



Sirindhorn International Institute of Technology

Thammasat University

School of Information, Computer and Communication Technology

## ECS 455: Course Syllabus

**Semester/Year:** 2/2011

**Course Title:** Mobile Communications

**Instructor:** Dr. Prapun Suksompong ([prapun@siit.tu.ac.th](mailto:prapun@siit.tu.ac.th))

**Course Web Site:** <http://www2.siiit.tu.ac.th/prapun/ecs455/>

**Please check the course web site regularly** for updated information about this course.

### Lectures:

Time and Place:

- Tuesday 15:30-17:20 BKD 3510
- Thursday 13:30-15:20 BKD 3510

You are **STRONGLY** encouraged to attend lectures. (See the grading policy below.)

### Undergraduate Student Dress Code:

- Undergraduate students must wear Thammasat University uniform OR polite dress.
- Plain white shirt, properly tucked in.
- Plain trouser/skirt in dark color.
- The followings are not allowed:
  - Sandals
  - T-shirt (even with the shop shirt)
  - Polo-shirt (even with the shop shirt)

### Course Information

**Prerequisite:** ECS 332 (Principles of Communications)

**Course Description:** This course introduces selected topics in mobile communications to undergraduate students. Students are not assumed to have taken a course on digital communications. Topics include wireless channel, principles of cellular communications, multiple access methods, digital mobile communication systems: TDMA, GSM, CDMA, WCDMA, multi-carrier and OFDM systems.

**Textbook:** A. Goldsmith, "Wireless Communications," Cambridge Press, 2005.

[<http://wsl.stanford.edu/~andrea/Wireless/>]

- Chapters from other books will be used as well.

## References:

1. D. Tse and P. Viswanath, "Fundamentals of Wireless Communication," Cambridge University Press, 2005  
[<http://www.eecs.berkeley.edu/~dtse/book.html>]
2. Theodore S. Rappaport, "Wireless Communications: Principles and Practice," 2nd Edition, Prentice Hall PTR, 2002. ISBN-13: 978-0130422323. Call No. TK5103.2 R37 2002  
[<http://authors.phptr.com/rappaport/>]
3. M. R. Karim and Mohsen Sarraf, *W-CDMA and cdma2000 for 3G Mobile Networks*, McGraw-Hill Professional, 2002.
4. J. S. Lee and L. E. Miller, "CDMA Systems Engineering Handbook." Boston, MA: Artech House, Oct. 1998.
5. R.E. Ziemer, "Fundamentals of Spread Spectrum Modulation." Colorado Springs: Morgan & Claypool Publishers, 2007
6. A. Bahai, B. R. Saltzberg, and M. Ergen, *Multi-Carrier Digital Communications: Theory and Applications of OFDM*, 2nd ed., New York: Springer Verlag, 2004.
7. H.G. Myung and D.J. Goodman, *Single Carrier FDMA: A New Air Interface for Long Term Evolution*, Wiley, 2008.

**Grading Policy:** Coursework will be weighted as follows:

Assignments	5%
Quiz	5%
<b>Class Discussion/Participation</b>	<b>10%</b>
Midterm Examination	40%
Final Examination (comprehensive)	40%

- No late assignments will be accepted.
- Cheating will not be tolerated
- Copying homework/quiz/exam = cheating
  - Punishment:
    - First time cheater receives zero on that assignment
    - Second time cheater receives zero on all quizzes and/or HWs

**Assignments:** Homework will be assigned throughout the semester. Only some selected problems/parts will be graded. Of course, you do not know which problems will be selected; so you should work on all of them. The complete solutions to all problems will be posted on the course web site.

## Quizzes and Exams:

Exams will be closed book.

Quizzes will relate to current and previous topics. A quiz may be given at any time during any class period – at the beginning or end of a class, etc. There will be no make-up quizzes. Quizzes will be given only to those students who are present when the quizzes are passed out.

**The instructor should be notified before missing any exam if at all possible and immediately thereafter when not possible.** The instructor (and/or the fact-finding committee) will determine if the absence from an exam is legitimate. Simply not feeling well is not a reason to miss an exam. In the case of legitimate absence, an oral and/or written make-up exam could be arranged.

**Expectations:** You should expect to spend extra 5-8 hours per week studying outside of class. However, I do expect you to come to class and participate actively in class discussions. If you must miss a class, I expect you to find out and catch up with what happened in lecture, either from me or one of your classmates. You are responsible for all materials that are discussed in class.

## Academic Integrity

The work you submit in ECS 455 is expected to be the result of your individual effort. You are free to discuss course material, approaches to problems with your colleagues or the instructor but you should never misrepresent someone else's work as your own.

It is your responsibility to protect your work from unauthorized access. For example, do not discard copies of your codes/assignments in public places.

## Course Outline

The following is a tentative list of topics.

1. Introduction
2. Review
  - Fourier transform
  - Modulation
  - Basic communication systems
3. Cellular communications
  - Wireless Channel (Part 1)
  - Spectrum Allocation: Licensed and unlicensed
  - Frequency reuse, cluster and capacity
  - Hexagonal cells, co-channel interference, SIR.
  - Sectoring
  - Trunking Theory and Erlang B formula
  - Tradeoffs between capacity and SIR via cluster size
4. M/M/m/m Assumption and Derivation of Erlang B formula

- Poisson process with review of basic probability theory
  - Markov Chain and Erlang B formula
5. Duplexing: TDD vs. FDD
6. Multiple access schemes
- FDMA and TDMA
  - CDMA (Part 1) and SDMA
7. **MIDTERM:** 21 Feb 2012 TIME 09:00 - 12:00
8. Spread Spectrum Communications
- DS/SS
  - Pseudorandom sequence and m-sequences
  - Sync. CDMA (Part 2) and orthogonality
  - Walsh sequences and Hadamard matrix
  - IS-95
  - Async. CDMA, GPS and Gold codes
  - References:
    - M. R. Karim and Mohsen Sarraf, *W-CDMA and cdma2000 for 3G Mobile Networks*, McGraw-Hill Professional, 2002, pp 84-90.
    - Chapter 4 and 5 in J. S. Lee and L. E. Miller, *CDMA Systems Engineering Handbook*. Boston, MA: Artech House, Oct. 1998.
    - Chapter 4 in R.E. Ziemer, *Fundamentals of Spread Spectrum Modulation*. Colorado Springs: Morgan & Claypool Publishers, 2007
9. Multi-carrier and OFDM systems
- Wireless Channel (Part 2), multipath propagation and equalization
  - Multi-carrier transmission and frequency division multiplexing
  - Orthogonality (revisited)
  - DFT and FFT
  - Oversampling
  - Cyclic Prefix and circular convolution
  - OFDMA
  - Reference:
    - A. Bahai, B. R. Saltzberg, and M. Ergen, *Multi-Carrier Digital Communications: Theory and Applications of OFDM*, 2nd ed., New York: Springer Verlag, 2004.
10. Applications
- GSM, GPRS, EDGE, UMTS (W-CDMA) and OVSF code
  - WiMAX and OFDMA
  - LTE and SC-FDMA
  - Reference:
    - H.G. Myung and D.J. Goodman, *Single Carrier FDMA: A New Air Interface for Long Term Evolution*, Wiley, 2008.
11. **FINAL:** 3 Apr 2012 TIME 09:00 - 12:00