

ECE 462
Electronics RF Design (3 credits)□

Overview

Course Catalog Description: The course covers rf design techniques using transmission lines, strip lines and solid state devices. It includes the design of filters and matching elements required for realizable high frequency design. Amplifiers, oscillators and phase lock loops are covered from an rf perspective.

Prerequisites: 322, 360 and 460

Textbook: G. Gonzales, *Microwave Transistor Amplifiers, Analysis and Design*, 2nd edition, Prentice Hall

Class Goals: To get familiar with the general properties and design of linear and nonlinear solid state microwave circuits including low-noise, broadband and power amplifiers, oscillators, and mixers for wireless communication.

Course Coordinator: Prof. Christos Christodoulou

Table I: Objectives, Implementation, and Assessment

Objectives		Implementation	Assessment	A	B	C	D	E	F	G	H	I	J	K
O ₁	Review of transmission line theory, microstrip lines, matching techniques and scattering parameters.	First 2 weeks	HW	X	X	X	X							
O ₂	Understand the significance and the difference between stability circles and constant Gain circles. Understand the concept and technique of simultaneous Conjugate Matching.	Weeks 3-4	HW	X	X	X	X							
O ₃	Understand the fundamentals of microwave amplifier design fundamentals such as : Available power Gain Circles, Noise, Constant Noise Figure Circles, Broad Band Amplifier Design: Feedback, Distributed Amplifiers. Power Amplifier Design: Class A, B, and C, Linearity Considerations, Intermodulation Products	Weeks 5-10	HW Design Project using ADS Final Exam	X	X	X						X	X	X
O ₄	Understand the fundamentals of microwave oscillator design fundamentals such as: Negative Resistance Oscillators, Oscillation Condition and Oscillator Stability, Design for Maximum Power, Phase Noise in oscillators	weeks 10-14	HW Design Project using ADS Final exam	X	X	X						X	X	X
O ₅	Understand the fundamentals of diode and transistor mixer design	Last 2 weeks	HW Final Exam	X	X	X						X	X	X

Course Syllabus and Schedule

Chapter 1

- Microwave Network Analysis
- Transmission Line Theory
- S- parameters

- Diodes and Microwave Transistors
- Equivalent Circuits

Chapter 2

- Smith Chart
- Microstrip Matching Networks
- ADS (Computer-aided analysis software “Advance Design System” by Agilent) tutorial and Demo
- Signal Flow Graphs

Chapter 3

- Amplifier Design
- Gain circles, Stability circles, constant VSWR circles, etc..
- Conjugate Matching
- DC bias considerations
- Bipolar and FET design

Chapter 4

- Low Noise Amplifiers using ADS
- Noise Concepts
- Constant Noise Circles
- Broadband Amplifier Design
- Balanced Amplifiers
- Feedback Amplifiers
- Power Amplifiers
- Intermodulation Distortion

Chapter 5

- Microwave Transistor Oscillators
- One port Oscillator Design
- Two-port Design
- Large Signal Measurement design
- Oscillator Configurations
- Frequency Tunable Oscillators

Chapter 6

- Mixers
- Up converters and Down Converters
- SSB and DSB Mixers
- Noise Figure
- Mixer Analysis