Optoelectronics

Component
École Nationale Supérieure d'Électrotechnique d'Électronique d'Informatique d'Hydraulique et des Télécommunications

In brief

- **Ametys Code:** N8EE04B
- **Open to exchange students:** Yes

Presentation

Objectives

By the end of this course, students will be able to:

- Understand the fundamental principles of optical fiber communications and the physical properties of optical fibers (attenuation, bandwidth).
- Describe the operation and characteristics of light sources (PN junction LEDs, laser diodes) and photodetectors (photodiodes).
- Design and analyze amplification and filtering circuits for optical receivers, considering noise and bandwidth constraints.
- Evaluate the impact of noise in photodetection and propose solutions to optimize signal-to-noise ratio (SNR).
- Apply theoretical knowledge to practical scenarios in fiber optic communication systems.

Description

This course provides an introduction to optoelectronics, focusing on fiber optic communication systems. The main topics covered include:

- **Optical Fiber Fundamentals**: Types of optical fibers, attenuation mechanisms, dispersion, and bandwidth limitations.

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- **Light Sources**: Operation and characteristics of PN junction-based light sources (LEDs and laser diodes), including modulation and efficiency.
- **Photodetectors**: Principles of photodiodes (PIN, APD), responsivity, and noise mechanisms.
- **Amplification and Filtering Electronics**: Design of transimpedance amplifiers (TIAs), noise analysis, and filtering techniques for optical receivers.
- **Noise in Photodetection**: Sources of noise (shot noise, thermal noise, dark current), and strategies to minimize their impact on system performance.
- **System-Level Considerations**: Integration of components into fiber optic communication links, including budget calculations and performance optimization.

The course combines theoretical lectures, practical exercises, and laboratory sessions to reinforce concepts and develop hands-on skills.

Pre-requisites

- Basic knowledge of semiconductor physics and PN junctions.
- Familiarity with analog electronics (amplifiers, filters, and noise analysis).
- Understanding of fundamental communication principles (modulation, signal transmission).

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