EECE 640 – Wireless Communications

Catalog description:
A course that covers the fundamentals of wireless communications with emphasis on wireless channel modeling; digital modulation in wireless channels; diversity techniques; channel coding and interleaving in fading channels; adaptive equalization; multiple access techniques; the cellular concept; overview of current wireless communications systems.

Credit hours: 3 credits

Required or elective: Elective for ECE and CCE students

Prerequisites: By course: EECE 442, By topic: Basic understanding of probability theory; Basic understanding of digital communications; Basic knowledge of Matlab programming.

Textbook(s) and/or required materials:
Andrea Goldsmith, *Wireless Communications*. Cambridge University Press, 2005.
References:
- Andreas F. Molisch, *Wireless Communications*, Wiley, 2005.
- Theodore S. Rappaport, *Wireless Communications: Principles and Practice.* Prentice Hall, second edition, 2002.
- John G. Proakis, *Digital Communications*. McGraw-Hill, fourth edition, 2001.

Computer usage: Programming using Matlab.

Course Objectives

The objectives of this course are to:	*Correlates to program objectives*
Understand the basic principles of wireless communications	1, 2, 3
Understand the modeling of wireless channels and the design of transmitters and receivers in wireless systems	1, 2, 3
Provide an overview of practical wireless cellular communication systems	1, 2, 3, 4
Provide the basic background in wireless communications that will allow them to practice in this field, and that will form the foundation for more advanced courses in related areas	1, 4
Provide the basic skills needed to simulate and analyze wireless communication systems	1, 2, 3, 4

Course Topics

No.	*Subjects covered*	*75 min. lectures*
1	Wireless Channel Models (Pathloss, Shadowing, and Fading)	6
2	Basic Digital Modulation Techniques over Wireless Channels	4
3	GMSK Modulation	2
4	Spread Spectrum	2
5	Multicarrier Modulation and OFDM	2
6	Diversity Techniques (Time, Frequency, Space, Multipath)	3
7	Channel Coding and Interleaving over Wireless Channels	4
8	Multiuser Communications and Multiple Accessing	2
9	Overview of Existing Wireless Cellular Systems (GSM, UMTS, WLAN)	2

Course Learning Outcomes

At the end of the course, students should be able to:	*Correlates to program outcomes**		
	H	*M*	*L*
Explain the link level building blocks of transmitters and receivers in wireless systems	a, c, k, o	e, j	
Model pathloss in wireless channels	a, o		e
Model lognormal shadowing in wireless channels	a, o	l	e

Model fading in wireless channels (fast/slow fading, frequency selective/non-selective)	a, o	l	e
Analyze and compare the following digital modulation techniques: PSK, ASK, FSK, GMSK, and QAM	a, o	e	
Evaluate and analyze the performance of various digital modulation and demodulation techniques over AWGN and fading channels	a, o	e, k	l
Describe the design and analyze the performance of spread spectrum modulation	a, o	e, k	
Describe the design and analyze the performance of multicarrier modulation (OFDM)	a, o	e, k	
Describe the design and evaluate the performance of diversity techniques over wireless channels	a, o	e, k	l
Describe the design and analyze the performance of channel coding schemes for wireless systems	a, o	e, k	
Describe the design of interleavers for wireless systems	a, o	e, k	
Compare the various types of multiple accessing schemes (TDMA, FDMA, CDMA, OFDMA) for wireless systems	a, o	c, e, k	
Describe several design issues and system parameters of existing wireless technologies such as GSM, UMTS, and WLAN	a, c, j, k, o		
Develop simulations for the design and analysis of wireless systems using Matlab	a, c, e, k, o		

* *H: High correlation, M: Medium correlation, L: Low correlation*

Class/laboratory schedule: Two 75-minute lectures per week. Use of computer lab is needed for working on the assignments and projects.

Evaluation methods

1. Participation 5%
2. Homeworks and Quizzes 20%
3. Project 10%
4. Midterm Exam 30%
5. Final Exam 35%

Professional component

Engineering topics: 100%
General education: 0%
Mathematics and basic sciences: 0%

Person(s) who prepared this description and date of preparation

Zaher Dawy, September 2004

Date of last revision

January 2009