**Physics 411/611, ECE 411/611**  
**Optics for Scientists and Engineers**  
Syllabus, Fall Semester 2020

**Lectures:** 12:30-1:45 T/Th  
**Room:** South Engineering 120  
**Semester Credit Hours:** 3  
**Instructors:**  
Dr. Andrew B. Croll  
Physics South Engineering 212B  
413-320-3810  
Andrew.Croll@ndsu.edu  
Dr. Ivan T. Lima Jr.  
Electrical & Computer Engineering  
101-E E.E. Bldg  
231-6728  
Ivan.Lima@ndsu.edu  
Dr. David A. Rogers  
Electrical & Computer Engineering  
101-J E.E. Bldg  
231-7216  
David.Rogers@ndsu.edu

**Office Hours:** (Dr. Croll) 9:00-12:00 M,  
South Engineering 212B or via Zoom (email for link)

**Text:** *Optics* (Fifth Edition) by Eugene Hecht

**Physics/ECE 411 Prerequisite:** Physics 252, University Physics II  
**Physics/ECE 611 Prerequisite:** Physics 252, University Physics II or equivalent  
**Corequisite:** Physics 411L/611L or ECE 411L/611L

**Course Objective:**  
The goal of this course is to provide students with the fundamentals necessary to enable them to successfully apply optics in their respective disciplines. This will be accomplished through hands-on use of state-of-the-art equipment in the co-requisite laboratory course in conjunction with classroom discussions to experience and understand the most important concepts and phenomena of optics.

**Expectations:**  
In accordance with NDSU Policy 601, failure to comply with instructions, including this syllabus, may be handled according to the Code of Student Conduct resolution process and may result in disciplinary sanctions.

**Health and Safety:**  
While masks are not required as we begin the 2022 fall semester, NDSU administration has determined that faculty may request mask use in their classroom. In this class, **I ask that you wear a mask** to help protect my health and the health of your peers.

Where possible, please spread out within the classroom, including not sitting in the first row of the classroom, to maximize social distancing.
**Attendance Expectations:**
According to [NDSU Policy 333](www.ndsu.edu/fileadmin/policy/333.pdf), attendance in classes is expected, but this will be flexible. The course is taught to the classroom, but is broadcast on zoom (and recorded) for emergencies.

Please do not come to class:
· if you are feeling ill, particularly if you are experiencing COVID-19 symptoms, or
· if you are infected, during your five-day isolation period.

You will still need to complete the assignments, exams, reading, etc. necessary to meet class learning objectives. You can complete missed work by arranging a late submission with the instructor. If you are going to miss an exam for a valid excuse, e-mail or telephone your instructor before the test or on the same day. Phone number and e-mail address are listed above.

If you were exposed to COVID-19, please follow CDC guidance.
If you test positive for COVID-19, please follow CDC guidance.

Food and drink is not permitted in class unless a student has a documented accommodation through Disability Services. Students will have to remove their masks to eat or drink.

Veterans and student service members with special circumstances or who are activated are encouraged to notify the instructor as soon as possible and are encouraged to provide Activation Orders.

Lecture attendance will not be directly factored into the final grade, but active daily participation is essential. Students are expected to read the day's lesson prior to coming to class and to be prepared to discuss it in class. Material may be presented that is not in the text or it may be presented in a different way. Students are responsible for all material presented in class including that missed during excused absences. If you miss a class, it is your responsibility to view recorded classes and discuss with peers.

**BlackBoard:**
Course assignments, information, and messages will be posted to BlackBoard [http://bb.ndsu.nodak.edu/](http://bb.ndsu.nodak.edu/)

**Technical Issues:**
We will use lots of software, if you have trouble with any of it contact NDSU Help Desk:
Email: ndsu.helpdesk@ndsu.edu
Call: 701-231-8685 (option 1)

**Group Homework:**
Problem solving is a primary learning method for this course. Homework will be emphasized and assigned in groups. You will be assigned to a homework group, optimally 4 members, for the semester. **Each student in the group must complete or attempt each problem** and the group will then meet to compare results and to group solve the more difficult problems. One legible problem solution set per group will be turned in on 8 1/2" x 11" paper ONE SIDE ONLY. **SHOW all work. GIVE ALL EQUATIONS** before substituting numerical quantities into them and always give the UNITS INVOLVED. **UNDERLINE all answers.** The students in the group may be asked to present
and/or discuss their solutions in class. Each group needs to decide on their group rules such as when you will meet, what the consequences are for members that don't show up/contribute, rotation for preparing the solutions to hand in, rotation for presenting solutions in class, etc. STUDENTS ARE ENCOURAGED TO MEET VIA ZOOM. ASSIGNMENTS ARE TO BE TURNED IN DIGITALLY – photos are acceptable but must be legible. Camscanner software is suggested as this usually produces nice single PDF output.

Composition of Final Course Grade:
The final grade will be determined as follows:

<table>
<thead>
<tr>
<th>Physics/ECE 411</th>
<th>Physics/ECE 611</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1</td>
<td>Exam 1</td>
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<tr>
<td>20%</td>
<td>20%</td>
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<tr>
<td>Exam 2</td>
<td>Exam 2</td>
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<td>20%</td>
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<td>Exam 3</td>
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<td>20%</td>
<td>20%</td>
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<tr>
<td>Homework</td>
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<td>20%</td>
<td>20%</td>
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<tr>
<td>Project</td>
<td>Project</td>
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<tr>
<td>20%</td>
<td>20%</td>
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A total average of 89.5% of the possible points or more ensures an A, 75.5 to 89.4% ensures a B, 59.5 to 75.4% ensures a C, 49.5 to 59.4 ensures a D and below 49.5 will be an F. Depending on the class average, curving may be applied to grades; however the lowest passing final grade (C or higher) in the course will always be 50% or higher.

The exams will include conceptual questions requiring short answers, derivations, and quantitative problems similar to the assigned homework problems.

Graduate students will be assigned to a graduate homework group and will be assigned additional, more complex, homework. Graduate students will be graded separately on exams and the major related project and will be expected to have a more comprehensive understanding of the material.

Americans with Disabilities Act for Students with Special Needs:
Any students with disabilities or other special needs, who need special accommodations in this course, are invited to share these concerns or requests with the instructor and contact the Disability Services Office (www.ndsu.edu/disabilityservices) as soon as possible.

Academic Honesty Statement:
The academic community is operated on the basis of honesty, integrity, and fair play. NDSU Policy 335: Code of Academic Responsibility and Conduct applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the Office of Registration and Records. Informational resources about academic honesty for students and instructional staff members can be found at www.ndsu.edu/academichonesty.

Additional Resources for Students:
Encourage use of support resources

As a member of the NDSU community, resources are available for you should you need help in dealing with adverse reactions to things happening in the world today. A variety of resources are listed below:
For students on campus and remotely (telehealth):
Counseling Services: 701-231-7671; https://www.ndsu.edu/counseling/
Disability Services: 701-231-8463; https://www.ndsu.edu/disabilityservices/
Student Health Service: 701-231-7331; https://www.ndsu.edu/studenthealthservice/
Dean of Students Office: 701-231-7701; https://www.ndsu.edu/deanofstudents/

In a crisis or emergency situation:
Call University Police: 701-231-8998
Call 9-1-1
Go to a Hospital Emergency Room
Go to Prairie St. Johns for a Needs Assessment: 701-476-7216 (510 4th St. S.)
Call the FirstLink Help Line: 1-800-273- TALK (8255) or 2-1-1
Call Rape and Abuse Crisis Center: 701-293-7273

Course description:
Today, light pervades our lives in ways that could not have been imagined a few decades ago. Light is at the core of technologies ranging from computing and communications to surgical techniques. Optics, the study of light, plays the role of an enabling science since it touches essentially every field of technology.

This is a 3 semester-credit-hour senior undergraduate/first year graduate level course with minimum course prerequisites (University Physics II, electricity and magnetism) and the co-requisite Physics/ECE 411L/611L. Lectures will be based on the text *Optics, Fifth Edition*, by Hecht to provide the background required for performing the experiments.

The anticipated schedule is as follows:
First twelve weeks—three one-hour lectures per week, except holidays
Three weeks—laboratory five-hours per week to work on major-related experiment
Dead week—students present results—three classroom hours
A major experiment related to the student’s academic major (engineering, chemistry, physics, etc.) using optics will be selected by groups of three to four students for the last four-week project. Students will present their results to the class during Dead Week and write a research paper on this experiment that is due in lieu of a final exam. Students will be graded in this course on their paper, their presentation and their explanation of the results and will receive a separate laboratory grade based on their experimental apparatus and approach.
**Tentative Course Outline:**

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Text Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Properties of waves</td>
<td>Ch 1, 2</td>
</tr>
<tr>
<td>2</td>
<td>EM nature of light</td>
<td>Ch 3.1-3.4</td>
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<tr>
<td>3</td>
<td>Dispersion</td>
<td>Ch 3.5-3.6</td>
</tr>
<tr>
<td>4</td>
<td>Index of refraction</td>
<td>Ch 4.1-4.5</td>
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<tr>
<td>4</td>
<td>Exam 1 Thursday, Sep 17</td>
<td>Ch 1-3</td>
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<tr>
<td>5</td>
<td>Reflection S/P</td>
<td>Ch 4.6-4.9</td>
</tr>
<tr>
<td>6</td>
<td>Lenses, stops</td>
<td>Ch 5.1-5.3</td>
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<tr>
<td>7</td>
<td>Mirrors/prisms</td>
<td>Ch 5.4-5.5</td>
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<tr>
<td>8</td>
<td>Fiber optics and sensors</td>
<td>Ch 5.6</td>
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<tr>
<td>8</td>
<td>Exam 2 Thursday, Oct 15</td>
<td>Ch 4-5</td>
</tr>
<tr>
<td>9</td>
<td>Vibrations. Waves</td>
<td>Ch 7.1-7.2</td>
</tr>
<tr>
<td>10</td>
<td>Polarization</td>
<td>Ch 8.1-8.2 8.5-8.6</td>
</tr>
<tr>
<td>11</td>
<td>Interference</td>
<td>Ch 9</td>
</tr>
<tr>
<td>12</td>
<td>Diffraction</td>
<td>Ch 10</td>
</tr>
<tr>
<td>12</td>
<td>Exam 3 Thursday, Nov 12</td>
<td>Ch 7-10</td>
</tr>
<tr>
<td>13</td>
<td>Major related project</td>
<td>Ch 7-10</td>
</tr>
<tr>
<td>14</td>
<td>Major related project</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Major related project</td>
<td></td>
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<tr>
<td>16</td>
<td>Present results</td>
<td></td>
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<tr>
<td>17</td>
<td>Paper due Monday Dec 12</td>
<td>at 1:00 PM</td>
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</tbody>
</table>
### Optics Major Project Paper Rubric

<table>
<thead>
<tr>
<th>Levels of Achievement</th>
<th>Rubric Detail</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>10 to 20 points</td>
<td>Clearly and concisely states the paper's purpose. The introduction engages the reader, is well organized, and provides enough background information to understand the context of the project. The introduction clearly states the main topic and previews the structure of the paper. The introduction is engaging, and should capture the attention of the reader. The introduction is well written, and is free of spelling and grammatical errors. The overall coherence of the introduction is excellent.</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>6 to 9 points</td>
<td>Clearly and concisely states the paper's purpose. The introduction states the main topic and previews the structure of the paper. The introduction is well written, but may contain minor errors in spelling and grammar. The overall coherence of the introduction is satisfactory.</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>3 to 5 points</td>
<td>States the paper's purpose. The introduction states the main topic, but does not adequately preview the structure of the paper. The introduction is not engaging, and may be repetitive or off-topic. The introduction is not well written, and may contain significant errors in spelling and grammar. The overall coherence of the introduction is poor.</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>Less than 3 points</td>
<td>Does not clearly state the purpose of the paper. The introduction does not adequately preview the structure of the paper. The introduction is not engaging, and may be repetitive or off-topic. The introduction is not well written, and may contain significant errors in spelling and grammar. The overall coherence of the introduction is very poor.</td>
</tr>
</tbody>
</table>

### Sections

- **Introduction**: 12 to 18 points
- **Background Section**: 12 to 18 points
- **Experimental Section**: 12 to 18 points
- **Results and Discussion**: 12 to 18 points
- **Conclusion and References**: 8 to 16 points

### References

- Relevant references are included, and are cited correctly. The references are recent and relevant to the project. The overall coherence of the references is excellent.
- Relevant references are included, but may be cited incorrectly. The references are recent and relevant to the project. The overall coherence of the references is satisfactory.
- Relevant references are included, but may be cited incorrectly. The references are not recent or relevant to the project. The overall coherence of the references is poor.
- Relevant references are not included. The references are not recent or relevant to the project. The overall coherence of the references is very poor.

### Grammar and Spelling

- 5 to 10 pages including figures. No spelling or grammatical errors. The writing style is clear and concise. |
- 5 to 10 pages including figures. A few minor errors in spelling and grammar. The writing style is clear and concise. |
- 5 to 10 pages including figures. Several errors in spelling and grammar. The writing style is clear, but may be awkward. |
- 5 to 10 pages including figures. Numerous errors in spelling and grammar. The writing style is unclear and difficult to follow. |

### Notes

- Updated 8/23/2016
<table>
<thead>
<tr>
<th>Levels of Achievement</th>
<th>Criteria</th>
<th>Description of Experiment</th>
<th>Data</th>
<th>Plotting and fitting data</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>18 to 20 points</td>
<td>Project selected is within the level of scientific sophistication covered in 411/411L. Project is ambitious enough to constitute a 3-week project. All topics and data collection methods are clearly defined. Understanding of methods is conveyed clearly. Group displays a good grasp of data and uncertainty analysis techniques.</td>
<td>Data for every measurement are provided. Data are clearly presented.</td>
<td>Best-fit functions are properly chosen and presented as solid lines in your plot. Experimental points are plotted clearly with appropriate error bars.</td>
<td>Results are clearly presented.</td>
</tr>
<tr>
<td>B</td>
<td>16 to 17 points</td>
<td>Project selected is within the level of scientific sophistication covered in 411/411L. Project is ambitious enough to constitute a 3-week project. All topics and data collection methods are clearly defined. Understanding of methods is conveyed clearly. Group displays a good grasp of data and uncertainty analysis techniques.</td>
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</tr>
<tr>
<td>C</td>
<td>14 to 16 points</td>
<td>Project selected is within the level of scientific sophistication covered in 411/411L. Project is ambitious enough to constitute a 3-week project. All topics and data collection methods are clearly defined. Understanding of methods is conveyed clearly. Group displays a good grasp of data and uncertainty analysis techniques.</td>
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<td>Results are clearly presented.</td>
</tr>
<tr>
<td>D</td>
<td>12 to 13 points</td>
<td>Project selected is within the level of scientific sophistication covered in 411/411L. Project is ambitious enough to constitute a 3-week project. All topics and data collection methods are clearly defined. Understanding of methods is conveyed clearly. Group displays a good grasp of data and uncertainty analysis techniques.</td>
<td>Data for every measurement are provided. Data are clearly presented.</td>
<td>Best-fit functions are properly chosen and presented as solid lines in your plot. Experimental points are plotted clearly with appropriate error bars.</td>
<td>Results are clearly presented.</td>
</tr>
</tbody>
</table>

- **Relation of topic to project is underdeveloped.**
- **Missing several important experimental details.**
- **Significant aspects of the experiment and theory are described incorrectly.**
- **Fits are not appropriate for data.**
- **Discussion of results is missing.**

**Major Project Lab Component Rubric**

This rubric is used to grade the portions of the presentation and paper relevant to the 411/411L lab course.