Electrical Engineering 5430: Wireless Networks
Prior Number – Electrical Engineering 348

Class/laboratory schedule:
3 credit hours lecture (Three 50-minute lectures per week)

Instructor
Maciej Zawodniok, Ph.D.

Text
Professor-provided supplemental notes
Readings from various IEEE journals and magazines

Catalog Information
Introduction to wireless communications and networking. Topics include transmission fundamentals, wireless channel, coding techniques and error control, satellite and cellular networks, cordless systems, mobile IP and management, multiple access techniques and wireless protocols, wireless LAN, IEEE 802.11, and adhoc and sensor networks.

Prerequisite
Hardware competency, Electrical Engineering 3420 (243) or Computer Engineering 3150 (213) and graduate standing. (Co-listed with Computer Engineering 5430 (348) and Systems Engineering 5323 (348)).

Required or Elective Course
Elective course

Course Goals
General Outcomes
1. Understand the fundamentals and theoretical foundations of wireless communication systems
2. Understand transmission fundamentals and wireless channel challenges
3. Analyze requirements of a wireless application in context of wireless transmission fundamentals
4. Understand basic signal coding techniques and error control in context of wireless communication
5. Generate wireless network simulation scenarios and analyze the results
6. Understand essentials of modern wireless systems including satellite communications, cellular networks, cordless systems, mobile IP and mobility management.
7. Understand protocol design constraints and challenges of various multiple access techniques and protocols for wireless ad hoc and sensor networks systems including IEEE802.16, IEEE 802.11, IEEE 802.15.4, and Bluetooth standards
8. Perform a semester project that includes literature survey on modern wireless networking topic, comparative discussion of simulation or experimental results, and optional experimental validation.
### Relationship of Course to Program Outcomes

<table>
<thead>
<tr>
<th>ECE Outcome</th>
<th>Course Outcome</th>
<th>Comments</th>
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<tbody>
<tr>
<td>a</td>
<td>M S S M W M M</td>
<td>Students develop and analyze a wireless network simulations</td>
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<tr>
<td>b</td>
<td>W M S S W</td>
<td>Students must design, execute and interpret results of wireless communication simulations (GNU Radio and Ns2)</td>
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<tr>
<td>c</td>
<td>W S S M S W W W</td>
<td>Students develop and complete an engineering design based on professor-assigned requirements</td>
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<tr>
<td>d</td>
<td>S</td>
<td>Projects and laboratory assignments are performed in teams that consist of student from different majors (CpE/EE/CS/SysEng)</td>
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<tr>
<td>e</td>
<td>S S S S M</td>
<td></td>
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<tr>
<td>f</td>
<td>S</td>
<td>Students learn ethical conduct and proper citation of existing works while performing literature survey for semester project</td>
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<tr>
<td>g</td>
<td>M S</td>
<td>Students write mid-term progress and final report for semester project. Additionally, students prepare and present major findings from the project.</td>
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<tr>
<td>h</td>
<td>W M M M M</td>
<td>Fast-pace of continuous changes in wireless standards and development of new techniques are discussed for each topic.</td>
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<tr>
<td>i</td>
<td>W W W S S S</td>
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<td>j</td>
<td>S S S S M</td>
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<td>k</td>
<td>W M M M S S S</td>
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S – strong connection; M – medium connection; W – weak connection

### Topics Covered

1. Overview of wireless communications and networking
   1. Transmission fundamentals
   2. Communication networks
   3. TCP/IP protocol stack overview
2. Introduction to GNU Radio lab setup
3. Basic wireless communication technology, channel uncertainties and countermeasures
   1. Antennas and propagation theory and models
   2. Signal encoding techniques
   3. Modulation techniques for wireless systems
   4. Coding and error control
4. Overview of the wireless communication systems
   1. Satellite communication
   2. Cordless systems and wireless local loop
   3. Mobile IP
5. Introduction to network simulator tool
6. Cellular wireless networks
   1. Overview of cellular systems (TDMA, GSM, CDMA, 3G/UMTS, 4G/LTE)
7. Wireless LAN systems
   1. Wireless LAN overview
   2. Introduction to wireless ad hoc and sensor networks
   3. Wi-Fi (IEEE 802.11) wireless LAN standard
   4. Bluetooth and IEEE802.15.4/Zigbee standards
8. Semester Project Discussion and Presentations