

1. Course Title:

Information & Coding

2. Course Code:

EE4212

3. Course Aims & Objectives:

The aim of this course is to introduce the fundamental and advanced knowledge of information theory and coding. Characteristics of typical communication channels will be discussed and various coding methods for error control and secure communication in digital transmission systems will be covered in depth. The application of coding to error correction in compact disc (CD) digital audio system will be described as an example.

4. Units: 3**5. Level:** B4**6. Syllabus:**Review of Linear Algebra

Linear Algebra of Signal Spaces, Metrics, Algebra of Finite Fields

Fundamentals of Information Theory

Measurement of Information, Entropy, Mutual Information, Channel Theorem, Rate Distortion Theory

Waveform Coding

Antipodal Codes, Orthogonal Codes, Biorthogonal Codes

Block Coding

Parity-check Codes, Rectangular Codes, Linear Block Codes (Systematic and non-systematic), Generator Matrix, Parity-Check Matrix, Syndrome Testing, Error Correction, Coding Strength, Minimum Distance of a Linear Block Code, Error Detection and Correction Capability, Erasure Correction

Cyclic Codes

Algebraic Structure of Cyclic Codes, Binary Cyclic Code Properties, Encoding in Systematic Form, Circuit for Dividing Polynomials, Error Detection and Correction, Meggit Decoder

Other Well-known Block CodesHamming Codes, Extended Golay Codes, BCH Codes, Reed-Soloman Codes
Performance of various Block CodesConvolutional Codes

Basic Concepts of Convolutional Encoding, Representation of Convolutional Encoder, Decoding of Convolutional Codes (Sequential Decoding, Feedback Decoding, Maximum Likelihood Decoding), Distance Properties of Convolutional Codes, Catastrophic Error Propagation, Best Known Convolutional Codes

Applications of Error Control Codes

Code Interleaving, Concatenated Codes, Cyclic Redundancy Check (CRC) Code, POCSAG Code using in Paging, CIRC (Cross-interleave Reed-Solomon Code) for Compact Disc (CD) digital audio system, Trellis Coded Modulation (TCM) for MODEM communication

Advanced Topics

Punctured Convolutional Codes, Iterative Decoding, Turbo Codes

7. **Teaching pattern:**

Duration of course: 1 semester

Suggested lecture/tutorial/laboratory mix: *Lecture Hour:* 26

Tutorial Hour: 13

Laboratory Hour: 0

8. **Assessment pattern:**

Examination duration: 2 hours, at the end of the semester

Percentage of coursework, examination, etc.: 30% CW; 70% Exam

For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

9. **Pre-requisites:** *(please quote course code & title)*

MA2149 Mathematical Analysis or

MA2170 Linear Algebra and Multi-variable Calculus

10. **Pre-cursor:** *(please quote course code & title)*

MA3160 Probability & Stochastic Processes

11. **Equivalent Courses:** *(please quote course code & title)*

Nil

12. **Equivalent to the Old Course Code & Title**

IT4403 Information & Coding

13. **Booklist:**

Essential Reading

Sklar, Digital Communications : Fundamentals and Applications 2nd Edition, Prentice-Hall (2001)

Wilson, Digital Modulation and Coding, Prentice-Hall (1996)

Supplementary Reading

Anderson, Source and Channel Coding: An Algorithmic Approach, Kluwer Academic Publishers (1991)

Viterbi & Omura, Principles of Digital Communication and Coding, McGraw-Hill (1979)

Lafrance, Fundamental Concepts in Communication, Prentice-Hall (1990)

Jayant and Noll, Digital Coding of Waveforms, Prentice-Hall (1984)

Hamming, Coding and Information Theory 2nd Edition, Prentice-Hall (1986)