

**Department of Electrical and Computer Engineering  
New Jersey Institute of Technology**

**Fall 2014**

**ECE 425 – Wireless Communication Systems (3 credits, 3 contact hours,  
elective course)**

**Instructor:** Ali Abdi, Email: [ali.abdi@njit.edu](mailto:ali.abdi@njit.edu), Tel: 973-596-5621

**Textbooks:** P. M. Shankar, Introduction to Wireless Systems. ISBN: 0471321672 (main text)  
T. S. Rappaport, Wireless Communications. ISBN: 0130422320  
K. Pahlavan & A. H. Levesque, Wireless Information Networks. ISBN: 0471725420

**Course Description:**

This is a course on the fundamental of wireless communication systems and techniques. Topics include wireless systems and standards, the cellular concept, wireless propagation, co-channel interference, digital modulation over fading channels, antenna diversity, spread spectrum techniques, TDMA and CDMA cellular architectures, handoff, 3G and 4G systems. The course provides a general background for advanced courses on wireless communication systems and networks.

**Prerequisites:** ECE481 or ECE421.

**Specific course learning outcomes (CLOs):** The students will be able to:

1. Understand wireless propagation, cellular concept, modeling and mitigating interference, system capacity and traffic, basic digital modulation in wireless channels, spread spectrum and multiple access methods; for the purpose of working in wireless communication industry or taking more advanced courses in related areas.
2. Understand the concepts of wireless communication systems and standards, and the fundamentals of different wireless networks such as GSM, CDMA, LTE, etc.
3. Design and conduct computer simulations on basic and real-world wireless communication systems and standards (such as Bluetooth).

**Relevant student outcomes (ABET criterion 3):**

- (a) an ability to apply knowledge of mathematics, science, and engineering (CLO 1, 3)
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data (CLO 1, 3)
- (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 1, 2, 3)
- (f) an understanding of professional and ethical responsibility (CLO 2)
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context (CLO 2)
- (i) a recognition of the need for, and an ability to engage in life-long learning (CLO 1, 2)
- (j) a knowledge of contemporary issues (CLO 1, 2)
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (CLO 1, 3).

**Computer assisted design and course specific software:** Matlab, Simulink, Matlab Communication System Toolbox

<b>Tentative Course Schedule</b>		<b>Weeks</b>
Overview of Wireless Systems	Chapter 1: pp. 1-7	1
Propagation Characteristics of Wireless Channels (attenuation, also known as pathloss)	Chapter 2, pp. 10-24	2
Propagation Characteristics of Wireless Channels (multipath fading, frequency and time selective channels, delay and Doppler spreads, level crossing and fade duration, lognormal shadowing)	Chapter 2: pp. 24-39, pp. 42-43, pp. 51-52	3-4
Introduction to Matlab and Simulation of Wireless Channels	handouts	5
Cells and Cellular Traffic (geometry of hexagonal cells, co-channel interference)	Chapter 4: pp. 138-146	6
Cells and Cellular Traffic (co-channel interference reduction techniques, coverage area estimation)	Chapter 4: pp. 146-156	7
Cells and Cellular Traffic (traffic capacity and trunking, trunking efficiency)	Chapter 4: pp. 156-162	8
Digital Communication in Wireless Systems, using Matlab/Simulink Communication Blockset and Toolbox	Handouts	9
Multiple Access Techniques (FDMA, TDMA, CDMA, direct sequence and frequency hopping spread spectrum techniques)	Chapter 6: pp. 207-214, pp. 216-224	10
Multiple Access Techniques (overview of wireless systems and standards, North American digital cellular systems based on CDMA, comparison of multiple-access systems in wireless communications)	Chapter 6: pp. 224-235	11
More on Simulating Wireless Systems using Matlab/Simulink Communication System Toolbox	Handouts	12
Fading Mitigation in Wireless Systems (different forms of diversity, equalization, MIMO in LTE technology)	Chapter 5 and handouts	13
Wireless LAN, MAN and PAN Technologies, Miscellaneous Materials	Handouts	14

**Grading policy:** Exams (60%), Homeworks and Projects (40%)

**Homeworks and projects:** They are due at the beginning of the class on the due date. Late submissions are not acceptable. Please put a cover page on your homework or project, with your name on it. All the pages should be stapled. Please write legibly. For computer projects, please provide a printout of your program and the outcome of the program.

**Updates and assignments:** see class website: <http://web.njit.edu/~abdi/ECE425/download>

**Office hours:** Tuesday (5 - 6 pm), Wed. (5 - 6 pm), and by appointment

**Honor Code:** The NJIT Honor Code will be upheld. Any violations will be brought to the immediate attention of the Dean of Students.

**Office:** ECE Bldg., Room 303

**Prepared by:** A. Abdi