The University Of Sheffield.

Electronic & Electrical Engineering.

EEE6221 DATA CODING TECHNIQUES FOR COMMUNICATION AND STORAGE

Credits: 15

Course Description including Aims

Processing techniques to enable transmission and storage of data with reliability and security are a key element in nearly all of modern communication systems. This course deals with data coding techniques required for reliable and secure data transmission and storage; it covers various aspects of digital communication tying in elementary communication theory with practical solutions to problems encountered. The aims of this course are :

1. To make students aware of the various techniques available for transmitting binary data, and the situations where each might be appropriate.
2. To look at problems that are associated with signal distortion and the limitations that these impose on a data channel.
3. To examine ways of reliably transmitting information in the presence of non-ideal communication channels.
4. To examine ways of securely transmitting and receiving information over insecure communication channels.
4. To outline various communication architectures in use, referring to practical solutions.
5. To make students aware of some of the communication standards that exist.

Outline Syllabus

Asynchronous Communication : RS232, timing constraints, character framework, standards, UARTs, error checking, modems. **Synchronous Serial Communication :** How it differs from asynchronous communication, biphase codes, Miller codes, ternary codes, advantages, uses, bandwidth requirements, constraint lengths and self clocking ability. **Data Compression:** lossless compression, lossy compression, DCT, JPEG. **Data Integrity:** Error detection, parity check, cyclic redundancy checking, theory and hardware implementation. Error correction, distance, coding gain, BER, soft-decision decoding, Galois fields, algebraic and non-algebraic decoding of block codes. Hamming codes, BCH codes, Reed Solomon codes, software and hardware implementation issues. Covolutional codes, Viterbi decoding, implementation issues. Practical configurations, cross-interleaving, multi-stage coding, serial and parallel concatenation, product codes; introduction to Turbo codes and LDPC codes.

Data Security: security functions and definitions; private key primitives (stream ciphers, AES); public-key primitives (RSA, ECC). Hashes and Random number generators.

Time Allocation

24 lectures plus 12 hours of additional support material.

Recommended Previous Courses

None, although background information equivalent to EEE104 “Digital Systems”, EEE206 “Communication Systems”, and EEE317 “Principles of Communications” would be of value.

Assessment

3 hour examination, answer 4 out of 6 questions.

Recommended Books

Halsall	*Data Communications and Computer Networks*	Addison-Wesley
Stallings	*Data and Computer Networks*	McMillan
Sweeney	*Error Control Coding*	Prentice-Hall
Guy	*Data communications for Engineers*	Macmillan
Bissell	*Digital Signal Transmission*	Cambridge
Houghton	*The Engineer’s error coding Handbook*	Chapman & Hall

Objectives

By the end of this module successful students will be able to

1. make sensible choices about the type of communication system that will be required in a given situation, and the type of channel coding that will be best suited to the given environment.
2. display awareness of the sorts of problems that will arise as a result of the design choices made in their solution.
3. demonstrate a working knowledge of the techniques available for combating errors in a given system, and the sorts of errors they will encounter.
4. demonstrate a working knowledge of the techniques available for data compression (both lossy and lossless).
5. show an awareness of some of the communications standard that are provided.
6. describe the basis of data security and be aware of the techniques that exist to encrypt/decrypt data.
7. design a simple error control codec.