EuroTeQ Engineering University

Course

Part of the EuroTeQ course catalogue spring/summer 2023

Transceivers 2: Design

Subject area: Electrical Engineering

University:	TU/e
Level:	MA1, MA2
Teaching mode:	hybrid: some students participate online, other students attend real-life
Instructor(s):	Peter Baltus

Short description

In this course you will learn design of advanced RF transceivers circuits, both schematic and layout. The course will cover the subcircuits most often found in modern transceivers, such as low-noise amplifiers, power amplifiers, mixers, oscillators and synthesizers. Other circuits such as frequency dividers, beam formers, phase shifters, switches, filters, matching networks etc. will be discussed depending on interest & available time.

Full description

The course consists of a short introduction, followed by 2 similar blocks of flipped classroom sessions. During the flipped classroom sessions, students will work in teams to design a wireless transceiver, with each student addressing a single type of subciruit. Each lecture in a block will be focussing on a type of subcircuit, and students will study and design their subcircuit in preparation for such a lecture. The lectures themselves will be organized as design reviews, similar to those in industry. In a design review, the designer will present her/his circuit to the other students, and it is the task of the other students to examine the design for flaws, risks and shortcomings and discuss them with the designer to further improve the quality of the design. A design review is one of the last steps in a design process, shortly before a design is sent out for prototype fabrication. Because of the high cost and long duration of prototype fabrication, a design review is very important since it will reduce the risk of the circuit not performing or even not being functional at all. The resulting need for redesign and a new prototype run is a major cause of delays and cost overruns in projects, both in research and in industr.
In the first block, we will address an RF (MHz range) wireless transceiver based on very old technology, since such a design can easily be breadboarded and measured in the lab without having to go through IC prototyping. We will then actually build and measure the circuits that have been designed in a lab that is scheduled in between the two blocks. As a preparation for this lab, students will be able to borrow a "home lab" kit with the components and measurement devices to build and evaluate their circuit at home already, and there is also a possibility to build and evaluate the circuit remotely through a web browser that allows you to control and view a similar measurement set-up in our lab. The on-campus lab sessions will focus on integrating and evaluating the complete transceiver of each team based on the individual circuits prepared at home. In the second block, we will address a mm-wave transceiver in advanced CMOS technology using the same approach, so each subcircuit type will be

discussed twice: once for RF frequencies and once for mm-wave frequencies. The second iteration will help deepen the understanding and insights into the circuits, helped by the experience of the first block and the lab.
Finally, the exam will be in the format of a carrousel exam: again you will design as a team a transceiver, with each student addressing one specific circuit type.

Learning outcomes

At the end of the course, the learner will be able to explain the properties of common modern IC technologies and devices and their relation to RF transceiver circuits.
At the end of the course, the learner will be able to explain and effectively use appropriate RF transceiver circuit design methods.
At the end of the course, the learner will be able to explain and effectively use advanced CAD tools in the design and verification of RF transceiver circuits.
At the end of the course, the learner will be able to explain, analyse and design the following RF circuit types using a modern IC technology according to predefined specifications: low-noise amplifiers, power amplifiers, mixer, VCO, and filters.

General information

Contact hours per week:	8
Total workload:	140 (in student hours for the whole course)
ECTS credits:	5
Language:	English
Course start date:	06 February 2023
Course end date:	23 April 2023
Add. info about start date:	
Weekly teaching day/time:	
Time zone:	CET (Denmark, Germany, France, Netherlands, Switzerland, Czech Republic)
Further information:	
Prerequisites:	Theoretical knowledge on CMOS IC design. Concepts in modern CMOS
Activities and methods:	Lectures, Lab-work
Presence on campus:	

Final examination

Form: oral

Date:

Location/format:

Re-sit possibility:

Transcript available: on request

Add. info/requirements:

Registration

To register for this course, follow the registration requirements of your **home university** as specified here: www.euroteq.eu/courses-registration.

Administration

Number of places:

Minimum participants:

Internal course code: 5SFE0

Contact: P.G.M.Baltus@tue.nl

This course is part of the EuroTeQ Engineering University joint course catalogue 2023. This is a collaborative activity of the partner universities DTU, L'X, TU/e, TalTech, CTU, TUM as well as Technion. Students from these universities can participate in the offered courses. It is the responsibility of the student to check if you fulfil the requirements to participate in a specific course. Students are also advised to check with their home institution how to get recognition of the ECTS credits gained in courses of the EuroTeQ course catalogue. For further information about EuroTeQ Engineering University, visit www.euroteq.eu or get in touch with the above-mentioned point of contact.