Optical Systems and Sensors (OSS)

Optical Systems and Senors (OSS) Courses

OSS 1002 [0.5 credit]
Photonics and Optoelectronics Applications
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
Precludes additional credit for PLT 1002 (no longer offered).
Prerequisite(s): restricted to students in the B.I.T. degree program.
Lectures two hours a week, tutorial/laboratory two hours a week.

OSS 1003 [0.5 credit]
Optics/Optical Fibers (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
Precludes additional credit for PLT 1003 (no longer offered).
Prerequisite(s): OSS 1006.
Lectures two hours a week, tutorial/laboratory two hours a week.

OSS 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
Precludes additional credit for PLT 1005 (no longer offered).
Prerequisite(s): BIT 1203, restricted to students in the B.I.T. degree program.
Lectures two hour a week, tutorial/laboratory three hours a week.

OSS 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
Precludes additional credit for PLT 1006 (no longer offered).
Prerequisite(s): restricted to students in the B.I.T. degree program.
Lectures two hour a week, tutorial/laboratory two hours a week.

OSS 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
Precludes additional credit for PLT 2001 (no longer offered).
Prerequisite(s): BIT 1201. Restricted to students in the BIT degree program.
Lectures two hours a week, tutorial/laboratory two hours a week.

OSS 2002 [0.5 credit]
Optical Communication Networks I
Adaptive Optical Communication Networks with 10Gb/s-200Gb/s Packet-Optical Platforms and WaveServers, OTN, flexible WaveLogic Photonics, ROADM, SONET/SDH, programmable network, optimized mapping techniques, optical carriers (OC-n/STM-m). Extensive hands-on experience using state-of-the-art Optophotonics Lab to work on OAM&P, facility/equipment, synchronization, bandwidth management, performance monitoring and other functionalities.
Includes: Experiential Learning Activity
Precludes additional credit for PLT 2002 (no longer offered).
Prerequisite(s): OSS 1003.
Lectures two hours a week, tutorial/laboratory three hours a week.

OSS 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
Precludes additional credit for PLT 2003 (no longer offered).
Prerequisite(s): OSS 2001 or PLT 2001 (no longer offered).
Lectures two hours a week, tutorial/laboratory two hours a week.

OSS 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
Precludes additional credit for PLT 2005 (no longer offered).
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.

OSS 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, PLT 2006 (no longer offered).
Prerequisite(s): OSS 2005 or PLT 2005 (no longer offered). Restricted to students in the B.I.T. degree program.
Lectures two hours a week, laboratory and problem analysis three hours a week.

OSS 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 2008 (no longer offered).
Prerequisite(s): OSS 1002 or PLT 1002 (no longer offered). Restricted to students in the B.I.T. degree program.
Lectures two hours a week, laboratory two hours a week.

OSS 2009 [0.5 credit]
Microcontrollers for Sensing Applications
Microcontrollers study, emphasizing on their applications in sensing systems. Topics include microcontroller architecture, instruction sets, sensor interfacing, and programming techniques-Python for embedded programming; brief introduction to assembly and machine language. Students gain practical experience for real-world applications in automation and embedded systems development.
Includes: Experiential Learning Activity
Precludes additional credit for NET 1004 (no longer offered), NET 2013, PLT 1007 (no longer offered), PLT 2009 (no longer offered).
Prerequisite(s): BIT 2400.
Lectures two hours a week, tutorial/laboratory two hours a week.

OSS 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.
Includes: Experiential Learning Activity
Precludes additional credit for PLT 2010 (no longer offered).
Prerequisite(s): BIT 1200 and BIT 1201. Restricted to students in the B.I.T. degree program.
Lectures three hours a week, tutorial one hour a week.

OSS 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: alarm provisioning, line and path protection switching, security, data communications management, optical network backup and restore, load upgrade and installation management.
Includes: Experiential Learning Activity
Precludes additional credit for PLT 3000 (no longer offered).
Prerequisite(s): OSS 2002.
Lectures two hours a week, tutorial/laboratory three hours a week.

OSS 3001 [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.
Precludes additional credit for PLT 3002 (no longer offered).
Prerequisite(s): OSS 2009 or PLT 2009 (no longer offered).
Lectures three hours a week, tutorial/laboratory two hours a week.

OSS 3002 [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 bean propagation. Near-field diffraction and waveguides.
Includes: Experiential Learning Activity
Precludes additional credit for PLT 3004 (no longer offered).
Prerequisite(s): OSS 1003 or PLT 1003 (no longer offered).
Lectures two hours a week, tutorial/laboratory three hours a week.

OSS 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
Precludes additional credit for PLT 3003 (no longer offered).
Prerequisite(s): BIT 1204 and BIT 2010.
Lecture and tutorial three hours a week.

OSS 3004 [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
Also listed as NET 3004.
Precludes additional credit for PLT 3010 (no longer offered).
Prerequisite(s): BIT 2400.
Lectures three hours a week, tutorial/laboratory two hours a week.

OSS 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
Precludes additional credit for PLT 3009 (no longer offered).
Prerequisite(s): third year standing in the Optical Systems and Sensors program.
Lectures two hours a week, tutorial/laboratory two hours a week.

OSS 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.
Includes: Experiential Learning Activity
Precludes additional credit for PLT 3012 (no longer offered).
Prerequisite(s): OSS 2010 or PLT 2010 (no longer offered).
Lectures three hours a week, tutorial one hour a week.

OSS 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 using Python. Topics include: system and requirement analysis, algorithms, component identification, common design patterns, and working with reusable components.
Includes: Experiential Learning Activity
Precludes additional credit for PLT 3013 (no longer offered).
Prerequisite(s): BIT 2400.
Lectures three hours a week, tutorial two hours a week.

OSS 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.
Includes: Experiential Learning Activity
Precludes additional credit for PLT 3014 (no longer offered).
Prerequisite(s): OSS 3003 or PLT 3003 (no longer offered).
Lectures three hours a week, tutorial two hours a week.

OSS 4001 [0.5 credit]
Optoelectronic Devices and Smart Sensor Systems
This course delves deep into advanced opto-electronics devices, sensing systems, emphasizing emerging technologies. Topics: semiconductors, semiconductor lasers, detectors, photovoltaics, fiber sensors, amplifiers, and modulation. It integrates smart sensor systems and optical sensors with algorithms for analysis in various applications. Students participate in hands-on laboratory experiences.
Includes: Experiential Learning Activity
Precludes additional credit for PLT 4001 (no longer offered).
Prerequisite(s): OSS 2009 and OSS3013.
Lectures two hours a week, tutorial/laboratory two hours a week.

OSS 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
Precludes additional credit for PLT 4004 (no longer offered).
Prerequisite(s): OSS 3003 or PLT 3003 (no longer offered).
Lectures two hours a week, tutorial/laboratory two hours a week.

OSS 4005 [0.5 credit]
Introduction to Deep Learning
Introduction to classification and regression. Optimization, vectorization, gradient descent, cost, loss and activation functions. Introduction and basics to AI, Artificial Neural Networks, forward and backward propagation, Multi Layer Perceptron, and other types of Deep Neural Network models, their applications in multimedia, networks, finance, etc.
Includes: Experiential Learning Activity
Also listed as IRM 4005.
Prerequisite(s): BIT 2000 and BIT 2400.
Lectures three hours a week.

OSS 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
Precludes additional credit for PLT 4006 (no longer offered).
Prerequisite(s): BIT 2400 and OSS 3012.
Lectures three hours a week, tutorial/laboratory two hours a week.

OSS 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.
Includes: Experiential Learning Activity
Precludes additional credit for PLT 4008 (no longer offered).
Prerequisite(s): OSS 3014 or PLT 3014 (no longer offered).
Lectures three hours a week, tutorial two hours a week.

OSS 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.
Includes: Experiential Learning Activity
Precludes additional credit for PLT 4009 (no longer offered).
Prerequisite(s): OSS 4006 or PLT 4006 (no longer offered).
Lectures three hours a week, tutorial two hours a week.

OSS 4900 [1.0 credit]
OSS Capstone 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
Precludes additional credit for PLT 4900 (no longer offered).
Prerequisite(s): fourth-year standing.
Tutorial hours arranged.