Fall 9-1-2018

PHSX 343.01: Modern Physics

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Physics 343: Modern Physics Fall 2018

Course Information

- Instructor: Dr. David A. Macaluso
- Office: C.H. Clapp Building, room 119
- Telephone: (406) 243-6641
- Email: david.macaluso@umontana.edu
- Lectures: MWF 2:00 – 2:50 PM, CHCB 230/231
- Office Hours: MW 11-12, TTr 2-3. I am happy to help students and answer questions outside my normally scheduled office hours and I strongly encourage students to seek my assistance whenever necessary.

Overview

Modern Physics is a general term used to describe several disciplines of physics developed primarily in the early 20th century. This was a revolutionary time in physics when radical new ideas were being proposed to address the inability of Classical Physics to explain certain observable phenomena (thus Modern Physics is firmly ***empirical***). Of the numerous fields and subfields that comprise Modern Physics today, most can be traced to two fundamental concepts: Relativity and Quantum Mechanics. In this class we will explore Modern Physics from its inception with these two monumental theories to its applications in Particle, Nuclear, Atomic, Molecular, and Solid-State, and if time permits, Statistical Physics and Cosmology.

Learning Outcomes

Upon completing this course, students should have:

1. A qualitative and quantitative understanding of Relativity and Quantum Mechanics and their associated and complimentary fields, such as atomic, molecular, nuclear, particle, and solid state physics (for example).
2. Improved problem solving and study skills in preparation for advanced physics coursework.
3. A fundamental background in quantum mechanics in preparation for Quantum Mechanics I and II.

Textbook

Modern Physics, 3rd Edition, By Krane
ISBN-13: 978-1118061145
ISBN-10: 1118061144

Add/Drop/Withdraw

Please refer to the University policy on adding, dropping, and withdrawing from the course at http://www.umt.edu/registrar/students/dropadd.php.

From the 16th through the 45th instructional day, all classes must be dropped using Drop forms (instructor signature required, advisor signature required for undergraduates). **$10 fee applies.**

From the 46th to the last instructional day prior to finals week, classes must be dropped using the Drop form (instructor and Dean signatures required, advisor signature required for undergraduates). **$10 fee applies.**

Websites

Grades and other materials will be posted on Moodle.

Course Expectations

This is an ***upper division*** course intended for physics majors. The expectations are therefore appropriate for advanced undergraduate students who are familiar with the concepts of personal responsibility, accountability, and academic honesty. For example:

Prerequisites/Co-requisites: I expect all students to have completed the prerequisite courses; one year of calculus-based College Physics (PHSX 215 and PHSX 217 or equivalent), and Calculus II (Mathematics 172 or equivalent). It is also expected that students will be concurrently enrolled in the co-requisite course (Mathematics 273 - Multivariable Calculus).

Attendance: Exams will be based at least partially on lectures, in-class discussions, and in-class assignments. In addition, quizzes represent a significant percentage of the course grade. Thus regular attendance, while not compulsory, is vital to student success.

Reading Assignments: Students are expected to ***read the assigned material before class***. Intermittent quizzes will be given usually at the beginning of class that will be based at least partially on the reading. These quizzes will not be demanding, so reading ahead will both prepare you for the upcoming lecture and help assure you earn the "low hanging fruit" of reading quizzes.

Original Work: I strongly encourage students to work together, and to seek assistance from me whenever necessary. However, written work submitted in this class must be the original work of the student. The Student Conduct Code at the University of Montana embodies and promotes honesty, integrity, accountability, rights, and responsibilities associated with constructive citizenship in our academic community. This Code describes expected standards of behavior for all students, including academic conduct and general conduct, and it outlines students' rights, responsibilities, and the campus processes for adjudicating alleged violations. See the full code at: http://www.umt.edu/vpsa/policies/student_conduct.php

Do not use electronics in class, including phones and laptops.

Therefore, you must have a dedicated calculator (i.e. no smartphone calculator apps, please).

Grading Policy

Grading will be based on the traditional letter grade percentage scale. Grade breakdown:

Midterm Exams (three at 10% each)	**30%**
Cumulative Final Exam	**30%**
Homework	**20%**
Quizzes (*at least one per week*)	**20%**

Midterm exams will take place in the regular classroom during normal class time. Exams are 50 minutes and will likely take every second of those 50 minutes to complete, so *be prepared*. The Final Exam will take place in the

normal classroom from **1:10 – 3:10 PM on Tuesday, December 11th**. If you are unable to attend an exam, arrangements must be made *beforehand* so that you can take the exam *early.* **Missed exams are a zero**.

Homework will be due at the beginning of class. **Late assignments will be accepted with a maximum grade of 50% (except where prior arrangements have been made with me).**

Academic Honesty

I encourage students to work together and to seek assistance from me whenever necessary. However, work submitted in this class must be the original work of the student. In addition, the majority of your grade will be based on quizzes and exams that test your mastery of the homework problems, so doing the problems on your own will give you the best chance to succeed.

University policy statement on academic honesty: All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the Student Conduct Code: (http://www.umt.edu/vpsa/policies/student_conduct.php).

Students with Disabilities:

Students with disabilities may request reasonable modifications by contacting me. The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students. "Reasonable" means the University permits no fundamental alterations of academic standards or retroactive modifications. For more information, visit the Disability Services for Students website at http://life.umt.edu/dss/.

Tentative Course Schedule (dates, topics and reading assignments subject to change)

Sept.	Day	Topics	Reading
8/27	M	Syllabus, Course Intro, Chapter 1, Intro to Special Relativity	Preface, Ch. 1 (all), 2.1 – 2.3
	W	Special Relativity	2.4 - 2.5
	F	Special Relativity	2.6 - 2.9
9/3	M	***Labor Day – no class***	
	W	Special Relativity - Applications	Review Ch. 2
	F	Particle-like Waves	Chapter 3 (all)
9/10	M	Wave-like Particles	4.1 - 4.2
	W	Wave-like Particles	4.3 - 4.4
	F	Particle/Wave Duality & Exam I Review	4.5 - 4.7
9/17	M	**EXAM I**: Chapters 1-4	
	W	The Schrödinger Equation	5.1 - 5.3
	F	The Schrödinger Equation: *Free Particle, ISW*	5.4
9/24	M	The Schrödinger Equation: *FSW* & *SHO*	5.5
	W	The Schrödinger Equation	5.6
	F	The Schrödinger Equation Problem Solving Day	Review Ch. 5

Oct.	Day	Topics	Reading
10/1	M	The Rutherford-Bohr Model of the Atom	6.1 – 6.3
	W	The Rutherford-Bohr Model of the Atom	6.4 – 6.5
	F	The Rutherford-Bohr Model of the Atom	6.6 – 6.8
10/8	M	The Hydrogen Atom In Wave Mechanics	7.1 – 7.3
	W	The Hydrogen Atom In Wave Mechanics	7.4 – 7.6
	F	The Hydrogen Atom In Wave Mechanics	7.7 – 7.9
10/15	M	Many-Electron Atoms – Pauli, notation, & transitions	8.1 – 8.3
	W	Many-Electron Atoms – addition of angular momenta	8.4 – 8.6
	F	Many-Electron Atoms – Lasers! & Exam II Review	8.7
10/22	M	**EXAM II**: Chapters 5-8	
	W	Molecules – H_2 & covalent bonds	9.1 – 9.2
	F	Molecules – ionic bonds	9.3
10/29	M	Molecules – vibrations & rotations	9.4 – 9.5
	W	Solid-State Physics – electrons & conduction	11.1 – 11.4
	F	Solid-State Physics – superconductors	11.4 – 11.5

Nov.	Day	Topics	Reading
11/5	M	Solid-State Physics – semiconductors	11.6 – 11.7
	W	Nuclear Physics	12.1 – 12.5
	F	Nuclear Physics – radioactive decay	12.6 – 12.9
11/12	M	***Veterans Day – no class***	
	W	Nuclear Reactions	13.1 – 13.3
	F	Nuclear Reactions & Exam III Review	13.4 – 13.6
11/19	M	**EXAM III**: Chapters 9, 11-13	
	W	***Student Travel Day – no class***	
	F	***Thanksgiving Break – no class***	
11/26	M	Particle Physics	Chapter 14
	W	Particle Physics	Chapter 14
	F	Cosmology	Chapter 15

Dec.	Day	Topics	Reading
12/3	M	Cosmology	Chapter 15
	W	Cosmology	Chapter 15
	F	Final Exam Review & Course Evaluations	*Everything, again!*
12/11	**Tu**	**Cumulative Final Exam 1:10 PM – 3:10 PM**	