

Course Description:

This is an introductory course in mobile and wireless networks. The course covers fundamental techniques in design and operation of the second, third, and fourth generations of wireless cellular networks and wireless LANs. The emphasis is on the traditional design of cellular mobile systems, including both voice and data services. We will start by covering topics related to the wireless channel; i.e., the radio propagation models and the multiple access techniques. Then, we will proceed with studying the engineering of a cellular system, including detailed explanation of some standards of the existing common air interfaces for voice and data (e.g., GSM, GPRS, IS-95, WCDMA, LTE, WiFi, WiMAX). We will learn how signaling is performed in cellular networks, how a mobile session and a mobile call are controlled, and how security features are designed in those networks. Introduction to third generation wideband systems and novel technologies, such as Bluetooth and ad hoc networks, will be covered as well.

The course is a mixture of theoretical, engineering, and practical topics in contemporary wireless systems.

Pre-requisites: A course in Computer Networks (e.g., CS 5390) and a course in Probability.

Course Instructor: Prof. Zygmunt J. Haas, haas@utdallas.edu

Office Hours: Tuesdays, 2:00pm-4:00pm, Room: ECSS 4.405

Course TA: TBA

Course URL: http://www.utdallas.edu/~haas/courses/wireless_networks

Course Schedule: Mondays/Wednesdays, 10:00am – 11:15am; Room: JO 3.536

Course Text:

- * T.S. Rappaport, Title: Wireless Communications: Principles and Practice, **2nd Edition**, Prentice Hall 2002
- * References to technical articles will be provided during the course

Homework Assignments:

There will be 8-10 homework sets, which will be typically posted on Tuesdays. Each assignment will be due typically two weeks after its distribution (before class), with some exceptions. Some assignments may require limited computer use.

Grading Policy:

Exam 1:	35%
Exam 2:	40%
Homework Sets:	25% (total)
Extra Credit:	Small extra credit will be awarded for active class participation



Grading Rules:

- ★ All the components are essential for the final grade.
- ★ No one is exempt from the exams. If you have missed an exam due to a legitimate reason, you need to reschedule a makeup exam as soon as possible.
- ★ If you did not turn in up to 2 homework sets due to a legitimate reason, the turned-in assignments will carry the total of the 25% of the final score.
- ★ Final project requires an in-class demo. More details to follow.
- ★ Any final score component missed not due to a legitimate reason will count as no credits in the final score calculation.
- ★ See the course web site for what constitute a legitimate reason.
- ★ Individual work is assumed in all grading components.
- ★ Note (1): The date of the final exam is set by the University. It will not be changed and no exceptions will be allowed.
- ★ Note (2): You have to complete and personally return to Prof. Haas the Course Pre-requisite Form by the end of class on Wednesday, Aug. 31. Failure to do so will cause your registration in the course to be dropped.
- ★ Note (3): The CS department has a new attendance policy: three consecutive absences leads to one letter grade drop; four consecutive absences leads to an F.

Reading Assignments:

Reading assignments will be posted weekly. It is very important to go over the reading material before the classes. Unless specified otherwise, reading assignments are from the textbook.

Tentative Syllabus:

- ★ Introduction to the world of Mobile Radio (incl. Overview of Smart Phone Technologies)
- ★ Fundamentals of wireless systems design:
 - ★ The Cellular Principle - frequency reuse
 - ★ The Interference vs. Capacity tradeoff
 - ★ Channel Assignment techniques
 - ★ Capacity Planning, Traffic Engineering, and Trunking Efficiency
 - ★ Brief Introduction to Queuing Theory
 - ★ Handoff Algorithms
 - ★ Power Control Schemes
- ★ Signaling and Call Control
- ★ Radio Propagation Models
 - ★ Fundamentals (Path Loss, Doppler)
 - ★ Large-scale fading (shadowing)
 - ★ Small-scale fading (multipath)
- ★ Modulation, Equalization, Diversity techniques, Channel Coding, Speech Coding
- ★ Wireless Local Area Networks (802.11, 802.15, Bluetooth, etc)
 - ★ Multiple Access, Medium Access, and Physical Layer Considerations
- ★ Mobility Management, Mobility in the Internet (RFC 2002)
- ★ Introduction to Wireless Network Security
- ★ Details of Air Interface designs (e.g., IS-95, GSM, GPRS, WCDMA(3GPP))
- ★ Fourth Generation Broadband Systems (incl. LTE)
- ★ Ad Hoc Networks, Sensor Networks, Internet of Things, 5G



Student Conduct and Discipline:

The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student and each student organization to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained in the UTD publication, *A to Z Guide*, which is provided to all registered students each academic year.

The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the *Rules and Regulations, Board of Regents, The University of Texas System, Part I, Chapter VI, Section 3*, and in Title V, Rules on Student Services and Activities of the university's *Handbook of Operating Procedures*. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations (SU 1.602, 972/883-6391).

A student at the university neither loses the rights, nor escapes the responsibilities of, citizenship. He or she is expected to obey federal, state, and local laws as well as the Regents' Rules, university regulations, and administrative rules. Students are subject to discipline for violating the standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.

Academic Integrity:

The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in his or her scholastic work.

Scholastic dishonesty includes, but is not limited to, statements, acts or omissions related to applications for enrollment or the award of a degree, and/or the submission as one's own work or material that is not one's own. As a general rule, scholastic dishonesty involves one of the following acts: cheating, plagiarism, collusion and/or falsifying academic records. Students suspected of academic dishonesty are subject to disciplinary proceedings.

Any form of plagiarism, including from the WWW, from portions of papers for other classes, and from any other source is unacceptable and will be dealt with under the university's policy on plagiarism (see general catalog for details). This course may use the resources of turnitin.com, which searches the web for possible plagiarism and is highly effective.

Email Use:

The University of Texas at Dallas recognizes the value and efficiency of communication between faculty/staff and students through electronic mail. At the same time, email raises some issues concerning security and the identity of each individual in an email exchange. The university encourages all official student email correspondence be sent only to a student's U.T. Dallas email address and that faculty and staff consider email from students official only if it originates from a UTD student account. This allows the university to maintain a high degree of confidence in the identity of all individual corresponding and the security of the transmitted information. UTD furnishes each student with a free email account that is to be used in all communication with university personnel. The Department of Information Resources at U.T. Dallas provides a method for students to have their U.T. Dallas mail forwarded to other accounts.

Withdrawal From Class:

The administration of this institution has set deadlines for withdrawal of any college-level courses. These dates and times are published in that semester's course catalog. Administration procedures must be followed. It is the student's responsibility to handle withdrawal requirements from any class. In other words, the instructor cannot drop or withdraw any student. The student must do the proper paperwork to ensure that s/he will not receive a final grade of "F" in a course if the student chooses not to attend the class once s/he are enrolled.

Student Grievance Procedures:

Procedures for student grievances are found in Title V, Rules on Student Services and Activities, of the university's *Handbook of Operating Procedures*.

In attempting to resolve any student grievance regarding grades, evaluations, or other fulfillments of academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the instructor, supervisor, administrator, or committee with whom the grievance originates (hereafter called "the respondent"). Individual faculty members retain primary responsibility for assigning grades and evaluations. If the matter cannot be

resolved at that level, the grievance must be submitted in writing to the respondent with a copy of the respondent's School Dean. If the matter is not resolved by the written response provided by the respondent, the student may submit a written appeal to the School Dean. If the grievance is not resolved by the School Dean's decision, the student may make a written appeal to the Dean of Graduate or Undergraduate Education, and the dean will appoint and convene an Academic Appeals Panel. The decision of the Academic Appeals Panel is final. The results of the academic appeals process will be distributed to all involved parties.

Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations.

Incomplete Grades:

As per university policy, an incomplete grade will be granted only for work unavoidably missed at the semester's end and only if 70% of the course work has been completed. An incomplete grade must be resolved within eight (8) weeks from the first day of the subsequent long semester. If the required work to complete the course and to remove the incomplete grade is not submitted by the specified deadline, the incomplete grade is changed automatically to a grade of **F**.

Disability Services:

The goal of Disability Services is to provide students with disabilities educational opportunities equal to those of their non-disabled peers. Disability Services is located in room 1.610 in the Student Union. Office hours are Monday and Thursday, 8:30 a.m. to 6:30 p.m.; Tuesday and Wednesday, 8:30 a.m. to 7:30 p.m.; and Friday, 8:30 a.m. to 5:30 p.m. The contact information for the Office of Disability Services is:

The University of Texas at Dallas, SU 22
PO Box 830688
Richardson, Texas 75083-0688
(972) 883-2098 (voice or TTY)

Essentially, the law requires that colleges and universities make those reasonable adjustments necessary to eliminate discrimination on the basis of disability. For example, it may be necessary to remove classroom prohibitions against tape recorders or animals (in the case of dog guides) for students who are blind. Occasionally an assignment requirement may be substituted (for example, a research paper versus an oral presentation for a student who is hearing impaired). Classes enrolled students with mobility impairments may have to be rescheduled in accessible facilities. The college or university may need to provide special services such as registration, note-taking, or mobility assistance.

It is the student's responsibility to notify his or her professors of the need for such an accommodation. Disability Services provides students with letters to present to faculty members to verify that the student has a disability and needs accommodations. Individuals requiring special accommodation should contact the professor after class or during office hours.

Religious Holy Days:

The University of Texas at Dallas will excuse a student from class or other required activities for the travel to and observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, Tax Code, Texas Code Annotated.

The student is encouraged to notify the instructor or activity sponsor as soon as possible regarding the absence, preferably in advance of the assignment. The student, so excused, will be allowed to take the exam or complete the assignment within a reasonable time after the absence: a period equal to the length of the absence, up to a maximum of one week. A student who notifies the instructor and completes any missed exam or assignment may not be penalized for the absence. A student who fails to complete the exam or assignment within the prescribed period may receive a failing grade for that exam or assignment.

If a student or an instructor disagrees about the nature of the absence [i.e., for the purpose of observing a religious holy day] or if there is similar disagreement about whether the student has been given a reasonable time to complete any missed assignments or examinations, either the student or the instructor may request a ruling from the chief executive officer of the institution, or his or her designee. The chief executive officer or designee must take into account the legislative intent of TEC 51.911(b), and the student and instructor will abide by the decision of the chief executive officer or designee.