

Photonics (PLT)

Photonics and Laser Technology (PLT) Courses

PLT 1002 [0.5 credit]

Applications in Photonics & Optoelectronics

Survey of the history and future of photonics. Photonics benefits and impact on technology and society. Emerging applications of photonics in industry and commercial products. The forces (business, social, political, economic, technical, and educational) that influence the development, adoption and success or failure of technologies.

Includes: Experiential Learning Activity

Prerequisite(s): restricted to students in the B.I.T. degree program.

Lectures two hours a week, tutorial/laboratory two hours a week.

PLT 1003 [0.5 credit]

Optics/Optical Fibers I (Principles)

Principles of optics, optical fiber, waveguides and hands-on experience with optical components. Optical fiber manufacturing and variety of industrial applications.

Topics covered include: optical sources, detectors, fiber modes and mode-coupling, couplers, multiplexers, optical amplifiers, physical layer of optical networks, dispersion and nonlinear effects management.

Includes: Experiential Learning Activity

Prerequisite(s): restricted to students in the B.I.T. degree program.

Lectures / laboratory or tutorial four hours a week.

PLT 1005 [0.5 credit]

Introduction to Optics

Physics of waves, optics and light propagation through lectures and lab experiments. Geometrical optics, refraction and reflection, interference, diffraction and polarization, thin lens equation, laser beams, Michelson interferometer, birefringence, and Abbe theory of imaging. Electromagnetic spectrum, quantum nature of light, photons, and photoelectric effect.

Includes: Experiential Learning Activity

Prerequisite(s): BIT 1203, restricted to students in the B.I.T. degree program.

Lectures / laboratory or tutorial five hours a week.

PLT 1006 [0.5 credit]

Introduction to Automation and Simulation

Introduction to basic programming in both the Matlab and Labview environments. Program development, basic structures (loops, control structures), I/O, data visualization and graphing will be covered. Students will learn to use Labview to develop basic applications and model simple physical systems with Matlab.

Includes: Experiential Learning Activity

Prerequisite(s): restricted to students in the B.I.T. degree program.

Lectures two hour a week, tutorial/laboratory two hours a week.

PLT 2001 [0.5 credit]

Fundamentals of Light Sources

Introduction to incoherent light sources and lasers.

Lasers operation, energy levels, quantum mechanics basics. Pumping/excitation, population inversion, laser cavity design, gain and loss, and characteristics of laser emission. An extensive lab manual of relevant experiments, variety of lasers, spectrometers, and detection equipment will be used.

Includes: Experiential Learning Activity

Prerequisite(s): BIT 1201. Restricted to students in the BIT degree program.

Lectures two hours a week, tutorial/laboratory two hours a week.

PLT 2002 [0.5 credit]

Optical Communication Networks I

Fiber-laser implementation and optical networks, topologies, OSI, SONET/SDH, synchronous payload envelope, virtual tributaries, optimized mapping techniques, and optical carriers (OC-n/STM-m). Extensive lab manual and hands-on experience using state-of-the-art Optophotonics Lab to work on OAM; P, facility/equipment, synchronization, bandwidth management, and performance monitoring and other functionalities.

Includes: Experiential Learning Activity

Prerequisite(s): PLT 1003.

Lectures two hours a week, tutorial/laboratory three hours a week.

PLT 2003 [0.5 credit]

Laser Systems

Laser theory, devices and systems. Safety procedures, laser power supplies, and laser system applications.

Solid state, gas, and other types of lasers. Basic material processing, micro machining, bio/medical, and military applications will be covered. Hands-on experience with advanced laser equipment in lab.

Includes: Experiential Learning Activity

Prerequisite(s): PLT 2001.

Lectures two hours a week, tutorial/laboratory two hours a week.

PLT 2005 [0.5 credit]

Circuits and Signals

Students learn properties of electricity and measurement techniques. Topics covered include RMS, average, applied, peak-to-peak and instantaneous values. Lab experiments deal with RC and RL circuits and LC filters. RLC circuits, and series and parallel resonance are also covered.

Includes: Experiential Learning Activity

Prerequisite(s): BIT 1204 or PHYS 1004 or PHYS 1002
Restricted to students in the BIT degree program.

Lectures two hours a week, laboratory and problem analysis three hours a week.

PLT 2006 [0.5 credit]**Integrated Circuits**

Fundamentals of logic circuitry in digital systems are studied including basic logic gates, Boolean algebra, signal decoding, logic circuit design, flip-flop circuits, timers and counters. The proper use of semi-conductor components is demonstrated through the use of laboratory experiments.

Includes: Experiential Learning Activity

Precludes additional credit for ELEC 2507.

Prerequisite(s): PLT 2005. Restricted to students in the B.I.T. degree program.

Lectures two hours a week, laboratory and problem analysis three hours a week.

PLT 2008 [0.5 credit]**Manufacturing Photonics Components**

Manufacturing techniques and methods used to produce photonics components and devices/systems. Micro assembly, adhesives, optical tests and measurement, lean manufacturing and quality control standards (Telcordia). Laboratory exposure to optical component production processes: grinding, polishing, coating, mounting, tolerance and accuracy.

Includes: Experiential Learning Activity

Precludes additional credit for PLT 1004 (no longer offered).

Prerequisite(s): PLT 1002. Restricted to students in the B.I.T. degree program.

Lectures / laboratory or tutorial four hours a week.

PLT 2009 [0.5 credit]**Assembly and Machine Language**

Structured approach to assembly language programming.

Topics include data and address registers, data and address busses, condition code register and stack pointers, machine code format, instruction sizes, operand encoding, translation of source code into machine language, and how the processor executes instructions. Also listed as NET 2009.

Precludes additional credit for PLT 1007 (no longer offered), NET 1004 (no longer offered).

Prerequisite(s): BIT 2400.

Lectures three hours a week, tutorial/laboratory one hour a week.

PLT 2010 [0.5 credit]**Signals and Systems**

This course provides a solid theoretical foundation for the analysis and processing of experimental data, and real-time experimental control methods. Topics include various properties of signals and systems, convolution, the Fourier transform, sampling theorem, z-transform, spectral analysis, filter design, and system identification.

Prerequisite(s): BIT 1200 and BIT 1201.

Lectures three hours a week, tutorial one hour a week.

PLT 3000 [0.5 credit]**Optical Communication Networks II**

Operation, management and maintenance of metro/long haul optical network elements and systems. Hands-on skills using GUI, Transaction Language One (TL1), optical network management to perform line and path protection, alarm provisioning, security and data communications, optical network backup and restore, load upgrade and installation management.

Includes: Experiential Learning Activity

Prerequisite(s): PLT 2002.

Lectures two hours a week, tutorial/laboratory three hours a week.

PLT 3002 [0.5 credit]**Real-time Systems**

Principles of event-driven systems, review of computer organization; parallel and serial interfaces; programmable timer; I/O methods; polling and interrupts. Real-time kernels. Critical design consideration: concurrency, dead lock, synchronization. Maintaining and improving system performance. Programming exercises in low and high level languages.

Includes: Experiential Learning Activity

Also listed as NET 3001.

Prerequisite(s): PLT 2009.

Lectures three hours a week, tutorial/Laboratory two hours a week.

PLT 3003 [0.5 credit]**Fundamentals of Electromagnetics**

Review of basic vector calculus followed by an introduction to electrostatics and magnetostatics. Maxwell's equations and EM wave solutions. EM waves in dielectrics media, reflection, refraction, Fresnel relations and Brewster angle. Introduction to guided waves emphasizing slab waveguides.

Includes: Experiential Learning Activity

Prerequisite(s): BIT 1204 and BIT 2010.

Lecture and tutorial three hours a week.

PLT 3004 [0.5 credit]**Design of Optical Components and Systems**

Optical ray-tracing for analysing systems of sources, lenses, mirrors, prisms, fibers, diffractive elements, MEMS. Zemax® fundamentals, pupils, aspherics, non-sequential tracing, aberrations, image metrics, optimization/merit functions. Applications: imaging, illumination, lasers. Trade-offs, mechanical constraints, tolerances and cost. Physical optics modeling of beam propagation. Near-field diffraction and waveguides.

Includes: Experiential Learning Activity

Prerequisite(s): PLT 1003.

Lectures / laboratory or tutorial five hours a week.

PLT 3008 [0.5 credit]**Communication Skills for PLT**

Development of competence in written and oral communication. Focus on technical reports, proposals, and other related project documents; formal and informal oral presentations.

Includes: Experiential Learning Activity

Prerequisite(s): restricted to students in the B.I.T. degree program.

Lecture and tutorial three hours a week.

PLT 3009 [0.5 credit]**Project Management**

Identification, selection, initiation, and organization of projects. Risk assessment, budget issues, communication, project scheduling, performance monitoring and control. Emphasis on practical techniques related to the field of photonics using case studies.

Includes: Experiential Learning Activity

Prerequisite(s): third year standing in the Photonics and Laser Technology program.

Lectures two hours a week, tutorial/laboratory two hours a week.

PLT 3010 [0.5 credit]**Data Structures**

Specification and design of abstract data types and their implementation as stacks, queues, trees, tables and graphs. Common and useful examples. Parsing and finite state machines. Analysis of algorithms, recursion, re-entrance. Special focus: abstraction, interface specification and hierarchical design using object-oriented programming.

Includes: Experiential Learning Activity

Precludes additional credit for NET 3004.

Prerequisite(s): BIT 2400.

Lectures three hours a week, tutorial/laboratory two hours a week.

PLT 3012 [0.5 credit]**Digital Signal Processing**

Operations-related topics including: sampling/reconstruction of continuous time signals, Fourier and Z-transforms, Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT). Examination of other time and frequency domain techniques for designing and applying infinite impulse response (IIR) and finite impulse response (FIR) digital filters.

Prerequisite(s): PLT 2010.

Lectures three hours a week, tutorial one hour a week.

PLT 3013 [0.5 credit]**Software Design for Optical Systems and Sensors**

Provides students with knowledge and expertise to design and develop complex software systems and programs for common optical systems and sensors. Topics include: system and requirement analysis, algorithms, component identification, common design patterns, and working with reusable components.

Prerequisite(s): BIT 2400.

Lectures three hours a week, tutorial two hours a week.

PLT 3014 [0.5 credit]**Optical Waves, Waveguides, and Sensors**

Analysis of guided-wave propagation and sensors. Topics include Maxwell's time-dependent wave equations, dielectric waveguides (slab, planar, segmented, rib, strip), optical fibres (modes, dispersion relations, propagation in dispersive media, nonlinear fibres), beam propagation methods, free space beam propagation, waveguide devices, and study of sensors technology.

Prerequisite(s): PLT 3003.

Lectures three hours a week, tutorial two hours a week.

PLT 4001 [0.5 credit]**Optoelectronic Devices**

Review of semiconductors, semiconductor lasers, detectors, photovoltaics. Electro, magneto and acousto-optic modulation devices. Transmitters, receivers, photo diodes, fiber sensors, and amplifiers, Mach-Zehnder interferometers. Polarization-mode dispersion. Experiments on non-linear optical elements, Sagnac and ring resonator, optical modulation.

Includes: Experiential Learning Activity

Prerequisite(s): PLT 3004.

Lectures two hours a week, tutorial/laboratory two hours a week.

PLT 4004 [0.5 credit]**Medical Imaging and Biosensors**

Biological and medical photonics. Effect of light on biological systems, medical imaging, medical treatments, biological research and bio/medical applications. Laser manipulation of cells, laser surgery, and photo-therapy. Biophotonic lab experiments with scanning confocal microscopes, endoscopes, DNA scanners.

Includes: Experiential Learning Activity

Prerequisite(s): PLT 3003.

Lectures two hours a week, tutorial/laboratory two hours a week.

PLT 4006 [0.5 credit]**Image Processing**

Developing and evaluating algorithms for extracting the necessary information signals. Topics include filter design, fast transforms, adaptive filters, spectrum estimation and modeling, sensor array processing, image processing, motion estimation from images, applications in biomed, computer-aided tomography, image restoration, robotic vision, and pattern recognition.

Includes: Experiential Learning Activity

Prerequisite(s): BIT 2400.

Lectures two hours a week, tutorial/laboratory two hours a week.

PLT 4008 [0.5 credit]**Remote Sensing**

Introduction to the basics of remote sensing, characteristics of remote sensors, and applications.

Topics include: image acquisition and data collection, LIDAR sensors and platforms and derived digital products, imagery analysis, topographic mapping, and 3D modeling of urban infrastructure for autonomous vehicles.

Prerequisite(s): PLT 3014.

Lectures three hours a week, tutorial two hours a week.

PLT 4009 [0.5 credit]**Computer Vision**

Introduction to topics in computer vision, including: fundamentals of image formation, camera imaging geometry, f camera models, camera calibration, structure from motion, feature detection and matching, depth and stereo, image stabilization, image classification, automated alignment, scene understanding, recognition, and image searching.

Prerequisite(s): PLT 4006.

Lectures three hours a week, tutorial two hours a week.

PLT 4900 [1.0 credit]**Photonics Research Project**

Research project develops students' ability to direct own learning and pursue advanced study in variety of subjects. Select topic, perform literature search, theoretical background, preliminary measurements, calculations, and design. Present findings in a preliminary thesis. Encourage writing technical papers. Research opportunities with industry and academia.

Includes: Experiential Learning Activity

Prerequisite(s): fourth-year standing.

Tutorial hours arranged.