The University of Texas at Tyler
Department of Electrical Engineering

EENG 4350-043, EENG 4350-044 and EENG 5301-040, EENG 5301-041

Wireless Communications Networks

Spring 2023

Syllabus

Catalog Description:

Introduction to Wireless Communications and Networks: transmission fundamentals, LANs, MANs, WANs, switching, ATM, TCP/IP; Wireless Communications: antennas, propagation, signal encoding, spread spectrum, error control; Wireless Networking: satellite communications, cellular networks, analog, TDMA, CDMA, cordless systems, wireless local loop, mobile IP, WAP; Wireless LANS: infrared, microwave, IEEE 802.11, Bluetooth, IEEE 802.15.

Class Meetings and Modality: This is a virtual class. A new lecture video will be uploaded on Canvas every week. Each lecture will be accompanied by a slide set.

Prerequisites: EENG 4312 and MATH 3351

Credits: 3 (3 hours lecture; 0 hours laboratory work)

Texts(s): Cory Beard and William Stallings, *Wireless Communication Networks and Systems,* First Edition (Pearson); ISBN-10 0133594173.

Instructor: Muhammad Ikram; Ph.D., P.E.
Email: mikram@uttyler.edu

Office Hours: Virtual – Fri. 1pm to 3pm (Central Standard Time);
Link: https://uttyler.zoom.us/j/82026344257?pwd=cE9DZXJDdjgzeXlBTmZDWWZ1Y0liZz09

Topics Covered: (paragraph of topics separated by semicolons)

Wireless channel, Signal encoding techniques, OFDM, OFDMA, spread spectrum; Bluetooth, Cellular wireless network, multipath fading Theory; 4th generation and advanced LTE.

Evaluation Methods: (only items in dark print apply)

1. Examinations / Quizzes
2. Homework
3. Report
4. Computer Programming
5. Project
6. Presentation
7. Course Participation
8. Peer Review

Course Learning Outcomes[1]: By the end of this course students will be able to:

1. Understand transmission fundamentals [1]
2. Know Nyquist Formulation and concept of Shannon's capacity of transmission channel [1]
3. Know type of communication network, LAN, WAN, MAN (circuit switching vs packet switching) [1]
4. Know OSI, Protocols and TCP/IP suite (OSI layers vs. TCP/IP layers) [1]

5. Get an overview of wireless communication (spectrum, signal propagation, antenna, path loss, BER vs Eb/No, Calculation of fading in the mobile environment [4]
6. Understand digital signal encoding techniques (BPSK, FSK, QPSK, MFSK [4]
7. Understand error rate and error correction [1]
8. Understand orthogonal frequency division multiplexing (OFDM), Analyze of different medium access (spread spectrum, frequency hopping spread spectrum, direct sequence spread spectrum, code division multiple access [1,4]
9. Explain Spread spectrum (DSSS, FHSS, CDMA)
10. Explain bluetooth, ZigBee, IEEE 802.15 [1]
11. Understand cellular wireless networks (call set up, handoff, WCDMA vs UMTS) [1]
12. Know 4th Generation systems and Long term evolution (FDD, TDD, LTE, carriers aggregation) [1]
13. Understand mobile applications and mobile IP [1]
14. Demonstrate knowledge of terminology, concepts, FCC rules to provide basis to communicate effectively with others in the technical community [1]
15. Find an article from IEEE Spectrum, or other source that has relevance. Describe in short essay to describe this item [3]
16. Write short one page report on role and provide short description for a communication on the role impact of on the role and impact of engineering on Society based on instructor supplied article [3,6]

[1]Numbers in brackets refer to method(s) used to evaluate the course learning outcome.

Relationship to Student Outcomes (only items in dark print apply)[2]: This course supports the following Electrical Engineering Student Outcomes, which state that our students will:

1. have the ability to apply knowledge of the fundamentals of mathematics, science, and engineering;[3]
2. have the ability to use modern engineering tools and techniques in the practice of electrical engineering;[5]
3. have the ability to analyze electrical circuits, devices, and systems;[1, 6, 7, 8, 9, 10, 11, 12, 13, 14]
4. have the ability to design electrical circuits, devices, and systems to meet application requirements; [2, 4]
5. have the ability to design and conduct experiments and analyze and interpret experimental results.
6. have the ability to identify, formulate, and solve problems in the practice of electrical engineering using appropriate theoretical and experimental methods;
7. have effective written, visual, and oral communication skills;
8. possess an educational background to understand the global context in which engineering is practiced, including:
    a. knowledge of contemporary issues related to science and engineering;[16]
    b. the impact of engineering on society;[17]
    c. the role of ethics in the practice of engineering.
9. have the ability to contribute effectively as members of multi-disciplinary engineering teams;
10. have a recognition of the need for and ability to pursue continued learning throughout their professional careers.[15]

[2]Numbers in brackets refer to course learning outcome(s) that address the Program Outcome.

Contribution to Meeting Professional Component:

Component	Semester hours
Mathematics and Basic Sciences	
Engineering Sciences and Design	**3**
General Education Component	

Course Schedule:

Week	Lecture	Dates	Topic	Chapters
1	1	Week of Jan. 9	Introduction: Wireless, Cellular revolution; Transmission Fundamentals: Analog and digital transmission, channel capacity; Communication Networks: LAN, MAN, WAN, Circuit/packet switching, Asynchronous transfer mode	1, 2, 3
2	2	Week of Jan. 16	Protocols and TCP/IP suite: The OSI model; Overview of wireless communication: Spectrum, Line of sight transmission, Fading in the mobile environment	4, 5
3	3	Week of Jan. 23	Wireless channel: Antennas, Line of sight transmission	6
4	4	Week of Jan. 30	Wireless channel: Fading in the mobile environment, Channel correction	6
5	5	Week of Feb. 6	Signal encoding techniques: Encoding criteria, Digital data-analog signals, Analog data-analog signals, Analog data-digital signals	7
6	6	Week of Feb. 13	Orthogonal frequency division multiplexing: OFDMA, Single-channel OFDMA	8
7	7	Week of Feb. 20	Spread spectrum: Concept of spread spectrum, Frequency hopping spread spectrum, Direct sequence spread spectrum, Code division multiple access	9
8	8	Week of Feb. 27	Coding and error control: Error detection, Block error correction codes, Convolution codes, Automatic repeat request	10
9		Week of Mar. 6	Mid-term Exam	
10		Week of Mar. 13	Spring Break	
11	9	Week of Mar. 20	Wireless LAN technology: Overview and motivation, 802 architectures, 802.11 architecture and services, Medium access control, Physical layer, Wi-Fi	11
12	10	Week of Mar. 27	Bluetooth and IEEE 802.15: Internet of things, Motivation and overview, Specifications, IEEE 802.15, ZigBee,	12
13	11	Week of Apr. 3	Cellular wireless network: Principles of cellular network, First generation analog, Second generation TDMA, Second generation CDMA, Third generation systems	13
14	12	Week of Apr. 10	Fourth generation systems and LTE-advanced: Purpose, motivation and approach to 4G, LTE architecture, Evolved packet core, LTE resource management, LTE channel structure and protocol, LTE radio access network, LTE advanced	14
15	13	Week of Apr. 17	Review	
16		Week of Apr. 24	Exam week	

Assessment:

- Quizzes – 20%
- Midterm Exam – 20%
- Homework and project – 30%
- Final Exam – 30%

Grading Scale:

Grades will be assigned based on the total score as per the distribution below:

A:	90% – 100%
B:	80% – 89%
C:	70% – 79%
D:	60% – 69%
F:	0% – 59%

Any deviation from the above policy such as scaling or curving to calculate the individual item or final scores will be at the sole discretion of the instructor and performed by the instructor uniformly for all students in the class section.

Attendance and Make-up Policy:

The progressive nature of the class means that perfect attendance is recommended if a good grade is desired. Makeup quizzes, exams or projects will only be provided for valid and legitimate absences and at the sole discretion of the instructor.

Course communication:

Course communication will take place by e-mail and by announcements on UT-Tyler's Learning Management System (LMS). University policy requires that official e-mail communication be sent only to Patriot e-mail accounts.

Academic misconduct:

Academic misconduct that comes to light will be dealt through the formal discipline process. Examples of academic misconduct include (but are not limited to) submitting the work of others as one's own, copying from others during quizzes, and doing work intended to be submitted by another person.

General Policies of the University of Texas at Tyler

Grade Replacement/Forgiveness and Census Date Policies: Students repeating a course for grade forgiveness (grade replacement) must file a Grade Replacement Contract with the Enrollment Services Center (ADM 230) on or before the Census Date of the semester in which the course will be repeated. Grade Replacement Contracts are available in the Enrollment Services Center or at http://www.uttyler.edu/registrar. Each semester's Census Date can be found on the Contract itself, on the Academic Calendar, or in the information pamphlets published each semester by the Office of the Registrar.

Failure to file a Grade Replacement Contract will result in both the original and repeated grade being used to calculate your overall grade point average. Undergraduates are eligible to exercise grade replacement for only three course repeats during their career at UT Tyler; graduates are eligible for two grade replacements. Full policy details are printed on each Grade Replacement Contract.

The Census Date is the deadline for many forms and enrollment actions that students need to be aware of. These include:

- Submitting Grade Replacement Contracts, Transient Forms, requests to withhold directory information, approvals for taking courses as Audit, Pass/Fail or Credit/No Credit.
- Receiving 100% refunds for partial withdrawals. (There is no refund for these after the Census Date)
- Schedule adjustments (section changes, adding a new class, dropping without a "W" grade)
- Being reinstated or re-enrolled in classes after being dropped for non-payment
- Completing the process for tuition exemptions or waivers through Financial Aid

State-Mandated Course Drop Policy: Texas law prohibits a student who began college for the first time in Fall 2007 or thereafter from dropping more than six courses during their entire undergraduate career. This includes courses dropped at another 2-year or 4-year Texas public college or university. For purposes of this rule, a dropped course is any course that is dropped after the census date (See Academic Calendar for the specific date).

Exceptions to the 6-drop rule may be found in the catalog. Petitions for exemptions must be submitted to the Enrollment Services Center and must be accompanied by documentation of the extenuating circumstance. Please contact the Enrollment Services Center if you have any questions.

Disability Services: In accordance with federal law, a student requesting accommodation must provide documentation of his/her disability to the Disability Services counselor. If you have a disability, including a learning disability, for which you request an accommodation, please contact the Disability Services office in UC 3150, or call (903) 566-7079.

Student Absence due to Religious Observance: Students who anticipate being absent from class due to a religious observance are requested to inform the instructor of such absences by the second class meeting of the semester.

Student Absence for University-Sponsored Events and Activities: If you intend to be absent for a university-sponsored event or activity, you (or the event sponsor) must notify the instructor at least two weeks prior to the date of the planned absence. At that time the instructor will set a date and time when make-up assignments will be completed.

Social Security and FERPA Statement: It is the policy of The University of Texas at Tyler to protect the confidential nature of social security numbers. The University has changed its computer programming so that all students have an identification number. The electronic transmission of grades (e.g., via e-mail) risks violation of the Family Educational Rights and Privacy Act; grades will not be transmitted electronically.

Emergency Exits and Evacuation: Everyone is required to exit the building when a fire alarm goes off. Follow your instructor's directions regarding the appropriate exit. If you require assistance during an evacuation, inform your instructor in the first week of class. Do not re-enter the building unless given permission by University Police, Fire department, or Fire Prevention Services.