Photonics (PLT)

Photonics (PLT) Courses

Faculty of Engineering & Design

PLT 1000 [0.5 credit]
Problem Solving
Introduction to systematic methods for problem solving in the context of object oriented programming. Defining and modeling problems, designing algorithms, testing, debugging and analysis of results. Numeric methods, data presentations, data abstraction, classes, class relationships, inheritance, error handling and program style and documentation.
Precludes additional credit for NET 1000.
Prerequisite(s): restricted to students in the B.I.T. degree program. Precludes .
Lectures three hours a week, tutorial/laboratory three hours a week.

PLT 1001 [0.5 credit]
Laser Safety, WHMIS and Ethics
Introduction to sociological and historical perspective on health and safety issues in industrial environments, ethics implementation to modern technology. Laser and electrical safety. Health and safety related to ergonomics. Workplace Hazardous Materials Information System (WHMIS), Material Safety Data Sheets (MSDS).
Prerequisite(s): Prerequisite: restricted to students in the B.I.T. degree program.
Lectures one hour a week, tutorial/laboratory two hours a week.

PLT 1002 [0.5 credit]
Trends in Photonics
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.
Prerequisite(s): restricted to students in the B.I.T. degree program.
Lectures one hour a week, tutorial/laboratory two hours a week.

PLT 1003 [0.5 credit]
Optics/Optical Fibers I (Principles)
Principles of optics, optical fibers and waveguiding and hands-on experience with optical components. Optical fibers manufacturing and variety of industrial applications including telecommunications, and bio/medicine. Optical sources, detectors, fiber splicing, fiber testing in lab environment.
Prerequisite(s): restricted to students in the B.I.T. degree program.
Lectures / laboratory or tutorial four hours a week.

PLT 1004 [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.
Prerequisite(s): PLT 1001. 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.
Prerequisite(s): BIT 1203, restricted to students in the B.I.T. degree program.
Lectures / laboratory or tutorial five hours a week.

PLT 2000 [0.5 credit]
Optics/Optical Fibers II (Devices)
Optical and fiber optical devices used in metrology, sensing, telecommunications, oil/gas civil and biomedical engineering applications. Lectures and lab experiments on fiber modes and mode-coupling, transmitters, couplers, splitters, receivers, wavelength division multiplexers, optical amplifiers, physical layer of optical networks, dispersion, and nonlinear effects management.
Prerequisite(s): PLT 1003, BIT 1201.
Lectures two hours a week, tutorial/laboratory three 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.
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]
Fiber Optics Communications 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.
Prerequisite(s): PLT 2000.
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.
Prerequisite(s): PLT 2001.
Lectures two hours a week, tutorial/laboratory two hours a week.

PLT 2004 [0.5 credit]
Intermediate Programming
A study of object-oriented programming with emphasis on techniques used in multimedia applications. Topics include basic and user defined data structures, classes, memory management, basic image processing, and plugin development.
Prerequisite(s): PLT 1000.
Lecture three hours a week, tutorial/laboratory three hours a week.

PLT 2005 [0.5 credit]
Circuits and Signals
Properties of signals. Basic circuit elements: voltage and current sources. Kirchhoff's laws, linearity, superposition. Thevenin and Norton's theorems. Circuit simplification. AC steady-state analysis: impedance, admittance, phasors, frequency response. Transient
response of RL and RC circuits: form of response, initial and final conditions. RLC circuits: resonance.
Prerequisite(s): BIT 1200 and BIT 1203.
Lectures three hours a week, laboratory and problem analysis three hours a week.

PLT 2006 [0.5 credit]
Semiconductors
Qualitative semiconductor physics, leading to the diode equation. Diode applications. Operational amplifiers and their application in feedback configurations including active filters. Introduction to bipolar transistors and MOSFETs, analysis of biasing circuits. Transistor applications including small signal amplifiers.
Prerequisite(s): PLT 2005.
Lectures three hours a week, laboratory and problem analysis two hours a week

PLT 3000 [0.5 credit]
Fiber Optics Communications 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.
Prerequisite(s): PLT 2002.
Lectures two hours a week, tutorial/laboratory three hours a week.

PLT 3001 [0.5 credit]
Photonics Manufacturing Systems
Laser based manufacturing, measurement and control systems, further applications of laser machining, welding, emphasizing industrial real world systems. Extensive hands on laser lab experiments, measurement jigs, scanners, swept wave systems (SWS), motion stages, optics, wavelength measuring, pulse detection, oscilloscopes, digital spectrometers.
Prerequisite(s): PLT 2003.
Lectures two hours a week, tutorial/laboratory two 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.
Prerequisite(s): PLT 2004.
Lectures three hours a week, tutorial/Laboratory two hours a week.

PLT 3003 [0.5 credit]
Electro Magnetics I
Electrostatics and magnetostatics. Solution of Poisson's and Laplace's equations. The Lorenz equation and force. Time varying fields. Magnetic circuits and transformers. DC and AC motors.
Prerequisite(s): BIT 2005.
Lectures three hours a week, laboratory and problem analysis three hours alternate weeks.

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 bean propagation.
Near-field diffraction and waveguides.
Prerequisite(s): PLT 2000. .
Lectures / laboratory or tutorial five hours a week.

PLT 3005 [0.5 credit]
Introduction to Solid State Physics
This course provides the students with the study of materials via the techniques of solid state physics. Topics include bonding and structure of crystals, energy band in insulators, semiconductors, and metals. Also included are electrical conductivity, optical properties, lattice vibration, elasticity, point defects and dislocations.
Prerequisite(s): third-year standing in the Photonics and Laser Technology program.
Lectures three hours a week.

PLT 3006 [0.5 credit]
Physical Electronics
Fundamentals of device physics and operation of the pn junction, bipolar transistor and MOSFET. Basic integrated circuit processing and application to diodes, BJTs and MOSFETs. Correlation between processing, structure, operation and modeling. Consideration of parasitic and small-geometry effects, reliability and process variation.
Prerequisite(s): PLT 3003 or permission of the Department.
Lectures three hours a week, problem analysis three hours alternate weeks.

PLT 3007 [0.5 credit]
Electro Magnetics II
Maxwell's equations and EM wave solutions. Polarization. Poynting vector. EM waves in dielectrics and conductors; skin depth. Reflection and refraction. Standing waves. Fresnel relations, Brewster angle. Transmission lines. Line termination, basic impedance matching and transformation. Smith charts. Introduction to guided waves; slab waveguide.
Prerequisite(s): PLT 3003.
Lectures three hours a week, problem analysis two hours a week.

PLT 3008 [0.5 credit]
Communication Skills for PLT
Development of competence in written and oral communication in relation to network design, development, and management. Focus on technical reports, proposals, and other related project documents; formal and informal oral presentations.
Prerequisite(s): restricted to students in the B.I.T. degree program.
Lecture and tutorial three hours a week.

PLT 4000 [0.5 credit]
Applications of Quantum Physics
Fabrication, operation and modeling of advanced devices for information technology. Topics: physics of materials, quantum mechanics of solids, optical transitions, physical analysis and models for state-of-the-art electronic/optical technologies and materials. Technologies: MOS and III-V based transistors, solidstate optical devices, MEMS and nano-technology based devices.
Prerequisite(s): PLT 3006.
Lectures three hours a week, problem analysis two hours alternate weeks.

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.
Prerequisite(s): PLT 3005.
Lectures two hours a week, tutorial/laboratory two hours a week.

PLT 4002 [0.5 credit]
Applied Advanced Optics
Wave optics: scalar Kirchhoff's diffraction, Fraunhofer/Fresnel cases, Fourier optics crystal optics. Devices and applications: multilayer coatings, fiber gratings, diffractive optics, spatial-light modulators. Novel microscopies, super-resolution, sub/superluminal light and metamaterials. Labs on diffractionless beams, vectorial focusing, computer generated beams/holograms, nonlinear optics and modeling in Zemax®.
Prerequisite(s): PLT 3004.
Lectures / laboratory or tutorial five hours a week.

PLT 4003 [0.5 credit]
Materials Science
Properties and behavior of materials. Chemistry of materials, interactions between materials and laser energy, including organic and biological substances. Energetics, phases, equilibrium, kinetics in solids, crystals and polymers. Applications of high power laser systems, safety, materials in manufacturing and design. Nanomaterials and nanophotonics.
Prerequisite(s): PLT 3001, PLT 4001.
Lectures / laboratory or tutorial five hours a week.

PLT 4004 [0.5 credit]
Biomedical Photonics
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.
Prerequisite(s): PLT 3007.
Lectures / laboratory or tutorial four hours a week.

PLT 4005 [0.5 credit]
Fiber Optic Theory
Fundamentals of optoelectronics with application to fiber optic communications. Optical fibre: modes, losses, dispersion, splices and coupling to sources. Optical sources: LEDs and laser diodes. Optical detectors: photoconductor, pin and avalanche photodiodes. Optical receiver design. Fiber optic communications systems: intensity modulation/direct detection; coherent homodyne or heterodyne detection.
Prerequisite(s): PLT 4002.
Lectures three hours a week, laboratory three hours alternate weeks.

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.
Prerequisite(s): fourth-year standing.
Tutorial hours arranged.

Summer session: some of the courses listed in this Calendar are offered during the summer. Hours and scheduling for summer session courses will differ significantly from those reported in the fall/winter Calendar. To determine the scheduling and hours for summer session classes, consult the class schedule at central.carleton.ca

Not all courses listed are offered in a given year. For an up-to-date statement of course offerings for the current session and to determine the term of offering, consult the class schedule at central.carleton.ca