PHOE 301: Foundations of Photonics and Optical Engineering

The student will be able to explain the significance of current research about the working principles of fundamentals of photonics and optical engineering. PHOE 301 is designed to teach students the initial things they need to know to get started in understanding, and eventually designing, photonics and optical engineering devices and solutions.

- Students will start by understanding the theory of how light is generated as a single photon from semiconductor materials.
- Students will understand the theory and applications of light sources. such as light emitting diodes and lasers and theory and applications of detectors.
- Students will understand the light as a wave and begin to understand how it propagates through various optical and photonic components in free space and through photonic integrated circuit (PIC) chips.

PHOE 323: Optical Engineering

The student will be able to explain the significance of current research about the working principles of optical engineering. PHOE 323 is designed to introduce the basic properties of lasers and optical systems. geometrical and gaussian wave optics

- Students will work to align lasers and optical components, examine the properties of beams, and conduct experiments using interferometers.
- Students will learn the concepts of optics through hands on experiments. This should enhance the basic understanding of the concepts and familiarize students with current trends of scientific instrumentation.
- Students will learn how to maintain a lab note book and present scientific reports based on your experiment results. Both conceptual and practical knowledge gained in this course should give students confidence in explaining the similar physical observations that they see in day-to-day life.

PHOE 330: Fiber Optics Communication

The student will be able to explain the significance of current research about the working principles of Fiber Optics.

- Students will be able to design an experiment plan for free space and waveguided optics.
- Students will acquire data on transmission and interpret experimental data and results with respect to appropriate theoretical models.
- Students will explain observed differences between model and experiment (bad model, bad measurements, noise, etc.) and draw conclusions.
- Students will understand the functionality of each of the components that comprise a fiber-optic communication system: transmitter, fiber, amplifier, and receiver.
- Students will understand the properties of optical fiber that affect the performance of a communication link.
- Students will understand to differentiate between direct modulation and external electro-optic modulation.
- Students will understand basic optical amplifier operation and its effect on signal power and noise in the system.
- Students will demonstrate basic fiber handling skills, including cleaving and splicing.
- Students will apply concepts listed above to the design of a basic communication link.

PHOE 342: Digital and Electronic Devices

This course relates to the big picture PHOE student learning outcomes of teaching engineering design and providing opportunities to write about design and lab work.

- Students will develop a thorough understanding of the function and use of digital and electronic devices.
- Students will design solutions to engineering problems using digital and electronic devices.
- Students will understand the underlying theory and operation of a range of electronic devices.
- Students will model and simulate the behavior of electronic circuits using LabView, MultiSim and ELVI.
- Students will Bbe able to draw and read digital and electronic device schematics.

PHOE 403: Semiconductor Devices

Upon completing this course,

- Students will be able to work and explain problems where the quantum mechanical energy-bands of semiconductors are exploited,
- Students will be able to work and explain problems using the concept of charge transport,
- Students will be able to explain the design of devices that make use of PN junctions and bipolar transistors,
- Students will be able to explain and develop models using MOS structure including MOST Field Effect Transistors, and
- Students will be able to explain and develop models for optical wave guides and basic photonics integrated circuits (PIC).

PHOE 420: Laser Engineering

The student will be able to explain the significance of current research about the working principles of Lasers.

- Students will design an experiment plan for the characterization of a laser.
- Students will acquire data on transmission and interpret experimental data and results with respect to appropriate theoretical models.
- Students will explain observed differences between model and experiment (bad model, bad measurements, noise, etc.) and draw conclusions.
- Students will understand the operation principle of the different lasers and the role of the cavity, the pumping system, and the gain medium.
- Students will understand the difference between continuous wave and pulse mode operation.
- Students will understand the difference between LED and laser light.
- Students will demonstrate basic laser operating skills, including safety and stability parameters.
- Students will apply concepts listed above to the design of a laser system for a given application.

PHOE 450: Photonics Integrated Circuit Design

The photonics integrated circuit or PIC is the central component in a growing field whose aims are to provide more accurate sensors, improve telecommunications, and create circuit components at the microprocessor level. Key elements and strategies for PIC devices will be discussed, and students will model, analyze and design PICs using computational software. Upon completion of this class and lab,

- Students will be able to explain the critical elements used in PICs.
- Students will be able to discuss laser sources for PICs.
- Students will design a PIC and analyze its properties using numerical programs.

PHOE 455: Advanced Optics

The student will be able to explain and perform analytic and numerical / modeling calculations involving the fundamental properties of Optical Systems.

- Students will use the Zemax package for ray tracing,
- Students will apply numerical methods to solve linear algebra problems for lens tracing for the Jones Matrices and Polarization.
- Students will apply mathematical modeling, including MATLAB, to the Fresnel equations, Fourier optics, and absorption.

PHOE 483: Senior Design 1

The student will be able to work in teams in collaboration with a company to solve state-of-the-art industrial problems.

- Students will provide the collaborators with prototypes that have gone through the design loop several times and have been tested at BSU facilities
- Each year, industry sponsors' cutting-edge projects will motivate and excite our students to explore the challenges of design engineering in the real economic environment.
- Students will work in teams, demonstrating teamwork, project management, oral and written communication.
- Students will demonstrate a consolidation of learnt skills during the previous engineering years in Math, Physics, simulations, experimental work and reporting.
- Students will learn of new software and hardware depending on the project needs.

PHOE 484: Senior Design 2

The student will be able to work in teams in collaboration with a company to solve state-of-the-art industrial problems in a continuation of Senior Engineering Design I.

- Students will provide the collaborators with prototypes that have gone through the design loop several times and have been tested at BSU facilities.
- Students will continue research, design, and implementation for their projects.
- Students will give oral presentation and/or demonstration of the project to faculty and other interested parties.
- Students will demonstrate a consolidation of learnt skills during the previous engineering years in Math, Physics, simulations, experimental work and reporting.
- Students will learn new software and hardware depending on the project needs.
- Students will answer appropriate questions related to the project in presentations.
- Students will generation of a final technical report documenting design, development, and performance of the project.