



THE UNIVERSITY OF
TENNESSEE
KNOXVILLE
BIG ORANGE. BIG IDEAS.

PHYS 251 Waves, Optics, and the Breakdown of Classical Physics, Fall 2022

University of Tennessee, Knoxville

Meeting Time and Place: Nielsen 207 8:30 – 11:15 am

Course Credit Hours: 4

Faculty Contact Information

Dr. Kate Jones: Nielsen 407B

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Dr. Tova Holmes: Nielsen 504

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Course Description/Information: Explores oscillations, waves, optics, and the breakdown of nineteenth century physics, and special relativity. Topics covered include simple harmonic motion; mechanical waves; sound; geometric optics; interference; diffraction; and special relativity. This course incorporates both a laboratory component and basic scientific computing. Prerequisites: PHYS 136 or 138 or 231 or 222 with a C or better and MATH 142 co-req

Value Proposition: This course covers oscillatory behavior from simple harmonic motion, through light and optics. We will then explore some of the failures of classical physics, to explain some physical phenomena such as blackbody radiation, and the concepts of time and space. The purpose of the course is both to introduce students broadly to concepts related to waves, optics and relativity, and to prepare them for PHYS 252 “Quantum Physics and Applications”.

Learning Environment: This is a studio class, meaning that lectures, in-class activities, laboratories, and recitations are interspersed in the class time. Students are responsible for

reading the material ahead of class sessions and will be ready to discuss in class. Each class will start with a quick review of the reading material, and an opportunity to ask questions relating to the current or previous reading assignments. When there are in-class activities, students will work in pairs, or small groups and will prepare a single slide with a short summary of the in-class activity and findings to present in the next class.

Course Communications: Communication outside of class times will be through UTK email and Canvas. Please monitor your UTK email and Canvas regularly. For technical issues, contact the OIT HelpDesk via phone (865) 974-9900 or online at <http://help.utk.edu/>.

How to Be Successful in This Course: Being organized and keeping up with reading assignments is essential to success in this course. Come to class prepared to discuss the material and to work with other students. If you're willing to work and learn this should be a really fun course.

Texts/Resources/Materials:

There is a textbook recommended for this course, you will need to have access to this text either in paper copy, or digitally: Open Stax University Physics Volumes 1 – 3

<https://openstax.org/details/books/university-physics-volume-1>

<https://openstax.org/details/books/university-physics-volume-2>

<https://openstax.org/details/books/university-physics-volume-3>

Homework is through OpenStax Tutor. The first assignment opens August 25 and is due September 6. There will be assignments most weeks. You will need to enroll using this link:

<https://tutor.openstax.org/enroll/981137/Physics-251-Fall-2022-Fall-2022>

Course Requirements, Assessments, and Evaluations:

The final grade will be assigned from the weighted average based on the following *provisional* grading scale.

A	90 and above
A-	87 and above
B+	83 and above
B	80 and above
B-	77 and above
C+	73 and above
C	70 and above
C-	67 and above
D+	63 and above
D	60 and above
D-	57 and above
F	below 57

Grade Breakdown **PROVISIONAL**

Homework	25%
Exams	45% (15% each for three exams)
Labs/ in class activities	30%

Late Policy

Worked handed in late will incur a 10% penalty with an additional 5% penalty after the first day, up to a maximum of 50%. Work will not usually be accepted after the answers have been discussed in class. If there are mitigating circumstances, please let us know.

Modules:

Topic 1	Periodic Motion	SHM, simple/physical pendulum, resonance
Topic 2	Mechanical Waves	Waves on a string, interference, boundary conditions, superposition, standing waves, normal modes, wave equations.
Topic 3	Sound	Speed, intensity, resonance, beats, Doppler effect.
Topic 4	Light	EM spectrum, reflection, refraction, total internal reflection, polarization.
Topic 5	Geometric Optics	Ray tracing, plane and spherical surfaces, thin lens, camera.
Topic 6	Interference	Coherent sources, two source interference, intensity in interference patterns, thin films, Michelson interferometer.
Topic 7	Diffraction	Fresnel and Fraunhofer, single slit, multiple slits, grating, X-ray diffraction.
Topic 8	Failures of Classical Physics	Review of classical physics, simultaneity, UV catastrophe.
Topic 9	Relativity	Length contraction, time dilation, relativistic doppler shift, twin paradox, Michaelson-Morley experiment

Tentative Schedule:

Day	Date	Topic	Homework Due Date (TBD)
Thursday	8/25/22	Intro and Topic 1	
Tuesday	8/30/22	No Class	
Thursday	9/1/22	Topic 1 Lab 1 Pendulum/SHM	
Tuesday	9/6/22	Topic 1	OpenStax Tutor 1
Thursday	9/8/22	Topic 2	
Tuesday	9/13/22	Lab 2 Mechanical Waves	
Thursday	9/15/22	Topic 2	OpenStax Tutor 2
Tuesday	9/20/22	Topic 3	OpenStax Tutor 3
Thursday	9/22/22	Topic 3 + Lab 3 Standing Waves	
Tuesday	9/27/22	Topic 3	OpenStax Tutor 4
Thursday	9/29/22	Topic 4 & Review Topics 1-3	
Tuesday	10/4/22	Exam 1 1hr 15 minutes	
Thursday	10/6/22	Fall Break	
Tuesday	10/11/22	Exam 1 solutions + Lab 4	
Thursday	10/13/22	Topic 5	
Tuesday	10/18/22	Topic 5	OpenStax Tutor 5
Thursday	10/20/22	Lab 5 Optics	
Tuesday	10/25/22	Topic 6	OpenStax Tutor 6
Thursday	10/27/22	Topic 6	
Tuesday	11/1/22	Topic 7	OpenStax Tutor 7
Thursday	11/3/22	Topic 7 + Review Topics 4 - 6	
Tuesday	11/8/22	Exam 2 1hr 15 minutes	
Thursday	11/10/22	Exam 2 solutions + Lab 6 Demo e- diff and measurements	
Tuesday	11/15/22	Topic 8	OpenStax Tutor 8
Thursday	11/17/22	Topic 8	
Tuesday	11/22/22	Topic 9	
Thursday	11/24/22	Thanksgiving	
Tuesday	11/29/22	Lab 7 Photoelectric effect	
Thursday	12/1/22	Topic 9	
Tuesday	12/6/22	Review	
		Final Exam pm	

University Policies:

Academic Integrity: “An essential feature of the University of Tennessee, Knoxville is a commitment to maintaining an atmosphere of intellectual integrity and academic honesty. As a student of the university, I pledge that I will neither knowingly give nor receive any inappropriate assistance in academic work, thus affirming my own personal commitment to honor and integrity.”

University Civility Statement: Civility is genuine respect and regard for others: politeness, consideration, tact, good manners, graciousness, cordiality, affability, amiability and courteousness. Civility enhances academic freedom and integrity, and is a prerequisite to the free exchange of ideas and knowledge in the learning community. Our community consists of students, faculty, staff, alumni, and campus visitors. Community members affect each other’s well-being and have a shared interest in creating and sustaining an environment where all community members and their points of view are valued and respected. Affirming the value of each member of the university community, the campus asks that all its members adhere to the principles of civility and community adopted by the campus: <http://civility.utk.edu/>

Physics and Astronomy Civility Statement: As a department, we are committed to creating an environment that welcomes all people, regardless of their identities. We value the diversity that enriches our department. We understand the importance of free and open dialogue that includes the free exchange of ideas. We do not tolerate uncivil speech or any form of discourse that infringes on others’ rights to express themselves, or has a negative impact on their education, or work environment. We actively promote an environment of collegiality and an atmosphere of mutual respect and civility. We understand that respect includes being considerate of others’ feelings, circumstances, and their individuality. We recognize the necessity of a civil community in realizing the potential of individuals in teaching, learning, research, and service. We believe these values extend beyond the department into our work within physics regionally, nationally, and internationally, as well as work and studies in the university, and the broader community. We encourage all members of the department to intervene and report any incidents involving bigotry, or that violate the university code of conduct.

Reporting: Anyone who experiences or observes any such incident is encouraged to report it to the Department Head or one of the Associate Heads. Students can also speak to any faculty or staff member with whom they feel comfortable. Incidents that involve sexual harassment or stalking will be reported to the office of Title IX under mandatory reporting requirements.

Additional resources and reporting available at: <http://www.phys.utk.edu/about/civility-community.html>

Disability Services: “The University of Tennessee, Knoxville, is committed to providing an inclusive learning environment for all students. If you anticipate or experience a barrier in this course due to a chronic health condition, a learning, hearing, neurological, mental health, vision, physical, or other kind of disability, or a temporary injury, you are encouraged to contact Student Disability Services (SDS) at 865-974-6087 or sds@utk.edu. An SDS Coordinator will meet with

you to develop a plan to ensure you have equitable access to this course. If you are already registered with SDS, please contact your instructor to discuss implementing accommodations included in your course access letter.”

Your Role in Improving Teaching and Learning Through Course Assessment:

At UT, it is our collective responsibility to improve the state of teaching and learning. During the semester, you may be requested to assess aspects of this course either during class or at the completion of the class. You are encouraged to respond to these various forms of assessment as a means of continuing to improve the quality of the UT learning experience.

Key Campus Resources for Students:

- [Center for Career Development](#) (Career counseling and resources; HIRE-A-VOL job search system)
- [Course Catalogs](#) (Listing of academic programs, courses, and policies)
- [Hilltopics](#) (Campus and academic policies, procedures and standards of conduct)
- [OIT HelpDesk](#) (865) 974-9900
- [Schedule of Classes/Timetable](#)
- [Student Health Center](#) (visit the site for a list of services)
- [Student Success Center](#) (Academic support resources)
- [Undergraduate Academic Advising](#) (Advising resources, course requirements, and major guides)
- [University Libraries](#) (Access to library resources, databases, course reserves, and services)

If you need to miss class for illness, please email: kgrzywac@utk.edu as soon as possible. You can find COVID 19 information and updates at utk.edu/coronavirus.

The instructor reserves the right to revise, alter or amend this syllabus as necessary. Students will be notified in writing / email of any such changes.

Updated August 19, 2022