**

- touchscreen
- Multitasking.
- BlackBerry Hub
- Third-party applications
- Released Devices Canceled devices

**32. Differentiate native apps and web apps (Apr/May 2021)**

A native app is one that is built for a specific platform, such as iPhone or Android, using their code libraries and accessing their available hardware features (camera, GPS, etc). A web-based app, on the other hand, is one that is hosted on the web and accessed from a browser on the mobile device.

### **PART – B**

1. Explain in detail about the architecture of Mobile Operating system. (U)
2. Explain the components of Mobile Operating Systems. (U) (May/June 2016)
3. Explain the following: (U)
  - a) Android OS
  - b) Windows Phone OS
  - c) Apple IOS
  - d) Blackberry OS
4. Explain various operating systems for mobile computing. (U) (April/May 2017)
5. Compare and Contrast the various Mobile OS. (10) (AN) (Nov/Dec 2016)
6. Write short notes on Android SDK. (U) (May/June 2016)(April /May 2021)
7. Explain android platform with its features, software stack and SDK. (R) (Nov/Dec 2017)
8. Explain about M-Commerce and its structure with neat sketch. (R)
9. Write detailed notes on mobile commerce. (U) (April/May 2017)
10. Explain the various applications of M-Commerce. (U) (May/June 2016) (Nov/Dec 2016)
11. Discuss briefly about the various technologies involved in M-Payment system. (A)
12. Explain the working of M-Payment system with any example application. (U)
13. Illustrate the process of mobile payment. Compare and contrast mobile payment schemes. (U) (Nov/Dec 2017)
14. Explain the Mobile Payment Scheme and Security Issues. (U) (May/June 2016)
15. Explain Mobile Payment Models and Security Issues. (10) (U) (Nov/Dec 2016)
16. What is RFID? Explain few applications in which RFID is useful. (6) (AN) (Nov/Dec 2016)
17. Explain about Android OS , features, software stack , SDK and their layers ( MAY/JUNE 2016, NOV/DEC 2017,NOV/DEC2018)
18. Explain in detail about M Commerce, its applications, advantages and disadvantages (MAY/JUNE 2016 , NOV/DEC2016, APR/MAY 2017, NOV/DEC2018)
19. Explain in detail about M Commerce, its applications, advantages and disadvantages. MAY/JUNE 2016 , NOV/DEC2016, APR/MAY 2017, NOV/DEC2018
20. Explain in detail components of iphone OS? List the special features of a Mobile OS? APR/MAY2018
21. Explain the features of Mobile OS. NOV/DEC2018
22. Explain android software stack with neat diagram? NOV/DEC 2018
23. Explain the lifecycle of an android app development APR/MAY 2021

- 24.** Explain the structure of ios. **APR/MAY 2021**
- 25.** Explain the lifecycle of an ios app development. **APR/MAY 2021**
- 26.** Assume that you are going to design and implement a cellular network for Uthiramerur Taluk which is full of small villages except few small towns. Discuss the ways in which you'll decide the number of cells, type of cells, handoff, frequency band allocation and call blocking. Draw a rough diagram that conveys your design. You have to implement a cellular network for T. Nagar in Chennai. Repeat all the activities what you had done for Uthiramerur network for T. Nagar network also. **APR/MAY 2021**
- 27.** An University decides to go for a campus wide network to provide the Internet connectivity using WiFi hotspots. Discuss the various factors to be considered like number of hotspots required, key locations in which the hotspots are to installed, connecting hotspots to the Internet Service Provider of the university. Draw a sketch that conveys your design. **APR/MAY 2021**