EE 585 Physical Design of Wireless Systems
Syllabus

Catalog Description:

EE 585 Physical Design of Wireless Systems
Physical design of wireless communication systems, emphasizing present and next generation architectures. Impact of non-linear components on performance; noise sources and effects; interference; optimization of receiver and transmitter architectures; individual components (LNAs, power amplifiers, mixers, filters, VCOs, phase-locked loops, frequency synthesizers, etc.); digital signal processing for adaptable architectures; analog-digital converters; new component technologies; specifications of component performance; reconfigurability and the role of digital signal processing in future generation architectures; direct conversion; RF packaging; minimization of power dissipation in receivers. Cross-listed with PEP 685 and MT 685.

Text Book:

Razavi, "RF Microelectronics," Prentice Hall, 1998, ISBN 0-13-887571-5.
Pozar, "Microwave and RF Design of Wireless Systems," J. Wiley, 2000, ISBN 0-47-132282-2.
Access to the latest version of Mathcad is very useful, but not required to be able to experiment with example worksheets.

Starting Fall 2008, course notes will be modified to use Ludwig and Bogdanov, "RF Circuit Design: Theory and Applications," Prentice-Hall, 2nd edition, ISBN 0-13-147137-6. Homework problems will be drawn from this text.

Instructor:

Bruce McNair, Distinguished Service Professor of ECE.

Goals:

The goal of this course is to give students an understanding of the issues involved in designing wireless communications systems and introduction to the tools and techniques used to address these issues.

Prerequesites by Topic:

- Linear Systems
- Probability and Random Variables
- Circuits and Systems
- Digital Systems

Grading Policy:

Homework 10%
Participation in on-line WebCT discussions 10%
Quizzes 30%
Design Project 20%
Final 30%

All assignments provide opportunities for extra credit work. Work that goes significantly beyond what is asked will be graded accordingly.

Course structure

At present, this course is offered only on-line. The on-line section of the course will be consist of weekly on-line lectures, Mathcad simulation models that students may modify, and weekly assignments to focus on developing understanding of the course topics. There is also a course project, intended to integrate all the technologies presented in the course. There will be no "real-time" synchronous meetings. That is, no aspect of the on-line course interactions need to be completed at any specific times or days.

Course Components:

- Engineering - 100%

Course Web Site:

http://koala.stevens-tech.edu/~bmcnair/PDWS-XXX where XXX is the current semester, e.g., S08

Schedule of Topics

Week 1: Basic issues
- Linearity and time invariance
- Random processes and noise
- Sensitivity, dynamic range and noise floor
- Interference

Week 2: Modulation
- Analog modulation
- Digital modulation
- Detection

Week 3: Multiple Access Techniques
- Mobile RF communications
- Multiple Access
- Wireless standards

Week 4: Transmitter Design
- Transmitter architecture
- Transmitter performance tests

Week 5: Receiver Design
- Receiver architecture

Week 6: Low Noise Amplifiers
- Input matching
- Stability
- Performance tradeoffs

Week 7: RF Mixers
- Designs of mixers
- Performance of mixers

- Noise in mixers

Week 8: Oscillators
- Basic LC oscillators
- Voltage controlled oscillators
- Design of oscillators
- Quadratic signal generation
- Single sideband conversion
- Phase noise

Week 9: Frequency synthesis
- Phase locked loops
- RF synthesizer architecture
- Frequency dividers
- Spurious responses
- Direct Digital Synthesis

Week 10: Power Amplifiers
- Class A, B, AB, C, D amplifiers
- High efficiency power amplifiers
- Linearization techniques

Week 11: Antennas and Propagation
- Electromagnetic radiation
- Polarization
- Friis equation
- Small antenna designs, dipoles, monopoles, patch antennas
- Path loss and fading

Week 12: Filters, Digital Signal Processing and Reconfigurable Wireless Systems (Software Defined Radio)
- Filter specification and design
- Filter types
- Filter technologies: LC, crystal, mechanical, SAW, and digital
- DSP tradeoffs
- Software Defined Radio considerations

Week 13: System Design Considerations
- Packaging
- Power
- Heat dissipation
- Parameter tradeoffs

Last revised: October 6, 2010