Send To Printer | Close Window

Syllabus

Physics 1

Syllabus Fall 2019

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

Recitation Instructors:
Cedric Yu (Tu 5:00 pm -- 6:15 pm; Th 2:00 pm -- 3:15 pm)
Office: Physics 942
E-mail: cedric.yu@nyu.edu

Shahrzad Zare (W 2:00 pm -- 3:15 pm; Th 5:00 pm -- 6:15 pm)
Office: Physics 864F
E-mail: sz2507@nyu.edu

Tutoring:
Javan Tahir (Mondays and Wednesdays 3:30 pm -- 5:00 pm)
Location: Physics 802

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

Meeting Times & Places
Lectures: Tuesdays and Thursdays 12:30 pm -- 1:45 pm. Room: Meyer 122
Recitation I: Tuesdays 5:00 pm -- 6:15 pm. Meyer 264
Recitation II: Wednesdays 2:00 pm -- 3:15 pm. Meyer 264
Recitation III: Thursdays 5:00 pm -- 6:15 pm. Meyer 264
Recitation IV: Thursdays 2:00 pm -- 3:15 pm. Meyer 264

Note: The Department of Physics is located at 726 Broadway (at Waverly Place). Meyer Hall is located at 4 Washington Place (at Broadway).

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 a exploration of Special Relativity and its role in everyday life.

Text

Daniel Kleppner and Robert Kolenkow, *An Introduction to Mechanics*, 2nd ed. (Cambridge University Press, 2014).

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 Intermediate Experimental Physics I (PHYS-UA 73).

Problem Sets

Problem sets will be assigned roughly once per week on Tuesdays. They are due in class on the following Tuesday. Graded problem sets will be returned in recitation. You are encouraged to work with others in completing the problem sets for this course. That being said, you are responsible for turning in your own work. Copying solutions from other students and other sources is a violation of NYU's policy on academic integrity.

Recitation

Recitations provide an alternative perspective on the material covered in lecture. They also are a forum for asking questions and working through challenging problems individually and in groups. Most recitations will feature a quiz question to get the conversation going. Quiz questions are graded on a one-point scale -- the point is for trying out an answer, not just 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 in-class midterm exams (Thursday October 10 and Tuesday November 5) and a final exam (Date TBD). These are closed-book tests. You are permitted to bring one (8.5" x 11") sheet of handwritten notes (double-sided) to each of the midterms, and two sheets to the final.

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
Tu Sep 3	Kinematics: Systems of units, length, position K&K 1.1, 1.2 and 1.7, and K&K 2.7	Coordinate systems, vectors
Th Sep 5	Kinematics: Time, displacement, speed, velocity and acceleration K&K 1.3 and 1.8	Addition and subtraction of vectors, derivatives
Tu Sep 10	Kinematics: motion with constant velocity, motion with constant speed, motion with constant acceleration, Galileo and gravity	Derivatives of vector functions, antiderivatives.
Th Sep 12	Kinematics: uniform and nonuniform circular motion	Polar coordinates, chain rule of differentiation
Tu Sep 17	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 19	Axiom: Newton's Third Law Statics: forces in equilibrium Force 3: tension in strings	Addition of vectors
Tu Sep 24	Applications: pulleys, Atwood's machine Force 4: friction	Addition of vectors
Th Sep 26	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 1	Dynamics: The work done by a force, the work-energy theorem Concept: energy, kinetic energy.	Integration
Th Oct 3	Force 5: Hooke's law for springs Concepts: potential energy, conservative and nonconservative forces.	Path integrals
Tu Oct 8	Dynamics: force and potential energy Principle: conservation of energy Application: potential energy stored in a spring.	Partial derivatives. Gradient
Th Oct 10	Midterm Exam I: Kinematics and Dynamics	
Th Oct 17	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.
Tu Oct 22	Oscillations: Damped harmonic oscillator. Driven damped harmonic oscillator. Resonance.	Ordinary differential equations.

Th Oct 24	Dynamics: Momentum. Conservation of momentum. Systems of particles. Center of mass.	Volume integrals.
Tu Oct 29	Applications: Conservation of momentum: Center of mass motion, explosions, recoil and rockets.	
Th Oct 31	Collisions: laboratory frame and center-of-mass frame	
Tu Nov 5	Midterm Exam II: Conservation of energy, oscillations, conservation of momentum.	
Th Nov 7	Relativity: Newtonian relativity, Galilean transformations. The problem with Maxwell's equations. Einstein's Postulates of Special Relativity. Lorentz transformation equations.	
Tu Nov 12	Special Relativity: Length contraction and time dilation. Synchronizing clocks. Relativistic kinematics.	
Th Nov 14	Special Relativity: Relativistic dynamics. Conservation of relativistic momentum. Relativistic mass transformation.	
Tu Nov 19	Special Relativity: Relativistic force, work and kinetic energy. The mass-energy relation and some of its consequences.	
Th Nov 21	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 Dec 3	Rotational Dynamics: Conservation of energy. Angular momentum. Conservation of	Vector multiplication: Scalar (dot) product and vector (cross) product.

	angular momentum.
Th Dec 5	**Rotational dynamics: Torque and Newton's second law for rotations. Physical pendulum and rotational oscillations. Gyroscope motion. Angular momentum in collisions.**
Tu Dec 10	**Gravitation and Orbits**
Th Dec 12	**Orbital Dynamics**
TBD	**Final Exam**