Waves and Signal

ECTS credits
5 credits

In brief

Course langage: French

Presentation

Learning objectives

WAVES:
- Gain insight into fundamental aspects of wave phenomena, such as the composition of wave packets by Fourier superpositions, the uncertainty relation, and causality.
- Understand the physics behind the response of material media to electromagnetic waves and the resulting optical properties of these media.
- Be able to describe optical polarization and the physical phenomena that modify it.
- Understand the concept of waveguides and their applications, as well as the dispersion effects caused by both their configuration and material properties.
- Understand the phenomenon of diffraction in the paraxial regime through the use of the Fresnel propagation formula
- Be able to model simple optical systems.

SIGNAL:
- Know the physical nature of signals and the processes of their digitization.
- Know and know how to implement the basic methods of signal processing.
- To approach the notion of optimal processing and to master some optimal filtering techniques in the presence of noise.
- To carry out a work related to signal processing.
- To take advantage of the lessons given in the case of a multidisciplinary project or an autonomous work related to signals.

Description of the programme

WAVES:
This course begins with an introduction to some of the most common equations in Physics, including the wave, diffusion and continuity equations. The study of optical waves then follows from studying Maxwell's equations, first in free space and then in a

linear medium. The main properties of electromagnetic wave propagation are described, including polarization, dispersion, refraction and reflection, and diffraction. These concepts are then used to present applications such as waveguides (used for sensors or telecommunications) and imaging systems.
The course follows four main blocks:
- mathematical background: Fourier theory and the equations of physics ;
- Electromagnetic plane waves in free space and polarization;
- Material response to electromagnetic waves: dispersion, refraction, reflection and guided waves;
- 3D spatial propagation: diffraction and lenses.

SIGNAL:
This course allows the identification of problems that may be related to signal processing and provides the basic elements of this field. This field is one of the foundations of digital technologies. It presents the principles of a new and specific scientific and technical approach, whose industrial and societal applications are in full expansion. The main concepts covered are
- representation of linear systems ;
- temporal and spectral representation of deterministic and random signals ;
- linear filtering ;
- signal digitization and digital signal processing methods.

How knowledge is tested

Continuous assessment:

CC waves : written tests (40 %) + Project (10%)

CC signal : written tests (50 %)

Bibliography

Course notes, CDF interactive documents.
Book " De l'Optique électromagnétique à l'Interférométrie - Concepts et illustrations ", M. Lequime and C. Amra, EDP Sciences,
Book " Théorie du signal ", Ph. Réfrégier, Masson (1993).

Teaching team

ONDES :

* Miguel Alonso
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* Nicolas Sandeau
* Frédéric Lemarquis
* Luis Arturo Alemán Castañeda
* Julien Fade

SIGNAL :

* Salah Bourennane
* Caroline Fossati
* Thierry Gaidon
* Muriel Roche

Sustainable Development Goal

Access to health

Quality education

Sustainable cities and communities

Total des heures		**78h**
CM	Master class	34h
TD	Directed work	24h
TP	Practical work	12h
AU		8h

Useful info

Name responsible for EU

Lead Instructor

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