COURSE TITLE	**TE142439: Channel Coding** Credits: 2 ELECTIVE COURSE
LEARNING OBJECTIVES	To study various channel coding techniques for digital communication as well as their performance caharacterisations.
COMPETENCY	The students will understand the following topics as well as their applications in digital communication system: • Theoritical limits and capacities related with channel coding • Modern channel coding techniques • Performance analysis of channel coding techniques for various channel conditions
SUBJECTS	**Basic, History, Towards Channel Capacity:** Introduction, Shannon Capacity, Bandwidth, Power, and Code Efficiencies, Discrete Capacities, System Complexity, Optimal Detection, Two-Codeword Error, Battacharyya Bound, The Cutoff Rate. **Random Coding Performance Bounds** : Gallager's Error Bound, The Error Exponent Function, Exponent Function and Capacity, Bounds for Linear Codes, Bounds for low Rates, Code Ensemble Expurgation, The Expurgated Bounds for Block and Trellis Codes, Sphere-Packing Lower Bounds. **Fundamental Coding Concepts** : Hamming Codes, Parity Check Equations, Hamming Bound, Code Generator Matrices, Graphical Representations of Codes: Parity Check Trellis, Systematic Trellis Construction for Block Codes, Tail-biting trellises and the square root bound. **LDPC Coding (Algorithmic Coding):** Low-density parity-check codes (LDPC), definition, regular and irregular LDPCs, decoding algorithms for binary erasure and binary symmetric channel models. Decoding on the additive white Gaussian noise channel, Probablility density analysis of LDPCs, probability propagation for the BEC and BSC channels, density evolution for the additive white Gaussian noise channels, designs of LDPCs, Variations of LDPC codes, practical considerations, Repeat-accumulate codes. **Turbo Coding (Introduction):** Turbo Code Encoding, Parallel Concatenation, Iterative Information Exchange and Soft-Information Message, Quantifying Message Passing, Mutual Extrinsic Information Transfer, Mutual Extrinsic Information Exchange (EXIT) Analysis. **Convolutional Coding:** Trellis of Convolutional Description, Algebraic Description, Feedback-, Systematic-, and Recursive Systematic Encoders. Maximum-Likelihood Decoding, The Union Bound, The Distance Spectrum, The A Posteriori Probability (APP) Algorithm, Log-APP, Max-Log APP and Binary Implementations. **Algebraic Coding** Algebraic Approaches to Error Control Coding, Finite Fields, Codes in the Light of Galois Fields, Error Correction and Error Correcting Equations. Reed-Solomon Codes, Basic Algebraic Decoding, BCH Codes, Fast Decoding, The Berlekamp-Massey Algorithm, P**erformance Analysis and Implementation** Code Performance Analysis,

	Importance Sampling Principles, when can IS be applied, Stopping Sets and Trapping Sets, Implementation Aspects, Implementation Methods.
MAIN REFERENCES	• Todd K. Moon, Error Correction Coding: Mathematical Methods and Algorithms, Wiley, 2005.
OPTIONAL REFERENCES	• Tom Richardson & Ruediger Urbanke, Modern Coding Theory, Cambridge University Press, 2008. • IEEE Transaction on Information Theory • IEEE Transaction on Communications
PREREQUISITE	-