University of Pittsburgh - *Department of Physics & Astronomy*

Physics 0481
Principle of Modern Physics 2
Spring Term 2025

Welcome to the official syllabus of Physics 0481!

Contents

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Course Information

- ***Time and Place of Class***

  MWF 11:00---11:50am, 11 Thaw

- ***Modern Physics Topics: Planned list***

  - Physics of laser:
    - Laser amplification

        - Laser cooling and atomic trap
    - Condensed matter physics
        - The Bravais lattice
        - Crystal structures
        - Reciprocal lattice
        - Lattice planes
        - Bloch's theorem
        - The band structure of solids
        - Classification of solids
        - Free electron model of metals
        - Semiconductors and doping
        - Semiconductor devices
        - Superconductivity*
        - Semiconductor lasers*
    - Relativistic wave equations and general relativity
        - Momentum and energy
        - Dirac theory of electron
        - General theory of relativity
        - Einstein's equations
        - Gravitational waves and detection
        - LIGO frontiers: 2016 discovery of gravitational waves*
    - Particle physics and cosmology
        - Particle conservation laws
        - Leptons and quarks
        - Particle accelerators and dectors
        - The standard model
        - The big bang
        - The evolution of early universe*

  * May be included as further reading or special topic presentations by students, depending on class time and student interest.

- ***Textbooks***

    - *More of formal theory:* "Modern Physics with Modern Computational Methods", John C. Morrison, 3rd ed. Elsevier. ISBN 978-0-12-817790-7
    - *More phenomenology*: OpenSTAX, University Physics, Volume 3. This online textbook provides a good free reference of an introductory calculus-based intro physics mechanics course.

- ***Supplementary Reading***

  Some additional readings may be provided on CourseWeb during the term.

- ***Course Plan Schedule: see CourseWeb***

  See CourseWeb for dynamical updating as our class moves forward progressively.

Grading policy

The grades for this course will be based on homework (30%), two midterm exams (40%), and the special topic research presentation and term paper (30%).

Letter grade boundaries: The letter grade cutoffs will be calculated (and curved if needed) uniformly--- based on the statistics of this class and the previous similar courses --- at the very end of the term. Here let me outline a general scheme (tentative): a total score around (90%, 80%, 70%, 60%) is a probable cutoff for the grade of (A, B, C, D). Final grade will be determined by your total weighted performance score according to the final letter grade boundaries for the entire class.

Late and Absent Assignments. We do NOT accept late homework assignments, NOR provide makeup exams, unless there is a special, strong, justifiable reason (such as athletes going out for games on behalf of the University, being in emergency room during the recitation time with hospital evidence, or a case as strong).

Change of Classes

See announcement.

Homework

Note: *Please visit the "Homework" folder on the CourseWeb Main page of this course for assignments and solutions!*

Homework Guidelines:

Homework will be assigned weekly and will be due a week later. Homework exercises are essential for understanding the course material. Often, due to the time pressure, I will explain the general theory in class and leave the examples for homework assignment.

a. Homework must be turned in through the CourseWeb page of this course on Canvas in PDF format, not by email or paper.
b. All homework sets are *due on Canvas* on the date and time designated (see "Course Calendar" folder on Canvas), unless there is emergency or the due date/time is extended uniformly for all students because of special circumstances.
c. You are strongly encouraged to discuss all topics of modern physics, including homework problems, with others. A *direct* copy of other's homework, however, will receive zero credit for the particular problems. Who lends the homework may get less than full credit. Thank you for holding up a high standard for our course!
d. Emails regarding homework are discouraged. Instead, you should bring physics questions during the Instructor's office hours or right after the class.
e. Homework grading questions and requests: please first direct to TA grader office hours or send by email (see "Instructor and TAs" for information). If you are not satisfied by the response/help provided by the TA/grader, you are welcome to come to see the course Instructor.
f. Questions or requests posted on the Canvas website (in any form!) will not be answered!

Exams

There will be two mid-term exams (in class) and no final examination. The exams are set on:

- Midterm Exam 1: Friday, Feb 21, Room: our classroom
- Midterm Exam 2: Friday, Apr 4, Room: our classroom
- Final: no final exam (but research paper presentation)

All midterm exams will be held during the regular class meeting time in the regular lecture room unless otherwise announced. There will be no make-up midterm examinations under any circumstance (sorry, no exceptions).

For each exam, you will be permitted to open any one or both of our textbooks, namely the books by Morrison and OpenStax. You may also bring a summary sheet [double sided, single page of the standard letter paper size], which will be prepared by yourself in whatever format you choose. Any materials not specifically mentioned above (such as homework sets, lecture notes, previous exams, etc.) are ***not*** permitted.

Research Paper Topic

Please visit the relevant folder in our Course Web page on Canvas for the list of topics for your selection and the instruction on the deadlines for this assignment.

Tables and References

- Physical constants [Source: Particle Data Group in LBNL]

Course Calendar

Week of	Due	Reading
Jan 6	Classes begin Wed 1/8	[M]Ch 6
Jan 13	HW 1	[M]Ch 6
Jan 20	HW 2	[O]Ch 9.1-5
Jan 27	HW 3	[O]Ch 9.1-5
Feb 3	HW 4	[M]Ch 9.1-5
Feb 10	HW 5	[M]Ch 9.1-5
Feb 17	HW 6, Midterm 1	[O]Ch 9.6-8
Feb 24	HW 7	[O]Ch 9.6-8
Mar 3	Spring Recess	free
Mar 10	HW 8	[M]Ch 13
Mar 17	HW 9	[M]Ch 13
Mar 24	HW 10	[M]Ch 13, [O]Ch 11
Mar 31	HW 11, Midterm 2	[O]Ch 11
Apr 7	HW 12	[O]Ch 11
Apr 14	HW 13	student presentations, no lecture
Apr 21	research assay, last day of class Monday 4/21	student presentations, no lecture

Chapter notation:

- [M] = John C **M**orrison, *"Modern Physics with Modern Computational Methods"*
- [O] = **O**penStax, *"University Physics"*, **Volume 3** **(https://openstax.org/details/books/university-physics-volume-3)** .

Homework assignments: all due on **Wednesday 11:30pm** unless otherwise noted uniformly for all.