Optical Engineering and Instrument Design Certificate Programs

University of California Irvine
University Extension

UNIVERSITY OF CALIFORNIA, IRVINE

UNIVERSITY EXTENSION

CERTIFICATE PROGRAMS IN

Optical Engineering and Instrument Design

Program Description

Optical components are critical in today's most advanced technological systems and are common requirements in many industries including, defense, medical, clean energy, nanotechnology, automotive, electronics, communications, entertainment, computers and an ever increasing number consumer products. A wide range of systems from lasers that perform delicate surgery to those that slice through metals and from cell phones cameras to advanced unmanned defense systems, all rely on optical technologies. Companies have an ever increasing need to find professionals with optical engineering and design skills.

The Optical Engineering and Instrument Design certificate programs are unique in the world. These programs will prepare you for careers in fast-moving and exciting technology fields. Graduates of these programs are needed to meet industry's growing demand for engineers and designers who are skilled in the analysis and development of advanced optical and opto-mechanical systems. Attendees gain foundational knowledge and design experience including the use of industry standard optical and optomechanical design software that gives them skills that can be applied immediately within their organizations or can help them transition to a new career.

Graduates of these programs also effectively bridge the gap between mechanical and optical designers so they can improve collaboration on projects that have both optical and mechanical requirements, saving teams time and money. They can also apply their skills directly into careers related to their educational majors invloving health care technology, remote optical sensing, imaging technology, communication systems, aerospace and defense and allied technical, research and scientific fields.

Program Benefits

- Acquire essential working knowledge of optical engineering and design.
- Gain useful insights and practical skills for designing and engineering optical and optomechanical components and instruments.
- Learn about the latest technologies in optical engineering including new optical materials with mechanical structures and the latest cost effective manufacturing techniques.
- Develop skills with industry standard optical and mechanical software tools.
- Learn to develop innovative approaches for optical instrument design and analysis.
- Hands-on design courses provide skills in manual design, computer simulation, and the art of creating optical systems.
- Bridge the gap for improved collaborations between optical and mechanical design engineers.
- Learn how to understand and effectively communicate details of optical and opto-mechanical technical specifications to manufacturers' quality control personnel.
- Enhance your marketability with a practical credential.
- Learn form practicing professionals in the industry

The curriculum is designed to allow students with little or no optics background to start from the beginning. The programs offer introductory optics, lasers, fiber optics, mechanical, motion and vibration control elective courses.

To receive the Optical Engineering Certificate a student needs to complete 3 required courses and 2 elective courses. For the Optical Instrument Design Certificate, the student needs to complete 3 elective courses and an additional 2 required courses. One elective course may be used to satisfy both certificate requirements; so a student may receive both certificates with 9 courses total.

Who Should Attend

These programs are intended for engineers and senior technicians who have a desire to move into this exciting field and those already in this or related fields who would like to increase their career options and job stability.

These programs will benefit students who wish to distinguish themselves across a wide range of employment and technical disciplines and want to learn and practice the science and art of optical engineering and instrument design. Students who want to have a complete working knowledge of the optical instrument design process from concept through to a finished engineering design package ready for manufacturing should consider completing the optical instrument design certificate program.

Individuals who want to have a working knowledge of any particular component of these programs should complete those courses that apply to their interests. All students taking the required courses will be allocated a current network license for the design software being used in each course. Additional design software programs may be reviewed by the instructor and other qualified representitives. To accommodate the busy schedules of these professionals, courses will be taught either in the evenings or on weekends.

Certificate Candidacy

The program is open to senior technicians, engineers, college and university students, faculty and staff and others with equivalency in education or work experience with consent of the lead instructor and advisory committee chair. An Application for Candidacy must be submitted before the completion of the third course in the program.

Certificate Requirements

An Optical Engineering certificate is awarded upon completion of 15 credit units: 3 required courses (3 units each), at least two elective courses (a minimum of 6 units total). A grade point average of "B" or better is required.

An Optical Instrument Design certificate is awarded upon the additional completion of 12 credit units: 2 required courses and at least two more elective courses (3 more elective courses if the Optical Engineering Certificate was not completed based on previous equivalency.)

Optical Engineering and Instrument Design Certificate Programs

COURSE SEQUENCE

Department	Course Number	Course Title	Units
Prerequtise Courses Optical Engineering Program			
ELECTRICAL ENGINEERING and COMPUTER SCIENCE	EECS_X493	Introduction to Lens Design	3
Required Courses Optical Engineering Program (9 units)			
ELECTRICAL ENGINEERING and COMPUTER SCIENCE	EECS_X493.1	Advanced Lens Desgin	3
ELECTRICAL ENGINEERING and COMPUTER SCIENCE	EECS_X496	Optical Systems Design I	3
ELECTRICAL ENGINEERING and COMPUTER SCIENCE	EECS_X496.1	Optical Systems Design II	3
Required Courses for Optical Instrument Desgin (6 units)			
ELECTRICAL ENGINEERING and COMPUTER SCIENCE		Optical Mechanical Component Design	3
ELECTRICAL ENGINEERING and COMPUTER SCIENCE		Optical Instrument Design	3
Elective Courses for both Programs			
ELECTRICAL ENGINEERING and COMPUTER SCIENCE	EECS_X496.51	Geometrical Optics	3
ELECTRICAL ENGINEERING and COMPUTER SCIENCE	EECS_X496.52	Physical Optics	3
ELECTRICAL ENGINEERING and COMPUTER SCIENCE		Introduction to Lasers	3
ELECTRICAL ENGINEERING and COMPUTER SCIENCE		Introduction to Fiber Optics	3
ELECTRICAL ENGINEERING and COMPUTER SCIENCE		Introduction to Solid Works	3
ELECTRICAL ENGINEERING and COMPUTER SCIENCE	EECS_X493.54	Precision Positioning & Motional Control for Optical Systems	3
ELECTRICAL ENGINEERING and COMPUTER SCIENCE		Introduction to Vibration Control	3

CERTIFICATE PROGRAMS IN

Optical Engineering and Instrument Design

Required Courses:

Lens Design Part I
EECS_ X493

This is an introductory hands-on lens design course. Until recently, lens design was a skill reserved for a few professionals, but today with readily available commercial design software and powerful personal computers, it is accessible to the general optical engineering community. Consequently some skill in lens design is now expected by a wide range of employers who utilize optics in their products. Lens design is, therefore, a strong component of a well-rounded education in optics, and a skill valued by industries employing optical engineers and technicians.

Lens Design Part II
EECS_X493.1

In this course, the students learn about merit functions and how to contrast and use them to optimize their lens designs, set parametric variables and boundary constraints. More complex lens designs are reviewed in detail such as achromatic and multi-element lens systems.
Prerequisite: Lens Design Part I

Optical System Design Part I
EECS_X496

This course then begins with modeling using coordinate breaks so that students can model components such as beam splitters, mirrors, tilts and decenters. Then modeling with multi-configuration systems such as interferometers, mutli-channel systems, zoom lenses, scanning and gradient index systems are reviewed.
Prerequisite: Lens Design Part II

Optical Systems Design Part II
EECS_X496.1

Various default and custom merit functions for mutli-configured systems are reviewed with optimizations based on different parameters such as MTF, RMS and PTV. System analysis using geometric and diffraction optical parameters are reviewed with spot size, ray fan, OPD diagrams, field curvatures/distortion and aberrations as means to determine the optical performance of a system. Thermal analysis and system athermalization are introduced and used to design systems that can operate over a wide range of temperatures. System Tolerancing including error budgets, construction and assembly errors, passive and active compensators, Monte Carlo statistical tolerance analysis, test plate fitting and alignment design and analysis. Physical optics is also introduced using Gaussian beam propagation, analysis and control and beam characterization for use with laser systems**.**
Prerequisite: Optical System Design Part I

Opto-mechanical Component Design
EECS_X

Current state-of-the-art optical and mechanical system design engineering tools like are used to bring our students to the level of professionalism required by employers. It is rare to find a person skilled in both optical and optomechanical engineering, which is a growing demand of employers, especially those in small companies and start-ups. This Optomechanical component design course begins the process of teaching about the performance specifications required in the preliminary designs of Optomechanical components that the optical elements are mounted. Exporting the optical designs from the optical design software tools into Optomechanical design software tools is an important step. Material selection for optical and mechanical components is reviewed, followed by various optical component mounting techniques for lenses, prisms, mirrors, filters and windows.
Prerequisite: Intro Lens Design and Intro SolidWorks

Optical Instrument Design
EECS_X

Once students complete the Optomechanical component design course, they are ready for the final course in the program that pulls all the material together and design complete optical instruments. Here the students can integrate the concept of tolerancing of optical and mechanical components as one complete integrated system. This course includes learning about design lens assemblies with moving parts, 'wrapping' mechanics around the complete optical system model, stray light considerations and packaging the complete system. There are also lessons on instrument alignment strategies and procedures and final system test considerations.
Prerequisite: Optomechanical Component Design

The following Elective Courses are generally held on three consecutive Saturdays in a give month. Basic algebra, trigonometry, geometry and physics are prerequisites.

Geometric Optics
EECS_X496.51

This course is intended for students intending to use optics and photonics and to introduce them to the design and use of optical components and systems. This course surveys geometrical optics covering prisms, lenses, mirrors and gratings for their use in optical systems. Selection of materials for optics is described. Special topics may include optics of aspherics, crystals and magneto-optic isolators. An introduction to eyeball optics, telescopes, microscopes, interferometers and other optical instruments is covered.

Physical Optics
EECS_X496.52

This is part 2 of the beginning course in optics and introduces the principles and nature of optical phenomenon in systems. This course surveys physical optics covering diffraction, interference and polarization as they are observed in nature and used in optical systems. Introductory and some complex concepts are reviewed both mathematically and experimentally. The classes will be a balanced mix of lectures and hands-on laboratory experiments. This course is intended for students who wish to enter a field where optics is used.

Introduction to Lasers
EECS_X

This course is intended to expose students to the basic physical and engineering principles of lasers and review different types of lasers. Topics include spontaneous and induced transitions between atomic levels, absorption and amplification, optical resonators, Gaussian beams, three- and four-level lasers, mode-locked and Q-switched lasers, and specific laser systems: Nd:YAG and other solid-state lasers; He-Ne, argon-ion, carbon dioxide lasers and other gas lasers; semiconductor diode lasers; and laser applications.

Introduction to Fiber Optics
EECS_X

This course introduces the student to the properties of light, characteristics and control of LEDs (light emitting diodes) and lasers, fabrication of optical fiber, transmission of information via light, and fiber-optic transmission networks are covered. Topics emphasize devices, system analysis and design, including internal and external laser modulation, light coupling to fiber, fiber waveguide dispersion, attenuation and scattering phenomena, connectors, couplers, splitters, amplifiers, photo detectors, and receivers for digital and analog applications. Class will analyze and design a fiber optic link.

Introduction to SolidWorks
EECS_X

3D CAD solids modeling instruction topics include: parts, assemblies, documentation, drawings, structural weldments, photorealistic rendering, animation, simple static stress analysis, and the SolidWorks DWG editor),demonstrate SolidWorks 2007-2008 w/Smartfeatures, and also – some specific information about OptoMechanical Design.

Precision Positioning & Motion Control for Advanced Optical Systems
EECS_X493.54

Micro and Nano positioning solutions for advanced optical systems are key to many high-tech instruments in many fields. This course provides the fundamentals for understanding these key motion control technologies as they are used in different technology fields from semiconductors to biotechnology and telecommunications.

Introduction to Vibration Control
EECS_X

Course description coming soon.

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College of Engineering

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