Digital Communications
Course Outline

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Prerequisites:
- Probability, Random Process, and Introduction to Communication Systems (preferred)
Textbook:


References:


Schedule:
  - Wednesday BCD

Classroom:
  - SC204
Course Content

- **Chapter 1: Introduction (Self-Study)**
  1. 1.1: Elements of a Digital Communication System
  2. 1.2: Communication Channels and Their Characteristics
  3. 1.3: Mathematical Models for Communications
  4. 1.4: A Historical Perspective in the Development of Digital Communications

- **Chapter 2: Deterministic and Random Signal Analysis**
  1. 2.1: Bandpass and Lowpass Signal Representations
  2. 2.2: Signal Space Representations of Waveforms
  3. 2.7: Random Processes
     (2.7.2 Cyclostationary Process will be incorporated into Chapter 3.)
  4. 2.8: Series Expansion of Random Processes
  5. 2.9: Bandpass and Lowpass Random Processes
Course content

**Chapter 3: Digital Modulation Schemes**
1. 3.1: Representation of Digitally Modulated Signals
2. 3.2: Memoryless Modulation Methods
3. 3.3: Signaling Schemes with Memory
4. 3.4: Power Spectrum of Digitally Modulated Signals

**Chapter 4: Optimum Receivers for AWGN Channels**
1. 4.1: Waveform and Vector Channel Models
2. 4.2: Waveform and Vector AWGN Channels
3. 4.3: Optimal Detection and Error Probability for Band-Limited Signaling
4. 4.4: Optimal Detection and Error Probability for Power-Limited Signaling
5. 4.5: Optimal Detection in Presence of Uncertainty
6. 4.6: A Comparison of Digital Signaling Methods
7. 4.8: Detection of Signaling Schemes with Memory: Maximum Likelihood Sequence Detector
Chapter 6: An Introduction to Information Theory

6.5: Channel Models and Channel Capacity
6.6: Achieving Channel Capacity with Orthogonal Signals

(These two sections will be incorporated into Chapter 4.)

Chapter 13: Fading Channels I: Characterization and Signaling

13.1: Characterization of Fading Multipath Channels
13.2: The Effect of Signal Characteristics on the Choice of a Channel Model
13.3: Frequency-Nonselective, Slowly Fading Channel
13.4: Diversity Techniques for Fading Multipath Channels
13.5: The RAKE Demodulator
Course content

- Chapter 12: Spread Spectrum Signals for Digital Communications
  1. 12.1: Model of Spread Spectrum Digital Communication System
  2. 12.2: Direct Sequence Spread Spectrum Signals

- Chapter 9: Digital Communication Through Band-Limited Channels
  1. 9.1: Characterization of Band-Limited Channels
  2. 9.2: Signal Design for Band-Limited Channels
  3. 9.3*: Optimum Receiver for Channels with ISI and AWGN (partially covered)
  4. 9.4*: Linear Equalization (partially covered)
Course content

• Chapter 11: Multichannel and Multicarrier Systems
  1. 11.1: Multichannel Digital Communications in AWGN Channels
  2. 11.2: Multicarrier Communications

• Chapter 5: Carrier and Symbol Synchronization
  1. 5.1: Signal Parameter Estimation
  2. 5.2: Carrier Phase Estimation
  3. 5.3: Symbol Timing Estimation
  4. 5.4: Joint Estimation of Carrier Phase and Symbol Timing
  5. 5.5: Performance Characteristics of ML Estimators
We will **not** cover . . .

- **Chapter 6: An Introduction to Information Theory**
  Will be covered by **Information Theory** (消息理論)

- **Chapter 7: Linear Block Codes**
  Will be covered by **Error Correcting Codes** (編碼理論)

- **Chapter 8: Trellis and Graph Based Codes**
  Will be covered by **Error Correcting Codes** (編碼理論)

- **Chapter 10: Adaptive Equalization**
  Special topic in Digital Communications
We will **not** cover . . .

- **Chapter 14: Fading Channels II: Capacity and Coding**
  
  Advanced topics in *Information Theory* and *Error Correcting Codes*

- **Chapter 15: Multiple Antenna Systems**
  
  Advanced topics in Digital Communications

- **Chapter 16: Multiuser Communications**
  
  Advanced topics in Digital Communications
No Homework and Quiz. Sample Problems will be given weekly.

Midterm 50% and Final 50%
  - Closed Books: Most of the problems will be from the slides.

Midterm (November 21): Chapters 2, 3, 4 and 6

Final (January 9): Chapters 13, 12, 9, 11 and 5