AC –
Item No. –

As Per NEP 2020

University of Mumbai

Syllabus for Minor Vertical 2		
Faculty of Engineering		
Board of Studies in Electronics & Telecommunication		
Second Year Programme in Minor (Electronics & Telecommunication)		
Semester	**V & VI**	
Title of Paper (Theory)	**Sem.**	**Total Credits 4**
I) Wireless and Mobile Communication	**V**	**3**
I) Internet and Data Communication	**VI**	**3**
Title of Paper (Lab)		**Credits**
I) Wireless and Mobile Communication Laboratory	**V**	**1**
II) Internet and Data Communication Lab	**VI**	**1**
From the Academic Year		**2026-27**

Sem. - V

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tuts	Theory	Practical	Tuts	Total
MDC501	Wireless and Mobile Communication	3	---	---	3	--	--	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
MDC501	Wireless and Mobile Communication	20	20	40	60	2	-	-	100

Course Objectives: The course aims to

1. Introduce fundamental concepts of wireless and mobile communication systems relevant to modern digital infrastructure.
2. Provide understanding of cellular technologies and their evolution from 1G to 5G.
3. Familiarize students with widely used wireless technologies such as Wi-Fi, Bluetooth, and IoT-based systems.
4. Explain signal propagation, interference, and practical challenges in wireless environments.
5. Develop system-level understanding of mobile network architecture and operations.
6. Expose students to emerging trends such as 5G, IoT, and smart communication ecosystems.

Course Outcomes: After successful completion of the course, students will be able to

1. Explain basic principles of wireless communication and spectrum utilization.
2. Describe evolution and working of modern cellular systems (GSM, LTE, 5G).
3. Compare different wireless technologies and identify their applications.
4. Analyze effects of propagation, noise, and interference in wireless systems.
5. Illustrate architecture and operations of cellular/mobile networks.
6. Interpret emerging trends such as IoT, 5G, and future communication systems.

Module No.	Topics	Hours	CO Mapping
1	**Basics of Wireless Communication**. 1.1 Wireless Transmission Principles -Need for wireless communication (real-world applications: mobile, IoT, defense), Elements of communication system (Tx, channel, Rx), Wireless transmission basics (path loss concept – qualitative) 1.2 Frequency Spectrum Allocation - Electromagnetic spectrum overview (licensed vs unlicensed bands) 1.3 Introduction to Cellular Communication: Introduction to cellular concept (cells, frequency reuse – intuitive understanding)	7	CO1
2	**Mobile Communication Generations** 2.1 Limitations of wired communication → need for mobility 2.2 Evolution: 1G → 5G (features, services comparison)	8	CO2

	2.3 GSM architecture (simplified: BTS, BSC, MSC) 2.4 CDMA concept (idea of spread spectrum – conceptual) 2.5 LTE/4G basics (high data rate, packet switching) 2.6 Introduction to 5G (use cases: eMBB, URLLC, mMTC)		
3	**Wireless Networking Technologies** 3.1 Wi-Fi (802.11) – working and applications 3.2 Bluetooth – short range communication 3.3 Zigbee – low power IoT networks 3.4 NFC – contactless communication 3.5 Comparison of technologies (range, data rate, power) 3.6 Introduction to Wireless Sensor Networks (WSN) 3.7 Use cases: smart homes, healthcare, agriculture	7	CO3
4	**Signal Propagation and Interference** 4.1 Basics of wave propagation (LOS, NLOS) 4.2 Path loss and shadowing (conceptual only) 4.3 Multipath fading (real-life effect: call drops) 4.4 Noise types (thermal, interference) 4.5 Sources of interference (co-channel, adjacent channel) 4.6 Simple mitigation techniques (power control, frequency planning)	7	CO4
5	**Mobile Network Architecture** 5.1 Cellular network components (BTS, Core Network, User Equipment) 5.2 Call flow (simplified call setup process) 5.3 Handover concept (why required, types) 5.4 Roaming (national/international concept) 5.5 Role of SIM, IMSI, authentication (basic security idea) 5.6 Introduction to packet core networks (data services)	8	CO5
6	**Future Trends in Wireless Communication** 6.1 5G architecture overview (high-level) 6.2 Applications of 5G (smart cities, autonomous systems) 6.3 Internet of Things (IoT ecosystem) 6.4 Smart devices and connected systems 6.5 Edge computing and AI in telecom (introductory) 6.6 Future directions: 6G vision (conceptual awareness)	7	CO6
	Self-Learning Topics Wi-Fi Network Analysis, Edge Computing in Telecom, AI/ML in Wireless Communication, Network Security in Wireless Systems, Mobile App–Network Interaction		

Text Books:

1. Rappaport, Theodore S. Wireless Communications: Principles and Practice, Pearson.
2. Mischa Schwartz. Mobile Wireless Communications, Cambridge University Press.

References:

1. Feher, Kamilo. Wireless Digital Communications: Modulation and Spread Spectrum Applications, Prentice Hall.
2. Pahlavan, Kaveh & Levesque, Allen H. Wireless Information Networks, Wiley.

Recommended Swayam NPTEL Courses:

1. NPTEL course on ***Wireless Communications by*** Prof. Aditya K. Jagannatham
2. NPTEL course on ***Introduction to Cellular and Mobile Communication by*** Prof. Ranjan Bose

Assessment:

Internal Assessment (IA) for 20 marks each:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of the syllabus content must be covered in the IAT-I and the remaining 40% to 50% of the syllabus content must be covered in the IAT-II.

End Semester Theory Examination:

- **Question paper format**

  - Question Paper will comprise a total of **six questions each carrying 15 marks Q.1** will be **compulsory** and should **cover the maximum contents of the syllabus**

  - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

  - A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tuts	Theory	Practical	Tuts	Total
MDL501	Wireless and Mobile Communication Lab	-	2	---	-	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Practical & Oral	Total
MDL501	Wireless and Mobile Communication Lab	Internal Assessment Test (IAT)			End Sem Exam			
		IAT1	IAT2	Total				
		-	-	-	-	25	25	50

Laboratory Objectives:

1. Provide hands-on exposure to cellular and wireless communication concepts.
2. Enable students to simulate and analyze mobile network operations.
3. Familiarize students with short-range wireless technologies such as Wi-Fi and Bluetooth.
4. Introduce spectrum analysis and signal observation using modern tools (including SDR).
5. Develop understanding of wireless security mechanisms and practices.
6. Expose students to real-world applications and emerging wireless technologies.

Laboratory Outcomes:

After successful completion of the course student will be able to

1. Simulate and analyze basic cellular network operations such as call setup and handover.
2. Configure and evaluate Wi-Fi and Bluetooth communication systems.
3. Analyze RF spectrum and identify signal characteristics.
4. Interpret GSM/LTE communication fundamentals and device interaction.
5. Apply basic wireless security mechanisms in practical scenarios.
6. Evaluate real-world applications and trends in wireless communication.

Suggested List of Experiments:

No	List of Experiments	LO
1	Study of electromagnetic spectrum allocation and wireless bands used in communication.	1
2	Simulation of basic communication system (Tx–Channel–Rx) using MATLAB / Python / online tools.	2
3	Demonstration of frequency reuse concept in cellular systems (simulation/visualization).	2
4	Wi-Fi network scanning using mobile apps (SSID, RSSI, channel mapping).	2
5	Measurement of signal strength vs distance for Wi-Fi router.	3
6	Analysis of channel interference in the 2.4 GHz band.	3

7	Throughput and latency measurement using network tools (e.g., ping, speed test).	4
8	Study of Bluetooth communication using mobile devices (pairing, range testing).	4
9	Data transfer using Bluetooth and analysis of performance.	4
10	Study of path loss in an indoor environment (RSSI vs obstacles).	5
11	Analysis of multipath effects (signal fluctuation observation).	5
12	Noise and interference analysis in wireless communication.	6
13	Study of cellular network parameters using smartphones (signal strength, network type 2G/3G/4G/5G).	6
14	Analysis of handover behaviour while moving (field observation).	6
15	Introduction to network simulation tool (NS-3 / any GUI-based simulator) – basic experiment.	6

Suggested List of Assignments:

Sr. No	List of Assignment/Tutorial	LO
01	1. **Case Study Assignment:** Compare Wi-Fi, Bluetooth, and Zigbee in terms of range, data rate, and applications.	6
02	**Technology Analysis Assignment:** Study evolution of cellular systems (1G to 5G) with focus on real-world applications.	6
03	**Application-Based Assignment:** Analyze wireless communication used in any one system (smart home / drone / healthcare).	6
04	**Mini Design Assignment:** Propose a wireless communication setup for a given scenario (e.g., campus Wi-Fi design, smart parking system).	6

References

1. Prasad, Ramjee. 4G: LTE/LTE-Advanced for Mobile Broadband, Academic Press.

2. Garg, Vijay K. Wireless Communications & Networking, Morgan Kaufmann.

Assessment:

Term Work: Term Work shall consist of at least 08 practical and 02 assignments based on the above list.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 05 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

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Sem. - VI

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tuts	Theory	Practical	Tuts	Total
MDC601	Internet and Data Communication	3	---	---	3	--	--	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
MDC601	Internet and Data Communication	20	20	40	60	2	-	-	100

Course Objectives:

1. Introduce fundamental concepts of Internet architecture and data communication models.
2. Explain key technologies enabling wired and wireless data communication.
3. Develop understanding of modern data networks including cloud and mobile systems.
4. Familiarize students with cybersecurity mechanisms in communication networks.
5. Provide insights into IoT communication frameworks and real-world applications.
6. Expose students to emerging trends such as AI-driven networks and quantum communication.

Course Outcomes: After successful completion of the course, students will be able to

1. Explain Internet architecture and core protocols such as TCP/IP and DNS.
2. Describe various data communication technologies including fiber optics and satellite systems.
3. Analyze wireless data communication systems and cloud-based networking.
4. Identify cybersecurity threats and apply basic protection mechanisms.
5. Interpret IoT communication protocols and applications.
6. Evaluate emerging trends in Internet communication such as AI and quantum technologies.

Module No.	Topics	Hours	CO Mapping
1	**Basics of Internet Communication** 1.1 Evolution of Internet and data communication 1.2 Layered communication models: OSI vs TCP/IP (comparison) 1.3 TCP/IP model in detail (Application, Transport, Network, Link layers – functions only) 1.4 Overview of key protocols: HTTP, FTP, TCP, UDP, IP 1.5 Domain Name System (DNS): hierarchy, name resolution process 1.6 IP addressing basics (IPv4, IPv6 – concept only) 1.7 Packet switching vs circuit switching	7	CO1
2	**Data and Feature Extraction from Signals** 2.1 Guided vs unguided transmission media overview 2.2 Fiber optic communication: principle, advantages, applications	7	CO2

	2.3 Satellite communication: GEO, MEO, LEO systems (conceptual) 2.4 Optical networks: basic architecture and applications 2.5 Introduction to high-speed backbone networks 2.6 IoT connectivity basics (LPWAN, NB-IoT – conceptual overview) 2.7 Comparison of communication technologies		
3	**Wireless Data Networks** 3.1 Wi-Fi (802.11): architecture and working 3.2 Cellular data networks: 4G LTE and 5G basics 3.3 Mobile data communication architecture (user → base station → core network) 3.4 Concepts of bandwidth, latency, throughput 3.5 Introduction to cloud communication and cloud networking 3.6 Data delivery models: client-server, peer-to-peer 3.7 Applications: streaming, VoIP, online services	8	CO3
4	**Cybersecurity in Telecommunication** 4.1 Need for security in communication systems 4.2 Common threats: eavesdropping, spoofing, DoS attacks 4.3 Encryption basics: symmetric vs asymmetric (conceptual) 4.4 Virtual Private Networks (VPN): working and applications 4.5 Firewalls: types and functions 4.6 Network security protocols (SSL/TLS – basic idea) 4.7 Secure communication practices	7	CO4
5	**Internet of Things (IoT)** 5.1 IoT architecture (devices, gateways, cloud) 5.2 IoT communication protocols: MQTT, CoAP, HTTP 5.3 Sensor networks and data collection 5.4 Smart applications: smart homes, healthcare, agriculture 5.5 Challenges in IoT (security, scalability, power) 5.6 Edge computing basics	8	CO5
6	**Future of Internet Communication** 6.1Role of AI in telecommunication (network optimization, automation) 6.2 Self-organizing networks (SON concept) 6.3 Introduction to intelligent traffic management 6.4 Quantum communication basics (qubits, quantum key distribution – conceptual) 6.5 Future Internet trends: 6G, ultra-low latency systems 6.6 Integration of AI, IoT, and cloud in next-gen networks	8	CO6
	Self-Learning Topics Case study: smart city system, Case studies on future of Internet communication and emerging applications		

Text Books:

1. Stallings, William. Data and Computer Communications, Pearson.
2. Kurose, James & Ross, Keith. Computer Networking: A Top-Down Approach, Pearson.

References:

1. Tanenbaum, Andrew S. & Wetherall, David J. Computer Networks, Pearson.
2. Peterson, Larry & Davie, Bruce. Computer Networks: A Systems Approach, Morgan Kaufmann.

Recommended Swayam NPTEL Courses:

1. NPTEL course on communication Networks, Prof. Goutam Das. IIT Kharagpur https://onlinecourses.nptel.ac.in/noc26_ee43/preview
2. NPTEL course on Network Security by prof Gaurav Kasbekar, IIT bombay https://onlinecourses.nptel.ac.in/noc25_ee54/preview

Assessment:

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  - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

  - A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tuts	Theory	Practical	Tuts	Total
MDL601	Internet and Data Communication Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Practical & Oral	Total
MDL601	Internet and Data Communication Lab	Internal Assessment Test (IAT)			End Sem Exam			
		IAT1	IAT2	Total				
		-	-	-	-	25	25	50

Laboratory Objectives:

1. Provide hands-on understanding of IP addressing, routing, and network configuration.
2. Enable students to configure and analyze wired and wireless communication systems.
3. Introduce practical aspects of cybersecurity and secure communication.
4. Familiarize students with IoT communication and data transmission.
5. Develop skills to measure and analyze network performance parameters.
6. Expose students to real-world Internet-based applications and systems.

Laboratory Outcomes:

After successful completion of the course student will be able to

1. Configure IP addressing and basic routing in network setups.
2. Implement and test Wi-Fi and wired communication systems.
3. Apply basic cybersecurity techniques for secure communication.
4. Demonstrate data transmission using IoT devices.
5. Analyze network performance using standard tools.
6. Evaluate real-world Internet applications and communication frameworks.

Suggested List of Experiments:

Module No	List of Experiments	LO
1	Network Configuration and Routing 1. Study of IPv4 addressing and subnetting using simulation tools. 2. Configuration of static IP addresses in a LAN. 3. Demonstration of routing using Packet Tracer (static routing).	1
2	Wi-Fi and Optical Fiber Setup 4. Wi-Fi network setup and configuration (SSID, password, security mode). 5. Measurement of Wi-Fi signal strength vs distance.	2

	6. Demonstration of optical fiber communication (simulation/video-based if hardware not available).	
3	Cybersecurity and Data Privacy 7. Study of secure communication using HTTPS vs HTTP. 8. VPN setup and secure browsing demonstration. 9. Firewall configuration and testing (basic OS firewall or simulator).	3
4	IoT Device Communication 10. Data transmission using the IoT platform (ESP32 / simulator like Tinkercad). 11. MQTT-based communication demonstration (publish–subscribe model). 12. Sensor data transmission to cloud/dashboard (basic demo).	4
5	Network Performance Analysis 13. Measurement of network latency using ping command. 14. Bandwidth and speed testing using online tools. 15. Packet analysis using Wireshark (basic packet inspection).	5
6	Case Study / Application-Oriented 16. Case study analysis of an e-governance system (network architecture). 17. Study of fintech transaction flow (secure communication). 18. Cloud-based application communication analysis (client-server interaction).	6

Suggested List of Assignments:

Sr. No	List of Assignment/Tutorial	LO
01	**Network Design Assignment** Design a small office/home network with IP addressing and routing plan.	1
02	**Security Analysis Assignment** Compare HTTP vs HTTPS and analyze real-world data security mechanisms	3
03	**IoT Application Assignment** Propose an IoT-based solution (smart home, agriculture, healthcare).	4
04	**Case Study Assignment** Analyze any one Internet-based system (UPI, Aadhaar, cloud platform, etc.) focusing on communication flow.	6

Suggested Tools / Platforms:

1. Cisco Packet Tracer
2. Wireshark
3. Ping / Traceroute (command line)
4. Tinkercad / IoT simulators
5. Web-based speed test tools
6. Mobile apps for Wi-Fi analysis

References

1. Forouzan, Behrouz. Data Communications and Networking, McGraw Hill.
2. Kurose, James & Ross, Keith. Computer Networking: A Top-Down Approach, Pearson.

Assessment:

Term Work: Term Work shall consist of at least 08 practical and 2 Assignments based on the above suggested list.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 05 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held for 25 marks based on the above syllabus.

Sd/-	**Sd/-**	**Sd/-**
Dr. Faruk Kazi	**Dr. Deven Shah**	**Prof. Shivram S. Garje**
BoS-Chairman- Electronics and Telecommunication Engineering Faculty of Technology	**Associate Dean Faculty of Science & Technology**	**Dean Faculty of Science & Technology**