Master Erasmus+ *"EUROPHOTONICS"*

COURSE PROGRAM FOR ACADEMIC YEAR 2023/2024

IN BARCELONA

3rd and 4th semesters

In Barcelona, this program is offered jointly by four institutions involved in Photonics teaching and research:

- Universitat Politècnica de Catalunya (UPC)
- Universitat Autònoma de Barcelona (UAB)
- Universitat de Barcelona (UB)
- ICFO – The Institute of Photonic Sciences (ICFO)

COURSE PROGRAM FOR ACADEMIC YEAR 2023/2024

IN BARCELONA

Third semester in Barcelona

For the third semester in Barcelona, the student must choose **30 ECTS** from a list of elective courses. This same list of the offered courses is presented in this document in two forms:

- **Table 1** presents the list of courses, classified in "Modules" (or "Teaching Units") defining different fields of applications of Photonics, as they are defined in the local Master "Photonics BCN" in Barcelona. Since the official Spanish Master's Degree Diploma obtained by the students from Spain does not define any specialty, the choice of the 30ECTS of elective courses from these teaching units is, completely free. Thus, this classification into modules is made only for scientific guidance purpose (each course belongs to a specific module, but the suitability of each course for other modules is also indicated).
- **Table 2** presents the same list of courses, pointing out their compatibility with the "specialties" defined by KSOP (Karlsruhe Institute of Technology). This "compatibility table" must be considered only by the students applying also for the German diploma. Students must choose a minimum of 12 ECTS credits compatible with the specialty the student has selected in Karlsruhe (further requirements established by Karlsruhe are given below).

Before coming to Barcelona, a tutor, chosen among the professors of the Master, will be assigned to each student. The tutor may help the student in selecting the most appropriate courses for his/her training.

Student's effort is "measured" in credits ECTS (European Credits Transfer System). One credit ECTS corresponds to, approximately, a total of 25-30 hours of work from witch 8-9 hours will be dedicated to lectures or other face to face activities.

In any course of the Master, the student may be invited to attend seminars to be given by visiting professors or researchers, or by any other specialist, at scheduled "seminar times" (or, if not possible, at other times) separated from the regular lectures schedule. Attending this seminars, or related activities, might be accounted for the grading of the course.

- The detail content of each course can be seen at: https://photonics.masters.upc.edu/en/curriculum-2022-23
- The CV of the professors can be checked at: https://photonics.masters.upc.edu/en/academic-staff-list
- The timetable for the academic year 2023-2024 can be download from:
- https://photonics.masters.upc.edu/en/shared/contents/academic_year_2023-24/timetable_2023-24.pdf
- The Master thesis proposals for the academic year 2023-24 will be published in November 2023. As a reference, you can see the proposals for 2022-23 at: https://photonics.masters.upc.edu/en/list-of-proposals-2022-23

TABLE 1

Course name (Courses offered in Barcelona) See the contents of each course at https://photonics.masters.upc.edu/en/curriculum-2021-22	***Credits ECTS***	**Module name** (only for guidance purpose)					
		Quantum Optics	***BioPhotonics & Imaging***	***Materials & Nanophotonic***	***Telecom & Photonic Circ.***	***Optical Engineering***	***Additive key competencies***
Quantum optics	**3**	✓		✓			
Quantum light-matter interfaces: modern systems and applications	**3**	✓					
From cooling and trapping of neutral atoms to Bose-Einstein condensates	**3**	✓					
Quantum simulators with ultracold quantum gases	**3**	✓					
Advanced quantum optics with applications	**3**	✓					
Machine learning on classical & quantum data	**3**	✓					
Qubit application	**3**	✓					
Experimental optical techniques in biology	**3**		✓			✓	
Image processing in biophotonics	**3**		✓			✓	
Visual optics and biophotonics	**3**		✓				
Active and spectral imaging	**3**		✓			✓	
3D light control for biological applications	**3**		✓			✓	
Photonics materials and metamaterials	**3**	✓	✓	✓		✓	
Nonlinear optics II		✓	✓	✓			
Nanophotonics	**3**	✓	✓	✓		✓	
Ultrafast and ultraintense laser light	**3**	✓	✓	✓		✓	
Semiconductor photonics: applications and technology	**3**			✓		✓	
Fibers and telecommunications	**3**				✓	✓	
Integrated photonics	**3**				✓	✓	
Optoelectronics and photovoltaic technology	**3**			✓	✓	✓	
Laser Systems & Applications	**3**		✓	✓	✓	✓	
Measuring with Light	**3**		✓		✓	✓	
Optical design	**3**		✓			✓	
	3						
Business and patents in photonics	**5**						✓

Remark: Other courses, also offered in Barcelona (for the local Master in Photonics) cannot be chosen since they overlap significantly with similar courses taken by the students in the 1st or 2nd semesters in Marseille or Karlsruhe. These courses are:

- Introduction to Photonics. Optics and Lasers 5 ECTS
- Beam propagation and Fourier Optics 5 ECTS
- Photonics Laboratory 5 ECTS
- Managing Light with Devices 3 ECTS

- Nonlinear Optics II (overlaps only for students doing the 2nd semester at KIT)	3 ECTS

These courses could be exceptionally authorized by the coordinators.

Requirements for the German Diploma (KIT – Karlsruhe)

For students applying also for the German Master Degree Diploma from KSOP, Karlsruhe (KIT), the choice of the elective courses for the 3rd semester in Barcelona has to be coherent with the "specialty" student have chosen for the Karlsruhe Master Diploma.

This requires the following:

1) **At least 15 of the 30 ECTS to be chosen in Barcelona, must belong to one of the specialties defined in Table 2 below**. Each column indicates the Barcelona courses that are related with each Karlsruhe specialty:

   Photonic Materials and Devices
   Quantum Optics and Spectroscopy
   Biomedical Photonics
   Optical Systems
   The specialty **Solar Energy** cannot be chosen since is not compatible with courses offered in Barcelona.

   For the rest of credits up to 30 ECTS, any course from Table 2 can be chosen.

2) For the KIT Master Degree the student has to cover a total of 6 ECTS of "Additive key competencies" along the whole master program (be it in Karlsruhe, Barcelona or Marseille).

3) As equivalent to a "seminar" course, each student should give an oral presentation of 30 min about an advanced topic in Photonics. This presentation will be made either in the framework of one of the courses taken by the student in Barcelona, or in front of a jury organized by the executive committee of the Master in Barcelona. This presentation should not be linked to the internship.

4) Students who did the industrial internship in summer and cannot do the oral presentation about the work done during the internship in Karlsruhe will have the opportunity to do this presentation (aprox.10 minutes) in Barcelona. The executive committee of the Master in Barcelona will organize a jury to assess and evaluate this presentation.

TABLE 2

Course name (offered in Barcelona) *(See the contents of each course at: https://photonics.masters.upc.edu/en/academic-year-2022-23)*	**Credits ECTS**	**Relationship with the Specialization defined at KIT (A minimum of 15 ECTS must be chosen from the same column)**			
		Photonic Materials & Devices	**Quantum Optics & Spectroscopy**	**Biomedical Photonics**	**Optical Systems**
Quantum optics	3	x	x		
Quantum light-matter interfaces: modern systems and applications	3		x		x
From cooling & trapping of neutral atoms to BE condensates	3		x		x
Quantum simulators with ultracold quantum gases	3		x		x
Advanced quantum optics with applications	3	x	x		x
Machine learning on classical and quantum data	3		x		
Qubit application	3		x		
Experimental optical techniques in biology	3			x	
Image processing in biophotonics	3			x	x
Visual optics and biophotonics	3			x	
Active and spectral imaging	3	x		x	x
3D light control for biological applications	3			x	
Photonic materials and metamaterials	3	x			
Nanophotonics	3	x	x	x	
Ultrafast and ultraintense laser light	3		x		x
Semiconductor photonics: applications and technology	3	x			x
Fibers and telecommunications	3	x			x
Optoelectronics and photovoltaic technology	3	x			
Integrated photonics	3	x			x
Laser systems and applications	3	x		x	x
Measuring with light	3		x	x	x
Optical Design	3	x			x
Business and Patents in Photonics	5	“Additive Key Competencies”			
Total number of credits		30	27	24	36

Additive Key Competencies: 5 ECTS
The specialization “Solar Energy” cannot be chosen by the students coming to Barcelona for the 3rd semester.
Nonlinear optics - same course in 2nd sem. at KIT.

Fourth semester in Barcelona

The fourth semester is devoted to the Master Thesis development, report and oral presentation. It corresponds to 30 ECTS of student's work.

During the 3rd semester, the student will be able to choose a master thesis subject from a list of proposals made by the professors of the Master, in Marseille, Karlsruhe, Barcelona, Tampere or Vilnius. Even before that date the student may start contacts with professors or researchers from the Barcelona institutions to explore the potential Master Thesis opportunities. If the student choses a Master Thesis from Barcelona, then he/she may start working on it as soon as the supervisor accepts it. The student will have time until the first week of September to complete the Master Thesis work, write the corresponding Report-Memory (in a format that will be specified in duly time) and present it orally on front of a jury composed of three professors of the Europhotonics Master.

There is also the possibility to perform the MSc thesis in a company or a lab external to the Master Consortuim. In this case a co-supervisor (Master professor) is needed.

KSOP - KIT requires that, besides the MSc Thesis supervisor in Barcelona, a co-supervisor belonging to KSOP also must be assigned in advance. The executive committee of the Master will help to fulfill this requirement so that it does not entail any difficulty for the student. Master's Theses that are not performed within the Europhotonics consortium need permission by the KSOP examination board in advance.

- - - - - - - - -

Spanish MSc Degree Diploma

Student who had register and had approved a minimum of 30 ECTS credits in Barcelona is entitled to be awarded the official Spanish master's degree in Photonics "Europhotonics". This minimum of 30 ECTS credits may correspond to courses (excluding language course credits) or/and to the MSc Thesis.
The student may request the corresponding master's degree Diploma.