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:
   b. GNU Radio available at http://gnuradio.org
   c. Instructor provided material

13. Recommended Reading:

14. Course Outline:

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