MASTER IN PHOTONICS

COURSE PROGRAM FOR ACADEMIC YEAR 2015/2016

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 has an official extent of 60 ECTS (European Credits Transfer System) and can be obtained in one year. 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 tree modules, as shown below. After the official enrolment, the Executive Committee of the Master assigns to each student a tutor (a professor of the Master). The election of the elective courses must be made in dialog with the tutor and needs his/her agreement.

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 background 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.

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 a 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 and the professors in charge 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 Physics, in particular in Optics (geometrical and wave optics, electromagnetic waves) and Solid-State Physics (electronic bands in semiconductors), and Mathematics (complex numbers, derivatives, integrals, basic types of differential equations, vectors and vectorial operators). Also some minimum knowledge about Quantum Physics would be necessary (a deeper knowledge of quantum physics would only be necessary for students that want to take courses dealing with quantum optics phenomena).

For students that lack such background, or part of it, in September, during the week previous to the beginning of classes, as well as in the next weeks, leveling lectures will be given to minimally reinforce such background. Such lectures are strongly recommended, for those students to better follow the Master's classes.

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. There 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) ([1]). The registration fees are proportional to the number of credits registered, plus a small fixed amount.

[1]() The rules stated in this Section are based on the general regulations for Master Programs at UPC University for academic year 2014-2015. If some change for academic year 2015-16 is introduced it will be indicated in this Course Program document.

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).

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.