

# ECE 5022: Radio Frequency Integrated Circuits

## Course Description

Modulation, wireless standards, transceiver architecture, transistor models, passive component models, LNA, VCO, PLL, Mixers, integrated PA, RFIC layout.

**Prior Course Number:** 620

**Transcript Abbreviation:** RFICs

**Grading Plan:** Letter Grade

**Course Deliveries:** Classroom

**Course Levels:** Undergrad, Graduate

**Student Ranks:** Senior, Masters, Doctoral

**Course Offerings:** Spring

**Flex Scheduled Course:** Never

**Course Frequency:** Every Year

**Course Length:** 14 Week

**Credits:** 3.0

**Repeatable:** No

**Time Distribution:** 3.0 hr Lec

**Expected out-of-class hours per week:** 6.0

**Graded Component:** Lecture

**Credit by Examination:** No

**Admission Condition:** No

**Off Campus:** Never

**Campus Locations:** Columbus

**Prerequisites and Co-requisites:** Prereq or concur: 4021 or 5021, or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences.

**Exclusions:** Not open to students with credit for 620.

**Cross-Listings:**

**Course Rationale:** Existing course.

**The course is required for this unit's degrees, majors, and/or minors:** No

**The course is a GEC:** No

**The course is an elective (for this or other units) or is a service course for other units:** Yes

**Subject/CIP Code:** 14.1001

**Subsidy Level:** Doctoral Course

## Programs

Abbreviation	Description
CpE	Computer Engineering
EE	Electrical Engineering

## Course Goals

Learn principles of RF systems and understand tradeoffs in system's sensitivity and linearity
Learn aerial access techniques (i.e. duplexing and multiple access)
Basic understanding of RF active and passive device modeling and RF layout
Understand principle of phase noise and its impact on transceivers

Learn fundamental design principles of RF blocks (e.g. LNAs, Mixers, VCOs, PAs)

## Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Noise figure and sensitivity	3.0							
Linearity (IP2, IP3)	3.0							
Aerial access and modulation	4.0							
Phase noise	2.0							
Transceivers systems design	4.0							
Impedance matching and transformation	2.0							
RF device modeling	2.0							
Low noise amplifiers (LNAs)	4.0							
Mixers	3.0							
Voltage-controlled oscillators	4.0							
Phase-locked loop	4.0							
Power amplifiers	4.0							

## Representative Assignments

Homeworks
Computer Aided Simulation Projects
Midterm Exam
Final Project

## Grades

Aspect	Percent
Homeworks	20%
Projects	20%
Midterm Exam	30%
Final Project	30%

## Representative Textbooks and Other Course Materials

Title	Author
<i>Wireless Receiver Design for Digital Communications (2nd edition)</i>	Kevin McClaning

## ABET-EAC Criterion 3 Outcomes

Course Contribution	College Outcome
***	a An ability to apply knowledge of mathematics, science, and engineering.
**	b An ability to design and conduct experiments, as well as to analyze and interpret data.
***	c An ability to design a system, component, or process to meet desired needs.
***	d An ability to function on multi-disciplinary teams.
***	e An ability to identify, formulate, and solve engineering problems.

Course Contribution		College Outcome
	f	An understanding of professional and ethical responsibility.
**	g	An ability to communicate effectively.
	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
	i	A recognition of the need for, and an ability to engage in life-long learning.
	j	A knowledge of contemporary issues.
***	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### CpE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
***	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
*	2	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	an ability to communicate effectively with a range of audiences
	4	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	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	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
**	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

### EE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
***	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
*	2	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	an ability to communicate effectively with a range of audiences
	4	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	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	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
*	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

### Additional Notes or Comments

Change prereqs and exclusions to match university version.  
Deleted two texts and added McClaning per area 1/28/12

Change 5021 from pre to co 4/23/12

Add 4021 to prereqs 3/30/18

**Prepared by:** Betty Lise Anderson