

# **ECE 592 Course Syllabus**

## **ECE 592 – Diffraction and Interferometry**

**Section TBD**

**SPRING 2015**

**1.5 Credit Hours**

### **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](mailto: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

Component	Weight	Details
Homework / Projects	60	
Midterm	20	
Final	20	

## Letter Grades

This Course uses Standard NCSU Letter Grading:

97	≤	<b>A+</b>	≤	100
93	≤	<b>A</b>	<	97
90	≤	<b>A-</b>	<	93
87	≤	<b>B+</b>	<	90
83	≤	<b>B</b>	<	87
80	≤	<b>B-</b>	<	83
77	≤	<b>C+</b>	<	80
73	≤	<b>C</b>	<	77
70	≤	<b>C-</b>	<	73
67	≤	<b>D+</b>	<	70
63	≤	<b>D</b>	<	67
60	≤	<b>D-</b>	<	63
0	≤	<b>F</b>	<	60

## 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/](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**

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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>), 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>.

## 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> 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