



2008-2009 Undergraduate Bulletin

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Contact

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Course Descriptions - Optical Engineering

Professors: Bunch, Ditteon, Duree, Granieri, Joenathan, Kirkpatrick, Kirtley, Lepkowicz, Letfullin, McInerney, Moloney, Siahmakoun, Syed, Wagner, and Western.

NOTE: In courses which include a laboratory, satisfactory completion of the laboratory work is required in order to pass the course.

OE 171 Photography and Holography 2R-OL-2C F

Introduce students to basic knowledge of optics, principles and operation of a camera, shutters, films, and film development, color photography, basic understanding of interference of waves, concept of holography, properties of various holograms, application of holography, and each student makes individual hologram that can be seen in sunlight.

OE 172 Optics in Technology 2R-OL-2C S

Introduction to the properties of lasers; types of lasers; characteristics of optical fibers, optical communication, applications of lasers and fibers in industry, medicine and commercial products; fundamentals of holography, applications in art and industry.

OE 280 Paraxial Optics 3.5R-1.5L-4C W Pre: PH 113

First order geometrical optics including image formation, y-nu ray tracing, cardinal points, stops and apertures, matrix methods and an introduction to optical instruments. Introduction to computer-aided analysis.

OE 290 Directed Research Credit arranged Pre: Consent of instructor

Research for freshmen and sophomore students under the direction of a physics and optical engineering faculty member. May earn up to a maximum of 2 credits for meeting the graduation requirements. The student must make arrangements with the faculty member for the research project prior to registering for this course.

OE 295 Optical Systems 3.5R-1.5L-4C S Pre: PH 113 and MA 221

Components of optical systems; introduction to lasers light and Gaussian beams; Optical fibers; Fiber optic systems; radiometry and photometry; optoelectronics; LEDs; optical sources; detectors; noise in detectors; CCD arrays, optical instruments.

OE 360 Optical Materials and Opto-Mechanics 4R-OL-4C F Pre: OE 295

Optical properties of materials, optical coatings, principles of opto-mechanical design, fold mirrors and prisms, tolerancing, specifications of optical components, lens and mirror mounting, kinematics systems, precision adjustments and control.

OE 392 Wave Optics & Coherence 4R-OL-4C Arranged Pre: PH 292, MA 222

Propagation of light, Fresnel equations; Fraunhofer and Fresnel diffraction; coherence; Fourier transforms, convolution and correlation; optical transfer function (OTF), modulation transfer function (MTF); speckles; holography, moire.

OE 393 Fiber Optics and Applications 3R-3L-4C W Pre: OE 295, PH 316 or ECE 341 or consent of instructor

Basic dielectric waveguide equations; wave optics and ray optics; step-index and graded-index fibers; single mode and multi-mode fibers; mode cutoff conditions; numerical aperture; fabrication of optical fibers; fiber measurements; fiber cable designs; source coupling, splices and connectors; fiber optic sensors; fiber optic components and systems.

OE 395 Optical Instrumentation 3R-3L-4C Arranged Pre: OE 280 and PH 292

Radiometry and photometry; optoelectronics; LEDs; optical sources; detectors; signal conditioning and noise; CCD arrays; optical instruments; color; selected experiments on the application of optical instruments.

OE415 Optical Engineering Design I 2R-6L-4C S Pre: OE 295 Coreq: RH330 or consent of the instructor

Principles of design. Codes of ethics appropriate to optical engineers. Case studies related to optical engineering professional practice, teamwork, contemporary issues, patents and intellectual property. Team-oriented design project work on selected topics in optical engineering. Introduction to product development practices, product research,

planning and project management. Preliminary design of a product and product specifications. Deliver a design document specific to customer needs and constraints.

OE416 Optical Engineering Design II 2R-6L-4C F Pre: OE 415

Design project, system-level design and detail design. Construction of a prototype product. Product development economics, costs and market research. Testing optical components and systems, electronic systems, optical measurement tools, mechanical measurements, opto-mechanics, and opto-electronics.

OE417 Optical Engineering Design III 2R-6L-4C W Pre: OE416

Continuation of OE416 design project. Delivery of a functional prototype product. Complete product development documentation including a technical report, design documents, product design specification, drawings, acceptance test document, project plan. Oral presentation.

OE 435 Biomedical Optics 4R-0L-4C W Pre: PH 113, MA 222, and SR/GR standing

Optical techniques for biomedical applications and health care; laser fundamentals, laser interaction with tissues, laser diagnostics and therapy, laser surgery, endoscopy and applications; fiber optics; fiber optic biosensors; microscopes; optics-based clinical applications. Same as BE 435.

OE 450 Laser Systems and Applications 3R-3L-4C S Pre: PH 292 and MA 222 or JR standing or consent of instructor

Laser safety; Gaussian beam propagation; cavity design; longitudinal and transverse modes; stimulated emission; population inversion; rate equations; gain and threshold; Q-switching and mode-locking; types of laser systems; laser applications in communication; medicine, military, industry.

OE 470 Special Topics in Optical Engineering 2-4 Credits Pre: Consent of instructor

Lectures on special topics in optics.

OE 480 Lens Design and Aberrations 4R-0L-4C F Pre: OE 280 Coreq: OE 360 or SR/GR standing or consent of instructor

Chromatic and third order aberrations, exact ray tracing, y-y bar diagrams as a design tool, methods for reducing aberrations in initial designs, optimization. Design of simple lens systems. Introduction to computer-aided design, design of optical systems including camera lenses, mirror systems and catadioptric systems.

OE 485 Electro-Optics and Applications 3R-3L-4C W Pre: PH 292 and PH 316 or SR/GR standing or consent of instructor

Optical wave propagation in anisotropic media; normal surface, birefringence, index ellipsoid, optical activity, Faraday rotation, Pockels and Kerr effects, electro-optic modulators, electro-optic effect in liquid crystals, photorefractive effect, acousto-optic effect and modulators, second-harmonic generation, optical phase-conjugation and applications.

OE 490 Directed Research Credit arranged Pre: Consent of instructor

Research for junior and senior students under the direction of a physics and optical engineering faculty member. May earn a maximum of 8 credits between PH/OE 290 and PH/OE 490 for meeting graduation requirements. Maximum of 4 credits per term. The student must make arrangements with the faculty member for the research project prior to registering for this course.

OE 493 Fundamentals of Optical Fiber Communications F 3R-3L-4C Pre: OE393, ECE310, graduate standing or consent of the instructor

Analysis and design of common fiber optic communication systems and optical networks. Transmission penalties: dispersion, attenuation. Optical transmitters and receivers: fundamental operation and noise. Intensity and phase modulation. Optical amplification: types of amplifiers, noise and system integration. Point-to-point links: power budget and rise-time analysis. Performance analysis: BER and eye diagrams. WDM concepts and components: multiplexers, filters, common network topologies. Soliton propagation. Relevant laboratories

OE 495 Optical Metrology 3R-3L-4C F Pre: PH 292 or SR/GR standing or consent of instructor and Co-Req OE 480

Optical testing: geometrical test methods (refractometers, knife edge, Ronchi, Wire, Hartmann); review of interference and coherence; fringe visibility; conventional interferometers (Newton, Fizeau, Twyman-Green and shearing); fringe localization; phase shifting, holographic, Moire, photoelastic and speckle interferometry; emerging optical methods.

OE 497, OE 498, OE 499 Senior Thesis 1-2C F,W,S Pre: Consent of PHOE faculty

Literature search, research proposal preparation, and laboratory project work. This

sequence is designed to result in a completed senior thesis or initiation of research to be completed in an MSOE degree at Rose-Hulman.

GRADUATE COURSES

Note: SR/GR standing is required for enrolling in the following 500-level courses.

OE 520 Principles of Optics 2R-0L-2C F Pre: OE 295, PH 292, PH 316 or SR/GR standing or consent of instructor

Classical optics; exact ray tracing; aberrations, interference, polarization, spatial and temporal coherence; lasers and Gaussian beam propagation; diffraction; optical sources and detectors; selected applications of optics.

OE 535/BE 535 Biomedical Optics 4R-0L-4C W Pre: PH 113, MA 222 or SR/GR standing or consent of instructor

Optical techniques for biomedical applications and health care; laser fundamentals, laser interaction with tissues, laser diagnostics and therapy, laser surgery, endoscopy and applications; fiber optics; fiber optic biosensors; microscopes; optics-based clinical applications. For graduate credit, students must do additional project work on a topic selected by the instructor.

OE 570 Special Topics in Optics 2 or 4C F,W,S Pre: OE 295, PH 292, and PH 316

Lectures on special topics in optics such as: optical materials, optics of thin films and infrared optics.

OE 580 Lens Design and Aberrations 4R 0L 4C F Pre: OE 280 or SR/GR standing or consent of instructor

Chromatic and third order aberrations, exact ray tracing, y y bar diagrams as a design tool, methods for reducing aberrations in initial designs, optimization. Design of simple lens systems. Introduction to computer aided design, design of optical systems including camera lenses, mirror systems and catadioptric systems. For graduate credit, students must do additional project work on a topic selected by the instructor.

OE 585 Electro Optics and Applications 3R 3L 4C W Pre: PH 292 and PH 316 or SR/GR standing or consent of instructor

Optical wave propagation in anisotropic media; normal surface, birefringence, index ellipsoid, optical activity, Faraday rotation, Pockels and Kerr effects, electro-optic modulators, electro-optic effect in liquid crystals, photorefractive effect, acousto-optic effect and modulators, second-harmonic generation, optical phase-conjugation and applications. For graduate credit, students must do additional project work on a topic selected by the instructor.

OE 592 Fourier Optics and Applications 3R-3L-4C F Pre: SR/GR standing or consent of instructor

Two-dimensional linear systems; diffraction theory (Fresnel & Fraunhofer); imaging properties of lenses; frequency analysis of optical imaging systems; spatial filtering; optical information processing; Vander-Lugt filters; wavefront reconstruction; holography; optical computing.

OE 593 Fundamentals of Optical Fiber Communications 3R-3L-4C S

Pre: OE393 or graduate standing or consent of the instructor

Evolution of fiber optics links and networks: information rate, evaluation of fiber optic systems, optical fiber transmission link. Digital transmission systems: point-to-point links, line coding, error correction. Analog systems: links, dynamic range, noise figure, bandwidth, carrier-to-noise, multi-channel transmission, cross talk. WDM concepts: operational principles, passive components, system considerations. Optical networks: network topologies, performance of linear bus, performance of star architecture, SONET, WDM networks, wavelength-routed networks, optical CDMA, ultra high capacity WDM networks, bit-interleaved optical TDM, time-slotted optical TDM.

Students enrolled in OE593 must do project work on a topic selected by the instructor.

OE 594 Guided-Wave Optics 3R-3L-4C S Pre: OE 485 or SR/GR standing or consent of instructor

Theory of optical waveguides; waveguide modes; fabrication techniques; input and output coupling techniques; waveguide losses; waveguide gratings; electro-optic modulators; integrated optical detectors; applications of integrated optics.

OE 595 Optical Metrology 3R 3L 4C F Pre: PH 292 or SR/GR standing or consent of instructor and Co-Req OE 480

Optical testing: geometrical test methods (refractometers, knife edge, Ronchi, Wire, Hartmann); review of interference and coherence; fringe visibility; conventional interferometers (Newton, Fizeau, Twyman-Green and shearing); fringe localization; phase shifting, holographic, Moire, photoelastic and speckle interferometry; emerging optical methods. Students must do additional project work on a topic selected by the instructor.

OE 599 Thesis Research

Graduate students only. Credits as arranged; however not more than 12 credits will be applied toward the requirements for the MS (OE) degree.

