

PHYS 102 Modern Physics (with CUREs) Syllabus

Fall 2025

(Updated on 8/20/2025)

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Instructor Information

Instructor Name: [Pei-Chun Ho](#)
Department: [Physics](#)
Email / Telephone: peiho@mail.fresnostate.edu / (559) 278-5990
Office: McLane 255 (Doorbell on McLane 254)
Student Support Hours: (days/times)
Tuesday & Thursday at McLane 162 or 255: 7:45 PM – 9 PM
Monday & Wednesday at McLane 255: 12:15 PM – 1:15 PM

Course Information

Course Modality: [in-person](#)
Course ID: PHYS102–01-75646-2257
Units: 3
Class Meeting Location & Time: McLane 258 & M, W 11 AM – 12:15 PM
Canvas: fresnostate.instructure.com
Prerequisites:

MATH 77 Calculus III: three-dimensional calculus, partial derivatives, multiple integrals, Green's Theorem, Stokes' Theorem.

MATH 81 Applied Analysis (can be taken concurrently): Introduction to ordinary linear differential equations and linear systems of differential equations; solutions by Laplace transforms. Solution of linear systems of equations; introduction to vector spaces; eigenvalues, and eigenvectors.

PHYS 4C Light and Modern Physics: Geometrical optics; electromagnetic radiation; physical optics; introduction to special relativity; quantum physics; and the physics of atoms, nuclei, and the solid state.

Course description:

This three-unit upper division course explores the development of Modern Physics from the late 19th to early 20th centuries, highlighting the transition from Classical Physics to Quantum Mechanics and Special Relativity. Modern Physics has evolved from phenomena, unresolved experimental results, and technical challenges from the turn of the 20th century to the present. Therefore, representative experiments, their setups, results, and technical applications will be greatly emphasized. Key topics include the particle-wave duality of light and matter, wave functions and particle probabilities, atomic structure, energy level schemes, and black body radiation. The course also covers fundamental concepts in Statistical Physics, such as Fermions, Bosons, and Fermi energy of conduction electrons, Bose-Einstein Condensation, which are essential for understanding Condensed Matter Physics and modern technological devices.

- ❖ For the lecture component, it is generally expected that students will spend approximately 2 hours of study time outside of class for every one hour in class. Since this is a 3-unit class, you should plan to study an average of 6 hours outside of class each week.

Required Course Materials

- I. **Textbook:** *Modern Physics for Scientists and Engineers*, Publisher Brooks Cole, either 3rd, 4th, or 5th edition, by Stephen T. Thornton and Andrew Rex.
- II. **Immediate Access (IA)** is set up for this course by using the **Canvas - Vital Source**.
 - IA contains an **iClicker-Reef/Cloud access code**, which will be directly sent from the Kennel Bookstore to student's email account.
 - All Immediate Access (IA) communication will be delivered to the student's Fresno State email account. It is the STUDENT'S RESPONSIBILITY to read all communication coming from the Kennel Bookstore. They should look for email headers such as "IMPORTANT INFORMATION" or "REMINDERS" and check the SPAM folder!
 - iClicker-Reef/Cloud operated through APP (on laptops or Mobile device) is required for in-class quick quizzes. The iClicker-Reef Class is "**PHYS102Ho2025F**".
 - (** According to students who had used it. New student has to use Fresno State email address to create an account on iClicker website (via a laptop or tablet), then the iClicker APP on Mobile phone can be used for clicking during the class time.)
 - ALL IA materials are accessible for the first few days of the start of the semester to all students enrolled. After the opt-out date of the term, students who did not OPT OUT of the materials will be charged on their Fresno State student account the cost of the materials. This information can be found in their welcome letter email from the Kennel Bookstore. If they did not receive an email, please contact ecarmona@mail.fresnostate.edu
 - OPTING OUT means that students DO NOT want the digitally delivered materials we are offering. STUDENTS will then be responsible to get the materials on your own – usually at a higher cost. If students OPT OUT, their digital IA access will be revoked. **IMPORTANT!** If students OPT OUT of the program, they will also OPT OUT of the required ADAPTIVE materials associated with the IA eBook including their homework, quizzes, tests, etc.... This access will be turned off after the last date to opt-out for the semester.
 - We ask students to **NOT purchase IA digital materials directly from the Publisher website or make any other outside purchase** that would require them to enter a credit card or pay out of pocket. This will result in a DOUBLE charge! If they are OPTED IN, the campus will bill their Fresno State student account after the opt out date.
 - **DO NOT pay for your materials through Canvas!!!** If the link provided requires an "ACCESS CODE" it will be delivered to the student in their **IA VitalSource** link or on any IA emails sent to their Fresno State email account from the Kennel Bookstore. ALL CHARGES will be billed to their Fresno State student account.
 - **THE LAST DAY TO OPT OUT for Fall 2025 is September 5, 2025.** – – It is the STUDENT'S responsibility to OPT OUT. Once they click on the OPT OUT link in their Professor's Canvas page, they will receive a confirmation email within 24

hours. If they did not receive an email within 24 hours, please contact ecarmona@mail.fresnostate.edu

- Student accounts will be charged around **September 15, 2025**. Charges will be due around **September 19, 2025**. Students may pay on their Fresno State student account either online or at Joyal Administration.
 - **To make an on-line payment, go to <https://my.fresnostate.edu>, click on Student Self Service>Student Center>My Finances>View eBills/Make a Payment.
 - **To see your current balance, go to Student Self Service>Student Center>My Finances>Account Inquiry.
 - If students are on financial aid, scholarship, or other benefit programs they are still obligated to pay on their account...They should put this money aside.
 - If students enroll **after** the Opt-out date, they will have **24 hours** to review the materials and contact ecarmona@mail.fresnostate.edu if they choose to purchase elsewhere and OPT OUT of the program.
 - Any questions about the IA program can be directed to ecarmona@mail.fresnostate.edu
- I. **Scientific Calculator** (Graphing Calculator is “Not” allowed for this course).
- II. A Fresno Stat email account. The instructor will not respond to the emails not sent through the Fresno State system.

Zoom (available to all Fresno State students)

https://fresnostate.edu/help/students/video_conferencing/

Course Specifics

This course will include assigned readings in your textbook that should be completed outside of the class session. During the class sessions there will be lectures, demonstrations, quick quizzes, small group discussions, and class discussions. In order to facilitate your understanding of assigned readings, lectures may review portions of the readings, but they will not serve as a substitute for reading the materials. Important additional information will be presented during the lectures, which will be included in the exams.

Course goals:

Upon completion of this course, students are expected to analyze various properties of the quantum states using the free-electron model and understand and apply these concepts to modern technologies, such as X-ray diffractometer, Electron microscopes, PET scan, and development of dye-sensitized solar cells.

Student Learning Outcomes:

Students will develop a strong foundation to identify, analyze, and solve problems within the core disciplines described in the textbook of “Modern Physics For Scientists and Engineers,” by 4th edition, by Stephen T. Thornton and Andrew Rex, which is universally recognized as a standard in undergraduate physics education.

Course Requirements/Assignments:

- I. Quick Quizzes: In order to encourage students to preview the textbook contents before class, focus learning in the virtual class room, and engages in interactive learning, 1-10 questions will be randomly given as quick quizzes in most of the class meeting time. Total of the quick-quiz score which will be counted as 12% of the weighted grade. **Full participant points (i.e., attendance) will only be given when students complete all quick-quiz questions.**
- II. Homework will be assigned through Canvas. Detail procedures need to be provided. One combined PDF file of each homework with proper page order is required to be uploaded to Canvas. Homework passes the deadline will be counted as zero. (15% of weighted grade)
- III. Two midterms will be offered and each weighs 17%.
- IV. Final exam will be given according to the University Final Exam (24% of weighted grade).
- V. CUREs project: Dye-Sensitized Solar Cells will

Instructions for significant assignments: If your course has a project, a paper, or other significant assignment, please give detailed requirements and instructions on how to complete them, such as length, fonts and/or number of references that must be used for the project/paper.

Attendance: (attendance and participation is required)

Full participant points (i.e., attendance) will only be given when students complete all quick-quiz questions.

Grading policy: List how grades are distributed and weighted by assignments to make 100% of the course grade. Your grading policy should include a description of how you calculate grades, if applicable (such as using a grading scale).

Explain exactly how you will calculate the course grades. What will be the point values and weightings for assignments, activities, and examinations? What will be the cut-off points on percent for each grade (e.g., 80 to 89% is B, etc.)? An optional "Assignment and Examination Schedule" with point values may be an efficient way to transmit some of this information (this is only an example for your reference):

A grade of C or better is required to pass this class.

Grade will “Not” be curved, completely based on performance.

Table 1 Assignment and Point Distribution

Assignment	Points/Percent
Lecture Total Percentage	100%
Quick Quizzes (In Class)	15%
Homework	20%
Two Midterms	40% (20% each)
Final Exam	25%

Table 2 Distribution of Letter Grade to Percent and Points

Letter Grade	Percent	Points
A	87	100
B	74	86.999
C	60	73.999
D	50	59.999
F	0	49.999

Course Policies & Safety Issues

Classroom Behavior

([University Policy on Disruptive Classroom Behavior](#))

Both the instructor and the students are to adhere to high standards of professionalism, common courtesy, and respect for others. Please refrain from the following behaviors, bearing in mind that if your behavior interrupts the class you may be asked to leave the class for the rest of the period:

- Coming to class late, please use the back doors for entrance. If you must leave early, please sit near a door.
- During lecture sessions, mute all cell phones, laptops and other electronic devices. You only need one electronic device to run iClicker-Cloud (formerly iClicker-Reef).
- Do not speak or write to anyone in a rude or aggressive fashion, or speak of others in a disrespectful fashion
- The University Policy on Disruptive Classroom Behavior ([APM 419](#)) is well worth reading and can be found in the Class Schedule and the Academic Policy Manual.

If you are absent from class, it is your responsibility to check on announcements made while you were away.

Late work and make-up work policy: Either delayed or make-up exams for midterms and final exam will not be allowed by the instructor. If a midterm is missed for a “*compelling reason*” (e.g. illness documented by a physician’s note, official evidence of which has to be provided), the part of the grade that midterm would have counted will be voided, and the rest of the grade will be counted as 100%. If the final exam is missed for a “*compelling reason*” (e.g. illness documented by a physician’s note, the student will receive a grade of “I” (incomplete) for the semester. It will also be the student’s responsibility to contact the university administration in a timely manner and make the necessary arrangements to remove the “I” grade. Please check “the California State University Fresno General Catalog” for regulation regarding the “I” grade. Only students who can document very compelling reasons to miss final exams, e.g. with a physician’s note, will be eligible for incompletes; other students missing the final exam will receive 0% for the grade of final exam.

The following sections regarding COVID are subject to change given changing circumstances on-campus and in the community. Please check the [COVID website](#) for the most up-to-date information

Vaccination: The California State University system strongly recommends the COVID-19 vaccination and booster for all students, faculty, and staff. As a reminder, you are eligible for a booster five (5) months after receiving a final dose of the Pfizer or Moderna vaccine; or two (2) months after receiving a Johnson & Johnson vaccine.

Face Coverings: Fresno State no longer requires masks to be worn indoors, but based on updated guidance from public health experts, the University highly recommends that all students, faculty, and staff, regardless of vaccination status, wear a surgical grade or KN95 mask indoors. ***Faculty will continue to have the discretion to require face coverings for their in-person classes as they evaluate the health and safety needs of their individual classroom environments.***

Testing: The campus was fortunate to receive the Higher Education Emergency Relief (HEERF) Funds during the pandemic and through June 2023 but funds are no longer available. Students will still be able to obtain free kits from the Student Health and Counseling Center. Additionally, free [COVID-19 test](#) options are offered by the Fresno County Department of Public Health.

Intellectual Property: All course materials, including but not limited to the syllabus, readings, quiz questions, exam questions, and assignments prepared by the instructor are property of the instructor and University. Students are prohibited from posting course materials online (e.g., Course Hero) and from selling course materials to or being paid for providing materials to any person or commercial firm without the express written permission of the professor teaching this course. Doing so will constitute both an academic integrity violation and a copyright violation. Audio and video recordings of class lectures as well as images of chat or messages shared during course sessions are prohibited unless the instructor gives you explicit permission in advance. Students with an official letter from the Services for Students with Disabilities office may record the class if SSD has approved that service. Otherwise, recordings of lectures are included in the intellectual property notice described above. These provisions exist regardless of the modality of the course. That is they apply to in-person, hybrid and online courses.

Student Ratings of Instruction: In the final weeks of the semester, you will be asked to complete a short survey to provide feedback about this class. The primary goal of student ratings is to help your instructor improve the class. Feedback will also be reviewed by the department chair and the college dean. You will be given 15 minutes of class time to complete student ratings. Please offer feedback honestly and thoughtfully. Your participation is appreciated. You can access your student rating surveys and get more information at [Fresno State Student Ratings for Instruction \(SRI\)](#)

University Policies

Students with Disabilities: Upon identifying themselves to the instructor and the university, students with disabilities will receive reasonable accommodation for learning and evaluation. For more information, contact Services to Students with Disabilities in the University Library, Room 1202 (278-2811).

Financial Aid Satisfactory Academic Progress Standards and Appeals Process:
<https://studentaffairs.fresnostate.edu/financialaid/policies/sap/index.html>

The following University policies can be found on the web at:

- [Adding and Dropping Classes](#)
- [Cheating and Plagiarism](#)
- [Computers](#)
- [Copyright Policy](#)
- [Disruptive Classroom Behavior](#)
- [Honor Code](#)
- [Title IX](#)

Fresno State is committed to fostering a safe, productive learning environment for all students. Title IX and CSU policy prohibit discrimination on the basis of sex, which includes sexual harassment, domestic and dating violence, sexual assault, sexual exploitation, and stalking. We understand that sexual violence can impact a students' **ability to be successful** in the learning environment. We encourage students who have experienced sexual misconduct **to seek information on where to report from any member of our faculty or staff in order to ensure that the university can provide students with the necessary resources and supportive measures.**

As an instructor, I have a mandatory reporting responsibility as a part of my role. It is my goal that you feel comfortable sharing information related to your life experiences in classroom discussions, in your written work, and in our one-on-one meetings. I will seek to keep the information you share private to the extent possible. However, I am required to report any information I receive regarding sexual misconduct or information about a crime that may have occurred during your time at Fresno State.

Students can report incidents of alleged sexual misconduct to either or both of the following resources:

Office of Compliance and Civil Rights | occr.fresnostate.edu | 559.278.5003
Fresno State Police Department | fresnostate.edu/police | 559.278.8400

Students can also report other incidents of discrimination or harassment to:

Office of Compliance and Civil Rights | occr.fresnostate.edu | 559.278.5003

Students can access *confidential support* from two separate resources on campus:

Counseling Services | studentaffairs.fresnostate.edu/health/counseling | 559.278.2734
Survivor Advocacy Services | fresnostate.edu/survivoradvocate | 559.278.6796

Pregnancy or Related Conditions:

Pregnant Students or those with related conditions should contact the Title IX Coordinator in the Office of Compliance and Civil Rights for assistance. The Title IX Coordinator can coordinate specific actions to prevent sex discrimination and ensure the student's equal access to educational programs or activities.

Office of Compliance and Civil Rights | occr.fresnostate.edu | 559.278.5003

Parent scholars provides information on priority registration and other support for parenting students.

Services for Students with Disabilities can also provide assistance with accommodations.

If you have concerns and you are unsure who to contact, please visit the [Concern & Action Guide](#).

Emergency Information: In the event of an emergency, everyone in the campus community becomes a partner in the response. To ensure you are prepared and remain calm you must make yourself familiar with campus protocols. To contact the Fresno State Police Department call 559.278.8400 from your cell phone or 911 from a campus phone. Prior to an emergency, assess your environment for options depending on the emergency. Identify all possible exit routes, in an emergency always use the closest most safe exit. Once you exit the building go to the predetermined evacuation assembly point, if that is unavailable then go to an open safe space away from the emergency. Identify where and how you can secure yourself inside if you need to shelter in place or hide from a threat. Be prepared to help guide those around you and assist individuals who may be in need. Additional information can be found at www.fresnostate.edu/emergency

University Services

The following University services can be found on the web at:

- [Associated Students, Inc.](#)
- [Students with Disabilities](#)
- [Dream Success Center](#)
- [Library](#)
- [Learning Center Information](#)
- [Student Health and Counseling Center](#)
- [Academic Success Coaching](#)
- [Survivor Advocacy](#)
- [Writing Center](#)

Subject to Change Statement

THIS SYLLABUS AND SCHEDULE ARE SUBJECT TO CHANGE IN THE EVENT OF EXTENUATING CIRCUMSTANCES.

Course Calendar

All deadlines of prelecture activities and homework can be found on the [Canvas](#).

Table 4 **Examination Schedule**

Date	Exam	Points
Monday, 10/1/2025 8:30 AM – Pencils down 4:30 PM	1 st Midterm Bulldog Testing Center (Bring Blue Book)	100
Wednesday, 11/12/2025 8:30 AM – Pencils down 4:30 PM	2 nd Midterm Bulldog Testing Center (Bring Blue Book)	100
Monday, 12/15/2025 8:30 AM – Pencils down 4:30 PM (University Final Exam Schedule 11 AM – 1 PM)	Final Exam Bulldog Testing Center (Bring Blue Book)	100

Tentative Course Schedule

The course schedule is subject to change in the event of extenuating circumstances.

If you are absent from class, it is your responsibility to check on announcements made verbally in class while you were absent.

Table 6 Fall 2024 Tentative Course Schedule: Monday, Wednesday Courses

Day	Date	Topic	Reading Assignment
1	Wed., Aug 20	Course Syllabus & General Rules Introduction to Modern Physics, unresolved Questions of 1895 Review of Classical Statistics	Ch1 The birth of modern physics Ch9 Statistical physics 9.1 Historic Overview Entropy –Degeneracy
2	Mon., Aug 25	Maxwell Boltzmann Statistics	Ch9 Statistical physics 9.2 Maxwell Velocity Distributions & Phase Space
3	Wed., Aug 27	Maxwell Boltzmann Statistics	Ch9 Statistical physics 9.2 Maxwell Speed Distributions & Average Thermal Energy of an ideal-gas particle
N/A	Mon., Sep 1	Holiday, Labor Day	
4	Wed., Sep 3	Quantum Statistics Two classes of particles: Fermions Bosons	Ch9 Statistical physics 9.3 Equipartition Theorem 9.4 Maxwell Speed Distribution
5	Mon., Sep 8	Quantum Statistics Two classes of particles: Fermions Bosons	Ch9 Statistical physics 9.5 Classical and Quantum Statistics 9.6 Fermi-Dirac Statistics
6	Wed., Sep 10	Quantum Statistics Two classes of particles: Fermions Bosons	Ch9 Statistical physics 9.6 Fermi-Dirac Statistics
7	Mon., Sep 15	Quantum Statistics: Fermi-Dirac Statistics	Ch9 Statistical physics 9.6 Fermi-Dirac Statistics
8	Wed., Sep 17	Quantum Statistics: Fermi-Dirac Statistics	Ch9 Statistical physics 9.6 Fermi-Dirac Statistics
9	Mon., Sep 22	Quantum Statistics: Bose-Einstein Statistics	Ch9 Statistical physics 9.7 Bose-Einstein Statistics
10	Wed., Sep 24	New discoveries in the end of 19 th century	Ch3 The experimental basis of quantum theory 3.1 Discovery of X-ray and Electrons, line spectra, and helium

Day	Date	Topic	Reading Assignment
		Black Body Radiation	3.2 Determination of Electron Charge
11	Mon., Sep 29	Black Body Radiation Transition from Classical interpretation to Quantum Explanation in Statistics	Ch3 The experimental basis of quantum theory 3.3 Line Spectra 3.4 Quantization 3.5 Blackbody Radiation
12	Wed., Oct 1	Particle property of Light – Photon	Ch3 The experimental basis of quantum theory 3.6 Photoelectric Effect 3.7 X-ray Production
13	Mon., Oct 6	Particle property of Light – Photon	Ch3 The experimental basis of quantum theory 3.8 Compton Effect 3.9 Pair Production and Annihilation
14	Wed., Oct 8	Atomic Model and Rutherford Scattering	Ch4 Structure of the Atom 4.1 The Atomic Model of Thompson and Rutherford 4.2 Rutherford Scattering
15	Mon., Oct 13	Classical Atomic Model and Bohr's Model for Hydrogen Atom	Ch4 Structure of the Atom 4.2 Rutherford Scattering 4.3 The Classical Atomic Model
16	Wed., Oct 15	Characteristic X-ray and spectroscopy	Ch4 Structure of the Atom 4.4 The Bohr Model of the Hydrogen Model 4.5 Success and Failure of the Bohr Model
17	Mon., Oct 20	X-ray Scattering and Crystallography	Ch4 Structure of the Atom 4.6 Characteristic X-ray Spectra and Atomic Number 4.7 Atomic Excitation by Electrons
18	Wed., Oct 22	Wave nature of Particles	Ch5 Wave properties of matter and quantum mechanics I 5.1 X-ray Scattering 5.2 De Broglie Waves
19	Mon., Oct 27	Wave-Particle Duality Concept of Probability and Wave Function of a Particle	Ch5 Wave properties of matter and quantum mechanics Wave-Particle Duality 5.3 Electron Scattering 5.4 Wave Motion 5.5 Wave or Particles?
20	Wed., Oct 29	Wave-Particle Duality Concept of Probability and Wave Function of a Particle	Ch5 Wave properties of matter and quantum mechanics Wave-Particle Duality 5.3 Electron Scattering 5.4 Wave Motion 5.5 Wave or Particles?

Day	Date	Topic	Reading Assignment
21	Mon., Nov 3	Uncertainty Principle Particle in a Box	Ch5 Wave properties of matter and quantum mechanics Wave-Particle Duality 5.6 Uncertainty Principle 5.7 Probability, Wave Functions, and the Copenhagen Interpretation 5.8 Particle in a Box
22	Wed., Nov 5	Application of the Schrödinger Equation to Solve for a Wave Function	Ch6 Quantum Mechanics II 6.1 The Schrodinger Wave Equation 6.2 Expectation Values 6.3 Infinite Square-Well Potential
23	Mon., Nov 10	Application of the Schrödinger Equation to Solve for a Wave Function	Ch6 Quantum Mechanics II 6.3 Infinite Square-Well Potential 6.4 Finite Square-Well Potential
24	Wed., Nov 12	Application of the Schrödinger Equation to Solve for a Wave Function	Ch6 Quantum Mechanics II 6.3 Infinite Square-Well Potential 6.4 Finite Square-Well Potential
25	Mon., Nov 17	Application of the Schrödinger Equation to Solve for a Wave Function	Ch6 Quantum Mechanics II 6.5 Three-Dimensional Infinite Potential Well 6.6 Simple Harmonic Oscillator
26	Wed., Nov 19	Analysis and Application of Wave Functions	Ch6 Quantum Mechanics II 6.7 Barrier and Tunneling
N/A	Mon., Nov 24	Thanksgiving Break	
N/A	Wed., Nov 26	Thanksgiving Break	
27	Mon., Dec 1	Analysis and Application of Wave Functions	Ch6 Quantum Mechanics II 6.7 Barrier and Tunneling
28	Wed., Dec 3	Wave Function and Electron Clouds for a Hydrogen Atom	Ch7 The hydrogen atom 7.1 Application of the Schrodinger Equation to the Hydrogen Atoms
29	Mon., Dec 8	Energies and Quantum States for Hydrogen-Like Atoms	Ch7 The hydrogen atom 7.1 Application of the Schrodinger Equation to the Hydrogen Atoms 7.2 Solution of the Schrodinger Equation for Hydrogen
30	Wed., Dec 10	Splitting of the Energy Levels in Magnetic Field	Ch7 The hydrogen atom 7.3 Quantum numbers 7.4 Magnetic Effects on Atomic Spectra – The Normal Zeeman Effect

Day	Date	Topic	Reading Assignment

Table 2 Finals Week Schedule

Finals week	Days	Dates
Final Exam Preparation & Faculty Consultation Days:	Thursday and Friday	Dec 11 and 12
Final Semester Examinations	Monday – Thursday	Dec 15 to 18
Final Exam in this course	Monday	Dec 15 11 AM -1 PM