

WEST VIRGINIA UNIVERSITY  
COLLEGE OF ENGINEERING AND MINERAL RESOURCES  
DEPARTMENT OF COMPUTER SCIENCE AND ELECTRICAL ENGINEERING

***CPE 462***  
***Wireless Networking***  
**Fall 2019**  
**3 credit hours**

**Class Info:** Meeting times: 2:00 – 3:15 PM T/H  
Location: ESB 251

**Instructor:** Matthew C. Valenti  
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Office: AER 363  
Office phone: 304-293-9139

**Office Hours:** Immediately after class (i.e., 3:15 to 4:00 PM T/H) or by appointment (just send email to request an appointment).

**Description:** Design and analysis of modern wireless data networks. Digital modulation techniques, wireless channel models, design of cellular networks, spread spectrum, carrier sense multiple access, ad-hoc networks and multihop routing, error control coding, automatic repeat request strategies.

**Objectives:** To provide students with a general understanding of the principles of modern wireless networking and the application of these principles to current and next-generation wireless networking standards.

**Outcomes:** At the end of the semester you should:

- Understand the limiting factors of wireless propagation and interference that make wireless networks behave fundamentally different from wireline networks.
- Design an economically feasible wireless cellular network by planning the usage of spectrum and the placement of base stations.
- Analyze how many subscribers a particular wireless system can support at a particular quality of service (QoS).
- Describe the principle technologies used in wireless networks, including:
  - Digital modulation and detection.
  - Multiple-access, including OFDM.
  - Coding and error control, including retransmission protocols; i.e., ARQ.
  - The role of multiple antennas; i.e., MIMO.
- Apply the above concepts to understand the details of a complete wireless standard or protocol, such as LTE.

**Prerequisites:** EE 327 (I/O relationship of LTI systems) and STAT 215 (probability and random variables).

**Required**

**texts:** M.C. Valenti, *The Wireless Networking Workbook*, 2018, available for free download from instructor's website.

**Recommended**

**texts:** T.S. Rappaport, *Wireless Communications: Principles and Practice*, Second Edition, Prentice Hall, 2002, ISBN 0-13-142232-0. *Electronic version available to WVU students at no cost from Safari Books Online.*

E. Dahlman, S. Parkvall, and J. Skold, *4G: LTE/LTE-Advanced for Mobile Broadband*, Second Edition, Academic Press, 2014, ISBN 978-0-12-419985-9, *Electronic version available to WVU students at no cost from Safari Books Online.*

J.D. Gibson, *The Mobile Communications Handbook*, Third Edition, CRC Press, 2012, ISBN 978-1-4398-1723-0. *Electronic version available to WVU students at no cost from Safari Books Online.*

<b>Assessment:</b>	Semester group project	30%
	Quizzes based on homework	20% (about 5, with the lowest dropped)
	Mid-term exam	20%
	Final exam	30%

**Grade**

<b>Boundaries:</b>	A	90%	You are guaranteed at least the letter grade shown here if you obtain the corresponding score. However, at the discretion of the instructor, these decision boundaries may be adjusted in the students' favor. A '+' or '-' grade may be reported if the score is near a boundary.
	B	80%	
	C	70%	
	D	60%	

**Semester**

**Project:** A multi-part semester-long project will challenge teams of 2 or 3 students to design an economically viable wireless cellular network. Software will be provided to support the effort. More information will be provided as the semester progresses.

**Quizzes:** Homework assignments will be given periodically. **On the day that the homework is due, an in-class quiz will be given based on the homework.** When you take the quiz, you will be allowed to use your homework, a calculator, and one page of equations/notes. When you turn in your quiz, please also turn in your homework solutions. While I might provide limited feedback on your homework, it will not be graded. Your score on the assignment will be determined entirely by your performance on the quiz. I will post solutions to the homework, but only after the quiz has been administered. If you have an unexcused absence on the date of the quiz, then your score will be zero on that quiz. **Your lowest quiz score will be dropped.**

**Tests and**

**Exam:** There will be a mid-term exam during the semester, plus a final exam at the end of the semester. **You will be allowed a calculator and equation sheets at each exam.**

**Webpage:** A course webpage is maintained at the following location:

**<http://ecampus.wvu.edu>**

On this webpage you will find selected course notes, matlab programs, homework assignments and their solutions, papers, course-related links, and information about the semester group project.

**Honor Code:** While you may confer with your colleagues on interpretation and approach to homework problems, the homework solution that you bring to the quiz must be your own work and in your own writing. You may not communicate in any way with another student during any quiz or exam, and all solutions turned in for quizzes, tests, and final must be your own work without any assistance from anybody else. Honor code guidelines for the semester project will be discussed when the project is assigned.

**Missed Test**

**Policy:** You are expected to attend the quizzes, tests, and final. If you have a legitimate unavoidable conflict, please let me know as soon as possible, but no later than one week in advance. If you miss a quiz, test, or the final without being excused, you will receive a zero on that quiz/test/final. Appeals must be directed to the Associate Dean of Academic Affairs.

**Days of Special**

**Concern:** *WVU recognizes the diversity of its students and the needs of those who wish to be absent from class to participate in Days of Special Concern, which are listed in the Schedule of Courses. Students should notify their instructors by the end of the second week of classes or prior to the first Day of Special Concern, whichever is earlier, regarding Day of Special Concern observances that will affect their attendance. Further, students must abide by the attendance policy of their instructors as stated on their syllabi. Faculty will make reasonable accommodation for tests or field trips that a student misses as a result of observing a Day of Special Concern.*

**Inclusivity**

**Statement:** *The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect and inclusion.*

**Accessibility**

**Statement:** *If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with Accessibility Services (304-293-6700).*

### Lecture Topics (Dates and topics subject to change)

<u># lectures</u>	<u>Topic</u>	
1	Course policies and introduction	syllabus
4	Wireless propagation: Large-scale effects and path loss	Workbook Ch. 1
4	The cellular concept and wireless network design	Workbook Ch. 2
2	Spectrum policy	Notes
1	Review of probability	Workbook Ch. 3
3	Outage probability, trunking, and grade of service	Workbook Ch. 3
2	Intro to LTE and layered radio interface architecture	Dahlman Ch. 1, 2, 8, 9
Mid-term exam on Tuesday, Oct. 30 (subject to change)		
1 or 2	OFDM	Dahlman Ch. 3-4
1 or 2	MIMO	Dahlman Ch. 5
1 or 2	ARQ	Dahlman Ch. 6, 12, 13
1 or 2	Random access	Dahlman Ch. 14
1 or 2	LTE Data Transmission	Dahlman Ch. 7, 10, 11
1 or 2	LTE Advanced	Dahlman Ch. 15-18

Final Exam on Friday, Dec. 20, 8-10 AM.