

ECE3051: INFORMATION THEORY AND CODING

Programme: B.Tech. (ECE)
Course: Core

Year: 2015
Credits: 4

Semester: EVEN
Hours: 40

Course Context and Overview (100 words): This course will provide relation between Information theory, probabilities, likelihood and communication theory. Review of data compression: source encoding, shanon-fano codes, Huffman codes. Review of channel capacity: discrete channels, Gaussian channel, parallel Gaussian channels (MIMO streams) and water filling. Review of channel coding, various error correcting codes like linear block codes, convolution codes, TURBO codes, Viterbi hard-soft decision (SOVA), CTC Decoder: Exit chart and iterative decoding.

Prerequisites Courses: Probability Theory

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1 Explain the key concepts of Entropy in Information theory.
C02 Explain and analyse source coding and data compression, Channel capacity over single, multiple communication channels.
C03 Differentiate the characteristic, design understanding and requirements of various error correction codes in different applications like day to day communication, satellite communication etc.
C04 List the error detection and correction capabilities, design limitations of various error protection codes like LDPC, cyclic, convolution and TURBO codes.
C05 Simulate and practice the encoding decoding algorithms with hard and soft decision, end to end communication system with error control coding.

Course Topics:

Topics	Lecture Hours	
UNIT – I		
1. Entropy and Mutual Information		
1.1 Probability, Entropy and its properties, Mutual information.	3	9
1.2 Source coding, Kraft inequality, Shannon-fano codes	4	
1.3 Huffman codes	2	
UNIT – II		
2. Channel Capacity		
2.1 Shannon’s channel capacity over BSC	3	6
2.2 Diversity and Transmission rate over SISO	1	
2.3 MIMO channels(MIMO channel capacity)	2	
UNIT – II		
1. Channel Coding		
1.1 Channel Coding, Error Detection and Correction	2	12

capability		
1.2 Linear Block codes, Reed-Muller Codes	2	
1.3 Cyclic codes	2	
1.4 BCH, Reed-Solomon Codes	3	
1.5 Convolutional codes , Interleaves, Convolutional TURBO Codes	3	
UNIT – IV		
2. Decoding		
2.1 Decoding Algorithms	1	6
2.2 Viterbi hard-Soft Decoding	1	
2.3 Exit Chart and Iterative Decoding,	2	
4.3 ML-MAP based TURBO Decoding	2	
UNIT-V		
3. Theory to Practice : Simulation of Coded Systems		
3.1 Channel Coding Performance of various codes, AWGN channels, Fading channels	2	7
3.2 Use of Source coding, Channel coding gain in current days communication systems	2	
3.3 Channel Coded System simulation	3	

Textbook references (IEEE format):

Text Book:

- T.M. Cover and J.A. Thomas, *“Elements of Information Theory”*, John Wiley & Sons, 1991.
- Shu Lin, Daniel J. Costello *“Error Control Coding: Fundamentals and Applications”* , 2004
- Khalid Sayood, *“Introduction to Data Compression”*, Elsevier Inc., 2006.

Reference books:

- R. G. Gallager, *“Information Theory and Reliable Communication,”* John Wiley & Sons, 1965.
- Tom Conway, *“Information theory and Coding,” Online Pdf*, 2012
- Peter Sweeney, *“Error Control coding”*, John Wiley & Sons. 2002.

Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.):

Evaluation Methods:

Evaluation criteria will be shared by the concerned course instructor.

Prepared By:

Last Update: 31/02/2015