Gyanmanjari Innovative University

Syllabus
Gyanmanjari Institute of Technology
Semester-3 (B.Tech)

Subject: Communication System - BET2EC13301

Type of course: Professional Core.

Prerequisite: Basic understanding of Electronics and Programming.

Rationale: This course provides core knowledge of how information is generated, transmitted, and received across wired and wireless channels. It builds understanding of modulation, signaling, and system reliability, linking basic electronics to modern technologies such as mobile networks, the internet, IoT, and radar. It prepares students to analyze and maintain efficient communication systems used in today's connected world.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
CI	T	P	C	SEE	CCE	
4	0	2	5	100	50	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; SEE - Semester End Evaluation; CCE-Continuous and Comprehensive Evaluation.

Course Content:

Sr. No.	Course Content	Hrs.	% Weightage
1	**Introduction to Communication Systems & Signals** *Theory Topics:* • Signals:Definition,Classification,Elementary signals,Basic Operations on Signals . • Communication Systems: Definition, need and Basic Concepts of Modulation and Demodulation • Elements of Communication System: Information Source, Transmitter, Channel, Receiver, Destination, Noise. • Types of communication: Analog and Digital.	18	20%

- Classification of Communication Systems: Wired & Wireless, Analog & Digital, Simplex, Half Duplex, Full Duplex.
- Electromagnetic Spectrum and Frequency Bands.

Practical:

1. To generate and observe different types of signals using simulation software, and to classify them based on their characteristics such as continuous-time and discrete-time, periodic and aperiodic, deterministic and random, as well as energy and power signals.
2. To Study & generate elementary signals such as unit step, ramp, impulse, sinusoidal, and exponential signals using simulation software.
3. To perform amplitude scaling operations such as amplification and attenuation on different signals using simulation software.
4. To analyze the effect of time shifting on signal representation and behavior.
5. To perform time scaling operations such as compression, expansion, and signal folding (time reversal) on different signals.
6. To generate different communication signals using simulation tools/CRO and measure their amplitude, frequency, time period, and phase.
7. To generate and analyze different analog and digital communication signals using simulation software./HARDWARE
8. To simulate modulation and demodulation processes using message and carrier signals.
9. To study different regions of the electromagnetic spectrum and their frequency ranges.
10. To simulate a basic communication system including transmitter, channel, receiver, and noise.

Evaluation Method

Sr. No.	Evaluation methods	SEE (Marks)	CCE (Marks)

	1	**Signal Analysis:** Students must identify and analyze different types of communication signals.	10	–		
	2	**Signal Operations:** Students will perform given signal operations using simulation and compare it with mathematical results.	10	-		
	2	**Frequency Band Exploration:** Students will prepare a chart showing Frequency range Application area Example devices(include Radio Waves, Microwaves, Infrared, Visible Light, Ultraviolet.(ALA-1)	–	10		
		Total	20	10		

Examination style:

Signal Analysis(10 marks)

The faculty will provide the characteristics of a signal. Students are required to identify the type of signal based on the given characteristics, generate the signal using appropriate software tools, and perform a detailed analysis of its properties. The analysis should include the evaluation of relevant signal parameters such as amplitude, frequency, period, phase, power, energy, bandwidth, and other associated characteristics, as applicable. Students should demonstrate their understanding of signal classification and interpretation by presenting the generated signal and discussing the observed results. Marks will be awarded based on the accuracy of signal identification, software implementation, parameter analysis, and presentation of findings.

Signal Operations(10 marks)

Students are required to perform the specified signal operations using appropriate simulation software and verify the results through mathematical analysis. The assigned operations may include time shifting, time scaling, amplitude scaling, signal addition, subtraction, multiplication, folding, and other fundamental signal transformations. After completing the simulation, students should compare the simulated outputs with the corresponding mathematical results and discuss any observations. The evaluation will focus on the correctness of the

	implemented operations, accuracy of the mathematical calculations, consistency between simulated and analytical results, and the clarity of the interpretation and presentation of findings. Marks will be awarded based on both technical accuracy and analytical understanding. **Frequency Band Exploration(10 marks)** Students will prepare a comprehensive chart illustrating different regions of the electromagnetic spectrum, including Radio Waves, Microwaves, Infrared, Visible Light, and Ultraviolet bands. The chart should clearly present the frequency range, application areas, and example devices or systems associated with each frequency band. Students should investigate the characteristics and practical uses of these frequency ranges in communication, sensing, medical, industrial, and consumer applications. The activity aims to enhance understanding of the relationship between frequency bands and their real-world applications. Marks will be awarded based on the accuracy of the frequency ranges, relevance of applications and examples, completeness of the chart, and the overall quality of presentation.		
2	**Analog Communication Techniques** ***Theory Topics:*** • Introduction to Analog Communication. • Amplitude Modulation (AM): Principle, Modulation Index, Waveforms, Spectrum, Applications. • Frequency Modulation (FM): Principle, Frequency Deviation, Waveforms, Bandwidth, Applications. • Phase Modulation (PM): Basic Concept and Applications. • Comparison of AM, FM, and PM Techniques. • Demodulation Techniques for AM and FM Signals. • Transmitters and Receivers: Basic Block Diagram and Working. • Applications of Analog Communication ***Practical:*** 11. To generate an amplitude modulated (AM) signal using message and carrier signals. 12. To determine the modulation index of an AM signal from its waveform 13. To study variation in modulation index with change in modulating signal amplitude. 14. To recover the original message signal from an AM waveform using demodulation.	**20**	**25%**

15. To generate a frequency modulated (FM) signal and observe its waveform.
16. To demodulate an FM signal and recover the original message signal
17. To generate a phase modulated (PM) signal using simulation or hardware.
18. To observe the effect of modulating signal amplitude on phase deviation.
19. To demodulate & compare the recovered signal with the original input signal.
20. To generate and analyze AM, FM, and PM signals under similar conditions.

Evaluation Method

Sr. No.	Evaluation Component	SEE (Marks)	CCE (Marks)
1	**Numericals:** Students will solve Numericals based on AM,FM and PM.	10	-
2	**Analog Communication signal Generation and Reconstruction:** Students will generate AM/FM /PM (given)communication signals and also reconstruct signals back.	10	-
3	**Analyse application of AM,FM and phase Modulation in real Time application:** Students will take real time Examples and categories its modulation Type and upload observation reports on the GMIU web portal.(ALA-2)	-	10
	Total	20	10

Examination style

Numericals(10 marks)

	Students will solve numerical problems related to Amplitude Modulation (AM), Frequency Modulation (FM), and Phase Modulation (PM). The problems may involve the calculation of modulation index, carrier and sideband frequencies, bandwidth, transmitted power, frequency deviation, phase deviation, and other relevant modulation parameters. Students should demonstrate a clear understanding of the underlying concepts by applying appropriate formulas and presenting step-by-step solutions. The activity is designed to strengthen analytical and problem-solving skills in analog communication systems. Marks will be awarded based on the accuracy of calculations, correct application of formulas, clarity of the solution process, and interpretation of results. **Analog Communication signal Generation and Reconstruction(15 marks)** Students will perform practical activities related to the generation and reconstruction of analog communication signals. The experiment may involve generating message signals, modulating them using suitable analog modulation techniques, transmitting the modulated signal through a communication channel, and reconstructing the original message signal at the receiver using appropriate demodulation methods. Students should demonstrate a clear understanding of the principles of signal generation, modulation, transmission, demodulation, and signal reconstruction by applying correct procedures and explaining each stage of the process. The activity is designed to strengthen practical skills and conceptual understanding in analog communication systems. Marks will be awarded based on the correct setup and operation of equipment, accurate observation of waveforms and measurements, proper application of modulation and demodulation techniques, clarity of the procedure followed, interpretation of results, and the overall quality of the experimental report. **Analyse application of AM,FM and phase Modulation in real Time application(10 marks)** Students will analyze the real-time applications of Amplitude Modulation (AM), Frequency Modulation (FM), and Phase Modulation (PM) in communication systems. The activity may include studying technologies such as AM/FM radio broadcasting, television, satellite communication, mobile networks, and wireless data transmission. Students should explain the suitability of each modulation technique based on factors such as bandwidth, noise immunity, signal quality, and transmission efficiency. The activity aims to develop analytical and application-oriented skills in analog communication. Marks will be awarded based on technical		

	accuracy, relevance of examples, comparison of techniques, and clarity of analysis.		
3	**Digital Communication Systems** *Theory Topics:* • Introduction to Digital Communication and its Advantages. • Sampling and Quantization Concepts. • Pulse Modulation Techniques: PAM, PWM, PPM. • Pulse Code Modulation (PCM): Block Diagram and Working. • Digital Modulation Techniques: ASK, FSK, PSK. • Data Transmission Concepts: Bit Rate, Baud Rate, Bandwidth. • Error Detection and Correction Techniques. • Applications of Digital Communication in Computer Networks and Mobile Communication. *Practical:* 21. To perform sampling of an analog signal and study the effect of different sampling frequencies on the resulting discrete-time signal. 22. To reconstruct the original analog signal from its sampled data using appropriate techniques. 23. To analyze the quantization process by converting sampled signal amplitudes into discrete levels. 24. To generate a PAM signal and reconstruct the original message signal using simulation or hardware. 25. To study the variation of pulse width with input signal amplitude and understand PWM operation. 26. To simulate Pulse Code Modulation (PCM) including sampling, quantization, and encoding processes. 27. To generate an Amplitude Shift Keying (ASK) signal using simulation or hardware. 28. To analyze frequency and phase variation with binary input and recover original data. 29. To implement error detection techniques such as parity check or checksum. **Evaluation Method**	**18**	**20%**

Sr. No.	Evaluation Component	SEE (Marks)	CCE (Marks)
1	**Digital Communication System generation Technique:** Students will generate and analyze digital communication signals and explain transmission concepts.	10	–
2	**Error check:** Transmit a digital data sequence using given technique. Introduce an error intentionally during transmission and demonstrate how the receiver detects the error. Record observations and draw conclusions.	10	-
3.	**Comparative analysis:** Students will make comparative study of Different digital Techniques and Submit reports on the GMIU web portal.(ALA-3)	–	10
	Total	20	10

Examination style

Digital Communication System generation Technique(10 marks)

Students will generate and analyze digital communication signals and explain transmission concepts. The activity may involve the generation of digital signals using techniques such as ASK, FSK, PSK, and PCM, along with the observation and interpretation of their waveforms. Students should demonstrate an understanding of signal generation, encoding, modulation, and transmission processes in digital communication systems. The activity is designed to strengthen practical and analytical skills in digital communication. Marks will be awarded based on the correct generation of signals, accuracy of analysis, understanding of transmission concepts, interpretation of results, and clarity of presentation.

Error check(10 marks)

Students will perform error detection in digital communication systems using parity checking and checksum techniques. The activity may involve generating digital data, transmitting it through a communication channel, introducing errors due to noise or disturbances, and detecting these errors at the receiver. Students should demonstrate an understanding of data

	integrity, reliable communication, and the limitations of basic error detection methods.It is designed to strengthen analytical, logical reasoning, and practical skills in digital communication. Marks will be awarded based on the accuracy of implementation, effectiveness of error detection, interpretation of results, understanding of concepts, and clarity of presentation. . **Comparative analysis(10 marks)** Students will conduct a comparative study of different digital communication techniques such as ASK, FSK, PSK, and PCM. The activity may involve analyzing their working principles, bandwidth requirements, noise immunity, transmission efficiency, advantages, limitations, and practical applications. Students should evaluate the performance of each technique and present their findings in a well-structured report. The activity is designed to develop analytical, research, and technical writing skills in digital communication systems. Marks will be awarded based on the depth of analysis, technical accuracy, quality of comparison, interpretation of results, and timely submission of the report on the GMIU Web Portal .		
4	**Signal Processing & Multiplexing Techniques** ***Theory Topics:*** • Sampling Theorem and Nyquist Rate. • Aliasing: Causes, Effects, and Prevention Techniques. • Quantization and Quantization Error. • Signal-to-Noise Ratio (SNR) in Communication Systems. • Multiplexing Techniques: Frequency Division Multiplexing (FDM), Time Division Multiplexing (TDM). • Introduction to Multiplexer (MUX) and Demultiplexer (DEMUX). • Applications of Multiplexing in Communication Networks. • Pulse Transmission and Signal Distortion. • Practical Applications of Signal Processing in Modern Communication Systems. ***Practical:*** 30. To verify the Sampling Theorem by sampling an analog signal at different sampling frequencies and studying accurate signal reconstruction. 31. To observe the effects of undersampling and aliasing when a signal is sampled below the Nyquist rate. 32. To analyze the quantization process by converting sampled analog signals into discrete amplitude levels.	**18**	**20%**

33. To measure and evaluate quantization error by comparing original and quantized signals at different quantization levels.
34. To calculate the Signal-to-Noise Ratio (SNR) of a signal and study its effect on communication quality.
35. To implement and study the operation of Multiplexer (MUX) and Demultiplexer (DEMUX) circuits for signal transmission and routing.
36. To simulate Time Division Multiplexing (TDM) and study the transmission of multiple signals over a common communication channel using different time slots.
37. To implement Frequency Division Multiplexing (FDM) and study the simultaneous transmission of multiple signals using different carrier frequencies.
38. To demonstrate the application of filters in communication systems for removing unwanted frequency components and noise from signals.

Evaluation Method

Sr. No.	Evaluation Component	SEE (Marks)	CCE (Marks)
1	**TDM/FDM :** Students are required to Combine signals using the given techniques and retrieve original signals.	10	
2	**Signal Processing & Multiplexing :** Students are required to Simulate sampling, aliasing analysis, and multiplexing operations.	10	–
3	**Test, observe and Reconstruct:** Students are Divided into groups. Each group generates a sinusoidal signal using MATLAB. Use different sampling frequencies: Below Nyquist rate, Equal to Nyquist rate,Above Nyquist rate Compare reconstructed signals. Upload report.	–	10

		Total	20	10	

Examination style

TDM/FDM(10 marks)
Students are required to combine multiple signals using **Time Division Multiplexing (TDM)** and **Frequency Division Multiplexing (FDM)** techniques and retrieve the original signals through the demultiplexing process. The activity may involve generating input signals, performing multiplexing, observing the combined signal, and recovering the individual signals at the receiver. Students should demonstrate an understanding of multiplexing principles, channel utilization, signal separation, and transmission efficiency. The activity is designed to strengthen practical and analytical skills in communication systems. Marks will be awarded based on the correct implementation of TDM/FDM techniques, accuracy of signal recovery, interpretation of results and understanding of concepts.

Signal Processing & Multiplexing (10 marks)
Students are required to simulate sampling, aliasing analysis, and multiplexing operations using appropriate software or hardware tools. The activity may involve generating analog signals, performing sampling at different rates, observing aliasing effects, and applying multiplexing techniques such as TDM or FDM for signal transmission. Students should analyze the impact of sampling frequency on signal reconstruction and evaluate the efficiency of multiplexing methods. The activity is designed to strengthen practical understanding of signal processing and communication concepts. Marks will be awarded based on the accuracy of simulation, analysis of results, understanding of concepts, and interpretation of observations.

Test, observe and Reconstruct(10 marks)
Students will be divided into groups and required to generate a sinusoidal signal using MATLAB. Each group will perform sampling at different rates: below the Nyquist rate, equal to the Nyquist rate, and above the Nyquist rate. The sampled signals will be reconstructed and compared to analyze the effects of sampling frequency on signal recovery and aliasing. Students should observe waveform characteristics, evaluate reconstruction accuracy, and interpret the results. The activity is designed to strengthen understanding of sampling theory and signal reconstruction. Marks will be awarded based on simulation accuracy, analysis of observations, comparison of results, understanding of concepts, and submission of a well-structured report on the GMIU Web Portal.

5	**Radio Communication Transmitters, Receivers, and Noise** ***Theory Topics:***	**16**	**15%**

	• AM Transmitters, FM Transmitters • AM Receiver, FM Receiver • Comparison of AM and FM Receivers. • Types of noise: thermal, shot, impulse, etc. Signal-to-noise ratio (SNR) Noise figure, Noise in AM and FM systems *Practical:* 39. To generate and analyze Amplitude Modulated (AM) signals with different modulation indices and study their time-domain and frequency-domain characteristics. 40. To generate and analyze Frequency Modulated (FM) signals with varying frequency deviations and examine the relationship between modulation index and bandwidth. 41. To design and simulate an AM transmitter and study the generation and transmission of amplitude-modulated signals. 42. To design and simulate an FM transmitter and analyze the effects of message signal parameters on the generated FM waveform. 43. To design and simulate an AM receiver using an envelope detector and recover the original modulating signal from the received AM waveform. 44. To design and simulate an FM receiver using a frequency discriminator and recover the original message signal from the FM waveform. 45. To study the effects of different types of noise on AM signals and analyze the resulting degradation in signal quality. 46. To measure the Signal-to-Noise Ratio (SNR) of communication signals under different noise conditions and evaluate its impact on system performance. 47. To perform pre-emphasis and de-emphasis operations in an FM communication system and study their effect on noise reduction and signal quality improvement. 48. To compare the performance of AM and FM receivers under identical noise conditions and evaluate their noise immunity, fidelity, and overall communication quality. 49. To apply pre-emphasis techniques in FM communication systems and observe the enhancement of higher-frequency components before transmission. 50. To implement de-emphasis techniques in FM communication systems and study the recovery of the original signal at the receiver. 51. To compare the performance of AM and FM communication systems under noisy channel conditions and analyze their relative noise immunity. **Evaluation Method**		

Sr. No.	Evaluation Component	SEE (Marks)	CCE (Marks)
1	**Software simulation:** Students will draw a complete given communication system and simulate it on software.Also explain block(given) in detail	10	–
2	**Noise Analysis:** Students will add the given type of Noise and remove it.	10	
3	**Model Preparation:** Students will make a model of any communication system and upload video on the GMIU web portal.	–	10
	Total	20	10

Examination style

Software simulation(20 marks)
Students will draw a complete communication system based on the given specifications and simulate its operation using appropriate software tools such as MATLAB, Simulink, or other communication simulation platforms. The activity may include signal generation, modulation, transmission through a channel, reception, demodulation, and output signal analysis. Students should demonstrate an understanding of the functioning of the given block and evaluate the overall system performance through simulation results. The activity is designed to strengthen practical skills in communication system design and analysis. Marks will be awarded based on the accuracy of system implementation, simulation results, understanding of concepts, and interpretation of observations.

Model Preparation(10 marks)
Students will design and develop a working model of any communication system, such as AM, FM, digital communication, optical communication, or wireless communication systems. The activity may involve demonstrating the basic principles, components, signal transmission process, and practical applications of the selected system. Students should explain the operation of the model and present its functionality through a video demonstration. The activity is designed to enhance creativity, practical understanding, teamwork, and application-oriented learning in

	communication engineering. Marks will be awarded based on the originality of the model, technical accuracy, working demonstration, clarity of explanation, video quality, and timely upload of the video on the GMIU Web Portal.		

Suggested Specification Table with Marks:

Distribution of Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage %	10%	15%	25%	15%	10%	25%

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

Course Outcome:

After learning the course, the students should be able to:	
CO1	Explain the fundamentals of communication systems, signal types, and basic communication components.
CO2	Analyze and implement analog communication techniques such as AM, FM, and PM modulation systems.
CO3	Demonstrate digital communication concepts including sampling, PCM, digital modulation, and error detection techniques.
CO4	Apply signal processing concepts such as aliasing, multiplexing, MUX/DEMUX operations, and sampling analysis in communication systems.
CO5	Develop and analyze basic communication applications using transducers, sensors, and wireless communication interfaces for real-world applications.

Instructional Method:

The course delivery method will depend on the content requirements and students' needs. The teacher, in addition to the conventional teaching method by the blackboard, may also use any of the tools, such as demonstration, role play, quizzes, brainstorming, MOOCs, etc.

From the content, 10% of topics are suggested for flipped-mode instruction.

Students will utilise supplementary resources, including online videos, NPTEL/SWAYAM videos, e-courses, and Virtual Laboratories.

The internal evaluation will be done on the basis of the CCE-Continuous and Comprehensive Evaluation.

SEE: Semester End Evaluation will be conducted at the end of each module for the evaluation of the performance of students in the laboratory.

Reference Books

[1] B.P. Lathi, "Modern Digital and Analog Communication Systems", Oxford University Press

[2] George Kennedy and Bernard Davis, "Electronic Communication Systems", McGraw-Hill Education

[3] D. Roddy, Electronic Communications. New Delhi, India: Pearson.

[4] Taub and Schilling, "Principles of Communication Systems", McGraw-Hill Education

[5] John G. Proakis and Masoud Salehi, "Fundamentals of Communication Systems", Pearson Education