

## SEMESTER S4

### CODING THEORY

(Common to CS/CM/AM/CI)

<b>Course Code</b>	<b>PECST414</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	None	<b>Course Type</b>	Theory

#### Course Objectives:

1. To introduce students to some of the classical methods in coding theory
2. To give the concept of code construction through the mathematical foundations and examples.

### SYLLABUS

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	Binary block codes, Minimum distance, Error-detecting capability and error-correcting capability.  Introduction to linear block codes, generator matrix and parity check matrix. Properties of linear block codes: Syndrome, error detection. Distance properties of linear block codes. Single parity check codes, Hamming codes, Reed Muller codes.	<b>9</b>
<b>2</b>	Cyclic Codes : Generator and Parity-Check Matrices of Cyclic Codes. Encoding of Cyclic Codes, Syndrome Computation and Error Detection, Decoding of Cyclic Codes, Cyclic Hamming Codes, Shortened Cyclic Codes	<b>9</b>
<b>3</b>	Convolutional codes: Encoding, state diagram, trellis diagram, Classification, realization, distance properties. Viterbi algorithm, BCJR algorithm. Performance bounds for convolutional codes	<b>9</b>
<b>4</b>	Turbo codes: Turbo decoding, Distance properties of turbo codes, Convergence of turbo codes.  Automatic repeat request schemes. Applications of linear codes	<b>9</b>

**Course Assessment Method**  
(CIE: 40 marks, ESE: 60 marks)

**Continuous Internal Evaluation Marks (CIE):**

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

**End Semester Examination Marks (ESE)**

*In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions*

Part A	Part B	Total
<ul style="list-style-type: none"> <li>• 2 Questions from each module.</li> <li>• Total of 8 Questions, each carrying 3 marks</li> </ul> <p style="text-align: center;"><b>(8x3 =24 marks)</b></p>	<ul style="list-style-type: none"> <li>• Each question carries 9 marks.</li> <li>• Two questions will be given from each module, out of which 1 question should be answered.</li> <li>• Each question can have a maximum of 3 subdivisions.</li> </ul> <p style="text-align: center;"><b>(4x9 = 36 marks)</b></p>	<b>60</b>

**Course Outcomes (COs)**

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
<b>CO1</b>	Construct the encoder and decoder of linear block codes	<b>K3</b>
<b>CO2</b>	Understand the concept of error correction coding	<b>K2</b>
<b>CO3</b>	Understand the implementation of cyclic codes	<b>K2</b>
<b>CO4</b>	Apply Viterbi algorithm for decoding convolutional codes	<b>K3</b>
<b>CO5</b>	Experiment with turbo codes using iterative map and BCJR algorithm	<b>K3</b>

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

### CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									2
CO2	3	3	3	2								2
CO3	3	3	3	2								2
CO4	3	3	3									2
CO5	3	3	3	2								

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Error Control Coding	Shu Lin and Daniel J. Costello, Jr.	PHI	2/e, 2004
2	Error Correction Coding	Todd K. Moon	Wiley-Interscience	1/e, 2006

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The Theory of Error-Correcting Codes	F. J. MacWilliams, N. J. A. Sloane	North-Holland, Amsterdam	1/e, 1977
2	Algebraic Codes for Data Transmission	R. E. Blahut	Cambridge University Press	1/e, 2003
3	Fundamentals of Error-Correcting Codes	Cary W. Huffman, Vera Pless	Cambridge University Press	1/e, 2003

Video Links (NPTEL, SWAYAM...)	
Mod. No.	Link ID
1	<a href="https://archive.nptel.ac.in/courses/108/104/108104092/">https://archive.nptel.ac.in/courses/108/104/108104092/</a>
2	<a href="https://nptel.ac.in/courses/108102117">https://nptel.ac.in/courses/108102117</a>
3	<a href="https://archive.nptel.ac.in/courses/108/104/108104092/">https://archive.nptel.ac.in/courses/108/104/108104092/</a>
4	<a href="https://archive.nptel.ac.in/courses/108/104/108104092/">https://archive.nptel.ac.in/courses/108/104/108104092/</a>