ENTS 759B Wireless OFDM Systems

Spring 2019 Syllabus

Course Description: The objective of the course is to introduce the main concepts and technologies used in the design of current wireless OFDM systems, focusing on the physical layer. Topics include OFDM modulation/demodulation, role of the cyclic prefix, pilot symbols and preambles, transmit/receive filtering, RF impairments and their impact on performance, channel estimation, timing and synchronization. Then, the 3PP Long Term Evolution (LTE) standard is described as an example of a state-of-the-art wireless OFDM system, emphasizing its physical-layer aspects. As a part of the course work, the students will explore the design and implementation issues of an OFDM-based transceiver using the Ettus B210 software defined radio.

Time and place:
Section 0101: Tuesdays 2:00pm – 4:45pm in JMP 1109

Instructor:
Name: Alejandra Mercado  
E-Mail Address: mercado@umd.edu  
Office Hours: Mondays 2PM-4PM (always set up appointment online, here)  
Office Location: AV Williams Building 1365  
Web Site: https://elms.umd.edu/

Logging in to the Course for announcements, instant messaging, documents, etc.:
Go to http://elms.umd.edu. Type in your Maryland Directory ID in the box labeled Username. Enter your Directory password in the Password box

Texts: No required textbook

Grading
Attendance Quiz: 4%
Midterm exam: 30%
Project: 33%
Final Exam: 33%
Total 100%

Final Grading will be determined using the following scale based on the overall average score:
Threshold for A-, A, A+ 90 %
Threshold for C-, C, C+ 70 %
Threshold for B-, B, B+ 80 %
Threshold for D-, D, D+ 60 %
Threshold for F everything else

±A denotes excellent mastery of the subject and outstanding scholarship.
±B denotes good mastery of the subject and good scholarship.
±C denotes acceptable mastery of the subject and the usual achievement expected.
±D denotes borderline understanding of the subject and marginal performance.
F denotes unsatisfactory performance.
XF denotes failure due to academic dishonesty
### Tentative Course Schedule

The instructor reserves the right to make schedule changes based on the needs of the students and class progress.

<table>
<thead>
<tr>
<th>Lecture Number</th>
<th>Date</th>
<th>Lecture Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jan 30</td>
<td>Overview of basics: Signals, spectral analysis, communications systems</td>
</tr>
<tr>
<td>2</td>
<td>Feb 6</td>
<td>Overview of channel noise and fading. Overview of single-carrier communications. Introduction to OFDM.</td>
</tr>
<tr>
<td>3</td>
<td>Feb 13</td>
<td>OFDM system model. Transmit/receive filtering, RF impairments and their impact on performance.</td>
</tr>
<tr>
<td>4</td>
<td>Feb 20</td>
<td>OFDM reference signals and receiver design issues: channel estimation, timing and synchronization</td>
</tr>
<tr>
<td>5</td>
<td>Feb 27</td>
<td>OFDM multi-antenna MIMO and beamforming transmission techniques.</td>
</tr>
<tr>
<td>6</td>
<td>Mar 6</td>
<td>Introduction to LTE: design targets, overview, system architecture.</td>
</tr>
<tr>
<td>7</td>
<td>Mar 13</td>
<td>Midterm</td>
</tr>
<tr>
<td>-</td>
<td>Mar 20</td>
<td>Spring Break</td>
</tr>
<tr>
<td>8</td>
<td>Mar 27</td>
<td>Project Overview</td>
</tr>
<tr>
<td>9</td>
<td>Apr 3</td>
<td>LTE downlink transmission.</td>
</tr>
<tr>
<td>10</td>
<td>Apr 10</td>
<td>LTE uplink transmission.</td>
</tr>
<tr>
<td>11</td>
<td>Apr 17</td>
<td>LTE access and transmission procedures, flexible bandwidth operation</td>
</tr>
<tr>
<td>12</td>
<td>Apr 24</td>
<td>LTE-A Carrier Aggregation, Enhancements to MIMO</td>
</tr>
<tr>
<td>13</td>
<td>May 1</td>
<td>LTE-A HetNets, CoMP DL &amp; UL, Relaying, cross-layer optimization</td>
</tr>
<tr>
<td>14</td>
<td>May 8</td>
<td>LTE-A Enhanced inter-cell interference coordination &amp; Enhanced Location and Positioning</td>
</tr>
<tr>
<td>-</td>
<td>May 15</td>
<td>Final exam (tentative)</td>
</tr>
</tbody>
</table>

### A. Requirements

Students are expected to be on time, attend all class meetings, and complete all assignments and all assessments of their knowledge and understanding of the class material.

### B. Assignments

Any assignment that is turned in should be complete, and represent the student’s individual and original work. Turn in your assignment at the beginning of the class. Late assignments will not be accepted, as this would place an unfair burden on students who hand in their work in a timely manner.

### C. Make-up Policy

In the case of an excused absence (such as a disabling medical emergency with a letter from a physician on official letterhead, or a death in the immediate family with proper documentation), the instructor will redefine the grading distribution in accordance with what assessment was lost.

Excused Absence: If you miss an assessment (test or project), contact me as soon as possible. You may receive an excused absence for such things as: medical emergencies, or death of an immediate relative. Unexcused absences will result in a grade of zero for the missed assessment.
Religious Observance: The student should inform the instructor at the beginning of the semester about any absences due to religious observances. We will make appropriate arrangements for the missed assessment. This must be NO LATER than the second week of classes.

D. Audit Policy
Audit students must participate fully in the course and follow all policies and procedures to audit the course. Exception: exams and reports are not required.

E. Academic Honesty
The maintenance of the highest standards of intellectual honesty is the concern of every student and faculty member at the University of Maryland. Plagiarism, which is defined as appropriating or closely imitating another person's work or ideas and representing them as one's own original work, is strictly prohibited. Use of phones, iPhones, tablets or other electronic devices during a test is not allowed.

Academic Dishonesty or Misconduct can occur in many ways. Some examples are:
   a) Plagiarizing from written, video, or Internet resources
   b) Forgery
   c) Submitting materials that are not the student's own work, such as Matlab code
   d) Taking examinations in the place of another student, including assessment tests
   e) Assisting others in committing academic dishonesty
   f) Copying from another student during an examination or on an assignment.

Failure to abide by the rules of Academic Integrity (which, in addition to the described above is detailed in http://www.president.umd.edu/policies/docs/III-100A.pdf) will result, at the very least, in a grade of XF: the grade appears on the student's transcript with the notation "Failure due to academic dishonesty." As well as further disciplinary actions.

E.1. Lectures are UM Intellectual Property
In accordance with ENTS and UM policy, persons who publicly distribute or display or help others publicly distribute or display copies or modified copies of an instructor's Course Materials will be considered in violation of the University Code of Student Conduct.

Lecture materials may not be video-taped, audio-taped, photographed, or otherwise reproduced for distribution without the explicit knowledge and permission of the course instructor and written permission of the Director of the Master's in Telecommunications Program.

F. Support Services
Disability Support Services (DSS): Any student who may need an accommodation due to a disability should contact DSS offices at 0106 Shoemaker Building (301.314.7682). A letter from DSS authorizing your accommodations will be needed. For a complete list of other student support services, please refer to the Student Handbook.

G. Cancellation of Classes
If inclement weather forces the campus to suspend classes or close, public service announcements will be provided to local radio and television stations as early as possible. Assume that classes will be held unless you read or hear otherwise from the university website or radio or television.

The following radio and television stations usually broadcast information about campus closings:
- WAMU (88.5 FM)
- WETA (90.0 FM)
- WMAL (630 AM)
- WINX (1600 AM)
- WRC (980 AM)
- Channels 4, 7, 9 TV

For a complete list, check the Student Handbook.
You may also call check the UMCP web page at http://www.umd.edu/emergencypreparation/weather_emer/

Check the canvas course site frequently and always before coming to campus for lecture, as instructor will post announcements there about class cancellations or other course-related matter.
CONTACTS:
Students learn best from each other when studying together. Also, class contacts are useful in the event you miss a class. In that vein, I encourage you to meet your neighbors, and get some contact information.

Name: __________________________ Name: __________________________
Email: __________________________ Email: __________________________
Phone: __________________________ Phone: __________________________

Name: __________________________ Name: __________________________
Email: __________________________ Email: __________________________
Phone: __________________________ Phone: __________________________

Name: __________________________ Name: __________________________
Email: __________________________ Email: __________________________
Phone: __________________________ Phone: __________________________

Contact the instructor: The best ways to reach me is during my office hours or via email. Please only use your UM email address; due to privacy issues I will not read mail from personal email addresses.

VETERANS
If you are a veteran or on active or reserve status and you are interested in information regarding opportunities, programs and/or services, please visit the University of Maryland Veterans Program Office website at http://www.veterans.umd.edu/