

## **EEL 6528 Digital Communications with Software-defined Radios (Fall 2023)**

1. Catalog Description:  
Basics of software-defined radios; Introduction to USRP radios and GNU Radio software platform; Practical communication algorithms and designs; Implementation of communication systems in USRP radios. (3 credit hours)
2. Pre-requisites and Co-requisites:
  - EEL4514 Communication systems & components, EEL6535 Digital communications, or EEL6905 Wireless communications
  - EEL4750 Introduction to digital signal processing or EEE5502 Foundations of digital signal processing
  - Reasonable proficiency in C++ programming
3. Course Objectives:  
To introduce practical communication algorithms and designs via a software-defined radio platform. Upon completion of this course, the student should be able to:
  - i. understand typical constraints in the practical communication systems,
  - ii. design communication algorithms and techniques taking these constraints into consideration,
  - iii. proficiently use UHD as a programming tool to support development with USRP radios, and
  - iv. implement simple communication algorithms and systems using USRP radios.
4. Contribution of course to meeting the professional component (ABET only)
5. Relationship of course to program outcomes (ABET only)
6. Instructor: Tan F. Wong
  - i. Office location: NEB461
  - ii. Telephone: 352-392-2665
  - iii. Fax: 352-392-0044
  - iv. E-mail address: twong@ece.ufl.edu
  - v. Office hours: MWF 2:45pm–3:45pm
7. Teaching Assistant: David Greene
  - i. Office location: NEB405
  - ii. E-mail address: djgreene@ufl.edu
8. Meeting Times: MWF 4 (10:40-11:30am)
9. Class/laboratory schedule: 3 session of 50-min. class each week
10. Meeting Location: 239 LAR

11. Material and Supply Fees: \$\$\$

12. Textbooks and Software Required:

- a. UHD available at <http://code.ettus.com/redmine/ettus/projects/uhd/wiki>
- b. *GNU Radio* available at <http://gnuradio.org>
- c. Instructor provided material

13. Recommended Reading:

- a. J. G. Proakis and M. Salehi, *Digital Communications*, McGraw-Hill, 5<sup>th</sup> ed., 2008. (ISBN 978-0-07-295716-7)

14. Course Outline:

Week	Topic
1	Introduction to USRP, UHD, and GNU Radio
2	Multi-thread programming, Boost, and UHD
3	Signal generation, capture, and automatic gain control
4	FFT and multi-rate filtering
5	Time synchronization
6	Non-coherent and differential modulations
7	Carrier synchronization
8	Coherent modulations
9	Simple link-layer protocols (half-duplexing)
10	Simple link-layer protocols (half-duplexing)
11	OFDM
12	OFDM
13	Convolutional and trellis codes
14	Convolutional and trellis codes

15. Attendance and Expectations: Attendance is required.

- a. Attendance at each session is mandatory.
- b. There is an open lab associated with each session (or a pair of sessions). The lab requires the use of the USRP radios, which can be accessed online and are shared among all students in class. Students need to make online reservation to use the USRP radios to complete the lab.
- c. **Reports:** Report your laboratory findings in a systematic way. Your report should be self-sufficient i.e., the report should be self-explanatory independent of the lab manual. Detailed instructions on formatting the report will be provided.

16. Grading – methods of evaluation: There will be 5 to 6 lab projects through the semester. Grade (0-100%) will be assigned based on the reports of the lab projects.

17. Grading Scale: 95-100 A, 90-94 A-, 85-89 B+, 80-84 B, etc. (may change to match class average)

18. Make-up Exam Policy: No make-up exam.
19. Honesty Policy – All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.
20. Accommodation for Students with Disabilities – Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.
21. UF Counseling Services – Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
  - University Counseling Center, 301 Peabody Hall, 392-1575, Personal and Career Counseling.
  - SHCC mental Health, Student Health Care Center, 392-1171, Personal and Counseling.
  - Center for Sexual Assault/Abuse Recovery and Education (CARE), Student Health Care Center, 392-1161, sexual assault counseling.
  - Career Resource Center, Reitz Union, 392-1601, career development assistance and counseling.
22. Software Use – All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.