



Sirindhorn International Institute of Technology
Thammasat University

School of Information, Computer and Communication Technology

ECS455: Course Syllabus

Semester/Year: 2/2016

Course Title: Mobile Communications

Instructor: Asst. Prof. Dr.Prapun Sukksompong (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

- Wednesday 10:40-12:00 BKD 3511
- Friday 10:40-12:00 BKD 3511

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

Course Information

Prerequisite: ECS 332 or consent of Head of School

Course Description: This course introduces selected topics in mobile communications to undergraduate students. Topics include wireless channel, principles of cellular communications, multiple access methods, digital mobile communication systems: TDMA, GSM, CDMA, WCDMA, multi-carrier and OFDM systems.

Grading Policy: Coursework will be weighted as follows:

Assignments (HWs)	5%
In-Class Exercises	5%
Class Discussion/Participation	10%
Midterm Examination	40%
Final Examination (comprehensive)	40%

- Late assignments will be heavily penalized or rejected.
- The lowest in-class exercise score will be dropped. Similarly, the lowest assignment score will be dropped.
- Cheating will not be tolerated

Textbook: D. Tse and P. Viswanath, "Fundamentals of Wireless Communication," Cambridge University Press, 2005

- [<http://www.eecs.berkeley.edu/~dtse/book.html>]
- Chapters from other books will be used as well.

Additional References:

1. A. Goldsmith, "Wireless Communications," Cambridge Press, 2005.
[<http://wsl.stanford.edu/~andrea/Wireless/>]
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.

Assignments: Homework will be assigned throughout the semester. Most assignments will be graded on completeness, not correctness: if an honest attempt was made on an assigned problem, it will be considered complete. Occasionally, part(s) of a selected problem will be graded. Of course, you do not know which problem of which assignment will be selected; so you should work on all of them. The complete solutions to all problems (not just answers) will be posted on the course web site.

In-Class Exercises: In-class exercises will focus on current or recently-discussed topics. An exercise may be given at any time during any class period. Students are expected to work in groups of at most three persons. In-class exercises will be given only to those students who are present. There will be no make-up exercise.

Exams: Exams will be **closed book**. Some formulas will be provided on the exams.

Students should notify the instructor 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 this class 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
 - Wireless Channel (Part 1)
 - Spectrum Allocation: Licensed and unlicensed
2. Cellular communications
 - 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
 - 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
3. Duplexing and Multiple access schemes
 - TDD vs. FDD
 - FDMA and TDMA
 - CDMA (Part 1) and SDMA
4. **MIDTERM: 23 Mar 2017 TIME 09:00 - 11:00**
5. 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
6. 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.

7. 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.

8. FINAL: 9 Jun 2017 TIME 09:00 - 12:00

Additional Remarks

- 1) Calculator: Casio FX-991 is permitted in exams and for in-class exercises
- 2) MATLAB: Computer simulation will be used to enhance learning. MATLAB is available in SIIT computer labs.

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