INFORMATION THEORY AND CODING TECHNIQUES

VI Semester: ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AECC34	**Elective**	3	-	-	3	30	70	100

Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**	**Total Classes: 45**

Prerequisites: Probability Theory and Stochastic Processes

I. COURSE OVERVIEW:
Information theory and coding is the study of the quantification, storage and Communication of digital information with the properties of codes for specific applications. These courses covers classifications of error control coding and source coding techniques, coding algorithms for audio, speech, image and video compression techniques. The applications include cryptography, error detection and correction in digital communication systems.

II. COURSE OBJECTIVES:
The students will try to learn:
I.   The concepts, principles and applications of information theory on communication systems.
II.   The data compression techniques with text, audio, speech, image and video for real world applications
III. The block codes and convolution codes for coding and decoding of digital data.

III. COURSE OUTCOMES:
After successful completion of the course, students should be able to:

CO 1   **Illustrate** source and channel coding techniques for error-free transmission of message over a noisy communication channel.   Understand

CO 2   **Make use of** linear and cyclic block codes for the performance analysis of error detection and correction in terms of efficiency.   Understand

CO 3   **Outline** the various types of convolution codes for channel encoding processing data streaming.   Apply

CO 4   **Choose** the Viterbi and turbo decoder algorithms for detection of the convolution code sequence in error controlling.   Apply

CO 5   **Relate** the various source coding techniques and algorithms for text, audio and speech processing   Understand

CO 6   **Categorize** the image and video formats and compression methods for data storage and compression.   Analyze

IV. COURSE SYLLABUS:
MODULE-I: INFORMATION THEORY (09)
Information – Entropy, information rate, classification of codes, Kraft McMillan inequality, source coding theorem, mathematical model of information, a logarithmic measure of information, Shannon-Fano coding, Huffman coding, extended Huffman coding–Joint and conditional entropies, mutual information, discrete memory less channels–BSC, BEC–Channel capacity, Shannon limit.

MODULE-II: ERROR CONTROL CODING: BLOCK CODES (09)
Definitions and Principles: Hamming weight, Hamming distance, minimum distance decoding, single parity codes, Hamming codes, repetition codes, linear block codes, cyclic codes, syndrome calculation, shortened cyclic codes, majority logic decoding for cyclic codes, encoder and decoder, CRC.

MODULE-III: ERROR CONTROL CODING: CONVOLUTIONAL CODES (09)
Convolutional codes – code tree, trellis, state diagram - Encoding Decoding: Sequential search and Viterbi algorithm.

Principle of turbo coding, types of errors, error control strategies.

MODULE-IV: SOURCE CODING: TEXT, AUDIO AND SPEECH (09)
Source code: Definition, techniques, Text: Adaptive Huffman coding, arithmetic coding, variable-length codes, LZW algorithm – Audio: Linear predictive **coding (LPC),** Perceptual coding, masking techniques, psychoacoustic model, MEG audio layers I,II,III, Dolby AC3 - Speech: Channel vocoder, linear predictive coding.

MODULE-V: SOURCE CODING: IMAGE AND VIDEO (09)
Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, motion estimation, motion compensation, H.261, MPEG standard, standards-based and nonstandard approaches to coding.

V. TEXT BOOKS:
1. R Bose, "Information Theory, Coding and Cryptography", TMH 2007.
2. Fred Halsall, "Multidedia Communications: Applications, Networks, Protocols and Standards", Perason Education Asia, 2002.

VI.   REFERENCE BOOKS:
1. K Sayood, "Introduction to Data Compression" Elsevier, 3 Edition, 2006
2. S Gravano, "Introduction to Error Control Codes", Oxford University Press, 2007.
3. Amitabha Bhattacharya, "Digital Communication", TMH 2006.

VII. WEB REFERENCES:
1. https://www.youtube.com/watch?v=Uk9zFrEGguM
2. https://lecturenotes.in/subject/540/information-theory-coding-itc

VIII. E-TEXT BOOKS:
1. http://web.stanford.edu/class/ee376a/files/scribes/lecture_notes.pdf
2. http://www.everythingvtu.wordpress.com