III YEAR / VI SEMESTER
DEPARTMENT OF ELECTORNICS & COMMUNICATION ENGINEERING
SUBJECT CODE / NAME: EC8004 WIRELESS NETWORKS

EC8004   **WIRELESS NETWORKS**   **L T P C 3 0 0 3**

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, Wireless HART

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 UTMS 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

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. B 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

EC8004- WIRELESS NETWORKS (Regulation 2017)
UNIT 1
WIRELESS LAN
PART-A

1. List the comparison between wired LAN & wireless LAN.

PARAMETERS	WIRED LAN	WIRELESS LAN
Installation	Moderate level of difficulty	Easier
Cost	Less	More
Reliability	High	Reasonable high
Mobility	Limited	outstanding

2. State the MAC management functions. (NOV'17)
> ➢ Synchronization
> ➢ Power management
> ➢ Roaming
> ➢ Management information base

3. Define wireless LAN.
A Wireless Local Area Network (WLAN) is a wireless computer network that links two or more devices using wireless distribution method within a limited area.
         Eg:- School, office building etc

4. Describe BRAN.
The broadband Radio access networks (BRAN) is standardized by European telecommunications standards institute (ETSI). The primary motivation of BRAN is the deregulation and privatization of the telecommunication sector. The radio access gains its advantages for its high flexibility and quick installation.

5. What is the functionality of L2CAP? (NOV'17)
The logical link control and adaptation protocol (L2CAP) is a data link control protocol on top of baseband layer offering logical channels between Bluetooth devices with QoS properties.
The different types of logical channels are,
> ➢ Connectionless
> ➢ Connection-oriented
> ➢ Signaling

6. **What is HIPERLAN? List any four differences between HIPERLAN1 and HIPERLAN 2. (APR'18)**

The HIPERLAN stands for High Performance Radio LAN is an initiation of RES-10 group of the ETSI as a PAN European standard for high speed wireless local networks.

PARAMETERS	HIPERLAN 1	HIPERLAN 2
Application	Wireless LAN	Access to ATM fixed networks
Range	50 m	50 – 100 m
Data rate	23.5 M bits/ sec	> 20 M bits / s

7. **Examine the features of Wireless LAN**.
    - Global operation
    - Low power
    - License free operation
    - Robust transmission technology
    - Simplified spontaneous cooperation
    - Easy to use
    - Protection of investment
    - Safety and security
    - Transparency for applications

8. **Identify the different phases of HIPERLAN1.**

    Prioritization: Determine the highest priority of a data packet ready to be sent by competing nodes.

    Contention: Eliminate all but one of the contenders, if more than one sender has the highest current priority.

    Transmission: Finally, transmit the packet of the remaining node.

9. **Draw the architecture of BRAN layered model.0**
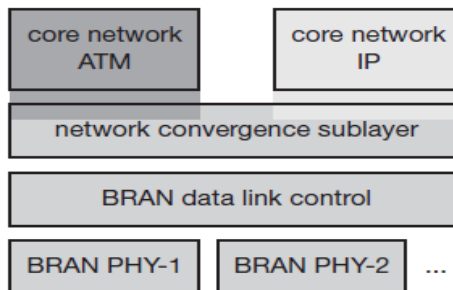
10. List the type of architecture used in IEEE 802.11

There are two different kinds of architecture styles are possible in IEEE 802.11

- ✓ Infrastructure based.
- ✓ Ad-Hoc based.

11. List the advantages & disadvantages of Wireless LAN.

Advantages:

- ✓ Flexibility.
- ✓ Planning
- ✓ Robustness.

Disadvantages:

- ✓ QoS
- ✓ Proprietary solutions.
- ✓ Safety & security.

12. Evaluate and describe the piconet and scatternet. (APR'19)

A piconet is a collection of Bluetooth devices which are synchronized to the same hopping sequence. One device in the piconet can act as master (M) , all other devices connected to the master must act as slaves(s).

Group of piconet's is called scatternet. Only those units really must exchange data share the same piconet.

13. Draw the PHY packet format 802.11b.
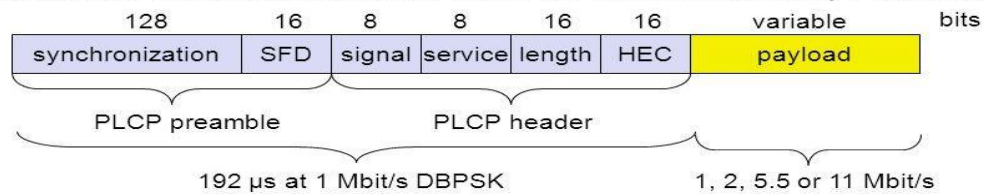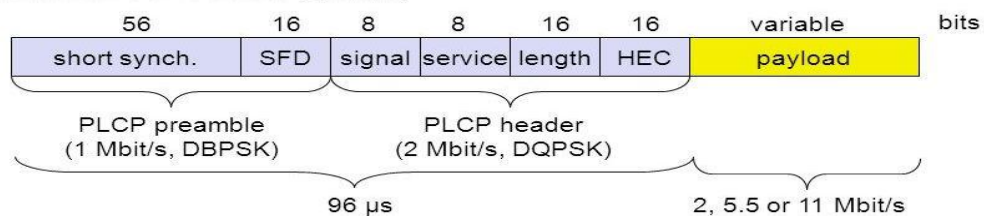
14. Identify the functions of Link manager protocol.

The link manager protocol (LMP) manages various aspects of the radio link between a master and a slave and the current parameter setting of the devices. The functions are,

- ➢ Authentication, pairing and encryption
- ➢ Synchronization

> ➢ Capability negotiation
> ➢ Quality of service negotiation
> ➢ Power control
> ➢ Link supervision

15. Define DIFS.
   DCF inter-frame spacing (DIFS): This parameter denotes the longest waiting time and has the lowest priority for medium access. This waiting time is used for asynchronous data service within a contention period. DIFS is defined as SIFS plus two slot times.

16. Define SIFS.
   Short Inter Frame Spacing (SIFS): The shortest waiting time for medium access (so the highest priority) is defined for short control messages, such as acknowledgements of data packets or polling responses.

17. Discuss about Bluetooth and describe the states of Bluetooth.
   Bluetooth is a wireless technology standard exchanging a data over short distances using short wavelength UHF radio waves. Bluetooth is designed to operate in two networks piconet and scatternet. It operates in the range of 2.4GHz to 2.485GHz on fixed and mobile devices.

18. What is meant by wireless ATM? (or) What is the need of WATM? (APR'19)
   Wireless ATM does describe a transmission technology and also tries to specify a complete communication system.

19. What is IEEE 802.11? What is the function of MAC layer in IEEE 802.11?(APR/MAY 2018)
   IEEE 802.11 defines Media access control (MAC) and physical (PHY) layers specifications for wireless LAN's. The function of MAC layer in IEEE 802.11 is Medium access, fragmentation of user data and encryption.

20. What is Zigbee?
   It is a control & sensor networks on IEEE 802.15.4 standard for wireless personal area networks (WPAN) low cost, low powered mesh network for controlling & monitoring applications. ISM 2.4 GHz, Global band at 250 Kbps.

PART-B

1. **Explain and compare the medium access mechanism of DCF methods adapted in IEEE 802.11 WLAN. (APR'16) (APR'17) (APR'19)**
   Ref:" Mobile Communications" by Jochen Schiller [Page.no:214-222]

2. **Define HIPERLAN-2. Discuss about the various operation modes and protocol stack in HIPERLAN-2. (NOV'17) (APR/MAY 2018)**
   Ref:" Mobile Communications" by Jochen Schiller [Page.no:257-269]

3. **Explain the concept of HIPERLAN-1. (NOV'16) (APR'18)**
   Ref:" Mobile Communications" by Jochen Schiller [Page.no:240-244]

4. **Explain in detail about the IEEE 802.11 protocol architecture and bridging with other networks? (NOV'17) (NOV'18) (APR'19)**
   Ref:" Mobile Communications" by Jochen Schiller [Page.no:210-211]

5. **Write short notes on (i) WATM (ii) BRAN**
   Ref:" Mobile Communications" by Jochen Schiller [Page.no:244-257]

6. **Compare the performance between 802.11a & 802.11b**
   Ref:" Mobile Communications" by Jochen Schiller [Page.no:231-238]

7. **Explain the concepts of Bluetooth with neat diagrams? (APR'19)(APR 2017)**
   Ref:" Mobile Communications" by Jochen Schiller [Page.no:269-293]

8. **Describe the user scenario architecture and protocol stack of Bluetooth technology. (APR'17)**
   Ref:" Mobile Communications" by Jochen Schiller [Page.no:271-282]

9. **Explain the concepts of Zigbee with neat diagrams?**
   Ref:" Wireless Communications and Networking" by Vijay K.Garg [Page.no:669-671]

10. **Write short notes on**
    i) 6LoWPAN.   ii) Wireless HART.
    Ref:" Wireless Communications and Networking" by Vijay K.Garg [Page.no:671-673]

11. **Explain in detail about the IEEE 802.11 MAC data frame format with relevant diagram. Elucidate the advantages of WLAN techniques.(APR/MAY 2019)(NOV/DEC 2018) (APR/MAY 2018)**
    Ref:" Mobile Communications" by Jochen Schiller [Page.no:214-222]

12. **Give the strategy of logical link and adaption protocol(L2CAP) (APR/MAY 2019)**
    Ref:" Mobile Communications" by Jochen Schiller [Page.no:285-287]

UNIT 2

MOBILE NETWORK LAYER

PART-A

1. **When the agent solicitation message has to be sent by mobile node? (NOV'17)**
   If no agent advertisements are present or the inter-arrival time is too high, and an MN has not received a COA by other means, the mobile node must send agent solicitations.

2. **Define SIP. Write the function of SIP. (NOV/DEC 2018)**
   Session Initiation Protocol (SIP) is used for provisioning services in IP based mobile networks. SIP specification defines architecture of user agents and servers that support communications between SIP peers through user tracking, call routing.

3. **What is care of address in mobile IP? (APR'17) (APR'19)**
   The COA defines the current location of the MN from an IP point of view. All IP packets sent to the MN are delivered to the COA, not directly to the IP address of the MN.

4. **Illustrate the applications of MANET.**
   - ➢ Military applications
   - ➢ Commercial sector.
   - ➢ Sensor networks.
   - ➢ Industrial applications
   - ➢ Education sector

5. **What is Encapsulation in mobile- IP? (APR'17)**
   Encapsulation is the mechanism of taking a packet consisting of packet header and data and putting it into the data part of a new packet.

6. **Why is routing in multi-hop ad-hoc networks complicated? (NOV'17)**
   While in wireless networks with infrastructure support a base station always reaches all mobile nodes, this is not always the case in an ad-hoc network. A destination node might be out of range of a source node transmitting packets. Routing is needed to find a path between source and destination and to forward the packets appropriately.

7. **What is binding request?**
   Any node that wants to know the current location of an MN can send a binding request to the HA. The HA can check if the MN has allowed dissemination of its current location. If the HA is allowed to reveal the location it sends back a binding update.

8. **Illustrate the advantages and disadvantages of DSDV.**
   Advantages
   - Less Delay is involved in route setup process.
   - DSDV protocol guarantees loop free paths.
   - Incremental updates with sequence number tags make the existing wired network protocols adaptable to ad-hoc wireless networks.
   - Count to infinity problem is reduced in DSDV.
   - Path Selection: DSDV maintains only the best path instead of maintaining multiple paths to every destination. With this, the amount of space in routing table is reduced.

   Disadvantages
   - Updates due to broken links lead to heavy control overhead during mobility.
   - The control overhead is directly proportional to the number of nodes.
   - Small network with high mobility or large network with low mobility can choke the available bandwidth.
   - Wastage of bandwidth
   - Delay in obtaining information about a node could result in stale routing at the nodes.

9. **Describe triangle routing in detail**.

   The inefficient behavior of a non optimized mobile IP is called triangular routing.

   The data is sent in three steps, CN to HA, HA to COA/MN, and MN to CN. Even if the MN is in nearby area the packets are forwarded to MN, this consumes a lot of time.

10. **Compare proactive with reactive routing protocols. (NOV'18)**

S.No	Proactive	Reactive
1	Route is pre-established	Route establishment is on-demand
2	Continuously discover the routes	Route discovery by some global search
3	Updates topology information(table) periodically	No information update is done
4	No latency in route discovery	longer delay due to latency of route discovery
5	Large capacity is needed to update network information	Large capacity is not needed
6	A lot of routing information may never be used	May not be appropriate for real-time communication
7	Eg: DSDV, WRP	Eg: AODV, ABR

11. What is reactive protocol? Mention some of the reactive routing protocols.

This type of protocol finds a route on demand by flooding the network with Route Request packets.Some of the reactive routing protocols are,

➢ Dynamic source routing
➢ Ad hoc On-demand Distance Vector(AODV)
➢ ABR - Associativity-Based Routing
➢ Temporarily Ordered Routing Algorithm (TORA)

12. How routing is divided in DSR?

Route discovery: A node only tries to discover a route to a destination if it has to send something to this destination and there is currently no known route.

Route maintenance: If a node is continuously sending packets via a route, it has to make sure that the route is held upright. As soon as a node detects problems with the current route, it has to find an alternative.

13. Discuss about MANET and its advantages. (APR'16) (NOV'16) (APR'19)

A Mobile Ad-Hoc Network (MANET) is an infrastructure less collection of mobile nodes that can arbitrarily change their geographic locations such that these networks have dynamic topologies which are composed of bandwidth constrained wireless links.

Advantages:

➢ Instant infrastructure
➢ Disaster relief
➢ Can be used in Remote areas
➢ High effectiveness

14. What is mobile IP? Mention its benefits & entities. (APR'18)

Mobile IP is a protocol developed to allow internetwork mobility for wireless nodes without them having to change their IP addresses.

The major benefit of Mobile IP is that it frees the user from a fixed location. Mobile IP makes invisible the boundaries between attachment points, it is able to track and deliver information to mobile devices without needing to change the device's long-term Internet Protocol (IP) address. Entities: Mobile Node(MN), Correspondent node(CN), Home network, foreign network, foreign agent, care of address. etc.

15. Differentiate Ad-hoc & cellular network.

PARAMETERS	AD-HOC	CELLULAR NETWORK
Infrastructure	Fixed infrastructure based.	Infrastructure-less
Cost	High setup cost.	Cost effective

16. Explain the process of IP packet delivery with a neat diagram.
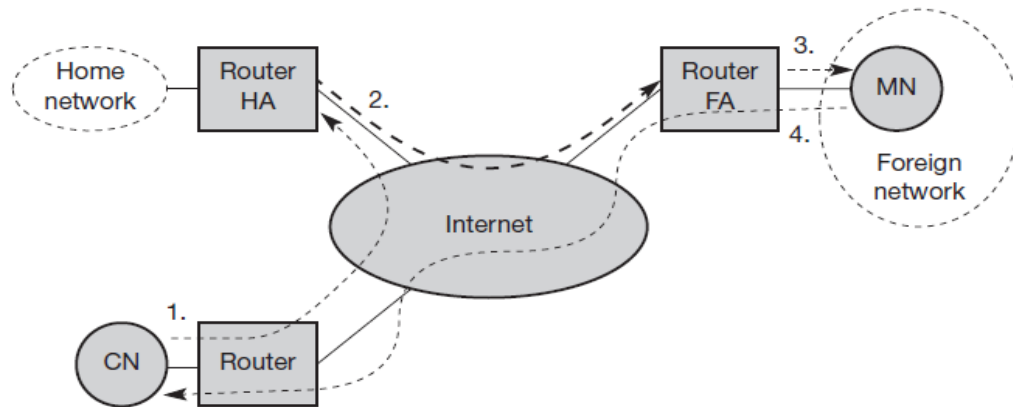
17. Explain encapsulation and decapsulation.

Encapsulation is the mechanism of taking a packet consisting of packet header and data and putting it into the data part of a new packet. The reverse operation, taking a packet out of the data part of another packet, is called decapsulation.

18. What is tunneling?

A tunnel establishes a virtual pipe for data packets between a tunnel entry and a tunnel endpoint. Packets entering a tunnel are forwarded inside the tunnel and leave the tunnel unchanged.

19. What is CoAP? Mention its necessity.

Constrained Application Protocol (CoAP) is a specialized Internet Application Protocol for constrained devices. It enables constrained devices (nodes) to communicate with the wider Internet using similar protocols. CoAP is designed for use between devices on the same constrained network , between devices and general nodes on the Internet, and between devices on different constrained networks both joined by an internet.

20. What is IoT? Mention its different domains of application.

The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, that are provided with unique identifiers (UIDs) and the ability to transfer data over a network.

Application:
- ✓ Consumer applications
- ✓ Commercial applications
- ✓ Industrial applications
- ✓ Infrastructure applications
- ✓ Military applications.

PART-B

1. **Illustrate the concept of DHCP.**
   Ref:" Mobile Communications" by Jochen Schiller [Page.no:328-330]

2. **Explain and compare the working mechanism of both DSDV and DSR routing protocols when applied on a mobile ad-hoc network scenario. (APR'17) (APR'18) (NOV'18)**
   Ref:" Mobile Communications" by Jochen Schiller [Page.no:335-339]

3. **How does DSR handle routing? What is the motivation behind DSR compared to other routing algorithms for fixed networks? (NOV'17) (APR'19)**
   Ref:" Mobile Communications" by Jochen Schiller [Page.no:336-339]

4. **Write short notes on (i) Optimizations (ii)Micro mobility support**.
   Ref:" Mobile Communications" by Jochen Schiller [Page.no:319-321,324-328]

5. **Explain the following terms: (i) IPV6 (ii) Agent discovery and Agent registration.**
   Ref:" Mobile Communications" by Jochen Schiller [Page.no:310-315,323-324]

6. **Discuss the basic concepts of Mobile IP and write short notes on IP Packet delivery. (APR/MAY 2018)**
   Ref:" Mobile Communications" by Jochen Schiller [Page.no:304-310]

7. **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. (NOV'17) (APR'19)**
    Ref:" Mobile Communications" by Jochen Schiller [Page.no:315-319]

8. **Explain the mobile session initiation protocol**. **(APR'18)**
   Ref:" Wireless Networks" by L.Gopinath [Page.no:2.46-2.47]

9. **State the entities and terminologies used in Mobile IP and explain the concepts of tunneling. (APR'17) (NOV'18) (APR'19)**
   Ref:" Mobile Communications" by Jochen Schiller [Page.no:307-309,315-319]

10. **Explain the concept of IoT with the help of Constrained Application Protocol (CoAP).**
    Ref:" Mobile Communications" by Jochen Schiller [Page.no:, 339-343]

UNIT-3
3G OVERVIEW
PART-A

1. **What is UMTS?(APR/MAY 2019)(APR/MAY 2018)**
   The Universal Mobile Telecommunication system (UMTS) is a third generation (3G) mobile communications system that provides a range of broadband services to the world of wireless and mobile communications. The UMTS delivers low-cost, mobile communications at data rates of up to 2 Mbps.

2. **What are the main elements of UTRAN architecture?**
   In UTRAN architecture, there are three main elements are available such as
   1. User Equipment (UE)
   2. Radio Network Subsystem(RNS)
   3. Core Network. (CN)

3. **Define User equipment.**
   In UTRAN user equipment is any device used directly by an end-user to communicate. It can be a hand-held telephone, a laptop computer equipped with a mobile broadband adapter or any other device.

4. **What are the planes of UTRAN?**
   There are three planes available in UTRAN such as
   - Control plane
   - User plane
   - Transport network control plane.

5. **What are the horizontal layers in UTRAN?**
   The UTRAN consists of two horizontal layers such as
   - Radio network layer
   - Transport network layer.

   The radio network layer is concerned with user data and control information. The transport network layer is concerned with transport technologies used for the UTRAN interfaces.

6. **What are the functions of RNC? (NOV/DEC 2018)**
   A radio network controller is responsible for the use and allocation of all the radio resources of the RNS to which it belongs. It can also handle the user voice and packet data traffic. It can perform the necessary action to access the radio bearers on the user data stream.

7. What is meant by control plane?

The control plane includes the application protocols and the signaling bearers which transport the control information.

8. What is meant by user plane?

The user plane includes the user data between the UE and the network and the data bearers. The user data consists of data streams characterized by frame protocols specific to a UTRAN interface.

9. Define Iu interface.

The Iu interface is specified at the boundary between the core network (CN) and UTRAN. It is an open interface that divides the system into radio specific UTRAN and CN.

10. What is Transport Network control plane?

The transport network control plane acts between control plane and user plane. It carries all control all control signaling within the transport layer. It does not include radio network layer information.

11. What are the functions of user equipment in UTRAN?

- **Mobile management**
- **Call control**
- **Session management**
- **Identity management.**

12. What is CDMA?

CDMA is technology for the evolution of IS-95 3G services. The CDMA 2000 cellular technology provides an evolutionary high data rate upgrade path for current users of
2G(IS-95) ,(2.5G) CDMA technology.

13. List the features of CDMA2000.

- Leading performance.
- Efficient use of spectrum.
- Support for advanced mobile services.
- More flexibility & higher BW efficiency.
- Support Broadest selection of mobile devices

14. Mention the advantages of CDMA 2000.

- Superior voice quality.
- High speed broadband data connectivity.
- Improved security & privacy.
- Lower total cost of ownership.
- Multimode- multiband global roaming features.

15. List the de-merits of CDMA2000.
- Channel pollution.
- International roaming.

16. What is TD-SCDMA?

Time Division Synchronous Code Division Multiple Access (TD-SCDMA) refers to an air interface used in Universal Mobile Telecommunications System (UTMS) networks. TD-SCDMA was developed as a substitute for W-CDMA. It is also referred to as IMT 2000 Time-Division (IMT-TD) or UMTS-TDD.

17. What is 3GPP?

The 3rd generation partnership project more commonly known as 3GPP is an mobile communications industry collaboration that organizes and manages the standards and development of mobile communication standards. 3GPP was set up to develop a specification to move on from the 2G system, global system for mobile communications, GSM within the scope of ITU**.**

18. Explain TD-CDMA.

Time-division-Code division multiple access(TD-CDMA), is a channel access method based on using spread spectrum multiple access (CDMA) across multiple time slots (TDMA). TD-CDMA is the channel access method for UTRA-TDD HCR, which is an acronym for UMTS Terrestrial Radio Access-Time Division Duplex High Chip Rate

PART –B

1. Outline the overview of UMTS Terrestrial radio access network.(APR/MAY 2019)
Ref:" Wireless Communications and Networking" by Vijay K.Garg [Page.no:497-504]

2. With neat diagram explain the reference architecture of UMTS.(NOV/DEC 2018)(APR/MAY 2018)(APR 2017)
Ref:" Wireless Communications and Networking" by Vijay K.Garg [Page.no:495-497]

3. Describe channel structure in UMTS terrestrial radio.(NOV/DEC 2018)(APR/MAY 2018)
Ref:" Wireless Communications and Networking" by Vijay K.Garg [Page.no:497-504]

4. Explain about UTRAN logical interfaces. (NOV'17)
Ref:" Wireless Communications and Networking" by Vijay K.Garg [Page.no:497-504]

5. Describe about UMTS core network architecture.(APR 2017)
Ref:" Wireless Communications and Networking" by Vijay K.Garg [Page.no:497-504]

6. **Explain about 3GPP architecture.**
    Ref:" Wireless Communications and Networking" by Vijay K.Garg [Page.no:22.3-22.6]

7. **Illustrate CDMA2000 with suitable diagram.**
    Ref:" Wireless Communications and Networking" by Vijay K. Garg [Page.no:544-540]

8. **List the components of radio network. With suitable diagram explain network structure of radio network.**
    Ref:" Wireless Communications and Networking" by Vijay K. Garg [Page.no:624-626]

9. **Write short notes on**
       i)   TD-CDMA   ii) TD- SCDMA
    Ref:" Wireless Communications and Networking" by Vijay K. Garg [Page.no:168-173]

UNIT 4
INTERNETWORKING BETWEEN WLANs AND WWANs
PART A

1. List the objective of the Internetworking

   i. To allow independent evolution of WWAN and WLAN standards.

   ii. To obtain 3GPP (WWAN) –WLAN internetworking setup.

   iii. Allow 3GPP access services without substantial network software upgrade.

   iv. To minimize the independence of WLAN & WWAN standards at the point of interconnection.

2. What are the requirements of Internetworking?

- Common billing and customer care.
- 3GPP based access control and charging.
- Access to 3GPP-based packet switched services.
- Service continuity.
- Access to 3GPP circuit-switched services.

3. Mention the Internetworking schemes to connect WLAN & 3G networks.

   i. Mobile IP approach.

   ii.Gateway approach.

   iii.Emulator approach.

   .

4. State the drawback of Mobile-IP approach

   This approach suffered from the triangular routing between networks if Mobile-IP does not support route optimization.

5. **Mention the approaches to obtain internetworking architecture of WLAN & GPRS.**

   i. Tight coupling Approach.

   ii. Loose coupling Approach.

   .

6. List the advantages of Gateway approach.

   ✓ Two different approaches can operate independently.

   ✓ Reduces Handoff delay..

   ✓ Reduced Loss.

7. Give the merits & demerits of Emulator approach.

   Merits:

   Packet loss & delay can be reduced significantly.

   Demerits:

   As Gateway GPRS support node(GGSN) turns to single access point Internet in emulator approach the core network becomes bottle network.

8. Define Session Mobility.

  A user session should be able to move from one user agent environment to another.

9. List the Advantages of Tightly coupled architecture.

  i. .Seamless service continuation across WLAN & GPRS.

  Ii.Reuse of GPRS AAA

  Iii.Reuse of GPRS infrastructure.

  iv.Increased security.

  v.Access to core GPRS service. Eg:-SMS,MMS etc.

10. What is the main function of GIF.

  GIF- GPRS Internetworking Function.

  The main function of GIF is to provide a standardized interface to the GPRS core network and to virtually hide the WLAN particularities.

11. Define GPRS.

  General Packet Radio Services (**GPRS**) is a packet-based wireless communication service that
   Promises data rates from 56 up to 114 Kbps and continuous connection to the Internet for mobile
  Phone and computer users.

12. List the functions of WAF.

  ✓ WAF-WLAN Adaption Function.

  ✓ WAF indicates the signal activation of WLAN interface when a mobile enters into WLAN
     Area.

  ✓ It supports GIF/RAI discovery procedure.

  ✓ It supports paging procedure.

  ✓ It transfer uplink LLC PDUs from MS to the GIF & transfer downlink LLC PDUs
     Vice versa.

  ✓ It supports Qos by implementing transmission scheduling.

13. What is LMDS?

  LMDS- Local Multipoint Distribution System. LMDS is a new type of stationary broadband wireless access technology designed for a mass subscriber market place. It is based on millimeter Micro frequencies 2.4 GHz & above. The coverage area of LMDS is 3-5Km.

14. Mention the applications of LMDS.

  i.Full scale campus networking.

  ii. Alternative cable TV.

  iii. Video conferencing / Video Broadcasting.

  iv. Corporate video on demand.

  v. Virtual Private network for corporate government genies

vi. ATM telephony

vii. Streaming video.

15. Mention the Advantages of LMDS.

- ✓ Lower entry deployment costs.
- ✓ Ease. Speed of deployment.
- ✓ Fast realization of revenue.
- ✓ Scalable architecture.
- ✓ Cost-effective network.

16. What are the limitations of MMDS?

- ✓ **Bandwidth limitation**
- ✓ **Propagation characteristics.**

17. Differentiate LMDS & MMDS

FEATURES	LMDS	MMDS
Frequency range	28-31GHz(U.S) 2.42 GHz (rest of world)	2.5-2.7GHz
Propagation characteristic	Good for medium range. LOS<=5 miles, free space attenuation.	Good for short range LOS<=35 miles free space attenuation.
Impact of cell architecture	Large bandwidth available, which can effectively be increased by decreasing cell size.	Limited bandwidth availability due to frequency reuse.
Favored cell architecture	Multiple, small microcells	Single, large microcell
Range	Up to 5 miles	Up to 35 miles
Data rate	Typically up to 45Mbps, Burst rate up to 311 Mbps	Typically 0.5 to 3 Mbps.
Access schemes	FDMA,TDMA,CDMA	FDMA,TDMA,OFDM,CDMA

18. **Advantages of MMDS.**

   i.MMDS signals have larger wavelengths and can travel farther without losing significant power

   ii.Equipment at lower frequencies is less expensive

   iii.MMDS signals don't get blocked as easily by objects and are less susceptible to rain absorption.

PART B

1. **What are the requirements for interworking between a wireless wide area network (WWAN) and a wireless local area network (WLAN) ?**
   Ref:" Wireless Communications and Networking" by Vijay K.Garg [Page.no:22.2-22.3]

2. **Discuss briefly the various ways to achieve interworking between a WWAN and a WLAN.**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:22.3-22.5]

3. **Discuss tight coupling architecture between the IEEE 802.11 WLAN and GPRS.**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:22.8-22.9]

4. **What is the WLAN adaption function (WAF) in tight coupling architecture? Discuss briefly**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:22.13-22.15]

5. **Discuss the GPRS interworking function (GIF)/routing area update(RAU) discovery procedure in tight coupling architecture.**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:,22.9-22.17]

6. **Discuss loose coupling architecture between the IEEE 802.11 WLAN and GPRS.**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:22.17-22.26]

7. **How is authentication achieved in loose coupling architecture? Discuss briefly**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:22.17-22.23]

8. **Compare tight and loose coupling architecture for interworking between IEEE 802.11 WLAN and GPRS.**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:22.31]

9. **Discuss briefly local multipoint distribution system(LMDS)**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:22.26-22.29]

10. **What is the multichannel multipoint distribution system (MMDS) Compare it with LMDS.**
    Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:22.29-22.32]

UNIT 5
4G & Beyond
PART A

1. **Define multi carrier modulation. (APRIL 2017) (NOV/DEC 2018)**

   Multicarrier modulation (MCM) is a derivative of frequency-division multiplexing. It is not a new technology. 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.

2. **What are the features of 4G Wireless Systems?(APR/MAY 2017)**

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

3. **Write a short note on security challenges in 4G**

   The heterogeneity of wireless networks complicates the security issue. Dynamic   reconfigurable, adaptive, and lightweight security mechanisms should be developed.

4. **What is Smart Antenna?**

   Smart antenna techniques, such as multiple-input multiple-output (MIMO) systems, can extend the capabilities of the 3G and 4G systems to provide customers with increased data throughput for mobile high-speed data applications.

5. **Explain in detail about LTE.(APR/MAY 2019)**

   Long Term Evolution (LTE) has been designed to support only packet-switched services. It aims to provide seamless Internet Protocol (IP) connectivity between user equipment (UE) and the packet data network (PDN), without any disruption to the end users' applications during mobility.

6. **Define 4G. What are the goals of 4G?**

   4G can defined as MAGIC
   MAGIC
          a. Mobile Multimedia
          b. Anytime Anywhere
          c. Global Mobility Support
          d. Integrated Wireless Solution
          e. Customized Personal Services

   Also known as Mobile Broadband Everywhere

The ambitious goal of 4G is to allow everyone to access the Internet anytime and everywhere. The provided connection to Internet will allow users to access all types of services including text, databases and multimedia. Unlike 3G, 4G is IP based, that is every user connected to the Internet will have an IP address.

7. **Mention the features and challenges of 4G. (APRIL 2017)(APR/MAY 2019)(NOV/DEC 2018)**
    - High usability: anytime, anywhere, and with any technology
    - Support for multimedia services at low transmission cost
    - Personalization
    - Integrated services
    - The main challenges are
        a. Multimode user terminals
        b. Wireless System Discovery and Selection
        c. Terminal Mobility
        d. Network Infrastructure and QoS Support
        e. Security and Privacy
        f. Fault tolerance and Survivability
        g. Multiple Operators and Billing Systems
        h. Personal Mobility

8. **What are the main issues in terminal mobility of 4G?**
    To locate and update the locations of the terminals in various systems. Also, to perform horizontal (within the same system) and vertical (within different systems) handoff as required with minimum handover latency and packet loss.

9. **Write a short note on time slot scheduler.**
    The time slot scheduler shares the spectrum efficiently between users by satisfying the QoS requirements. When the channel quality for each radio link can be predicted for a short duration into the future and accessible by the link layer, then ARQ with an adaptive modulation and coding system can be selected for each user to satisfy the Bit Error Rate(BER) requirement and offer throughput.

10. **What are the various technologies used in 4G?**
    The technologies used in 4G are
        a. Multi Carrier Modulation (MCM)
        b. Smart Antenna Techniques
        c. OFDM – MIMO Systems
        d. Adaptive Modulation and Coding with Time Slot Scheduler
        e. Cognitive Radio.
        f. Software defined ratio.

11. Describe in detail cognitive radio. (NOV 2017) (APR/MAY 2019)(APR/MAY 2018)

The Federal Communications Commission FCC defined Cognitive Radio as "A radio that can change its transmitter parameters based on interaction with the environment in which it operates.

12. Mention the main functions and goal of Cognitive Radio.

Main Functions of Cognitive Radio

- Spectrum sensing: Detecting unused spectrum
- Spectrum management : Capturing the best available spectrum ,,
- Spectrum mobility: Maintaining seamless communication during the spectrum transition
- Spectrum sharing: ,, Providing fair spectrum scheduling method

Cognitive radio is considered as a goal towards which a software-defined radio platform should evolve: a fully reconfigurable wireless transceiver which automatically adapts its communication parameters to network and user demands.

13. Discuss about MIMO. (APR/MAY 2017)

MIMO systems can be viewed as a combination of MISO and SIMO channels. MIMO means Multiple Input and Multiple Output that represents multiple individual, parallel data streams that are carried on the air interface.

14. Compare 3G with 4G.(NOV/DEC 2018)(APR/MAY 2018)

Content	3G	4G
Major requirement driving architecture	Predominantly voice driven, data was always add on	Converge data and voice over IP
Network architecture	Wide area cell-based	Hybrid-integration of WLAN (WiFi, Bluetooth)
Speeds	384 kbps to 2 Mbps	20 to 100 Mbps in mobile mode
Frequency band	Dependent on country or continent (1.8 to 2.4 GHz)	Higher frequency bands (2 to 8 GHz)
Bandwidth	5 to 20 MHz	100 MHz or more
Switching design basis	Circuit and packet	All digital with packetized voice
Access technologies	WCDMA, cdma2000	OFDM and multicarrier (MC)-CDMA
Component design	Optimized antenna design, multiband adapters	Smart antenna, software defined multiband and wideband radios
Internet protocol	Number of air link protocol	All IP (IPv6.0)

(IP)	including IPv5.0	
Mobile top speed	200 km/h	200 km/h
Forward error correction	Convolution codes rate 1/2, 1/3	Concatenated coding schemes

15. What are the benefits of Smart Antenna Technology?

The benefits of Smart Antenna Technology are:

      a. Reduction in Co – Channel Interference

      b. Range Improvement

      c. Increase in Capacity

      d. Reduction in Transmitted Power

      e. Reduction in Handoff

16. Define Multi Carrier Modulation (MCM).What are the advantages of MCM?(APR/MAY 2018)

Multicarrier modulation (MCM) is a derivative of frequency-division multiplexing. It is not a new technology. 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.

The advantages of MCM are :

a. Better performance in the Inter Symbol Interference environment

b. Avoidance of single frequency interference

17. List out the applications of 4G technologies.   (NOV 2017)

- 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.
- Education — 4G will provide a good opportunity to people anywhere in the world to continue their education on-line in a cost-effective manner.

18. What is meant by receiver diversity?

The Single Input Multiple Output (SIMO) configuration of the radio channel is known as receiver diversity. The input the channel is single transmitter signal that feeds two receiver paths. Depending on multipath fading and the correlation between two receiver gain is achieved in the form of fading resistance.

19. What is MVNO?

A mobile virtual network operator (MVNO) is a wireless communications services provider that does not own the wireless network infrastructure over which it provides services. An MVNO may use its own customer service, billing support systems, marketing, and sales personnel, or it could Employ the services of a mobile virtual network enabler (MVNE)

20. Define BLAST?

Bell Labs Layer Space-Time (BLAST) is a transceiver architecture for offering spatial multiplexing over multiple-antenna wireless communication systems. Such systems have multiple antennas at both the transmitter and the receiver in an effort to exploit the many different paths between the two in a highly-scattering wireless environment.

PART-B

1. **What is a Multi-Input –Multi-Output (MIMO) system? Explain in detail.(Nov'17) (NOV/DEC 2018) (APR/MAY 2018)**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:23.12-14]

2. **Explain in detail about Cognitive Radio.(NOV/DEC 2018)**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:23.20-21]

3. **Describe the basic concept of Adaptive Modulation and Coding Time-Slot scheduler. (Nov'17)**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:23.14-15]

4. **Explain the various technologies used in 4G.**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:23.7-20]

5. **Explain in detail about the Multi carrier modulation (MCM).**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:23.7-10]

6. **Explain adaptive modulation and coding with time slot scheduler along with cognitive radio concept. (APRIL'17)**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:23.14-15]

7. **Explain in detail, the 4G vision, features and challenges of 4G with applications.**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:23.2-3]

8. **Write your understanding on behavior of smart antenna techniques. (APRIL'17) (APR/MAY 2019)**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:23.10-14]

9. **Explain in detail about the key challenges faced by 4G networks and also explain about the motivation behind the evolution of 4G technology. (APR/MAY 2019)**
   Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:23.1-7].

10. **What is LTE? Explain the operation of LTE with the help of IMS architecture.(APR/MAY 2018)**
    Ref:" Wireless Networks" by L.Gopinath [Page.no:4.46-4.56].

11. **Write short notes on:**
    i) Smart Antenna Techniques.   ii) MVNO (APR 2017)
    Ref:" Wireless Communications and networking" by Vijay Garg [Page.no:23.10-23.7]