Module Description

Applied Photonics

General Information

Number of ECTS Credits

3

Module code

TSM_AppPhot

Responsible of module

Markus Michler, NTB (FHO)

Language

Explanations regarding the language definitions for each location:

- Instruction is given in the language defined below for each location/each time the module is held.
- Documentation is available in the languages defined below. Where documents are in several languages, the percentage distribution is shown (100% = all the documentation).
- The examination is available 100% in the languages shown for each location/each time it is held.

	Berne	Lausanne			Lugano	Zurich		
Instruction	☐ E 100%	☐ E 100%		☐ F 100%	☐ E 100%	☒ E 100%		☐ D 100%
Documentation	☐ E 100%	☐ E 100%	☐ E %	☐ F %	☐ E 100%	☒ E 100%	☐ E %	☐ D %
Examination	☐ E 100%	☐ E 100%	☐ E 100%	☐ F 100%	☐ E 100%	☒ E 100%	☐ E 100%	☐ D 100%

Module category

☐ FTP Fundamental theoretical principles

☒ TSM Technical/scientific specialization module

☐ CM Context module

Lessons

2 lecture periods and 1 tutorial period per week

Entry-level competencies

Prerequisites, previous knowledge

- Optics: basics of wave and geometrical optics
- Physics: Basic for engineers (bachelor niveau)
- Electronics: Basic analog electronics

Brief course description of module objectives and content

Applied photonics imparts knowledge on the subject of modern photonic devices and their applications. After a short optics brush-up, the student is introduced into the basic physics of light matter interaction. This subject leads into a detailed description on modern opto-electronics in the field of light detection systems and light sources. After a review of standard components, the student will be introduced to modern devices like single photon detectors, light emitting diodes and telecom semiconductor laser diodes. The third course covers the subject of signal transmission in optical waveguides. The students will be introduced to the basic light guiding principle and the occurrence of fiber modes. Dispersion phenomena in waveguides and fibers will be discussed. Moreover, the students will be given an overview of different types of fibers and their appropriate field of application. Another important topic covers the field of coupling efficiency between the components of an optical circuit. Light source to fiber coupling as well as fiber to fiber coupling will be treated exemplarily. For a better understanding of photonic systems the module will be completed with a detailed selection of photonic systems.

Aims, content, methods

Learning objectives and acquired competencies

- The student is familiar with the basic wave optical principles, interference phenomena, filters and gratings
- The student knows the main principles of light matter interaction
- The student has a clear picture of the main types of semiconductor light sources and detectors used today.
- The student knows the principles of light guiding in optical waveguides
- The student is familiar with different types of fibers and their field of applications
- The student knows how to assess coupling mechanisms to light sources
- The student knows how to select and apply sources, detectors and fibers for designing a system using photonics devices

Contents of module with emphasis on teaching content

- Basic physical optics, interference phenomena, filters and gratings (~10%)
- Light-matter interaction (absorption, emission, scattering) (~10%)
- Detectors: photodiodes, photomultipliers, CCDs, CMOS sensors and dedicated electronic circuits (~20%)
- Sources: LEDs, superluminescent diodes, laser diodes (~20%)
- Waveguide optics: Principles of light guiding in waveguides, types and properties of waveguides (e.g. fibers), waveguide
- and fiber modes, laser to waveguide coupling, dispersion properties of fibers and waveguides, etc. (~20%)
- Photonic systems will be introduced by illustrating typical applications in metrology, telecommunication and medical fields (~20%)

Teaching and learning methods

- Ex cathedra teaching
- Practical exercises
- Self study and discussion of papers

Literature

- “Fundamentals of Photonics“, B.E.A. Saleh, M. C. Teich, Wiley & Sons
- “Optoelectronics & Photonics”, S.O.Kasap, Prentice-Hall Inc.
- “Optical electronics in modern Communications“ A. Yariv, Oxford University Press

Assessment

Certification requirements for final examinations (conditions for attestation)

none

Basic principle for exams:
All the standard final exams for modules are written exams.
The repetition exams can be either written or oral.

Standard final exam for a module and written repetition exam

Kind of Exam	written
Duration of exam	120 minutes
Permissible aids	☐ no aids
	☒ permissible aids:
	☐ Electronical aids: _____
	☒ Hardcopy form: Script (without exercises)
	☒ Personal formulary

Special case: Repetition exam as an oral exam

If an oral exam is set (only possible for ≤ 4 students), the following applies:

Kind of Exam	oral
Duration of exam	30 minutes
Permissible aids	no aids