ECOLE NATIONALE D'INGENIEURS DE BREST (ENIB)
IMT ATLANTIQUE
ENSSAT LANNION
INSA Rennes
UNIVERSITE DE RENNES 1
UNIVERSITE DE BRETAGNE OCCIDENTALE (UBO)

Master in Fundamental and Applied Physics

Photonics

Aims

The field of "photonics" is recognized alongside advanced materials, nanotechnology, micro and nanoelectronics, industrial biotechnology and advanced manufacturing technologies as one of 6 Key Enabling Technologies (KETs) by the European Commission. Brittany is a hub for this discipline as illustrated by the academic institutions—offering technical diplomas, Master's degrees, engineering programmes and PhDs in this field—, academic laboratories and companies gathered within the Photonics Brittany cluster.

Four engineering schools based in Brittany—ENIB, ENSSAT, INSA Rennes and IMT Atlantique—and two universities—Université de Bretagne Occidentale and Université de Rennes 1—have come together to offer a high-level scientific and technical programme in the field of advanced photonics, the Master in Photonics, available in Brest, Lannion and Rennes. This Master's degree (5 years of higher education) addresses research and R&D aspects. This photonics course (M2) is organized into 2 core blocks in semester 3: a scientific block with 3 specializations and an 'outlook' block (scientific, technological, professional). Students complete an internship in semester 4. The broad reach of the course also grants students from M1 courses direct access to scientific and technological positions without necessarily pursuing a PhD. A specific international programme in optical communications is open to English-speaking international students who will graduate with a Master of Photonics.

This Master's degree draws on over 15 years of teaching experience in photonics and of the use of the latest digital technologies in teaching.

Skills acquired

Graduates from the **Master of Photonics** will be capable of designing, managing and implementing new products and technologies, and conducting feasibility studies. They gain general skills in the field of photonics as well as a general culture and techniques in scientific and professional aspects.

Students become proficient in theoretical tools and gain knowledge of modern photonics through a common core (Propagation and spatial optical functions, laser sources, integrated and microwave optics) and specialization modules in a field chosen by the student (Information and Communication Technologies, Optical Nanotechnologies or Photonics for living organisms and the environment).

Admission requirements

Admission to the Master of Photonics at ENIB only concerns the second year (Master 2) and is open to students with a 4-year post-secondary qualification in the field of physics and electronics (optics, electromagnetism, signal processing).

For applicants who are not studying for a qualification issued by a French institution, admission is only possible via institutions which have an agreement with ENIB.

Applications

The admission process is selective and is based on applicants' written application and cover letter. The application form can be downloaded from the ENIB website: *https://www.enib.fr/fr/formation/formation-ingenieur/masters*

Applications must be submitted to ENIB (Service scolarité) by 15th June 2021.

Internship

Mandatory long-term internship (4 to 6 months)

- Start of internship: February/March
- Duration: Between 16 weeks (minimum) and 24 weeks (maximum).
- It may take place in:
  - a laboratory affiliated with the Master's course (CNRS Lab-STICC, CNRS Foton, Photomag),
  - another French or international laboratory
  - a major group or SME conducting R&D in photonics.

Further study

This Master's degree is a combined professional and research course and has been designed so as to ensure that the Photonics Master's graduates are job-ready or, for those seeking to pursue a research career, are on track to continue on to doctoral studies.

Every year, various research teams from affiliated laboratories propose research topics for funded PhDs accessible to our Master's graduates.

Career opportunities

Graduates can enter the job market as research and development engineers in businesses ranging from SMI/SMEs to world-class groups that use photonics in their developments (components and materials, subsystems). Photonics is a generic technology, capable of providing solutions to societal challenges (factories of the future, health, agri-food, renewable energy, etc.). Graduates may work in a variety of sectors (telecommunications, aerospace, energy, medicine, etc.). All industrialized countries are investing in the field of photonics. The rise of photonics today is comparable to the rise of electronics at the end of the 20th century. This is a rapidly growing sector.

Learning environment

Although this Master's degree is jointly accredited by several Breton institutions, students enrolled at ENIB take all their classes at the Technopôle Brest-Iroise and Brest campuses.

The exceptional immersive classroom and videoconferencing resources developed in Brittany are used to teach these classes. In these virtual classrooms, students at the schools in Brest (ENIB, IMT Atlantique and UBO), Rennes (UFR SPM and INSA Rennes) and Lannion (ENSSAT) meet together.

Considerable time is devoted, from the first semester of M2, to laboratory immersion via a scientific project.

This course builds on the expertise of the jointly accredited institutions' CNRS laboratories. The teaching staff are experienced research lecturers from these recognized laboratories, supported by technological platforms.

Promoting success

Class sizes are small (no more than 20 students) to facilitate discussions with teachers and ensure that students benefit from close supervision.

Practical information

- **Ecole Nationale d'Ingénieurs de Brest (ENIB)**
- **Teaching location:** Brest
- **Contacts:**

Course Director:

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Course content

The second year of this Master's course is divided into two semester-long course units, S9 and S10, the details of which are provided in the table below.
The courses offered for the international programme (for English-speaking international students) are indicated.

Semester 9

	Credits	Hours
Common core ***Only UE2 and UE3 are offered in international program***		
UE1 - Propagation and spatial optical functions Spatial optical functions Free-space optical propagation	3	24
UE2 - Laser sources Introduction to semiconductor lasers Static and dynamic properties of laser sources	3	24
UE3 - Integrated and microwave optics Integrated optics Microwave optics	3	24
Optional modules (students choose 1 option: UE4, UE5 or UE6). ***Only UE4 is offered in international program***		
UE4 - Information and Communication Technologies (option A) Optical amplification and non-linear propagation Optical transmission SOA-based optical functions Dynamic systems for networks Network basics Advanced optical networks	9	72
UE5 - Nanotechnologies (option B) Resonators and mode coupling 1 Resonators and mode coupling 2 Electronic properties of nanostructures Optical properties of nanostructures Non-linear optics Hybrid integrated photonics	9	72
UE6 - Imagery for living organisms and the environment (option C) Two-dimensional optical processing Noise and information in images Biophotonics Photonics for the environment Statistical methods for the analysis of biomedical data Biomedical diagnostic methods	9	72

Outlook modules ***(all courses are offered in international programme)***		
UE7 - Technological outlook (students choose 1 of the 5 units) High-speed transmission for access and long distances and specialty optical fibers Microscopy for living organisms III-V optoelectronic technologies Experimental workshops on SOA-based amplification, acousto-optic switching and WDM device simulation Dynamic imaging techniques	4	24
UE8 - Scientific outlook Laboratory-based scientific project	4	84
UE9 - Professional outlook English or French practice Scientific communication	4	

Semester 10

UE1 - Internship	30	

For further information, please contact the Course Director at ENIB.