Corso di Laurea in

SCIENZA E TECNOLOGIA DEI MATERIALI

Triennale – L30

General information	
Academic subject	***Laboratory of Optoelectronics***
Degree course	*Materials Science and Technology*
Academic Year	*2021-2022*
European Credit Transfer and Accumulation System (ECTS)	10
Language	*Italian*
Academic calendar (starting and ending date)	*According to teaching calendar*
Attendance	*Compulsory on site for the laboratory activities*

Professor/ Lecturer	
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Department and address	*Department of Physics*
Virtual headquarters	
Tutoring (time and day)	*by appointment via email*

Syllabus	
Learning Objectives	*Basic knowledge of materials and devices used for optoelectronics, including modeling tools of electric circuits and optical systems. Ability to measure the specifications of some devices used in optoelectronics and to characterize visible radiation.*
Course prerequisites	*Linear circuits, electromagnetic waves, ray optics, physical optics, calculus I, basics of data analysis and numerical calculus, practice in optics and circuits laboratory*
Contents	*Transparent materials and their use in optoelectronics: optical crystals, glasses, oxides, thin films, introduction to optical CAD, paraxial optics and Gaussian beams, polarization and interaction of radiation with birefringent materials.* *Semiconductor materials for optoelectronics: organic and inorganic semiconductors, optical properties, alloys and heterostructures, doping and homojunctions, p-n diode, introduction to electronic CAD, diode as circuit element, transistors at low and high frequencies. Semiconductor light sources and detectors: LEDs, lasers, photodiodes.* *Photons: statistical and quantum properties of radiation, linear optical systems.* *Introduction to signal analysis and conditioning: sources and characteristics of optical and electronic noise, statistical analysis and correlation functions, techniques for signal extraction from noise: hardware (gating and lock-in) and software* *Design and test of a current / voltage supply* *Design and test of an operational amplifier* *Optical characterization of amorphous glasses: Fresnel, Brewster, critical angle* *Optical characterization of crystals: transmittance, birefringence* *Optical characterization of semiconductor sources: LED and LASER* *Team work project.*
Books and bibliography	*Fundamentals of Photonics 2nd ed., B.E.A.Saleh, M.C.Teich (Wiley)* *Optoelettronica e Fotonica, A.Cutolo (Aracne)* *Microelettronica, J. Millman, C.C.Halkias (Bollati Boringhieri)*
Additional materials	

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Self-study hours

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Hours			
250	*48*	*60*	*142*
ECTS			
10	*6*	*4*	

Teaching strategy	*Lectures, team working, laboratory projects*
Expected learning outcomes	
Knowledge and understanding on:	*of fundamentals of semiconductor physics and their applications in optoelectronics (circuits, sources and detectors); optical properties of optoelectronic materials, such as liquid crystals, fibers and waveguides; characterization and filtering of optical and electronic signals*
Applying knowledge and understanding on:	*to the use of optical and electronic CAD, signal filtering and conditioning codes, measurement and diagnostic tools for optical and electronic signals, models for data analysis*
Soft skills	*Making informed judgments and choices: evaluate the most suitable among different possible options in terms of external parameters (cost, timing) and internal (effectiveness, versatility), define threshold levels and comparison criteria for choosing between different options* *Communicating knowledge and understanding: summarize the operational results of the measurements in short reports, discuss the design and analysis choices against other options* *Capacities to continue learning: by comparison with other work groups, independently from the online bibliographic sources, from the analysis of errors in laboratory practice* •

Assessment and feedback	
Methods of assessment	*Laboratory reports, project presentation*
Evaluation criteria	*Knowledge and understanding* *<u>Minimum level:</u> qualitative knowledge of the physical properties of optoelectronic materials, main uses of the diode and the transistor as circuit elements, the basic linear optical components and systems, semiconductor sources and detectors;* *<u>Intermediate level:</u> knowledge of the interpretative models and of the quantitative aspects of the characteristic relations of the p-n junctions and of their use in circuit devices; characteristic aspects of wave propagation in optical crystals, in waveguides and in periodic structures;* *<u>Upper level:</u> definition and characteristics of noise sources in optoelectronic measurements and methods to filter and improve SNR.* *Autonomy of judgment* *<u>Minimum level:</u> choose the best graphical presentation of the available data;* *<u>Intermediate level:</u> adequately motivate your own work;* *<u>Upper level:</u> evaluate the work of your colleagues.* *Communicating knowledge and understanding* *<u>Minimum level:</u> correct use of scientific terms;* *<u>Intermediate level:</u> appropriate use of specific communication methods (diagrams, figures, tables);*
Criteria for assessment and attribution of the final mark	*Final project presentation (up to 50%). Written reports on the design and laboratory activity (up to 30%). Mid-term test (up to 20%). Optional supplementary oral exam.*
Additional information	

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