

NEW COURSE

# Wireless Systems Instructional Design

Course No: 16:332:559 - Advanced Topics in Communications Engineering (Spring 2004)

Registration Index No: TBA

**Class Hours/Place:** Wednesday 4-7 PM, Eng. Building (Room B-113)

**Instructor:** Narayan B. Mandayam (narayan@winlab.rutgers.edu, WINLAB 119)

**Computer Science Contact:** Prof. Badri Nath (badri@cs.rutgers.edu, 445-2082)

## Course Description :

This course will expose graduate students (typically in their second year of study) in Electrical & Computer Engineering (ECE) as well as Computer Science (CS) to a design experience that will augment their knowledge base from existing courses related to wireless communications systems at Rutgers. This multidisciplinary course is intended to foster understanding and hands-on design of wireless systems with emphasis on crosslayer issues. The class structure will revolve around design experiments in an instructional laboratory (funded in part by Intel) that will be augmented by tutorial style lectures on the following topics:

- RF propagation/measurements for an understanding of spectrum and interference issues
- Simulation, evaluation & implementation of physical (PHY) layer options
- Design and prototyping of medium access control (MAC) and radio link-layer options
- Design and evaluation of mobile network layer protocols including adhoc routing protocols and TCP
- Design of applications for a mobile and resource limited environment

Along with graduate students in ECE, graduate students from CS are strongly encouraged to participate in this new course. Each student will be expected to participate as a member of a diverse “interdisciplinary team” in two or three projects on the following aspects of wireless system design: PHY, MAC, Network and Application Layer Design

The course will be organized into two segments:

In the first segment, tutorial style material will be presented to illustrate how the activities of various layers such as PHY, MAC and networking impact a wireless communication system. Experts in different fields (namely ECE and CS) will present invited lectures on specific issues while still adhering to the general interdisciplinary level of the class. Along with presentation of technology issues, there will also be a tutorial style presentation of various software and hardware packages (such as SPW, Spectrum Analyzer, ns2, OPNET,

etc.) that will be used in the instructional laboratory. At the end of this period the class will be divided into appropriate multidisciplinary teams with assigned projects in PHY, MAC and Networking layers. The design projects will all be related to wireless systems using unlicensed band technology such as 802.11, bluetooth, etc.

In the second segment (representing about 60% of the course), the students will focus individually as well as a team on their selected projects. During this time each student will describe periodically his/her goals and progress at a level of detail appropriate to the interdisciplinary nature of the class. Where new problems emerge, it will be necessary for each team to understand the implications of these problems and identify remedial actions. This phase will culminate in a final presentation of project results.

### **Topical Course Outline:**

1. Introduction to Wireless Systems and Technologies: Standards, Spectrum and Evolution
2. Introduction to Radio Propagation, Interference and PHY layer issues
3. Introduction to MAC layer design and protocols
4. Introduction to Network layer design and protocols
5. Challenges, as well as opportunities, in application designs for resource and cost constrained mobile terminals,
6. Impact and interaction of PHY, MAC and Network layers; Challenges of crosslayer design
7. Challenges in simulation and emulation of Wireless System Design: PHY, MAC, Network layers as well as crosslayer design
8. Introduction to Software and Hardware Packages in the Instructional Laboratory e.g. SPW, Spectrum Analyzer, ns2, OPNET, etc.
9. Project outlines and guidelines

### **Course Requirements:**

Weekly updates and progress presentation when appropriate  
Final project presentations

### **Recommended References/Reading :**

Will be furnished as appropriate