Syllabus

ECE-GY 6013: Digital Communications

Prof. I-Tai Lu
ECE-GY 6013 Digital Communications

• Credits: 3.00
• Description:

Prerequisites: ECE-UY 3404, ECE-GY 6303. *Online version available.
Pre-requisites

• EL6303 Graduate probability and stochastic processes
  • This is essential
  • Chapters 1-7 and chapter 9 from Papoullis, Pillai
  • This class is offered this semester

• Undergraduate communications theory

• Undergraduate signals & systems
  • Fourier transforms, filters, sampling, bandwidth

• We will review probability, stochastic processes and signals & systems very briefly.
Text and Notes

• Text: “Fundamentals of Digital Communications”, Madhow

• Notes will be provided through emails.
Grading

• Homework: 20%
• Online class participation: 20%
• Midterm: 30%
• Final: 30%
People

• Prof: I-Tai Lu, itl211@nyu.edu
  • Phone: 646-997-3041
  • Office Hour: TBD
Lecture Plan

ECE-GY 6013: Digital Communications
Prof. I-Tai Lu
Lecture 1a Reviews of Signals and Systems

*Textbook: Section 2.1 (pp.7-18)*

**Note:** 1a SignalSystemSpectrum (pp. 1-49; matlab programs are optional and will not be tested)
Lecture 2a Complex Signal and RF modulation

Textbook: Sections 2.2 (pp.18-31)

Note: 2a Complex Signal (pp. 1-11)

Lecture 2b Energy and Power Spectrum (deterministic)

Note: 2b Energy and Power (pp. 1-19)

Lecture 2c Reviews of Probability

Note: 2c Probability (matlab programs are optional and will not be tested)
Lecture 3a Reviews of Random Processes

**Note: 3a Random Processes** (pp. 1-19; matlab programs are optional and will not be tested)

Lecture 3b Energy and Power Spectrum (random)

*Textbook: Section 2.3 (pp. 31-41)*

**Note: 3b Energy and Power**

Lecture 3c Gaussian Random Variables and Processes

*Textbook: Section 3.1 (pp. 74-88)*

**Note: 3c The Q-function** (pp. 1-3)
Lecture 4 Baseband Modulation (Digital Modulation)

Textbook: Sections 2.4-2.7 (pp.41-60)

Note: 4a Sampling Theorem (pp. 1-3)
Note: 4b Nyquist ISI Criterion (pp. 1-3)
Note: 4c Degrees of Freedom (pp. 1-3)
Lecture 5a Hypothesis testing

*Textbook: Sec. 3.2 (pp.88-94)*

Lecture 5b Digital Communications Framework

**Note: 5a Digital Communications Framework** (pp. 1-19)

**Note: 5b Performance of Optimum Receiver** (pp. 1-21)
Lecture 6a Signal Vector Space I

**Note: 6a Signal Vector Space** (pp.1-27)

Lecture 6b The Signal Vector Space Version of Optimum Reception in AWGN I

**Note: 6b The Signal Vector Space Version of Optimum Receiver** (pp.1-32)
Lecture 7a Signal Vector Space II

*Textbook: Sec. 3.3 (pp.94-102)*

Lecture 7b The Signal Vector Space Version of Optimum Reception in AWGN II

*Textbook: Sec. 3.4 (pp.102-109)*

*Textbook: Sec. 3.5 (pp. 109-127)*
Week 8 Midterm
9a. Channel capacity and random coding

*Textbook: Sec. 6.1 (pp. 252-263)*

*Note: 9a Channel capacity and random coding (pp. 1-33)*

9b. Shannon Theory Basics I

*Note: 9b Capacity_Lu (pp. 1-20)*
Lecture 9 – Lecture 10 Channel Capacity (2 lectures)

10a. Shannon Theory Basics II

*Textbook: Sec 6.2 (pp. 263-272)*

10b Capacity Computation and Optimization

*Textbook: Sec 6.3 – 6.4 (pp. 272-286)*
Lecture 11 – Lecture 14 Channel Coding (4 lectures)

Lecture 11a. Block & Convolutional Codes

Note: L11a Block and Convolutional Codes (Introduction)

Lecture 11b. Block Code

Note: 11b Block Code (pp.1-38)
Lecture 11 – Lecture 14 Channel Coding (4 lectures)

Lecture 12. Convolutional Code

Note: 12 Convolutional Code (pp.1-37)

Textbook: Sec 7-1 (pp.293-311)
Lecture 11 – Lecture 14 Channel Coding (4 lectures)

Lecture 13 Turbo Code

*Textbook: Sec. 7-2 (pp. 311-329)*
Lecture 11 – Lecture 14 Channel Coding (4 lectures)

Lecture 14. Low Density Parity Code

*Textbook: Sec. 7-3 (pp. 342-354)*
Week 15: Final
2020 Fall Schedule

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ECE 6013 Schedule
8th Week: Mid-term
15th Week Final