**PHOE 140: Intro. to Advanced Manufacturing and Photonics**

This course, which includes both online and in-class components, reviews the basic technical mathematics and science of measurements required for a technician in manufacturing, develops problem solving skills, and builds familiarity with software like Microsoft Excel and PowerPoint. The course teaches basic safety procedures for personal and equipment protection, cleanroom fundamentals, oral presentations and written communication skills, and general workplace ethics. The course covers in some detail data collection, manipulating data in spreadsheets, plotting graphs, calculating standard deviation with upper and lower limits, and plotting control charts. It also introduces the students to basics of Six Sigma tools like Process Maps, Cause and Effect diagrams and Pareto Charts used in advanced manufacturing processes and introduces the students to fundamentals of Photonics. The course includes several visits to MIT for photonic manufacturing “bootcamp” days that involve demonstrations and hand-on experiences with lasers, photonic devices that use light in circuits instead of electrons, and a sampling of advanced Photonic topics.

(updated 10/20 by P. Nargarkar)

**PHOE 142: Electricity and Electronics**

The working operations of DC and AC analog electrical components as discrete devices and as part of larger electrical circuits and systems will be covered in parallel with hands-on experimentation in the lab employing basic measure and test equipment. Basic ideas and applications of ADC and DAC computer-based data acquisition will also be used. Trouble shooting and lab-based problem solving will be emphasized coordinating skills interpreting data sheets, schematics and systems specifications.

**PHOE 144: TOOLS AND TESTING EQUIPMENT**

The Tools & Testing course offers students a hands-on approach to learning to identify and use the most common tools in a photonics lab or manufacturing facility. With a combination of labs, online, and group projects, students will practice with tools and taught methods for using measurement, testing, and quality control, instruments as they troubleshoot and repair electronic circuit-based systems. This class blends online and in-class learning, with a heavy emphasis on lab skill development.

This course is a foundation course of the Advanced Manufacturing and Integrated Photonics Technician Certificate Program - AMIP. Students will use project-based learning along with peer discussions, demonstrations of techniques and safety training, leading to federal OSHA-10 certification.

After successful completion, a student should have the ability to:

* Conduct work in a safe manner
* Use, test, and repair lab equipment
* Make analog and digital electronic measurements
* Make optical measurements

These course-level learning outcomes will help all students achieve the overall program level learning of:

* Safety
* Quantifying the properties of complex systems
* Equipment testing and repair

(updated 10/20 by B. Nosiglia)

**PHOE 150: Tools and Materials for Advanced Manufacturing and Photonics**

This course, which includes lab, online, and in-class lab components, provides a hands-on introduction to the mechanical and advanced manufacturing systems and materials for design engineering and CNC manufacturing. Applications include design with Solidworks, MasterCam, additive and subtractive manufacturing, 3D scanning, 3D printing and metrology applications.

The course provides an overview of the mechanical and manufacturing concepts necessary for the understanding of design tools and fabrication processes along with the safety requirements for working with lasers. Emphasis will be placed on the properties of specific materials in manufacturing processes. Students will develop hands on lab skills. Online course modules that provide video lectures and quizzes will be used to test whether the student is ready for lab work. PHY 150 is a course in the second semester of the Photonics Technician Certificate program. (updated 10/2020 by P. Leinard)

**PHOE 152: Digital Fundamentals**

Fundamentals of digital electronics including number systems, Boolean algebra and Karnaugh mapping will be covered. Students will apply foundational concepts in applications including Programmable Logic Controls, and microprocessors such as Arduinos, LabView and PICs with the goal of understanding the function, testing and troubleshooting of control and mechatronics systems. Programming and basic ideas and applications of ADC and DAC computer-based data acquisition and signal processing will also be used.

**PHOE 154: Statistical Process Control in Photonics and Automation**

This course focuses on the principles of data analytics, automation, and process control utilizing data measurement software such as the Mitutoyo Data Management Measurlink System. These principles will be practiced through extensive exercises, online learning, and lab work that will introduce the student to working with Measurement, Quality Systems, Lean Six Sigma, Control Charts, Improvement & Control, 5S Workplace Organization & Team Development & Management.

PHOE 154 is a course in the second semester the Photonics Technician program. This class blends online and in-class learning, with a heavy emphasis on lab skill development. The student will use online Amatrol course modules which provide video lectures and quizzes that test whether they are ready for lab work. In class, we will have more detailed discussions, demonstrations of techniques and equipment, and plenty of lab bench time. The overall goal of the course is to learn the process of planning and evaluating a fabrication process and utilizing appropriate software for Statistical Process Control and Quality Control Evaluations. (updated 10/2020 by P. Leinard)

**PHOE 160: Introduction to Optics**

Students will develop advanced experience with lasers, optics and optical systems that are commonplace for the photonics and optical technician based on SPIE Photonics publications. Laser fundamentals, safety and operation will be covered along with basics of geometric and wave optics theory. Optical system set up, including alignment, interferometers and test and measurement (component and system characterization) will also be covered.

**PHOE 162: Introduction to Fiber Optics**

Students will develop experience working with lasers, fiber optics and fiber optics applications that are commonplace for the photonics and optical technician. Fiber optics theory including index of refraction, materials, single and multi-mode operation, as well typical fiber optics applications including cleaning, cleaving and splicing will be covered.

**PHOE 164: Photonic Integrated Circuits**

This course, which includes both online and in-class components, provides an introduction to the basic concepts and methods of integrated photonics. Integrated photonics integrates the optical components: waveguides, waveguide bends, Y branch, grating couplers, interconnect, detectors, and so on. This course will teach students how to design, fabricate, and test an integrated photonic circuit and conduct a data analysis cycle, and will include the design and testing of an integrated circuit as a final project.

**PHOE 190: Photonics Internship**

This course will consist of a summer apprenticeship at a company, gaining experience in optics- or photonics-related work. Coming in the final semester of the photonics technician certificate program, the student will gain practice at applying the skills learned in previous courses and will develop workplace experience and industry contacts, in preparation for seeking permanent employment at the end of the program.

**PHOE 198: Photonics Capstone**

Students will apply photonics and optical technician training in a capstone project of their choice, studying a problem or application of personal interest. Students are responsible for completing brief written descriptions of their work and making oral presentations to the Photonics faculty.