GANPAT UNIVERSITY

FACULTY OF DIPLOMA ENGINEERING

Programme	Diploma in Electronics and Communication Engineering		
Semester	IV	Version	1.0.0.0
Effective from Academic Year	2025-26	Effective for the batch Admitted in	JULY 2025
Course code	1EC4101	Course Name	Analog and Digital Communication

I.TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Type	Course Code	Learning Scheme						Assessment Scheme										
		Actual Contact Hrs./Week			SLH	NLH	Credits	Theory				Practical				Based on SL		Total Marks
		CL	TL	LL				FA-TH	SA-TH	TOTAL		FA-PR	SA-PR	TOTAL		SLA		
								MAX	MAX	MAX	MIN	MAX	MAX	MAX	MIN	MAX	MIN	
SEC	1EC4101	3	-	2	3	8	4	40	60	100	40	30	20	50	20	20	8	170

Abbreviation:	**CL-** Classroom Learning	**TL -** Tutorial Learning	**LL -** Laboratory Learning
	SLH - Self Learning Hours	**NLH -** Notional Learning Hours	**SLA -** Self Learning Assessment
	FA - Formative Assessment (Term work +Mid Sem Exam +Attendance)		**SA -** Summative Assessment

II. PRE-REQUISITES

Basic knowledge of Electronic Devices and Circuits (EDC), including semiconductor devices, amplifiers, and basic signal concepts.

III. INDUSTRY / EMPLOYER EXPECTED OUTCOMES

- Ability to analyze and implement basic analog and digital communication techniques used in modern electronic and telecommunication systems.
- Capability to understand communication channels, noise, and multiplexing for effective system design, testing, and troubleshooting in industry applications.

IV. COURSE LEARNING OUTCOMES

At the end of the course, students will be able to achieve the following course learning outcomes:

CO1: Understand the basic concepts of analog and digital communication systems.

CO2: Analyze AM, FM, and PM modulation techniques.

CO3: Apply sampling, quantization, and pulse modulation techniques.

CO4: Analyze digital modulation schemes and their performance.

CO5: Understand multiplexing, channel characteristics, and noise effects.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:

Name of Unit	Theory Learning outcomes (TLO's) aligned to CO's	Learning Content mapped with Theory Learning outcomes (TLO's) & CO's	Marks	Hours
Unit-1 Introduction to Communication Systems	**TLO 1.1** Understand the basic concept and importance of communication. **TLO 1.2** Differentiate between analog and digital communication systems. **TLO 1.3** Identify the basic components of a communication system. **TLO 1.4** Classify communication systems as point-to-point and broadcast. **TLO 1.5** Understand the concepts of modulation and demodulation. **TLO 1.6** Explain the need and advantages of modulation in	1.1 Introduction to Communication 1.2 Analog and Digital Communication Systems 1.3 Basic Components of a Communication System 1.4 Types of Communication Systems (Point-to-Point, Broadcast) 1.5 Modulation and Demodulation 1.6 Need and Advantages of Modulation	**06**	**08**

	communication systems.			
Unit-2 Analog Modulation Techniques	**TLO 2.1** Understand the basic principle of amplitude modulation. **TLO 2.2** Analyze the mathematical representation of AM signals. **TLO 2.3** Calculate modulation index and interpret AM frequency spectrum. **TLO 2.4** Understand the working of an AM transmitter. **TLO 2.5** Explain the operation of an AM receiver. **TLO 2.6** Understand the concept of frequency modulation. **TLO 2.7** Analyze the mathematical representation of FM signals. **TLO 2.8** Apply Carson's rule to estimate FM bandwidth. **TLO 2.9** Understand the working of FM transmitter and receiver. **TLO 2.10** Understand the basic concept of phase modulation. **TLO 2.11** Differentiate between AM, FM, and PM techniques.	2.1 Amplitude Modulation (AM) – Introduction 2.2 Mathematical Representation of AM 2.3 Modulation Index and Frequency Spectrum of AM 2.4 AM Transmitter 2.5 AM Receiver 2.6 Frequency Modulation (FM) – Introduction 2.7 Mathematical Representation of FM 2.8 Carson's Rule and Bandwidth of FM 2.9 FM Transmitter and Receiver 2.10 Phase Modulation (PM) – Basics 2.11 Comparison of AM, FM, and PM	**10**	**14**
Unit-3 Digital Communication and Pulse Modulation	**TLO 3.1** Understand the fundamentals of digital communication. **TLO 3.2** Explain the advantages of digital communication over analog. **TLO 3.3** Identify characteristics of digital signals. **TLO 3.4** Understand the sampling theorem. **TLO 3.5** Apply Nyquist rate and Nyquist criterion. **TLO 3.6** Understand the concept and effects of aliasing. **TLO 3.7** Explain the process of quantization. **TLO 3.8** Understand the principle of pulse amplitude modulation (PAM). **TLO 3.9** Understand the principle of pulse width modulation (PWM). **TLO 3.10** Understand the principle of pulse position modulation (PPM).	3.1 Introduction to Digital Communication 3.2 Advantages of Digital Communication over Analog 3.3 Digital Signals 3.4 Sampling Theorem 3.5 Nyquist Rate and Nyquist Criterion 3.6 Aliasing 3.7 Quantization 3.8 Pulse Amplitude Modulation (PAM) 3.9 Pulse Width Modulation (PWM) 3.10 Pulse Position Modulation (PPM)	**10**	**14**
Unit - 4 Digital Modulation Techniques	**TLO 4.1** Understand the need for digital modulation. **TLO 4.2** Explain the working of Binary Amplitude Shift Keying (BASK). **TLO 4.3** Explain the working of Binary Phase Shift Keying (BPSK). **TLO 4.4** Explain the working of Binary Frequency Shift Keying (BFSK). **TLO 4.5** Understand modulation and demodulation processes in digital systems. **TLO 4.6** Interpret signal space	4.1 Introduction to Digital Modulation 4.2 Binary Amplitude Shift Keying (BASK) 4.3 Binary Phase Shift Keying (BPSK) 4.4 Binary Frequency Shift Keying (BFSK) 4.5 Modulation and Demodulation Processes 4.6 Signal Space Diagrams 4.7 M-ary Phase Shift Keying (M-PSK)	**09**	**12**

	diagrams for digital modulation schemes. **TLO 4.7** Understand M-ary Phase Shift Keying (M-PSK). **TLO 4.8** Understand Quadrature Amplitude Modulation (QAM). **TLO 4.9** Analyze Bit Error Rate (BER) performance of modulation schemes.	4.8 Quadrature Amplitude Modulation (QAM) 4.9 Bit Error Rate (BER) Performance		
Unit-5 Multiplexing, Channel and Noise	**TLO 5.1** Understand the need for multiplexing in communication systems. **TLO 5.2** Explain the concept of Time Division Multiplexing (TDM). **TLO 5.3** Understand TDM frame structure and applications. **TLO 5.4** Explain the concept of Frequency Division Multiplexing (FDM). **TLO 5.5** Identify applications of FDM. **TLO 5.6** Differentiate between TDM and FDM techniques. **TLO 5.7** Understand the basic concept of Code Division Multiplexing (CDM). **TLO 5.8** Understand the concept of Wavelength Division Multiplexing (WDM). **TLO 5.9** Explain communication channel characteristics such as bandwidth, attenuation, and distortion. **TLO 5.10** Identify different types of noise in communication systems. **TLO 5.11** Understand the concept and importance of Signal-to-Noise Ratio (SNR). **TLO 5.12** Explain the concept of channel capacity.	5.1 Introduction to Multiplexing 5.2 Time Division Multiplexing (TDM) 5.3 TDM Frame Structure and Applications 5.4 Frequency Division Multiplexing (FDM) 5.5 Applications of FDM 5.6 Comparison of TDM and FDM 5.7 Code Division Multiplexing (CDM) 5.8 Wavelength Division Multiplexing (WDM) 5.9 Communication Channel Characteristics (Bandwidth, Attenuation, Distortion) 5.10 Noise in Communication Systems (Thermal, Shot, White Noise, etc.) 5.11 Signal-to-Noise Ratio (SNR) 5.12 Channel Capacity	**10**	**12**

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL

Sr. No.	Practical/Laboratory Learning Outcome (LLO)	Practical Titles	Relevant COs
1	Identify and explain the basic blocks of a communication system through simulation or hardware demonstration.	Study of Basic Communication System Blocks	CO1
2	Demonstrate the process of modulation and demodulation using simple waveforms.	Study of Modulation and Demodulation Concepts	CO1
3	Analyze amplitude modulation parameters and observe AM waveforms.	Generation and Observation of AM Signal	CO2
4	Measure modulation index and frequency spectrum of an AM signal.	AM Modulation Index and Spectrum Analysis	CO2
5	Study the operation of AM transmitter and receiver circuits.	Study of AM Transmitter and Receiver	CO2

6	Generate and observe frequency modulated signals and analyze bandwidth.	Generation and Observation of FM Signal	CO2
7	Verify Carson's rule for FM bandwidth using experimental results.	Verification of Carson's Rule	CO2
8	Generate pulse modulated signals and analyze their characteristics.	Generation of PAM, PWM and PPM Signals	CO3
9	Verify sampling theorem and observe aliasing effect.	Verification of Sampling Theorem	CO3
10	Generate and analyze digital modulation signals.	Study of BASK, BPSK and BFSK	CO4
11	Analyze signal space diagrams and BER performance for digital modulation schemes.	Study of BER Performance of Digital Modulation Techniques	CO4
12	Demonstrate multiplexing techniques for efficient signal transmission.	Study of TDM and FDM Techniques	CO5
13	Analyze the effect of noise on communication signals and calculate SNR.	Study of Noise Effect and SNR Measurement	CO5

VII. SUGGESTED MICRO PROJECT / ASSIGNMENTS / ACTIVITIES FOR SELF LEARNING / SKILL DEVELOPMENT (SELF LEARNING)

A.Self-Learning Assignments / Activities

1. Prepare a chart showing the basic block diagram of a communication system with functions of each block.
2. Create a comparative chart of AM, FM, and PM modulation techniques with waveforms and applications.
3. Prepare a short report explaining advantages of digital communication over analog communication.
4. Develop an animated PPT or video explaining Sampling Theorem, Nyquist rate, and aliasing.
5. Draw and explain waveforms of PAM, PWM, and PPM pulse modulation techniques.
6. Prepare a presentation on digital modulation techniques (BASK, BPSK, BFSK) with diagrams.
7. Create a chart comparing multiplexing techniques such as TDM, FDM, CDM, and WDM.
8. Solve and submit numerical problems related to SNR and channel capacity.
9. Prepare a brief report on different types of noise in communication systems and their effects.

B.Self-Learning Assignments / Activities

1. Generate and demodulate an AM signal and analyze modulation index.
2. Generate an FM signal and verify bandwidth using Carson's rule.
3. Simulate sampling of analog signals and study aliasing effect.
4. Design a pulse modulation signal generator for PAM, PWM, and PPM.
5. Simulate digital modulation schemes (BASK, BPSK, BFSK) and observe waveforms.
6. Analyze Bit Error Rate (BER) performance of digital modulation techniques.
7. Demonstrate Time Division Multiplexing (TDM) or Frequency Division Multiplexing (FDM).
8. Study the effect of noise on communication signals and calculate SNR

VIII. LIST OF INSTRUMENTS / EQUIPMENT / TRAINER BOARD

1. Analog and Digital Communication Trainer Kit
2. AM–FM Modulator and Demodulator Trainer Board
3. Pulse Modulation Trainer (PAM / PWM / PPM)

4. Digital Modulation Trainer (ASK / PSK / FSK)
5. Time Division Multiplexing (TDM) Trainer Kit
6. Frequency Division Multiplexing (FDM) Trainer Kit
7. Function Generator / Signal Generator
8. Cathode Ray Oscilloscope (CRO) / Digital Storage Oscilloscope (DSO)
9. Regulated DC Power Supply
10. Audio Signal Source / Microphone Unit
11. Noise Generator
12. Spectrum Analyzer (optional / virtual)
13. Patch Cords, Connecting Wires, and Accessories
14. Computer System with Simulation Software (MATLAB / Scilab / Multisim)

IX. LIST OF REFERENCE BOOKS

1	Electronic Communication Systems	George Kennedy, Bernard Davis	McGraw-Hill Education
2	Communication Systems	Simon Haykin	Wiley India
3	Principles of Communication Systems	Herbert Taub, Donald Schilling	McGraw-Hill Education
4	Analog and Digital Communication	K. Sam Shanmugam	Wiley
5	Modern Digital and Analog Communication Systems	B. P. Lathi	Oxford University Press
6	Electronic Communication Systems	George Kennedy, Bernard Davis	McGraw-Hill Education

X. LINK OF LEARNING WEB RESOURCE

1	https://nptel.ac.in/courses/117106086
2	https://nptel.ac.in/courses/108105132
3	https://ocw.mit.edu/courses/6-450-principles-of-digital-communications-i-fall-2006/
4	https://www.tutorialspoint.com/digital_communication/index.htm

XI. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	Introduction to Communication Systems	CO1	6	4	3	1	**8**
2	Analog Modulation Techniques	CO2	10	5	5	4	**14**
3	Digital Communication & Pulse Modulation	CO3	10	4	5	5	**14**
4	Digital Modulation Techniques	CO4	9	3	4	5	**12**
5	Multiplexing, Channel & Noise	CO5	10	4	5	3	**12**
Total	—	—	45	20	22	18	**60***

XII. COs AND POs AND PSOs MAPPING

Course outcome (Cos)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	3	0	2	1	1
CO2	3	3	3	3	2	2	2	3	2	3
CO3	3	3	3	2	2	2	2	2	2	3
CO4	3	3	2	2	2	2	0	2	3	2
CO5	3	3	3	1	2	3	0	3	1	1

Legends: - *3- High 2-Moderate/Medium 1-Slight/Low 0-None*