

Physics 312: Waves and Optics

Description: Laboratory survey of wave and optical phenomena and associated instrumentation.

Prerequisite: (Undergraduate level PHYS 251 Minimum Grade of C or Undergraduate level PHYS 251 Minimum Grade of XS) and (Undergraduate level PHYS 261 Minimum Grade of C or Undergraduate level PHYS 261 Minimum Grade of XS).

Text: *Introduction to Optics* (3rd Edition) by Frank L Pedrotti, Leno M Pedrotti, Leno S Pedrotti

Instructor: [Karen L. Sauer](#)

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Zoom Office Hours: Tuesdays 9-10 am (or by appointment)

See blackboard for link.

Course Structure:

Lab	12:00 pm - 2:45 pm	T	Planetary Hall 320 and 324
Lecture	12:00 pm - 1:20 pm	R	Zoom, link in Blackboard.

Lab partners: one “red” and one “blue”, will be formed in groups in Blackboard.

Red partner (last name comes first alphabetically in the group) comes to campus on red lab days and is virtual on blue lab days.

Blue partner (last name comes second alphabetically in the group) comes to campus on blue lab days and is virtual on red lab days.

Partners will interact via Webex teams. It is expected the virtual partner will collaborate on details of lab set-up, label the components of the final experimental setup, and assist in data analysis through Matlab at home. I will be a nominal third partner on each team in case there are problems.

On-campus attendance:

All students taking face-to-face courses are required to take Safe Return to Campus Training prior to visiting campus. Training is available in Blackboard (<https://mymason.gmu.edu>). Students are required to follow the university’s public health and safety precautions and procedures outlined on the university Safe Return to Campus webpage (www2.gmu.edu/safe-return-plan). Similarly, all students in face to face must also complete the Mason COVID Health Check daily, seven days a week. The COVID Health Check system uses a color code system and students will receive either a Green, Yellow, or Red email response. Only students who receive a “green” notification are permitted to attend courses with a face-to-face component. I will ask you to show your Green response as you enter the lab. If you suspect that you are sick or have been directed to self-isolate, please quarantine or get testing. In this case, the roles of the virtual and in-campus partners can be switched.

Reports: Lab reports should be concise, but self-contained with figures and important equations labeled and referred to in the text and all variables defined. See sample report in Blackboard for

guidance; note only a few sentences are dedicated to each section - Introduction, Procedure and Apparatus, Results, and Conclusion.

Before each lab, starting with the one on February 2nd, write the first part of the lab report before the lab, that is the Introduction, Apparatus and Procedure, including a self-generated (not cut and paste from another source!) experiment schematic and sample graph with units on each axis.

Submit on Blackboard before the lab period. Results and Conclusions will be done during class time, either together with your lab partner or separately; submit on Blackboard before leaving the lab. In addition, a labeled photo of your final experimental set-up must be included. You will need to work efficiently, and come to lab prepared, to complete the experiment and write-up on time. Points will be deducted if you arrive late (virtually or on-campus).

Homework Assignments: Homework problems will be assigned in Blackboard and are due 30 minutes before the start of the lab. Scan handwritten answers to your homework and submit the scan as a single PDF file to Blackboard. Files that are illegible will not receive credit. Include a number on the page that indicates the order. If you have a mobile phone, use a scanning App, and take the scan in a well-lit environment.

You are encouraged to work on your homework assignments together in small groups, BUT copying homework from each other is not permitted. Sign each homework at the top of the first page as a pledge that you have not copied your homework (the signature will count towards your grade). Full marks will only be given for homework where the full work is shown. Because solutions will be given out at the same time as the homework is handed in, no late homework will be accepted, except with a VALID medical excuse. The lowest homework grade will be dropped.

Note: You can email a fellow student through Blackboard by going to Tools on the side bar and choosing "Send email." Also the Course Room in Blackboard is open for study groups any time.

Schedule:

January 26	Lab 0:	Introduction to measurement of wavelength with Ocean Optics.
January 28	Lecture 1:	Light as a photon. Chapter 1.
February 2	Lab 1:	Photoelectric effect
February 4	Lecture 2:	Snell's law. Chapter 2.1-2.8
February 9	Lab 2:	Refraction, Reflection, Total internal reflection
February 11	Lecture 3:	Thin lens. Chapter 2.9, 3.5-3.7
February 16	Lab 3:	Thin lens configurations
February 18	Lecture 4:	Wave equation. Chapter 4
February 23	Lab 4:	Measurement of the speed of light in matter
February 25	Lecture 5:	Energy quantization. Chapter 6
March 2	Lab 5:	LEDs V vs I. Atomic spectra through Ocean optics
March 4	Lecture 6:	Blackbody radiation and gas lasers. Chapter 6
March 9	Lab 6:	Blackbody radiation and Wien's law

March 11	Lecture 7:	Interference. Chapter 7-8
March 16	Lab 7:	Michelson interference
March 18	Lecture 8:	Fourier analysis. Chapter 9.
March 23	Lab 8:	Fourier analysis
March 25	Lecture 9:	Diffraction. Chapters 11-12
March 30	Lab 9:	Two-slit and measurement of wavelength via diffraction grating.
April 1	Lecture 10:	Polarized light. Chapters 14-15
April 6	Lab 10:	Malus's law, 3D images with linear polarization
April 8	Lecture 11:	Birefringence and circular polarization. Chapters 14-15
April 13	Lab 11:	3D images with circular polarization. Stress-induced birefringence.
April 15	Lecture 12:	Optical activity. Chapter 15
April 20	Lab 12:	Rotation by optically active material
April 22	Lecture 13:	Fresnel equations. Chapter 23
April 27	Lab 13:	Fresnel
April 29		Final during class time

Grading: All labs are counted equally; lowest grade is dropped. The exam will weigh as 2 labs and the homework as 2 labs. Attendance/participation in lecture will count towards 5% of your grade.

Final exam: The exam is virtual, with open lab reports and notes, but no access to the web, beyond Blackboard. More details will be given about the exam closer to the time of the exam.

If you are a student with a disability and you need academic accommodations: please see me and contact the Office of Disability Services at 703.993.2474. All academic accommodations must be arranged through that office. Students must inform the instructor at the beginning of the semester, and the specific accommodation will be arranged through ODS.

Academic Integrity: GMU is an Honor Code university; please see the University Catalog for a full description of the code and the honor committee process. Honor Code: To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University community and with the desire for greater academic and personal achievement, we, the student members of the university community, have set forth this honor code: *Student members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work.*

Technology requirements

1. Computation with Matlab

Some of the labs will require numerical computation via [Matlab](#); the appropriate codes will be in Blackboard. Download Matlab on your home computer, <https://www.mathworks.com/academia/tah-portal/george-mason-university-31483444> (Mason now has a site license so it is free!). Be sure to download the following Matlab toolboxes as well: Optimization, Curve Fitting, Symbolic Math, Audio, Image Processing, Computer Vision, and any other one you think looks fun; all the toolboxes are included in the license so take advantage.

2. Submission of homework and lab reports via Blackboard

Activities and assignments in this course will regularly use the Blackboard learning system, available at <https://mymason.gmu.edu>.

3. Lab communication via Webex Teams

Download Webex Teams - <https://its.gmu.edu/service/webex-teams/> as soon as possible since it takes time for ITS to process the request. Let me know if you have trouble. I found it very useful in a lab environment to have the app not only on my computer, but also on my smartphone, so that I could immediately send photos. All lab computers will have a webcam. A snipping tool, such as this one - <https://support.microsoft.com/en-us/windows/use-snipping-tool-to-capture-screenshots-00246869-1843-655f-f220-97299b865f6b> – can also be quite useful.

4. Office hours via Zoom (link within Blackboard)

Activities and assignments in this course will regularly use web-conferencing software. Students are required to have a device with a functional camera and microphone. In an emergency, students can connect through a telephone call, but video connection is the expected norm.

A student's guide to Zoom is below.

A Student's Guide to



FAQs

What's Zoom like?

If you've ever done a Google Hangout or met up with more than one person on any platform (Bb Collaborate Ultra, Skype, FaceTime, etc.) then that's pretty much what it's like. It has some different functionality (like sharing your screen and annotation) but it's very similar to other conference call platforms. From time to time some of the menu options or windows are minimized so you may not see some settings you expect to see. Zoom is a cloud-based web conferencing tool for video and audio conferencing,

FAQs

collaboration, chat, and webinars across mobile devices, desktops, telephones, and room systems. Poke around -- you won't break it!

How do I get & install Zoom? Zoom is available at gmu.zoom.us/join. This is free to all GMU students, faculty, and staff. To know more about Zoom installation, please visit: <https://its.gmu.edu/service/zoom/>

What should I do to be on Zoom? Download the app to your desktop, laptop, phone, or whatever device you plan to use. It can be helpful to download it to a few devices. It has a web-based version, but there's more functionality in the app.

Set your name and add pronoun or pronunciation if you want. Go to zoom.us/profile and log in. Select **Sign Me Out From All Devices** located at the bottom of your profile page. Log out of the web session. Then go to gmu.zoom.us/join and log in using your NetID and Patriot Pass Password to join the Mason institutional license. You can go to your **"profile"** and change your name. Use the first and last name you prefer. If you have enough space, consider if you want to add a pronoun or phonetic pronunciation. For example, "Meredith Grey (she)" or "Kalie (Kay-lee) Smith."

Once in a meeting room, what should I do? Plan to arrive early and you can test your audio and video. If you expect your internet connection to be spotty, you can dial in on your phone for audio. The meeting request will give you a phone number to dial in (it actually provides many!). Please have your video on. Studies show people communicate better with faces visible.

What does it look like if I don't share my video? Others will see a black screen and name for the account. Add a photo and name under settings; it'll be more personal and help if you have a question to be able to use your name. In general, though, if you are able to have the video on, it can feel more approachable for all. (If you don't want to show your surroundings, choose a virtual background in settings.)

How should I dress? Join in whatever you feel like wearing, but also be mindful about class etiquette. It's a pandemic. Just keep learning!

FAQs

What if I have a question? You can unmute yourself, use the “**raise your hand feature**” in the participants window, or if your video is on, physically raise your hand. Ask your professor what they prefer in their sessions.

Is there a feedback channel? Yes. The chat window. You have the option to ask or talk to all members of the Zoom meeting or specific members. The host (professor) cannot see the private messages you send to others.

What if my connection is glitchy? It happens. You can leave and re-join the meeting or try a different device. Sometimes turning off your video helps.

What’s the deal with break out rooms? This is a place where the host can assign you to a smaller group to talk. You should not be on mute there. You will get instructions on what to do there and when finished you can leave and re-join the larger group or wait until the “host” brings you back. You can click **Ask for Help** in order to ask a host for help.

Will a professor know if I joined Zoom? Can it be used for attendance? Yes, Zoom can produce a list if your instructor sets it up this way.

Can I save what was written in the chat window? Yes, you can save the chat by clicking on the three little dots on the bottom right. It will save as a .txt file to your computer. Save it before exiting the meeting.

How do I leave? You can use the “**leave the meeting**” prompt. In small groups people often unmute and say thank you or goodbye. In larger groups, people often smile and wave before exiting.

If I have additional questions? Always ask your professor for direction about Zoom class expectations. For technical and/or support related questions, contact <https://its.gmu.edu/service/zoom/>
