NIRMA UNIVERSITY

Institute:	Institute of Technology, School of Technology
Name of Programme:	MTech CSE
Course Code:	6CS262ME22
Course Title:	Wireless Networks
Course Type:	Department Elective-I
Year of Introduction:	2022-23

L	T	Practical Component				C
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Course Learning Outcomes (CLO):

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

1. explain the fundamental principles and architectures of various mobile communication technologies (BL2)
2. analyse the performance of different medium access techniques (BL4)
3. evaluate the challenges and opportunities presented by emerging mobile communication technologies (BL5)
4. design basic mobile communication network scenarios to investigate the impact of network parameters. (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction to Wireless Networks:** Growth of mobile communications, Mobile Communications Fundamentals and its Evolution, Mobile data, Wi-Fi, Bluetooth, Overview of 1G and 2G	04
Unit-II	**Third-Generation (3G) Overview:** Universal Mobile Telecommunications Service (UMTS), UMTS Services, The UMTS Air Interface, Overview of 3GPP Releases Network Architectures, Overview of CDMA2000, TD-CDMA, TD-SCDMA	05
Unit-III	**Universal Mobile Telecommunications Service (UMTS):** UMTS Basics, The WCDMA Air Interface, The UTRAN Architecture, Establishment of a UMTS Voice Call, UMTS Packet Data, High-Speed Packet Data, Handover, HSPA Connection Establishment	08
Unit-IV	**CDMA2000:** Radio and Network Components, Network Structure, Packet-Data Transport Process Flow, Radio Network, EVDO	03
Unit-V	**TD-SDMA and TD-CDMA:** Generic TD-SDMA Architecture, Core Network, Radio Network, Interference Mitigation Techniques, RAN Traffic Planning, Handover, Generic TD-CDMA Architecture, Core Network, Radio Network, Interference Mitigation Techniques, RAN Traffic Planning, Handover	05
Unit-VI	**Long-Term Evolution (LTE):** LTE Ecosystem, Standards, Radio Spectrum, LTE Architecture, User Equipment, Enhanced Node B, Core Network, Radio Channel Components, TD-LTE, Multiple Input Multiple Output (MIMO), LTE Scheduler, Carrier Aggregation, Cell Search, Cell Re-selection, Attach and Default Bearer Activation,	06

	Handover, Self-Organizing Networks (SONs), Relay Cells, Heterogeneous Network (HetNET), Remote Radio Heads (RRH), VoLTE, LTE Advanced	
Unit- VII	**Fifth-Generation (5G):** 5G Goals, Performance Requirements, Next Generation Mobile Networks (NGMN) and 3GPP Use case families, Building blocks of 5G: New Radio (NR) Interface - Millimetre Wave Spectrum, Massive MIMO, Flexible OFDM Numerologies, Multi-RAT Connectivity, Advance Channel Coding, Network Features - Cloud RAN, 5G Core, Service Based Architecture, RAN Architecture Optimization, Multi-access Edge Computing (MEC), Network Slicing, Virtualization and Automation Technologies	06
Unit- VIII	**Introduction to Sixth-Generation (6G):** Outlook of 6G, Computational Holographic Radio and Enabling Technologies for 6G, Air-interfaces for ultra-low power communications, Semantic Plane Filtering and Control, AI-assisted PHY technologies for 6G, Mobility-Enhanced Edge inTelligence (MEET) for 6G	05
Unit- IX	**Wi-Fi:** 802.11 Standards, WiFi Protocols, Frequency Allocation, Modulation and Coding Schemes, Network Architecture, Security, 802.11 Services, Hot Spots, Virtual Private Networks (VPN), Mobile VPN, VPN Types, Wi-Fi Integration with 3G/4G.	03

Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/ References:

1. Clint Smith and Daniel Collins, Wireless Networks, McGraw Hill
2. Nishith Tripathi and Jeffrey Reed, 5G Cellular Communications: Journey and Destination, A Multimedia, Rohde & Schwarz
3. Kaveh Pahlavan and Prashant Krishnamurthy, Principles of Wireless Networks: A Unified Approach, Prentice Hall
4. William Stallings, Wireless Communications and Networks, Pearson
5. 6G Networks: http://www.6gsummit.com/program/the-1st-6g-wireless-summit/

Suggested List of Experiments:

Sr. No.	Name of Experiments/Exercises	Hours
1	Familiarisation with a simulator like NS-3 for modeling and analyzing networks	04
2	Implement a basic CDMA system in software (MATLAB/Python) to grasp the spread spectrum	04
3	Analyse call setup signaling in UMTS using a protocol analyzer to illustrate 3G core network procedures	02
4	Set up a basic LTE network in a simulator with a focus on key LTE features like OFDMA and scheduling	04
5	Simulate a MIMO channel in software (MATLAB/Python) to understand spatial multiplexing	04

6	Analyze LTE handover procedures in a simulator with device mobility	02
7	Simulate a 5G NR network with different numerologies	04
8	Configure a Wi-Fi network and implement security protocols (WPA2/3)	02
9	Analyse network traffic traces (Wireshark) to understand protocol behaviour	02
10	Experiment with different Wi-Fi channels and observe the impact of interference on network performance.	02