

## PHYSICS 274 – GENERAL PHYSICS III INTRODUCTION TO MODERN PHYSICS

Spring Semester 2023; TR 1:30–2:45; HIG 110

*Instructor:* Eric B. Szarmes (szarmes@hawaii.edu)

*Office:* Watanabe Hall, Room 212; *Office hours:* to be announced

<u>Course description</u>	This course is the third installment of the University of Hawai‘i introductory physics program, and provides an introduction to the two cornerstones of modern physics, quantum mechanics and the theory of relativity. Because wave motion comprises a fundamental aspect of quantum phenomena, and also provides the impetus for a rubric known as “mathematical methods of physics”, the course begins with a study of physical optics based on the wave equation and the wave nature of light.			
<u>Textbooks</u>	<ul style="list-style-type: none"> <li>• T.A. Moore, <i>Six Ideas That Shaped Physics, UNIT Q</i>, 4<sup>th</sup> ed., McGraw Hill, 2023</li> <li>• T.A. Moore, <i>Six Ideas That Shaped Physics, UNIT R</i>, 4<sup>th</sup> ed., McGraw Hill, 2023</li> </ul>			
<u>Course website</u>	<a href="https://laulima.hawaii.edu/">https://laulima.hawaii.edu/</a> → PHYS-274-001 [MAN.80964.SP23]			
<u>iClickers</u>	iClickers (or iClicker Cloud ... your choice) will be used for in-class quizzes and 2-minute problems. Instructions for registering iClicker remotes can be found at <a href="https://www.iclicker.com/register-a-remote/">https://www.iclicker.com/register-a-remote/</a> . The registration code using iCloud is <a href="https://join.iclicker.com/FPBC">https://join.iclicker.com/FPBC</a> .			
<u>Grade distribution</u>	Daily/Weekly Homework:	20%/20%		
	Quizzes/Midterm 1/Midterm 2:	15%/15%/15%		
	Final Examination:	15%		
	In-class 2-minute problems:	5% bonus		
<u>Grade assignment</u>	A+ 90 >	B+ 75–80	C+ 60–65	C– 40–50
	A 80–90	B 65–75	C 50–60	D/F < 40

### COURSE OUTLINE

1. Review of Waves	<ul style="list-style-type: none"> <li>- the wave equation; principle of superposition</li> <li>- harmonic waves; boundary conditions</li> <li>- standing waves; Fourier analysis</li> <li>- resonance</li> </ul>	<ul style="list-style-type: none"> <li>review</li> <li>Ch. Q1,2</li> </ul>
2. Physical Optics	<ul style="list-style-type: none"> <li>- interference</li> <li>- diffraction</li> <li>- the wave nature of light</li> </ul>	<ul style="list-style-type: none"> <li>Ch. Q3</li> </ul>
3. Quantum Mechanics	<ul style="list-style-type: none"> <li>- the particle nature of light</li> <li>- the wave nature of matter</li> <li>- spin</li> <li>- principles of quantum mechanics</li> <li>- quantum weirdness</li> <li>- the wave function</li> <li>- simple quantum systems</li> <li>- spectra</li> <li>- the Schrödinger equation</li> <li>- nuclei and nuclear stability</li> </ul>	<ul style="list-style-type: none"> <li>Ch. Q4</li> <li>Ch. Q5</li> <li>Ch. Q6</li> <li>Ch. Q7</li> <li>Ch. Q8</li> <li>Ch. Q9</li> <li>Ch. Q10</li> <li>Ch. Q11</li> <li>Ch. Q12</li> <li>Ch. Q13,14</li> </ul>
4. Theory of Relativity	<ul style="list-style-type: none"> <li>- 3-dimensional structure of space; Newtonian relativity</li> <li>- nature of space and time; 4-dimensional structure of spacetime</li> <li>- Lorentz transformation</li> <li>- kinematic consequences of spacetime transformations</li> <li>- 4-vector mechanics and the mass-energy equivalence</li> </ul>	<ul style="list-style-type: none"> <li>Ch. R1</li> <li>Ch. R2,3,4</li> <li>Ch. R5</li> <li>Ch. R6,7</li> <li>Ch. R8,9</li> </ul>

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Daily and Weekly Homework will be submitted and returned to you on Laulima under the Assignments tab. The file format in both cases will be a single pdf file for each entire assignment.

### **Daily Homework**

Daily homework will consist of two or three homework problems from the text and will be due by the *start of class* each day. These problems will be based on material covered in the lectures and will generally require you to read ahead. Each problem will be graded according to the following guidelines:

- 5: a good effort with correct results *and* reasoning;
- 4: a good effort with minor errors, or a fair effort with no conceptual or math errors;
- 3: a good effort with modest conceptual errors and/or math errors, or a fair effort with minor errors;
- 2: a fair effort involving modest conceptual errors, or a good effort involving serious conceptual errors;
- 1: a poor effort;
- 0: no initial effort.

A good effort involves at least *some* English explanation and/or use of appropriate diagrams along with calculations, and/or some recognition of an implausible result. Be sure to write something for every part of a problem, even if only to indicate where you may be stumped.

### **Corrections**

Up until one week after each problem is due, you may use the online solutions and a red or colored pen to turn in a corrected version of any daily problem, even if you did not submit an initial effort. Be sure to correct deficiencies in effort as well as math or conceptual errors. Your corrections will be evaluated on 2-point scale:

- 2: everything is suitably corrected;
- 1: some items remain uncorrected;
- 0: major issues remain uncorrected.

These correction points will be added to your initial score to yield your final score for that problem (up to a total of 5 per problem). Online solutions and other course documents will be accessible at <https://laulima.hawaii.edu/> under the Resources tab.

### **Weekly Homework**

In addition to the daily problems, a weekly problem set consisting of one or two more challenging problems will be due by start of class on Tuesday. Please make an effort on these weekly problems to write solutions that are coherent and clear as well as correct; *scratch work will not be accepted*. Each problem will be graded out of 10. Solutions will be posted on or after the due date, but corrections will not be accepted for the weekly problems.

### **Guidelines for Weekly Problem Sets**

*For presentation:*

1. Solutions should be properly composed and written in clear and proper English. Mathematical derivations and steps should be clearly indicated. Place a box around your final answers.
2. Proper units must accompany all final numerical results.
3. Draw diagrams when appropriate, and label them clearly.
4. Do not insert numerical values until the *final step* in a calculation.  
(Physics is learned symbolically. If you simply insert numbers at the start of a calculation and crunch away, nothing will ever make sense.)

*In general:*

5. Regarding significant figures: Do not round the results of intermediate calculations (*ever!*) Leave at least four significant figures when reporting numerical results.
6. Form the habit of checking the dimensions of any equations that you derive. Many times, this simple exercise will reveal whether you've made an error somewhere along the line.
7. Whenever possible, ask yourself whether an answer makes sense physically.