

Course Code	Course Title	L	T	P	C
BECE313L	Information Theory and Coding	3	0	0	3
Pre-requisite	BECE306L, BECE306P	Syllabus version			
		1.0			
Course Objectives					
<div>1. This course provides an understanding of fundamental information theoretic techniques including applications to compression and error control coding.</div> <div>2. It also aims at quantitative measure of information may be used in order to build efficient solutions to multitudinous engineering problems.</div>					
Course Outcomes					
At the end of the course, students will be able to					
<div>1. Analyze probability theory and evaluate the average and mutual information.</div> <div>2. Examine different types of channels and determine their capacity.</div> <div>3. Implement various types of source coding algorithms and analyze their performance.</div> <div>4. Apply various types of coding techniques and standards on audio and video.</div> <div>5. Design linear block codes and cyclic codes (encoding and decoding).</div> <div>6. Design and build the channel coder for 5G standard.</div>					
Module:1	Information Measures	7 hours			
Review of Probability Theory, Introduction to information theory, Uncertainty, self-information, average information, Marginal Entropy, Joint Entropy and Conditional Entropy, Mutual Information, Relationship between entropy and mutual information and their properties, Markov statistical model for information source, Entropy and information rate of markov source , Information measures of continuous random variables.					
Module:2	Channel Models and Capacity	6 hours			
Importance and types of various channel models - Channel capacity calculation – Binary symmetric channel, binary erasure channel - Shannon’s channel capacity and channel coding theorem - Shannon’s limit.					
Module:3	Probability based Source Coding	6 hours			
Source coding theorem - Huffman coding - Non binary Huffman codes - Adaptive Huffman coding - Shannon Fano Elias coding - Non binary Shannon Fano codes, Arithmetic coding					
Module:4	Non Probability based Source Coding	5 hours			
Lempel-Ziv coding, Run-length encoding and rate distortion function - Transform coding - JPEG and JPEG 2000.					
Module:5	Audio and Video Coding	5 hours			
Audio Coding: types – Linear Predictive Coding (LPC) – Code Excited LPC – Perceptual Coding - MPEG Audio Coding. Video Coding: Motion Estimation and Compensation – Types of Frames – Encoding and Decoding of Frames – Video Coding Standard: MPEG 4.					
Module:6	Channel Coding	9 hours			
Introduction to Error control codes - Block codes, linear block codes, cyclic codes and their properties, Encoder and Decoder design- serial and parallel concatenated block code, Convolution Codes- Properties, Encoder-Tree diagram, Trellis					

diagram, state diagram, transfer function of convolutional codes, Viterbi Decoding, Trellis coding, Reed Solomon codes, Turbo coder, Iterative Turbo decoder			
Module:7		Channel Coding for 5G standard	
		5 hours	
Low Density Parity Check code - LDPC code construction, construction in 5G standard, encoding of LDPC codes, Message passing decoding on Tanner graph. Polar code – Representation, generator matrix, Successive cancellation decoder for polar codes.			
Module:8		Contemporary Issues	
		2 hours	
		Total Lecture hours:	
		45 hours	
Text Book(s)			
1	Simon Haykin, “Communication Systems”, 2017, 5 th Edition, Wiley India Pvt Ltd, India.		
2	Khalid Sayood, “Introduction to Data Compression, 5 th Edition, The Moragan Kaufmann Series in Multimedia Information and Systems, Elsevier, 2017.		
Reference Books			
1.	Ranjan Bose, “Information Theory, Coding and Cryptography”, 2015, 1 st Edition, McGraw Hill Education (India) Pvt. Ltd., India.		
2	Murlidhar Kulkarni, K.S. Shivaprakasha, “Information Theory and Coding As per AICTE”, 2019, 2 nd Edition, Wiley India Pvt Ltd, India.		
3	Orhan Gazi, “Polar Codes: A Non-Trivial Approach to Channel Coding”, 2019, 1st Edition, Springer Topics in Signal Processing Book 15.		
Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test			
Recommended by Board of Studies		28-02-2023	
Approved by Academic Council		No. 69	Date 16-03-2023