Department of Electrical and Computer Engineering
ECE 481: Digital Communication Systems

ECE 481 – Digital Communication Systems (3-0-3)

Instructor: Moshe Kam; e-mail address: kam@njit.edu; Tel: 973-596-6506

Textbook:

Herbert Taub, Donald L Schilling, Goutam Saha: Taub's Principles of Communication Systems, Fourth Edition, ISBN-13: 978-1-25-902985-1; ISBN-10: 1-25-902985-9 (main text)

Other useful texts:

B.P. Lathi and Z. Ding: Modern Digital and Analog Communication Systems, ISBN 978-0-19-533145-5
R.E. Ziemer and R.L. Peterson: Introduction to Digital Communication, ISBN 978-0-13-896481-5

Course Description:

Introduction to analog and digital communication systems and techniques; simulation of communication systems and techniques in Matlab/Simulink; amplitude and angle modulations; sampling and digitization of signals; baseband and carrier-modulated digital transmission; signal detection and reception in noise; broad overview of the information-theoretic approach to communications and error-control coding.

Prerequisite: ECE 321 **Corequisite**: none

Specific Course Learning Outcomes (CLO): The student will be able to

1. describe and analyze the generation and reception of amplitude or angle modulated signals;
2. recognize and provide a block-diagram level design of communication systems that use pulse modulation techniques and digital transmission of analog signals;
3. recognize and provide a block-diagram level design of communication systems that use digital modulation and transmission systems;
4. address the effect of noise in the reception of AM, FM, pulse-modulated and digital signals;
5. describe the basic tenets of information theory as pertaining to communications, and perform basic calculations of relevant properties;
6. describe the basic principles of error-control coding and use them in block-diagram level design of communication systems; and
7. use the basic capabilities of MATLAB and Simulink for modeling and simulation of analog and digital communication systems.

Relevant Student Outcomes:
(a) an ability to apply knowledge of mathematics, science, and engineering (CLO 1, 2, 3, 4, 5, 6, 7)
(b) an ability to design and conduct experiments, as well as to analyze and interpret data (CLO 1, 2, 3, 4, 6, 7)
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (CLO 2, 3, 6)
(e) an ability to identify, formulate, and solve engineering problems (CLO 2, 3, 4, 6, 7)
(f) an understanding of professional and ethical responsibility (class project)
(g) an ability to communicate effectively (class project)
(i) a recognition of the need for, and an ability to engage in life-long learning (CLO 5, 6)
(j) knowledge of contemporary issues (CLO 3,6)
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (CLO 7)

Computer assisted design and course specific software:
Matlab, Simulink

Topics:

Topic	Week
Review of Linear Systems • Properties of signals and systems • The Fourier Series • The Fourier Transform • Orthogonal representation of signals	1-2
Linear and Angle Modulation techniques • Amplitude Modulation • Frequency Modulation • Simulation of communication Systems using Matlab/Simulink	3-4
Pulse modulation and digital transmission of analog signals • Analog to Digital conversion • Time division multiplexing • PAM, PWM, PPM • PCM, DPCM, Delta Modulation	5-6
Digital Modulation and Transmission • BPSK, DPSK, DEPSK, QPSK, M-ary PSK • QASK • BFSK, M-ary FSK, MSK • Pulse shaping to reduce inter symbol interference • Equalization • OFDM	7-9
Review of Random Variables and Noise	10
Mathematical representation of noise	10
Detection and reception in noise • AM reception	11

• FM reception • Digital Signal reception • Noise in PCM and Delta Modulation systems	
Information Theory and Compression Techniques • Basic Concepts • Source and Channel Coding • Capacity of AWGN Channels • Lossless Compression Techniques	12
Channel Coding Techniques • Block Codes • Convolutional Codes • Turbo Codes	13
Final exam	14

Grading: Class participation, Homework 15%; Group project including simulation 15%; Mid-term examination 25%; Final examination 45%.

Homework Problems:
Homework problems will be assigned every week to be collected a week later (or at a later date, as announced).
Topics for the class project will be selected by groups of students and approved by the instructor (time frame will be announced in week 2).

Honor Code: The NJIT Honor Code will be upheld. In particular, students will be expected to acknowledge the source of narratives, software and code if not original. In the unlikely case of violations, these will be brought to the immediate attention of the Dean of Students.

Office: GTIC 5700
Office hours: F 3:30 PM–4:30 PM
Or by appointment – send e-mail to Ms. Sheryl Baker sheryl.baker@njit.edu

Prepared by: Moshe Kam, January 2015