

IL2219 Radio Electronics p3, 2024

Welcome to the first lecture on Tuesday January 16, 10.15 in room 211, Electrum. (At first lecture we can adjust [the schedule](#) to handle any collisions. Also time for examination will be discussed.)

Course responsible and Examiner: Håkan Olsson

Lab Assistant: Mahmoud Zaher

Exam: 6 credits, Grades A-F based on combined results from two parts I and II.

Part I. Oral/Written exam on Chapters 1-4*.

Part II. Individual short reports on chapters 5, 6, 8, 9 and 12.

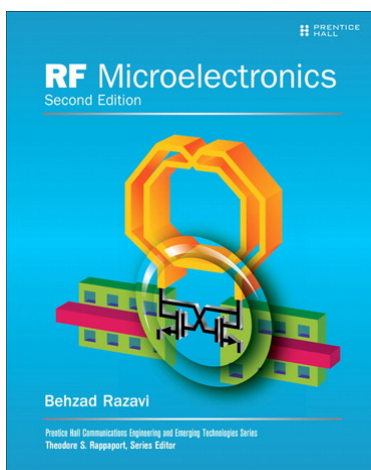
Lab 1, 2 1.5 credits. Grade P/F.

* Last three years we have combined a 60 min written part with oral examination, initially due to pandemic situation. Due to good experience with this method, we may continue also 2024.

Specific prerequisites

Knowledge in Analog electronics, minimum 6 higher education credits, equivalent to completed course in IE1202/IE1207.

Text book: RF Microelectronics, Behzad Razavi, Pearson 2nd edition (available via Kårbokhandeln on KTH campus. Pearson also suggests https://www.bokab.net/products/rf-microelectronics?_pos=1&_sid=ab72091aa&_ss=r but there may be alternative ways to find the book)



Additional course material: Lecture slides and Lab Memo etc are available through Canvas.

Overview plan

Ch 1-4 First 3-4 weeks: lectures => oral exam and problems

Lab 1&2 3rd-4th week: Labs [room 305](#) Electrum

Ch 5-12 Last 3 weeks => individual reports (upload pdf to Canvas)

Exam March 11-12th (oral + written solution upload to Canvas)

Both lectures and labs are based on chapters 1-4. The course also covers chapters 5, 6, 8, 9, 12 but in an overview way. You will make short reading reports on each of these latter chapters. The oral exam can give 10 points, reports 10 points, so up to 20 points in total but minimum 5 points for each part. 10 points for grade E and higher grades in proportion. (E=10-, D=12-, C=14-, B=16-, A=18-)

Oral exam based on Ch 1-4: You will receive your problems by mail an hour before your oral exam starts. You then upload your solutions to Canvas before the oral exam starts and they will be one basis for the oral discussion. 0-10 points will be given based on the discussion. Discussions take about half an hour per student.

Labs: The first lab include rf-measurements of radio building blocks using spectrum analyzers, while the second lab contains building a radio transmitter and a receiver from the blocks including transmitting audio content from transmitter to receiver. These topics relate to Chapters 1-4. No Canvas up-loads for the labs but you must solve preparatory questions in Lab memo before coming to the lab!

Reports on Chapters 5, 6, 8, 9 and 12: Individual reading and reports that summarizes each chapter or parts of each chapter is the examination. It is specifically the Razavi course text book content that should be summarized. The self-study part is a way to cover a large material content without going in on depth and is suitable at an advanced Master level. It is not required to report on the full chapters. It would be too long reports. The basic requirement is a general understanding of each chapter topic (or part thereof) and, say, a one page such report could give one point, as an example. There are no exact rules. Reports are often 1-3 pages, but sometimes longer ones appear- maybe with extensive use of figures. Two points could be to penetrate the material a bit more, or display an exceptional understanding of the topic and context. It is required that you write using your own words and make references to the text book! Figures can be borrowed freely from the text book and often helps making the report readable. Text may not be copied. All texts will be examined for plagiarism! All use of AI tools is forbidden. 0-2 points per report and up to five reports, one per chapter. Reports are uploaded to Canvas before the deadlines.

Course contents: The first part of the course covers the textbook chapters 1-4 with two matching labs. This part is systems oriented. The second part covers chapters 5-12 and goes into detail of radio building blocks. These latter chapters are more circuit oriented and in particular previous knowledge from basic analog electronic courses is required.

Chapters 1-4 provide an understanding of how modern radios are designed and function. A number of basic concepts are discussed that limit the radio performance such as noise and non-linearity which combined lead to the radio dynamic range. Modulation techniques are discussed and architectures of receivers and transmitters and how to make design choices

depending on desired performance. Wireless standards are discussed and transceiver examples are given. All concepts covered are in much industrial demand at the moment as we are transitioning to fifth and sixth generation mobile systems.

The textbook contains so much material it could fill two or more courses. To get an overview of several chapters with material central to designing a modern radio, we include chapters 5, 6, 8, 9 and 12. The key building blocks in radio design covered in these chapters are low noise amplifiers, mixers, oscillators, phase locked loops and power amplifiers.

Course lectures, labs and reports

- L1 Historical background to Mobile communication Chapter 1 Introduction to rf and wireless technology
- L2 Chapter 2 Basic concepts in rf design. Slides 4-24 (ISI in ch 3.3.1)
- L3 Chapter 2 Basic concepts in rf design. Slides 4-24 (Not ch 2.6-2.8)
- L4 Problems Chapter 2
- L5 Chapter 3 Communication concepts (selected parts of text book, use book as reference)
- L6 Chapter 4 Transceiver Architectures Part I (selected parts of text book)
- L7 Chapter 4 Transceiver architectures Part II Slides 8-15 (not ch. 4.2.5 and 4.4)
- L8 Continued Ch 4 on Transmitters. Exercise Chapter 4
- L9 Optional lecture if needed

LAB 1 Basic concepts in rf design

LAB 2 Transceiver architectures

Written reports

Chapter 5 LNA -Low Noise Amplifiers

Chapter 6 Mixers

Chapter 8 Oscillators

Chapter 9 PLL –Phase Locked Loops

Chapter 12 PA -Power Amplifiers

Tentative schedule

W3: L1 Jan 16, 10-12 L2 Jan 17, 13-15 L3 Jan 18, 13-15

W4: L4 Jan 22, 10-12 L5 Jan 24, 15-17 L6 Jan 26, 10-12

W5 L7 Jan 29, 10-12 L8 Jan 30, 13-15 Lab1 Jan 31 or Feb 2, 10-17 (lab groups of 8 students)

W6 L9 Feb 5, 13-15 Lab 2, Feb 7 or Feb 8, 10-17 (lab groups of 8 students)

W7 Report 1, Feb 14

W8 Report 2, Feb 20 Report 3, Feb 23

W9 Report 4, Feb 28

W10 Report 5, Mar 4

W11 IL2219 oral exam over Zoom + problems Ch1-4, March 11 and 12, 08-19 (30-60 min each).

(KTH schedule study period 3: January 16 to March 4. Exam period March 8 to 15.)

In this course, the EECS code of honor applies, see:

<http://www.kth.se/en/eecs/utbildning/hederskodex> .