

Fall 2020	MSCI 220C The Science of Light
Section:	MSCI 220C Sections 02 and 05 (Math/Science elective)
Time and Location:	ONLINE - Synchronous session times: Section 02: "Monday 2:00pm-4:50pm" Section 05: "Tuesday 5:00pm-7:50pm"
Credits:	3
Type of Course:	Lecture – via Remote Learning
Class Meetings:	14 ONLINE meetings, Final Exam
Prerequisites:	None
Class Zoom Materials:	Will be posted by 12:00pm NOON on Mondays
Class Resources:	http://www.charlesrubenstein.com/220
Instructor:	Dr. Charles Rubenstein; Professor Email → crubenst@pratt.edu / Voicemail Mobile: +1 (516) 884-7642 Office Hours: Wednesday Zoom Sessions by appointment only
Syllabus date:	20 August 2020 – Revision 2

I would like to thank Dr. Rosin for providing the majority of the materials used in this course.

I. Course Overview:

This introduction to light and optical phenomena in nature and technology will acquaint students with various physical aspects of light. We will delve into optical effects in nature such as the formation of rainbows, the colors of the sky and bubbles, mirages, the formation of images by our eyes and reception of those images by the rods and cones of our retinas. The use of light in technology will be explored by examining topics such as fiber optics, light sources (from the sun to light bulbs to pixels), one-way mirrors, 3D movie glasses, and image formation with pinholes, lenses and mirrors. Special attention will be paid to the operating principles and functioning of cameras, from their lenses, to their viewfinders, apertures, and filters.

II. Learning Goals and Outcomes:

II.a. GOALS:

Students taking this course will:

- develop an understanding of the fundamental physical nature of light how light is created and how it interacts with various materials
- become familiar with technical applications involving light that are useful to students pursuing careers in art, design, architecture, and writing
- gain understanding of how objects are sensed by the eye.

II.b. LEARNING OBJECTIVES:

After taking this course, students should be able to:

- describe the relationship between the properties of light (wavelength, speed, energy, etc.) and observed effects of light such as color, refraction, scattering, and image formation.
- explain wave effects such as diffraction and interference.
- explain how the emission of light is linked to the characteristics of the light source.
- discuss the manifestations of light polarization in nature and its uses in technology.
- diagram image formation by reflection in mirrors and by refraction using lenses.
- explain how the optics of cameras function (focus, depth of field, exposure, etc.).
- identify, evaluate, and incorporate sources of information from the scientific literature in the development of a project that is also informed by the above.

III. About the Learning Management System (LMS):

During the course of the semester, we will make use of Pratt's Learning Management System (LMS). To access the LMS, go directly to lms.pratt.edu (*the my.pratt.edu entrance point doesn't always work*). If you should have any problems with the LMS, immediately contact me via email or phone, or email/visit the Help Desk in the basement of the Engineering Building (they can also be contacted at x3765 or helpdesk@pratt.edu). In order for me to verify claims of LMS outages, I must hear from you IMMEDIATELY when the LMS problem occurs, not hours or days later.

Consult the Course Website at <http://www.charlesrubenstein.com/220> one week prior to each class for weekly reading and assignment due dates.

IV. Texts on reserve at the Library:

- Waldman, Gary. "Introduction to Light: The Physics of Light, Vision, and Color" 2002, Dover Publications ISBN: 0-486-42118-X. [*Prentice-Hall 1983 Edition: Out of Print*]. (Pratt Library Number 535 W164)
- Rossing, Thomas D. and Christopher J. Chiaverina. "Light Science: Physics and the Visual Arts" 2nd Edition 2019. Springer ISBN 978-3-030-27103-9 (Pratt Library Number 535 R835)
- Williamson, Samuel J and Herman Z Cummins. "Light and Color in Nature and Art" 1983. John Wiley & Sons. ISBN 0471083747 (Pratt Library Number 535 W732)
- Falk, David R., Dieter R. Brill, and David G. Stork "Seeing the Light: Optics in Nature, Photography, Color, Vision, and Holography" 1986. John Wiley & Sons. ISBN 0471603856 (Pratt Library Number 535 F191)

V. Course Requirements:

V.a. ZOOM MEETING ATTENDANCE: Absences (partial and full) will not be excused without written proof showing that the time and date of the appointment overlapped with class time, and the completion of a make-up assignment on the work covered during the day of the absence. Partial attendance, i.e. lateness or early departure, will result in a reduced grade for that day's participation grade if not excused in advance. Arriving more than fifteen minutes late will constitute a class absence.

Students are expected to complete all work whether they are present or not. Three (3) unexcused absences will result in an automatic "F" for the course.

During Zoom class sessions, unless you are asking a question, please mute your microphone.

V.b. READINGS: There is no required textbook for this course. Readings and videos will be online and must be completed before the next session - see the weekly guides for details. Reading assignments should be regarded as required unless otherwise noted.

V.c. EQUIPMENT: You must have a calculator or smartphone app that can take square roots and calculate sine and cosine, especially for class activities. A ruler or protractor will be very useful in both exams and class activities.

VI. Method of Assessment and Grading:

VI.a. EXAMS: MIDTERM EXAM (20%), FINAL EXAM: (20%)

A closed book take home midterm exam, covering material from weeks 1 through 6, will be emailed and due as noted on the class schedule.

A closed book comprehensive take home final exam will be emailed to you two weeks before the end of the semester and due back to me the last week of class.

VI.b. RESEARCH PAPER: (20%)

You are responsible for preparing a three (3) page paper (plus one page of references) on a device or piece of optical equipment of your choosing on any of the topics in the Science of Light. See the attached class schedule for proposal and paper due dates.

VI.c. FINAL PROJECT + PRESENTATION: (30%)

You will research a topic covered in this course of your choosing and communicate the results of your research with a creative work in a medium of your choice, a short paper and a presentation (followed by Q&A) to the class. Expectations and assessment guidelines are posted on the course website. An assignment proposal is due several weeks beforehand.

VI.d. CLASS PARTICIPATION AND ACTIVITIES (priceless... OK, OK = 10%)

Participation in Zoom classroom discussions and activities is expected. There will be questions on the readings and the material covered in the lectures during each class. There will also be hands-on activities and tasks which you will be expected to complete on your own.

VII. PRATT INSTITUTE POLICIES

Policy 1. Academic Integrity Policy

The link to the full policy and standards (Last updated 2017) is <https://www.pratt.edu/student-life/student-affairs/office-of-the-vice-president-for-student-affairs/student-policies/community-standards/academic-integrity/>

At Pratt, students, faculty, and staff do creative and original work. This is one of our community values. For Pratt to be a space where everyone can freely create, our community must adhere to the highest standards of academic integrity.

Academic integrity at Pratt means using your own and original ideas in creating academic work. It also means that if you use the ideas or influence of others in your work, you must acknowledge them.

At Pratt,

- We do our own work,
- We are creative, and
- We give credit where it is due.

Based on our value of academic integrity, Pratt has an Academic Integrity Standing Committee (AISC) that is charged with educating faculty, staff, and students about academic integrity practices. Whenever possible, we strive to resolve alleged infractions at the most local level possible, such as between student and professor, or within a department or school. When necessary, members of this committee will form an Academic Integrity Hearing Board. Such boards may hear cases regarding cheating, plagiarism, and other infractions described below; these infractions can be grounds for citation, sanction, or dismissal.

Policy 2. Academic Integrity Code

When students submit any work for academic credit, they make an implicit claim that the work is wholly their own, completed without the assistance of any unauthorized person. These works include, but are not limited to exams, quizzes, presentations, papers, projects, studio work, and other assignments and assessments. In addition, no student shall prevent another student from making their work. Students may study, collaborate and work together on assignments at the discretion of the instructor.

Examples of infractions include but are not limited to:

1. Plagiarism, defined as using the exact language or a close paraphrase of someone else's ideas without citation.
2. Violations of fair use, including the unauthorized and uncited use of another's artworks, images, designs, etc.
3. The supplying or receiving of completed work including papers, projects, outlines, artworks, designs, prototypes, models, or research for submission by any person other than the author.
4. The unauthorized submission of the same or essentially the same piece of work for credit in two different classes.
5. The unauthorized supplying or receiving of information about the form or content of an examination.
6. The supplying or receiving of partial or complete answers, or suggestions for answers; or the supplying or receiving of assistance in interpretation of questions on any examination from any source not explicitly authorized. (This includes copying or reading of another student's work or consultation of notes or other sources during an examination.)

For academic support, students are encouraged to seek assistance from the Writing and Tutorial Center, Pratt Libraries, or consult with an academic advisor about other support resources. Refer to the Pratt website for information on **Academic Integrity Code Adjudication Procedures**: <https://www.pratt.edu/the-institute/administration-resources/office-of-the-provost/policies-processes-and-forms/>

VII. PRATT INSTITUTE POLICIES**(continued) Policy 3. Attendance Policy**

The link to the full policy and standards (Last updated 2017) is https://www.pratt.edu/uploads/attendance_policy_clean_13_feb_17.pdf

[NOTE: the specific attendance policy for this course is contained in section V.a. and VI.d. above]

General Pratt Attendance Policy:

Pratt Institute understands that students' engagement in their program of study is central to their success. While no attendance policy can assure that, regular class attendance is key to this engagement and signals the commitment Pratt students make to participate fully in their education.

Faculty are responsible for including a reasonable attendance policy on the syllabus for each course they teach, consistent with department-specific guidelines, if applicable, and with Institute policy regarding reasonable accommodation of students with documented disabilities. Students are responsible for knowing the attendance policy in each of their classes; for understanding whether a class absence has been excused or not; for obtaining material covered during an absence (note: instructors may request that a student obtain the material from peers); and for determining, in consultation with the instructor and ahead of time if possible, whether make-up work will be permitted.

Consistent attendance is essential for the completion of any course or program. Attending class does not earn students any specific portion of their grade, but is the pre-condition for passing the course, while missing class may seriously harm a student's grade. Grades may be lowered a letter grade for each unexcused absence, at the discretion of the instructor. Even as few as three unexcused absences in some courses (especially those that meet only once per week) may result in an automatic "F" for the course. (Note: Students shall not be penalized for class absences prior to adding a course at the beginning of a semester, though faculty may expect students to make up any missed assignments.)

Pratt Institute respects students' requirements to observe days of cultural significance, including religious holy days, and recognizes that some students might need to miss class to do so. In this, or other similar, circumstance, students are responsible for consulting with faculty ahead of time about how and when they can make up work they will miss.

Faculty are encouraged to give consideration to students who have documentation from the Office of Health and Counseling. Reasonable accommodations for students with disabilities will continue to be provided, as appropriate.

Refer to the Pratt website for information on **Attendance**: <https://www.pratt.edu/the-institute/administration-resources/office-of-the-provost/policies-processes-and-forms/>

Policy 4. Students with Disabilities and Accessibility

Pratt Institute is committed to the full inclusion of all students. If you are a student with a disability and require accommodations, please contact the Learning/Access Center (L/AC) at LAC@pratt.edu to schedule an appointment to discuss these accommodations. Students with disabilities who have already registered with the L/AC are encouraged to speak to the professor about accommodations they may need to produce an accessible learning environment.

Requests for accommodation should be made as far in advance as reasonably possible to allow sufficient time to make any necessary modifications to ensure the relevant classes, programs, or activities are readily accessible. The Learning/Access Center (L/AC) is available to Pratt students, confidentially, with additional resources and information to facilitate full access to all campus programs and activities and provide support related to any other disability-related matters.

VII. PRATT INSTITUTE POLICIES (continued)**Policy 5. Human Rights, Equity, BERT, and Title IX**

Pratt Institute seeks to provide an environment that is free of bias, discrimination, and harassment. If you have been the victim of harassment, discrimination, bias, or sexual misconduct, we encourage you to report this.

If you inform me of an issue of harassment, discrimination or bias, or sexual misconduct I will keep the information as private as I can, but I am required to bring it to the attention of the institution's Title IX Coordinator. You can access Title IX services by emailing titleix@pratt.edu. You can also speak to someone confidentially by contacting our non-mandatory reporters: Health Services at 718-399-4542, Counseling Services 718-687-5356 or Campus Ministries 718-596-4840.

In cases of Bias, this information may go to our Bias Education & Response Taskforce (BERT). You can contact BERT by either reaching out directly via bert@pratt.edu or by contacting the BERT Co-Chair and Title IX Coordinator, Dr. Esmilda Abreu.

For more information, please refer to the **Community Standards webpage**:

<https://www.pratt.edu/student-life/student-affairs/office-of-the-vice-president-for-student-affairs/student-policies/community-standards/>

VIII. PRELIMINARY DRAFT ONLINE SEMESTER SCHEDULE: (Subject to change)**NO CLASSES: Monday 9/07/20 - Labor Day – Pratt Holiday****NO CLASSES: Monday 9/28/20 - Instructor's Holiday (See * below)****NO CLASSES: Tuesday 11/03/20 - Election Day – Pratt Holiday**

Session No.	Monday Tuesday Dates	Topic
1	8/24 8/25	Introduction to Waves and Light – The wave nature of light will be introduced, and visible light will be placed in the context of electromagnetic waves.
2	8/31 9/01	Ray Tracing - We will discuss the ray model of light and the basic properties of images. We will show how ray tracing explains the Solar Eclipse. Finally, refraction and reflection will be introduced.
3	9/14* 9/08	Reflection & Curved Mirrors – Several applications of flat mirrors will be presented before we examine how ray tracing can be used to understand image formation by curved mirrors; Research Paper Proposal Due
4	9/14 9/15	Snell's Law and Lenses – We will discuss some interesting manifestations of refraction in nature and technology such as mirages, optical fiber technology, and we will examine how ray tracing can be used to understand image formation by lenses; Research Paper Proposal Returned with Comments
5	9/21 9/22	Photography and the Eye – We will the various parameters of photography including focal length variation, F-stops, depth of field, exposure times, and aberrations. 'Midterm' Project Proposal Due
6	10/5* 9/29	Photography and the Eye – Continued; Midterm emailed 9/27 Midterm' Project Proposal Present in class; Returned with Comments
7	10/5 10/6	MIDTERM EXAM DUE - Closed book midterm on material from weeks 1 – 6 Color in Nature – Dispersive refraction will be discussed and used to understand rainbows. Light scattering will then be discussed and used to explain the colors of the sky.
8	10/12 10/13	Color in Nature – Continued; MIDTERM EXAM REVIEW Final Project proposal due
9	10/19 10/20	Color Vision – Methods of displaying and making predictions about color will be presented. Optical filters will then be explained, followed by more detail of the way the eye functions. Research Paper Draft Due
10	10/20 10/27	Polarization – Light polarization states will be introduced, followed by a discussion of the ways that these polarization states can be produced. Subsequently, several examples of the use of polarization in technological applications will be given. Research Paper Draft Returned with Comments
11	11/9 11/10	Light Sources – Light emission from blackbodies, diffuse gasses, lasers and fluorescent materials will be described in the context of the development quantum theory; Research Paper Due
12	11/16 11/17	Light Sources – Continued; Research Paper Returned with Comments
13	11/23 11/24	Optical Devices – Several common devices that use light and optics will be presented including photocopiers, CD/DVDs, barcode scanners, and CCD arrays. Various types of aliasing will then be discussed. Final emailed 11/22
14	11/30 12/01	FINAL EXAM DUE - Closed book final exam on material from weeks 8 - 13
15	12/07 12/08	FINAL PROJECT DUE by NOON - Zoom Class Presentations

NOTE* Monday classes do NOT meet on 9/7 or 9/28. We will arrange for either make-up sessions or double classes as noted above (no Monday class 11/2)