INFORMATION THEORY and CODING

Course Code	: **18EC54**	CIE Marks	: 40
Lecture Hours/Week	: 3	SEE Marks	: 60
Total Number of Lecture Hours : 40 (8 Hrs / Module)		Exam Hours	: 03
CREDITS – 03			

Course Learning Objectives: This course will enable students to

- Understand the concept of Entropy, Rate of information and order of the source with reference to dependent and independent source.
- Study various source encoding algorithms.
- Model discrete & continuous communication channels.
- Study various error control coding algorithms.

Module-1

Information Theory: Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model for Information Sources, Entropy and Information rate of Markoff Sources

(Section 4.1, 4.2 of Text 1) **L1, L2,L3**

Module-2

Source Coding: Encoding of the Source Output, Shannon's Encoding Algorithm**(Sections 4.3, 4.3.1 of Text 1),** Shannon Fano Encoding Algorithm **(Section 2.15 of Reference Book 4)**

Source coding theorem, Prefix Codes, Kraft McMillan Inequality property – KMI, Huffman codes **(Section 2.2 of Text 2)**

L1, L2, L3

Module-3

Information Channels: Communication Channels, Discrete Communication channels Channel Matrix, Joint probabilty Matrix, Binary Symmetric Channel, System Entropies. **(Section 4.4, 4.5, 4.51,4.5.2 of Text 1)**

Mutual Information, Channel Capacity, Channel Capacity of Binary Symmetric Channel, **(Section 2.5, 2.6 of Text 2)**

Binary Erasure Channel, Muroga's Theorem **(Section 2.27, 2.28 of Reference Book 4)**

L1, L2, L3

Module-4

Error Control Coding:
Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error detection & Correction capabilities of Linear Block Codes, Single error correction Hamming code, Table lookup Decoding using Standard Array.

Binary Cyclic Codes: Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction **(Sections 9.1, 9.2,9.3,9.3.1,9.3.2,9.3.3 of Text 1)** ,

L1, L2, L3

Module-5

Convolution Codes: Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm) **(Section 8.5 – Articles 1, 2 and 3, 8.6- Article 1 of Text 2),**

L1, L2, L3

Course Outcomes: After studying this course, students will be able to:

1. Explain concept of Dependent & Independent Source, measure of information, Entropy, Rate of Information and Order of a source
2. Represent the information using Shannon Encoding, Shannon Fano, Prefix and Huffman Encoding Algorithms
3. Model the continuous and discrete communication channels using input, output and joint probabilities
4. Determine a codeword comprising of the check bits computed using Linear Block codes, cyclic codes & convolutional codes
5. Design the encoding and decoding circuits for Linear Block codes, cyclic codes, convolutional codes, BCH and Golay codes.

Question paper pattern:

- Examination will be conducted for 100 marks with question paper containing 10 full questions, each of 20 marks.
- Each full question can have a maximum of 4 sub questions.
- There will be 2 full questions from each module covering all the topics of the module.
- Students will have to answer 5 full questions, selecting one full question from each module.
- The total marks will be proportionally reduced to 60 marks as SEE marks is 60.

Text Book:

1. Digital and Analog Communication Systems, K. Sam Shanmugam, John Wiley India Pvt. Ltd, 1996.
2. Digital Communication, Simon Haykin, John Wiley India Pvt. Ltd, 2008.

Reference Books:

1. ITC and Cryptography, Ranjan Bose, TMH, II edition, 2007
2. Principles of Digital Communication, J. Das, S. K. Mullick, P. K. Chatterjee, Wiley, 1986 - Technology & Engineering
3. Digital Communications – Fundamentals and Applications, Bernard Sklar, Second Edition, Pearson Education, 2016, ISBN: 9780134724058.
4. Information Theory and Coding, HariBhat, Ganesh Rao, Cengage, 2017.
5. Error Correction Coding, Todd K Moon,Wiley Std. Edition, 2006