Basic/Essential Course Information	
Course title	Quantum Optics with Lab
Degree Course title	Physics
ECTS	6
Compulsory attendance	No
Course teaching language	ENGLISH

Teacher	Milena D'Angelo	milena.dangelo@gmail.com

ECTS Details	Disciplinary area/broad field:	SSD	ECTS
		FIS/03	6

Time management and teaching activity type	Period	Year	lesson type
	1st semester	2nd	Lessons (40h) Laboratory (15h)

Time management,	Total hours	in-class/in-lab study hours	out-of-class study hours
	150	55	95

Course calendar	Starting date	Ending date
	Third week of September	Third week of December

Syllabus	
Prerequisites	Background knowledge on ….
Expected learning outcomes (according to Dublin Descriptors)	**Knowledge and understanding**: Using the concepts of… **Applied knowledge and understanding:** The student is able to …. **Judging autonomy:** Students are encouraged to … **Communicative Skills:** Know how to expose …. **Learning Skills:** Know how ….
Course contents summary	Basics of quantum optics. Theory of coherence. Quantum entanglment in optics. Lab experiments.
detailed syllabus	***Basics of quantum optics.*** Quantum theory of e.m. radiation: Field quantization and Fock states. Other states of e.m. radiation: thermal light, coherent states, squeezed states. Photon statistics and photon counting. Squeezing. Phase space and quasi-probability distributions. ***Theory of coherence.*** Review of classical theory of interference and

	diffraction. Mutual coherence function and degree of coherence: temporal coherence and spectrum. Spatial coherence. Coherence and stellar interferometers: Michelson stellar interferometer, Hanbury-Brown and Twiss interferometer. Quantum theory of coherence: Correlation functions and their measurement. ***Quantum entanglment in optics.*** Pure states and mixed states, factorizable and entangled states. EPR paradox and Bell inequality (CHSH, Franson). Sources of entangled photons. Some historical experiments: Multi-photon interference, Quantum eraser, Quantum imaging (ghost imaging, ghost interference, quantum lithography ...), Teleportation and entanglement swapping. ***Lab experiments.*** Intensity interferometry. Quantum imaging. Individual project (quantum eraser, Hong-Ou-Mandel dip, quantum criptography, …).
books	Scully & Zubairy, *Quantum Optics* Gerry & Knight, *Introductory Quantum Optics* *Scientific papers*
notes	Selected chapters
Teaching methods	Lessons with proposal of cases of study. Hands-on computer codes. Discussion of real cases.
Assessment % of final mark	Oral examination
Evaluation criteria	Knowing how …