EE 440: Photonic Systems and Technology

Ecole Polytechnique Fédérale de Lausanne

Spring 2025

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Description	This course is a graduate-level introduction to the field of photonics systems, with an emphasis on optical communications. The main goal of this course is to provide a solid basis and methodology of fiber optics and optoelectronics. We will cover the different components found in standard optical communication systems, and look at design parameters and limitations. As much as possible, we will look at recent advances in this exciting field. Overall this course is intended to present the operation principles of contemporary optical communication systems employing optical fibers and modern optoelectronic devices.
Topics	Photonic sources, modulation of light, signal propagation and distortions in optical fibers, optical amplification of light, signal recovery and evaluation of performance, nonlinear optical effects, multi-channel systems.
Objectives	Describe fundamental properties & limitations of fiber-optics systems Evaluate a proposed system design and understand trade-offs Describe and analyze the most important system components - For optical transmitter: understand the basic of light sources and transmitter implementations primarily based on external modulators. - For typical components: resonators, Bragg gratings, couplers … - For optical fibers: understand the origin and quantify dispersion, attenuation and to some extent nonlinearities. Know how to assess their impact on signal transmission. - For optical receivers: understand basic of photo-detection, analyze receiver's performance with/without optical pre-amplifier. Estimate bit error rates. - For optical amplifiers: understand the basic of optical amplification (doped fiber or Raman based), and the fundamental properties of erbium doped fiber amplifiers. - For systems: evaluate the different implementations such as wavelength division multiplexing or time division multiplexing.
Pre-requisite	Electromagnetics I and II, Introduction to Photonics
Language	English
Coordinates	Lectures Tuesday 2:15 – 4:00 pm, in **DIA 004** Exercises/Computer Labs Tuesday 4:15 – 6:00 pm, in **DIA 004/ CM1 103**

Credits	4
Website	All information/documents relating to the course will be put on the Moodle. Lecture notes, exercise series and computer labs will be uploaded before the lecture. Please print and read the labs documentation beforehand! The solutions to the series will be put online a couple of days after the session.
Exercises & computer labs	**Exercises** will be given in class for you to practice and make sure you have understood the material. In addition to the standard exercise series **there will be 5 graded exercises** scattered throughout the semester. **These exercises will count for 15% of the final grade.** *They will have to be handed in individually using Moodle*. For the submission: 1. Scanning of hand-written pages (please make sure the scan is readable – no shadows, good handwriting and resolution) and PDF (preferred) prepared by MS Word / latex are acceptable. 2. Students should avoid direct submission of MS Word documents (compatibility issues might arise) or PDFs generated by iPad/Android/Windows tablet digital-pen scratches (as they are generally unreadable). Please do not hand in on paper. 3. There are no specific formatting requirements, as long as the procedures and the final results are clearly presented 4. If you don't know how to solve the questions, try writing some procedures. 5. If the content is unreadable (poor handwriting, or presentations) it will not be graded… we cannot 'interpret' what is handed in. Following the given schedule, **computer labs** will be carried out on a topic covered in the lectures. The labs use the commercial software VPI, which will be installed on machines in room **CM1103**. *Questions will have to be answered and submitted on Moodle before the next lecture.* You will have to work in groups (typically 3 depending on the number of students). These **lab reports will be graded and will count for 20% of the final grade**.
Resources	**B. Saleh, M. Teich "Fundamentals of Photonics", Wiley (2007)** **G. Agrawal "Fiber-optic Communication Systems", Wiley (2021)** G. Agrawal "Lightwave Technology", Wiley (2005) Note: I will mainly follow textbooks from Saleh & Teich and Agrawal using a mixture of slides with blackboard derivations/proofs in class. So remember that not all information will be posted online and that some components of the course will be given in class only. I thus strongly encourage you to attend the lectures
Grading scheme	The 3-hour final written exam given during the examination period will count for **65%** your grade. The graded exercises, and computer lab reports will count for the remaining **35%** of the final grade. During the exam, you will **only be allowed a two-sided A4 cheat sheet prepared by yourself**. You can write on this sheet any information (aside from exercises/correction) from the course you would like to have with you. Textbooks, exercise series, corrections, lecture notes and scrap paper will NOT be allowed. You will also need to bring a CALCULATOR.