

PHYS 102 Modern Physics

Fall 2023

(Updated on 8/18/2023)

Course Modality: face-to-face	
Course ID number PHYS102-01-75769-2237	Instructor Name Pei-Chun Ho
Units: 3	Department of Physics California State University, Fresno
Class Meeting Location & Time: McLane 258 Monday: 11 AM – 12:15 PM Wednesday: 11 AM – 12:15 PM	Email / Telephone peiho@mail.fresnostate.edu (559) 278-5990
Canvas: fresnostate.instructure.com	Office
Prerequisites: PHYS 4C MATH 81 (may be taken concurrently).	Student Support Hours Monday & Wednesday: 12:15 PM – 1:15 PM (Continuing from PHYS 102 in McLane 258 or 255) Tuesday & Thursday: 7:45 PM – 9 PM (Continuing from PHYS 4A in McLane 162 or 255) For further hours, upon request by email

Course description:

This three unit upper-division physics course will introduce the development of Modern Physics, which started from in the end of 19th and beginning of 20th centuries and its transition from classical Physics to Quantum Mechanics and Relativity. These concepts include the wave-particle duality of light, wave functions and probabilities of particles, atomic and nuclear structure, energy level schemes and radiation, and the development of Solid State Physics.

Modern Physics is developed from the phenomena, unresolved experimental results, and technical challenges near the turn of the 20th centuries until now. Therefore, representative experiments, their setups, results, and technical application will be greatly emphasized.

- ❖ It is usually 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 expect 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.
- I. **Immediate Access (IA)** is set up for this course by using [the Canvas System](#).
 - 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!
 - IA contains an iClicker-Reef from **Canvas- iClicker Sync**:
 - iClicker-Reef operated through APP (on laptops or Mobile device) is required for in-class quick quizzes. The iClicker-Reef Class is "**PHYS102Ho2023F**" (remember that it [has been synced with the Achieve course](#)).
 - [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!
 - 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 2023 is September 2, 2023.** – – 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 7, 2023**...Charges will be due around **September 16, 2023**. 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
- II. **Scientific Calculator (Graphing Calculator is "Not" allowed for this course).**
 - III. A Fresno Stat email account. **Instructor will not respond to the emails not sent through the Fresno State system.**
 - IV. 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 be able to analyze various properties of the quantum states by free-electron model and the concepts applied to the modern technology, such as X-ray diffractometer, Electron microscopes, PET scan.

Student Learning Outcomes: Students will develop a strong foundation to identify, analyze, and solve problems within the core driplines described in the text book of "Modern Physics For Scientists and Engineers," by 4th edition, by Stephen T.

Thornton and Andrew Rex, which are universally recognized as standards in undergraduate physics education.

Course requirements/assignments: In this section, list all required work that makes up the total grade for the course, such as quizzes, exams, homework, paper, service hours, project and presentation, etc. Be sure to specify **if attendance and/or participation is required** and how it impacts student grades.

- 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 15% of the weighted grade. Full participant points 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 order is required to be uploaded to Canvas. Homework passes the deadline will be counted as zero. (20% of weighted grade)
- III. Two midterms will be offered and each weighs 20%.
- IV. Final exam will be given according to the University Final Exam (25% of weighted grade).

Besides the regular Office hours student can talk to the instructor in person, other communications are preferred done through Fresno State email or Zoom appointments upon request. **When sending an email message you must use a specific format. Type your last name and first initial in the 'subject' line along with the course number (PHYS 102). Example: Doe, John PHYS 102.**

Grading policy:

Weighted Grades:

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

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

Letter Grade	Percent (lower limit)	Percent (upper limit)
A	87	100
B	74	86.999
C	60	73.999

Letter Grade	Percent (lower limit)	Percent (upper limit)
D	50	59.999
F	0	49.999

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

Course Policies & Safety Issues

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.

- ❖ **Audio and video recordings of class lectures are prohibited unless I give you explicit permission to do it. Students with an official letter from the Services for Students with Disabilities office may record the class if SSD has approved that service."**

Late work and make-up work policy: Either delayed or make-up exams for three 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), 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 at:

covid.fresnostate.edu

Vaccination: All Students who access Campus/Programs must be Fully Vaccinated (including the booster dose when eligible to receive it) in order to participate in any in-person course-related activities (either on-campus or off-campus). Students may select that they will not be participating in any in-person activities (which includes use of the Library, Student Union and/or Student Health & Counseling Center) and/or may attest to a Medical or Religious Exemption from the vaccine policy requirement in accordance with CSU and campus procedures. Students should go to the Student Portal to update their COVID self-certification form and vaccine documentation. Requests for exemptions can be found there. You are not to come to campus if any of the following are true:

- You are not considered fully vaccinated, and you have not attested to a medical or religious exemption.
- You have attested to an exemption, but you have not completed your mandatory weekly COVID-19 test.

Health Screening: Please do not come to campus or off-campus learning site if any of the following is true:

- If you have experienced COVID-19 symptoms (vaccinated or not).
- If you have tested positive within the past 10 days.

Please complete the campus [online reporting form](https://covid.fresnostate.edu/cases/reporting.html) (<https://covid.fresnostate.edu/cases/reporting.html>), and you will then receive further guidance.

Safety Measures: While masks will no longer be required, we strongly encourage their use, as face coverings are still a valuable tool in the fight against COVID-19, especially in large group settings. We fully support and respect those who wish to continue wearing face coverings.

Individuals can pick up face coverings, provided at no cost, at any of the following locations:

- Library
- University Student Union
- Student Health and Counseling Center
- Student Housing Atrium
- COVID Testing Site – check the below website for location

Please see university website for the most updated information:

www.fresnostate.edu/coronavirus

Please remember that the same student conduct rules that are used for in-person classroom instruction also apply for virtual/online classrooms. Students are prohibited from any unauthorized recording, dissemination, or publication of any academic presentation, including any online classroom instruction, for any commercial purpose. In addition, students may not record or use virtual/online instruction in any manner that would violate copyright law. Students are to use all online/virtual instruction exclusively for the educational purpose of the online class in which the instruction is being provided. Students may not re-record any online recordings or post any online recordings in any other format (e.g., electronic, video, social media, audio recording, web page, internet, hard paper copy, etc.) for any purpose without the explicit written permission of the faculty member providing the instruction. Exceptions for disability-related accommodations will be addressed by Student Disability Services working in conjunction with the student and faculty member.

Plagiarism Detection: The campus subscribes to Turnitin, a plagiarism prevention service, through Canvas. You will need to submit written assignments to Turnitin. Student work will be used for plagiarism detection and for no other purpose. The student may indicate in writing to the instructor that he/she refuses to participate in the plagiarism detection process, in which case the instructor can use other electronic means to verify the originality of their work. Turnitin Originality Reports WILL/WILL NOT* be available for your viewing. *FACULTY: Please choose for your course WILL or WILL NOT be available for your viewing.

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 are prohibited unless I give 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.

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: <https://sites.google.com/mail.fresnostate.edu/fresno-state-sri/fssri-for-students>.

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).

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](#)

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](#)
- [SupportNet](#)
- [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 deadline of prelecture activities and homework can be found on the [Canvas](#).

Examination Schedule

Date	Exam	Points
Monday, 10/2/2023 (Time: To Be Announced)	1 st Midterm either on Canvas or at Bulldog Testing Center To Be Announced	100
Monday, 11/13/2023 (Time: To Be Announced)	2 nd Midterm either on Canvas or at Bulldog Testing Center To Be Announced	100
Monday, 12/11/2023 11 AM – 1 PM (Following the University Final Exam Schedule)	Final Exam McLane 258	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.

Fall 2023 Tentative Course Schedule: Monday, Wednesday Courses			
	Date	Topic	Reading Assignment
1	Mon., Aug 21	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	Wed., Aug 23	Maxwell Boltzmann Statistics	Ch9 Statistical physics 9.2 Maxwell Velocity Distribution
3	Mon., Aug 28	Quantum Statistics Two classes of particles: Fermions Bosons	Ch9 Statistical physics 9.3 Equipartition Theorem 9.4 Maxwell Speed Distribution
4	Wed., Aug 30	Quantum Statistics Two classes of particles: Fermions Bosons	Ch9 Statistical physics 9.5 Classical and Quantum Statistics 9.6 Fermi-Dirac Statistics
	Mon., Sept 5	Holiday - Labor Day	
5	Wed., Sept 6	Quantum Statistics Two classes of particles: Fermions Bosons	Ch9 Statistical physics 9.6 Fermi-Dirac Statistics
6	Mon., Sept 11	Quantum Statistics: Fermi-Dirac Statistics	Ch9 Statistical physics 9.6 Fermi-Dirac Statistics
7	Wed., Sept 13	Quantum Statistics: Bose-Einstein Statistics	Ch9 Statistical physics 9.7 Bose-Einstein Statistics
8	Mon., Sept 18	New discoveries in the end of 19 th century Black Body Radiation	Ch3 The experimental basis of quantum theory 3.1 Discovery of X-ray and Electrons, line spectra, and helium 3.2 Determination of Electron Charge
9	Wed., Sept 20	Black Body Radiation	Ch3 The experimental basis of quantum theory 3.3 Line Spectra

Fall 2023 Tentative Course Schedule: Monday, Wednesday Courses

	Date	Topic	Reading Assignment
		Transition from Classical interpretation to Quantum Explanation in Statistics	3.4 Quantization 3.5 Blackbody Radiation
10	Mon., Sept 25	Particle property of Light – Photon	Ch3 The experimental basis of quantum theory 3.6 Photoelectric Effect 3.7 X-ray Production
11	Wed., Sept 27	Particle property of Light – Photon	Ch3 The experimental basis of quantum theory 3.8 Compton Effect 3.9 Pair Production and Annihilation
12	Mon., Oct 2	1st Midterm	
13	Wed., Oct 4	Atomic Model and Rutherford Scattering	Ch4 Structure of the Atom 4.1 The Atomic Model of Thompson and Rutherford 4.2 Rutherford Scattering
14	Mon., Oct 9	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
15	Wed., Oct 11	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
16	Mon., Oct 16	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
17	Wed., Oct 18	Wave nature of Particles	Ch5 Wave properties of matter and quantum mechanics I 5.1 X-ray Scattering 5.2 De Broglie Waves
18	Mon., Oct 23	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?
19	Wed., Oct 25	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

Fall 2023 Tentative Course Schedule: Monday, Wednesday Courses

	Date	Topic	Reading Assignment
			5.8 Particle in a Box
20	Mon., Oct 30	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
21	Wed., Nov 1	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
22	Mon., Nov 6	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
23	Wed., Nov 8	Analysis and Application of Wave Functions	Ch6 Quantum Mechanics II 6.7 Barrier and Tunneling
24	Wed., Nov 13	2nd Midterm	
25	Mon., Nov 15	Wave Function and Electron Clouds for a Hydrogen Atom	Ch7 The hydrogen atom 7.1 Application of the Schrodinger Equation to the Hydrogen Atoms
26	Mon., Nov 20	Wave Function and Electron Clouds for a Hydrogen Atom	Ch7 The hydrogen atom 7.1 Application of the Schrodinger Equation to the Hydrogen Atoms
	Wed., Nov 22	Thanksgiving Break Nov. 22 - 24	
27	Mon., Nov 27	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
28	Wed., Nov 29	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
29	Mon., Dec 4	Electron Spin, Gyromagnetic Ratios & Selection Rules	Ch7 The hydrogen atom 7.6 Energy Levels and Electron Probabilities 7.6 Energy Levels and Electron Probabilities
30	Wed., Dec 6	Magnetic Moments of free ions, Spin-Orbital Coupling &	Ch8 Atomic physics 8.1 Periodic Table 8.2 Total Angular Momentum

Fall 2023 Tentative Course Schedule: Monday, Wednesday Courses			
Date	Topic	Reading Assignment	
Last Day of Instruction	Anomalous Zeeman Effect	Hund's Rule Ground State of Localized Ion Moment 8.3 Anomalous Zeeman Effect	
Finals week		Days	Dates
Final Exam Preparation & Faculty Consultation Days:		Thursday and Friday	Dec 7 - 8
Final Semester Examinations		Monday – Thursday	Dec 11 - 14
Final Exam in this course		Monday, Dec 11	11 AM-1 PM