EuroTeQ Engineering University

Course

Part of the EuroTeQ course catalogue spring/summer 2023

Electromagnetics-II

Subject area: Electrical Engineering

University: TU/e
Level: BA2
Teaching mode: hybrid: some students participate online, other students attend real-life
Instructor(s): Ramiro Serra and Mark Bentum

Short description

This course provides an introduction to space-time and space-frequency, free and guided electromagnetic waves in one to three spatial dimensions, with applications in circuit theory, communication theory and wireless devices and systems.

Full description

So, you might wonder why we need to depart from the safe zero-dimensional confines of circuit theory? Simply put, the answer is the finite speed of light. In this course, the space-time dependence of electromagnetic fields takes centre stage, in theory, but also through ubiquitous electric and electromagnetic circuit applications.
In the first half of the course, we explore the most elementary types of electromagnetic wavefields, i.e., waves in time and one spatial dimension. We shall treat electromagnetic plane waves and more general transverse electromagnetic waves propagating along transmission lines in the same transmission-line formalism. This will include reflection and transmission across interfaces, and resonance effects in plane layers or cascades of transmission lines with applications to filter design. We shall take a systems approach to the interaction of electromagnetic waves with matter, and distinguish between group and phase speed, and discuss pulse dispersion.
In the second half of the course, we analyse plane-wave polarisation, inhomogeneous plane waves, oblique incidence, refraction, the Fresnel reflection and transmission coefficients, Brewster and critical angles, waveguide modes, cavity modes, dipole radiation, basic antenna parameters, and as a practical example of many of the facets discussed in the course: the rainbow from an electromagnetic point of view.

Learning outcomes

At the end of the course, the student will (should) be able to:

- Understand the role of this course in various applications within electrical engineering, e.g. wired and wireless applications and high-frequency circuit design.
- Apply advanced mathematical concepts and skills related to vector calculus.

- Interpret and apply physical concepts regarding time-dependent and time-harmonic electromagnetic fields.
- Apply the mathematical models for the design of transmission lines and related circuits. Analyze and interpret waveguide modes and dipole radiation.

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:	24 April 2023
Course end date:	09 July 2023
Add. info about start date:	-
Weekly teaching day/time:	Tuesday morning (8:45-12:30) and Friday afternoon (13:30-17:15)
Time zone:	CET (Denmark, Germany, France, Netherlands, Switzerland, Czech Republic)
Further information:	-
Prerequisites:	Students are assumed to know and master all the basic mathematics (e.g. vector calculus, complex analysis, trigonometry, Cartesian, cylindrical and spherical coordinate systems, linear algebra and differential equations) and physics (e.g. circuits and network theory, basic electricity and magnetism, Maxwell's equations, etc.). In particular, students should have successfully passed, for instance: - Circuits, - Mathematics 1 , - Applied Natural Sciences , - Electromagnetics I
Activities and methods:	Lectures, Self-study, Exercises, Tutorial sessions, Student-led-tutorials
Presence on campus:	-

Final examination

Form:	written

Date:	30/06/2023
Location/format:	online
Re-sit possibility:	yes
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:	5EPB0
Contact:	m.j.bentum@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.