

Northwestern University

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
McCORMICK SCHOOL OF ENGINEERING AND APPLIED SCIENCE
EVANSTON, IL 60208

ECE 307 – COMMUNICATIONS

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Prof. Michael Honig

0. *Introduction*

- Electrical communication systems
- Basic elements of a communication system
- Limitations on performance: bandwidth, noise, nonideal effects
- Modulation: motivation and categories
- Chronology of communication theory and practice

I. *Signal Analysis Review*

I1. Signal Classifications

I2. Fourier Transform

- Delta function
- Transform theorems
- Convolution
- Fourier transform of periodic signals

I3. Linear Systems and Transforms

- Definition and examples
- Impulse response and superposition integral
- Time-invariant systems
- Transfer function

I4. Correlation and Power Spectrum

- Inner product and norm

- Cauchy-Schwarz inequality
- Autocorrelation and cross-correlation
- Power and energy spectral density
- Input-output relations

I5. Hilbert Transform

- Definition and properties
- Analytic signals

II. *Continuous-Wave Modulation*

II1 Linear: Double-Sideband, Amplitude, Single-Sideband, Vestigial

II2 Exponential: Frequency, Phase

- Spectral analysis
- FM bandwidth

III. *CW Modulation Systems*

- Superheterodyne receiver
- Multiplexing: Frequency-Division, Time-Division

IV. *Random Processes*

- Probability review (random variables, pdf's, expectation)
- Description in terms of joint pdf's
- Strict- and wide-sense stationarity
- Ergodicity
- Gaussian process
- Correlation and Power Spectral Density
- Linear Systems and Random Processes
- Representation of Narrowband Noise

IV. *Noise in CW Modulation*

- SNR in Coherent Demodulation of AM, DSB, SSB
- SNR in AM Envelope Detection

V. Introduction to digital modulation

Textbook:

R. Ziemer and W. Tranter,
Principles of Communications,
Sixth Edition, New York: John Wiley & Sons, Inc., 2009.