AMITY UNIVERSITY
UTTAR PRADESH

Course Title: Advanced Information Theory Coding
Course Code: ECE731
Credit Units: 4
Course Level: PG

L	T	P/ S	SW/F W	TOTAL CREDIT UNITS
3	1	0	0	4

Course Objectives: This course introduces how various coding takes place in communication and what type of different codes are used in communication system. It also introduces different entropies, channel capacity and purpose of encoding.

Prerequisites: Boolean Algebra, Digital Communication

Course contents/Syllabus:

	Weightage (%)
Module I : Fundamental Limits in Information Theory	**20%**
Measure of Information, Data Compaction, Discrete Memory less Channels, Relationship among different Entropies, Mutual information, Channel Capacity, Capacity of channel with symmetric noise structure BSC and BEC, Channel Coding Theorem, Differential Entropy and Mutual Information for Continuous Ensembles, Information Capacity Theorem, Rate Distortion Theory.	
Module II: Elements of Encoding	**20%**
Source Coding: Instantaneous Codes, Source Coding Theorem, The Kraft Inequality and McMillan's Theorem, Average Length and Compact Codes, Shannon's Noiseless Coding Theorem, Fano Coding, Huffman Coding, Arithmetic Coding, Higher-order Modelling. **Fundamentals of Channel Coding**: Code Rate, Decoding Rules, Hamming Distance, Bounds on M, Maximal Codes and Perfect Codes, Error Probabilities, Shannon's Fundamental Coding Theorem.	
Module III: Introduction to Algebra	**20%**
Groups, Ring, Vector space and Fields, Linear Spaces, Linear Spaces over Binary Fields, Construction of Galois field GF (2m), Basic Properties of Galois Field GF (2m), Codes Derived from Hadamard Matrices.	
Module IV: Error Correcting Codes	**20%**
Linear Block Codes: Introduction to Linear Block codes, Syndrome and Error detection, Minimum distance of block code, error detecting and Error correcting capability a block code. **Cyclic Codes:** Rings of Polynomials, Description of Cyclic codes, Encoding and Decoding of Cyclic Codes and its Circuits, Goley Codes,	

Hamming Codes, Cyclic Redundancy Check Codes, Reed-Muller Codes.	
Module V: Burst Correcting Codes	**20%**
Finite Fields, Irreducible Polynomials, Construction of Finite Fields, Bursts of Errors, Fire Codes, Minimum Polynomials, Bose-Chaudhuri-Hocquenghem Codes, Other Fields, Reed-Solomon Codes. **Convolution Codes:** Binary Convolution Codes, Decoding Convolution Codes, the Viterbi Algorithm, Sequential Decoding, Trellis Modulation, Turbo Codes	

Student Learning Outcomes:

- Calculate the information content of a random variable from its probability distribution;
- Relate the joint, conditional, and marginal entropies of variables in terms of their coupled probabilities;
- Define channel capacities and properties using Shannon's Theorems;
- construct efficient codes for data on imperfect communication channels;
- Generalize the discrete concepts to continuous signals on continuous channels;
- To obtain an understanding of the theoretical principles of source coding.
- Describe the information resolution, compression, and efficient coding properties.

Pedagogy for Course Delivery: The course would be covered under theory and tutorial. Continuous evaluation of the students would be covered under quiz, Presentation etc.

Assessment/ Examination Scheme:

Theory L (%)	Lab/Practical (%)	Total
100%	NA	100%

Theory Assessment (L&T):

Continuous Assessment/Internal Assessment					End Term Examination
Components (Drop down)	Mid-Term Exam	Assignment	Viva	Attendance	
Weightage (%)	10%	7%	8%	5%	70%

Text & References:

- F.M. Reza: Information Theory, McGraw Hill
- ShuLin& J Costeib: Error Control Coding, (PHI)
- Dass, Mullick&Chatterjee : Digital Communication, John Wiley, Ed. 1992