Course Description

This course will cover two important aspects of optics: diffraction and interferometry. Interference, generated by two coherent optical beams, forms the foundation of many optical systems, including but not limited to lithographers, spectrometers, depth and distance measurement (e.g., optical testing), and holographers. Thus, the study of different interferometer architectures will be investigated, including how each interferometer type (division of amplitude, lateral shearing, radial shearing, etc.) relates to the classical Young's Double Pinhole Interferometer (YDPI). As such, it is expected that the student will be able to derive the OPD in a YDPI "instinctively" once completed with this course. Meanwhile, the other significant aspect is diffraction. While geometrical optics implies that perfect imaging can occur (e.g., rays can focus to an infinitely small "singularity"), this is not a realistic model; rather, it is a first order approximation to what the light is doing. Thus, treating light propagation from a wavefront standpoint lends itself to a higher order approximation, which is commonly referred to as Fourier optics or scalar diffraction theory. This theory states that a focus of rays can not actually create a singularity, but has some dimensional constraints. Through this course, we will see that the concept of diffraction can be related back to interferometry, the limitations of which creates the basis for many of the limitations in current high-tech lithography systems.

Learning Outcomes

Once completed, this course will allow the student to:

1) Derive the optical path difference and optical path length within an arbitrary interferometer, and relate its behavior to the Young's Double Pinhole (YDPI) interferometer.
2) Relate optical path difference to physical depth in an optical testing or optical measurement scenario.
3) Calculate the scalar diffraction intensity distribution of a light field behind a series of apertures and optical surfaces.
4) Apply Fourier transformations or Fourier relationships to derive the far field intensity distribution of a light field.
5) Interpret, in their own words, how the phase of the light field changes vs propagation distance and how this influences the measured intensity.

Course Structure

One 75 minute lecture will be given per week. Interactive forms of teaching will be used throughout, including lecture tutorials and think-pair-share questions. Most work will be assigned as take-home (e.g., homework and/or exams and finals).

Course Policies

The use of cell phones is not permitted.
Instructors

Michael W Kudenov (mwkudeno) - Instructor
Email: mike.kudenov@ncsu.edu
Phone: (919)-515-3473
Office Location: Monteith Engineering Res.Ctr. (M
Office Hours: TBD

Course Meetings

Lecture

Days: TH
Time: 11:05am - 12:20pm
Campus: Centennial
Location: TBD
This meeting is required.

Meeting Notes

Class only meets one day per week (Tuesdays OR Thursdays)

Course Materials

Textbooks

Linear Systems, Fourier Transforms, and Optics - J. Gaskill
Edition: 1st
ISBN: 978-0471292883
Web Link: http://catalog.lib.ncsu.edu/record/NCSU456510
Cost: 170
This textbook is required.

Optical Shop Testing - D. Malacara
Edition: 3rd
ISBN: 9780471484042
Web Link: http://catalog.lib.ncsu.edu/record/NCSU1974220
Cost: 141
This textbook is required.

Expenses

None.

Materials

None.

Requisites and Restrictions

Prerequisites

ECE 523

Co-requisites

None.

Restrictions

None.
### General Education Program (GEP) Information

#### GEP Category
This course does not fulfill a General Education Program category.

#### GEP Co-requisites
This course does not fulfill a General Education Program co-requisite.

#### Transportation
This course will not require students to provide their own transportation. Non-scheduled class time for field trips or out-of-class activities is NOT required for this class.

#### Safety & Risk Assumptions
None.

### Grading

#### Grade Components

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<thead>
<tr>
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<th>Details</th>
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<tr>
<td>Homework / Projects</td>
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<tr>
<td>Midterm</td>
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<tr>
<td>Final</td>
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#### Letter Grades

This Course uses Standard NCSU Letter Grading:

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<tr>
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<tr>
<td>A</td>
<td>93 ≤</td>
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<tr>
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</table>

#### Requirements for Credit-Only (S/U) Grading
Performance in research, seminar and independent study types of courses (6xx and 8xx) is evaluated as either "S" (Satisfactory) or "U" (Unsatisfactory), and these grades are not used in computing the grade point average. For credit only courses (S/U) the requirements necessary to obtain the grade of "S" must be clearly outlined.

Requirements for Auditors (AU)

Information about and requirements for auditing a course can be found at http://policies.ncsu.edu/regulation/reg-02-20-04.

Policies on Incomplete Grades

If an extended deadline is not authorized by the Graduate School, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) by the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student. The university policy on incomplete grades is located at http://policies.ncsu.edu/regulation/reg-02-50-03. Additional information relative to incomplete grades for graduate students can be found in the Graduate Administrative Handbook in Section 3.18.F at http://www.fis.ncsu.edu/grad_publicns/handbook/.

Late Assignments

Late assignments will be accepted up to 24 hours past the original due date and will be accepted at a 10% penalty (e.g., the assignment will be graded and multiplied by 0.9 to calculate the new "late" score). No other late assignments will be accepted without prior authorization from the instructor.

Attendance Policy

For complete attendance and excused absence policies, please see http://policies.ncsu.edu/regulation/reg-02-20-03

Attendance Policy

None.

Absences Policy

None.

Makeup Work Policy

None.

Additional Excuses Policy

None.

Academic Integrity

Academic Integrity

Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct found at http://policies.ncsu.edu/policy/pol-11-35-01

Academic Honesty

See http://policies.ncsu.edu/policy/pol-11-35-01 for a detailed explanation of academic honesty.
**Honor Pledge**

Your signature on any test or assignment indicates "I have neither given nor received unauthorized aid on this test or assignment."

**Electronically-Hosted Course Components**

Students may be required to disclose personally identifiable information to other students in the course, via electronic tools like email or web-postings, where relevant to the course. Examples include online discussions of class topics, and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.

**Electronically-hosted Components:** Moodle will be used to host course components (lecture notes, homework assignments, projects, etc.)

**Accommodations for Disabilities**

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, student must register with the Disability Services Office ([http://www.ncsu.edu/dso](http://www.ncsu.edu/dso)), 919-515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation at [http://policies.ncsu.edu/regulation/reg-02-20-01](http://policies.ncsu.edu/regulation/reg-02-20-01).

**Non-Discrimination Policy**

NC State University provides equality of opportunity in education and employment for all students and employees. Accordingly, NC State affirms its commitment to maintain a work environment for all employees and an academic environment for all students that is free from all forms of discrimination. Discrimination based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation is a violation of state and federal law and/or NC State University policy and will not be tolerated. Harassment of any person (either in the form of quid pro quo or creation of a hostile environment) based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation also is a violation of state and federal law and/or NC State University policy and will not be tolerated. Retaliation against any person who complains about discrimination is also prohibited. NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at [http://policies.ncsu.edu/policy/pol-04-25-05](http://policies.ncsu.edu/policy/pol-04-25-05) or [http://www.ncsu.edu/equal_op/](http://www.ncsu.edu/equal_op/). Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Equal Opportunity (OEO) at 919-515-3148.

**Course Schedule**

**NOTE:** The course schedule is subject to change.

TBD