➜ Instructor:

David Grier
Office: Physics 873
E-mail: david.grier@nyu.edu
Phone: (212) 998-3713
Office Hours: Fridays from 3:30 pm -- 5:30 pm and by appointment

➜ Recitation Instructors:

Mohammed Abdelaziz
Office: Physics 864E
E-mail: maa643@nyu.edu
Office Hours: TBD

Shahrzad Zare
Office: Physics 1042
E-mail: sz2507@nyu.edu
Office Hours: TBD

➜ Tutoring:

The Department of Physics has a dedicated tutor for Physics 1. Tutoring sessions take place in Physics 1067 on Mondays and Wednesdays from 6:00 pm -- 7:30 pm

Brian Chiang
E-mail: bc2611@nyu.edu

The University Learning Center (ULC) also offers tutoring for Physics 1. The schedule and sign-up sheet are available here: (link).

➜ Administration:

Bill LePage
Office: Physics 1005C
E-mail: wlp1@nyu.edu
Phone: (212) 998-7704

➜ Meeting Places & Times

Lectures:	Meyer Hall 122 (4 Washington Place)		
	Tuesdays	12:30 pm -- 1:45 pm	
	Thursdays	12:30 pm -- 1:45 pm	
Recitations:	Meyer Hall 264 (4 Washington Place)		
Section 2	Tuesdays	5:00 pm -- 6:15 pm	Shahrzad Zare
Section 3	Wednesdays	2:00 pm -- 3:15 pm	Shahrzad Zare
Section 4	Thursdays	5:00 pm -- 6:15 pm	Mohammed Abdelaziz
Section 5	Thursdays	2:00 pm -- 3:15 pm	Mohammed Abdelaziz
Tutoring:	Physics 1067 (726 Broadway)		
	Mondays	6:00 pm -- 7:30 pm	
	Wednesdays	6:00 pm -- 7:30 pm	

➜ Course Description

Physics is the study of motion and change. Starting from a remarkably small number of axioms, physicists use tools of mathematical induction to predict how systems will evolve over time. Comparing these predictions with experimental observations yields profound insights into the fundamental composition of matter and space, and provides the guidance needed to create new and useful technology. This course starts with kinematics, an unambiguous and extremely powerful description of motion. It then introduces Newton's laws as axiomatic principles that elevate kinematics into dynamics, a quantitative framework for predicting motion and change. We will apply this framework to analyze illustrative systems whose behavior might seem counterintuitive and bewildering without the benefit of the physicist's world-view. These studies naturally lead to concepts of force, energy and momentum, reveal such universal phenomena as oscillations and orbits, and culminate with an exploration of Special Relativity and its role in everyday life.

➜ Text

Required:

- Young & Freedman, *University Physics* 15th ed. (Pearson, 2020).

This course is participating in the ***Follett Access program***. This is an NYU Bookstore initiative that delivers required course materials at the lowest possible price. The required textbook, *Young & Freedman*, will be delivered to you digitally. The **cost of the book is $27.75**, which will be added as a “book charge” to your bursar bill**,** this is a savings of $127.24 over the publisher’s hardcopy list price.

If you decide not to use this digital edition you can opt out of the program. **The deadline for opting out is September 17th.** If you don’t opt out by this date you will be charged. The link to opt out of the program is: https://includedcp.follett.com/2015.

Supplementary

- OpenStax College Physics: A free web-based college physics textbook.
- OpenStax University Physics Volume 1, Volume 2 and Volume 3: Online calculus-based physics textbooks.
- OpenStax Calculus Volume 1, Volume 2 and Volume 3: Online calculus textbooks.

➜ Prerequisites and Corequisites

Although there are no formal prerequisites for this course, students are assumed to be familiar with differential and integral calculus at the level of AP Calculus.

Corequisite: Calculus I (MATH-UA 121), or Calculus II (Math-UA 122), or Calculus III (Math-UA 123), or the equivalent with permission from the instructor.

Physics majors also must register for Introductory Experimental Physics I (PHYS-UA 71).

➜ Problem Sets

Problem sets will be assigned once per week on Tuesdays. They are due one week later on the following Tuesday and should be turned in electronically via Brightspace. Graded problem sets will be available in recitation, where they will be discussed. You are encouraged to work with others in completing the problem sets for this course. That being said, you are responsible for writing up your solutions yourself and for turning in your own work. Directly copying solutions from other students or from other sources is a violation of NYU’s policy on academic integrity.

➜ Recitation

Recitations combine small-group discussions, hands-on help with problem sets, and additional course material. The first recitations will take place in the week of **September 6**. Most recitations will feature a quiz question to get the conversation going. Answering a quiz question may require working out the physics with pencil and paper. Answers will be turned in via Zoom poll, which will be greatly facilitated if you bring a Zoom-capable device to recitation. Quiz questions are graded on a two-point scale -- one point for trying out an answer and the second for getting it “right”. Recitation quizzes are only offered in recitation and cannot be made up.

Graded problem sets will be returned in recitation. This provides an opportunity to raise questions about solutions to the problems and to clarify the underlying physics.

➜ Exams

There will be two midterm exams (Thursday **October 14** and Thursday **November 4**) and a final exam (Thursday **December 16**). These will be closed-book open-notes exams.

➜ Grading (approximate guidelines)

- Two midterm exams: 30%
- Problem sets: 25%
- Recitation quizzes: 15%
- Final exam: 30%

➜ Schedule of Lectures and Exams

Date	Physics Topics	Math Topics
Th Sep 2	**Philosophical and Historical Introduction:** Why and how to measure natural phenomena. Measuring lengths.	Counting, systems of units
Tu Sep 7	**Kinematics**: length, position, displacement	Coordinate systems, vectors
Th Sep 9	**Kinematics**: Time, displacement, speed, velocity and acceleration	Addition and subtraction of vectors, derivatives
Tu Sep 14	**Kinematics**: motion with constant velocity, motion with constant speed, motion with constant acceleration, Galileo and gravity	Derivatives of vector functions, antiderivatives.
Th Sep 16	**Kinematics**: uniform and nonuniform circular motion	Polar coordinates, chain rule of differentiation
Tu Sep 21	**Axioms**: Newton's First and Second Laws Concepts: "force" and "mass" **Forces 1 and 2**: Galileo's gravity, "normal" forces	Addition of vectors, first mention of differential equations.
Th Sep 23	**Axiom**: Newton's Third Law Statics: forces in equilibrium **Force 3**: tension in strings	Addition of vectors
Tu Sep 28	**Applications**: pulleys, Atwood's machine **Force 4**: friction	Addition of vectors

Th Sep 30	**Applications**: motion with friction, sliding down a ramp, turning a corner **Force 4** (continued): viscous drag **Concept**: the work done by a force	Projection of vectors
Tu Oct 5	**Dynamics**: The work done by a force, the work-energy theorem **Concept**: energy, kinetic energy.	Integration
Th Oct 7	**Force 5**: Hooke's law for springs **Concepts**: potential energy, conservative and nonconservative forces.	Path integrals
Tu Oct 12	**Dynamics**: force and potential energy **Principle**: conservation of energy **Application**: potential energy stored in a spring.	Partial derivatives. Gradient
Th Oct 14	**Midterm Exam I: Kinematics and Dynamics**	
Tu Oct 19	**Oscillations**: Potential energy landscape. Equilibrium. Obtaining equations of motion from Newton's second law. Simple harmonic oscillator: Amplitude, frequency, period and phase.	Ordinary differential equations. Solution by substitution.
Th Oct 21	**Oscillations**: Damped harmonic oscillator. Driven damped harmonic oscillator. Resonance.	Ordinary differential equations.
Tu Oct 26	**Dynamics**: Momentum. Conservation of momentum. Systems of particles. Center of mass.	Volume integrals.
Th Oct 28	**Applications**: Conservation of momentum: Center of mass motion, explosions, recoil and rockets.	
Tu Nov 2	**Collisions**: laboratory frame and center-of-mass frame	
Th Nov 4	**Midterm Exam II: Conservation of energy, oscillations, conservation of momentum.**	
Tu Nov 9	**Relativity**: Newtonian relativity, Galilean transformations. The problem with Maxwell's equations. Einstein's Postulates of Special Relativity. Lorentz transformation equations.	
Th Nov 11	**Special Relativity**: Length contraction and time dilation. Synchronizing clocks. Relativistic kinematics.	
Tu Nov 16	**Special Relativity:** Relativistic dynamics. Conservation of relativistic momentum. Relativistic mass transformation.	
Th Nov 18	**Special Relativity**: Relativistic force, work and kinetic energy. The mass-energy relation and some of its consequences.	
Tu Nov 23	**Rotational Kinematics**: Describing rotations. Angular speed, angular velocity. Angular acceleration. Rigid body motion. Rotational kinetic energy. Moment of inertia. Parallel axis theorem.	Volume integrals
Tu Nov 30	**Rotational Dynamics**: Conservation of energy. Angular momentum. Conservation of angular momentum.	Vector multiplication: Scalar (dot) product and vector (cross) product.

Tu Dec 2	**Rotational Dynamics**: Torque and Newton's second law for rotations. Physical pendulum and rotational oscillations. Gyroscope motion. Angular momentum in collisions.
Th Dec 7	**Gravitation and Orbits**
Th Dec 11	**Orbital Dynamics**
Th Dec 16	**Final Exam (2 pm -- 3:50 pm)**