<table>
<thead>
<tr>
<th>Course number</th>
<th>ECE 5325</th>
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<tbody>
<tr>
<td>Course title</td>
<td>Wireless Communication</td>
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<tr>
<td>Required/elective</td>
<td>Elective (also serves as one of four core courses in EE, three of which are required for graduation)</td>
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<tr>
<td>Catalog description</td>
<td>An introduction to wireless communication systems. Analysis of how hardware, modulation methods, network protocols, multiple access techniques (TDMA, FDMA, CDMA DSSS and FHSS), cell structure, affect system design and performance. Analysis of the transmission channel (large and small scale fading, Doppler, reflection and diffraction).</td>
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<td>Pre-requisite(s)</td>
<td>ECE 3300: Fundamentals of Electromagnetics and Transmission Lines ECE 3500: Fundamentals of Signals and Systems</td>
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<td>Textbook(s) and/or required material</td>
<td>T.S. Rappaport, <em>Wireless Communication</em>, Prentice Hall, 2002 Edition; <a href="http://www.ece.utah.edu/~ece5325">www.ece.utah.edu/~ece5325</a></td>
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| Course objectives | At the completion of this course, students will be able to:  
  1) Topics related to cellular systems  
    a. Describe how a cellular system functions.  
    b. Compute the number of users a particular system can accommodate.  
    c. Compute the required S/I ratio for a system, list and compute sources of interference.  
    d. Design a system for increased capacity using trunking, cell splitting, directional antennas, etc.  
  2) Topics related to physical multipath channels  
    a. List the types of interferers that contribute to multipath interference, large and small scale fading, reflections and attenuation, etc. Describe and determine the effect of these effects on system performance.  
    b. Determine appropriate interference models to use for a given environment and compute the effective interference.  
    c. Compute and measure Raleigh and Rician fading channels.  
    d. Compute a system link budget for a bandlimited channel and also for a spread spectrum channel. Include the effects of multipath fading, interference, Doppler spread, etc. and the effects of the cellular network.  
  3) Topics related to modulation techniques  
    Describe, analyze, simulate, and outline hardware block diagrams for:  
    a. Analog Modulation: AM, FM  
    b. Digital Modulation:  
      i. Phase Shift Keying: BPSK, QPSK (incl OQPSK, π/4 QPSK ), DPSK, M-ary PSK  
      ii. Frequency Shift Keying: FSK, MSK, GMSK  
      iii. Spread Spectrum Systems: DSSS, FHSS  
      iv. Multiple access strategies (TDMA, CDMA, Amps)  
  4) Students will also research one area of wireless communication, networking, or systems that is not covered in this course, prepare an on-line tutorial for it, and present it to the class. |
| Topics covered   | Modern wireless communication systems (including global and local standards, regulations, etc.); cell systems (including capacity, trunking, splitting, sectoring, etc.) and networks; small and large scale fading (its implications, how it is avoided or designed for, how it is measured and |
calculated); link budgets; analog and digital modulation schemes (algorithms and block diagrams, pros and cons); multiple access techniques (TDMA, CDMA OFDM, etc.)

<table>
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<tr>
<th>Class schedule</th>
<th>MWF 50 minute lecture</th>
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<tr>
<td>Lab schedule</td>
<td>None</td>
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**Contribution of Course to meeting requirements of Criterion 5**

- The course is one of four core courses in electrical engineering, of which three are required for graduation. The course is an elective course, providing depth in electrical engineering. It teaches engineering science and wireless communication system design. This course discusses engineering standards and realistic constraints such as: economic, environmental, manufacturability, ethical, health and safety, social, and political.

**Relationship to program outcomes**

MODERATE (a) An ability to apply mathematical, scientific, and engineering knowledge to solve electrical engineering problems. Wireless communication engineering principles are utilized extensively. Basic wave reflection, diffraction, superposition, etc. are utilized to understand the wave transmission environment.

MODERATE (c) An ability to design an electrical engineering system, component, or process to meet desired needs. Basic wireless communication systems are designed, including their link budgets, power requirements, and cell size limitations.

MODERATE (f) An understanding of professional and ethical responsibility. Safety, health, and public concerns are discussed throughout this course. Government regulation and how a communication system receives FCC approval are also discussed.

MODERATE (g) An ability to communicate technical information effectively in oral and written form. Students write a 6+-page “textbook” section on a wireless communication topic, and do a 15-minute presentation on their topic for a “wireless communication symposium.” They also peer-review eight other talks and three other papers.

MODERATE (h) The broad education necessary to understand the impact of engineering solutions in a global and societal context. The social considerations involved in wireless communication business and design are considered.

MODERATE (i) A recognition of the need for, and an ability to engage in, lifelong learning. In addition to journal publications used to supplement the text, students must research their final topic at the library, on the net, etc. This ensures that they have the skills and capability to continue finding new information as it is needed in their later design projects.

LIMITED (j) An awareness of current events and trends affecting the electrical engineering profession. Current events and debates are routinely discussed in this course.

MODERATE (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. The link budget and communication systems that are simulated with MATLAB and Elanix Systemview are typical of what a working engineer will simulate.

**Prepared by**

Cynthia Furse – Course being taught this year by Dr. David Landon

**Date**

December 1, 2008