COEN 331 Syllabus

Wireless & Mobile Networks Summer 2021

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1. Introduction to Wireless Communication Technology (June-21-2021)

Part 1- Introduction to Wireless Communication Technology

- **Transmission**
- **Reflection**
- **Free-space propagation**
- **Scattering**
- **Diffraction**
- **Polarization**
- **SNR (Signal-to-Noise Ratio)**
- **Licensed and Unlicensed Spectrums**
- **Antenna**
- **Noise**
- **Fading**

2. Introduction to Wireless Communication Technology (June-23-2021)

Part 1- Introduction to Wireless Communication Technology

- **Radio Transmission**
- **Microwave Transmission**
- **Satellite Communications Transmission**
- **Error Correction**
- **Synchronization**
- **Modulation**
- **Different types of spectrums**
- **Spectrum usage**

3. Introduction to IEEE 802.11(June-28-2021)

Part 2-WiFi

- **Introduction to WLAN (Wireless Local Area Network)**
- **Network functions**
- **Wireless LAN Standards**
- **OFDM (Orthogonal Frequency Division Multiplexing)**
- **Physical Layer**
- **Frequency Hopping**
- **Wireless LAN layer 2 operation**
- **Timing sequence**
- **Network Allocation Vector (NAV)**

4. Media Access Control, IEEE 802.11 Frame (June-30-2021)

Part 2-WiFi

MAC Access Methods:

- **DFC (Distributed Coordination Function)**
- **PCF (Point Coordination Function)**

IEEE 802.11 Frame (using LLC 802.2 encapsulation):Frame Control

- **Fragmentation**
- **Basic Service Set ID (BSSID)Management Operation:Management Architecture**
  - **Management Layers**

5. Power Conservation (July-05-2021)

Part 2-WiFi

- **Power Conservation (Multicast and Broadcast)**
- **IBSS (Independent Basic Service Set) Power Conservation**
- **Time Synchronization**
- **Contention Free Service with PCF (Point Coordination Function)**

6. IEEE 802.11i, e, k, n, ZigBee IEEE 802.15.4(July-07-2021)

Part 2-WiFi

- **EAPOL (Extensible Authentication Protocol over LAN)**
- **RFC 2284**
- **IEEE 802.11i**
- **IEEE 802.11e**
- **IEEE 802.11k**
- **SIMO (Single Input, Multi Output)**
- **MISO (Multi Input, Single Output)**
- **IEEE 802.11n MIMO (Multi Input, Multi Output)**
- **LWAPP (Light Weight Access Point Protocol)**
- **Low Power Wireless Standard IEEE 802.15.4, ZigBee**

7. Cellular Access Technology, Introduction (July-12-2021)

**** Midterm Test *****

Part 3-Cellular Technology

- **Mobile Network Topology**
- **Wireless Mobile Access TDMA/TDD (Time Division Multiple Access with Time Division Duplexing)**
- **FDMA/TDD (Frequency Division Multiple Access with Time Division Duplexing)**
- **GSM (Global System for Mobil Communications)**
- **GPRS (General Packet Radio Service) DGE (Enhanced Data Rate for Global Execution, or Enhanced Data Rate for GSM Evolution)**
- **CDMA 2000W CDMA (Wideband Code Division Multiple Access)**
- **CDPD (Cellular Digital Packet Radio)**

- **User Traffic**

8. Public Land Mobile Network, Hand off Types, Registration (July-14-2021)

Part 3-Cellular Technology

Introduction to Public Land Mobile Network and overview:

- **Roaming**
- **Handoff**

Handoff Types:

1. **MCHO (Mobile Controlled Handoff)**
2. **NCHO (Network Controlled Handoff)**
3. **MAHO(Mobile Assisted Handoff)**
4. **Inter-Base Staion Handoff**
5. **Inter-System Handoff**

- **Registration**
- **Call process**

9. GSM (Global System for Global Communications) (July-19-2021)

Part 3-Cellular Technology

GSM (Global System for Global Communications)

GSM Subsystem Elements:

- **MS (Mobile Station)**
- **SIM (Subscriber Identity Module)**
- **BTS(Base Transceiver Station)**
- **BSC(Base Station Controler)**
- **TRAU(Transcoding Rate and Adaptation Unit)**
- **MSC(Mobile Switching Center)**
- **HLR(Home Location Register)**
- **VLR (Visitor Location Register)**
- **EIR(Equipment Identity Register)**
- **GMSC(Gateway Mobile Switching Center)**

GSM Interfaces:

- **A-interface**
- **Abis-interface**
- **Air-interface(U_m-interface)**
- **B-interface**
- **C-interface**
- **E-interface**
- **G-interface**
- **H-interfacesubscriber Identity Module(SIM)**

Mobile Station Types and Functions

10. Base Station Subsystem, NSS (Network Switching Subsystem) (July-21-2021)

Part 3-Cellular Technology

- **BTS(Base Transceiver Station) Elements:**

1. **Radio Module**

2. **Processing Module**
3. **Control Module**
4. **Transport Module**

Base Tranceiver Station Configuration:

1- **Standard configuration**
2- **Umbrella Cell Configuration**
3- **Sectroized (Collocated)**

- **BSC (Base Station Controller)**
- **TRAU (Transcoding Rate and Adaptation Unit)**
- **NSS(Network Switching Subsystem)**

NSS Elements:

1. **MSC (Mobile Switching Center)**
2. **HLR (Home Location Register)/Authentication**
3. **VLR (Visitor Location Register)**
4. **EIR (Equipment Identity Register)**

11. GSM A-Interface, Abis-Interface (July-26-2021)

Part 3-Cellular Technology

- **GSM MS registration Process**
- **GSM Call (Setup and delivery) Process**

Abis-Interface Functions and operation

- **GSM Air-Interface:**

1. **FDMA**
2. **TDMA**
3. **GSM FDMA/TDMA structure**
   - **GSM burst (time slots) frame**
   - **Channel types**
   - **Call setup in behalf of MSC to MS**
   - **Frame Hierarchy in GSM**
   - **Basic communication in GSM**
   - **Signaling Channels**

Air-Interface:

- **Layer 2**

  $LAPD_m$ (LAPD modified) Signaling:

  1. **A-Format Control Field**
  2. **B-Format**
  3. **Bbis-Format**

- **Layer 3 Frame Format**

12. SS7 (Signaling System 7) (July-28-2021)

Part 3-Cellular Technology

Signaling System 7 (SS7)

- **Signaling System 7 features**
- **SS7 protocol layers**
- **Signaling System 7 (SS7) Protocol Stack**
- **Signaling messages:**

1. **FISU (Fill-in Signal Unit)**
2. **LSSU (Link Status Signal Unit)**
3. **MSU (Message Signal Unit)**

- **Addressing and Routing**
- **SS7 Connection Establishment**
- **SS7 Network Management and test**
- **SCCP(Signaling Connection Control Part)**
    1. **Connection Oriented Services**
    2. **Connectionless Services**

13. SCCP (Signaling Connection Control Part) Services (August-02-2021)

Part 3-Cellular Technology

- **SCCP Messages:**
    3. **CR (Connection Request)**
    4. **CC (Connection Confirm)**
    5. **CREF (Connection REFused)**
    6. **RLSD (ReLeaseSeD)**
    7. **RLC (ReLease Complete)**
    8. **DT1 (Data Form 1)**
    9. **IT (Inactivity Test)**
    10. **UDTS (Unit Data Service)**
- **SCCP Connection Setup and Release**

    The A-Interface Signaling:
    1. **BSSMAP(Base Station Subsystem Management Application Part)**
    2. **DTAP(Direct Transfer Application Part)**

- **Communications Transaction Capabilities and Mobile Application Part**

14. SCCP (Signaling Connection Control Part) and QoS (August-04-2021)

Part 3-Cellular Technology

- **TCAP Messages**
- **MAP Services procedures:**
    1. **Request**
    2. **Indication**
    3. **Response**
    4. **Confirmation**
    - **Common MAP Services**
    - **Special MAP Services**
    - **QoS(Quality of Service)**

(Saturday August-08-2021) ** Project Deadline ******

15. GPRS (General Packet Radio Service), VoIP in Wireless (August-09-2021)

Part 3-Cellular Technology

GPRS

- **GPRS Networks Network Toplogy**
- **GPRS Network Functional blocks and Architecture**
- **MSC (Mobile Switching Center)**
- **VLR (Visitor Location Register**
- **HLR (Home Location Register)**

- **GGSN (Gateway GPRS Support Node)**
- **BTS (Base Transceiver Station)**
- **BSC (Base Station Controller)**
- **MSC (Mobile Switching Center)**
- **SGSN (Serving GPRS Support Node)**

VoIP and Mobile Networks:

- **VoIP and Mobile Networks Using GPRS**
- **iGSM Wireless VoIP Solution**
- **Call delivery to IP network**

16. Additional Cellular Technologies and Mobile IP (August-11-2021)

Part 3-Cellular Technology

Additional Cellular Technologies:

- **UMTS (Universal Mobile Telecommunication System)**
- **WCDMA (Wideband Code Division Multiple Access)**
- **CDMA 2000 (Code Division Multiple Access 2000)**
- **CDPD (Cellular Digital Packet Data)**

Part 4- Mobile IP

- **Mobile IP**
- **Mobile Network Elements**
- **Mobile IP Operation**

17. Mobile IP and 4G LTE (Long Term Evaluation) (August-16-2021)

Part 4- Mobile IP

- **Discovery and advertisement**
- **Handoff mechanism**
- **Co-Located Addresses**
- **Registration**

Part 5- 4G LTE (Long Term Evolution)

- **LTE Functions**
- **LTE Topology**
- **LTE Elements**
- **LTE Interfaces**
- **LTE Physical Layer**
- **LTE Channel Concept**
  - **Uplink**
  - **Downlink**
- **Connecting to LTE network and getting IP address**

18. 5G (August-18-2021)

Part 6- 5G

- **Transition from 4G to 5G**
- **5 G Technology Standard progress in ITU**
- **10 Key Features**
- **mmWave (Millimeter Wave)**
- **5G Concept and Architecture**
- **Network Slicing**
- **ICN (Information Centric Networking)**
- **5G mobile using IPV6**

- **What is 6G**

19. Software Defined Radio and Satellite Communications(August-23-2021)

Part 7- Software Defined Radio

- **Introduction to SDN (Software-Defined Networks)**
- **Software Defined Radio Software Communication Architecture**
- **Software Defined Radio Aspects**
- **Adaptive Radio**
- **Cognitive Radio**
- **Intelligent Radio**

Part 8- Satellite Communications

- **Network Elements:**
  - **Space Segment**
  - **Control Segment**
  - **Ground Segment**
- **Access Methods:**
  - **TDMA**
  - **FDMA**
  - **CDMA**
- **Protocols:**
  - **Aloha**
  - **Slotted Aloha**
- **Satellite Types based on the coverage areas:**
  - **Single Beam**
  - **Multiple Beams**

20. Satellite Communications (Continue)(August-25-2021)

Part 8- Satellite Communications (Continue)

- **Frequency Reuse:**
  - **Polarization**
  - **Angular beam separation**
- **Interconnection between coverage areas:**
  - **On Board Switching**
  - **Beam Scanning**
- **Information Processing:**
  - **Transparent Satellite**
  - **Regenerative Satellite**

- **Inter-Satellite Links (ISL):**
  - **Inter orbital Link (IOL)**
  - **GEO-GEO**
  - **LEO-LEO**
- **Ground Segment:**
  - **Bandwidth control**
  - **Compression**
  - **Digital Speech Interpolation (DSI)**

21.Final (August-30-2021)