ECE 401 - Communication Electronics

Radio frequency AM, FM, and PM transmitter and receiver principles. Design of mixers, oscillators, impedance matching networks, filters, phase-locked loops, tuned amplifiers, power amplifiers, and crystal circuits. Nonlinear effects, intermodulation distortion, noise. Transmitter and receiver design specification. Credit will be given for either ECE 401 or ECE 409, but not for both. Prerequisite(s): [(ECE 307, ECE 312, and ECE 403*)] An asterisk (*) designates a course which may be taken concurrently. (3-0-3) (P)

Enrollment:  Elective course for CPE and EE majors.


Coordinator:  Y. Xu, Associate Professor of ECE

Course goals:
After completing this course, the student should be able to do the following:
1. Identify the functional blocks for a radio system and specify their performance requirements.
2. Apply circuit analysis principles to the design of R.F. resonant circuits for impedance transformation.
3. Perform stability analysis on high-frequency amplifiers and arrive at circuit designs that will meet practical requirements.
4. Specify the circuit configurations for different types of oscillators and apply the working equations to determine their output characteristics.
5. Make selection on mixers to accomplish frequency translation, phase detection and other operations on the signal spectrum. Determine the performance of a mixer in a circuit from the mixer specifications.
6. Specify and design the key functional elements in AM and FM receivers. Interpret the specifications of a receiver.
7. Differentiate among the various classes of high-frequency power amplifiers. Make quantitative assessment of their performance in a transmitter to fulfill the requirements of a communication link.
8. Arrive at effective circuits for carrier modulation, and make proper estimation on the resulting spectrum.
9. Analyze a phase-locked loop by means of linear model and predict the circuit performance. Use the phase-locked loop to accomplish signal conditioning objectives in a communication system.

Prerequisites by topic:
1. Traveling waves
2. Electronic Circuits
3. Communications and Modulation Theory
4. Signal Spectral Analysis

Lecture schedule:  Two 75-minute sessions per week

Topics:
1. Radio Systems, Modulation, Multiplexing (1 week)
2. Small-Signal Amplifiers (1 week)
3. Amplifier Stability (1.6 weeks)
4. Amplifier Gain (1.6 weeks)
5. Series-Parallel Impedance Transformation (2 weeks)
6. Tapped Coils and Transformers (1 week)
7. Oscillators (1.6 weeks)
8. Mixers: Unbalanced, Single Balanced, Double Balanced (1.3 weeks)
9. Detectors: Envelope and Product (0.6 week)
10. AM Receiver Design (1.3 weeks)
11. Phase-Locked Loops (1.3 weeks)
12. FM Receiver Design (0.6 week)
13. Tests (0.6 week)

**Computer usage:**
None.

**Laboratory topics:**
None.

**Relationship of ECE 401 Course Goals to Student Outcomes:**

<table>
<thead>
<tr>
<th>Student Outcomes</th>
<th>Course Goals</th>
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<tbody>
<tr>
<td>a Apply knowledge of math, engineering, science</td>
<td>1, 2, 3, 4, 7, 8, 9</td>
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<td>b Design and conduct experiments /Analyze and interpret data</td>
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<td>c Design system, component, or process to meet needs</td>
<td>2, 3, 5, 6, 8, 9</td>
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<td>d Function on multi-disciplinary teams</td>
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<tr>
<td>e Identify, formulate, and solve engineering problems</td>
<td>2, 3, 4, 7, 8, 9</td>
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<td>f Understand professional and ethical responsibility</td>
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<td>g Communicate effectively (written / oral)</td>
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<td>h Broad education</td>
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<tr>
<td>i Recognize need for life-long learning</td>
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<tr>
<td>j Knowledge of contemporary issues</td>
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<td>k Use techniques, skills, and tools in engineering practice</td>
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**Prepared by:** Yang Xu  
**Date:** November 1, 2013