Photonic communication systems

Lecturer
Simon-Pierre GORZA (Coordinator)

Course mnemonic
ELEC-H507

ECTS credits
5 credits

Language(s) of instruction
English

Course period
First term

Campus
Solbosch

Course content

This course is about the properties of the main components of a photonic communication system, i.e. planar waveguides and optical fibers, passive optical components, optical emitters and receivers, as well as optical amplifiers. It deals with chromatic dispersion management, birefringence and polarization mode dispersion, as well as wavelength multiplexing techniques. The system aspect is studied through the bit error rate (BER) performance and the quality factor of point-to-point optical links; and through coherent optical systems. Finally, the course focuses on nonlinear effects in optical fibers relevant for fiber optic communications as well as devices based on nonlinear effects for all optical signal processing.

Objectives (and/or specific learning outcomes)

Objectives:

To master the basic components of ultrahigh bit rate mid- and long-haul telecommunication systems.

Learning outcomes:

- The student is able to summarize and describe:

o The physics and properties of optical waveguides;

o How optical fiber properties impact the performances of a telecomunications system;

o The principles and limitations of optical fiber amplifiers;

o The principle of emitters (source, modulator) and receivers (detector, design) used in optical telecommunication systems;

o How nonlinear effects impact the system performances.

- The student is able to analyze and justify the design of modern point-to-point optical telecommunication systems.
- The student is able to calculate the signal distortion due to linear effects between any points of a telecommunication system.
- The student is able to evaluate the performances (bit error rate, quality factor) of an optical telecommunication system.
- The student is able to design a system which meets specific requirements (wavelength, propagation distance, bit rate, BER).

Teaching method and learning activities

36h ex-cathedra teaching (material available online), 6 exercise sessions of 2h each (material available online) and 2 laboratories of 6h each.

Contribution to the teaching profile

The skills trained in this course are related to the programme profile of the master's degre in physics and electrical engineering:

- modelling: construction of physical models describing, for example, guidance and propagation in optical waveguides; the laser effect in semiconductor lasers;
- photonics: mainly optical sources, coherent/incoherent detection and guided propagation, optical amplification.
- optical telecommunication systems: power budget, factors impacting the distance*bandwidth product or the bit error rate.

Some more general skills in the programme of the master's degree in engineering science will be specifically developed, including:

- mastering multidisciplinary problems, by highlighting the link between the mathematical modelling and experimental tools;
- group work, during the laboratories.

References, bibliography and recommended reading

Govind P. Agrawal - Fiber-optic communication systems - Wiley et Sons (2010) 4th ed - ISBN : 978-0-470-50511-3

Course notes

Syllabus and Université virtuelle

Other information

Place(s) of teaching

Solbosch

Contact(s)

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Evaluation method(s)

Other

Evaluation method(s) (additional information)

The assessment consists of an oral examination on both the exercices (applications) and the theory (understanding of the theoretical concepts).

The practical laboratories are assessed on a written report and the participation during the laboratory sessions.

Determination of the mark (including the weighting of partial marks)

The final mark is computed as follow:

- Oral examination: 2/3 of the course mark, with 50% for the exercies and 50% for the theory.
- Laboratories: 1/3 of the course mark, based on a writen report and the participation.

The mark on 20 is modulated (between -1 and +1) given the assessment of the active participation during the exercice sessions.

Main language(s) of evaluation

English

Other language(s) of evaluation, if applicable

French

Programmes

Programmes proposing this course at the Brussels School of Engineering

MA-IREL | Master of science in Electrical Engineering | finalité electronics and information technologies/unit 2 and MA-IRPH | Master of science in Physical Engineering | finalité Professional/unit 2