ET 570 Digital Communications
Spring 2010 - 3 Credit Hours

Instructor: Dr. James Z. Zhang

Contact Info: Office Hours: Tuesdays & Thursdays: 2:00pm – 5:00pm or by appointment.
Please call or e-mail if these times will not work with you. I can be contacted at the following:
Phone: 828-227-2159 E-mail: zhang@email.wcu.edu

Office Location: 164 Belk Building

Meeting Periods: Lectures – Mondays, Wednesdays and Fridays: 1:25pm – 2:15pm, in Belk 253.

CourseEval Dates: **TBA**

Course Description: Introduction to digital communication systems and spread spectrum communications. Topics include analog message digitization, signal space representation of digital signals, binary and M-ary signaling methods, detection of binary and M-ary signals, comparison of digital communication systems in terms of signal energy and signal bandwidth requirements. The principal types of spread spectrum systems are analyzed and compared. Application of spread spectrum (including UWB) to multiple access systems and to secure communication systems is discussed.

Course Goals:

A. General Course Goals/Objectives:

Provide the student with a broad, yet strong background in the traditional topics associated with digital communications, e.g., binary and M-ary signaling methods. Provide student with a strong background in traditional topics associated with digital communications systems performances, e.g., power efficiency vs. bandwidth efficiency. Introduce the student to some of the more recent developments that promise to have a broad impact on digital communications (e.g., SS and UWB).

B. Specific goals and objectives (Knowledge, Skills, and Abilities):

(A) KNOWLEDGE

The students will:
1. An understanding of signaling and detection methods.
2. The ability to design basic communications systems and analyze their performances.
3. Knowledge of spread spectrum systems.
4. The ability to apply above knowledge and skills to engineering problems.

Evaluation: Class discussions, homework assignments and unit tests.

(B) SKILLS

The students will:
1. Be able to use Matlab to design and analyze communication systems
2. Prepare a formal report of an experiment and present the findings orally

Evaluation: Mini-design projects, ability of writing Matlab scripts and functions.

Prerequisites: Graduate Student Standing - completion of a statistics course will be helpful

Required Text: *none required. The instructor will provide class-notes based on the reference textbooks.*

Reference Text: Michael B. Pursley, *Introduction to Digital Communications*, Prentice Hall, 2005.

John G. Proakis, *Digital Communications*, 4th Ed., McGraw-Hill, Inc., 2001.

Instructional Approach: Three lecture/discussion periods per week. Some lecture periods maybe dedicated to Matlab simulation sessions. Open class discussion is an important element of this class. Students are responsible for the content of all reading assignments whether or not the material is covered in class. Additionally all students will be required to utilize the assigned software for project administration.

Assignments: There will be about 10 assignments, 1 project, 3 term exams, and a final exam. All homework solution MUST be typeset by PCTex or other LaTex equivalent software.
Late work (no more than one week) accepted with 50% penalty, otherwise will not be accepted.

Project: Each student must complete an applied research project. This project will be completed during the last 4 weeks of class (but do not wait until week 12 to start). A preliminary proposal must be submitted for instructor approval by week 8. The project will be treated as equivalent to 4 weekly problem sets. A format guide for writing the final report will be provided. With minor modifications and proper formatting, it is expected that the final report is publishable in an appropriate media.

Evaluation: Final grades will be based on the following percentages:

Assignments (10)	3% each	Project	15%
Term Exams (3)	30%	Final Exam	25%

Grading Scale:

80-100	A	60-69	C
70-79	B	59 & below	F

Honor Code: Students are expected to comply with the spirit and intent of the University Academic Honesty Policy as stated in the Undergraduate Catalogue**. Visit WCU's graduate Student Handbook for all related policies and procedures. http://www.wcu.edu/studentd/StudentHandbook**

Accommodations for Students with Disabilities: Western Carolina University is committed to providing equal educational opportunities for students with documented disabilities. Students who require disability services or reasonable accommodations must identify themselves as having a disability and provide current diagnostic documentation to Disability Services. All information is confidential. Please contact Disability Services for more information at (828) 227-2716, lalexis@wcu.edu or 144 Killian Annex.

Lecture Outline (Topics will be selected from the following to construct a 40-lecture semester).

Class	Topic	Text
1	Introduction, Basic Digital Modulation	MBP 5.1
2	Baseband Signals	---
3	Random Variables	MBP 1
4	Random Processes	MBP 2
5	Lin. Syst. with Random Inputs	MBP 3
6	Frequency Domain Analysis	MBP 4
7	Narrowband Noise	---
8	Linear Receivers	MBP 5.2
9	"	---
10	Thresholds	MBP 5.3
11	"	---
12	General Decision Rules	MBP 5.4

13	Matched Filter	MBP 5.5
14	Opt. Filter in Additive Gaussian Noise	MBP 5.6
15	Signal Space Concepts	MBP 5.7
16	**Test No. 1**	---
17	BPSK, Imperfect Phase Ref.	MBP 6.1
18	Detection of RF Binary Signals	MBP 6.2
19	QPSK, MSK	MBP 6.3
20	Orthogonal Representation	MBP 6.4
21	Signal Space Revisited	MBP 6.5
22	Coherent Det. of M-ary Sig.	MBP 6.6
23	Orthogonal Signal Performance	MBP 6.7
24	Detection of Nonorthogonal Sig.	MBP 6.8
25	Optimum Noncoherent Detection	MBP 7.1-7.2
26	**Test No. 2**	---
27	Noncoherent Det. of RF Binary Sig.	MBP 7.3-7.5
28	"	MBP 7.6-7.7
29	Noncoherent Det. of M-ary Sig.	MBP 7.8
30	Intersymbol Interference	MBP 8.1
31	Intersymbol Interference and Equalization	MBP 8.2-8.4
32	Methods of Comparing Communication Systems	Notes
33	Examples	---
34	Examples	---
35	Intro. Spread-Spectrum Sys.	Notes
36	**Test No. 3**	---
37	Direct-Sequence Spread-Spectrum	MBP 9.1
38	"	MBP 9.2
39	Coherent DS/SS Receiver	MBP 9.3
40	DS/SS Receiver Analysis	MBP 9.4
41	Noise Figure and Link Budgets	MBP 9.5
42	Acquisition of DS/SS	MBP 9.6
43	Diversity Reception of DS/SS	MBP App. A
44	Freq. Hopping Spread-Spectrum	MBP App. B