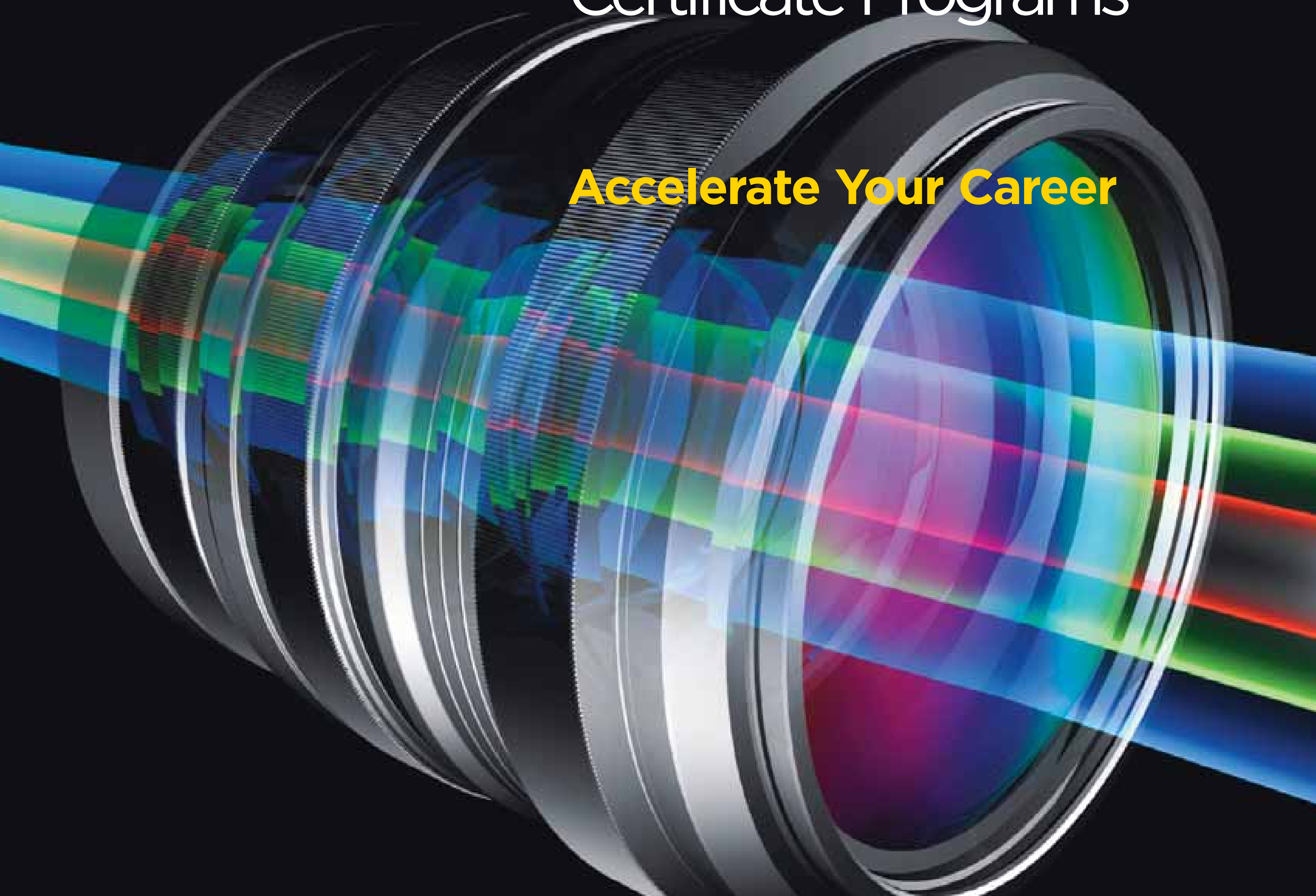
UCI Division of Continuing Education

Engineering Programs

Optical Engineering and Optical Instrument Design Certificate Programs



Accelerate Your Career

ce.uci.edu/optics

University of California, Irvine

Improve Your Career Options with a Professional Certificate

UCI Division of Continuing Education's professional certificate and specialized studies programs help you increase or enhance your current skills or prepare for a new career. Courses are highly practical and instructors are qualified leaders in their field. Convenient online courses make it easy to learn on your own time, in your own way. A certificate bearing the UC seal signifies a well-known, uncompromising standard of excellence.

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Optical Engineering Certificate Program

An increasing amount of today's consumer, industrial and business products incorporate lenses and optical systems. These are essential to virtually every industry including defense, medical, clean energy, nanotechnology, automotive, electronics, communications, entertainment, computers, and consumer products. The **Optical Engineering Certificate Program** addresses the growing demand for skilled professionals who can conceptualize, design, and manufacture optical components and systems.

Who Should Enroll

The **Optical Engineering Program** gives students the skills and experience needed to enter this growing field. The program will benefit entry and mid-level professionals who need to broaden their knowledge and improve their career options.

Program Benefits

- Gain useful insights and practical skills for designing and engineering optical components and systems
- Explore the latest technologies in optical engineering including new optical materials and the latest cost effective manufacturing techniques
- Develop skills with industry standard optical software tools
- Discover innovative approaches for optical engineering and analysis
- Learn through hands-on design courses which provide skills in manual design, computer simulation, and the art of creating optical components and systems
- Understand and effectively communicate details of optical technical specifications to manufacturer's and quality control personnel

Certificate Eligibility and Requirements

Candidates should complete EECS X496.51 Geometrical Optics and EECS X496.52 Physical Optics or possess equivalent experience or education. **Candidates that choose to take both courses may count one as an elective course.**

A certificate is awarded upon completion of 15 credit units (9 required and 6 elective credit units) with a grade of "C" or better in each course.

To become an official candidate in the program, students pursuing the certificate must submit a **Declaration of Candidacy**. To receive the certificate after completing all program requirements, students must submit a **Request for Certificate**. All requirements must be completed within 5 years after the student enrolls in his/her first course. Students not pursuing the certificate program are welcome to take as many individual courses as they wish.

Optical Engineering Program Fees

The total cost of the program varies depending on the elective and prerequisite courses chosen. Actual fees may differ from the estimate below. Fees are subject to change without prior notice.

Course Fees (6 prerequisite, 9 required and 6 elective units)	$5,055
Candidacy fee	$125
Textbooks and Materials	$975
Total Estimated Cost	**$6,155**

Register for a membership with the Optical Society of Southern California to receive 15% off r**equired courses**.

OPTICAL SOCIETY OF SOUTHERN CALIFORNIA

Optical Instrument Design Certificate Program

An increasing amount of today's consumer, industrial and business products incorporate optomechanical systems. These are essential to virtually every industry including defense, medical, clean energy, nanotechnology, automotive, electronics, communications, entertainment, computers and consumer products. The **Optical Instrument Design Certificate Program** builds on optical systems engineering skills gained in the Optical Engineering Program and address the growing demand for skilled professionals who can conceptualize, design, and manufacture these optical and optomechanical components, systems,and instruments.

Who Should Enroll

The **Optical Instrument Design Program** provides advanced study options for experienced optical engineering professionals allowing them to address a wider range of optical and optomechanical design issues. The elective courses provide an opportunity for students to develop specialized skills related to their professional needs or personal interests.

Program Benefits

- Gain useful insights and practical skills for designing and engineering optomechanical components and instruments
- Explore the latest technologies in optical engineering including new optomechanical materials and the latest cost effective manufacturing techniques
- Develop skills with industry standard optical and mechanical software tools
- Discover innovative approaches for optical instrument design and analysis
- Learn through hands-on design courses which provide skills in manual design, computer simulation, and the art of creating optical instruments
- Understand and effectively communicate details of optical & optomechanical technical specifications to manufacturer's and quality control personnel

Certificate Eligibility and Requirements

Candidates should complete EECS X496.51 Geometrical Optics and EECS X496.52 Physical Optics or possess equivalent experience or education. **Candidates that choose to take both courses may count one as an elective course.**

A certificate is awarded upon the completion of 15 credit units (6 required and 9 electives credit units), with a grade of "C" or better in each course.

To become an official candidate in the program, students pursuing the certificate must submit a **Declaration of Candidacy**. To receive the certificate after completing all program requirements, students must submit a **Request for Certificate**. All requirements must be completed within 5 years after the student enrolls in his/her first course. Students not pursuing the certificate program are welcome to take as many individual courses as they wish.

Optical Instrument Design Program Fees

The total cost of the program varies depending on the elective and prerequisite courses chosen. Actual fees may differ from the estimate below. Fees are subject to change without prior notice.

Course Fees (6 prerequisite, 6 required and 9 elective units)	$5,025
Candidacy fee	$125
Textbooks and Materials	$945
Total Estimated Cost	**$6,095**

Register for a membership with the Optical Society of Southern California to receive 15% off **required courses**.

OPTICAL SOCIETY OF SOUTHERN CALIFORNIA

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Curriculum

OPTICAL ENGINEERING		
COURSE#	**PREREQUISITE COURSES**	**UNITS**
EECS X496.51	Geometrical Optics#	3
EECS X496.52	Physical Optics#	3
COURSE#	**REQUIRED COURSES**	**UNITS**
EECS X493	Introduction to Lens Design	3
EECS X493.1	Advanced Lens Design	3
EECS X496	Optical Systems Engineering	3
COURSE#	**ELECTIVE COURSES (Minimum 6 units)**	**UNITS**
EECS X496.53	Optical Metrology and Interferometry*	3
EECS X497	Optomechanical Component Design	3
EECS X498	Optical Instrument Design	3
EECS X493.55	Introduction to Lasers	3
EECS X493.56	Introduction to Fiber Optics	3
EECS X499	Optomechanical Systems Engineering	3
EECS X493.58	Vibration Control for Optomechanical Systems	3
EECS X494.1	Introduction to Radiometry: The Propagation and Measurementof Optical Radiant Energy	3

OPTICAL INSTRUMENT DESIGN		
COURSE#	**PREREQUISITE COURSES**	**UNITS**
EECS X496.51	Geometrical Optics#	3
EECS X496.52	Physical Optics#	3
COURSE#	**REQUIRED COURSES**	**UNITS**
EECS X498	Optical Instrument Design	3
EECS X499	Optomechanical Systems Engineering	3
COURSE#	**ELECTIVE COURSES (Minimum 9 units)**	**UNITS**
EECS X496.53	Optical Metrology and Interferometry*	3
EECS X497	Optomechanical Component Design	3
EECS X493.55	Introduction to Lasers	3
EECS X493.56	Introduction to Fiber Optics	3
EECS X493.58	Vibration Control for Optomechanical Systems	3
EECS X493	Introduction to Lens Design	3
EECS X493.1	Advanced Lens Design	3
EECS X496	Optical Systems Engineering	3
EECS X494.1	Introduction to Radiometry: The Propagation and Measurementof Optical Radiant Energy	3

#Course requires hardware or software, please refer to online listing for details.
*Course can be taken at Irvine Community College (IVC) http://academics.ivc.edu/physci/photonics.
Submit final transcripts to UCI Division of Continuing Education department for transfer credit after course completion.

Curriculum

Geometrical Optics

EECS X496.51 (3 units)

In this course you will be introduced to the principles and use of optical components and systems. This course surveys geometrical optics covering plan surfaces, prisms, spherical surfaces, lenses, and mirrors for use in optical systems. Special topics include optical instruments like telescopes, microscopes, beam projectors, cameras and optical measuring benches. The classes will provide a balanced mix of lectures and hands-on laboratory experiments for those that are interested in entering fields where optics are used.

Physical Optics

EECS X496.52 (3 units)

Learn about the principles and use of optical components and physical optics systems. Gain knowledge about diffraction grating, polarizers, interference filters, and other similar components for use in optical systems. Special topics include optical instruments such as spectroscopes, polariscopes, interferometers, and related optical measuring systems. Offers a balanced mix of lectures and hands-on laboratory experiments.

Introduction to Lens Design

EECS X493 (3 units)

This practical, hands-on course will provide you with the fundamental principles in optical lens design. Participants will learn how to design various lenses from simple landscape lens to the complex triplet. The knowledge and skills achieved in this course will prepare participants for advanced level study in optical design. Topics include: review of geometric optics, image formation, paraxial ray tracing, aberration theory, analysis, manual pre-design calculation, design principles, modeling with optical design software, image evaluation such as spot diagram, Strehl ratio, MTF, etc. During the course of the class students will have access to industry standard software for optical design. *Prerequisites: College level algebra, physics and familiarity with optics or equivalent experience.*

Advanced Lens Design

EECS X493.1 (3 units)

Understand optical systems with first and third order analysis. Explore design principles such as bending, symmetry, stop shift, and lens splitting. Apply these principles to various optical systems with tolerancing. Learn advanced lens designs for photographic systems, telecentric lenses, zoom systems, microscopes, and telescopes.

Optical Systems Engineering

EECS X496 (3 units)

Examine the fundamentals of systems engineering as applied to the design of optical, infrared, and laser systems. Understand requirements analysis, trade studies, error budgets, requirements flow down, component specifications, and vendor selection. Develop first-order models for the radiometric, optical source, focal plane array, and overall performance of an optical system. Quantify radiometric performance using etendue and stray light analysis. Compare FPA types and properties. Predict MTF and SNR performance combining optical, source, and FPA parameters. Explore detector-selection specifications and tradeoffs. Examine component fabrication and STOP analysis.

Optical Metrology and Interferometry

(OFFERED AT IVC - Irvine Community College)*

EECS X496.53 (3 units)

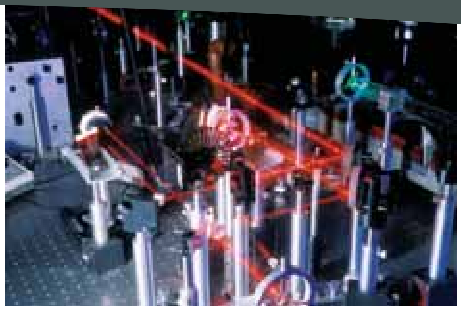
This course is a hands-on laboratory course that will detail the measurement techniques required to ensure that a fabricated assembly or system meets its procurement specifications. It covers the design and application of optical metrology instrumentation such as interferometers and modulation transfer function measurement systems. Emphasis in on test applications that are required in optical engineering and manufacturing. Students will gain hands-on experience with industrial hardware and tools in the laboratory.

*NOTE: Course is offered at Irvine Community College (IVC) - LET 235: Metrology of Optical Systems http://academics.ivc.edu/physci/photonics/. Course is a semester course offered over the WINTER and SPRING term. Students who are taking courses at UCI DCE in the Optics Programs and wish to pursue this course must apply to IVC and then will submit final transcripts to UCI DCE department for transfer credits after course completion. You will need to contact IVCphotonics@ivc.edu for course details.

Optomechanical Component Design

EECS X497 (3 units)

This introductory course fills the gap between optical and mechanical engineering by training students to integrate the optical and mechanical component designs. Students will learn how to ensure their designs can be reliably manufactured and that the built and assembled optical and mechanical components perform to the original designed and modeled system. Students learn to integrate and tolerance optical and mechanical components into subsystems by exporting the optical model into the mechanical design software and performing assembly design.



Introduction to Lasers

EECS X493.55 (3 units)

Learn about 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 X493.56 (3 units)

This course will introduce 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. Learn about a working knowledge of fiber optics and photonics, measurement and testing, and their applications in modern optical systems. 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.

Optomechanical Systems Engineering

EECS X499 (3 units)

Utilize the basic concepts and terminology of optical engineering required for the development of optomechanical components. Read conventional and ISO-10110 drawings used for the fabrication of lenses. Develop an alignment plan with an emphasis on critical tolerances, alignment mechanisms, and “go-no-go” decisions for adjusting tilt, decenter, despace, and defocus. Quantify the ability of a structural design to maintain alignment using efficient architectures and lightweight materials. Utilize the results of STOP (structural-thermal-optical) analysis for the structural deflection and distortion of optical components under static loads. Estimate the effects of vibration environments on the alignment of optomechanical systems; select COTS components for vibration isolation. Predict the effects of conductive, convective, and radiative thermal environments on the performance of optical systems; select materials and off-the-shelf hardware to manage the effects of heat loads and temperature changes. Compare kinematic and semi-kinematic mounts and the limitations of COTS hardware.

Vibration Control for Optomechanical Systems

EECS X493.58 (3 units)

The course will discuss ways in which vibration may affect optical performance, as well as methods and means of reducing this impact. Principal methods of vibration control, such as damping and isolation will be discussed using mathematical models and real life examples. Vibration measurements and environmental standards will be presented as applicable to optomechanical systems. State-of-the art vibration control systems will be reviewed, including pneumatic and elastomeric isolators, damping treatments and active control systems.

Introduction to Radiometry: The Propagation and Measurement of Optical Radiant Energy

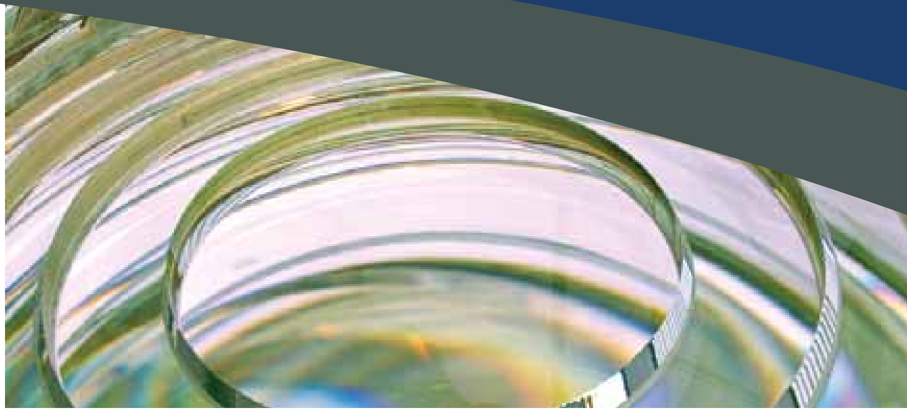
EECS X494.1 (3 units)

This course presents the basic quantities and units of radiometry and photometry, followed by radiometric propagation laws and approximations that allow calculation of optical radiant power transferred from a source to a receiver. The equation of radiative transfer is introduced, and simplifications are presented that allow the solution of many practical problems. The course covers source properties, blackbody radiation laws and approximations, and properties of optical materials including transmission, reflection, absorption, and emission. It also introduces detectors of optical radiant energy, figures of merit for visible and infrared systems, and radiometric calibration. We will use all of these components to develop a top-level radiometric system design that you can use within your present company or a start-up business.

Optical Instrument Design

EECS X498 (3 units)

Learn how to design optical instruments from a top level, tradeoffs-driven perspective. We will initially focus on the classic optical instruments: spectrometers, interferometers, telescopes and microscopes, using examples of each to gain understanding on how real world customer requirements and specifications often drive difficult choices in aperture, focal and track lengths, resolution and finesse. Guest lecturers will add world class expertise and insights into these topics. The course wraps up with a series of discussions on advanced instrument topics, and how these same choices are being made in state-of-the-art instruments today. Students would be well advised to have a firm understanding of geometrical and physical optics. While expertise in raytracing is helpful, it will not be essential for this course. The course text, “*Optical Instrument Design*” by Fischer will be mainly used as reference, as will a number of other books listed in the syllabus.



Advisory Committee

Ed Arriola, Chief Engineer, II-VI Optical Systems

Arnie Banzensky, Field Sales Manager, Schott Glass Technologies

Valentina Doushkina, M.Sc., Principal II Optical Systems Engineer, R&D, Vitreo/Retinal Surgical Instrumentation, ALCON

Derek Dunn-Rankin, Ph.D., Professor and Chair, Mechanical & Aerospace Engineering, University of California, Irvine

Mark Gallagher, Ph.D., J.D, Partner, Knobbe, Martens, Olson & Bear, LLP

Joshua Jo, Ph.D., Principle Engineer, Samsung Electro-Mechanics

Keith J. Kasunic, Ph.D., Technical Director, Optical Systems Group LLC

Gregory Klotz, Opto-Mechanical Design Engineer, nanoPrecision Products

G.P. Li, Ph.D., Professor, School of Engineering; Director, California Institute for Telecommunications & Information Technology, University of California, Irvine

Brian Monacelli, Ph.D., Optical Engineer, Jet Propulsion Laboratory; Photonics Instructor, Irvine Valley College

Forrest Reynard, CEO, Reynard Corporation, Advanced Optical Solutions

T. Scott Rowe, Principal, Rowe Technical Design

Donn M. Silberman, M.S., Founding Director, Optics Institute of Southern California, Sr. Applications Engineer, PI (Physik Instrumente); Board President, STEMBILITY

James D. Trolinger, Ph.D., Co-Founder, MetroLaser, Inc.

Bruce Tromberg, Ph.D., Professor, Biomedical Engineering; Director, Beckman Laser Institute, University of California, Irvine

Wytze van der Veer, Ph.D., Senior Director of Laser Engineering, Cutera Inc.

Desiré Whitmore, Ph.D., Mentorship Chair and founding board member, CABE; Assistant Professor, Irvine Valley College Photonics Technology Program

Academic Management

Dave Dimas, Ph.D., Director, Engineering, Sciences and Information Technologies

Optical Engineering Optical Instrument Design Certificate Program

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UCI Division of Continuing Education

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