

**RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY**  
**DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING**

**Spring Semester 2014**

**16:332:599-Advanced Topics in Electronics: RF Integrated Circuit Design**  
**(Cross-listed with Topics in ECE: 14: 332:445)**

**Time and Location:** Monday and Wednesday, 3:20-4:40 p.m., Hill-009

**Instructor:** Dr. Laleh Najafizadeh  
email: laleh.najafizadeh@rutgers.edu, Office: CoRE 520

**Office Hours:** Mondays, 1:30-2:30 pm, CoRE 520  
or by appointment (please send an email to set a time).

**Prerequisite:** 14:332:463 (Analog Electronics)  
General knowledge on semiconductor devices, transistor's frequency response, Analog Circuits, Electromagnetics

**Required Textbook:** *RF Microelectronics*, 2nd Edition, by Behzad Razavi, Prentice Hall,  
ISBN: 978-0137134731

**References:** *The Design of CMOS Radio-Frequency Integrated Circuits*, by Thomas H. Lee, ISBN: 978-0521835398

**Course Objectives:** The objective of this course is to present the concepts of design and analysis of modern RF and wireless communication integrated circuits. Topics covered are: basic concepts in RF design, scattering parameters, modern integrated circuit technologies, fundamental limitations of speed of operation of transistors, physics of noise, impedance matching, low-noise amplifiers, mixers, oscillators, phase noise, and phase locked loops. It is expected that the students be able to apply the concepts and design techniques presented in this course to a wide range of applications including high-speed wireless communications and biomedical electronics.

**Topics Covered:**

1. Basic Concepts in RF Design, Scattering Parameters
2. Modern IC technologies (SiGe, CMOS), fundamental limitation of speed of transistors, Physics of Noise
3. Transceiver Architectures, Heterodyne/Direct Conversion/Low-IF Receivers
4. Impedance Matching, RF Filters
5. Low Noise Amplifiers
6. Passive and Active Mixers
7. Oscillators, Basic Principles, Cross-Coupled, Phase Noise
8. RF Passive Components
9. Silicon-based receivers, Layout consideration, Packaging Issues
10. PLL

## **Course Grade:**

Quizzes and Homework	15%
Design Project	25%
Mid Term Exam	25%
Final exam	35%

Cutoffs for letter grades are:

**A:** (90-100)

**B+:** (85-89.99)

**B:** (75-84.99)

**C+:** (70-74.99)

**C:** (60-69.99)

**D:** (50-59.99 )

**F:** (<50)

**Homework and Quizzes:** Based on class lectures, there will be quizzes throughout the semester. Homework will be assigned on a regular basis.

**Exam:** There will be one in-class midterm exam and a final exam. Students can bring a one page formula sheet to the midterm, and up to two page to the final.

**Design Project:** A team project, in which you will be designing a receiver.

**Computer Usage:** The Design Project and assignments would require the use of Cadence Spectre Circuit Simulator.

**Class Attendance Policy:** Lectures will consist of mostly “**on-the-board**” notes. Therefore, attendance is strongly recommended to achieve the objectives of the course. It is your responsibility to learn all the materials covered in class (written or orally transmitted), which can appear in the exams. Meaningful participation during lecture matters a great deal to me and this requires preparation for lectures on your part, prior to coming to the class.

## **General Policies:**

1. Please be on time for lectures and be respectful of your fellow students (and me).
2. Please turn your cell phones, computers, laptops, and wireless internet connections off.
3. No eating or drinking will be allowed in the classroom.
4. Homework will be collected at the beginning of the lecture period on the due date. Late homework **will not** be accepted. Please make sure your homework has your name, student number, course number, homework number, and date. Each homework problem should be distinctly separated and final answers should be clearly indicated.
5. Attendance at tests is mandatory. Absence from an examination will not be excused except in cases of an illness or other emergency that is verified by appropriate written

documentation. For example, in case of illness a written statement from a physician is required with inclusive dates under care.

6. Unexcused absence from an examination will result in a grade of zero. It is the *student's* responsibility to see the instructor as soon as possible in regard to an excused absence. All make up work must be scheduled no later than the last day of classes in the semester.
7. Students are responsible for all material covered in the class as well as announcements for homework assignments, assignment due dates, and test dates.
8. If a class is missed due to school closure, the regularly scheduled test or lecture will occur the next time the class meets.
9. Mid-term exams will be announced at least two weeks ahead of time.
10. All exams must be taken at the scheduled time unless a *previous* arrangement has been with the instructor, or there is a valid excuse acceptable according to the University policy. Absence from quizzes or tests without a valid reason or prior arrangement will result in getting a zero for the missed test.

**Academic Honesty:** The Rutgers Student Academic Regulations and Policies states:

“The department expects each student to conduct himself/herself in a professional manner. Cheating offenses are reported to the appropriate academic office by the faculty of Electrical and Computer Engineering without hesitation. An engineer beginning a career cannot afford to have this kind of incident on record. Both the student who gives information and the one who receives it are considered guilty parties. The University policy on academic dishonesty is carefully spelled out in the undergraduate catalog. Note that copying from, or giving assistance to others, or using forbidden material on any exam or in any required report, is a Level Three violation. The recommended sanction is suspension from the University for one or more terms with a notation of academic disciplinary suspension placed on the student’s transcript.”

(see: [www.ece.rutgers.edu/files/undergraduate/UG-Handbook.pdf](http://www.ece.rutgers.edu/files/undergraduate/UG-Handbook.pdf))