CSE XXXX: CODING THEORY

Programme: B.Tech (CSE) **Year:** Second **Semester:** Fourth
Course: Program Elective **Credits:** 3 **Hours:** 40 hours (Theory)

Course Context and Overview (100 words):

Sending and receiving data through any transmission media are insecure and not efficient with respect to computational cost and communication overhead. Since storing and transmitting data are not trusted and reliable completely, it is important to find an efficient method to detect the error when it occurs and, ideally, correct it. Error-correcting codes that are designed, only ensure the reliability of data communications. Therefore, data compression algorithms and error-correcting code are essential to yield communications that would be efficient, robust to data transmission errors. This course will insights into Coding Theory deals with error detection and correction, data transmission and data storage. It will cover error controlling codes such as Linear Block Codes for Error Correction, Cyclic Codes, linear-feedback shift registers for encoding and decoding of cyclic code and BCH codes.

Prerequisites Courses:
Discrete Mathematical Structure

The Outcomes of this Course are
CO1: Construct codes that can correct a maximal number of errors while using a minimal amount of redundancy.
CO2: Explain principle of Linear feedback shift register for encoding and decoding cyclic code.
CO3: Understands data compression algorithms and error-correcting codes
CO4: Define and Construct binary BCH code.
CO5 Understands Errors syndromes in finite fields and Reed-Solomon Codes.

Course Topics

Contents		Lecture Hours	
UNIT – 1 : Basics of Communication and General Communication Systems			
1.1	Introduction, Message, Encoder, Channel, Received word, Decoder,	2	5
1.2	Some examples of codes , Repetition codes, Parity check and sum-0 codes, The [7,4] binary Hamming code, An extended binary Hamming code, The [4,2] ternary Hamming code.	3	
UNIT-2 :Error Control Coding **Linear Block Codes for Error Correction**			
2.1	Introduction to Error Correcting Codes, Basic definition, Matrix definitions, Matrix description of Linear Block,	3	8
2.2	Equivalent codes, Parity Check Matrix	1	
2.2	Decoding of Linear Block Code, Syndrome Decoding, and Probability of Error correction.	2	
2.3	Perfect Codes, hamming Codes, Low density parity check Codes.	2	
UNIT-3 Cyclic Codes			
3.1	Introduction to Cyclic Codes, Polynomials, Division Algorithms for Polynomials	2	10
3.2	Method of Generating Cyclic Codes, Matrix description of Cyclic Codes	3	
3.3	Quasi-Cyclic Codes and Shorted Cyclic Codes, Burst Error Correction	3	
3.4	Golay Codes, Cyclic Redundancy Check(CRC) Codes	2	
UNIT-4 Linear-feedback shift registers for encoding and decoding cyclic codes			
4.1	Linear-feedback shift resisters, example and solving problem	2	7
4.2	The polynomial-division register, examples	2	
4.3	Register for encoding	1	
4.5	Register for error detection and correction	2	

UNIT-5 Bose-Chaudhuri-Hocquenghem (BCH) codes			
5.1	Definition and construction of binary BCH codes	2	10
5.2	Errors syndromes in finite fields	2	
5.3	Decoding single error correcting BCH codes	2	
5.4	The error location polynomial	2	
5.5	Reed-Solomon Codes	2	

Textbook references (IEEE format):
Text Book:

1. **Salvatore Gravano, Introduction to Error Control Codes, Oxford University Press, 2017**
2. **Shu Lin, Daniel J.Costello, Jr. Error controlling Coding, second edition, Pearson 2011**

Reference books:

1. **Khalid Sayood, Introduction to Data compression, 2006**
2. **Ranjan Bose , Information Theory, Coding and Cryptography(Third edition), 2018**
3. **Wade Trappe, l. C Washington, Introduction to Cryptography and Coding Theory , Pearson, Second edition, 2007**

Evaluation Methods:

Item	Weightage
Quiz-I	10
Quiz-II	10
Mid Term	30
End Term	50

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