FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **BACHELOR OF TECHNOLOGY (Electronics and Communication)**

Semester: **V**

Course Code: **202060501**

Course Title: **Analog and Digital Communication**

Course Group: **Professional Core Course**

Course Objectives: To understand the basic fundamental concept of Analog and Digital Communication system along with their major Components. Further learn design and analysis of optimum receiver for various digital modulation schemes with their Bit Error Rate performance.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		
Lecture	Tutorial	Practical		Internal	External	Internal	External	Total
3	0	2	4	50/18	50/17	25/9	25/9	150/53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Communication System Concepts and Mathematical Preliminaries:** History and elements of a communication system; Characteristics of communication channel and their mathematical modeling; Review of Fourier series and Fourier transform with its properties; Parseval's theorem; Hilbert transform; Energy and Power Spectral Density (ESD and PSD); practical vs Ideal filters.	06
2	**Analog communication systems:** Concept of modulation and demodulation, Continuous wave (CW) modulation: amplitude modulation (AM) - double sideband (DSB); double sideband suppressed carrier (DSB-SC); single sideband suppressed carrier (SSB-SC) and vestigial sideband (VSB) modulation, angle modulation - phase modulation (PM) & frequency modulation (FM); narrow and wideband FM. Representation of narrowband noise; receiver model, signal to noise ratio (SNR), noise figure, noise temperature, noise in DSB-SC, SSB, AM & FM receivers, pre-emphasis and deemphasis; Superheterodyne receiver.	08

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3	**Pulse Modulation:** Sampling theorem and Nyquist criteria, aliasing and nonaliasing filter, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM), uniform and non-uniform quantization, Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Delta Modulation (DM) and Adaptive delta modulation (ADM), Time Division Multiplexing (TDM) and T_1 carrier system, noise consideration in PAM and PCM systems.	**06**
4	**Digital data transmission and pulse shaping:** line coding; Characteristic of Line codes, Various line codes and their PSD; Manchester coding and condition for DC null; Inter Symbol Interference (ISI) and Pulse Shaping; eye diagram, Scrambling and Descrambling, Regenerative repeater and equalizer, M-ary based signaling. Trade-off between bandwidth and power.	**05**
5	**Digital Modulation Schemes:** Overview of geometric representation of signals, Gram-Schmidt Orthogonalization procedure; Basic digital modulations schemes: Phase shift keying (PSK), amplitude shift keying (ASK), frequency shift keying (FSK) and Quadrature amplitude modulation (QAM); coherent demodulation and detection; Basics of equivalent complex baseband representation of digitally modulated signals.	**08**
6	**Probability Theorem and Random Processes:** Basics of Probability, Bernoulli Trials, Random Variables, Marginal and Conditional Probabilities, Probability Distribution Function (PDF), Cumulative Distribution Function (CDF), Central limit theorem, mean, variance, correlation and covariance, Chebyshev's inequality, Gaussian and Rayleigh PDF, Linear mean square estimation; Random Process: Stationary and Nonstationary Processes, Ergodic Wide-sense stationary Processes, Markov process, Markov chain model, Poisson process.	**06**
7	**Optimum receiver design and performance analysis for AWGN channel**s: Matched filter and correlation detector, Maximum like hood sequence detector Performance of optimum receiver for memoryless modulation, Optimum receiver for CPM signal, non-coherent receiver for digital modulation schemes, Bit Error Rate (BER) analysis for BPSK, FSK, PSK, QPSK and M-QAM signal. Orthogonal signaling and multicarrier system.	**06**
		45

List of Practicals / Tutorials:

1	To study transmission and reception of Amplitude Modulated (AM) and Frequency Modulated (FM) signal with their Power Spectral Density (PSD).
2	Observe the effect of various sampling rate on signal reconstruction and analyses the bandwidth of signal.
3	To study the quantization of signal with Pulse Code modulation and Delta Modulation trans-receiver unit.
4	To study the Time Division Multiplexing (TDM) with various synchronization methods.
5	To study various line codes and compare analyses their power spectral density.
6	To study ASK and FSK and PSK transmission and reception along with their frequency spectrum.
7	To observe and analyze BPSK and QPSK signal in time and frequency domain with constellation diagram.

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8	Analyze and study the Gaussian and Rayleigh PDF using simulation tool.
9	To study comparative analysis the BER Performance for ASK, FSK and BPSK signal for AWGN channel.
10	To study comparative analysis the BER Performance for QPSK and various M-QAM signal for AWGN channel.
11	Introduction of Universal Software Defined Radio (USRP) Platform and its set-up for real time wireless communication
12	**Open Ended Problem:** Develop an experiment for real time data transmission and reception using USRP kit.

Reference Books:

1	B. P. Lathi and Zhi Ding, **Modern Digital and Analog communication systems**, 4th Edition, OXFORD University Press.
2	John G. Proakis, **Digital Communication**, 4th Edition, PHI Publication.
3	Simon Haykin, **Digital Communications Systems**, 4th Edition, Wiley Publication.
4	Robert Gallager, **Principal of Digital Communication,** 4th Edition, Cambridge University Press.

Supplementary learning Material:	
1	NPTEL and Coursera Video lectures
2	Research papers from reputed Journals (IEEE, Elsevier, Springer etc..)

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

Internal Evaluation:

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
15	**40**	**10**	**15**	**10**	**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.

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Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	To understand the principles of Analog and Digital Communication system with its mathematical preliminaries.	**25**
CO-2	To study the various quantization scheme and basic principles of sampling with Power Spectral Density (PSD) analysis.	**25**
CO-3	To understand Inter symbol Interference (ISI) and pulse shaping mechanism.	**25**
CO-4	To study the Optimum receiver design for various modulation scheme and BER performance of higher modulation schemes.	**25**

Curriculum Revision:	
Version:	2.0
Drafted on (Month-Year):	June -2022
Last Reviewed on (Month-Year):	-
Next Review on (Month-Year):	June-2025

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