ENTS 656: Cellular Communications Networks Syllabus

Course Description
Concepts and techniques involved in wireless digital communications with emphasis on cellular, PCS, and 3G/4G systems. Properties of mobile radio channels; intersymbol interference, multipath, and fading effects; interleaving and diversity; multiple access schemes (TDMA, FDMA, CDMA, OFDMA); inter-user interference, traffic issues, and cell capacity; power control strategies; frequency reuse and channel assignment including fractional reuse; handoff, paging, and location update; cell layout; introduction to modern cellular standards. Python scripting will be taught and used for the class project.

Instructor Contact Information

Dr. Michael Dellomo
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Office hours:
1363 AV Williams Building
Days and times will be announced during the first and third class each semester and will be posted on my door.

Required Books
Wireless Communications, Principles and Practice 2nd Ed., by T. Rappaport

Course Policies

Attendance & participation
Attendance and participation are not required and students will not be graded on it. However, it is highly recommended that students attend lectures and labs to ask questions about the course and to better prepare for the exams.

Assignments
1) Cellular Homework: All assignments must be submitted by deadlines given in class. Each student is expected to complete the assignment on their own, however, it is acceptable for students to compare answers and check each others work. Plagiarism, however, is not permitted. It is each student's responsibility that the assignments are submitted in a timely manner so the professor can assess the assignment. In any event, all work must be completed by the end of the course.
2) Python Exercises: Python exercises will be given each week and will be due the following week. Assignments will start around the second week of class and go for 4 or 5 weeks. Collaboration of any kind on the Python exercises or project is NOT PERMITTED and will be considered cheating/plagiarism. Questions about Python can be brought to either the instructor or the lab teaching assistant.
3) Python Project: The class project will be assigned midway through the semester. Students will work on the project independently. The project should be considered similar to a take-home exam. Collaboration of any kind on the project is NOT PERMITTED and will be considered a serious infraction of the honor code. Questions about the project can be brought to the instructor or the lab teaching assistant.

Academic Integrity
The University of Maryland has a nationally recognized Honor Code, administered by the Student Honor Council. This code sets standards for academic integrity for all undergraduate and graduate students, and you are responsible for upholding these standards in this course. It is very important for you to be aware of the consequences for cheating, fabrication, facilitation

and plagiarism. For more information please visit: http://www.shc.umd.edu. Students who engage in academic dishonesty in this course will receive no points for the assignments and will be reported to the Honor Council and the Office of Judicial Programs for further action. There will be no warnings! Remember, it is not worth it!

Persons with Disabilities
Students with a documented disability should inform the instructor as soon as possible if academic accommodations are needed. Accommodations for individuals with disabilities can be arranged through the Disability Support Service (DSS), a division of the University Counseling Center. Please call 301.314.7682, email dissup@umd.edu, or visit Shoemaker Building for more information.

Video Taping, Recording and Photographing
It is against University and Program policy to video tape, record, or photograph lectures unless done in accordance with the procedures for Persons with Disabilities. Lecture material is considered to be copyrighted by the University and unauthorized reproduction is considered to be copyright infringement. The instructor will make available and distribute any necessary material which is too detailed for conventional note taking.

Cell phones
Any use of cell phones is not permitted during class time. Please turn off all cell phones prior to the start of class.

Grading
The course will consist of 4 cellular assignments, 4 python assignments, one python project, one midterm and one final exam. The point breakdown is given below.

Cellular Hwk	60 points	4 Assignments, 15 points each
Python Hwk	60 points	4 Assignments, 15 points each
Python Proj	80 points	Data Announced in Class
Midterm	100 points	Date Announced in Class
Final	200 points	Date Announced in Class
Total	500 points	

Cellular homework assignments
Each assignment is worth 15 points and will be given in more detail as the course progresses. The assignments consist of extended problem sets meant to prepare students for the midterm and final.

Python homework assignments
Each assignment is worth 15 points and will be given in more detail as the course progresses. The assignments consist of simple programming exercises meant to prepare students for the project. STUDENTS MUST WORK ON THESE EXERCISES INDEPENDENTLY!

Python Project
This is a significant project combining cellular class work with Python programming. Students will be given ample time to complete the project but should plan accordingly for the work required.

<u>Tentative</u> Course Schedule (will be adjusted as the course progresses)

1. Overview and Python basics (1 week)
    - Course Overview and Python Overview
    - Variables and Assignments
    - Libraries and Data Types

2. More Python (~2 weeks)
    - Basic I/O and Coding Style
    - Sequence Types, Indexing, and Dictionaries
    - Flow Control, Functions, Modules, and Scoping
    - Python Interfacing, File I/O and Exceptions
    - NumPy and MatPlotLib

3. Cellular Overview (~1.5 weeks)
    - History of Mobile Communications
    - Evolution of Cellular: from pre-1G to 4G
    - Licensing Issues and Unlicensed Spectrum

4. Cellular Concept and Design (~2.5 weeks)
    - Hexagons and Channelization
    - Handoff
    - Interference vs. Capacity
    - Trunking, Grade of Service, Erlang Computations
    - Cell Splitting and Sectoring

5. Mobile Propagation (~2.5 weeks)
    - Basic Equations and Mechanisms
    - Free Space Loss
    - Flat Earth Loss
    - Diffraction and Scattering
    - Longley-Rice and OHLoss Models
    - Okamura-Hata, COST-231, and Extensions
    - Walfisch, Ikagami, and Bertoni || Other Models

6. Small Scale Fading and Multipath(~2.5 weeks)
    - Doppler Shift
    - Impulse Response and the Cellular Channel
    - Time Dispersion and Flat vs Frequency Selective Fading
    - Coherence Time and Fast vs Slow Fading
    - Rayleigh and Ricean Distributions, Fading Statistics

7. Evolution to Modern Systems (~3 weeks)
    - Diversity and Downtilting
    - CDMA and Processing Gain
    - CDMA Capacity Calculations
    - OFDMA Concepts
    - LTE and Frequency Reuse
    - MIMO and Beamforming (and other LTE topics as time permits)