



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Electronics and Communication

Subject Code: BE05000361

Subject Name: Digital Communication

WEF Academic Year :	2024-25
Semester :	5
Category of the Course :	Professional Core Course

Course Outcome :

After Completion of the Course, Student will able to :

No	Course Outcomes	RBT Level*
01	Convert analog signal into digital signal using different techniques like PCM, DM, ADM.	UN
02	Understand the concept of ISI and reduction of ISI through nyquist criteria.	UN
03	Compare various digital modulation techniques	AN
04	Understand behavior of various modulation-demodulation techniques in presence of noise.	UN
05	Know probability, random variable and various statistical analysis methods.	UN
06	Derive channel capacity for discrete memory less channel and continuous channel.	AP
07	Compare various error detection and correction codes.	AP

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Teaching and Examination Scheme :

Teaching/Learning Scheme in hrs/semester					Total Credits	Assessment Pattern and Marks					Total Marks
L	T	P	PBL*	TH		Theory		Practical			
					ESE (E)	PA (M)	PA (I)	PBL(I)	ESE (V)		
45	0	30	15	90	3	70	30	20	30	50	200

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End-Semester Examination, PA = Progressive Assessment

* **Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.**



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Course Content :

Sr. No.	Content	Total Hrs	% Weightage
1	Base Band Modulation Base band system, sampling theorem, Sampling and signal reconstruction, Aliasing, Types of sampling, Quantization, PCM, Companding, DPCM, ADPCM, Delta modulation, Adaptive delta modulation, T1 carrier system	10	19
2	Digital Data Transmission Components of digital communication system, line coding, pulse shaping, Scrambling, Regenerative Repeater, Eye Diagram, Timing Extraction, Detection Error Probability, M-ary communication, Digital Carrier Systems	6	12
3	Digital Modulation Techniques Modulation techniques for ASK, QASK, FSK, M-ary FSK, BPSK, DPSK, DEPSK, QPSK, M-ary PSK, QAM, MSK, GMSK	7	15
4	Digital Carrier Demodulation Techniques Coherent and non coherent detection of ASK, QASK, FSK, PSK, QPSK, M-ary PSK, DPSK, Noise temperature, Noise bandwidth, Noise figure	5	12
5	Probability Theory and Random Variable Concept of probability, Conditional probability and independent event, random variable, types of random variable, CDF, PDF, Statistical Averages, Chebyshev's inequality, Central limit theorem, Concept of correlation,	6	15
6	Information Theory Measure of information, Entropy, Source encoding, Error free communication over noisy channel, channel capacity of discrete memory less channel, Channel capacity of continuous channel, Practical communication system in lights of Shannon theorem	5	12
7	Error Correcting Codes Introduction, Linear Block Code, Cyclic Code, Burst error detecting and correcting codes, Interlace codes for burst and random error correction, Convolution Code, Comparison of coded and un coded system	6	15

This syllabus is mapped with following United Nation's Sustainable Development Goals:

SDG 3 - Good Health and Well-being

SDG 4 - Quality Education.

SDG 9 - Industry, Innovation and Infrastructure,

SDG 11 - Sustainable Cities and Communities,

SDG 13 -Climate Action



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SDG 17 - Partnerships for the Goals

Relevant BIS standards:

IS/IEC 60950-1 – Safety of IT and Communication Equipment

IS/IEC 62368-1 – Audio/Video, IT & Communication Equipment Safety

IS/IEC 61000 Series – Electromagnetic Compatibility (EMC)

IS 14700 Series – EMC requirements for electronic equipment

IS 13252 (Part 1) – IT Equipment Safety

Telecom Regulatory Authority of India (TRAI) Relevant to:

QoS standards for telecom services

EMF radiation exposure norms

Broadband and mobile service regulations

Wireless Planning and Coordination Wing (WPC), India Relevant to:

Frequency allocation

Licensing of wireless transmitters

Compliance for modulation schemes and RF equipment

National Frequency Allocation Plan (NFAP – India)

Also explore other relevant Indian and international standards.

Reference Book :

1. Modern Digital and Analog Communication Systems, B. P. Lathi, (3rd Edition), Oxford Publication
2. Principles of Communication Systems, Taub & Schilling, (2nd Edition), Tata McGraw Hill Publication
3. S.Haykin, Communication systems, John Wiley 2001
4. Bhattacharya Amitabh, "Digital Communication", Tata McGraw-Hill, 1st Ed., 2006.

Suggested Course Practical List :

- 1 To understand sampling theorem and sample speech and audio signal
- 2 To generate and observe Pulse Amplitude Modulation, Pulse Width Modulation and Pulse position modulation waveforms.
- 3 To observe effect of oversampling and under sampling in PCM systems
- 4 To transmit and receive digital signal using Amplitude shift keying



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- 5 To transmit and receive digital signal using Frequency Shift Keying
- 6 To transmit and receive digital signal using Phase Shift Keying (BPSK and QPSK)
- 7 To understand Pulse Code Modulation to digitize speech signal
- 8 To understand time division multiplexing and de-multiplexing
- 9 To Implement Differential pulse code modulation and demodulation
- 10 To understand the concept of Delta Modulation and to achieve the Delta Modulation /De-Modulation.
- 11 To understand Error Detection and Correction codes
- 12 Simulation exercises on digital communication techniques

List of Laboratory/Learning Resources Required:

- Video lecture from NPTEL
- Learning material available on MIT open course ware
- SCILAB

Activities suggested under Self-learning/Team Work:

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h Total = 10h	Report /presentation based on the video learning outcomes.
3.	Assignment writing. Numericals based assignment is preferable.	5 assignments of 2h each. Total = 10h	Based on the assignment submitted.
4.	Problem solving/Coding using C, C++, Python, SCILAB, MATLAB, MS-EXCEL or any other relevant software	5 small coding based assignment of 2h each. Total = 10h	Based on the coding solution submitted.



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5.	Self learning on-line course	Minimum duration of the course should be 10h.	Examination based assessment at the end of course. Based on the certificate produced.
6.	Complex problem solving	Maximum 2 problem. Study of the problem and solution finding, Total = 10h	Based on the depth of the solution submitted.
7	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h Total = 10h	Based on quiz/report submitted
8	Discussion on research paper based on relevant subject	5 research paper = 20 h	Summarize research paper and evaluation critical parameters
9.	Poster/chart/power point preparation on technical topics	Duration = 6 h	Based on poster/chart preparation and presentation skills
10	Working/non-working model on technical topics	Working = 12 h Non- working = 8 h	Based on inter department/external evaluation
11	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/any other issue	Duration = 15 h for industrial exposure Problem identification and tentative solution = 10 h Total = 20 h	Based on evaluation of critical problems and solutions
12	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	Based on performance in group discussion, technical depth, knowledge etc.
13.	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 5h Total = 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.
14.	Application/Software development	Duration = 10 h	Depending on the complexity of the Application/Software

Note:



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1. All the suggested activity should be related to the subject.
2. The number of hours are suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
3. Rubrics for the evaluation can be prepared by the faculty.

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