# CODING THEORY

**17ECMC2T5B** **Credits: 4**

**Lecture: 4 periods/week** **Internal assessment: 40 marks**

**Semester end examination: 60 marks**

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**Prerequisites:** Digital Communications

**Course Objectives**

- To Analyse linear block codes and Cyclic codes and investigate the relationship between minimum distance and error correction/detection capabilities
- To Design efficient decoding Algorithms for BCH and Reed-solomon codes
- To Analyse structural properties of Convolutional codes with appropriate graphical representations.
- To study, encoding and decoding concepts of Turbo codes & LDPC codes in noisy channel environment.

**Course Outcomes**

Student is able to

- Implement Encoder and Syndrome calculator with appropriate digital logic.
- Design powerful Error correcting Algorithms for correcting more than one error.
- Develop efficient decoding Algorithms with lesser number of computations.
- Explore efficient design methods and the powerful soft iterative decoding techniques for high capacity codes like LDPC codes and Turbo codes.

**UNIT-I**

**Linear Block Codes:** Introduction to Linear Block Codes, Syndrome and Error Detection, The Minimum Distance of a Block Code, Error-Detecting and Error-Correcting Capabilities of a Block Code, Standard Array and Syndrome Decoding.

**Cyclic Codes:** Description of Cyclic Codes, Generator and Parity-Check Matrices of Cyclic Codes, Encoding of Cyclic Codes, Syndrome Computation and Error Detection, Decoding of Cyclic Codes.

**UNIT-II**

**Binary BCH Codes:** Binary Primitive BCH Codes, Decoding of BCH Codes, Iterative Algorithm for Finding the Error-Location Polynomial.
Reed-Solomon Codes, Decoding of Non binary BCH and RS Codes. The Berlekamp Algorithm.

**UNIT-III**

**Convolutional Codes:** Encoding of Convolutional Codes, Structural Properties of Convolutional Codes, Distance Properties of Convolutional Codes, The Viterbi Algorithm, The Soft-Output Viterbi Algorithm (SOVA), The BCJR Algorithm

**UNIT-IV:**

**Turbo Coding:** Introduction to Turbo Coding, Distance Properties of Turbo Codes, Performance Analysis of Turbo Codes, Design of Turbo Codes, Iterative Decoding of Turbo Codes.

**Low Density Parity Check Codes:** Introduction to LDPC Codes, Tanner Graphs for Linear Block Codes, A Geometric Construction of LDPC Codes.

**Text Books:**

1. Error Control Coding by Shu Lin, Daniel J.Costello Jr., Second Edition.