

Department of Electrical Engineering, IIT Madras
EE 4140: Digital Communication Systems

Online Mode

August 2020

1. Introduction (Chap-1 in book) to digital communications, and review of sampling theorem and representation of band-pass signals (Chap-2).
2. Overview of random processes – Random variable and random process, Gaussian, white, stationary processes, circular Gaussian random variable, auto-correlation and power spectral density, WSS random signal transmitted through LTI system, band-pass processes (Chap-4), [the random binary wave process](#).
3. Digital communications thro (band-unlimited) AWGN channels – Signal representation, PAM, PSK, and QAM signals, multi-dimensional signals, optimum receiver for AWGN measurement models, probability of error P_e for symbol detection (Sec. 7.1 thro 7.6 in Chap-7), [approximate \$P_e\$ using Union bound, Chernoff bound, \$P_e\$ for fading channels](#)
4. Digital communications thro band-limited “flat” channels – Power spectrum of random digital signal, symbol-by-symbol modulation based signal design for band-limited channels (Nyquist criterion), partial response signals (Sec. 8.1 thro 8.3 in Chap-8). Timing and frequency synchronization for linearly modulated digital signals (from Sec. 7.8 in Chap-7).
5. Digital communications thro distorting channels – Channel equalization, maximum likelihood sequence detection and the [Viterbi algorithm](#) (Sec. 8.6 and only some parts of Sec. 8.5 in Chap-8), [and practical \(fractionally-spaced, adaptive\) receivers for ISI channels, MAP sequence estimation and symbol detection](#)
6. Source coding preview – Source coding theorem, only Sec. 6.1 to 6.3 in Chap-6, and a “touch” of Sec.6.6 & 6.7.
7. Channel coding preview – Channel capacity theorem and understanding AWGN channel capacity, [random coding argument](#), simple block coding and syndrome decoding, convolutional codes and MLSE, trellis coded modulation, *concatenation and interleaving of simple codes to make a more powerful code* (touching upon nearly all topics the various sections in Chap-9 with the exception of sections 9.6 and 9.10).
8. Wireless communications preview – *Noise figure and receiver sensitivity, link budget, wireless repeaters and regenerators, wireless multipath fading channel*; [Why the evolution from single-carrier symbol-by-symbol modulation to multi-carrier block modulation, and broadband cellular communications measurement models](#)

(**Note:** The topics in [blue](#) color are not from the text book, and topics in *italics* will be covered if sufficient time is available.)

Text Book:

“*Communication Systems Engineering 2nd Ed*” J.G.Proakis & M.Salehi (Prentice Hall Intl. Edition); either hard-copy or E-book can be followed.

Assessment Method: (*tentative*)

Mid Sem Quiz: 15 marks; End Sem Exam: 45 marks; the remaining 40 marks will be awarded based on 4 (or 5) assignments which would include simulation problems that have to be submitted from time to time.

There are 4 TAs for this course; Contact me by Whatsapp or email me at giri@ee.iitm.ac.in for more details. Soft-copies of additional material will be made available at <http://www.ee.iitm.ac.in/giri/teaching.html> and/or on IIT Madras Moodle site.

K. Giridhar, ESB-334B, July 31, 2020