EE-624

Advanced electromagnetics

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Cursus	Sem.	Type
Electrical Engineering		Opt.
Photonics		Opt.

Language of teaching	English
Credits	3
Session	
Exam	During the semester
Workload	90h
Hours	**38**
Lecture	28
Exercises	10
Number of positions	**30**

Frequency

Every 2 years

Remark

Fall 2022

Summary

In this advanced electromagnetics course, you will develop a solid theoretical understanding of wave-matter interactions in natural materials and artificially structured photonic media and devices.

Content

1) Electromagnetic waves in continuous media (10h)
Maxwell equations, theorems, eigenmodal solutions, bi-anisotropic media, frequency dispersion, Kramers-Kronig relations, Lorentz and Drude models, wave velocities, double-negative media

2) Scattering of Electromagnetic waves (6h)
S-matrix properties, resonant scattering, coupled-mode theory, Lorentzian and Fano spectra, critical coupling, singularities, bound states in continuum, dipolar scattering, coupled-dipoles model, Mie scattering, multipoles.

3) Photonic crystals (6h)
Periodic sytems, reciprocal space, Bloch theorem, band structure, Bragg band gaps, transfer matrix theory, defects, omnidirectional dielectric mirrors, collimation, super prism

4) Metamaterials (7h)
Non-resonant mixtures, Maxwell-Garnett formula, effective parameters, superlens, locally-resonant metamaterials, hybridization band gaps, spoof surface plasmon polaritons, dipolar metasurfaces, spatial dispersion

Keywords

Photonics, Electromagnetic field theory, Scattering, photonic crystal devices, metamaterials

Learning Prerequisites

Required courses

EE-201 or other basic bachelor/master introductory course on electromagnetism.

Learning Outcomes

By the end of the course, the student must be able to:

- Understand the basics of electromagnetic wave-matter interactions
- Apply simple modeling techniques to solve a wide variety of research problems.

Resources

Bibliography

A Moodle page will be created.

Moodle Link

- https://go.epfl.ch/EE-624