

Fall 2019

# OPSE 301-001: Optical Science & Engineering Optics

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# OPSE 301 - Course Outline

## COURSE OUTLINE OPSE 301 - Intro to Optics Fall 2019

**Instructor:** John Federici, 973-596-8482, 474 Tiernan Hall, [federici@njit.edu](mailto:federici@njit.edu)

**Office Hours:** Tuesdays and Thursdays 9-10am or by appointment

**Pre-REQUISITES:** Phys 121, Math 112, Data Analysis software such as MATLAB

### COURSE MATERIAL:

§ **Textbook:** *Physics of Light and Optics* by Peatross and Ware (This textbook is available FOR FREE on the web) <http://optics.byu.edu/textbook.aspx>.


§ MATLAB (available for download from NJIT web page) or similar analysis and plotting software. **NOTE: EXCEL is good at making plots for reports, but it is NOT sufficient for fitting data to an arbitrary function.**

§ **Note:** The laboratory manual will be distributed via the course web page.

**ATTENDANCE:** It is expected that students will attend all lectures, recitations, labs. If you anticipate an absence, please let your lab partner and your instructor know immediately. If you miss a laboratory exercise, it is YOUR responsibility to make arrangements with the instructor to make up the laboratory outside of normal class hours. Absence from class DOES NOT alter the deadlines for turning in labs or assignments.

**HELP:** Visit or email your instructor if you are having trouble with the course; do not simply hope for a miracle and fall further behind.

**GRADING:** Your final letter grade in OPSE 301 will be based on a composite score for term's work that includes the mid-term, final exam, homework, and lab reports.

- **Homework** - Homework assignments are given in the syllabus below and are due weekly. Late homework will NOT  accepted.
- **Lab Reports** - Over the course of the semester, we will perform roughly 4 laboratory assignments during class time.



- Final Exam - A **Comprehensive Final Exam will be given** during Final Exam Period .

**Final Letter Grades** : Here are the approximate weights to be used for calculating the composite score:

§ 25% for mid-term exam

§ 25% for the final exam

§ 25% for the homework

§ 25% for lab reports

The cutoff percentages for various letter grades will be in the range of 80% for A, 75 % for B+, 70% for B, 65% for C+, 55% for C, and D or F below 50 %.

**HONOR CODE STATEMENT:** NJIT has a zero-tolerance policy for cheating of any kind and for student behavior that disrupts learning by others. Violations will be reported to the Dean of Students. The penalties range from a minimum of failure in the course plus disciplinary probation up to expulsion from NJIT. Avoid situations where your own behavior could be misinterpreted as dishonorable. **Students are required to agree to the NJIT Honor Code on each exam, assignment, quiz, etc. for the course.**

**NOISE and DISTRACTIONS:** Turn off all cellular phones, wireless devices, computers, and messaging devices of all kinds during classes and exams. Please do not eat, drink, or create noise in class that interferes with the work of other students or instructors. Creating noise or otherwise interfering with the work of the class will not be tolerated.

**Assignments:** You are responsible for all weekly reading and homework assignments listed in this outline. The reading should be completed BEFORE class each week. Homework assignments MUST be turned in ON TIME. For each assignment, you will receive partial credit for a 'reasonable' attempt at each problem. Homework assignments are due just about EVERY WEEK. Check syllabus weekly to see what is due. ALL ASSIGNMENTS not turned in by the assigned date will be scored as a zero. **Each student must turn in individual Homework assignments. No group submissions will be accepted.**

**Email/ Alternative Methods of Delivery Policy:** If you submit assignments by email, it is **REQUIRED that you put in the subject line "OPSE 301"**. (This helps me identify student submissions from my other emails.) The instructor is not responsible for assignments turned in outside of class time (in my mailbox, under my door) or not delivered by email. If assignments are delivered by email, it must be date stamped BEFORE the due date/ time. I will log them in when I receive them. THE INSTRUCTOR IS NOT RESPONSIBLE FOR LOST EMAILS, COMPUTER CRASHES, ETC.

**Groups and Working Together:** You will work with one partner for lab assignments. You are encouraged to help each other with homework and laboratory assignments. It is expected (although not required) that lab groups will present the same raw data in their laboratory reports. However, each student must submit an individual laboratory report with their own analysis, graphs, and discussion. DO NOT CUT AND PASTE your laboratory reports from other students' work. With regards to homework assignments, you are encouraged to work together if that method helps you learn the material. However, remember that you must understand the homework assignment well enough that you can do it BY YOURSELF on the exams.

index, power, intensity, and dispersion.

2. Comprehend basic concepts of light propagation using the concepts of rays, wavefronts, Huygen's principle. Apply these principles to the description of light propagation including reflection and refraction. Apply the equations and concepts governing wave propagation to optical problems for various initial conditions. Calculate unknown quantities based on physical relationships, initial conditions, and known quantities.
3. Apply the concepts of refraction and reflection to understand the operation of mirrors, lenses, prisms, and fiber optic cables.
4. Comprehend the meaning of the equations governing wave propagation as it applies to interference and diffraction. Apply principles of interference and diffraction to analyze these effects in several model systems including thin film interference, interferometry, light propagation through small holes, and spatial resolution. Calculate unknown quantities based on physical relationships, initial conditions, and known quantities.
5. Generalize the concepts underlying light propagation to an electromagnetic treatment of light using Maxwell's equations.
6. Comprehend the meaning and origin of color and its manifestation through various optical means such as scattering, dispersion, interference, diffraction gratings. Understand how to measure and quantify color.
7. Comprehend the meaning and mathematical representation of electromagnetic wave polarization. Explain the difference between linear, circular, and elliptical polarization states, and how the polarization state of light can be manipulated using reflection and birefringent materials.
8. Develop basic laboratory skills in the detection and manipulation of visible light using photodetectors, mirrors, lenses, and beamsplitters. Using these basic skills, assemble and test optical systems which demonstrate interference. Using these basic skills, explore experimental means for detecting color and manipulating the polarization state of light. Quantify the observed optical effects and compare measured results with theoretical predictions.

**Accommodations for Disabilities:** If you need accommodations due to a disability please contact Chantonette Lyles, Associate Director of Disability Support Services, Fenster Hall Room 260 to discuss your specific needs. A Letter of Accommodation Eligibility from the Disability Support Services office authorizing your accommodations will be required.

The table below shows the weekly topics, reading assignment, and HW problems. Under HW problems, any section which is UNDERLINED has a downloadable file for that week's material. When you click on the link, select the appropriate week's assignment.



1	EM Spectrum, Snell's Law, ABCD Matrices, Total Internal Reflection  <a href="#">Lecture Notes</a>  <a href="#">PPT Lecture Notes</a>	Ch. 9.2-9.6, 9.A	<a href="#">HW Set #1</a>  Prob: 9.4,9.7,9.8	<a href="#">MatLab Assignment</a>  <a href="#">Intro Lab Data)</a>  <a href="#">MatLab Hir</a>
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*Tuesday Nov 26 follows a THURSDAY schedule*

*Thursday Nov. 28<sup>th</sup> - Thanksgiving Break - no classes*

*READING DAY - Dec. 13*

*FINAL EXAM PERIOD - Dec 14th-20st*

Lab Number	Topic
3	Polarization-- Wave platesand polarizers
5	Absorption of colored dye
7	Detection of light --Photodiode detectors
7	Diffraction
13	Michelson Interferometer