Syllabus

ECE-GY 6013: Digital Communications

Prof. I-Tai Lu

ECE-GY 6013 Digital Communications

- Credits: 3.00
- Description:
  The course covers the following topics: Principles of M-ary communication: signal space methods, optimum detection. Fundamental parameters of digital communication systems, various modulation techniques and their performance in terms of bandwidth efficiency and error probability. Efficient signaling with coded waveforms. Block coding and convolutional coding. Joint modulation and coding. Equalization for communication over bandlimited channels. Brief overview of digital communications over fading multipath channels.

  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

Lecture 9 – Lecture 10 Channel Capacity (2 lectures)

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

ECE-GY 6013: Digital Communications

Prof. I-Tai Lu

September 2020

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1	2	3	4	5
6	7	8 1	9	10	11	12
13	14	15 2	16	17	18	19
20	21	22 3	23	24	25	26
27	28	29 4	30			

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October 2020

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1	2	3
4	5	6 5	7	8	9	10
11	12	13 6	14	15	16	17
18	19	20 7	21	22	23	24
25	26	27 8	28	29	30	31

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November 2020

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3 9	4	5	6	7
8	9	10 10	11	12	13	14
15	16	17 11	18	19	20	21
22	23	24 12	25	26	27	28
29	30					

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December 2020

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1 13	2	3	4	5
6	7	8 14	9	10	11	12
13	14	15 15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

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ECE 6013 Schedule

8th Week: Mid-term

15th Week Final