16.582/16.418 Wireless Communications

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Objectives: This course provides students with a solid background the propagation of radio waves, characterization of wireless channels, modulation and coding for wireless channels, technologies used for wireless communication, cellular systems and frequency reuse, and the design, deployment and operation of state of the art wireless networks.

Course Grading: Mid-Term 35% required of all students including auditors, Final Exam 45%, mini-projects (15%) and homework and class participation 5%. There will be a semi-optional measurement project this year.

Course Materials: Text: Wireless Communication, Principles and Practice, by T. Rappaport, Class Notes from web site. Please check web site frequently for announcements, and course materials.

16.418 vs 16.582: Students taking the course for graduate credit are required to do an extra project and also at times to read different and harder papers from the literature.

Projects: There are going to be 2 projects this year. 1) A Matlab exercise in which you will simulate Rayleigh fading and analyze different diversity techniques. 2) An exercise in cell radius planning in which you will use the Cost-231 model to determine estimated cell counts for a simulated design,

Prerequisites: 16.362 (Signals 1), 16.363 (Probability), MATLAB, 16.360 (Electromagnetics). These prerequisites are really needed for the course. This class is probability based. Please not enroll in the course unless you have the prerequisites.

Homework: Homework will be assigned each week and discussed at the beginning of the next class. Each class will begin with a brief review of the previous material. Solutions will be posted. Homework will not be graded, but trust me the exams are based on the homework.

Course Contents (schedule on website supersedes this document)

1/19/17: Introduction to Wireless, Course Expectations and Layout. The development of modern wireless and where we are going. Working in dB.

1/26/17 Cellular I: Operating in an interference vs noise limited environment. The concept of frequency reuse. Calculating signal to noise + Interference ratio. Performance of different technologies in Interference limited environments

2/02/17: Cellular II: Introduction to the tradeoffs between frequency reuse and capacity. Learning the basics of Traffic Engineering. Calculating blocking probabilities. Introduce the concept of trunking efficiency.

2/09/17: Propagation I: How information moves from one place to another without wires. When bad things happen to good signals: Attenuation, Shadowing, and micro-fading. We start with propagation in free space. Calculating link budgets in free space.

2/16/17: Propagation II: What happens when we add the effect of ground reflections? Moving from free space to practical propagation environments. Propagation by Diffraction. Calculating link budgets for modern cellular systems.

2/23/17: Propagation III: Effect of Shadowing and building penetration. Calculating the link budgets for modern wireless systems. Using Practical models used by radio engineers, Okumura-Hata, Cost-231, others. Models for indoor propagation

3/02/17: Channel Models for Wireless Communication I: What happens when signals propagate through the wireless channel: Temporal, Spatial, and frequency dispersion: Effects of multipath propagation including selective and non-selective fading. Coherence bandwidth

3/09/17: Mid Term Exam: Covers materials through and Including Propagation III. 2 hours, in class. You may bring 1 sheet of notes + calculator.

3/16/17: Spring Break

3/23/17: Channel Models for Wireless Communication II: Multipath and Doppler spreads create a fading multipath channel. Understanding the characteristics of Rician, Rayleigh, Nakagami and other fading channels. Concepts of Coherence bandwidth. Fast and slow fading.

3/30/17: Channel Models for Wireless Communication III: Calculating average fade duration, rate of fades, and depth of fades. Coherence bandwidth and Coherence Time. Indoor and out door propagation.

4/06/17: Channel Models for Wireless Communication IV: Systems to combat multipath fading: Concepts of time, space, frequency and coding diversity. Use of interleaving. Introduction to MIMO. How equalizers work. Project 2 assigned. Graduate Students must do parts 1-5, undergraduates 1-3. Graduate students should read the paper marked "Fading Channel Article". Undergraduate Students read "easier article" posted on website

4/13/17: Channel Models for Wireless Communication V. Indoor Wireless Communication. Profiles of multipath, fading and propagation for indoor wireless communication such as Wi-Fi and indoor cellular communications. Graduate Students are responsible for entire Section, undergraduate sare responsible only for parts 1-5.

4/20/17: The basics of modern wireless systems, A to Z. Architecture of modern wireless systems. What are the functions of BTS, BSC, MSC, RNC, backhaul, in a modern network? How handoff works in a modern system. Introduction to the major wireless standards.

4/27/17: Case: 4G LTE. We look at the LTE standard, which will form the basis of our wireless systems for the remainder of this decade. Graduate Students read all 4 papers, undergraduate students "Easy Tutorial"

5/04/17 Final Exam Comprehensive: Stresses Material since last exam