

The Legal House – International Business College
School of Electrical and Computer Engineering
7 Greenfield Parade
Bankstown 2200 NSW Australia

Error Control Coding
SECE 108

Subject Coordinator and Lecturer: Professor Minh Hung Le
The Legal House – International Business College
School of Electrical and Computer Engineering
7 Greenfield Parade
Bankstown 2200 NSW Australia
Tel: (02) 9790 3300
Fax: (02) 9790 3302
Emails: m.le@sece-unsw.org or minhle@ieee.org

Aim of Unit:

This unit will give students a thorough treatment of modern error control coding principles and practices. This unit includes theory of Galois fields, polynomials over Galois fields, linear block codes, cyclic codes, Golay codes, Reed-Muller codes, BCH and Reed-Solomon codes, block code performance analysis, trellis representations of block codes, hard and soft decoding of block codes, convolutional codes, the Viterbi decoding algorithm, the sequential decoding algorithms, trellis coded modulation, error control for channels with feedback, applications.

Unit Outline:

- Error Control Coding for Digital Communication Systems.
- Galois Fields.
- Polynomials over Galois Fields.
- Linear Block Codes.
- Cyclic Codes.
- Hadamard, Quadratic Residue, and Golay Codes.
- Reed-Muller Codes
- BCH and Reed-Solomon Codes.
- Decoding BCH and Reed-Solomon Codes.
- The Analysis of the Performance of Block Codes.
- Convolutional Codes.
- The Viterbi Decoding Algorithm.
- The Sequential Decoding Algorithms.
- Trellis Coded Modulation.
- Error Control for Channels with Feedback.
- Applications of Error Control Coding.

Mode of Delivery:

Two hours lecture per week.
One hour tutorial per week.

Unit Assessment:

Attendance at Lectures and Tutorials	20 %
Assignments, Laboratories	40 %
Final Presentation	40 %

Assessment Requirements:

Students must receive 50% or more for each component of Unit Assessment in order to pass the subject.

Student Workload:

Students will have 3 hours per week face-to-face learning during semester.
Students are expected to work at least 5 hours per week out of class.

Text Book:

1. Shu Lin, Daniel J. Costello, "Error Control Coding", 2nd edition, Prentice Hall, 2005

Recommended References:

1. Stephen B. Wicker, "Error Control Systems for Digital Communication and Storage", Prentice Hall, 1995
2. Richard B. Wells, "Applied Coding and Information Theory for Engineers", Prentice Hall, 1999

Subject Schedule

Weeks	Lecture/Tutorial Topics	Assignments/ Laboratories	Reading from Text Book
1	Coding for Reliable Digital Transmission and Storage, Introduction to Algebra	Lab #1	Chapters 1, 2
2	Linear Block Codes, Important Linear Block Codes	Lab #1	Chapters 3, 4
3	Cyclic Codes	Assignment #1	Chapter 5
4	Binary BCH Codes, Nonbinary BCH Codes, Reed-Solomon Codes, and Decoding Algorithms, Majority-Logic Decodable Codes	Lab #1, Assignment #1	Chapters 6, 7, 8
5	Trellises for Linear Block Codes, Reliability-Based Soft-Decision Decoding Algorithms for Linear Block Codes	Lab #1, Assignment #1	Chapters 9, 10
6	Convolutional Codes, Trellis-Based Decoding Algorithms for Convolutional Codes, Sequential and Threshold Decoding of Convolutional Codes	Collect Lab #1	Chapters 11, 12, 13
7	Trellis-Based Soft-Decision Algorithms for Linear Block Codes, Concatenated Coding, Code Decomposition and Multistage Decoding	Collect Assignment #1	Chapters 14, 15
8	Turbo Coding	Lab #2	Chapter 16
9	Low Density Parity Check Codes	Assignment #2	Chapter 17
10	Trellis Coded Modulation	Lab #2, Assignment #2	Chapter 18
11	Block Coded Modulation	Collect Lab #2	Chapter 19
12	Burst-Error-Correcting Codes, Automatic-Repeat-Request Strategies	Collect Assignment #2	Chapters 20, 21
13	Preparing for Final Presentation		
14	Final Presentation		

Subject Description

UNIT	SECE108 Error Control Coding
-------------	-------------------------------------

FIELD	Analyse and Design
--------------	---------------------------

DESCRIPTION	This unit describes the competency required to develop error control coding.
--------------------	--

RELATED COMPETENCY STANDARDS	The project lifecycle, Telecommunications and Computer Systems methodologies employed will determine which particular units of competency are relevant to this unit. Some include SECE101, SECE112, SECE105, SECE106, SECE107, SECE111.
-------------------------------------	---

ELEMENT		PERFORMANCE CRITERIA
1	Error Control Coding for Digital Communication Systems.	<ul style="list-style-type: none"> • Comprehensive treatment of Galois Fields, Polynomials over Galois Fields. • Coverage of essential elements of Linear Block Codes, Cyclic Codes, Hadamard, Quadratic Residue and Golay Codes.
2	BCH and Reed-Solomon Codes	<ul style="list-style-type: none"> • Full coverage of BCH and Reed-Solomon Codes, Decoding BCH and Reed-Solomon Codes. • Detailed specifications of Reed-Muller Codes, Analysis of the Performance of Block Codes.
3	Convolutional and Trellis Codes	<ul style="list-style-type: none"> • Implementation of Convolutional Codes, The Viterbi Decoding Algorithm. • Figure out Sequential Decoding Algorithms, Trellis Coded Modulation.
4	Applications	<ul style="list-style-type: none"> • Applications of Error Control Coding and Error Control for Channels with Feedback.