

Optical Science Engineering (OSE)

OSE 506 - COMMUNICATION THEORY

Semester Hours: 3

Review of elementary signals and systems including the Hilbert transform, cross and auto correlation, power density spectrum, and the Wiener-Khinchine theorem. Butterworth and Chebyshev lowpass filters. Bandpass signals and systems. The lowpass equivalent of a bandpass signal/system. Commonly used forms of linear and nonlinear modulation. Demodulation methods and circuits. Phase lock and frequency feedback techniques.

OSE 534 - OPTICAL FIBER COMMUNICATIONS

Semester Hours: 3

Introduction to optical fibers and their transmission characteristics, optical fiber measurements, sources and detectors, noise considerations for digital and analog communications, optical fiber systems.

OSE 541 - GEOMETRICAL OPTICS

Semester Hours: 3

Foundations and physics of geometrical optics, Fermat's principles and Huygen wavelets, refraction and reflection. The many forms of Snell's Law. Optical path lengths, geometrical wavefronts and rays. Ray tracing, ynu-chart and matrix methods. Gaussian imagery and paraxial optics, conjugate elements, cardinal points, and image-object relations. Stops and pupils, chief and marginal rays, vignetting, and the optical or Lagrange invariant. The y bar diagram, design of common systems: objectives, magnifiers, microscopes, collimators and detectors. Optical glasses and chromatic aberrations, wavefront and transverse aberrations, spot diagrams and ray fan plots.

OSE 542 - PHYSICAL OPTICS

Semester Hours: 3

Scalar and electromagnetic waves, polarization, coherence, reflection and refraction; two beam and multiple beam interference, interferometers, Fabry-Perots, thin films, diffraction, and absorption and dispersion. (Same as OSE 542 and EE 542.) Fall, Spring.

OSE 546 - RADIOMETRY, DETECTORS & SOURCE

Semester Hours: 3

Theory and practice of radiometry and photometry. Blackbody radiation and Lambertian sources. Propagation of radiant energy in free space and through optical systems. Detector classes, responsivity, bandwidth and noise, power spectral density, properties of sources, photon noise.

OSE 555 - INTRO QUANTUM MECHANICS I

Semester Hours: 3

Waves and particles; Bohr's model of the atom; de Broglie waves, wave packets and the uncertainty principle; postulates of quantum mechanics; Schroedinger's equation; simple systems in one, two and three dimensions; the hydrogen atom.

OSE 570 - OPT & PHOTONIC SYSTEMS DESIGN

Semester Hours: 3

Review of paraxial optics, ray tracing codes, aberration and diffraction calculations; acousto- and electro-optic modulators, spatial light modulators; fibers, fiber splicers and connectors; gratings and diffractive optical elements; laser and light emitting diodes, photodetectors and CCD arrays; correlator systems; optical communication networks; signal processing systems design.

OSE 632 - FOURIER OPTICS

Semester Hours: 3

Introducing the optical system as an invariant linear system, convolution, Sommerfield's diffraction integral, Fourier Transform, angular spectrum, coherent & incoherent imaging, optical transfer function.

OSE 634 - OPTICAL COMMUNICATIONS

Semester Hours: 3

Optical communication systems; counting statistics; the optical detector response process; direct detection; heterodyne detection parameter estimation in optical communications; pointing, spatial acquisition and tracking.

OSE 645 - LASERS

Semester Hours: 3

Resonant optical cavities. Atomic radiation. Laser oscillation and amplification. General characteristics of lasers. Laser excitation. Semiconductor lasers. Gas discharge phenomenon. Transition rates. Spectroscopy of common lasers. Detection of optical radiation.

OSE 653 - OPTICAL TESTING LAB

Semester Hour: 1

Provides students with hands-on experience via the in-depth testing of an aerial reconnaissance photographic lens. The main measurement tools are a 168-inch Collimator/T-Bar nodal slide for image plane measurements, and a Fizeau phase shifting interferometer for exit pupil measurements. Measurements include: effective focal length, F-number, axial color, spherical aberration, field curvature, distortion, astigmatism, transmission, relative illumination falloff, resolution, modulation transfer function, on-axis interferometry, fringe analysis. Prerequisite: OSE 654.

OSE 654 - OPTICAL TESTING

Semester Hours: 3

Spherometry; refractive index measurements; optical bench measurements of imaging systems via T-bar nodal slide (effective focal length, f-number, axial color, field curvature and distortion, transverse ray aberrations); illumination falloff; image resolution tests (finite object); modulation transfer function; star image testing; knife edge tests; Hartmann tests; Fizeau interferometer and testing configurations; null lens testing of aspheres; wavefront measurements (point diffraction interferometer, radial shear interferometer). Prerequisites: OSE 541 and OSE 542.

OSE 655 - APPLIED QUANTUM MECHANICS

Semester Hours: 3

Application of quantum mechanics in solid state, electronics, materials science and optics. Topics to include: Hydrogen atom and molecule, excitons, phonons, Bloch's theorem, periodic boundary conditions, electrons and holes, band structure of simple semiconductors, dipole transitions, optical constants, absorption and emission processes, introduction to device physics.

OSE 656 - LENS DESIGN

Semester Hours: 3

Design of refractive imaging systems. Skills acquired include thin lens pre-design, first and third order analytical methods, and computer-based design using Zemax. Designs include: Wollaston and Chevalier landscape lenses, a 10X microscope objective, the Rapid Rectilinear and Celor lenses, Cooke triplet and Petzval portrait lenses, and a telephoto lens. Prerequisites OSE 541 or EE 541 or PH 541 or Permission of Instructor.

OSE 670 - OPT DESIGN & MANUFACTURING

Semester Hours: 3

Practical aspects of optomechanical design, material selection, fabrication and integration of precision optical components and systems for commercial, space, and military application. Topics include: fixture design, tolerance analysis, machining methods, thermal stabilization, integrated computer-aided design and analysis, diamond machining, finishing and plating techniques.

OSE 690 - SEL TOPICS IN OPT SCI & ENGR

Semester Hours: 1-3

Sample topics include optical thin films and optical instrument systems analysis.

OSE 710 - OPTICAL SYSTEM DESIGN

Semester Hours: 3

Integrated view of what it actually takes to build a real optical system. All the tools of the trade are utilized, including conceptual design and computer modeling (optical and mechanical), control system design, fabrication issues, cost/schedule and system testing. Use of geometric and physical optics, radiometry, sources and detectors, electro-optics controlled positioning and feedback, environmental influences, optical systems architecture, optomechanical design, precision optics fabrication technologies, optical metrology, and operational and survivability testing.

OSE 742 - OPTICAL SCATTERING THEORY

Semester Hours: 3

Scattering and absorption of radiation by particles with spherical symmetry and arbitrary shapes described using Maxwell's equations, vector Helmholtz equations, the Jones and Mueller calculus, and numerical techniques. Prerequisites: PH 631, or EE 609, or ATS 561.

OSE 755 - QUANTUM DEVICES

Semester Hours: 3

Quantum aspects of optical, electronic, and semiconductor devices approached from a phenomenological/physical point of view. Topics will include: Quantum well devices, optical modulators, optical detectors, quantum Stark effects, electrooptic devices, high speed optical devices, frequency chirping in high speed devices and system applications.

OSE 790 - SEL TOPICS IN OPT SCI & ENGR

Semester Hours: 1-3

Sample topics include optical thin films and optical instrument systems analysis.

OSE 792 - OSE SEMINAR

Semester Hours: 0

This "brown bag" monthly seminar series is conducted jointly with the Huntsville Electro-Optical Society which sponsors the speakers. Presentations are given on a diverse range of optics and optics-related topics. All OSE students are expected to attend three of these seminars per semester.

OSE 799 - DOCTORAL DISSERTATION

Semester Hours: 3-9

Required each semester student is enrolled and receiving direction on a doctoral dissertation. The following optics courses are also available to students in the OSE program. See listings under indicated departments.