UNIVERSITY OF CALIFORNIA, RIVERSIDE
**EE 224 Digital Communication Theory and Systems**
Spring 2004

Lecture: MWF 2:10pm-3pm HMNSS 1407


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**Course Objective:** Introduction to Digital Communication and data transmission in presence of noise.

**Textbook:** B.P. Lathi. Modern Digital and Analog Communication Systems, 3rd ed., Oxford Uni. Press, 1998 (ISBN 0-19-511009-9).

**References:**


**1.** Simon Haykin, Communication Systems, Wiley, 4th Edition, 2001 (ISBN 0-471-17869-1).
**2.** J. Proakis, M. Salehi, Communication Systems Engineering, Prentice Hall, 2nd ed.,2002, ISBN 0-13—061793-8.
**3.** W. Feller, "An Introduction to Probability Theory and its Applications"; Wiley, 1971, ISBN 0471-25708-7.


**Course Outline:** (Section numbers correspond to the textbook. Sections marked **bold** give the most important basic material. Sections marked *italic* represent auxiliary or advanced material, this is mostly for extra reading**).**

**Introduction and Review**: Overview of Communication systems (Ch. 1,2). **Fourier transform and series.** (2.4, 2.8-2.10, 3.1-3.3). **Energy - and Power Spectral Density for nonrandom** *and random signals* **(3.6-3.8). Sampling theorem (6.1). Bandwidth and transmission rate.** *Amplitude and frequency modulation. Pulse Time modulation. Pulse Position Modulation (6.1).*

**Pulse Code modulation**.: **Sampling and Quantizing. Quantization Noise. Signal-to-noise ratio (SNR) and the Bandwidth.** μ-law and A-law**.** Digital multiplexing (6.2). **Line Coding. Polar, Unipolar, Bipolar, Duobinary, and Manchester Signaling (7.2). Intersymbol interference (ISI).** *Pulse shaping***. Nyquist criteria for Zero ISI (7.4).** *Differential Coding, Delta modulation and overloading . (6.3, 6.4).* **Detection error probability (7.6). M-ary Communication (7.7, 7.8).**

**Probability Theory as a Tool in Noisy Communication**: **Conditional Probability.** Channel models. **Threshold detection (10.2). Statistical Means and Variance. Characteristic function. Binomial, Gaussian, and Poisson Distributions**. The mean error of the Quantization Noise and the Channel Noise (10.3). Chebyshev inequality, Kolmogorov inequality, and **the Central limit theorem (10.4,10.5).** The Lindenberg theorem and Chernoff bound. *White Gaussian random processes (11.1).*

***Introduction to Optimum signal Detection.*** *Signal spaces: geometric representation of signals and random processes. Matched filter. Correlation receiver. Maximum likelihood reception (14.1-14.3)*

**Introduction to Information Theory and Error-correcting Coding.** Channel capacity and **Shannon theorem**. **Huffman compression codes**. **Hamming codes. Introduction to Reed-Solomon codes**.

**Midterm EXAM:** Open book. **2:10 pm -3:00 pm** **May 14, 2004** **(preliminary schedule)**

**Final presentations: the research topics assigned, through the last two weeks of classes**

**Homework (not required but recommended)**

Homework assignments and solutions will be posted on http://www.ilearn.ucr.edu/

**Grading** Midterm: 40%, Presentation: 60%.