

Course Code	Course Title	Lecture Periods	Tutorial Periods	Practical Periods	Credit
EC8004	Wireless Networks	3	0	0	3

COURSE OBJECTIVES:

- To understand the concept about Wireless networks, protocol stack and standards
- To understand and analyse the network layer solutions for Wireless networks
- To study about fundamentals of 3G Services, its protocols and applications
- To have in depth knowledge on internetworking of WLAN and WWAN
- To learn about evolution of 4G Networks, its architecture and applications

On Completion of the course students will be able to

C410.1	Identify and choose wireless transmission standard, physical layer protocol and MAC layer protocol on the basis of various network applications.
C410.2	Understand and explain mobile IP and data routing using it. Classify ad hoc network protocols
C410.3	Understand the TCP protocol for wireless networks and able to do congestion free transmission over wireless networks.
C410.4	Understand the major concepts involved in wireless wide-area networks and its architecture.
C410.5	Have knowledge of 4G technologies and analyze various smart antenna techniques, modulation and coding techniques used in 4G technology.

SYLLABUS:**UNIT I WIRELESS LAN****9**

Introduction-WLAN technologies: - IEEE802.11: System architecture, protocol architecture, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, WPAN – IEEE 802.15.4, Wireless USB, Zigbee, 6LoWPAN, WirelessHART

UNIT II MOBILE NETWORK LAYER**9**

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc

network: Routing: Destination Sequence distance vector, IoT: CoAP

UNIT III 3G OVERVIEW

9

Overview of UTMMS Terrestrial Radio access network-UMTS Core network Architecture: 3GPP Architecture, User equipment, CDMA2000 overview- Radio and Network components, Network structure, Radio Network, TD-CDMA, TD – SCDMA.

UNIT IV INTERNETWORKING BETWEEN WLANS AND WWANS

9

Internetworking objectives and requirements, Schemes to connect WLANS and 3G Networks, Session Mobility, Internetworking Architecture for WLAN and GPRS, System Description, Local Multipoint Distribution Service, Multichannel Multipoint Distribution System.

UNIT V 4G & BEYOND

9

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO.

TOTAL : 45 PERIODS

CO – PO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C410.1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
C410.2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
C410.3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
C410.4	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
C410.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C410	2.6	3	-	-	-	-	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1. Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education 2012.(Unit I,II,III)
2. Vijay Garg, "Wireless Communications and networking", First Edition, Elsevier 2007.(Unit IV,V)

REFERENCES:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy kuri, "Wireless Networking", First Edition, Elsevier 2011.
3. Simon Haykin , Michael Moher, David Koilpillai, "Modern Wireless Communications", First Edition, Pearson Education 2013

UNIT I - WIRELESS LAN

PART - A

1. What are the goals of HIPERLAN?(Remember)

1. Quality Of Service
2. Strong Security.
3. Handoff when moving between local area and wide area.
4. Increased throughput.
5. Ease of use, deployment and maintenance.
6. Affordability.
7. Scalability.

2. What are the versions of HIPERLAN? (Remember)

- HIPERLAN-1
- HIPERLAN-2
- HIPER Access
- HIPERLINK

3. List the protocols used in HIPERLAN-2. (Remember)

- Radio Link Control protocol.
- DLC Connection Control
- Radio Resource Control
- Association Control Function.

4. What are the advantages of wireless LAN? (Remember)

- Flexibility
- Planning
- Robustness
- Design
- Cost

5. Define HIPERLAN-2. (Remember)(Nov 17)

It is a mobile short-range access network specified in the Broadband Radio Access Networks (BRAN) project chartered by the European Telecommunications Standards Institute (ETSI). HIPERLAN-2, a competes directly with IEEE 802.11g/n, aka Wi-Fi.

6. What is Bluetooth? (Remember)

It is an open specification for short range wireless voice and data communications that was originally developed forcible replacement in PAN.

7. How is interference between Bluetooth and 802.11 handled? [AU April/May 2012](Analyze)

Bluetooth – CVSD Continuously Variable Slope Modulation.
IEEE 802.11 – CSMA/CA

8. List the logical channels provided by L2CAP.

L2CAP provides three types of logical Channels.

They are:

- Connectionless
- Connection oriented
- Signaling

**9. Write some of the characteristics of Bluetooth. (May /June 2012)
(Remember)**

Frequency band	2.5GHz
Technology	Spread spectrum
Transmission method	Hybrid direct sequence and frequency hopping
Transmitting power	1 mill watt
Data speed	Asymmetric- 721 +57.6 Kbps, symmetric link – 432.6Kbps
Range	10ms

10. What are the layers in IEEE 802.11 architecture? (Analyze)

Physical Layer.

- Physical layer convergence procedure(PLCP)
- Physical Medium dependent Sublayer (PMD).

Data link layer

- Logical Link Control Layer.(LLC)
- Medium Access Control (MAC).

11. What are the functions of Physical Layer? (Analyze) (Nov 17)

On transmission, assemble data into a frame with address and error detection fields.

On, reception, disassemble frame, and perform address and error detection.

Govern access to the LAN transmission medium.

Provide an interface to higher layers and perform flow and error control.

12. Draw the MAC frame format. (Apply)

MAC control	Destination MAC address	Source MAC address	Data	CRC
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Data:

DSAP	SSAP	LLC control	Information
------	------	-------------	-------------

DSAP:

I/G	DSAP value
-----	------------

I/G – Individual / Group

DSAP – Destination Service Access Point

SSAP:

C / R	SSAP value
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C / R – Command / Response

SSAP --Source Service Access Point

13. Define MANET. (Remember)

A MANET consists of a number of mobile devices that come together to form a network as needed, without any support from any existing Internet infrastructure or any other kind of fixed stations.

14. What are the characteristics of MANET? (May /June 2012)(Analyze)

- Dynamic topologies.
- Bandwidth constrained and variable capacity links.
- Energy constrained operations.
- Limited physical security

15. What are the applications of MANET?(Understand)

- Defense applications
- Crisis management applications.
- Telemedicine applications.
- Tele geo processing applications.
- Virtual navigation.
- Education via the Internet.

16. What are the building blocks of IEEE 802.11 architecture? (Understand)

- Basic Service SET. (BSS)
- Distribution System (DS)
- Access Point (AP).

17. What are the other IEEE.802.11 protocols?(Remember)

- 802.11a High speed physical layer in 5 GHz band
- 802.11b higher speed physical layer extension of wireless in 2.4 GHz band
- 802.11d Local and metropolitan area wireless 802.11g Broadband wireless

18. List out the IEEE 802.11 Services.(Remember)

- a. Distribution of Messages within a DS.
 - Distribution
 - Integration.
- b. Association Related Services
 - No Transition.
 - BSS Transition.
 - ESS transition.
- c. Access and Privacy Services.
 - Authentication.
 - DE authentication.
 - Privacy.

19. Define WIMAX(Remember)

- WiMAX (Worldwide Interoperability for Microwave Access) is a wireless industry coalition dedicated to the advancement of IEEE 802.16 standards for broadband wireless access (BWA) networks. WiMax is a standardized wireless version of Ethernet intended primarily as an alternative to wire technologies (such as Cable Modems, DSL and T1/E1 links) to provide broadband access to customer premises.

20. List Some of the salient features supported by WiMAX are: (Remember)

- i. High data rates: - WiMAX can typically support data rates from 500 Kbps to 2 Mbps. - The inclusion of multi-input multi-output (MIMO) antenna techniques along with flexible sub-channelization schemes, advanced coding and modulation all enable mobile to support peak downlink data rates of 63

Mbps per sector and peak uplink data rates of up to 28 Mbps per sector in a 10 MHz channel.

ii. Quality of service (QoS):

- WiMAX has clearly defined QoS classes for applications with different requirements such as VoIP, real time video streaming, file transfer and web traffic.

iii. Scalability:

- Mobile WiMAX is designed to be able to work in different channelization from 1.25 to 20 MHz to comply with varied world-wide requirements.

iv. Security:

- There is support for diverse set of user credentials like SIM/USIM cards, smart cards, digital certificates, username/password schemes.
- All this is based on relevant 'extensible authentication protocol (EAP)' methods for credential type.

v. Mobility:

- Mobile WiMAX supports optimized handoff schemes with latencies less than 50ms to ensure that real time applications such as VoIP can be performed without service degradation.
- Flexible key management schemes assume that security is maintained during handoff.

21. Write the Spectrum Allocation for WiMAX? (Understand)

- i. The biggest spectrum segment for WiMAX is around 2.5GHz.
- ii. The other bands are around 3.5HZ, 2.3/2.5GHz, or 5GHz, with 2.3/2.5GHz.

22. Difference between Wi-Fi and WiMAX: (Remember)(May 17)

Sr.No	Wi-Fi	WiMAX
1.	Wi-Fi technology is based on IEEE 802.11 standards.	WiMAX technology is based on IEEE 802.16 standards.
2.	802.11a-OFDM,maximum rate=54Mbps.,802.11b-DSSS,maximum rate=11Mbps.,802.11g-OFDM,maximum rate=54Mbps.	802.16-OFDM, maximum rate=50Mbps.,802.16e-OFDM, maximum rate~30Mbps.
3.	The stations gain access to media based on CSMA/CA and back off algorithm schemes.	There is time slot for each station and there is scheduling algorithm used by base station.
4.	Range is less than 100 meters.	A kilometer non-line-of-sight, more with line-of-sight.
5.	Indoor Environment.	Outdoor Environment.
6.	No Quality of Service.	Five Quality of service enforced by base station.

23.What are the differences between the 802.11a and HIPET LAN-2? (Remember)

- The HIPER LAN-2 standard uses the same physical layer as 802.11a with a MAC that supports the needs of the cellular telephone industry is supporting mechanisms for tariff, integration with existing cellular systems and providing QOS. IEEE 802.11camp is a connectionless WLAN camp that evolved from data oriented computer communications. HIPER LAN-2 camp is connection based WLANs addressing the needs of voice oriented cellular telephone.

24.State the relationship between HYPER LAN-2 and WATM. (Remember)

HIPER LAN-2 aims at higher data rates and intends to accommodate ATM as well as IP type access.

25. How many transport channels and logical channels are implemented in the HIPERLAN-2 DLC layer? (Analyze)

HIPERLAN-2 DLC layer has four transport channels and five logical channels.

26. What is meant by wireless ATM? (Remember)

Wireless ATM is sometimes called as mobile ATM or WATM. It does not only describe a transmission technology, but specify a complete communication system. It develops a set of specifications that extends the use of ATM technology to wireless network.

27. Define MAC layer of WIMAX? (Remember) (May 17)

The IEEE 802.16 MAC was designed for point-to-multipoint broadband wireless access applications. The primary task of the WiMAX MAC layer is to provide an interface between the higher transport layers and the physical layer.

28. Give any three differences between HIPERLAN 1 and HIPERLAN 2? (Analyze) (May 2018)

Specifications	HIPERLAN/1	HIPERLAN/2
Access technique	TDMA, EY NPMA	TDMA, TDD
Modulation	GMSK, FSK	BPSK-OFDM, QPSK-OFDM,
Data rate (Mbps)	23 (HBR), 1.4 (LBR)	From 6, 9, 12, 18, 27, 36, 48, 54
Frequency of	5.1 GHz to 5.3 GHz	5.1 GHz to 5.3 GHz
Data rate	23.2 Mbps	Greater than 20 Mbps
Application	WLAN	Wireless ATM, Indoor Access

Topology	Infrastructure, De-	cellular, centralized
Antenna type	Omni-directional	Omni-directional
Coverage Range	50 meters	50 to 100 meters
Interface	LAN	ATM networks
Mobility	less than 10 m/s	less than 10 m/s

29. What is IEEE 802.11? What are the functions of MAC layer in IEEE 802.11?(Remember) (May 2018)

IEEE 802.11 is a set of media access control (MAC) and physical layer (PHY) specifications for implementing wireless local area network (WLAN) computer communication in the 900 MHz and 2.4, 3.6, 5, and 60 GHz frequency bands.

30. List the features of Zigbee? (Understand)

Data rates of 250 kbps, 40 kbps, and 20 kbps.
 Two addressing modes; 16-bit short and 64-bit IEEE addressing.
 Support for critical latency devices, such as joysticks.
 CSMA-CA channel access.
 Automatic network establishment by the coordinator.
 Fully handshake protocol for transfer reliability.

31. Define Zigbee Coordinator?(Remember)

ZC is the starting point of the network and allows other devices to connect to it. This co-ordinator saves messages until they can be delivered, which is also called as Full Functional Device.

32. Write the Zigbee Applications? (Remember)

Home Automation
 a. Security Systems

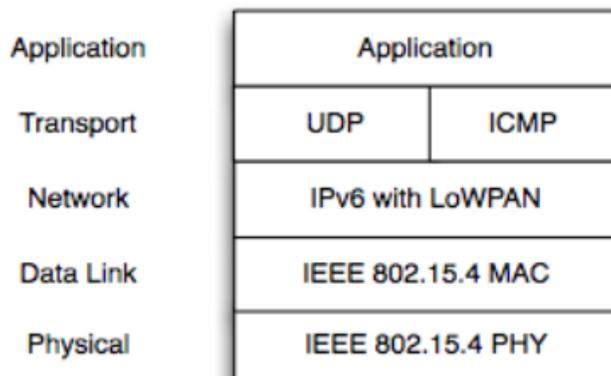
- b. Meter Reading Systems
 - c. Light Control Systems
 - d. HVAC Systems
- Consumer Electronics
- e. Gaming Consoles
 - f. Wireless Mouse
 - g. Wireless Remote Controls
- Industrial Automation
- h. Asset Management
 - i. Personnel Tracking
 - j. Livestock Tracking
- Healthcare
- Hotel Room Access
- Fire Extinguishers

33. Define 6LoWPAN Network?(Remember)

6LoWPAN is a networking technology or adaptation layer that allows IPv6 packets to be carried efficiently within small link layer frames, such as those defined by IEEE 802.15.4.

34. Draw the diagram of 6LoWPAN Stack?(Apply)

6LoWPAN Protocol Stack



35. Define Wireless HART?(Remember)

WirelessHART uses a **flat mesh network** where all radio stations (field devices) form a network. Every participating station serves simultaneously as a **signal source** and a **repeater**. The original transmitter sends a message to its nearest neighbor, which passes the message on until the message reaches the base station and the actual receiver.

36. Write the specifications of PHY layer of WirelessHART?(Remember)

- Same 16 mutually orthogonal channels
- Operates in the 2.4GHz ISM band
- Data rate of up to 250 Kbps

37. What is Zigbee? (Remember)[APRIL/MAY 2021]

Zigbee is a standards-based wireless technology developed to enable low-cost, low-power wireless machine-to-machine (M2M) and internet of things (IoT) networks.

38. What are the benefits of Bluetooth over other wireless technologies? (Remember)[APRIL/MAY 2021]

- Wireless. ...
- Affordable. ...
- Easy Automation. ...
- The Wireless Standard. ...
- Minimal Interference. ...
- Energy-efficient. ...
- Sharing of Data and Voice Communications. ...

PART-B

1. What are the basic differences between wireless WANs and WLANs, and what are the common features? **(Analyze)**
2. What are the problems of WLANs? What level of security can WLANs provide, what is needed additionally and how far do the standards go?**(Understand)**
3. Explain in detail about the IEEE 802.11 protocol architecture and bridgingwith other networks. **(Apply) (Nov-17) (May-17)**
4. Define HiperLan-2. Discuss about the various operation modes and protocolstack in HiperLan-2. **(Apply) (Nov-17)**
5. Compare IEEE 802.11, HiperLAN2, and Bluetooth with regard to their ad-hoc Capabilities. **(Analyze) (May-17)**
6. What are the reasons for the use of infra-red transmission for WLANs?**(Understand)**

7. Why is the PHY layer in IEEE 802.11 subdivided? What about HiperLAN2 and Bluetooth? (**Analyze**)
8. How do IEEE 802.11, HiperLAN2 and Bluetooth, respectively, solve the hidden terminal problem?(**Analyze**)
9. What are advantages and problems of forwarding mechanisms in Bluetooth networks regarding security, power saving, and network stability? (**Analyze**)
10. Why did WATM not succeed as stand-alone technology, what parts of WATM succeeded? (**Analyze**)
11. Discuss the methods by which data services get integrated with voice oriented networks. (**Understand**) [AU May / June 2012]
12. Explain in detail about security and privacy in wireless networks (**Understand**) (Nov/Dec 2014)
13. Write a note on security issues in wireless networks (April/May 2015)
14. Distinguish between collisions on PHY and MAC layer. How do the three wireless networks, try to solve the collisions or minimize the probability of collisions? (**Analyze**)
15. Compare the power saving mechanisms in all three LANs. What are the negative effects of the power saving mechanisms, what are the trade-offs between power consumption and transmission QoS? (**Analyze**)
16. Compare the QoS offered in all three LANs in ad-hoc mode. What advantages does an additional infrastructure offer? How is QoS provided in Bluetooth? (**Analyze**)
17. With neat sketch describe the architecture of IEEE 802.11 and explain the MAC management techniques(**Apply**)(May 2018)
18. Elucidate the advantages of WLAN techniques(**Remember**)(May 2018)

19. Explain the architecture of Hiperlan II protocol (**Understand**) (**May 2018**)
20. Describe about protocol architecture for IEEE 802.11. (**Understand**) [**APRIL/MAY 2021**]
21. Explain fully about WPAN. (**Understand**) [**APRIL/MAY 2021**]

ASSIGNMENT QUESTIONS

1. Discuss about reliable data delivery by the MAC layer? (PO1) (**Remember**)
2. Explain the overall architecture of HIPERLAN-1? (PO2) (**Understand**)
3. Explain the security services provided by IEEE 802.11? (PO4) (**Analyze**)
4. How do IEEE 802.11, HiperLAN2 and Bluetooth, respectively, solve the hidden terminal problem? (PO4) (**Analyze**)
5. Compare IEEE 802.11, HiperLAN2, and Bluetooth with regard to their ad-hoc capabilities. Where is the focus of these technologies? (PO4) (**Analyze**)
6. Name reasons for the development of wireless ATM. What is one of the main differences to Internet technologies from this point of view? Why did WATM not succeed as stand-alone technology, what parts of WATM succeeded? (PO2) (**Understand**)
7. What is protocol stack of Bluetooth? Explain the core protocol element of Bluetooth? (PO2) (**Understand**)
8. Explain the concept and silent features of IEEE802.11 MAC layer? (PO2) (**Understand**)
9. Compare the various enhancements of IEEE 802.11? (PO4) (**Analyze**) (**Nov 17**)
10. Why is the PHY layer in IEEE 802.11 subdivided? What about HiperLAN2 and Bluetooth? (PO4) (**Analyze**)

UNIT II MOBILE NETWORK LAYER

PART – A

11. What is Dynamic source Routing? (**Remember**)

Dynamic Source Routing eliminates all periodic routing updates. If a node needs to discover a route, it broadcast a route request with a unique identifier and the destination address as parameters. Any node that receives a route request gives a list of addresses representing a possible path on its way toward the destination.

12. List the Mobile ad-hoc routing protocol? (**Understand**)

Destination-Sequenced Distance-Vector (DSDV) Routing protocol. • Ad-hoc on demand distance vector routing protocol. • Dynamic source routing protocol.

13. What is mobile routing? (Remember)

Even if the location of a terminal is known to the system, it still has to route the traffic through the network to the access point currently responsible for the wireless terminal. Each time a user moves to a new access point, the system must reroute traffic. This is known as mobile routing.

14. List the major goals when selecting a routing protocol. (Remember)

Possible reliability by selecting alternative routes if node connectivity fails. minimizing the actual length between the source and destination through the least number of intermediate nodes. Especially important for interactive sessions between user applications.

15. What is a Mobile IP address? (Remember) (May-17)

Mobile IP (or MIP) is an Internet Engineering Task Force (IETF) standard communications protocol that is designed to allow mobile device users to move from one network to another while maintaining a permanent IP address.

16. Define IPv6? (Remember)

Internet Protocol Version 6 (IPv6) is an Internet Protocol (IP) used for carrying data in packets from a source to a destination over various networks. IPv6 is the enhanced version of IPv4 and can support very large numbers of nodes as compared to IPv4. It allows for 2¹²⁸ possible node, or address, combinations.

17. What is DHCP? (Remember)

Dynamic Host Configuration Protocol (DHCP) is a network protocol that enables a server to automatically assign an IP address to a computer from a defined range of numbers (i.e., a scope) configured for a given network

18. Name the entities of DHCP? (Remember)

The entities acquired via DHCP are, e.g., DHCP relay, DHCP server etc.

19. How can DHCP be used for mobility and support of mobile IP? (Analyze) (Nov 17)

DHCP is a good candidate for support the acquisition of COA for mobile nodes. The same holds for all other parameters needed, such as address of the default router, DNS servers etc. A DHCP server should be located in the subnet of the access point of the mobile node, or at least a DHCP relay should provide forwarding of the messages.

20. What advantages does the use of IPv6 offer for mobility? (Understand)

Many mobility supporting function are already integrated in IPv6. An explicit FA is not needed any more, all routers are capable of agent advertisements, tunnelling, forwarding of data, setting up security associations. Authentication is built-in as well as optimisation functions.

21. Name the main differences between multi-hop ad hoc networks? (Remember)

Ad-hoc networks in general do not require an infrastructure to operate (they can be connected to an infrastructure). Multi-hop ad-hoc networks additionally do not require that all nodes can receive each other. Nodes may forward transmissions for other nodes.

22. What are general problems of mobile IP regarding security? (Remember)

Mobile IP does not increase security compared to IP, on the contrary. The only additional security related function is the authentication of MN and HA. However, if MN and HA, together, want to attack an FA, nothing can prevent them.

23. What are the classifications of Table Driven routing protocols? (Understand)

Destination sequenced distance vector Routing.
Cluster Head Gateway switch routing.
Wireless routing protocols

24. Define Adhoc Networks? (Remember)

Adhoc network is an autonomous system node connected with wireless link. The node in the ad hoc network communicates with other node without any physical representation. The nodes in the ad hoc organization instantly form the network whenever the communication is established.

25. Write the advantages of Adhoc Networks? (Remember)

- Ease of deployment
- Speed of deployment
- Decreased dependence on infrastructure

26. List the issues of MANET? (Remember)

- Lack of a centralized entity.
- Network topology changes frequently and unpredictably
- Channel access/bandwidth availability
- Hidden/exposed station problem

27. List the disadvantages of Dynamic source routing? (Remember)

- Packet header size grows with route length due to source routing.
- Flood of route requests may potentially reach all nodes in the network

28. What are the features of IPv6? (Understand)

- Larger Address Space
- Simplified Header
- End-to-end Connectivity
- Auto-configuration
- Faster Forwarding/Routing
- IP Security
- No Broadcast
- Any cast Support
- Mobility
- Enhanced Priority Support
- Smooth Transition
- Extensibility

19. What are the advantages of IPv6 over IPv4? (Analyze)

Advantages of IPv6 compared to IPv4:

- IPv6 in addition to offering a significantly larger address space, has many other advantages over IPv4:
- The IPv6 protocol has built in support for multicast 1 transmission, while with IPv4 this feature is optional.
- IPv6 devices allocate also an only locally accessible and valid IPv6 address for a client connected, which allows communication between endpoints on the same sub-network regardless of the presence of a router. 2

- As for security features, the IPsec support (authentication and encryption) is a mandatory component of the IPv6 protocol, while in case of IPv4 this feature is optional.
- Contrary to the Mobile IPv4 protocol, the Mobile IPv6 (MIPv6) helps avoid triangular routing experienced earlier, and makes it possible for mobile (WiFi) clients to select a new router without renumbering, which results in a more reliable and faster connection with less network interruption.
- In case of IPv4, data packages have an upper size limit of 64 kB (kilobytes), while with IPv6 this may be extended up to 4GB (gigabytes), significantly increasing the transmission rate.

20. Write the differences between IPv4 and IPv6?(Understand) (Nov 17)

IPv4/IPv6 Differences

	IPv4	IPv6
Address	32 bits (4 bytes) 12:34:56:78	128 bits (16 bytes) 1234:5678:9abc:def0: 1234:5678:9abc:def0
Packet size	576 bytes required, fragmentation optional	1280 bytes required without fragmentation
Packet fragmentation	Routers and sending hosts	Sending hosts only
Packet header	Does not identify packet flow for QoS handling	Contains Flow Label field that specifies packet flow for QoS handling
	Includes a checksum	Does not include a checksum
	Includes options up to 40 bytes	Extension headers used for optional data
DNS records	Address (A) records, maps host names	Address (AAAA) records, maps host names
	Pointer (PTR) records, IN-ADDR.ARPA DNS	Pointer (PTR) records, IP6.ARPA DNS domain

	domain	
Address configuration	Manual or via DHCP	Stateless address auto configuration (SLAAC) using Internet Control Message Protocol version 6 (ICMPv6) or DHCPv6
IP to MAC resolution	broadcast ARP	Multicast Neighbour Solicitation
Local subnet group management	Internet Group Management Protocol (IGMP)	Multicast Listener Discovery (MLD)
Broadcast	Yes	No
Multicast	Yes	Yes
IPSec	optional, external	required

21. What is Mobile IP? What are the entities of Mobile IP (Remember) (May 17) (May 2018)

Mobile IP is an enhancement of the Internet Protocol (IP) that adds mechanisms for forwarding Internet traffic to mobile devices (known as mobile nodes) when they are reconnecting through other than their home network.

1. Entities
2. Mobile Node (MN)
3. Correspondent node (CN)
4. Home network
5. Foreign network
6. Foreign agent (FA)
7. Care-of address (COA)
8. Home agent (HA)

**22. Differentiate an ad hoc network and a cellular network with respect to
(a) Bandwidth usage (b) Cost Effectiveness (Analyze) (May 2018)**

Parameters	Cellular network	Ad Hoc network
Network routing	Centralized, all the traffic goes through the Base Station	Distributed, No centralized system such as Base station needed
Switching Type	Circuit Switching	Packet Switching
Number of Hops	single hop type	Multiple hops
Topology	Star	Mesh
Application	Designed and developed for voice traffic	Designed to meet best effort data traffic requirements
Cost and time for installation	Higher cost and takes more time for deployment	Lower cost and does not take more time for deployment
Call drops	Low call drops during mobility due to seamless connectivity across region	Higher breaks in the path during mobility
Network maintenance	requires periodic maintenance and hence it is costly.	nodes are self organising and hence it is less costly.
Frequency re-use	It utilizes same frequency channels in the nearby cells with proper RF planning and antenna	Dynamic frequency re-use is employed using carrier sense mechanism.

	placement. This is known as static frequency re-use.	
Bandwidth (BW) mechanism	The allocation of BW is guaranteed and easy.	The allocation of BW is based on shared channel using complex MAC algorithms.
Technologies	IS-95, IS-136, GSM, Mobile WiMAX, CDMA, LTE	WLAN 802.11e

23. What is CoAP?(Remember)

The Constrained Application Protocol (CoAP) is a specialized web transfer protocol for use with constrained nodes and constrained networks in the **Internet of Things**.

The protocol is designed for machine-to-machine (M2M) applications such as smart energy and building automation.

24. Write the features of CoAP?(Understand)

- Overhead and parsing complexity.
- URI and content-type support.
- Support for the discovery of resources provided by known CoAP services.
- Simple subscription for a resource, and resulting push notifications.
- Simple caching based on max-age.

25. Draw the Message format of CoAP?(Apply)

		CoAP Header																															
Offsets	Octet	0							1							2							3										
Octet	Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
4	32	VER		Type	Token Length			CoAP Request/Response Code							Message ID																		
8	64	Token (0 - 8 bytes)																															
12	96	Options (If Available)																															
16	128	Options (If Available)																															
20	160	1	1	1	1	1	1	1	1	Payload (If Available)																							

26. What are the differences between IPV6 and IPV4 ? (Understand)[APRIL/MAY 2021]

	IPv4	IPv6
Address length	IPv4 is a 32-bit address.	IPv6 is a 128-bit address.
Fields	IPv4 is a numeric address that consists of 4 fields which are separated by dot (.).	IPv6 is an alphanumeric address that consists of 8 fields, which are separated by colon.
Classes	IPv4 has 5 different classes of IP address that includes Class A, Class B, Class C, Class D, and Class E.	IPv6 does not contain classes of IP addresses.
Number of IP address	IPv4 has a limited number of IP addresses.	IPv6 has a large number of IP addresses.
VLSM	It supports VLSM (Virtual Length Subnet Mask). Here, VLSM means that Ipv4 converts IP addresses into a subnet of different sizes.	It does not support VLSM.
Address configuration	It supports manual and DHCP configuration.	It supports manual, DHCP, auto-configuration, and renumbering.
Address space	It generates 4 billion unique addresses	It generates 340 undecillion unique addresses.
End-to-end connection integrity	In IPv4, end-to-end connection integrity is unachievable.	In the case of IPv6, end-to-end connection integrity is achievable.
Security features	In IPv4, security depends on the application. This IP address is not developed in keeping the security feature in mind.	In IPv6, IPSEC is developed for security purposes.
Address representation	In IPv4, the IP address is represented in decimal.	In IPv6, the representation of the IP address in hexadecimal.
Fragmentation	Fragmentation is done by the senders and the forwarding routers.	Fragmentation is done by the senders only.

Packet flow identification	It does not provide any mechanism for packet flow identification.	It uses flow label field in the header for the packet flow identification.
Checksum field	The checksum field is available in IPv4.	The checksum field is not available in IPv6.
Transmission scheme	IPv4 is broadcasting.	On the other hand, IPv6 is multicasting, which provides efficient network operations.
Encryption and Authentication	It does not provide encryption and authentication.	It provides encryption and authentication.
Number of octets	It consists of 4 octets.	It consists of 8 fields, and each field contains 2 octets. Therefore, the total number of octets in IPv6 is 16.

27. What is IOT ?

The Internet of Things (IoT) refers to a system of interrelated, internet-connected objects that are able to collect and transfer data over a wireless network without human intervention.

PART – B

1. Name the consequences and problems of using IP together with the standard routing protocols for mobile communications. **(Understand) (Nov-17)**
- 2 How does dynamic source routing handle routing? What is the motivation behind dynamic source routing compared to other routing algorithms for fixed networks? **(Apply)(Nov-17)**
- 3 Name the requirements for a mobile IP and justify them. Does mobile IP fulfill them all? **(Understand)**
- 4 List the entities of mobile IP and describe data transfer from a mobile node to a fixed node and vice versa. Why and where is encapsulation needed? **(May 17) (Remember)**
- 5 How does registration on layer 3 of a mobile node work? **(Understand)**
- 6 Show the steps required for a handover from one foreign agent to another foreign agent including layer 2 and layer 3. **(Apply)**
- 7 Explain packet flow if two mobile nodes communicate and both are in foreign networks. What additional routes do packets take if reverse tunneling is required? **(Understand)**

- 8** Explain how tunneling works in general and especially for mobile IP using IP-in-IP, minimal, and generic routing encapsulation, respectively. Discuss the advantages and disadvantages of these three methods. **(Understand)(Nov-17)(May -17)**
- 9** Name the inefficiencies of mobile IP regarding data forwarding from a correspondent node to a mobile node. What are optimizations and what additional problems do they cause? **(Analyze)**
- 10** What advantages does the use of IPv6 offer for mobility? Where are the entities of mobile IP now? **(Understand)**
- 11** What are general problems of mobile IP regarding security and support of quality of service? **(Remember)**
- 12** What is the basic purpose of DHCP? Name the entities of DHCP. **(Analyze)**
- 13** How can DHCP be used for mobility and support of mobile IP? **(Understand)**
- 14** Name the main differences between multi-hop ad-hoc networks and other networks. What advantages do these ad-hoc networks offer? **(Analyze)**
- 15** Why is routing in multi-hop ad-hoc networks complicated, what are the special challenges? **(Analyze)**
- 16** Recall the distance vector and link state routing algorithms for fixed networks. Why are both difficult to use in multi-hop ad-hoc networks? **(Remember)**
- 17** Explain the Mobile IP session initiation protocol for IP packet delivery in Mobile IP Networks?**(Understand)(May 2018)**
- 18.** Explain with neat diagram and example the destination sequence distance vector routing algorithm of Adhoc Networks? **(Understand)(May 2018)**
- 19.** Describe about the Routing techniques used in Mobile Ad-Hoc network. . **(Understand)(April/May 2021)**
- 20.** Explain fully about the following : (i) IPpacket delivery (ii) agent discovery and (iii) tunneling and encapsulation. **(Understand)(April/May 2021)**

ASSIGNMENT QUESTIONS

- 29.** What are the solutions that were proposed to support mobility apart from mobile IP? What are the problems associated with these solutions?**(PO1)(Remember)**
- 30.** List and explain the requirements for mobile IP fulfill them all? Justify.**(PO2)(Understand)**

31. Draw and explain the various fields of agent advertisement packet of mobile IP? (PO1)(Remember)
32. Describe the registration of visiting mobile node on handover in Mobile IP how is the binding between home agent and foreign agent created?(PO2)(Understand)
33. How can DHCP be used for mobility and support of mobile IP?(PO2)(Analyze)
34. Name the requirements for a mobile IP and justify them. Does mobile IP fulfill them all?(PO1)(Remember)
35. What advantages does the use of IPv6 offer for mobility? Where are the entities of mobile IP now?(PO2)(Understand)
36. How does dynamic source routing handle routing? What is the motivation behind dynamic source routing compared to other routing algorithms from fixed networks?(PO4)(Analyze) (May-17)
37. Explain packet flow if two mobile nodes communicate and both are in foreign networks. What additional routes do packets take if reverse tunneling is required?(PO2)(Understand)
38. What is the basic purpose of DHCP? Name the entities of DHCP?(PO1)(Remember)

UNIT III 3G OVERVIEW

PART – A

1. Write about 3G system. (Apply)

It is to provide fairly high speed wireless communications to support multimedia, data and video in addition to voice.

2. Write the applications of 3G?(Understand)

Applications of 3G

The bandwidth and location information available to 3G devices gives rise to applications not previously available to mobile phone users. Some of the applications are:

- Global Positioning System (GPS)
- Location-based services
- Mobile TV

- Telemedicine
- Video Conferencing
- Video on demand

3. What is the speed of 3G network? (Apply)

The operators talk about 3G speeds of 3.6 mbps to 21 mbps on their network, but the actual speed is much lower. Last year, telecom regulator TRAI proposed to set a minimum of one mbps download speed for 3G networks. In fact, the difference between the speeds of 2G and 3G is hardly visible.

4. How the destination correspondent host works?(Analyze) (May 2018)

Mobile node (MN) is a node that shows mobility without changing its IP i.e. it can change its point of attachment from one link to another but will be reachable through its home address. Correspondent node (CN) is a node that is intended to communicate with a MN.

5. What is CDMA2000?(Remember)

CDMA2000, also known as IMT-CDMA Multi-Carrier or 1xRTT, is a code-division multiple access (CDMA) version of the IMT-2000 standard developed by the International Telecommunication Union (ITU). The CDMA2000 standard is third-generation (3-G) mobile wireless technology.

6. Write the features of CDMA2000?(Understand)

- CDMA2000 is a family of technology for 3G mobile cellular communications for transmission of voice, data and signals.
- It supports mobile communications at speeds between 144Kbps and 2Mbps.
- It has packet core network (PCN) for high speed secured delivery of data packets.
- It applies multicarrier modulation techniques to 3G networks. This gives higher data rate, greater bandwidth and better voice quality. It is also backward compatible with older CDMA versions.
- It has multi-mode, multi-band roaming features.

7. What is TD-CDMA?(Remember)

Time Division- Code Division Multiple Access is part of the UMTS standard for the 3rd generation of mobile communications (3G). TD-CDMA is also referred to as UMTS UTRA TDD High Chip Rate.

8. What is TD-SCDMA?(Remember)

TD-SCDMA is a time division duplex, TDD version of UMTS that was developed in China and offered some key advantages as a TDD version. TD-SCDMA standards for Time Division - Synchronous CDMA.

9. List the types of UMTS handover?(Understand)

- Hard handover: This form of handover is essentially the same as that used for 2G networks where one link is broken and another established.
- Soft handover: This form of handover is a more gradual and the UE communicates simultaneously with more than one Node B or base station during the handover process.
- Softer handover: Not a full form of UMTS handover, but the UE communicates with more than one sector managed by the same NodeB.

10. What is UMTS?(Remember)

The Universal Mobile Telecommunications System (UMTS) is a third generation mobile cellular system for networks based on the GSM standard. Developed and maintained by the 3GPP (3rd Generation Partnership Project), UMTS is a component of the International Telecommunications Union IMT-2000 standard set and compares with the CDMA2000 standard set for networks based on the competing cdma One technology. UMTS uses wideband code division multiple access (W-CDMA) radio access technology to offer greater spectral efficiency and bandwidth to mobile network operators.

11. What are the features of UMTS? (Remember)

UMTS supports maximum theoretical data transfer rates of 42 Mbit/s when Evolved HSPA (HSPA+) is implemented in the network. Users in deployed networks can expect a transfer rate of up to 384 kbit/s for Release '99 (R99) handsets (the original UMTS release), and 7.2 Mbit/s for High-Speed Downlink Packet Access (HSDPA) handsets in the downlink connection. These speeds are significantly faster than the 9.6 kbit/s of a single GSM error-corrected circuit switched data channel, multiple 9.6 kbit/s channels in High-

Speed Circuit-Switched Data (HSCSD) and 14.4 kbit/s for CDMA One channels.

12. What is meant by UMTS network? (Remember)

UMTS, short for Universal Mobile Telecommunications System, is a 3G networking standard used throughout much of the world as an upgrade to existing GSM mobile networks. UMTS makes use of WCDMA, a technology that shares much with CDMA networks used throughout the world, though it is not compatible with them.

13. What are the QoS classes in the UMTS? (Remember)

- Conversational class (voice, video telephony, video gaming)
- Streaming class (multimedia, video on demand, webcast)
- Interactive class (web browsing, network gaming, database access)
- Background class (email, SMS, downloading)

14. Write about the UMTS architecture? (Understand)

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

15. Define radio access network? (Remember) (May 17)

Wide band CDMA technology was selected to for UTRAN air interface. UMTS WCDMA is a Direct Sequence CDMA system where user data is multiplied with quasi-random bits derived from WCDMA Spreading codes. In UMTS, in addition to channelization, Codes are used for synchronization and scrambling. WCDMA has two basic modes of operation: Frequency Division Duplex (FDD) and Time Division Duplex (TDD).

16. What is the purpose of firewalls in UMTS Network? (Understand) (May 17)

The primary purpose of a firewall is packet filtering. When a computer sends a request across the Internet, it takes the form of small packets of data, which travel through the network to their destination. The target server responds with its own packets of data, which return along the same route.

17. What are the benefits of 3G over 2G? (Understand) (April/May 2021)

- Faster data transfer rate.
- Availability of fixed.
- Multimedia services are available.
- Anywhere access to the internet.

- Cheap call rate in worldwide.
- Security and reliability are more.
- Always online devices.
- Provide interoperability among service providers.

18. What are the limits of 3G technology ? (Understand)(April/May 2021)

- Needs different handsets.
- Insufficient bandwidth.
- Power consumption is high.
- Require closer base station and are expensive.
- Spectrum license cost.
- High expenses of 3G phones.
- 3G compatible handset.
- Connection rate.

PART – B

- 1. Discuss two evolution paths for the GSM to offer 3G services.(Understand)
(Nov-17)**
- 2. What is the high-speed circuit switched data (HSCSD) in the GSM?(Analyze)**
- 3.What is the role of the general packet radio service (GPRS) in the GSM?(Understand)**
- 4. What are the QoS classes in the UMTS? (Remember)**
- 5. Define roles of two new network entities in the GPRS. (Remember)**
- 6. How are higher data rates achieved in the enhanced data rates for GSM enhancement (EDGE)? Discuss.(Understand) (May 17)**

7. Describe the basic concepts of congestion control. What are the implications on mobility in traditional TCP ? **(Apply)(Nov-17)**
8. What are the modulation and coding schemes that are used for the packet mode in the EDGE? **(Analyze)**
9. Discuss the roles of 3G systems. **(Understand)**
10. What is the UMTS? List important features of the UMTS air interface. **(Remember)**
11. What are three channel types that are used in the UMTS? Discuss the role of each channel type. **(Remember)**
11. What are the three main entities of the UMTS network? Discuss their functions. **(Analyze)**
12. Discuss the responsibilities of the RNC in the UMTS network. **(Remember)**
13. What are the responsibilities of Node B in the UMTS network? **(Analyze)**
14. Discuss the role of the access link control application part (ALCAP) in the UMTS. **(Understand)**
15. Discuss Iu, Iur, and Iub interfaces in the UMTS. **(Analyze) (May 17)**
16. The core network of the UMTS is divided into three different functional areas. Name these areas and discuss their roles. **(Apply)**
17. What is adaptive multi-rate (AMR) codec? **(Remember)**
18. Discuss the UMTS bearer service layered architecture. **(Understand)**
19. How is isolation between users in the downlink accomplished in a WCDMA system? **(Analyze)**
20. What are some of the point-to-point (PTP) and point-to-multipoint (PTM) applications of the GPRS? **(Understand)**

21.Name the physical channels of the GPRS and discuss their functions.

(Remember)

22.Explain in detail about LTE Wireless Systems?(Understand) (May 18)

23.Explain the techniques about UMTS Network Reference Architecture?(Understand) (May 18)

24.Describe the Channel Structure in UMTS Terrestrial Radio?(Understand) (May 18)

25.Explain fully about the UMTS core network architecture. (Understand)(April/May 2021)

26.Explain about (i) TD-CDMA and (ii) TD-SCDMA. (Understand)(April/May 2021)

ASSIGNMENT QUESTIONS

- i. Explain the working of snooping TCP?(PO2)(Understand)
- ii. What are the mechanisms of TCP that are designed and suitable for wired network environment but not mobile environment?(PO3)(Remember)
- iii. Explain in Indirect TCP Access point is seen as the mobile host for the fixed host and as fixed host for mobile host? (PO2)(Understand)
- iv. How handover takes place in Indirect TCP?(PO4)(Analyze)
- v. Show the interaction of mobile IP with standard TCP. Draw the packet flow from a fixed host to a mobile host via a foreign agent. Then a handover takes place. What are the following actions of mobile IP and how does TCP react?(PO4)(Analyze)
- vi. How and why does I-TCP isolate problems on the wireless link? What are the main drawbacks of this solution?(PO4)(Analyze)

- vii. Compare the different types of transmission errors that can occur in wireless and wired networks. What additional role does mobility play? (PO4) (**Analyze**)
- viii. Name further optimizations of TCP regarding the protocol overhead which are important especially for narrow band connections. Which problems may occur?(PO1)(**Remember**)

**UNIT – IV INTERNETWORKING BETWEEN WLANS AND
WWANS
PART – A**

- 1. What are different services offered by GPRS? (Remember)**
 - i. Point to multi point, ii. Point to point
- 2. Name the connectionless and connection oriented services provided by the GPRS? (Remember)**

In GPRS Point to point communication, there are two types, i. IP – connection less service, and ii. CLNP Connection oriented on X.25.
- 3. What is GPRS-136? How does it differ from GPRS? (Remember)**

The adaptation of GPRS to the IS –136 TDMA cellular standard is called GPRS-136.It uses 30kHz physical channel instead of 200 KHz.
- 4. Is the EDGE network 2G or 3G? (Analyze)**

Letter E stands for EDGE (Enhanced Data Rates for GSM Evolution). It is also called Enhanced GPRS. This technology lies somewhere in between 2G and 3Gtechnology. So, some people refer to it as 2.5G.
- 5. Give the significance about link adaption scheme? (Understand) (May 18)**

The principle of link adaptation is to match the modulation, coding and other signal and protocol parameters to the condition of radio link. Link adaptation is an essential technology which can improve the system capacity.
- 6. List some applications of WLAN (Understand)**
 - Public Coffee Shop Airport Convention Center
 - Semi-Public University Hospital
 - Private Government Enterprise Manufacturing Facility Home
- 7. List the features of WLAN (Understand)**

- WLANs are flexible data communications systems using radio frequency (RF) technology, WLANs transmit and receive data over the air, thus it combine data connectivity with user mobility
- WLANs provide high-speed, reliable data communications in a building or campus environment as well as coverage in rural areas. WLANs are simple to install.
- The range of a WLAN depends on the actual usage and environment of the system. It may vary from 100 feet inside a solid walled building to several thousand feet in an outdoor environment with direct line-of sight.
- An important feature of WLANs is that they can be used independently of wired networks
- The network communications take place in a part of the radio spectrum that is designed as license free.
- Standard WLANs are capable of operating at speeds in the range of 1–2 Mbps depending on the actual system. The fastest WLANs use 802.11b high-rate standard to move data through air at a maximum speed of 11 Mbps.

8. What are the Design Goals of Wireless LAN?(Remember)

Global Operation, Low Power, License-free Operation, Robust Transmission technology, simplified spontaneous co-operation, Easy to use, protection of investment, Safety and Security, Transparency for application.

9. What are the limitations of GPRS? (Remember)

The limitations of GPRS are

- i) There is only a limited cell capacity for all users.
- ii) Speed is lower
- iii) When MS is not available there are no storage and forward services.

10. What is Multichannel Multipoint Distribution Service? (Remember)

Multichannel Multipoint Distribution Service (MMDS) is a broadcasting and communications service that operates in the ultra-high-frequency (UHF) portion of the radio spectrum between 2.1 and 2.7 GHz. MMDS is also known as wireless cable.

11. What is Local Multipoint Distribution Service?(Remember)

Local Multipoint Distribution Service (LMDS), is a broadband wireless point to multipoint communication system that provides reliable digital two-way voice, data and Internet services.

12. List the difference between MMDS and LMDS?(Understand)

Specifications	LMDS	MMDS
Full Form	Local Multipoint Distribution Service	Multichannel Multipoint Distribution Service
Architecture	The LMDS architecture consists of NOC (Network Operation Center), BS, CPE and Fiber backbone. It has cellular like architecture.	The MMDS architecture consists of tall antenna tower, backbone internet connectivity using router and network management system. It has microwave link like architecture.
Frequency of operation	28 GHz, 36 GHz	2.5 GHz, 3.5 GHz
Network Topology	P2MP (Point to Multi-point)	P2P (Point to Point)
Distance coverage	Good more smaller distances. (2 to 8 Km)	Covers larger distance. (50 to 100 Km)
Number of cells	more	very few
Data rate	1 to 10 Mbps	upto 2 Mbps
cost	CPE cost and deployment cost is medium to high.	CPE cost and deployment cost is low compare to LMDS.

13. What are the requirements for internetworking? (Remember)[April/May 2021]

(1.) Provide a link between networks. At minimum, a physical and link control connection is needed. (2) Provide for the routing and delivery of data between processes on different networks. (3) Provide an accounting service that keeps track of the use of the various networks and routers and maintains status information. (4) Provide the services just listed in such a way as not to require modifications to the networking architecture of any of the constituent networks.

14. What is session mobility? (Remember)[April/May 2021]

Transfer and Retrieval Session mobility involves both transfer and retrieval of an active session. A transfer means to move the session on the current device to one or more other devices. A retrieval causes a session currently on another device to be transferred to the local device.

PART – B

1. Explain about the architecture of GPRS in detail? (Understand)
2. Explain about the architecture of WLAN in detail? (Understand)
3. Explain about the architecture of WWAN in detail? (Understand)
4. Explain in detail about the design goals of WLAN? (Understand)
5. List and explain the various schemes to connect WLAN networks?(Remember)
6. Explain about Multichannel Multipoint Distribution System in detail? (Understand)
7. Explain about Local Multipoint Distribution Service in detail? (Understand)
8. Elaborate on the 'Internetworking architecture' used for connecting WLAN with GPRSsystem. (Understand)[April/May 2021]
9. Explain about the following : (i) Session mobility (ii) Local Multipoint distribution service and (iii) Multichannel multipoint distribution system. (Understand)[April/May 2021]

ASSIGNMENT QUESTIONS

1. Discuss the roles of 3G systems.(PO2)(Understand) (May-17)
2. Discuss the UMTS bearer service layered architecture. (PO2)(Understand) (May-17)
3. What are the responsibilities of Node B in the UMTS network? (PO4)(Analyze)
4. What are the new interfaces required for the UMTS R4 network? Mention their functions?(PO1)(Remember)
5. How are higher data rates achieved in the enhanced data rates for GSM enhancement (EDGE)? Discuss.(PO4)(Analyze)

6. What are the main functions of UMTS radio access bearer services?
(PO1)(Remember)
7. How many types of handoff are possible in UMTS networks? Describe the basic handoff procedures when mobile terminals move within the RNC?
(PO4)(Analyze)
8. How is isolation between users in the downlink accomplished in a WCDMA system?(PO4)(Analyze)

UNIT – V 4G NETWORKS

PART – A

1. What is 4g? (Remember)

4G is the fourth generation of mobile phone technology and follows on from 2G and 3G. 2G technologies was suitable for making calls and sending text messages while 3G makes it possible to access the internet more effectively through your mobile phone.

2. What is the difference between 4G and 4GLTE? (Remember)

While the difference between slower 3G networks and new 4G or LTE networks is certainly noticeably faster, most of the 4G and “true 4G” networks have upload and download speeds that are almost identical. For now, LTE is the fastest connection available for wireless networks.

3. What is the difference between 3G and 4G? (Remember) (Nov 17)

On the surface, the difference between 3G and 4G is pretty simple. The “G” is short for generation, so 3G and 4G represent the third and fourth generations of mobile broadband Internet. As a rule, provided that you're on the same carrier, a 4Gconnection will be faster than a 3G one.

4. How fast is the 3g network?(Analyze)

The average mobile broadband download speed on 4G (15.1Mbit/s) was more than twice as fast as 3G (6.1Mbit/s) across all the networks. The research found that performance varied by operator. EE and O2 offered faster than average 4G download speeds at 18.4 Mbit/s and 15.6Mbit/s respectively.

5. What is the data transmission speed of 4g network? (Remember)

Ultra Mobile Broadband (UMB), also known as CDMA2000 EV-DO, is an expected path to 4G for legacy CDMA network providers. It's an IP-based technology that is said to support 100Mbps through 1Gbps data-transmission speeds.

6. Compare 4G with 3G?(Analyze) (May 17)

Parameter	3G	4G
Major Require Driving Archtechure	Voice driven data	Converged data and Voice over IP.
Data Type	Predecessor network to 4G with a higher data transfer rates to access audio and internet data.	The successor to 3G network with much higher speed and access to audio and video files without any buffers.
Type data transmission	It is termed as Broadband Mobile Technology and uses packet data transmission	It is termed as 'MAGIC' Mobile multimedia, Anytime anywhere, Global mobility support and Customized Personal service.
Technology	Major 3G technologies are EDGE,CDMA2000, UMTS, etc	Major 4G technologies are HSPA+, LTE,Wimax2, etc
Data transfer speed	3G permits a minimum speed of 2Mpbs for stationary mobile and 384 Kbps for moving	The data transfer rates measured in 'mega' and the range is 20 to 1Gbps
Switching Technique	Switching Technique – Packet Switching	Switching Technique – Packet Switching and Message Switching
frequency band	The frequency band is only 1.5-2.8 GHZ	The frequency band is 2-8 GHz

7. Write the advantages of 4G?(Understand)

The need for 4G Technology

- For wider bandwidth for Seamless access to the multimedia, tele-conferencing & full motion video
- For uninterrupted global roaming and easy access to all the services with integrated standard networks
- For high end mobile ultra-broadband internet accessibility with low cost per bit

The Benefits of 3G

- Faster access to the internet to download high quality movies, audios, games etc.
- Video calls/conferencing facilities
- Access to weather reports, news or any other information and also provides highlights of the popular shows and sports
- Multiplayer's gaming option

The Benefits of 4G

- Higher bandwidth so a very quick access to the internet
- Can easily watch TV, streaming videos, albums, and also get access to social media, information, entertainment and online stores
- Location services, games, chat etc.
- Video conferencing

8. List the challenges of 4G?(Understand)

- High usability: anytime, anywhere, and with any technology
- Support for multimedia services at low transmission cost
- Personalization
- Integrated services

9. Write the applications of 4G? (Remember) (May 17)

- Virtual presence — 4G will provide user services at all times, even if the user is off-site.
- Virtual navigation — 4G will provide users with virtual navigation through which a user can access a database of streets, buildings, etc., of a large city.
- This requires high speed transmission.
- Tele-medicine — 4G will support the remote health monitoring of patients via video conference assistance for a doctor at anytime and anywhere.

- Tele-geo-processing applications — 4G will combine geographical information systems (GIS) and global positioning systems (GPS) in which a user will get location querying.

10. What is multi carrier modulation? (Remember) (Nov 17)

Multicarrier modulation (MCM) is a derivative of frequency-division multiplexing. Forms of multicarrier systems are currently used in DSL modems and digital audio/video broadcast (DAB/DVB). MCM is a baseband process that uses parallel equal bandwidth sub channels to transmit information and is normally implemented with fast Fourier transform (FFT) techniques.

11. Define OFDM? (Remember)

OFDM is possibly the most widely used form of multicarrier modulation. It uses multiple closely spaced carriers and as a result of their orthogonality, mutual interference between them is avoided.

12. What is the number of subcarrier in OFDM? (Remember)

An 802.11a OFDM carrier signal (burst type) is the sum of one or more OFDM symbols each comprised of 52 orthogonal subcarriers, with baseband data on each subcarrier being independently modulated using quadrature amplitude modulation (available formats: BPSK, QPSK, 16-QAM, or 64-QAM).

13. List the OFDM advantages (Understand)

- OFDM has been used in many high data rate wireless systems because of the many advantages it provides.
- Immunity to selective fading
- Resilience to interference
- Spectrum efficiency
- Resilient to ISI
- Resilient to narrow-band effects
- Simpler channel equalization

14. Write the OFDM disadvantages (Remember)

- High peak to average power ratio
- Sensitive to carrier offset and drift

15. What is MIMO technology? (Remember)

MIMO (multiple input, multiple output) is an antenna technology for wireless communications in which multiple antennas are used at both the source (transmitter) and the destination (receiver). The antennas at each end of the communications circuit are combined to minimize errors and optimize data speed.

16. What is MIMO support? (Remember)

Multiple-Input Multiple-Output (MIMO) technology is a wireless technology that uses multiple transmitters and receivers to transfer more data at the same time. All wireless products with 802.11n support MIMO, which is part of the technology that allows 802.11n to reach much higher speeds than products without 802.11n.

17. Define cognitive radio? (Remember)

Cognitive radio (CR) is a form of wireless communication in which a transceiver can intelligently detect which communication channels are in use and which are not, and instantly move into vacant channels while avoiding occupied ones.

18. What is the meaning of cognitive network? (Understand)

In communication networks, cognitive network (CN) is a new type of data network that makes use of cutting edge technology from several research areas (i.e. machine learning, knowledge representation, computer network, network management) to solve some problems current networks are faced with.

19. What is meant by dynamic spectrum access? (Understand)

Dynamic spectrum access is a new spectrum sharing paradigm that allows secondary users to access the abundant spectrum holes or white spaces in the licensed spectrum bands. DSA is a promising technology to alleviate the spectrum scarcity problem and increase spectrum utilization.

20. What do you mean by adaptive modulation or coding? (Understand)

Link adaptation, or adaptive modulation and coding (AMC), is a term used in wireless communications to denote the matching of the modulation, coding and other signal and protocol parameters to the conditions on the radio link. For example, WiMAX uses a rate adaptation algorithm that adapts the modulation and coding scheme (MCS) according to the quality of the radio channel, and thus the bit rate and robustness of data transmission.

21. What are 4G features? (Remember) [April/May 2021]

22.

- The features of 4G are :
- Better download speed
- Extremely high voice quality.
- Easy access to Internet, IM, social networks, streaming media, video calling.
- Higher bandwidth.
- Much faster than 3G

23. What are the challenges that designers have to confront while designing 4G systems? (Remember)[April/May 2021]

Speed, range, product design, efficiency and reliability from mobile phones to Wi-Fi and the Internet of Things are key challenges designers face for wireless applications and devices

PART – B

1. Discuss the role of the Access Link Control Application Part (ALCAP) in the UMTS.
2. Define the role of the 4G system. **(Remember)**
3. Compare the 3G and 4G systems. **(Analyze) (May 17)**
4. Discuss multicarrier modulation (MCM). **(Understand) (Nov 17)**
5. What is a multi-input multi-output (MIMO) system? Explain. **(Understand) (Nov 17)**
6. How are higher spectral efficiency and increased throughput achieved in the OFDM-MIMO system? **(Analyze) (May 17)**
7. What is the BLAST system? Explain. **(Understand)**
8. What is the software-defined radio system? **(Remember)**
9. What is cognitive radio? **(Remember)**
10. List some of the new technologies that will be used in the 4G system. **(Understand)**
11. Define 4G and compare the key parameters of 4G with 3G? **(Understand)(May 18)**
12. Write a note on Cognitive Radio? **(Understand)(May 18)**
13. What is a multi-input multi-output (MIMO) System? Explain and compare? **(Understand)(May 18)**
14. Explain fully about (i) Multi carrier modulation and (ii) smart antenna techniques. **(Understand)[April/May 2021]**
15. Explain fully about (i) IMS architecture and (ii) MVNO. **(Understand)[April/May 2021]**

ASSIGNMENT QUESTIONS

1. How are higher spectral efficiency and increased throughput achieved in the OFDM-MIMO system?(PO4)(Analyze)
2. What is a Multi-Input-Multi-Output (MIMO) system? Explain in detail. (Apply)(Nov-17)
3. Describe the basic concepts of Adaptive Modulation and Coding Time-Slot Scheduler, along with cognitive radio concept. (Apply)(Nov-17)(May-17)
4. What is the driving force for 4G technologies? What basic changes are required for implementing 4G from 3G networks?(PO1)(Remember)
5. Depending on the coverage areas, how many different wireless networks are defined? Discuss the main features of each network?(PO2)(Analyze)
6. Explain about the Multicarrier modulation techniques?(PO2)(Understand)
7. What is cognitive radio?(PO1) (Remember)
8. List some of the new technologies that will be used in the 4G system. (PO2)(Understand)
9. Write your understanding on behavior of smart antenna techniques.(Understand)(Nov-17)