ECE4418 Course Syllabus

ECE4418

RF Engineering II (3-0-0-3)

CMPE Degree
This course is Elective for the CMPE degree.

EE Degree
This course is Elective for the EE degree.

Lab Hours
0 supervised lab hours and 0 unsupervised lab hours

Course Coordinator
Kenney,James Stevenson

Prerequisites
ECE4415 [min C]

Corequisites
None

Catalog Description
Radio frequency (RF) electronics concentrating on transmitter components and architecture from 1 MHz to 1 GHz, including power amplifiers, oscillators, phase-locked loops, and transmitters.

Textbook(s)
Thomas H. Lee, *Planar Microwave Engineering*, Cambridge University Press, 2004. ISBN 0521835267(optional)

Steve C. Cripps, *RF Power Amplifiers for Wireless Communications* (2nd edition), Artech House, 2006. ISBN 9781596930186(optional)

Andrei Grebennikov, *RF and Microwave Transistor Oscillator Design*, John Wiley, 2007. ISBN 9780470025352(optional)

Course Outcomes
Upon successful completion of this course, students should be able to:
1. Design low-loss, high power matching networks
2. Model transistors for large-signal (nonlinear) operation
3. Analyze distortion contribution from components
4. Design, simulate, fabricate and test a multi-stage PA
5. Design, simulate, fabricate and test a VCO
6. Design, simulate, fabricate an FM transmitter

Student Outcomes
In the parentheses for each Student Outcome:
"P" for primary indicates the outcome is a major focus of the entire course.

“M” for moderate indicates the outcome is the focus of at least one component of the course, but not majority of course material.
“LN” for “little to none” indicates that the course does not contribute significantly to this outcome.

1. (P) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. (LN) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. (LN) An ability to communicate effectively with a range of audiences
4. (LN) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. (P) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. (P) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. (LN) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Topical Outline

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Introduction
  Communication Systems
  Noise in Communications Systems
  Methods of Modulation
  Radio Receivers
  FCC Rules

Linear and Non-Linear Amplifiers
  Amplifier Classes and Efficiency
  Dynamic Range
  Intermodulation Distortion

Small-Signal Amplifier Design
  Gain, Stability, and Noise Circles
  Low-Noise Design
  Design of Feedback Amplifiers

Frequency Mixers
  Definitions and Terms
  Diode Mixers
  Transistor Mixers
  Spurious Responses

Detectors
  AM Detectors
  FM and PM Detectors
  Noise Considerations
  Dyinamic Range

Oscillator Design
  Criteria for Oscillations to Occur
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- Build-Up of Oscillations
- Oscillator Analysis
- Resonator Theory
- Negative Resistance Oscillators
- Feedback Oscillators
- Tuned Oscillators
- Crystal Oscillators
- Frequency Synthesizers

Large Signal Amplifiers
- Amplifier Classes and Efficiency
- Dynamic Range
- Intermodulation Distortion
- Design of Large Signal Amplifiers

Transmitter Circuits
- Power Amplifiers
- AM Transmitters
- FM Transmitters
- High-Power Vacuum Tube Amplifiers
- Power Combining Techniques