Simon Fraser University
School of Engineering Science
ENSC 428-4 Data Communications
Spring 2001

Calendar Description	This course will cover the physical-layer design issues in digital communication systems. The major topics covered are: information measures and the notion of channel capacity; link budgets; digital modulation techniques, including the signal space concept and optimal detectors, error performance in noise, suboptimal detectors, pulse shaping, synchronization and equalization; error control techniques such as block and convolutional codes, as well as comparisons between FEC and ARQ. Laboratory work is included in this course.
Prerequisites:	ENSC 327 and 351 or 385.
Instructor	Jim Cavers ASB 9843 291-3281 cavers@sfu.ca
Teaching Assistants	TBA
Lab Engineer	Patrick Leung
Text	J.G. Proakis and M. Salehi, *Communication System Engineering*, Prentice Hall, 1994.
Relation of Lectures and Text	The text provides a good treatment of many specific topics. However, its range of examples is somewhat narrow, so I will use the lectures to introduce additional physical systems and examples.
Class Notes	Class notes (copies of the instructor's transparencies) are available on the ENSC 428 website. Please print them before you come to class, so that you can annotate them during the lecture.
Classes	Tuesday 9:30 – 11:20; Thursday 10:30 – 11:30. AQ 4100

Grades

5 assignments 3% each	15%
1 midterm	25%
1 final	45%
1 lab	15%

Total	100%

General Objectives

ENSC 428 develops the conceptual, analytical and practical bases of digital communications. It is a fascinating blend of statistics and systems theory. Fascinating? Yes, on two counts: the topics are inherently interesting, and they are an area of intense commercial interest around the world.

I have three objectives in this course. I want you to gain:

- an intuitive understanding of signals and detection methods in noise, so that you can work up solutions for unfamiliar problems;
- a facility with the analytical tools by which we describe and design data communication systems;
- some exposure to typical systems and practical algorithms.

The lab component is intended to reinforce the analytical topics and give you some hand-on experience.

Detailed Outline

This outline is a prediction, to some extent, because it is the first time I have taught the course. The section on information theory may or may not fit – we'll just have to see how far we get.

1. DIGITAL COMMUNICATIONS – PERSPECTIVE AND CONTEXT

2. BACKGROUND REVIEW
    - 2.1 Essentials of Probabilistics
    - 2.2 Random Processes
    - 2.3 Filtering of Random Processes

3. FIRST STEP: SINGLE RECTANGULAR PULSE IN WHITE NOISE

4. WHY DIGITAL?
    - 4.1 Digital Representation of Analog Sources
    - 4.2 For Reference: FM and Threshold
    - 4.3 PCM vs. FM: Bandwidth, Noise and Output SNR
    - 4.3 PCM vs. FM: Chain of Repeaters

5. FUNDAMENTALS: DETECTION OF ISOLATED PULSES
    - 5.1 Signal Space and Constellations
    - 5.2 Detection in White Noise: Correlators, Matched Filters
    - 5.3 Probability of Error
    - 5.3 Variations: Coloured Noise, Multichannel Reception

6. DIGITAL PAM SIGNALLING AT BASEBAND
    - 6.1 Detection of Pulse Sequences: Sufficient Statistics