

# AP<sup>®</sup> Physics C: Mechanics: Syllabus 2

Syllabus 1058808v1



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SC1 The course covers Newtonian mechanics in depth and provides instruction in kinematics.	3
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SC10 The course covers Newtonian mechanics in depth and provides instruction in oscillations.	5
SC11 The course covers Newtonian mechanics in depth and provides instruction in gravitation.	5
SC12 Introductory differential and integral calculus are used throughout the course.	2
SC13 The course utilizes guided inquiry and student-centered learning to foster the development of critical thinking skills.	2
SC14 Students spend a minimum of 20% of instructional time engaged in laboratory work.	2
SC15 A hands-on laboratory component is required.	2
SC16 Each student should complete a lab notebook or portfolio of lab reports.	2

Lecture/Discussion: Monday, Wednesday, and Friday—50 minutes each  
Two-hour labs: Tuesdays **[SC14]**

SC14—Students spend a minimum of 20% of instructional time engaged in laboratory work.

## Text

Halliday, David, Robert Resnick, and Kenneth S. Krane. *Physics*. 4th ed. 2 vols. New York: John Wiley and Sons, Inc., 1991.

AP<sup>®</sup> Physics C is a national calculus-based **[SC12]** course in physics. The syllabus for this course is designed by the College Board. This course is equivalent to the pre-engineering introductory physics course for the university students. The emphasis is on understanding the concepts and skills and using the concepts and formulae to solve problems. Laboratory work is an integral part of this course.

SC12—Introductory differential and integral calculus are used throughout the course.

## Teaching Strategies

Each day, students will be presented with a question and will be expected to work in small groups to answer that question. New topics will be introduced in this manner, but questions will also address topics already covered to enhance conceptual understanding. Students will have access to books, the Internet, lab equipment, computer simulations, etc. The teacher will act as a facilitator assisting and guiding students, at all times encouraging carefully articulated responses based on principles of physics. **[SC13]**

SC13—The course utilizes guided inquiry and student-centered learning to foster the development of critical thinking skills.

On a regular basis, students will also work in small groups on whiteboard problems. Each group will be given a problem and will be expected to work out and present their solution to the class. Throughout the course, examples of “real life” applications of interest to students will be used to challenge them to apply what they have learned; these examples will be used in the daily questions, in the whiteboard problems, in demos, etc.

## Final Grade

Final grade will be determined from the combination of the following scores.

Quizzes 40%  
Homework 20%  
Labs 20%  
Final Exam 20%

## Mechanics Labs

There is a two-hour hands-on lab every week. **[SC15]** The lab report will be graded on the student’s participation in the actual experiment and the written report.

SC15—A hands-on laboratory component is required.

**Students must save all the graded lab reports. They will be required to present the lab reports as proof of having done these labs when they seek credit for this course in college. [SC16]**

SC16—Each student should complete a lab notebook or portfolio of lab reports.

At least 10 of the following lab experiments will be performed.

1. Indirect measurement of inaccessible heights and distances
2. Areas, volumes, and densities of given solids and liquids
3. Prediction and reproduction of kinematics graphs with motion detector
4. Determination of acceleration due to gravity
5. Projectile motion — relationship between  $\theta$  and range
6. Projectile challenge — shoot the given target suspended from ceiling
7. Hooke's law: springs in series and parallel
8. Elastic force in rubber bands — nonlinear spring
9. Atwood's machine — verification of Newton's first law
10. Relationships between  $F_c$  and  $r$  for uniform circular motion
11. Rotational dynamics — relationships among rotational variables
12. Conservation of mechanical energy spring-mass system — air track
13. Conservation of linear momentum — the three kinds of collisions — air track
14. Simple pendulum — photogate and spring-mass system — force sensor
15. Physical pendulum — relationship between  $T$  and  $d$
16. Center of mass of flat discs of various shapes

Each lab will require:

- The formation of a hypothesis or hypotheses based on in-class discussion of the presented problem or focus of each experiment;
- Design of an experiment or multiple experiments, also based on in-class discussion, to test the hypothesis or hypotheses;
- Collection of data and observations;
- Calculations using the collected data;
- Conclusions about how well the hypothesis or hypotheses held up based on the experiment;
- Class discussion of variance and error analysis; and
- A written report.

### Aug. 9–24

#### Introduction

- Units and Measurements
- Scalars and Vectors
- Kinematics [SC1]
- Motion in 1-D
- Motion in 2-D
  - Projectiles
  - Uniform Circular Motion
- Relative Motion

SC1—The course covers Newtonian mechanics in depth and provides instruction in kinematics.

**Aug. 25–Sept. 7**
**Newton’s Laws of Motion and Classical Mechanics [SC2]**

- Force and Mass
- Tension and Normal Reaction
- Uniform Circular Motion
- Friction
- Drag Force

SC2—The course covers Newtonian mechanics in depth and provides instruction in Newton’s laws of motion.

**Sept. 8–28**
**Linear Momentum [SC7]**

- Impulse and Linear Momentum
- Law of Conservation of Linear Momentum
- Two-Body Collisions in 1-D and 2-D
- Systems of Particles [SC6]

SC7—The course covers Newtonian mechanics in depth and provides instruction in linear momentum.

SC6—The course covers Newtonian mechanics in depth and provides instruction in systems of particles.

**Sept. 29–Oct. 12**
**Rotational Kinematics**

- Constant Angular Speed
- Constant Angular Acceleration
- Relationships between Linear and Angular Variables

SC8—The course covers Newtonian mechanics in depth and provides instruction in circular motion.

**Oct. 13–26**
**Rotational Dynamics [SC8 & SC9]**

- Rigid Bodies
- Moment of Inertia and Torque
- Rotational Variables and Newton’s Second Law
- Angular Momentum
- Conservation of Angular Momentum
- Rotational Equilibrium
- Mechanical Equilibrium
- Rolling Motion

SC9—The course covers Newtonian mechanics in depth and provides instruction in rotation.

SC3—The course covers Newtonian mechanics in depth and provides instruction in work.

**Oct. 27–Nov. 2**
**Work, Energy, and Power [SC3, SC4 & SC5]**

- Work
- Energy
- Conservation of Energy
- Work Done by Conservative and Nonconservative Forces
- Work Done by Variable Forces
- Kinetic and Potential Energies

SC4—The course covers Newtonian mechanics in depth and provides instruction in energy.

SC5—The course covers Newtonian mechanics in depth and provides instruction in power.

- Conservation of Mechanical Energy
  - Translational Motion
  - Rotational Motion
  - Rolling Motion
- Power

**Nov. 3–14****Gravitation [SC11]**

- Newton’s Law of Gravitation
- Gravitational Potential Energy
- Motion of Planets and Satellites
- Kepler’s Laws
- Critical and Escape Velocities

SC11—The course covers Newtonian mechanics in depth and provides instruction in gravitation.

**Nov. 15–Dec. 1****Oscillations [SC10]**

- Simple Harmonic Oscillations
  - Kinematics
  - Dynamics
- Simple Pendulum
- Spring Mass System
- Physical Pendulum

SC10—The course covers Newtonian mechanics in depth and provides instruction in oscillations.

**Dec 4–8****Review****Dec. 11–15****Finals Week**