Course Syllabus
Gyanmanjari College of Computer Science
Semester-5 (BSCIT)

**Subject:** Wireless Communication – BSCIT15318

**Type of course:** Minor Stream

**Prerequisite:** Basic knowledge of Communication Systems, Computer Networks, and fundamental Electronics concepts, along with an understanding of signals and data transmission. Students should also possess analytical and problem-solving skills to understand wireless technologies, network behavior, and real-world communication scenarios.

**Rationale:**

This course equips students with the knowledge and skills to understand and analyze wireless communication systems and technologies used in modern networks. It covers wireless channels, cellular architecture, digital communication techniques, and emerging technologies like MIMO and IoT through both theoretical concepts and practical exposure. Students learn to evaluate network performance, understand signal behavior, and apply wireless solutions in real-world scenarios. The course prepares learners for careers in telecommunications, networking, and wireless system design.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | SEE | | CCE | | | |
| CI | T | P | C | Theory | Practical | MSE | LWA | ALA | |
| 3 | 0 | 2 | 4 | 75 | 25 | 30 | 20 | 50 | 200 |

***Legends:*** *CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; SEE - Semester End Evaluation; MSE- Mid Semester Examination; LWA - Lab Work Assessment; V – Viva voce, CCE-Continuous and Comprehensive Evaluation; ALA- Active Learning Activities.*

3 Credits * 25 Marks = 75 Marks (each credit carries 25 Marks) Theory
1 Credits * 25 Marks = 25 Marks (each credit carries 25 Marks) Practical
SEE 100 Marks will be converted in to 50 Marks
CCE 100 Marks will be converted in to 50 Marks
It is compulsory to pass in each individual component.

## Course Content:

| Sr. No | Course content | Hrs | % Weightage |
|---|---|---|---|
| 1 | **Fundamentals of Wireless Communication :** Basics of communication system including transmitter, receiver and channel, Types of signals: analog and digital, Wired vs wireless communication, History and evolution of wireless communication, Electromagnetic spectrum and frequency bands, Communication modes: simplex, half duplex and full duplex, Modulation basics: AM, FM and PM , Multiplexing techniques: FDM and TDM. | 9 | 20% |
| 2 | **Wireless Transmission, Channels & Propagation :** Wireless transmission fundamentals, Introduction to wireless communication, Characteristics of wireless channels, Large scale path loss, Path loss models: Free space and Two-ray model, Link budget design, Small scale fading, Multipath propagation, Time dispersion parameters, Coherence bandwidth, Doppler spread and coherence time, Types of fading: flat fading and frequency selective fading, Fast fading and slow fading, Interference in wireless communication: co-channel interference and adjacent channel interference. | 12 | 20% |
| 3 | **Cellular Communication & Multiple Access Techniques :** Introduction to cellular communication systems, Cellular concept and frequency reuse, Cell structure and cluster formation, Channel assignment strategies (fixed and dynamic), Handoff techniques (hard and soft handoff), Interference in cellular systems and system capacity (basic concept), Trunking and grade of service, Multiple access techniques: Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Overview of modern cellular systems. | 10 | 20% |
| 4 | **Digital Signaling For Wireless & Fading Channels :** Structure of a wireless communication link, Digital modulation techniques: Offset-QPSK, $\pi/4$-DQPSK, Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying (GMSK), Error performance in fading channels (basic concept), Introduction to Orthogonal Frequency Division Multiplexing (OFDM), Cyclic prefix, Windowing, Peak-to-Average Power Ratio (PAPR). | 8 | 20% |

| | | | |
|---|---|---|---|
| 5 | **Advanced Wireless Technologies & Applications :**<br>Introduction to Multiple Input Multiple Output (MIMO) systems, Spatial multiplexing, Beamforming, Transmitter and receiver diversity, Channel state information (CSI), Capacity in fading and non-fading channels.<br>Introduction to modern wireless technologies: 5G overview, Internet of Things (IoT), Applications of wireless communication in smart cities, mobile communication, wireless banking and e-commerce, Basics of wireless security. | 6 | 20% |

**Continuous Assessment:**

| Sr. No | Active Learning Activities | Marks |
|---|---|---|
| 1 | **Wireless Technology Survey :**<br>Students will study and compare different wireless technologies such as Wi-Fi, Bluetooth, 4G, and 5G. They will prepare a short report highlighting features, advantages, limitations, speed, range, and real-life applications of each technology. The report should be neat and well-organized with proper comparison in table format. All students must upload their **ALA report on the GMIU Web Portal in PDF format.** | 10 |
| 2 | **Signal Visualization and Comparison :**<br>Students will generate and compare analog and digital signals using simulation tools such as Python or MATLAB. They will plot waveforms and analyze differences in terms of continuity, amplitude, and representation. The report should include graphs and a brief comparison of both signal types. All students must upload their **ALA report on the GMIU Web Portal in PDF format.** | 10 |
| 3 | **Cellular Network Case Study :**<br>Students will study the working of cellular networks such as **2G, 3G, 4G, and 5G** and prepare a short report explaining important concepts like cell structure, base station, frequency reuse, handoff, coverage area, and mobile communication process with neat labeled diagrams. They should also compare different generations of cellular networks based on speed, technology, and applications. Students must include conclusions and practical uses of modern cellular systems. All students must upload their **ALA report on the GMIU Web Portal** in **PDF format.** | 10 |
| 4 | **Path Loss Analysis :**<br>Students will study signal attenuation using the free space path loss model. They will calculate path loss for different distances and plot the results using tools like Excel or Python. The report should include calculations, graph, and observations about signal behavior. All students must upload their **ALA report on the GMIU Web Portal in PDF format.** | 10 |

| | | |
|---|---|---|
| 5 | **Digital Modulation Comparison :**<br>Students will simulate and compare digital modulation techniques such as QPSK and BPSK. They will plot constellation diagrams and analyze differences in terms of data capacity and performance. The report should include diagrams and a comparison table. All students must upload their ALA report on the GMIU Web Portal in PDF format. | 10 |
| **Total** | | **50** |

## Suggested Specification table with Marks (Theory):75

| Distribution of Theory Marks **(Revised Bloom's Taxonomy)** | | | | | | |
|---|---|---|---|---|---|---|
| Level | Remembrance (R) | Understanding (U) | Application (A) | Analyze (N) | Evaluate (E) | Create (C) |
| Weightage | 30% | 40% | 20% | 10% | - | - |

**Note:** This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

## Course Outcome:

| After learning the course the students should be able to: | |
|---|---|
| CO1 | Understand the fundamental concepts of wireless communication systems, including signal types, modulation, multiplexing, and communication modes. |
| CO2 | Analyze wireless transmission characteristics, propagation models, path loss, fading, and interference in wireless communication systems. |
| CO3 | Explain cellular communication concepts, frequency reuse, handoff mechanisms, and multiple access techniques used in modern wireless networks. |
| CO4 | Understand digital modulation techniques and evaluate their performance in wireless and fading channel conditions. |
| CO5 | Explore advanced wireless technologies such as MIMO, IoT, and modern communication systems, and their real-world applications. |

## List of Practical

| Sr. No | Descriptions | Unit No | Hrs |
|---|---|---|---|
| 1 | Install and configure NS-3 simulator using WSL/Ubuntu and verify installation by running sample programs. | 1 | 4 |

| | | | |
|---|---|---|---|
| 2 | Generate and analyze analog and digital signals using simulation tools to understand basic signal types. | 1 | 2 |
| 3 | Implement AM and FM modulation techniques and observe waveform characteristics. | 1 | 2 |
| 4 | Create and simulate a point-to-point network using two nodes and analyze basic communication parameters. | 2 | 2 |
| 5 | Simulate node movement using mobility models and analyze dynamic network behavior. | 2 | 2 |
| 6 | Perform delay analysis by modifying channel delay and observe its effect on data transmission. | 2 | 2 |
| 7 | Simulate packet loss by increasing traffic load and reducing bandwidth to study network congestion. | 2 | 2 |
| 8 | Simulate free space path loss model and analyze signal attenuation with distance. | 2 | 2 |
| 9 | Implement UDP client-server communication and observe packet transmission between nodes. | 3 | 2 |
| 10 | Design and simulate a Wi-Fi network using NS-3 to understand wireless communication. | 3 | 2 |
| 11 | Simulate cellular frequency reuse and cluster formation to understand spectrum utilization. | 3 | 2 |
| 12 | Implement QPSK modulation and plot constellation diagram to analyze digital communication. | 4 | 2 |
| 13 | Simulate OFDM system using IFFT and analyze multicarrier transmission characteristics. | 4 | 2 |
| 14 | Simulate a basic MIMO system to study spatial diversity and channel capacity improvement. | 5 | 2 |
| **Total** | | | **30** |

## Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc. From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory.

The internal evaluation will be done on the basis of Active Learning Assignment.

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

## Reference Books:

[1] Wireless Communications: Technical Publications (2021), Bagad V.S.
[2] Mobile Computing and Wireless Communication: Tech-Max Publications (2018) J. S. Katre
[3] 3G Wireless Networks: Tata MCGRAW Hill Publication Limited (2011), Smith
[4] Wireless Communications: Principles and Practice, Second Edition (2002), Theodore S. Rappaport, Prentice Hall
[5] Fundamentals of Wireless Communication (2005), David Tse & Pramod Viswanath, Cambridge University Press