GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (COMMUNICATION SYSTEMS ENGG) (05)

INFORMATION THEORY & CODING

SUBJECT CODE: 2710502

SEMESTER: I

Type of course: Core - I

Prerequisite: Prerequisite material for this course is a minimal but firm understanding of Discrete Probability and elementary enumerating principles, Linear Algebra, and Calculus

Rationale: PG Students of EC Engineering need to possess good understanding of the fundamentals and applications of digital communication system. The course presents in detail the theory and practice of efficient storage and transmission of information over noisy channels. They are expected to be able to design efficient error correcting codes. Theory concepts of source coding, error detecting and correcting schemes, their encoding and decoding process, cryptography will be verified through implementation in MATLAB and Simulink

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
4	2#	2	6	70	30	20	10	10	10	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Basic concept of coding, Unique decodable codes and instantaneous decodable codes (IDC) Construction of IDC, Krafts inequality and MC Millan's theorem, Huffman and shannon-fano code.	6	14
2	Entropy, Entropy of sources and their extension. Loss less image compression	4	9
3	Arithmetic Coding Basic of channel coding and Hamming distances, channel capacity and shannon's fundamental theorem	4	9
4	Linear block codes ; Systematic linear codes and optimum decoding for the binary symmetric channel; Generator and parity Check Matrices Syndrome decoding on symmetric channels; Hamming codes	8	19
5	Cyclic code, Burst errors, BCH Code, Reedsolomon Codes	4	9
6	Convolution codes, Viterbi decoding algorithm	4	9
7	Wozencraft's sequential decoding algorithm, Fann's algorithm and other sequential decoding algorithms	4	9
8	Cryptography	4	9

Reference Books:

1. Jiri Adamek, Foundation of coding, John Wiley and sons.
2. A.J. Viterbi and J.K.Ormura, Principal of Digital Communication and Coding, McGraw
3. Hill
4. Bernard Sklar, Digital communication fundamental and Application, PE India.
5. N. Abramson, Information and Coding, McGraw Hill,1963
6. M Mansurpur, Introduction to Information Theory, McGraw Hill,1987
7. R.B.Ash, Information Theory, Prentice Hall,1970
8. Shu Lin and D.J.Costello Jr., Error Control Coding, Prentice Hall,1983

Interesting Video: Claude Shannon - Father of the Information Age

Course Outcome:

1. To obtain an understanding of the theoretical principles of source coding.
2. To focus on the application of Information Theory to communications in general and on channel coding and capacity in particular.
3. To analyze various error correcting codes.
4. To compare coded Vs. uncoded system.
5. To Use MATLAB for analysis of various source coding and channel coding techniques.

List of Experiments:

1. Verify **Kraft's inequality** for binary and ternary codes and generate instantaneous codes.
2. A) Simulate binary **Huffman code** in MATLAB.
   B) Find average length, entropy and coding efficiency of the code.
3. Write a MATLAB program that takes in channel transition probability matrix and compute Mutual Information & channel capacity of the discrete memory-less channel.
4. Write a MATLAB program to encode messages for a forward error correction system with a given **Linear block code .**
5. Write a MATLAB program to decode the encoded word for a forward error correction system with a given **Linear block code .**
6. Write a MATLAB program to encode messages for a system with given Cyclic Polynomial code.
7. Decoding the messages for a system with a given **cyclic polynomial code** and verifying through simulation.
8. Understanding the concept of loss less data compression technique using Huffman coding.
9. Write a MATLAB program to perform BCH encoding and decoding.
10. Write a MATLAB program to perform RS encoding and decoding.
11. Encoding the data bits using a **Binary Cyclic block** encoder in Simulink.
12. Decoding the code words using a **Binary Cyclic block** decoder in Simulink.
13. Encoding the data bits using a **Binary Linear block** encoder in Simulink.
14. Decoding the code words using **Binary Linear block** decoder in Simulink.
15. Implementation of Cryptography technique in MATLAB.

Open Ended Problems:

1. Design an encoder of a binary convolutional (3,2)-code of memory m = 2.
2. Design and encoder of the binary convolutional (2,1)-code. Encode all three bit massages. Draw the trellis diagram for the same.
3. Design a shift register encoder of the Hamming code of length 15

List of Software:

Matlab

List of Open Source Software: Scilab

Learning website:

www.nptel.ac.in