

# CSE4377/5377 Wireless Communication Systems

## Spring 2022

### Instructor Information

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**Instructor:**

Jason Losh, Ph.D.

**Office Number:**

ERB 649

**Office Telephone Number:**

+1 817-272-3785 (CSE Department)

**Email Address:**

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**Faculty Profile:**

<https://mentis.uta.edu/explore/profile/jason-losh>

**Office Hours:**

Office hours will be during lab times, prior to class, and by appointment for maximum flexibility.

**Teaching Assistants:**

Due to the new requirement that this syllabus be posted 30 days before the beginning of classes, no TA information is available. This will be given out during the first day of class and is not part of the syllabus.

### Course Information

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**Section Information:**

001

**Time and Place of Class Meetings:**

Lecture: TTh 2:00-3:20pm, ERB 131

Laboratory: Labs will be held in ERB 123

**Description of Course Content:**

Study of wireless systems including modulation, amplification, linearization techniques, filtering, antennas, propagation, reception, and demodulation. Topics include link budget and interference analysis of real systems.

Prerequisite: Admitted into an Engineering Professional Program. C or better in CSE 3313.

**Student Learning Outcomes:**

Upon successful completion of this course, students will have knowledge of:

- Modulation basics
- Amplification and linearization techniques
- Filtering
- Antennas
- Propagation
- Reception
- Demodulation

- Link budget analysis
- Interference analysis

### **Class Web Page:**

Additional files will be provided as needed on the course web site at <http://ranger.uta.edu/~jlosh/>.

### **Communication:**

All class-wide communication by the instructor, including distribution of homework sets, will occur via the class listserv. Please sign up for the CSE4377-L listserv by sending an e-mail from your UTA e-mail account to [listserv@listserv.uta.edu](mailto:listserv@listserv.uta.edu) from your UTA e-mail account (no subject line needed) and the command SUBSCRIBE CSE4377-L as the message body. You will then receive an e-mail from the listserv server to which you must acknowledge to join the listserv with "OK" in an e-mail. You must sign up to this listserv between the first and third day of class (it is part of your class grade).

Canvas will only be used for Echo360 access.

### **Textbooks and Other Course Materials:**

No textbook will be required for this course. Extensive references, datasheets, application notes, and class notes will be provided on the course web site.

### **Major Assignments and Examinations:**

Test 1: Tuesday, March 22  
 Test 2: Thursday, April 28  
 Labs: 6-8 labs will be assigned across the semester.

### **Technology Requirements:**

If student is unable to attend class, students will need a computer capable of accessing Canvas and watching the Echo360 lectures. The computer and OS must be capable of running Matlab.

## **Grading Information**

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### **Grading:**

- Grade scale: A (90-100), B (80-89), C (70-79), D (60-69), and F (0-59)
- Grade calculation: Test 1 (25%), Test 2 (25%), Labs (50%)  
 The instructor reserves the right to make reasonable changes in performance evaluation as needed.
- The instructor also reserves the right to make substantial changes in the structure of the course if the modality of the course must be changed.
- Any request for re-grading must be submitted to the teaching assistant within one week of the completion of grading. If, after requesting a re-grade from the teaching assistant and getting a response, you may refer the case to the instructor if you think further action is needed.

### **Tests:**

- Tests are on-campus
- Tests are open-book, open-notes, calculators allowed.
- No makeup will be provided for any test missed. Generally, you can request an incomplete in the course and makeup the missed test in the following semester.

### **Labs:**

- Lab attendance is required.
- You should complete and submit each lab assignment by the beginning of your lab session in the following week. There is reduced credit for work submitted after this time.

## **Course Schedule**

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- RF terminology overview, probability/noise/fields math review
- Noise: thermal/black-body/sky, quantization, noise bandwidth, noise figure/kTBF
- Diversity: space, frequency, time, polarization, angle, cyclic-delay, and combining techniques
- General topology: Duplexing and multiple-access, noise- vs. interference-limited systems, terrestrial and satellite systems, radar
- Frequency bands: licensed vs. unlicensed bands, white-space and LAA
- Modulation families: CDMA, OFDMA/SC-FDMA, 5G, IoT (BLE, WiFi, LTE, NB IoT, 5G) and impacts of modulation on RF design
- Non-linearities: Modulation and PAR, clipping/CFR, compression in RF devices
- Antennas: Gain (dBi), directivity, front-to-back ratio, down-tilt, polarization, aperture, basic derivation of theory for loop, microstrip, patch, array antennas, mmWave antennas, mMIMO, beam-steering, feed-line loss, efficiency, radome materials
- Channel: Fading models, TDL model, absorption, scintillations, scattering, reflection and refraction, foliage, Doppler, multi-path, noise, interference, shadowing, delay spread, ISI, equalization techniques, Doppler correction, multi-path combining/RAKE, depolarization, rain/ice, sun transit
- Link budget: Calculation, margin, availability
- Transmitter lineup: Baseband processing, clipping, filtering, DAC, PA, VSWR, feeder losses, non-linear sources, pre-distortion techniques, filtering, intermodulation, IF- vs. direct-launch lineups, impacts of DTX on design, efficiency analysis of power amplifiers
- Receiver lineup: LNA, gain control, feeder losses, down-conversion/zero-IF, ADC, baseband filtering, near-far desensitization from jammers and blockers, noise figure analysis, input intercept point, passive IM, noise sources
- Measurements: EVM/rho, emissions masks, TX phase noise, ACS/ACLR, SNR, C/I, sensitivity
- Regulatory: Emissions, EMC, EMI, regulatory and compliance issues, protection of GPS, RA bands

The instructor reserves the right to make changes in the schedule as needed as the class progresses.

The official dates for registration, census, and dropping are available at [www.uta.edu/acadcal](http://www.uta.edu/acadcal).

## Academic Integrity

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This information is extracted from <http://www.uta.edu/conduct/academic-integrity/index.php>.

The University of Texas at Arlington strives to uphold and support standards of personal honesty and integrity for all students consistent with the goals of a community of scholars and students seeking knowledge and responsibility. Furthermore, it is the policy of the University to enforce these standards through fair and objective procedures governing instances of alleged dishonesty, cheating, and other academic/non-academic misconduct.

Scholastic dishonesty includes, but is not limited to, cheating, plagiarism, and collusion on an examination or an assignment being offered for credit. Each student is accountable for work submitted for credit, including group projects.

- Cheating
  - Copying another's test or assignment (added note: remember this includes homework!)
  - Communication with another during an exam or assignment (i.e. written, oral or otherwise)
  - Giving or seeking aid from another when not permitted by the instructor
  - Possessing or using unauthorized materials during the test
  - Buying, using, stealing, transporting, or soliciting a test, draft of a test, or answer key
- Plagiarism
  - Using someone else's work in your assignment without appropriate acknowledgement
  - Making slight variations in the language and then failing to give credit to the source

- Collusion
  - Without authorization, collaborating with another when preparing an assignment

## **Safety Rules for ERB 121-127 and 132 Labs:**

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### Scope:

- All UTA safety rules and regulations must be followed.
- These rules are in addition to UTA lab safety rules.
- In the event that a rule contained below is in conflict with UTA lab safety rules, the UTA safety rules shall supersede.

### General rules:

- Students can only be in the lab when a teaching assistant, faculty member, or staff member is present.
- Students should be professional at all times in the lab.
- Food and drinks are not allowed in the lab at any time.
- When leaving the lab, all work surfaces and floors should be clear of breadboards, cables, wires, and tools prior to leaving.
- When leaving the bench, turn off all lab equipment and unplug soldering irons.
- When leaving the bench, make sure that all cables, tools, and soldering equipment are properly stored in the correct location.
- Please ensure that the lab is kept in a neat and tidy manner.
- Please pick up any loose wires or parts on the bench and floor before leaving the lab.
- Note any hazards observed in the lab to the teaching assistant, faculty, or staff member immediately.
- For test equipment incorporating multi-language menus, such as oscilloscopes, please return the language to English before leaving the bench.
- When returning parts that are not consumables, make certain that the parts are returned to the correct drawer. If you are not certain, please leave them with the teaching assistant, faculty member, or staff member.
- Students should store backpacks and similar items in a way that does not create a trip hazard to others.

### Personal protective equipment (PPE):

- Safety glasses must be worn at all times when using the soldering irons or using cutting tools, such as diagonal cutters, in the lab.
- When using chemicals, proper eye protection, gloves, and respiratory equipment must be worn.

### Soldering irons:

- Soldering must be performed in the labs only at the soldering benches.
- Soldering irons should be used with care, while wearing safety glasses, and only after receiving training.
- When soldering and removing parts, or reworking a board, please use special care to ensure that solder is not splattered.
- Soldering irons must be placed back in their soldering station holder when not soldering to prevent the chance of injury or fire.
- Please keep the soldering station sponges wet when cleaning the iron tip but ensure that water is not spilled on the floor creating a slip hazard.
- Use the soldering iron smoke absorber fan units when soldering. Use them in the horizontal position to prevent directing air flow across the table into the face of another user.
- Some solders can contain lead, so wash hands thoroughly after using the soldering irons. No eating or drinking is allowed in the lab, as previously stated.
- No self-contained butane soldering irons are permitted.

### Hand tools:

- Hand tools must be used with care and only when safety glasses are being worn.
- Diagonal cutters in particular can create tension on the wires during the cutting process, ejecting the loose wire, so please use special care.

Small powered rotary tools:

- Short use of powered cutting tools such as “Dremel” or small drill/driver can only be used at the soldering tables using a backup board to prevent damage to the tables.
- Jewelry, necklaces, and lanyards should be removed.
- Long hair should be tied back to prevent being caught in the tool.
- For extended machining tasks, please use the designated Makerspace areas that are designed to handle the additional safety requirements and dust inhalation hazards instead.

Electrical hazards:

- The labs for these classes use voltages of 30V or less, but care must always be shown in using electrical circuits, regardless of the voltage.
- Do not use voltages of more than 30V unless approved in writing by the instructor.
- Do not modify the wiring or attempt repair of any lab equipment.
- Most of the lab equipment operates from 120V AC, which is a lethal voltage. Never pull on a cord to unplug it as this can cause damage to the strain relief and insulation, potentially resulting in exposed conductors.
- Please notify the teaching assistant, faculty member, or staff member and stop using the equipment immediately if you see nicks or damage to a power cord.

Computers:

- Students should not install any software on the lab computers without approval of the teaching assistant, faculty member, or staff member.
- Students should not remove any of the cables on the computer and the monitor on the bench.
- For external connection, an HDMI cable is provided at each workstation for configuring Raspberry Pi and similar computer hardware. This cable should not be disconnected from the monitor.

## **Institution Information**

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UTA students are encouraged to review the below institutional policies and informational sections and reach out to the specific office with any questions. To view this institutional information, please visit the [Institutional Information](http://www.uta.edu/provost/administrative-forms/course-syllabus/index.php) page

(<http://www.uta.edu/provost/administrative-forms/course-syllabus/index.php>) which includes the following policies among others:

- Drop Policy
- Disability Accommodations
- Title IX Policy
- Academic Integrity
- Student Feedback Survey
- Final Exam Schedule

## **Additional Information**

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### **Face Covering Policy:**

While the use of face coverings on campus is no longer mandatory, all students and instructional staff are strongly encouraged to wear face coverings while they are on campus. This is particularly true inside buildings and within classrooms and labs where social distancing is not possible due to limited space. If a student needs accommodations to ensure social distancing in the classroom due to being at high risk they are encouraged to work directly with the Student Access and Resource Center to assist in these accommodations. If students need masks, they may obtain them at the Central Library, the E.H. Hereford University Center's front desk or in their department.

**Attendance:**

At The University of Texas at Arlington, taking attendance is not required but attendance is a critical indicator of student success. Each faculty member is free to develop his or her own methods of evaluating students' academic performance, which includes establishing course-specific policies on attendance. As the instructor of this section, However, while UT Arlington does not require instructors to take attendance in their courses, the U.S. Department of Education requires that the University have a mechanism in place to mark when Federal Student Aid recipients "begin attendance in a course." UT Arlington instructors will report when students begin attendance in a course as part of the final grading process. Specifically, when assigning a student a grade of F, faculty report must the last date a student attended their class based on evidence such as a test, participation in a class project or presentation, or an engagement online via Canvas. This date is reported to the Department of Education for federal financial aid recipients.

In this course, attendance in-class, on campus is expected. Attending online is not a substitute for attending in person. Whiteboards and in-person demonstrations will be used for some topics which will not be recorded by the in-class recording, so the online recordings will not contain all instructional information from the class.

**Emergency Exit Procedures:**

Should we experience an emergency event that requires evacuation of the building, students should exit the room and move toward the nearest exit. When exiting the building during an emergency, do not take an elevator but use the stairwells instead. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

**Student Success Programs:**

UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include [tutoring by appointment](#), [drop-in tutoring](#), [etutoring](#), [supplemental instruction](#), [mentoring](#) (time management, study skills, etc.), [success coaching](#), [TRIO Student Support Services](#), and [student success workshops](#). For additional information, please email [resources@uta.edu](mailto:resources@uta.edu), or view the [Maverick Resources](#) website.

**Emergency Phone Numbers**

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In case of an on-campus emergency, call the UT Arlington Police Department at **817-272-3003** (non-campus phone), **2-3003** (campus phone). You may also dial 911. Non-emergency number 817-272-3381