Physics 0174
Basic Physics for Students of Science and Engineering 1
Fall Term 2023 (2241) CRN: 10936

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Corequisites: MATH 0220 or MATH 0235

Text: **Fundamentals of Physics** (Twelfth Edition) by David Halliday, Robert Resnick and Jearl Walker, Chapters 1 – 13, 15 – 17. It is important to do the assigned reading **before** the associated lecture.

Lectures: The lectures are scheduled for 10:00 – 10:50 am on Mondays and Fridays, 10:00 – 11:50 am on Wednesdays in Room 343 Alumni Hall. The lectures will include class participation via Top Hat and possibly worksheets to be handed in, both of which will contribute to your grade. The lectures will also include demonstrations of physical phenomena. There is no charge for access to Top Hat. Most likely, the lectures will be recorded and made available on Canvas. They might also broadcast synchronously using Zoom, so that you can "attend" the lecture even if you are ill or away on a university-sponsored trip (for example, if you are on a sports team). In addition, links to sets of brief lecture videos and example problems used by Dr. David Nero in his "flipped" version of this course are available on Canvas in case you wish to use them. There will be concept quizzes (reading quizzes) using Achieve to try to identify which aspects of the material you already understand and which should be emphasized during the lectures. Long uninterrupted lectures are known to not be very effective for learning, so I would like the lectures to be focused and relatively brief episodes in the midst of student activities such as group problem solving, Top Hat questions, etc. Lecture activities will count for credit to the extent that performance can be recorded using Top Hat.

Homework: Homework will be assigned using the Achieve on-line system. The homework sets are due at 11:59 pm on Sundays. It is your responsibility to attempt the homework before the recitation section as preparation for the weekly quiz. Homework due dates are typically after the associated recitation quiz. The ability to understand and solve problems is essential for successful performance on quizzes and exams. There will also be short

reading check questions on Achieve due before many of the lectures. Your homework scores and reading check scores, automatically compiled by Achieve, will contribute to your grade. To sign up for Achieve, see the instructions on Canvas. The price for Achieve is $30 for one term and $48 for two terms. Last year, most (not all) Physics 0175 sections used Achieve.

Recitation: Your recitation section provides the opportunity to ask questions and discuss the material in a smaller group. You will also benefit from the alternative viewpoint of the recitation instructor. The format for the recitation depends on your instructor, but might resemble the following:

- Quick review of recent material (5-10 minutes)
- Questions / discussion / problem solving (25-30 minutes) It is highly desirable that most of the recitation period be used for active learning. For example, the recitation instructor can break up the group into smaller groups to do work sheets or guided problems or ask students to work out problems on the board.
- Weekly quiz (10-15 minutes), which will contribute to your grade.

Your recitation grade will be based on the quizzes.

Canvas Site: There is a Canvas site associated with this course. It can be accessed through your http://my.pitt.edu account. This site will be used to make important announcements and to make materials available such as lecture slides, recorded lectures, exam solutions, announcements, surveys, etc. As mentioned earlier, homework will be handled on-line using Achieve, which you can access through Canvas.

Examinations: There will be three 50-minute in-class exams, given during the regular lecture periods on Friday, September 29; Monday, October 30; and Wednesday, November 29. One way to remember these dates is to note that they are dates of the last lecture period in each of those months. The comprehensive final examination is scheduled by the University for Wednesday, December 13, from 8:00 – 9:50 pm, at a location to be determined.

Grading: Your letter grade will be based on the following percentages:

- In-class Exams 40%
- Final Exam 20%
- Homework (Achieve) 10%
- Recitation Quizzes 10%
- Reading Quizzes 10%
- Top Hat Lecture Questions 10%

Roughly, A: 90 – 100%, B: 75 – 90 %, C: 60 – 75%, etc., although some fine tuning is likely.

Scores are recorded in the Canvas grade book, as well as in software linked to Canvas, which includes Gradescope, Achieve, and Top Hat.

Help: There are many resources available for help in addition to the regular office hours of the instructor and teaching assistants. These include:

- "Resource Room" (312 Thaw Hall): This "room" is staffed by graduate student teaching assistants for the introductory physics and astronomy courses. The hours will be posted on the departmental website. The link is: http://www.physics.pitt.edu/resource-room .
- UTA Peer Tutors (Jack Palmerine and Maximiliano Jara Kunsemuller) See contact information above.

- Resources: https://www.studentaffairs.pitt.edu/drs/resources/ There are lots of links in the yellow rectangle at the top of the screen.
- If you wish to hire a private tutor, contact the Physics departmental office, 100 Allen Hall.

Academic Integrity

Students in this course will be expected to comply with the University of Pittsburgh's Policy on Academic Integrity. Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include, but is not limited to, the confiscation of the examination of any individual suspected of violating University Policy. Furthermore, no student may bring any unauthorized materials to an exam, including dictionaries and programmable calculators.

To learn more about Academic Integrity, visit the Academic Integrity Guide for an overview of the topic. For hands- on practice, complete the Understanding and Avoiding Plagiarism tutorial.

No Use of Generative AI Permitted

Intellectual integrity is vital to an academic community and for my fair evaluation of your work. All work completed and/or submitted in this course must be your own, completed in accordance with the University's Guidelines on Academic Integrity. You may not engage in unauthorized collaboration or make use of ChatGPT or any other generative AI applications at any time.

Disability Services

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and Disability Resources and Services (DRS), 140 William Pitt Union, (412) 648-7890, drsrecep@pitt.edu, (412) 228-5347 for P3 ASL users, as early as possible in the term. DRS will verify your disability and determine reasonable accommodations for this course.

Equity, Diversity, and Inclusion

The University of Pittsburgh does not tolerate any form of discrimination, harassment, or retaliation based on disability, race, color, religion, national origin, ancestry, genetic information, marital status, familial status, sex, age, sexual orientation, veteran status or gender identity or other factors as stated in the University's Title IX policy. The University is committed to taking prompt action to end a hostile environment that interferes with the University's mission. For more information about policies, procedures, and practices, visit the Civil Rights & Title IX Compliance web page.

I ask that everyone in the class strive to help ensure that other members of this class can learn in a supportive and respectful environment. If there are instances of the aforementioned issues, please contact the Title IX Coordinator, by calling 412-648-7860, or e-mailing titleixcoordinator@pitt.edu. Reports can also be filed online. You may also choose to report this to a faculty/staff member; they are required to communicate this to the University's Office of Diversity and Inclusion. If you wish to maintain complete confidentiality, you may also contact the University Counseling Center (412-648-7930).

E-Mail Communication

Each student is issued a University e-mail address (username@pitt.edu) upon admittance. This e-mail address may be used by the University for official communication with students. Students are expected to read e-mail sent to this account on a regular basis. Failure to read and react to University communications in a timely manner does not absolve the student from knowing and complying with the content of the communications. The University provides an e-mail forwarding service that allows students to read their e-mail via other service providers (e.g., Hotmail, AOL, Yahoo). Students that choose to forward their e-mail from their pitt.edu address to another address do so at their own risk. If e-mail is lost as a result of forwarding, it does not absolve the student from responding to official communications sent to their University e-mail address.

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See Library of Congress Copyright Office and the University Copyright Policy.

Statement on Classroom Recording

To ensure the free and open discussion of ideas, students may not record classroom lectures, discussion and/or activities without the advance written permission of the instructor, and any such recording properly approved in advance can be used solely for the student's own private use.

Sexual Misconduct, Required Reporting and Title IX

If you are experiencing sexual assault, sexual harassment, domestic violence, and stalking, please report it to me and I will connect you to University resources to support you.

University faculty and staff members are required to report all instances of sexual misconduct, including harassment and sexual violence to the Office of Civil Rights and Title IX. When a report is made, individuals can expect to be contacted by the Title IX Office with information about support resources and options related to safety, accommodations, process, and policy. I encourage you to use the services and resources that may be most helpful to you.

As your professor, I am required to report any incidents of sexual misconduct that are directly reported to me. You can also report directly to Office of Civil Rights and Title IX: 412-648-7860 (M-F; 8:30am-5:00pm) or via the Pitt Concern Connection at: Make A Report

If you wish to make a confidential report, Pitt encourages you to reach out to these resources:

- The University Counseling Center: 412-648-7930 (8:30 A.M. TO 5 P.M. M-F) and 412-648-7856 (AFTER BUSINESS HOURS)
- Pittsburgh Action Against Rape (community resource): 1-866-363-7273 (24/7)

If you have an immediate safety concern, please contact the University of Pittsburgh Police, 412-624-2121

Any form of sexual harassment or violence will not be excused or tolerated at the University of Pittsburgh.

For additional information, please visit the full syllabus statement on the Office of Diversity, Equity, and Inclusion webpage.

Your Well-being Matters

College can be an exciting and challenging time for students. Taking time to maintain your well-being and seek appropriate support can help you achieve your goals and lead a fulfilling life. It can be helpful to remember that we all benefit from assistance and guidance at times, and there are many resources available to support your well-being while you are at Pitt. You are encouraged to visit Thrive@Pitt to learn more about well-being and the many campus resources available to help you thrive.

If you or anyone you know experiences overwhelming academic stress, persistent difficult feelings and/or challenging life events, you are strongly encouraged to seek support. In addition to reaching out to friends and loved ones, consider connecting with a faculty member you trust for assistance connecting to helpful resources.

The University Counseling Center is also here for you. You can call 412-648-7930 at any time to connect with a clinician. If you or someone you know is feeling suicidal, please call the University Counseling Center at any time at 412-648-7930. You can also contact Resolve Crisis Network at 888-796-8226. If the situation is life threatening, call Pitt Police at 412-624-2121 or dial 911.

Learning Goals:
Overall

- State, both in words and equations, the laws of classical mechanics. Explain their meanings and give examples of situations to which they apply.
- Recognize and effectively make use of the terminology associated with classical mechanics.
- Work with various representations of physical laws, including conceptual, graphical, and equations, and be able to transfer between representations as necessary to analyze and solve specific problems/situations.
- Use relevant mathematics, including vector algebra, vector calculus, systems of linear equations, etc., as a tool to express the relevant laws of physics and apply them to specific situations.
- Describe a problem and a strategy to solve it conceptually.
- Analyze a problem conceptually and break up a complex problem or situation into simpler parts.
- Apply relevant physical laws and mathematics to formulate a strategy and then solve a given problem (towards the goal of recognizing the relevance of the material covered in this course to other fields in science and engineering, and to everyday life, and be able to take advantage of your acquired skills to analyze situations and apply the laws of physics to gain insight and make predictions).
- Check numerical results that the values make sense conceptually (having a feel for the numbers) and have the correct units and significant figures.

Topic/Chapter Specific

The following list was developed by a departmental committee. I have classified them according to the relevant chapters in the textbook, the 12th edition of Halliday, Resnick and Walker. I will include learning objectives in the lecture slides. Note that the book lists learning objectives at the beginning of each chapter and section.

Chapter 1: Measurement

Chapter 2: Motion Along a Straight Line

- Make a graph of the instantaneous displacement, velocity, and/or acceleration of a system based on a description of the motion or using another graph.
- Apply the equations of 1-D kinematics to one or more objects with constant acceleration. Examples include free-fall, two objects that meet one another, and an object that has different constant acceleration at different times.

Chapter 3: Vectors (will be covered before Chapter 2)

- Add or subtract two or more vectors. (Relative velocity problems are an application of this category.)
- Find the dot product or cross product of two vectors.

Chapter 4: Motion in Two and Three Dimensions

- Describe the behavior of an object undergoing projectile motion based on the equations of 2-D kinematics.

Chapter 5: Force and Motion I

- Apply a conceptual understanding of Newton's first and third law.
- Draw a free-body diagram and solve for an unknown force or acceleration of a system under the influence of two or more forces.

Chapter 6: Force and Motion II

- Calculate the force of static/kinetic friction or the coefficient of friction.
- Calculate the drag force or terminal speed of an object.
- Identify the centripetal force that acts on a system undergoing circular motion.

Chapter 7: Kinetic Energy and Work

- Find the work done by a force in cases were integration is not required (perhaps by inspecting a graph of force versus displacement). Alternately, find the force given work and displacement.
- Calculate the average power provided by a force.

Chapter 8: Potential Energy and Conservation of Energy

- Apply conservation of mechanical energy to describe the motion of a system.
- Use the work-energy theorem to identify the amount of mechanical energy that has been lost.

Chapter 9: Center of Mass and Linear Momentum

- Calculate the average force or impulse during a collision or series of collisions.
- Apply conservation of momentum to an explosion or collision. Be able to identify whether a collision is elastic, inelastic, or completely inelastic.
- Answer a conceptual question about momentum, rockets, and/or the motion of the center of mass.

Chapter 10: Rotation

- Apply kinematics to a rotating system. Be able to convert between the tangential values of s, v, a and θ , ω, using the radius r.
- Distinguish between angular, tangential, and centripetal acceleration.

Chapter 11: Rolling, Torque, and Angular Momentum

- Determine the net torque acting on a body about a given axis and/or the angular acceleration of that body. Doing so may require the use of one or more moments of inertia.
- Calculate the motion of a rolling object using torques and/or energy conservation. "Rolling" could be caused by a cord wrapped around the object, like in a yo-yo.
- Find the rotational kinetic energy of an object.
- Identify whether angular momentum is or is not conserved, and if appropriate, apply conservation of angular momentum to a rotating system.

Chapter 12: Equilibrium and Elasticity (Equilibrium will be covered with Chapter 11, Elasticity with Chapter 15)

- Use the definition of static equilibrium to solve for one or more unknown forces or torques acting on a system.

Chapter 13: Gravitation (will be covered after Chapter 15)

- Apply energy conservation to a system with gravity to describe the motion of an object in a case where U = mg is not an appropriate assumption.
- Use Kepler's laws of planetary motion to describe the motion of a planet, moon, or satellite about its parent body.

Chapter 15: Oscillations

- Apply the concepts of stress, strain, and ultimate strength to a deformed object.
- Calculate a spring constant given the elastic properties of a material.
- Identify when a system (spring, simple pendulum, or physical pendulum) is undergoing simple harmonic motion, and find the amplitude, period, frequency, angular frequency, phase angle, displacement, velocity, and/or acceleration.
- Apply conservation of mechanical energy to a simple harmonic oscillator (spring, simple pendulum, or physical pendulum). Damping may be involved.

Chapter 16: Waves I

- Determine the amplitude, period, frequency, angular frequency, wave number, wavelength, and/or propagation speed of a transverse traveling wave. If the wave is on a string, be able to calculate the propagation speed using the tension and linear density.
- Predict the result of interference between two waves with identical amplitude and frequency. Specifically, be able to identify constructive, destructive, and intermediate interference - determining the amplitude and/or phase difference in the latter case.

Chapter 17: Waves II

- Identify the resonant frequencies and/or harmonics of a string or open/closed pipe.
- Apply the equation for the Doppler effect to determine the shift in frequency caused by motion.

Physics 0174 (CRN 10936)
Basic Physics for Students of Science and Engineering 1
2241, Spring 2022
R.P. Devaty

Lectures: Mo, Fr 10:00 – 10:50 am, Wed 10:00 – 11:50 am 343 Alumni Hall
Recitation Instructors: to be determined

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Aug. 27	28 Lect 1	29	30 Lect 2	31	1 Lect 3	2
Sept. 3	4 Labor Day	5	6 Lect 4	7	8 Lect 5 Add/Drop ends	9
10	11 Lect 6	12	13 Lect 7	14	15 Lect 8 Extended Add/Drop Ends	16 Rosh Hashanah
17	18 Lect 9	19	20 Lect 10	21	22 Lect 11	23
24	25 Lect 12 Yom Kippur	26	27 Lect 13	28	29 Exam 1	30
Oct. 1	2 Lect 14	3	4 Lect 15	5	6 Fall Break	7 PJAS Cryogenics
8	9 Lect 16	10	11 Lect 17	12	13 Lect 18	14
15	16 Lect 19	17	18 Lect 20	19	20 Lect 21	21
22	23 Lect 22	24	25 Lect 23	26	27 Lect 24 Final Exam Conflict Form Submission Deadline; Monitored Withdrawal Deadline	28
29	30 Exam 2	31	1 Lect 25	2	3 Lect 26	4
Nov. 5 Daylight Savings Time ends	6 Lect 27	7 Election Day	8 Lect 28	9	10 Lect 29	11
12	13 Lect 30	14	15 Lect 31	16	17 Lect 32	18
19	20	21	22	23 Thanksgiving	24	25
26	27 Lect 33	28	29 Exam 3 Lect 34	30	1 Lect 35	2
Dec. 3	4 Lect 36	5	6 Lect 37	7	8 Lect 38 Last Class Hannukah First Day	9
10	11	12	13 Final Exam 8:00 – 9:50 am	14	15 Hannukah Last Day	16
17	18	19 Grades Due 11:59 pm	20	21	22	23

Recitations:

10937: W 1:00-1:50 pm 105 Allen (30) Aria Hajikhani

20113: W 2:00-2:50 pm 105 Allen (34) Aria Hajikhani

10938: H 11:00-11:50 am 105 Allen (30) Aria Hajikhani

16992: H 12:00-12:50 pm 105 Allen (23) Aria Hajikhani

10939: H 1:00-1:50 pm 105 Allen (22) Arthur Wu

Tentative Schedule: "(2)" indicates a double lecture period (Wednesdays)

Week 1 (4): Aug. 27 – Sept. 2

- Lecture 1: Introduction
- Lecture 2 (2): Measurements (units, dimensions, length, time, mass, significant figures); Scalars, Vectors: representations, components, unit vectors, addition and subtraction
- Belonging Intervention, Surveys
- Lecture 3: Vectors: scalar and cross products; Kinematic variables: position, displacement, velocity and acceleration (average and instantaneous)

Week 2 (3): Sept. 3 – 9.

- Lecture 4 (2): 1-D Motion, including free fall, use of graphical methods
- Quiz 1: Vector Addition
- Lecture 5: Motion in 2 and 3 dimensions (definitions of kinematic quantities as vectors)

Week 3 (4): Sept. 10 – 16

- HW 1: Vectors and 1-D Motion
- Lecture 6: Projectile Motion
- Lecture 7 (2): Uniform Circular Motion, Relative Motion in 1 and 2 Dimensions (relative velocity)
- Quiz 2: 1D (and possibly 2D) Kinematics
- Lecture 8: Forces and Mass, Newton's First Law

Week 4 (4): Sept 17 – 23

- HW 2: Kinematics
- Lecture 9: Newton's Second Law; Catalog of Forces: Gravity, Tension, Contact (normal) force
- Lecture 10 (2): Newton's Third Law; Applications of Newton's Second Law
- Quiz 3: Forces (not including friction)
- Lecture 11: Friction and Applications

Week 5 (3): Sept. 24 – 30

- HW 3: Forces I
- Lecture 12: Friction and Applications

- Lecture 13 (2): Applications of Newton's Laws to Circular Motion (Centripetal Force); Review
- Exam 1: Vectors, 1D and 2D Kinematics, Forces (not friction)

Week 6 (3): Oct. 1 – 7

- Lecture 14: Work Done by a Force (gravity, spring, variable force)
- Lecture 15 (2): Work; Kinetic Energy; Work-Energy Theorem with Applications; Power
- Quiz 4: Friction and Centripetal Force

Week 7 (4): Oct. 8 – 14

- HW 4: Forces II
- Lecture 16: Applications of Work-Energy Theorem; Power
- Lecture 17 (2): Conservative Forces and Potential Energy: gravity, spring; Conservation of Total Mechanical Energy with Applications; Potential Energy Diagrams; Generalization of Energy Conservation
- Quiz 5: Work
- Lecture 18: Applications/Examples of Energy Conservation

Week 8 (4): Oct. 15 – 21

- HW 5: Work
- Lecture 19: Conservation of Energy: Applications; Generalization of Energy Conservation
- Lecture 20 (2): Center of Mass; Linear Momentum; Impulse; Impulse Momentum Theorem; Conservation of Total Linear Momentum with examples
- Quiz 6: Energy Conservation
- Lecture 21: Collision Problems: 1D

Week 9 (4): Oct. 22 – 28

- HW 6: Energy
- Lecture 22: Collision Problems: 2D
- Lecture 23 (2): Angular Kinematic Variables; Rotational Motion for constant angular acceleration; relations between regular and rotational kinematic variables; moment of intertia; rotational kinetic energy; examples
- Quiz 7: Momentum Conservation
- Lecture 24: Torque; Newton's Second Law rewritten; Equilibrium problems

Week 10 (3): Oct. 29 – Nov. 4

- HW 7: Momentum
- Exam 2: Friction, Work, Energy, Momentum
- Lecture 25 (2): Rotational Dynamics: nonequilibrium problems; conservation of energy
- Lecture 26): Rolling: forces, kinetic energy, torque

Week 11 (4): Nov. 5 – Nov. 11

- HW 8: Rotation 1
- Lecture 27: Angular momentum; conservation of total angular momentum; applications
- Lecture 28 (2): Conservation of total angular momentum: Applications; Elasticity; Simple Harmonic Motion; Various Examples
- Quiz 8: Rotational Kinematics and Torque (also Angular Momentum, if ready)
- Lecture 29: Simple Harmonic Motion; Various Examples: mass and spring, simple pendulum, torsional oscillator, etc; energy, relation to uniform circular motion

Week 12 (4): Nov. 12 – Nov. 18

- HW 9: Rotation II
- Lecture 30: Simple harmonic motion: Examples
- Lecture 31 (2): Damped oscillations; forced oscillations and resonance; Newton's Law of Gravitation; superposition; gravity near the surface of the earth
- Quiz 9: Simple Harmonic Motion
- Lecture 32: Gravity inside the earth; gravitational potential energy
- Thanksgiving Break

Week 13 (3): Nov. 26 – Dec. 2

- HW 10: Elasticity, Oscillations
- Lecture 33: Gravity: orbits of satellites; Kepler's Laws
- Exam 3: Rotational Kinematics, Torque, Angular Momentum, Simple Harmonic Motion
- Lecture 34: Waves: Description of a transverse wave; wave speed and the medium
- Lecture 35: Waves: wave speed, power, Interference

Week 14 (4): Dec. 3 – Dec. 9

- Lecture 36: Waves: Standing waves and resonance
- Lecture 37 (2): Sound: Description, traveling waves, intensity, interference
- Quiz 10: Gravity and Waves
- Lecture 38: Sound: Beats; Doppler Effect
- HW 11: Gravity and Waves