NIRMA UNIVERSITY

Institute:	Institute of Technology, School of Technology
Name of Programme:	B.Tech. in Electronics & Communication Engineering
Course Code:	4EC302ME25
Course Title:	Information and Coding Theory
Course Type:	Department Elective
Year of Introduction:	2025-26

L	T	Practical Component				C
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Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to

1	comprehend probability and statistics in Information Theory	(BL2)
2	evaluate the performance of source coding algorithms such as Huffman, Arithmetic and dictionary techniques	(BL4)
3	analyse BER performance with block codes and convolutional codes in AWGN	(BL4)
4	compare the performance of the communication system with iterative decoding in AWGN for Turbo codes and LDPC codes.	(BL5)

Unit	Contents	Teaching hours (Total 45)
Unit I	**Information Theory:** Entropy, relative entropy and mutual information, channel capacity, Gaussian channel, Binary Symmetric Channel (BSC), Network information theory.	10
Unit II	**Source coding:** Lossless data compression, entropy coding, Huffman coding, Arithmetic coding, Shannon fano codes, Dictionary techniques, LZ77 and LZW techniques.	05
Unit III	**Channel Coding:** Channel capacity, Block codes, linear block codes, Hamming weight, Hamming bound, Maximum Likelihood (ML) detection, syndrome decoding, BCH and RS codes, Reed-Muller codes, soft-decision decoding algorithm and Network coding, Tradeoff between power and bandwidth	10
Unit IV	**Convolutional Codes:** Viterbi decoding, state diagrams, Trellis diagram, catastrophic encoders, soft-decision decoding, Product codes, Trellis coded modulation.	10
Unit V	**Iterative Decoding:** Turbo codes, constituent encoder, Interleaver, Soft information, Low-Density Parity Check (LDPC) codes, MAP algorithms.	10

Self Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the question will be asked from self-study contents.

Laboratory Work:

Laboratory work will be based on the above syllabus with a minimum of 10 experiments to be incorporated.

Suggested Readings/ Reference:
1. T. M. Cover and J. A. Thomas, *Elements of Information Theory*, John Wiley.
2. S. Lin, D. J. Costello, *Error Control Coding*, Pearson Education.
3. T. K. Moon, *Error Correction Coding: Mathematical Methods and Algorithms*, John Wiley.
4. Khalid Sayood, *Introduction to Data Compression*, Morgan Kaufmann.

Suggested List of Experiments

Sr. No.	Name of Experiments/Exercises	No. of Hours
1.	Design joint Huffman-Hamming codes with BPSK modulation in AWGN channel	02
2.	Design joint Shannon Fano-Hamming codes with BPSK modulation in AWGN channel	02
3.	Evaluate Arithmetic codes for text messages	02
4.	Evaluate dictionary techniques LZ77 and LZW for text messages	02
5.	Performance evaluation with BER of Reed Muller codes in AWGN channels	02
6.	Performance evaluation with BER of Golay codes in AWGN channel	02
7.	Performance evaluation with BER for feedforward and feedback convolutional codes with SOVA in AWGN channels	02
8.	Performance evaluation with MSE using image for cyclic codes in AWGN channel	02
9.	Performance evaluation with BER for BCH codes in AWGN channels	02
10.	Performance evaluation with BER for Product codes in AWGN channels	02
11.	Performance evaluation with BER for Turbo codes in AWGN channels	02
12.	Performance evaluation with BER for LDPC codes in AWGN channels	02
13.	Design BPSK system with TURBO coder and decoder in AWGN channel	02
14.	Performance evaluation with MSE using image for space time block codes in Rayleigh fading channel channel	02
15.	Performance evaluation with channel capacity of MIMO systems	02