All Fields Report

Basic Course Information	
College	Cañada College
Discipline	PALT-Photonics and Laser Technology
Course Number	404
Full Course Title	Wave Optics
Catalog Course Description	An introductory hands-on course in wave optics describing the properties of light and its interaction with objects using wave equations. Topics Include: concepts of superposition, polarization, interference and diffraction; the interaction of light waves with small objects such as wires, apertures and multilayered coatings; mathematical techniques needed to quantify interactions.
Class Schedule Course Description	An introductory hands-on course in wave optics describing the properties of light and its interaction with objects using wave equations. Topics Include: concepts of superposition, polarization, interference and diffraction; the interaction of light waves with small objects such as wires, apertures and multilayered coatings; mathematical techniques needed to quantify interactions.
Proposal Information	
Proposed Start	Year: 2021 Semester: Fall
Proposed Curriculum Committee Meeting Date:	01/22/2021
Deadline for submission to Dean's Queue:	12/17/2020
Deadline for submission of curriculum proposal to the Technical Review Committee:	12/29/2020
Proposal Origination Date:	10/13/2020
Justification For Board Report OR Curriculum Inventory update:	1. For NEW Courses: Provide a brief justification statement describing the need for the course, its place in the curriculum, and pertinent information such as the role of advisory committees. New courses require approval of the SMCCCD Board of Trustees. The justification statement will be included on the annual Curricular Board report. Use complete sentences and present tense. 2. For all types of Course MODIFICATIONS (modifications, banking, deletions and reactivations): Provide a brief justification statement describing the need for the change. The justification statement will be used for course updates in the State Curriculum Inventory as necessary. Use complete sentences and present tense. The course content is recommended by the Advisory Board. It provides students with necessary hands-on skills to assemble, align and analyze optical systems based on principles of wave phenomenon. This course is a core requirement for the Certificate of Achievements in Photonics and Laser Technology and in Advanced Photonics and Laser Technology.
Honors Course	No
Open Entry/Open Exit	No 0

Equivalent Courses	
Will this course replace an existing course in the catalog,	No

or an experimental course?	
If yes, identify and explain.	

Similar Courses

Is there a similar or equivalent course in SMCCCD?	No
Added Similar Courses	

Units/Hours

Unit Types	Fixed
Units	Min: 4.00
Variable Range	Range (or)

Hours

Please enter hours as per term values

Method	Min Hours	Max Hours	Min Faculty Load	Min Units
Lecture	48.00	54.00	3.00	3.00
Lab	48.00	54.00	2.40	1.00
TBA	0.00	0.00	0.00	0.00
Work Experience	0.00	0.00	0.00	0.00
Field Experience	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00
Homework	96.00	108.00	0.00	0.00

Other Hours	

Course Details

Repeatable for Credit	No
Grading Methods	Letter Grade Only
Audit	Yes

Materials Fee

Fee Required?	No

Student Learning Outcomes

Upon successful completion of this course, a student will meet the following outcomes:

1. Demonstrate the principles of wave optics by solving analytical and numerical problems involving common optical elements like apertures and thin films.
2. Utilize matrix methods (for example, with popular computational tools like Matlab or Octave) to model the interaction of light waves with objects.
3. Demonstrate the principles of science, engineering and math by solving analytical and numerical problems.
4. Demonstrate ability to make measurements of wave-like optical properties, like polarization, interference, diffraction and coherence.
5. Show the ability to work in teams to gather and analyze data and prepare technical reports describing experimental work.
6. Work independently to prepare and deliver presentations of their laboratory findings through use of presentation software (like libreoffice impress or powerpoint).

Course Objectives

Upon successful completion of this course, a student will be able to:
1. Describe superposition of wave principles to describe light interactions.
2. Describe matrix techniques to describe polarization behavior.
3. Explore various types of interferometers.
4. Use mathematical tools to describe various diffraction effects
5. Use fourier transform to explore optical systems
6. Understand the limits to optical resolution
7. Explain the behavior of a common imaging and focusing system like a telescope
8. Perform alignment of wave optical elements
9. Obtain and measure intereference fringes in an interferometer
10. Perform polarization analysis of light
11. Investigate behavior of optical materials
12. Perform diffraction analysis

Course Lecture Content

1. Superposition of Waves
    a. Addition of waves of same frequency
    b. Addition of waves of different frequency
    c. Anharmonic periodic waved
    d. Non-periodic waves
2. Polarization
    a. Linear, Circular and Elliptical
    b. Polarizers and Malus’s law
    c. Dichroism
    d. Birefringince
    e. Scattering and Polarization
    f. Polarization by reflection
    g. Retarders and wave plates
    h. Optical activity
    i. Faraday effect
    j. Kerr and Pockels effects
    k. Mathematical Description of Polarization
    l. Stokes Parameters

m. Jones Vectors

n. Jones and Mueller Matrices

3. Interference

a. Conditions for interference

b. Wavefront splitting interferometers

c. Youngs experiment, Fresnel double mirror

d. Amplitude splitting interferometers

e. Dielectric films

f. Mirrored interferometers

i. Michelsons

ii. Mach-Zehnder

g. Multiple beam interferometer

i. Fabry-Perot

h. Single and Multilayer Films

i. ARC coatings

i. Applications of interferometry

4. Diffraction

a. Huygens-Fresnel principle

b. Fraunhofer diffraction

c. Single and multiple slit

d. Rectangular and circular apertures

e. Resolution of imaging systems

f. Diffraction grating and spectroscopy

g. Fresnel diffraction

h. Circular apertures and obstacles

i. Fresnel zone plate

j. Rectangular aperture

k. Cornu Spiral and Fresnel integrals

l. Diffraction by slits and obstacles

5. Fourier Optics

a. Fourier transforms in 1D and 2D

b. Len as a Fourier transformer

c. Dirac-Delta Function

d. Convolution theorem

e. Transfer functions

6. Coherence theory

7. Imagery – Spatial distribution of optical information

a. Abbe theory of image formation

b. Spatial filtering

Course Lab Content

1. Polarization of light
    1. Investigate polarization of HeNe laser light
    2. Investigate polarization modes (two of the modes polarized orthogonally to the third mode)
    3. Orientation and generate polarized light
    4. Mode sweeping.
2. Birefringence of materials
    1. Uniaxial crystals
    2. The extraordinary index of refraction
    3. Quarter-wave plates using birefringence of a material to change polarization of light
    4. Build an optical isolator and polarization rotator.
3. The Michelson interferometer
    1. Construct and align a Michelson interferometer
    2. Use interferometer to observe small displacements
    3. Meaure refractive index changes
4. Interference of light
    1. Newton’s rings
    2. Thin-film interference
    3. Test optical components in monochromatic light.
5. Diffraction of circular apertures
    1. Fresnel and Fraunhofer diffraction.
    2. Measure the diffraction effects of circular apertures
    3. Determine role of aperture size on diffraction
    4. Determines the resolving power of optical instruments.
6. Lasers and coherence
    1. Examine the frequency separation between the axial modes of a He-Ne laser with Michelson interferometer.
7. The Abbe theory of imaging
    1. Students investigate the spatial frequency content of objects and how they could be used to control shape and quality of image.

TBA Hours Content

Frequently Recommended Preparation

Frequently Recommended	

Justification for Frequently Recommended Preparation

Why is the knowledge of the recommended course(s), skill(s) or information necessary for students to succeed in the "target" course? Specify the relationship between the recommended knowledge and skills required of students and those taught in the "target course? (Please list the specific proficiencies students must possess in order to succeed in the "target" course.)

Other Recommended Preparation

You have no defined requisites.

Prerequisites/Corequisites

Drag and Drop to Reorder

Edit/Delete	Requisites	Analysis
	Prerequisite PALT 402	

Content Review

PALT 402 - Prerequisite
(Objective to Objective)
Launched

Mode of Delivery

Modes of Delivery
Hybrid
Lecture
Lab

Representative Instructional Methods

Methods	Lecture Lab Experiments Guest Speakers Other (Specify)
Other Methods	The course will be supplemented by technology and by video and/or Web-based content as appropriate.

Representative Assignments

Writing Assignments
(List all assignments, including library assignments. Outside assignments are not required for lab-only courses, although they can be given.)

1. Weekly report of analysis of wave optical phenomenon (1-3 pages in length).
2. Weekly Laboratory report (5-10 pages) for each laboratory experiment summarizing objectives, procedures, results and conclusions
3. Monthly formal laboratory report ((10-20 pages) following engineering technical writing guidelines.

Reading Assignments
(List all assignments, including library assignments. Outside assignments are not required for lab-only courses, although they can be given.)

1. Weekly textbook readings (50 pages).
2. Weekly Reading of laboratory handouts (2-20 pages)
3. Monthly Reading of technical articles in photonics and laser technology topics (2-6 pages)

Other Outside Assignments
(List all assignments, including library assignments. Outside assignments are not required for lab-only courses, although they can be given.)

- Out of class assignments will be in keeping with the goals and objectives of the course. The use of critical thinking is required for the students to apply the principles of optics to optical system design. Students are expected to complete a minimum of two hours of outside assignments for each hour of classroom lecture.

To be Arranged Assignments
(List all assignments, including library assignments. Outside assignments are not required for lab-only courses, although they can be given.)

- Not applicable

Representative Methods of Evaluation

This section defines the ways students will demonstrate that they have met the student learning outcomes.

Student grades will be based on multiple measures of student performance. Instructors will develop appropriate classroom assessment methods and procedures for calculating student grades, including the final semester grade. The following list displays typical assessment methods appropriate for this course. The actual assessment methods used in a particular classroom and section will be listed in the instructor?s syllabus.

Methods must effectively evaluate critical thinking. Credit courses must include written communication, problem solving, and/or skills demonstrations.

Multiple measures may include, but are not limited to, the following:

Methods	• Class Performance • Exams/Tests • Homework • Lab Activities • Oral Presentation • Quizzes • Written examination

Representative Texts

Textbooks such as the following are appropriate:

Formatting Style	APA

Textbooks

	1. Hecht, E.. *Optics*, 5 ed. Pearson, 2016
	2. Subhasish Dutta Gupta, Nirmalya Ghosh, Ayan Banerjee. *Wave Optics Basic Concepts and Contemporary Trends*, ed. CRC Press, 2019

Manuals

You have no manuals defined.

Periodicals

You have no periodicals defined.

Software

You have no software defined.

Other

You have no other defined.

Degree/Certificate Applicability

Designation	Degree Credit
Proposed For	Certificate/Skill Award
Course Designation Text	Are there degrees/certificates to which this course applies? CA in Photonics and Laser Technology CA in Advanced Photonics and Laser Technology

General Education/Degree/Transfer Course

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By Jose Pena

CSU Transfer Course

	Transfers to CSU Approved

Course Distance Education

Distance Ed Supplement	New distance education supplement
Distance Education	Distance education component was developed by an instructor with training in online pedagogy. Training: QOTL or equivalent Course at Canada College
Method of Distance Education	Online, Hybrid, Web Assisted Course; (If there are limitations on how this course would be offered please explain below)
Online Method Limitations	Will require students to access lab facilities on campus
Other Methods	
Course Content and Methodology	The objectives and content of the course are adequately covered by the methods of instruction, assignments, evaluation of student outcomes, and instructional materials.
Instructional Methodologies (How will you deliver the course content?):	Announcements/Bulletin Boards E-mail One-Way Video Conferencing (One-way interactive video and two-way interactive audio)

	Online Presentations Two-Way Video conferencing (Two-way interactive video and audio)
Representative Courseware/Textbooks Materials:	
Methods of Evaluation of Student Performance:	Multiple types of formative and summative assessments will be used 1. Bi-weekly assessment of laboratory reports that will be submitted online 2. Weekly assessment of homework assignments that will be submitted online
How are you ensuring that students with disabilities can access your course in accordance with Section 508?	Instructional materials have been tagged to indicate organizational structure and reading order. Images, tables and/or diagrams include textual representations. If applicable, the instructor will ask the publisher or content provider to provide a Voluntary Product Accessibility Template (VPAT) which evaluates how accessible the product is according to section 508 standards.

Plan for Regular Effective Communication Contact Between Faculty and Student (Title 5, 55204). "Local policies should establish and monitor minimum standards of regular effective contact."

Announcements/Bulletin Boards - Communication will occur at least two times a week. This will include course content as well as information on homework, labs, quizzes and tests. In addition, STEM related opportunities will also be announced at least once a month.
Email Communication - Response by email within 24-48 hours
Office hours - Weekly office hours held via video or phone call
Other (explain) - One ore more lessons content will be delivered each week by the online learning management platform

Resources Needed

Adequate Library Resources	Consultation with the Coordinator of Library Services regarding the adequacy of campus and online information resources to fulfill course objectives is required prior to course approval. Inadequate to support the course Please Specify:
Affected Resources	Which of the following resources do you expect to be affected by the offering of this class? Check as many as appropriate. New equipment needs
Explain what effect the areas you have checked will have upon this college:	

Comparable Transfer Course Information

Are there comparable courses?	Yes
Edit/Del	**College Info**

Minimum Qualification

Physics/Astronomy (Masters Required)

CB Codes

CB03 TOP Code	0934.80 - Laser and Optical Technol
CB04 Course Credit Status	D - Credit - Degree Applicable

CB05 Course Transfer Status	B = Transferable to CSU only
CB08 Course Basic Skill Status (PBS Status)	2N = Course is not a basic skills course.
CB09 SAM Code	C - Occupational
CB11 California Classification Codes	Y - Credit Course
CB21 Levels Below Transfer	Y = Not Applicable
CB23 Funding Agency Category	A = Fully Economic Development funds
CB25 Course General Education Status	Y - Not Applicable
CB26 Course Support Course Status	N - Course is not a support course

Codes/Dates

Entry of Special Dates

Instruction Office Review	01/22/2021
Last Outline Revision	
Content Review	01/22/2021
CC Approval	01/22/2021
DE Approval	01/22/2021
Effective Term	Term: Fall Year: 2021

Web Catalog

Course Family	
Web Catalog	☐ Exclude from Web Catalog

Instructional Services

Implementation Date	

Originator	Ramki Kalyanaraman
Origination Date	10/13/2020
Proposal Type	Cañada New Course
C-ID Numbers	
CB00 State ID	
CB03 TOP Code	0934.80 - Laser and Optical Technol
CB04 Course Credit Status	D - Credit - Degree Applicable
CB05 Course Transfer Status	B = Transferable to CSU only
CB08 Course Basic Skill Status (PBS Status)	2N = Course is not a basic skills course.

CB09 SAM Code	C - Occupational
CB10 Course COOP Work Exp-ED	N = Not part of Coop Work Exp
CB11 California Classification Codes	Y - Credit Course
CB13-Special Class Status	N - Not Special
CB21 Levels Below Transfer	Y = Not Applicable
CB22 Non Credit Course Category	Y - Not Applicable
CB23 Funding Agency Category	A = Fully Economic Development funds
CB24-Program Course Status	1 = Program Applicable
CB25 Course General Education Status	Y - Not Applicable
CB26 Course Support Course Status	N - Course is not a support course

Web Catalog Metadata