

CERTIFICATE IN PHOTONICS & LASERS TECHNICAL SPECIALIST

The Puerto Rico Photonics Institute (PRPI) is an initiative of the School of Environmental Affairs of Universidad Metropolitana (UMET). PRPI is the first institute in Puerto Rico and the Caribbean to specialize in research and education in optics and photonics (O&P). Its laboratories are located in the REDI Building at the Barceloneta Science Park.

Program Description

The Certificate in Photonics and Lasers is a **1-year program** comprising four eight-week terms, including three terms of concentration courses and an industry technical internship. The core curriculum covers the principles of optics and photonics and includes electronics, lasers, fiber optics, and devices and instruments. Students spend more than 40 percent of their time in the lab, training on laser and optical systems. This program is offered at the UMET Cupey campus, with laboratories at the PRPI labs in Barceloneta.

A career in lasers and optics offers opportunities in aerospace, agriculture, medical technology, construction, nanotechnology, alternative energy, environmental technology, IT, laser/optical scanning, laser welding, cutting and etching, additive manufacturing, solid state lighting, and biotechnology. The program also includes a course in entrepreneurship in emerging technologies. This certificate was approved by the Puerto Rico Council of Education in June 2015 and follows the curriculum developed by OP-TEC, the National Center for Optics and Photonics Education. This program is also certified by ETA International, the Electronics Technicians Association. Students completing our certificate can also be ETA-certified.

Job Opportunities

The need for competent, confident, career-minded technicians is rapidly increasing. An entry-level position can develop quickly as demand continues to grow. Salaries typically range from \$20,000 to more than \$47,000 per year.

Contact Us

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Courses Descriptions

TERM I

OPSC 100 Mathematics for Optics and Photonics – 3 Credits

Course Description: In this course students will review and develop the mathematics skills required for the technical certificate in Photonics and Lasers. To help aspiring photonics technicians begin their studies with adequate math skills, this course pulls together topics in numerical representation, usage and conversion of physical units, algebra, geometry, trigonometry, and phasors, applying those skills to specific, real-world optics and photonics scenarios. At the same time, students will become acquainted with the terminology used to describe electromagnetic waves, electromagnetic energy, and laser and optical fiber systems.

Competences / Objectives:

At the end of the course, the student will develop and apply the skills to:

1. Make simple arithmetic calculations such as those used in optics and photonics.
2. Make basic algebraic calculations and manipulations.
3. Make geometric diagrams with specific angles and measures, including scale drawings.
4. Measure angles and dimensions.
5. Make basic linear and polar plots.
6. Carry out basic trigonometric operations.
7. Calculate exponents, logarithms.
8. Calculate vector parameters using both trigonometric functions and complex numbers.

ENGL 103 Introductory English Language Course – 3 Credits

Course Description: This course is a thorough study of intermediate English grammar leading to the development of basic speaking, listening, reading, and writing skills. The duration is one semester, three hours per week.

Competences / Objectives:

At the end of the course, the student will develop and apply the skills to:

1. Master all phases of the pre-writing activities.
2. Identify and write topic sentences.
3. Identify and write supporting sentences.
4. Write a paragraph and essay outline.
5. Apply grammar principles correctly.
6. Write an example paragraph.
7. Write a compare and contrast paragraph.
8. Participate in group discussions of different topics.
9. Exhibit curiosity and respect for other people's viewpoints.
10. Generate hypotheses.
11. Challenge and support their own beliefs.
12. Use a variety of technological and information resources.



OPSC 101 Fundamentals of Light and Lasers – 5 Credits

Course Description: Fundamentals of Light and Lasers is the introductory course in the Certificate in Photonics and Lasers, and consists of a comprehensive study of photonics that provides the foundation required to prepare technicians in the areas of optics, electro-optics, lasers, and photonics. In this course, students will learn the basic physical principles of optics (geometric and physical optics) and in the lab they will develop the skills required to properly handle optical devices and components and to safely and efficiently manipulate laser beams.

Competences / Objectives:

At the end of the course, the student will develop and apply the skills to:

1. Set-up optical systems involving light sources, optical components, and sensors, on vibration-free tables, and correctly handle all optical components.
2. Understand the hazards of nonlaser and laser optical sources, and the ways to avoid and minimize any danger to the eye and the skin.
3. Develop physical and mathematical connections useful in explaining everyday optical phenomena.
4. Understand how laser light is generated, and how it differs from other types of light sources.
5. Maintain an individual logbook to record in an organized a systematic way all the procedures, data, and conclusions of each experiment.
6. Recognize the importance of optics, photonics, and lasers in present-day technology and their contribution to society.
7. Access information sources related to photonics and lasers effectively and use this information ethically and legally.

TERM II

ENMA 101 Introduction to Entrepreneurship – 3 Credits

Course Description: This course offers students a basic understanding and overview of the business world and the entrepreneurial field. It includes topics related to writing a business plan, business ethics, management, marketing, finance, accounting and the legal aspects of commercial operations.

Competences / Objectives:

At the end of the course, the student will develop and apply the skills to:

1. Demonstrate the capacity to interact, work as part of a team, and show leadership when necessary.
2. Demonstrate an entrepreneurial vision to identify opportunities and risks to establish, acquire, and develop a business.
3. Analyze problems and detect market opportunities.
4. Comply with the ethical and social responsibility to protect the environment.
5. Comply with the required permits and licenses to establish a business.



6. Develop the social and ethical responsibility to conduct a business in society and in the business environment.
7. Determine the nature and quality of information needed.
8. Access the required information in an efficient and effective way to achieve a specific goal.

OPSC 102 Lasers and Applications I – 4 Credits

Course Description: This is the first of two courses covering more advanced concepts in photonics and the operating principles, output characteristics, diagnostics, and applications for the most widely used laser types. These are described and classified according to their active medium, output wavelength, and applications. The lecture and lab will cover specific types of lasers such as diode-pumped Nd:YAG lasers, carbon dioxide (CO₂) lasers, and fiber lasers.
Requirements OPSC 100, OPSC 101.

Competences / Objectives:

At the end of the course, the student will develop and apply the skills to:

1. Understand why some lasers are appropriate for certain applications.
2. Identify which laser systems are used in various technology areas.
3. Select one or two types of lasers that are suitable for a particular application.
4. Manage, read, and understand specifications and other information available for commercial laser systems.
5. Describe what are the facility requirements, utility services and safety requirements for installing a commercially available laser system in a commercial, laboratory, or industrial setting
6. Measure the output characteristics of a laser.
7. Engage in basic troubleshooting of laser equipment.
8. Recognize the applications of the specific types of lasers studied to different industries and the used of these systems to address the needs of society at large.
9. Access information sources related to photonics and lasers effectively and use this information ethically and legally.

OPSC 110 Electronics for Optics and Photonics – 5 Credits

Course Description: Electronics for Optics and Photonics I is the first of two courses that provide basic coverage of electricity and electronics fundamentals. This first part provides the student with an understanding of the basics of DC circuit theory and laboratory practice, including basic electrical concepts, electronic components, basic laws, and the use of measuring devices. It also introduces the student to the industry-standard Multisim simulation environment and the LabVIEW development environment. Requirements OPSC 100.

Competences / Objectives:

At the end of the course, the student will develop and apply the skills to:



1. Understand basic electrical concepts of voltage, resistance, current, and power in DC circuits.
2. Understand DC circuits by using schematic diagrams and be able to perform tests and measurements.
3. Safely work with electronic components and be aware of the risks involved and how to minimize them.
4. Use industry-standard simulation and development environments such as Multisim and LabVIEW.
5. Recognize the importance of electronics and its use in different industries to address the needs of society.
6. Access information sources related to electronics and photonics effectively and use this information ethically and legally.

TERM III

OPSC 120 Industry Technical Internship – 5 Credits

Course Description: During the Industry Technical Internship, students will have a real-world full-time technical experience with a company or institution in areas where optics and photonics are enabling technologies. Students will acquire technical experience and skills in a manufacturing, industrial, or research setting. This internship will also give the students feedback on their strengths and weaknesses working in an environment that requires teamwork, respect for authority and experience, and cooperation. Students will be given an opportunity to hone their “soft skills”, and in so doing be better prepared for paying careers when they graduate. The coordination with the internship center will be done through the faculty assigned to this course. In addition, the student will have a mentor at the company where he/she performs the internship. The mentor’s input will be part of the evaluation process of the course. Requirements OPSC 102, OPSC 110.

Competences / Objectives:

At the end of the course, the student will develop and apply the skills to:

1. Allocate resources, which may include time, money, materials, and space.
2. Work in teams, learn from others, serve customers, lead, and negotiate.
3. Acquire and evaluate data, organize information, and interpret and communicate.
4. Understand social, organizational, and technological systems for the specific industry he/she is working in.
5. Select equipment and tools, and apply technology to specific tasks.
6. Access information sources related to photonics and lasers effectively and use this information ethically and legally.

TERM IV



OPSC 103 Lasers and Applications II – 4 Credits

Course Description: This is the second of two courses covering more advanced concepts in photonics and the operating principles, output characteristics, diagnostics, and applications for the most widely used laser types. These are described and classified according to their active medium, output wavelength, and applications. This second course covers diode lasers, Argon-Ion laser, Nd:YAG lasers, and laser systems integration. Their operation and the measurement of beam parameters will be covered in the laboratory session. Requirements OPSC102.

Competences / Objectives:

At the end of the course, the student will develop and apply the skills to:

1. Understand why some lasers are appropriate for certain applications.
2. Identify which laser systems are used in various technology areas.
3. Select one or two types of lasers that are suitable for a particular application.
4. Read and understand specifications for commercially available laser systems.
5. Describe what are the facility requirements, utility services and safety requirements for installing a commercially available laser system in a commercial, laboratory, or industrial setting.
6. Measure the output characteristics of a laser.
7. Engage in basic troubleshooting of laser equipment.
8. Recognize the applications of the specific types of lasers studied to different industries and the use of these systems to address the needs of society at large.
9. Access information sources related to photonics and lasers effectively and use this information ethically and legally.

OPSC 104 Photonic Enabled Technologies – 3 Credits

Course Description: This course on Photonics Enabled Technologies broadens the scope of the Certificate in Photonics and Lasers by providing the student with specific applications of optics and photonics to industry related fields. As such, the student will have the opportunity to learn about specific optical and laser systems and their integration to measurement and manufacturing techniques. The laboratory component will provide the required practical experience for each of these technologies. The specific applications to be studied are: holography, fiber optics, microscopy, optical coatings, and lasers in manufacturing. Requirements OPSC102.

Competences / Objectives:

At the end of the course, the student will develop and apply the skills to:

1. Understand the various issues surrounding the ownership and operations cost of laser systems.



2. Safely work with lasers that are part of a manufacturing or measurement system, being aware of the risks involved and how to minimize them.
3. Work with electronics as part of a laser or photonics system.
4. Search for and utilize external resources to understand the principles of a specific laser-based technology and the determining control parameters that affect the desired outcome.
5. Value the importance of team work in developing technological projects.
6. Access information sources related to photonics and lasers effectively and use this information ethically and legally.

OPSC 111 Electronics for Optics and Photonics II – 5 Credits

Course Description: Electronics for Optics and Photonics II is the second of two courses that provide basic coverage of electricity and electronics fundamentals. This second course provides the student with an understanding of the basics of AC circuit theory and practice, including the use of resistors, capacitors, inductors, transformers, diodes, transistors, and operational amplifiers. In the laboratory, students will learn to assemble basic AC circuits and analyze them using the industry-standard Multisim simulation environment and the LabVIEW development environment. Requirements OPSC 110.

Competences / Objectives:

At the end of the course, the student will develop and apply the skills to:

1. Understand basic electrical concepts of voltage, resistance, current, inductance, capacitance, and power in AC circuits.
2. Understand AC circuits by using schematic diagrams and be able to perform tests and measurements.
3. Safely work with electronic components and be aware of the risks involved and how to minimize them.
5. Work with electronics as part of a laser or photonics system.
6. Use industry-standard simulation and development environments such as Multisim and LabVIEW to perform testing, measurement, and automation of photonic systems.
7. Recognize the importance of electronics and its use in different industries to address the needs of society.
8. Value the importance of team work in developing technological projects to solve real-world problems.
9. Access information sources related to electronics and photonics effectively and use this information ethically and legally.

Students with Special Needs (ADA):



Students receiving Vocational Rehabilitation services, who present evidence, should communicate with his/her professor at the beginning of the semester to arrange for reasonable accommodations and the necessary assistance equipment. Any student needing any special accommodations should communicate these needs to the professor during the first week of class.

Equal Opportunity: Universidad Metropolitana (UMET) provides equal education and employment opportunities and does not discriminate on the basis of race, color, religion, sex, gender, gender identity, real or perceived sexual orientation, national origin, military status, status as protected veteran, physical or mental disability, social condition, age, marital status, political ideologies, domestic violence or sexual attack victim status, or any other characteristic protected by federal, state, or local law. Disabilities: Services are available to students who may need accommodations, interpreters, and/or specialized equipment. All student requests are dealt in confidential manner.

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