EE 432 – UHF and Microwave Engineering

Designation: EE elective course for electrical engineering majors.

University Bulletin Description: EE 432: (3) Transmission line and waveguide characteristics and components: design of UHF-microwave amplifiers, oscillators and filters: measurement techniques: design projects.
Prerequisites: EE 310, EE 330.

Prerequisites by Topics:
1. An understanding of transmission lines and characteristic impedance
2. Familiarity with laboratory equipment such as oscilloscope
3. Basic concepts of antenna and propagation of plane waves
4. Use of PSPICE for electronic circuit analysis and design
5. Linear analysis of two-port impedance and admittance parameters

Textbook/Required Materials:
Microwave Engineering, 2nd edition, by David Pozar, Wiley, 1998.

Learning Outcomes:
1. Use Smith charts to calculate reflection coefficients and impedance.
2. Microstrip layout and analysis of amplifiers, oscillators and couplers
3. Matching networks and S parameter description of active devices
4. Design amplifiers and oscillators and characterize their stability and performance.
5. Noise figure and dynamic range of amplifiers and oscillatory
6. Waveguides, modes, filters and microwave system analysis.

Topics:
1. Complex impedance calculations with transmission line lengths (2 classes).
2. Smith chart and S parameters in system analysis for matching (3 classes).
3. Noise and dynamic range characterization of amplifiers (2 classes)
4. Matching networks for gain, bandwidth and stability (3 classes).
5. Design of microwave amplifiers for gain and stability (4 classes).
6. Oscillator design, stability and dielectric resonators (3 classes).
7. Dividers, couplers, Wilkinson, quadrature and Lange couplers (4 classes).
8. Mixers, switches and MMIC (3 classes)
9. Project presentations and discussions (2 classes).
10. Review and overview of materials (2 classes)

Class/laboratory schedule: Two 75-minute lectures and one 2-hour laboratory per week.

Computer usage:
1. Microwave Office is used for homework and laboratory exercises during the semester.
2. Microwave Office and word processor used for formal technical reports on group projects.
3. Power Point used for class project presentations.

Laboratory exercises and projects:
1. Students complete four laboratory projects that demonstrate network analyzer measurements. Students are required to maintain laboratory notebooks and submit them for grade at mid-semester. Technical writing and maintaining lab notebook as well as working in groups are part of satisfying 15 % of the grade.

2. Laboratory projects involve using the spectrum analyzer and noise figure meter to understand amplifier design techniques and performance. Concepts developed in class are demonstrated and reinforced.
3. Microwave Office is used to analyze microwave amplifiers to familiarize students with capabilities for design and development. Student projects are expected to follow on and develop the amplifier capabilities and performance.

Contribution to Meeting the Requirements of Criterion 5. Curriculum:
This course contributes to both the engineering topics and design components.
This course builds on the electronic circuit design in EE 310 and the PSPICE usage for circuit analysis. The electromagnetic analysis follows fields in EE 330. Topics in microwave amplifiers relate to economic and manufacturability concepts in global competition.

Relationship to Program Outcomes:
O.1.1. Graduates will possess mathematics skills necessary for electrical engineering.
O.1.2. Graduates will have a theoretical and practical background in both physics and chemistry.
O.1.3. Graduates will have attained computer proficiency.
O.2.1. Graduates will understand how to analyze and design simple electrical/electronic circuits.
O.2.2. Graduates will understand electronic devices.
O.2.3. Graduates will understand the basic concepts of linear systems and how they interact with continuous-time signals.
O.2.4. Graduates will understand fundamental electricity and magnetism concepts and be able to use them in applications.
O.3.1. Graduates will have in-depth technical knowledge in one or more areas of specialization.
O.3.2. Graduates will have practical understanding of the major electrical engineering concepts and demonstrate application of their theoretical knowledge of the concepts.
O.4.1. Graduates will interact with industry both within and outside of a classroom setting.
O.4.2. Graduates will develop an appreciation of continuing educational and professional development.
O.5.1. Graduates will have good teamwork skills.
O.5.2. Graduates will possess good oral and written communication skills.
O.6. Graduates will appreciate their role as engineers in society.

Prepared by: Lynn Carpenter **Date:** 3/20/08