EE-440

Photonic systems and technology

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Cursus	Sem.	Type
Electrical and Electronical Engineering	MA2, MA4	Opt.
Microtechnics	MA2, MA4	Opt.
Minor in Quantum Science and Engineering	E	Opt.
Photonics minor	E	Opt.
Photonics		Obl.
Quantum Science and Engineering	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly
Number of positions	

Summary

The physics of optical communication components and their applications to communication systems will be covered. The course is intended to present the operation principles of contemporary optical communication systems employing optical fibers and modern optoelectronic devices.

Content

- **Photonic sources:** LEDs and laser diodes, Laser physics and operation. Characteristics of laser light, Laser technology. Spectral distribution. Coherence
- **Modulation:** Optical signal generation, Electro-optic effect, phase and intensity modulation, modulation formats, bit stream generation.
- **Signal propagation:** Propagation of a Gaussian pulse, impact of dispersion and management, impact of losses. Medium induced distortions
- **Amplification:** Doped fiber optical amplifiers, fiber Raman amplifiers, semiconductor optical amplifiers. Gain and rate equations, noise.
- **Signal recovery:** Photo detectors and photonic receivers, noise sources, sensitivity, bit error rate.
- **Nonlinear effects:** Self-phase and cross phase modulation, solitons, four wave mixing, scattering processes.
- **Multichannel systems:** WDM systems and components, OTDM.

Keywords

Optical communication, fiber optics, laser, optical amplification, nonlinear optics

Learning Prerequisites

Recommended courses

Electromagnetics I and II, Introduction to photonics

Learning Outcomes

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

- Identify the different sources of performance degradation on an optical link
- Assess / Evaluate the limitations of an optical link based on fiber and light source parameters
- Explain the operating principles of various electro-optics devices such as lasers, modulators and detectors
- Compare the performance of different photo-detectors

- Assess / Evaluate ther performance of optical data transmission based on bit error rates
- Explain the source of optical nonlinearities
- Compute power budgets, dispersion limits and rise time budgets
- Derive rate equations for lasing and amplification
- Justify the use of a component in an optical link depending on the application and the required performance

Teaching methods

Ex cathedra and integrated exercices

Assessment methods

Written

Resources

Bibliography

Handouts given during the class

Ressources en bibliothèque

- Fundamentals of photonics / Saleh
- Fiber-optic communication systems / Agrawal

Moodle Link

- https://go.epfl.ch/EE-440

Prerequisite for

Semester projects, master thesis projects, doctoral thesis