Electromagnetics-II

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

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  
ECTS credits: 5  
Language: English

Course start date: 26/04/2022  
Course end date: 10/07/2022  
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:  
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: TBD
Minimum participants: TBD
Internal course code: 5EPB0
Contact: m.j.bentum@tue.nl

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