

MASTER IN PHOTONICS

COURSE PROGRAM FOR ACADEMIC YEAR 2014/2015

Master Program jointly offered by the following institutions:

- Universitat Politècnica de Catalunya (UPC)
- Universitat Autònoma de Barcelona (UAB)
- Universitat de Barcelona (UB)
- Institut de Ciències Fotòniques (ICFO)

www.photonicsbcn.eu

60 ECTS Master Degree

[Lectures language: *English*]

The MSc degree in Photonics can be obtained in one year, having an official extent of 60 ECTS (European Credits Transfer System). One ECTS credit corresponds to 25-30 hours: 9 are “on-site” hours (lectures or other activities in the presence of a professor) and the rest are “off-site” (individual) work.

The course program consists of three modules, as shown below. Election of the elective courses must be made in dialog with the professor who acts as student’s tutor. Each student has a tutor assigned by the Executive Committee of the Master, and needs his/her agreement for the chosen courses.

Module name		ECTS (credits)
Module 1	Compulsory courses	20
Module 2	Elective courses	24
Module 3	Master thesis	16
Total:		60

Module 1: Compulsory courses (20 ECTS)

Includes subjects (courses) of 5 ECTS each, divided into two teaching units (or sub-modules):

- Fundamentals of photonics
- Applied photonics and transversal skills.

These courses are compulsory and have to be followed by all the students.

Teaching Unit 1.1: Fundamentals of Photonics (FUNPHO)

Build a solid foundation on the basics of Photonics.

Course code	Course name	ECTS
230550	Introduction to photonics. Optics and lasers	5
230553	Beam propagation and Fourier optics	5

Teaching Unit 1.2: Applied Photonics and Transversal Skills (APATS)

Course code	Course name	ECTS
230551	Photonics laboratory	5
230552	Business and patents in photonics	5

"Photonics Laboratory" includes different laboratory works on both basic and applied aspects of photonics. Each student, with the advice of a responsible professor, can choose among the available laboratory experiments, those that can better complement his/her previous expertise. Realization of such experiments, whenever possible, will take place in a relatively free format, which will allow for student's initiative.

The complementary skills associated to the second course can be useful for future work, be it professional or research oriented.

Module 2: Elective courses (24 ECTS)

Contains elective courses of 3 ECTS each, divided into five sub-modules (or teaching units), corresponding to different aspects of photonics:

- **Quantum Optics** (QUANTOP),
- **Biophotonics and Imaging** (BIOIMA),
- **Materials and Nanophotonics** (MATNANO),
- **Telecommunications and Photonics Circuits** (TELPHO)
- **Optical Engineering** (OPTENG).

The student **must choose 24 ECTS from any of these sub-modules**. Since the official Master Degree Diploma does not define any specialty, the choice of courses from these teaching units is completely free; there is no minimum nor maximum number of courses or credits to be chosen from each module. This classification into modules is only for scientific guidance purpose. However, if the student wants to get particular expertise in one or two of these specialties, he/she can choose all the courses composing one or two complete sub-modules.

Before election, the student should check the timetables for the compatibility in time between different courses.

Teaching Unit 2.1: Quantum Optics (QUANTOP)

Course code	Course name	ECTS
230555	Quantum optics	3
230556	Quantum simulators, Bose Einstein condensates and ultracold quantum gases	3
230557	Quantum information theory: communication and computation	3
230558	Advanced quantum optics with applications	3

Teaching Unit 2.2: Biophotonics and Imaging (BIOIMA)

Course code	Course name	ECTS
230554	Optical image in biology and medicine	3
230559	Optical micromanipulation workshop	3
230560	Visual biophotonics and multispectral imaging	3
230561	Image processing in biophotonics	3

Teaching Unit 2.3: Materials and Nanophotonics (MATNANO)

Course code	Course name	ECTS
230562	Photonics materials and metamaterials	3
230563	Nonlinear optics	3
230564	Nanophotonics	3
230565	Ultrafast and ultraintense laser light	3

Teachin Unit 2.4: Telecommunications and Photonics Circuits (TELPHO)

Course code	Course name	ECTS
230566	Fibers and telecommunications	3
230567	Integrated photonics	3
230568	Photonics systems in telecommunications	3
230569	Optoelectronics and photovoltaic technology	3

Teaching Unit 2.5: Optical Engineering (OPTENG)

Course code	Course name	ECTS
230570	Laser systems and applications	3
230571	Building optomechanical systems	3
230572	Managing light with devices	3
230573	Measuring with light	3

Module 3: Master Thesis or Project (16 ECTS)

Course code	Course name	ECTS
230574	Master Thesis	16

This module entirely corresponds to the Master Thesis that has to be performed by the student under the supervision of one of the Master's professors. External supervisor might also be possible, under some restrictions.

Soon after the beginning of the academic course, a list of the available proposals for master thesis projects will be published in the web-page. The students have to choose one of these proposals and contact the corresponding professor. Even if the third module is especially dedicated to the master thesis development, we advise the students to choose and start working as soon as the supervisor accepts it. The student will have time until the first week of September to complete the work, write the corresponding report (in a format that will be specified in duly time) and present it in a public oral defense session on front of a jury composed of three professors of the Master.

The Master Thesis offers two possibilities: it can be oriented toward a research activity (fundamental or applied character), or it can be oriented toward the deployment of a more technological activity in collaboration with companies: innovation, improving or testing, implementation of advanced production process, etc. Ideally, in this second case, the activity should be performed through an internship in a company (or in close connection with a company).

A short description of the contents of each course can be found in the "Course Contents" file (Course Program section of the Master's web page).

All information about the Program will be published in the website www.photonicsbcn.eu

General remarks

Minimum background requirements

Students with different backgrounds are welcome. Nevertheless, the student should have a minimum background in Optics (geometrical and wave optics, electromagnetic waves) and Mathematics (derivatives, integrals, basic types of differential equations, Fourier analysis).

Concerning the background in optics, the professors of the compulsory courses “Introduction to Photonics. Optics and Lasers” and “Beam propagation and Fourier optics” might orient the student about how to gain such knowledge, in case it were necessary. If the student wants to take courses dealing with quantum optics phenomena, then he/she should have a previous knowledge of the basics of quantum physics.

Very exceptionally, some of the compulsory courses included in Module 1 can be replaced by elective courses: If the student comes from another Master and has already learnt the contents or laboratory experiments of some of the compulsory courses of Module 1, the Executive Committee of the Master might allow the student to permute some of these courses by other courses of the Master, with the same total amount of credits. These substitutive courses would then be considered as courses of Module 1, in the student's curriculum. The change requires a previous agreement from the tutor.

Seminars

Seminars related to different subjects of the Master and given by visiting professors, researchers or consultants will be periodically scheduled. These seminars will be held, if possible, in the 2 hour/week slot reserved in the timetable. Attending these seminars, or related activities, is part of the master program.

Minimum number of courses to register, per academic year

The student may register for a reduced number of courses. University rules require that the student must succeed, each academic year, in a minimum of 15 ECTS (to be allowed to continue enrolled in the same Degree the next academic year). Thus, 15 ECTS is the minimum number of credits a student must register for, each academic year (for less than 15 ECTS an exceptional permission should be requested) (*). The registration fees are proportional to the number of credits registered, plus a small fixed amount.

Maximum number of courses to register

Present Ministry and University regulations establish that a student cannot register for more than 60 ECTS in our Master in Photonics. This is independent on whether these courses are taken in one academic year or along more than one academic year. Only very small increases above this total amount might be allowed (permission should be requested).

(*) The rules stated in this Section are based on the general regulations for Master Programs at UPC University for academic year 2013-2014. If some change for academic year 2014-15 is introduced it will be indicated in this Course Program document.

Mobility students, and students that do not aim to get the Master in Photonics Degree

Registration for elective courses, without registration for all the mandatory courses, needs specific authorization from the Executive Committee. Such authorization will be given only in case of students that do not aim to get the Master in Photonics Degree. In particular: mobility students, students that want to take a limited number of courses to complete the number of necessary credits to enter a Doctorate program, graduate persons that want to learn about specific subjects, or similar cases.

Courses with very few students

Elective courses with very few registered students might not be given. This will be dependent on the University regulations to be established before the beginning of the lecture period. In these cases, the student could then register for alternative courses, without any additional fees.