CERTIFICATE IN PHOTONICS & LASERS TECHNICAL SPECIALIST

OPSC 111 ELECTRONICS FOR OPTICS AND PHOTONICS II

Contact hours: Forty-five (45) lecture hours & sixty (30) laboratory hours – 5 Credit

Prepared by: **Dr. Andrés Díaz – 2014**
Revised by: Dr. Jonathan Friedman, Dr. Andrés Díaz
María C. Ortiz, Dean School of Environmental Affairs - 2015

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.
4. Work with electronics as part of a laser or photonics system.
5. Use industry-standard simulation and development environments such as Multisim and LabVIEW to perform testing, measurement, and automation of photonic systems.
6. Recognize the importance of electronics and its use in different industries to address the needs of society.
7. Value the importance of team work in developing technological projects to solve real-world problems.
8. Access information sources related to electronics and photonics effectively and use this information ethically and legally.

Course Content:

a. Alternating Voltage & Current
   AC Voltage
   Single-Phase and Three-Phase AC
   Electromagnetic Induction
   Electrical Generator Basics
   Measuring AC Voltage with a VOM and an Oscilloscope
   Capacitive Reactance and Capacitive Circuits
   Inductive Reactance and Inductive Circuits
   Inductance and Transformers: Mutual Inductance

Vector (Phasor) Diagrams
Power in AC Circuits

b. Frequency Response
   Filters
   Low-Pass Filters
   High-Pass Filters
   Band-Pass FiltersVolts, Ohms, and Amperes

c. AC Components and Testing
   AC Power Wiring and Components
   Wiring, Cabling, and Connectors
   AC Test and Troubleshooting

d. Semiconductor Devices: Diodes
   Semiconductor Theory
   Semiconductor Materials: N-Type and P-Type
   Junction Diodes
   Junction Biasing
   Diode Characteristics
   Diode Specifications and Diode Types

e. Transistors
   Introduction
   Field Effect Transistors, Amplifiers, and Switches
   Bipolar Transistors, Amplifiers, and Switches

f. Operational Amplifiers
   Fundamentals
   Operational Amplifiers
   Op-Amp Applications
   Power Amplifiers

LABORATORY - ELECTRONICS FOR OPTICS AND PHOTONICS II

The Electronics for Optics and Photonics courses prepare the student to understand the basics of DC and AC circuits and systems, and to apply these concepts to the area of Photonics. This second course focuses on AC Circuits and also introduces the student to the use of semiconductor devices such as diodes, transistors, and operational amplifiers, which are the basic building blocks of current electronic devices. The student will also continue using industry-standard tools such as Multisim and LabVIEW which he or she is likely to encounter in a research or industrial environment. At the end of this course, the student will be prepared to understand, use, and build basic electronic circuits and will be able to use the appropriate measurement tools to characterize and troubleshoot these circuits in a professional and safe.

Laboratory Content

a. Introduction Capacitive Reactance

b. Inductive Reactance

c. AC Circuits

d. Transformers and Turn Relationship

e. Diodes

f. Transistors

g. Motors and Generators

h. Using LabVIEW in Photonics applications

Grading Policy:

30%	Two (2) partial exams
20%	Homework and class presentations
30%	Laboratory logbook
20%	One (1) comprehensive final exam

The learning assessment policy and related tools may be accessed at: http://www.suagm.edu/umet/vicerrectoria_opai_papara.asp

Textbook:

Frenzel, L. (2013). *Contemporary Electronics: Fundamentals, Devices, Circuits and Systems*. (1st ed., p. 848). USA: WCB/McGraw-Hill.

References:

a. Printed Resources

Chen, W. (2005). *The Electrical Engineering Handbook*. Boston: Elsevier Academic Press.

Karris, S. T. (2012). *Electronic Devices and Amplifier Circuits: With MATLAB*. Fremont, California, USA: Orchard Publications.

National Instruments, Carballo, L., Ulloa, D. & Garro, F. (n.d.). *Laboratory Exercises for Analog and Digital Courses using NI ELVIS II and NI Multisim.* (p. 150). National Instruments Corporation.

Shields, T. (n.d.). *Practical Teaching Ideas With Multisim*. 11 (8th ed., p. 300). National Instruments Corporation.

b. Audiovisual Resources

Almedasur. [almedasur]. (2011, August 16). *AC Measurements using NI ELVIS*. [Video file]. Retrieved from http://youtu.be/6SrkEFoHMh8

Cortés, U. [Ulises Cortés Ramírez]. (2011, May 21). *Función Lógica AND con NI ELVIS I*. [Video file]. Retrieved from http://youtu.be/PNUnPGJjGCQ

Feedback. [The Feedback Group]. (2010, November 10). *Electricity and Electronics using NI ELVIS Console*. [Video file]. Retrieved from http://youtu.be/Nt4X-3XvaMo

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.

The Certificate in Photonics & Lasers Technical Specialist is part of New Horizons: Puerto Rico Lasers and Photonics Career Pathways, a project funded by the United States Department of Labor – Employment and Training Administration – Trade Adjustment Assistance Community College and Career Training Grant (TAACCCT) Round 4. TC-26472-14-60-A-72. The program materials were created by Puerto Rico Photonics Institute (PRPI)/UMET and do not necessarily reflect the official position of the U.S. Department of Labor.