

Syllabus for ECE 4863 - Software-Defined Radios

Lecture and Studio Location: Van Leer C456
Lecture Hours: Mondays and Wednesdays, 5-6pm
Studio Hours: Fridays, 5-7pm

Instructor: Matthew Trotter, Ph.D.
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Office hours: ???
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Course Outcomes

Upon successful completion of this course, students should be able to:

- Program and test software-defined radio transceivers,
- Implement timing, frequency, and frame synchronization,
- Equalize a wideband channel,
- Design specific physical layer and data layer techniques for various wireless applications,
- Analyze physical and data-layer features of LTE, 5G, 802.11 ac (Wi-Fi), and 802.11p (vehicle-vehicle).

Student Outcomes

- an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Prerequisites

- Coding: (ECE 2036 [min C] or ECE 3090 [min C] or CS 1331 [min C]) and
- DSP: (ECE 2026 [min C]) and
- Probability and Statistics: (CEE/ISYE/MATH 3770 [min C] or ISYE 2027 [min C] or ECE 3077 [min C])

Grading Criteria

Your final grade will be assigned as a letter grade according to the following scale:

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

Homeworks and projects will be equally weighted and will count 70% toward your final grade. The final exam will count 30% toward your final grade.

Attendance Policy

Attendance will not be taken, but demonstrations of homeworks and projects will occur during class. At least one member from your team must be present to demonstrate your homework.

Required Textbook and Resources

Books:

1. Collins, Travis F., Getz, Robin, Pu, Di, and Wyglinski, Alexander. *Software-Defined Radio for Engineers*, 2018, ISBN-13: 978-1-63081-457-1. <https://www.analog.com/en/education/education-library/software-defined-radio-for-engineers.html> (free online)
2. Xiong, Fuqin. *Digital Modulation Techniques*, Artech House, 2006. ProQuest Ebook Central. ISBN: 9781580538640. <https://ebookcentral.proquest.com/lib/gatech/detail.action?docID=286924> (available online through Gatech library)

SDRs:

These SDRs are inexpensive learning platforms that use software-controllable RF components (amplifiers, filters, and mixers). There are two options for getting these: Either purchase one or two for yourself or check them out from the ECE lab.

ADALM-PLUTO Active Learning Module
<https://www.analog.com/en/design-center/evaluation-hardware-and-software/evaluation-boards-kits/adalm-pluto.html>

Computer:

You will need to set up your own computer for this class. I recommend you use a Ubuntu variant. All homework and projects will be evaluated on Xubuntu 20.04 LTS. You can use Windows or MacOS as well, but these are less well supported by gnuradio developers. The computer will need a USB port as well. Here are some computer configurations:

1. (Preferred) Computer with Xubuntu 20.04 LTS natively installed either as the main OS or dual-booted with another OS.
2. VirtualBox VM of Xubuntu 20.04 LTS with extension pack installed.
3. MacOS with everything installed via MacPorts plus some custom tweaking.
4. Windows.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit <http://www.catalog.gatech.edu/policies/honor-code/> or <http://www.catalog.gatech.edu/rules/18/>.

Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404) 894-2563 or <http://disabilityservices.gatech.edu/>, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student Use of Mobile Devices in the Classroom

I may issue grading penalties to student(s) whose use of any mobile device in the classroom becomes disruptive for any reason.

Schedule

	Date	Class Type	Topic	Homework
1	17 Aug 2020	Lecture	Welcome, Syllabus, Course Goals, and Intro to SDR	Start HW1: Setup computer and install gnuradio
2	19 Aug 2020	Lecture	Intro to SDR	
3	21 Aug 2020	Studio	Gnuradio Setup and Coding	
4	24 Aug 2020	Lecture	Signals and Systems	Start HW2: Digital Filters
5	26 Aug 2020	Lecture	Signals and Systems	
6	28 Aug 2020	Studio	Signals and Systems	
7	31 Aug 2020	Lecture	Digital Modulation	Start HW3: Digital Modulators and Demodulators
8	02 Sep 2020	Lecture	Digital Modulation	
9	04 Sep 2020	Studio	Digital Modulation	
10	07 Sep 2020	Lecture	SDR Hardware	Start HW4: AM Transceiver
11	09 Sep 2020	Lecture	SDR Hardware	
12	11 Sep 2020	Studio	SDR Hardware	
13	14 Sep 2020	Lecture	Timing Synchronization	Start HW5: Timing Synchronizers
14	16 Sep 2020	Lecture	Timing Synchronization	
15	18 Sep 2020	Studio	Timing Synchronization	
16	21 Sep 2020	Lecture	Carrier Synchronization	Start HW6: Carrier Synchronizers
17	23 Sep 2020	Lecture	Carrier Synchronization	
18	25 Sep 2020	Studio	Carrier Synchronization	
19	28 Sep 2020	Lecture	Frame Synchronization	Start HW7: Frame Synchronizers
20	30 Sep 2020	Lecture	Frame Synchronization	
21	02 Oct 2020	Studio	Frame Synchronization	
22	05 Oct 2020		Fall break - no class	
23	07 Oct 2020	Lecture	Channel Estimation and Equalization	Start HW8: MQAM Transceiver
24	09 Oct 2020	Studio	Channel Estimation and Equalization	

25	12 Oct 2020	Lecture	Channel Estimation and Equalization	
26	14 Oct 2020	Lecture	Channel Estimation and Equalization	
27	16 Oct 2020	Studio	Channel Estimation and Equalization	
28	19 Oct 2020	Lecture	OFDM	
29	21 Oct 2020	Lecture	OFDM	
30	23 Oct 2020	Studio	OFDM	
31	26 Oct 2020	Lecture	OFDM	
32	28 Oct 2020	Lecture	OFDM	
33	30 Oct 2020	Studio	OFDM	
34	02 Nov 2020	Lecture	Adaptive Communications	
35	04 Nov 2020	Lecture	Adaptive Communications	
36	06 Nov 2020	Studio	Adaptive Communications	
37	09 Nov 2020	Lecture	LTE and 5G	
38	11 Nov 2020	Lecture	Wi-Fi and V2V	
39	13 Nov 2020	Studio		
40	16 Nov 2020	Lecture	Machine Learning and SDRs	
41	18 Nov 2020	Lecture	Machine Learning and SDRs	
42	20 Nov 2020	Studio	Machine Learning and SDRs	
43	23 Nov 2020	Lecture	Review Day	
44	25 Nov 2020		Thanksgiving break - no class	
45	27 Nov 2020		Thanksgiving break - no class	
46	30 Nov 2020	Lecture	Review Day	
47	02 Dec 2020		No class	
48	???		Final Exam	