University of California, Santa Barbara
Department of Electrical and Computer Engineering

ECE 250 Wireless Communications and Networking

A. Basic Course Information

This course covers topics in wireless communications and networking.

Instructor: Prof. Volkan Rodoplu
Room 4113, Harold Frank Hall
Email: vrodoplu@ece.ucsb.edu
Office Hours: after class, in classroom, and in office, by appointment.

Lecture Hours and Location:
4:00 PM - 5:50 PM Monday & Wednesday TD 2600

Course web page:
http://www.ece.ucsb.edu/courses/ECE250/250_S08Rodoplu

Course Objectives:

1. To bring together a diverse group of students from different backgrounds, such as EE, CE, and CS.
2. To teach the fundamentals of wireless propagation characteristics,
3. To teach how to read research papers, developing depth quickly as required,
4. To teach how to present research papers clearly,
5. To teach how to think critically about diverse areas within wireless networking, and to understand the interaction of phenomena at different layers of the protocol stack.

Textbook and References:

No textbook is required for the course. The reading list is below and is also posted on the web page.

Optional Reference: You might find *Wireless Communications: Principles and Practice*, 2nd edition (by Ted Rappaport), Chapters 3 - 5 useful for the first two weeks of the course.

Grading:

15%	Class Participation
25%	Homework
15%	Exam # 1
15%	Exam # 2
15%	Exam # 3
15%	Paper Presentation

Exam Dates: The dates of the three exams, and the student presentation are as noted in the calendar below. There is NO final exam in this course.

Presentations:

Each student (or group) will present a paper of his/her (or their) choice. The paper presentations will be scheduled for the last week of class.

Prerequisites:

A. Knowledge of the following material:
(1) Computer Networks: ECE 155A or CS 176A
(2) Analog Communications: ECE 146A

B. Some mathematical maturity is needed to be able to understand the proofs in the papers that we will read. (Typically, you need to have taken one of the following courses: a proof-oriented algorithms course or computing theory course as found in CS undergraduate curricula, OR a graduate-level course in information theory, queuing theory or stochastics as found in graduate EE curricula, OR any junior/senior undergraduate course for math majors.)

C. You need to have some previous exposure to mobile computing, or digital/wireless communications at the graduate level (Example courses: CS 276, CS 284, ECE 243A, ECE 243B), OR research experience (in sensor networks, ad hoc networks, cognitive radios, IEEE 802.11 networks).

B. Topics and Course Calendar:

High-Level Organization of Topics:

Weeks 1 - 3:	Wireless Communication Fundamentals
Weeks 4 - 9:	Selected Topics in Wireless Networking:
	Topology Control of Wireless Networks
	Scaling Laws of Wireless Networks
	MAC Protocols for Wireless Sensor Networks
	Routing for Wireless Sensor Networks
	Quality of Service in Mobile Wireless Networks
Week 10:	Student Presentations

Detailed Course Calendar:

All of the homework due dates and the exam dates are as noted below.

Week of	**Monday Lecture**	**Wednesday Lecture**
Mar. 31	(Lecture 1) Course Overview and logistics; Motivation and introduction; Cellular concept- system design fundamentals, frequency reuse, handoff, interference and system capacity.	(Lecture 2) Mobile Radio Propagation - Large-scale Path Loss; free space propagation model, reflection, diffraction, scattering, log-distance path loss model, shadowing, coverage area.
Apr. 7	(Lecture 3) Mobile Radio Propagation - Small-scale fading and multipath; Doppler shift, multipath channel; delay spread and coherence bandwidth; Doppler spread and coherence time; flat fading and frequency-selective fading; fast fading and slow fading.	(Lecture 4) Mobile Radio Propagation - Small-scale fading and Multipath: Rayleigh and Ricean distributions; multipath fading channels; fading statistics.
Apr. 14	Topology Control In-class discussion: Paper # 1 on the Reading List. [HW # 1 due]	Topology Control In-class discussion: Paper # 2 on the Reading List [HW # 2 on Paper 1 due]
Apr. 21	Topology Control In-class discussion: Paper # 3 on the Reading List. [HW # 3 on Paper 2 due]	**EXAM # 1** (Coverage: Lectures 1 - 4 only, and HW # 1)
Apr. 28	Scaling Laws In-class discussion: Paper # 4 on the Reading List.	Scaling Laws In-class discussion: Paper # 5 on the Reading List. [HW # 4 on Paper 4 due]
May 5	MAC Protocols for Sensor Networks	**EXAM # 2** (Coverage: Papers 1 - 5)

	In-class discussion: Paper # 6 on the Reading List. [HW # 5 on Paper 5 due]	
May 12	MAC Protocols for Sensor Networks In-class discussion: Paper # 7 on the Reading List. [HW # 6 on Paper 6 due] [Presentation Proposal due: Team members, and choice of paper]	Routing for Sensor Networks In-class discussion: Paper # 8 on the Reading List. [HW # 7 on Paper 7 due]
May 19	Routing for Sensor Networks In-class discussion: Paper # 9 on the Reading List. [HW # 8 on Paper 8 due]	Quality of Service in Mobile Ad Hoc Wireless Networks In-class discussion: Paper # 10 on the Reading List. [HW # 9 on Paper 9 due]
May 26	HOLIDAY (NO LECTURE)	**EXAM # 3** (Coverage: Papers 6 - 10)
June 2	STUDENT PRESENTATIONS	STUDENT PRESENTATIONS

C. Reading List:

The following is the list of papers that we will read in this course:

Please make sure that you read the version of the paper that is noted below. (It might be the particular choice of the conference or journal version of the same paper.)

You can find these papers on IEEE Xplore, or the ACM Digital Library, both of which are online. If you search these on Google Scholar, you might be able to find the links to these articles on those two libraries quickly.

Topology Control:

1. V. Rodoplu and T. H. Meng, ``Minimum energy mobile wireless networks,'' IEEE Journal on Selected Areas in Communications, vol. 17, pp. 1333--1344, Aug. 1999.

2. R. Ramanathan and R. Rosales-Hain, ``Topology control of multihop wireless networks using transmit power control adjustment", in Proc. INFOCOM 2000.

3. L. Li, J. Y. Halpern, P. Bahl, Y. M. Wang, R. Wattenhofer, ``Analysis of a cone-based distributed topology control algorithm for wireless multi-hop networks", in Proc. ACM PODC 2001.

Scaling Laws:

4. P. Gupta and P.R. Kumar, ``The capacity of wireless networks", IEEE Trans. Inform. Theory, vol. 46, No. 2, pp. 388 - 404, Mar. 2000.

5. M. Grossglauser and D. Tse, ``Mobility increases the capacity of ad-hoc wireless networks", in Proc. IEEE INFOCOM 2001, vol. 3, pp. 1360-1369.

MAC Protocols for Sensor Networks:

6. W. Ye, J. Heidemann, D. Estrin, ``Medium access control with coordinated adaptive sleeping for wireless sensor networks", IEEE/ACM Trans. Networking, vol. 12, no. 3, Jun. 2004.

7. M. K. Park, V. Rodoplu, ``UWAN-MAC: An Energy-Efficient MAC Protocol for Underwater Wireless Acoustic Networks", IEEE/MTS Journal of Oceanic Engineering, vol. 32, no. 3, pp. 710-720, July 2007.

Routing for Sensor Networks:

8. C. Intanagonwiwat, R. Govindan, D. Estrin, J. Heidemann, F. Silva, ``Directed diffusion for wireless sensor networking", IEEE/ACM Trans. Networking, vol. 11, no. 1, pp. 2 - 16, 2003.

9. Q. Fang, J. Gao, L.J. Guibas, V. de Silva, L . Zhang, ``GLIDER: Gradient landmark-based distributed routing for sensor networks", in Proc. IEEE INFOCOM 2005.

Quality of Service in Wireless Ad Hoc Networks:

10. S. Chen and K. Nahrstedt, ``Distributed Quality-of-Service routing in ad hoc networks," IEEE J. Selected Areas in Communications, vol. 17, no. 8, pp. 1488-1505, Aug. 1999.

D. Student Presentations:

You will present a paper of your choice (either individually or with team members) in 15 minutes plus 5 minutes of question and answer.

The due date for your presentation proposal is as noted on the calendar above. You will need to include a list of your team members, and your paper choice. Your paper choice must satisfy the following: It must be:

1. A paper in an "emerging" subfield of wireless communications. Typically, the paper needs to have been published some time within the last 3 years.

2. An important paper: It must have been either published as an IEEE/ACM journal article, OR published at a reputable ACM conference, OR must have a high number of citations (Google citations are fine, as long as they are not self-citations, or duplicates of same citations; they must be cited by actual conference or journal papers; web sites, online technical reports don't count.)

3. An interesting paper: It must be a paper that your classmates and I would find interesting, and worth knowing about. We will be the audience for your presentation.

Your presentation can have at most 1 slide per minute, so it should not exceed 15 slides.

E. Exam Policy:

All exams are closed book and will be administered in class.

F. Homework Policy:

In homeworks, we are interested in your own, original thinking. Homework is to be done individually, and it is very important to answer the homework questions yourself. Any ideas that you are not yours and that you read somewhere else MUST be cited.