

DEE4636: Principles of Communication System (I)

通訊原理 (一) (Sept. 2009)

Time: 9:10 – 10:00am (Tuesday) ED116; 1:30 – 3:20pm (Friday) ED201

Instructor: 杭學鳴 (Hsueh-Ming Hang), ED609, x31861 hmhang@mail.nctu.edu.tw
<http://cwww.ee.nctu.edu.tw>

Office hours: 1:30pm – 3:30pm Tuesday. **Please make an appointment in advance (請儘可能事先預約時段)**

Teaching Assistant: 周正偉 runners@commlab.com 陳呈毓 ccybob@gmail.com (ED423)

Objectives: 本課程為瞭解通訊系統的入門課，之後銜接數位通訊原理，兩門課完整涵蓋通訊基礎理論。過去這兩門課稱做通訊原理(一)及通訊原理(二)，鑒於許多本系學生修完通訊原理(一)後不再修習通訊原理(二)，因而對現代通訊的核心—數位通訊所知甚少，因此自本年度(98)起課程安排有些變化，通訊原理除了類比通訊外將強化對數位通訊的介紹，而數位通訊原理則有更深入的内容。

以下對通訊系統的課程内容做一簡介。於序論(1)之後，我們將複習關於訊號與系統之描述與分析的重要觀念(2-3)。接著介紹常用的類比調變方法，並討論如何接收這些信號(4-6)，我們將會強調類比通訊的觀念和作法、是未來瞭解數位通訊的必要基礎，在例子的選擇上，也會著重對數位通訊延伸和比較。藉由介紹脈衝調變(7-8)，我們逐步介紹從類比系統到數位系統的演進發展。接著介紹在無雜訊情況下的數位基頻通訊(9-10)，這是最簡單的數位通訊型式，經由與類比通訊的比較，凸顯兩種方式的深刻區別但亦同時具有密切關係。雜訊干擾是通訊過程中重要的現象，我們必須了解其特性與描述方法。這些數學工具在隨機過程(11-14)主題之下討論之。(事實上，許多時候不但是雜訊，連訊號也適合用隨機過程來描述。)我們使用這些工具探討雜訊對類比信號傳輸品質的影響(15-16)，並進一步理解數位基頻通訊系統的相關議題(17)。最後總結，在更廣的系統架構下比較數位/類比系統的異同(15)，建立更完整的通訊系統觀念。

本課程除了基礎理論的練習，也強調以電腦模擬來瞭解通訊系統的運作過程。因此對 Matlab 或 C 語言的熟練很重要，電腦模擬佔作業的比重也很可觀，請同學注意。

Class notes: 杭學鳴 <http://cwww.ee.nctu.edu.tw/course>

Textbook: R. E. Ziemer and W. H. Tranter, *Principles of Communications*, 6th ed., Wiley, 2010.

Recommended Readings:

1. S. Haykin and M. Moher, *Communication Systems*, 5th ed., Wiley, 2010.
2. J. G. Proakis and M. Salehi, *Fundamentals of Communication Systems*, Prentice-Hall, 2004.
3. A. B. Carlson and P. B. Crilly, *Communication Systems*, 5th ed, McGraw Hill, 2009

Grading: 五次作業(20%); 期中考(40%); 期末考(40%)

Background: Signals and Systems, Probability (and Statistics), Linear Algebra**Contents:**

1. Introduction: communication systems, channel effects, system analysis, probabilistic approach
2. Review of signals and systems: signal classification, Fourier transform, power spectral density
3. Review of signals and systems: signals and linear systems, sampling theory, frequency translation of signals (mixers), Hilbert transform
4. Continuous wave modulation (I): linear modulation
5. Continuous wave modulation (II): angle modulation
6. Continuous wave modulation (III): PLL
7. Pulse modulation (I): sampling, pulse amplitude modulation, quantization
8. Pulse modulation (II): pulse coded modulation, delta modulation, multiplexing
9. Baseband communication systems (I): baseband transmission, line codes, filtering effects, Nyquist criterion
10. Baseband communication systems (II): equalization, eye diagrams, synchronization, carrier modulation
11. Probability (I): review of probability theory, random variables
12. Probability (II): statistical averages, ergodicity, useful pdfs
13. Stochastic processes (I): stochastic processes, stationarity, correlation and power spectral density
14. Stochastic processes (II): LTI systems, Gaussian processes, white noise, narrow-band noise
15. Effects of noise on analog communications (I): linear modulation
16. Effects of noise on analog communications (II): angle modulation
17. Binary digital communication systems and noise: Noise effects, optimum receivers, performance comparison, signal space, signal analysis and synthesis
18. Comparison between digital and analog communications: source coding, modulation, channel/noise effects, BER, information theory