# Physics 201

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**COURSE TITLE: PHY 201**, College Physics I (Algebra base Physics I)

**Prerequisite(s):** MAT 111 or MAT 175 with a minimum grade of "C."

**COURSE DESCRIPTION:**

This is the first in a sequence of physics courses. Topics include mechanics, wave motion, sound, heat.

**General Education Outcomes**

Students who complete the general education core curriculum should be able to demonstrate

1. rationality, logic, and coherence, through critical thinking;
2. their ability to express themselves effectively in written and oral communication;
3. their ability to express themselves effectively in quantitative and qualitative terms;
4. their knowledge of the value and significance of diverse cultures;
5. the scientific method of inquiry;
6. their knowledge of global, political, social, economic, and historical perspectives; and
7. their ability to access, retrieve, synthesize, and evaluate information.

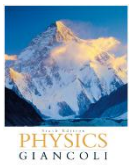
## Course Outcomes

After completion of this course, students will

- have an increased awareness of the physics behind phenomena observed in everyday life, including an understanding of our natural and technological environments.
- be able to apply abstract mathematical and physical principles to specific problems such as those presented in the homework and on tests, and to reason both qualitatively and quantitatively.
- be able to apply these same principles when confronted with similar situations in the real world, taking into account factors such as reasonable approximation and limitations due to uncertainty.
- have strengthened mathematical skills due to the constant application of mathematics in physics.
- be able to design experiments and acquire data with the goal of verification of physical principles.
- have the ability to communicate experimental procedures and results clearly and effectively through a written lab report.
- have an appreciation for the historical advancement of physics, and its relation to other disciplines.
- be prepared for future study in pre-medicine, biology, geology, or related fields.

**CREDITS/CONTACT HOURS:** 4 credit hour

**Textbook:** Giancoli, Douglas C., *Physics*, Englewood Clifts, NJ: Prentice Hall, Inc., 6th Ed.




**References:**

- Cutnell, John D. & Johnson, Kenneth W., *Physics*, 6th ed. Wiley, 2004.
- Sears, Francis W., Zemansky Mark W., & Young, Hugh D., *College Physics*, 7th ed. Addison Wesley/Benjamin Cummings, 1991.
- Serway, Raymond A. & Faughn, Jerry S., *College Physics*, 7th ed. Thompson Brooks/Cole, 2006.
- Walker, James S., *Physics*, 2nd ed. *Prentice-Hall*, 2004.
- Wilson, Jerry & Buffa, Anthony, *College Physics*, 5th ed. Prentice-Hall, 2003.
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**Recommended tools:** Scientific, graphic calculator (TI series)
**Method of Instruction:** The class will be taught by lecture and class participation in problem sessions and laboratories.

**Grading System:**

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| 90 | - | 100 | = | A | 60 | - | 69 | = | D |
| 80 | - | 89 | = | B | Below | - | 60 | = | F |
| 70 | - | 79 | = | C | | | | | |

**Methods of Evaluation for Student Performance:**

- Weekly problems assigned as homework
- Written quizzes and tests (including a comprehensive final examination)
- In class exercise/practice and/or activities
- Term papers and oral presentation
- Lab reports for each lab

**Grade Calculation Method:**
There will be midterm and final tests given during the semester. A comprehensive examination will be available. The course grade percentage from midterm tests and final test is weighted by individual instructor.

**Attendance Policy:**
Students are responsible for punctual and regular attendance in all classes, laboratories, field trips, and other class activities. The college does not grant excused absences; therefore, students are urged to reserve their absences for emergencies. When illness or other emergencies occur, the student is responsible for notifying instructors and completing work missed.

Except in extenuating circumstances with approval by the division dean, instructors withdraw students from class when 80 percent attendance is not maintained. Some courses have more restrictive attendance policies as indicated in course syllabus. If a student exceeds the allowable attendance, the instructor will withdraw the student and award a grade of "W" or "WF" based upon the student's academic standing at the last date of attendance.

Students are tardy if not in class at the time the class is scheduled to begin. Tardy students are admitted to class at the discretion of the instructor. Course syllabi reflect attendance policies related to tardiness.

**Withdrawl Policy**: During the first 75% of the course, a student may initiate withdrawl and receive a grade of 'W'. A student cannot initiate withdrawl during the last 25% of the course. Extending

circumstances require documentation and approval by the appropriate department head and academic dean.

Absences for Religious Holidays: Students who are absent from class in order to observe religious holidays are responsible for the content of any activities missed and for the completion of assignments occurring during the period of absence. Students who anticipate their observance of religious holidays will cause them to be absent from class and do not wish such absences to penalize their status in class should adhere to the following guidelines:

1. Observance of religious holidays resulting in three or fewer consecutive absences: Discuss the situation with the instructor and provide written notice at least one week prior to the absence(s). Develop (in writing) an instructor-approved plan which outlines the make up of activities and assignments.

Observances of religious holidays resulting in four or more consecutive absences: Discuss the situation with the instructor and provide the instructor with written notice within the first 10 days of the academic term. Develop an instructor-approved plan which outlines the make up of activities and assignments.

**Classroom Conduct:**
**ACADEMIC DISHONESTY**: Students are expected to uphold the integrity of the College's standard of conduct, specifically in regards to academic honesty. All forms of academic dishonesty including, but not limited to, cheating on assignments/tests, plagiarism, collusion, and falsification of information will call for disciplinary action. Disciplinary action imposed may include one or more of the following: written reprimand, loss of credit for assignment/test, termination from course, and probation, suspension, or expulsion from the College. For further explanation of this and other conduct codes, please refer to the Student Handbook.

**CELLULAR PHONES AND PAGERS/BEEPERS**: Cellular phones, pagers and beepers are not permitted to be turned on or used within the classroom. Use of these devices during classroom time will be considered a violation of the student code as it relates to "disruptive behavior."

**Class/Lab Procedures:**
The class is taught primarily by lecture. Questions from students are both expected and encouraged. Student participation is expected in problem sessions and laboratories. Problem sessions and laboratories are generally done in small groups.

**Accommodations:**
Students who need special accommodations in this class because of a documented disability should notify Student Disability Services by calling (864) 592-4818, toll-free 1-800-922-3679; via email through the SCC web site at www.sccsc.edu/resources/disabilities; or by visiting the office located in the East Building Room 30-B on the SCC Central campus. Contacting Student Disability Services early in the semester gives the College an opportunity to provide necessary support services and appropriate accommodations.

**Course Outcomes & Objectives:**
Upon satisfactory completion of this course, the student will be able to:

**Chapter 1: Introduction**
- Distinguish between a scientific model and a scientific theory.
- Explain why experiments are important in the testing of a theory and the improvement of a model.
- Explain why uncertainty is present in all measurements and state the uncertainty after taking a measurement.

- Calculate the percent uncertainty in a measurement.
- State the SI units of mass, length, and time.
- State the metric (SI) prefixes (multipliers) and use these prefixes in problem solving.
- Convert English units to SI units and vice versa and use the factor-label method in problem solving.
- Distinguish between basic quantities and derived quantities as well as basic units and derived units.
- Express a number in power of ten notation and use power of ten notation in problem solving.
- Explain what is meant by an order-of-magnitude estimate and use order-of-magnitude estimates in problems involving rapid estimating.

**Chapter 2: Describing Motion: Kinematics in One Dimension**

- State from memory the meaning of the key terms and phrases used in kinematics.
- List the SI unit and its abbreviation associated with displacement, velocity, acceleration, and time.
- Describe the motion of an object relative to a particular frame of reference.
- Differentiate between a vector quantity and a scalar quantity and state which quantities used in kinematics are vector quantities and which are scalar quantities.
- State from memory the meaning of the symbols used in kinematics: $x$, $x_o$, $v$, $v_o$, $a$, $y$, $y_o$, $v_y$, $v_{yo}$, $g$, $t$.
- Write from memory the equations used to describe uniformly accelerated motion.
- Complete a data table using information both given and implied in word problems.
- Use the completed data table to solve word problems.
- Use the methods of graphical analysis to determine the instantaneous acceleration at a point in time and the distance traveled in an interval of time.

**Chapter 3: Kinematics in Two Dimensions; Vectors**

- Represent the magnitude and direction of a vector using a protractor and ruler.
- Multiply or divide a vector quantity by a scalar quantity.
- Use the methods of graphical analysis to determine the magnitude and direction of the vector resultant in problems involving vector addition or subtraction of two or more vector quantities. The graphical methods to be used are the parallelogram method and the tip to tail method.
- Use the trigonometric component method to resolve a vector components in the $x$ and $y$ directions.
- Use the trigonometric component method to determine the vector resultant in problems involving vector addition or subtraction of two or more vector quantities.
- Use the kinematics equations of Chapter Two along with the vector component method of Chapter Three to solve problems involving two dimensional motion of projectiles.

**Chapter 4: Motion and Force: Dynamics**

- State Newton's three laws of motion and give examples that illustrate each law.
- Explain what is meant by the term net force.
- Use the methods of vector algebra to determine the net force acting on an object.
- Define each of the following terms: mass, inertia, weight and distinguish between mass and weight.
- Identify the SI units for force, mass, and acceleration.
- Draw an accurate free body diagram locating each of the forces acting on an object or a system of objects.
- Use free body diagrams and Newton's laws of motion to solve word problems.

**Chapter 5: Circular Motion; Gravitation**

- Calculate the centripetal acceleration of a point mass in uniform circular motion given the radius of the circle and either the linear speed or the period of the motion.

- Identify the force that is the cause of the centripetal acceleration and determine the direction of the acceleration vector.
- Use Newton's laws of motion and the concept of centripetal acceleration to solve word problems.
- Distinguish between centripetal acceleration and tangential acceleration.
- State the relationship between the period of the motion and the frequency of rotation and express this relationship using a mathematical equation.
- Write the equation for Newton's universal law of gravitation and explain the meaning of each symbol in the equation.
- Determine the magnitude and direction of the gravitational field strength ($g$) at a distance r from a body of mass $m$.
- Use Newton's second law of motion, the universal law of gravitation, and the concept of centripetal acceleration to solve problems involving the orbital motion of satellites.
- Explain the "apparent" weightlessness of an astronaut in orbit.
- State from memory Kepler's laws of planetary motion.
- Use Kepler's third law to solve word problems involving planetary motion.
- Use Newton's second law of motion, the universal law of gravitation, and the concept of centripetal acceleration to derive Kepler's third law.
- Solve word problems related to Kepler's third law.
- Identify the four forces that exist in nature.

**Chapter 6: Work and Energy**

- Distinguish between work in the scientific sense as compared to the colloquial sense.
- Write the definition of work in terms of force and displacement and calculate the work done by a constant force when the force and displacement vectors are at an angle.
- Use graphical analysis to calculate the work done by a force that varies in magnitude.
- Define each type of mechanical energy and give examples of types of energy that are not mechanical.
- State the work energy theorem and apply the theorem to solve problems.
- Distinguish between a conservative and a nonconservative force and give examples of each type of force.
- State the law of conservation of energy and apply the law to problems involving mechanical energy.
- Define power in the scientific sense and solve problems involving work and power.

**Chapter 7: Linear Momentum**

- Define linear momentum and write the mathematical formula for linear momentum from memory.
- Distinguish between the unit of force and momentum.
- Write Newton's Second Law of Motion in terms of momentum.
- Define impulse and write the equation that connects impulse and momentum.
- State the Law of Conservation of Momentum and write, in vector form, the law for a system involving two or more point masses.
- Distinguish between a perfectly elastic collision and a completely inelastic collision.
- Apply the laws of conservation of momentum and energy to problems involving collisions between two point masses.
- Define center of mass and center of gravity and distinguish between the two concepts.

**Chapter 8: Rotational Motion**

- Convert angular quantities from revolutions or degrees to radians and vice versa.
- Write the Greek symbols used to represent angular displacement, angular velocity, and angular acceleration.
- State the meaning of the symbols used in the kinematics equations for uniformly accelerated angular motion.

- Write from memory the equations used to describe uniformly accelerated angular motion.
- Complete a data table using information both given and implied in word problems. Use the completed data table to solve word problems related to angular kinematics.
- Distinguish between inertia and moment of inertia. Write from memory the formulas for the moment of inertia of selected objects and calculate the moment of inertia of these objects.
- Explain the meaning of the radius of gyration. Use the radius of gyration to solve for an object's moment of inertia.
- Distinguish between linear momentum and angular momentum. State and apply the law of conservation of angular momentum to solve word problems.
- Calculate the lever arm distance and determine the magnitude and direction of the torque vector if the magnitude and direction of the net force are given.
- Draw a free body diagram for each object in a system. Locate the forces acting on each object. Use $F = ma$ and $\tau = Ia$ to solve for the linear or angular acceleration of each object.
- Apply the law of conservation of angular momentum to a system where no net external torque acts. Determine the change in angular velocity of a system where the moment of inertia of the objects that make up the system changes.
- Distinguish between translational kinetic energy and rotational kinetic energy. Apply the Law of Conservation of Energy to solve problems that involve rotational as well as translational kinetic energy.

**Chapter 9: Bodies In Equilibrium: Elasticity and Fracture**

- Distinguish between static and dynamic equilibrium and state the two conditions for equilibrium.
- Solve equilibrium problems using the two conditions for equilibrium.
- Calculate the IMA, AMA, and efficiency of a simple machine.
- State whether an object is in stable, unstable, or neutral equilibrium.
- Use Hooke's law to solve problems.
- Distinguish between stress and strain and between tensile stress, compressive stress, and shear stress.
- Write the equations for the relationship between stress and strain for the three types of deformation of an elastic solid. Use these equations to solve problems.

**Chapter 10: Fluids**

- Distinguish between density, weight density, and specific gravity and given an object's mass and volume, calculate the object's density, weight density, and specific gravity.
- Define pressure and calculate the pressure that an object of known weight exerts on a surface of known area and express the magnitude of the pressure in psi, $lb/ft^2$, $N/m^2$, or pascals (Pa).
- Calculate the pressure acting at a depth $h$ below the surface of a liquid of density ($\rho$).
- Distinguish between absolute pressure and gauge pressure and solve problems involving each type of pressure.
- State Pascal's Principle and apply this principle to basic hydraulic systems.
- State Archimedes Principle and use this principle to solve problems related to buoyancy.
- Explain what is meant by streamline flow, the equation of continuity, and the flow rate. Apply these concepts to word problems to solve for the velocity of water at a particular point in a closed pipe.
- Use Bernoulli's equation and the concept of streamline flow to solve for the velocity of a fluid and/or the pressure exerted by a fluid at a particular point in a closed pipe.

**Chapter 11: Vibrations and Waves**

- State the conditions required to produce SHM.
- Determine the period of motion of an object of mass $m$ attached to a spring of force constant $k$.
- Calculate the velocity, acceleration, potential, and kinetic energy at any point in the motion of an object undergoing SHM.

- Write equations for displacement, velocity, and acceleration as sinusoidal functions of time for an object undergoing SHM if the amplitude and angular velocity of the motion are known. Use these equations to determine the displacement, velocity, and acceleration at a particular moment of time.
- Determine the period of a simple pendulum of length $L$.
- State the conditions necessary for resonance. Give examples of instances where resonance is a) beneficial and b) destructive. Explain how damped harmonic motion can be achieved to prevent destructive resonance.
- Distinguish between a longitudinal wave and a transverse wave and give examples of each type of wave.
- Calculate the speed of longitudinal waves through liquids and solids and the speed of transverse waves in ropes and strings.
- Calculate the energy transmitted by a wave, the power of a wave and the intensity of a wave, across a unit area $A$.
- Describe wave reflection from a barrier, refraction as the wave travels from one medium into another, constructive and destructive interference as waves overlap, and diffraction of waves as they pass around an obstacle.
- Explain how a standing wave can be produced in a string or rope and calculate the harmonic frequencies needed to produce standing waves in string instruments.

**Chapter 12: Sound**

- Determine the speed of sound in air at one atmosphere of pressure at different temperatures.
- Distinguish between the following terms: pitch, frequency, wavelength, sound intensity, loudness.
- Determine intensity level in decibels of a sound if the intensity of the sound is given in $W/m^2$.
- Explain how a standing wave can be produced in a wind instrument open at both ends or closed at one end and calculate the frequencies produced by different harmonics of pipes of a given length.
- Determine the beat frequency produced by two tuning forks of different frequencies.
- Explain how an interference pattern can be produced by two sources of sound of the same wavelength separated by a distance $d$.
- Solve problems involving two sources for $m$, $d$, $\lambda$, and the angular separation ($\theta$) when the other quantities are given.
- Solve for the frequency of the sound heard by a listener and the wavelength of the sound between a source and the listener when the frequency of the sound produced by the source and the velocity of both the source and the listener are given.
- Explain how a shock wave can be produced and what is meant by the term "sonic boom."

**Chapter 13: Temperature and Kinetic Theory**

- Convert a temperature given in degrees Fahrenheit to degrees Celsius and/or degrees Kelvin, and vice versa.
- State the factors that cause the volume of a solid or liquid to change or the length of a solid to change. Also, solve word problems and determine the final length or volume.
- Write the mathematical relationships that summarize Boyle's law, Charles law, Gay Lussac's law, and the ideal gas equation. Use these equations to solve word problems.
- State in your own words Avogadro's hypothesis. State from memory the modern value of Avogadro's number.
- State the postulates of the kinetic theory of gases.
- Rewrite the ideal gas equation in terms of motion of the molecules of an ideal gas.
- Explain what is meant by the term rms velocity.
- Explain what is meant by Van der Waal's forces.

- Given a phase diagram for water, determine the range of temperature and pressure at which water is a solid, liquid, or gas. Describe what is meant by the triple point of water and point out the triple point on a phase diagram.
- Explain what is meant by sublimation and use a phase diagram to determine the range of temperatures and pressures for which the sublimation of water could occur
- Explain why evaporation from a liquid is related to the temperature of the liquid and the average kinetic energy of the molecules of the liquid.
- Explain what is meant by vapor pressure and explain why vapor pressure is related to the temperature of the liquid and the boiling point of the liquid.
- Distinguish between relative humidity and absolute humidity and solve word problems related to relative humidity.
- Explain what is meant by diffusion and why diffusion is slower through a liquid than through a gas.
- Use Fick's law to solve word problems related to gaseous diffusion.
- State Graham's law of diffusion and use this law to determine the mass of a molecule of an unknown gas.

**Chapter 14: Heat**

- Distinguish between the concepts of temperature and heat.
- Explain what is meant by specific heat, latent heat of fusion, and latent heat of vaporization.
- Apply the law of conservation of energy to problems involving calorimetry.
- Distinguish the three ways that heat transfer occurs: conduction, convection, and radiation.
- Solve problems involving the rate of heat transfer by convection and radiation.

**Chapter 15: The Laws of Thermodynamics**

- Explain what is meant by a physical system and distinguish between an open system and a closed system.
- State the first law of thermodynamics and use this law to solve problems.
- Distinguish between an isothermal process, isobaric process, isochoric process and adiabatic process and draw a PV diagram for each process.
- Calculate the work done by a gas from a PV diagram. Use the equations for an ideal gas and for the internal energy of a gas to calculate the change in internal energy of a gas and the heat added or removed during a thermodynamic process.
- Calculate the amount of heat which must be added or removed to change the temperature of a gas held in a closed container under conditions of constant volume or constant pressure.
- Write from memory and explain the meaning of three equivalent ways of stating the second law of thermodynamics.
- Use the first and second laws of thermodynamics to solve problems involving a Carnot engine.
- Distinguish between a reversible process and an irreversible process. Give examples of each type of process.
- Determine the change in entropy for a system in which the thermodynamic process is either reversible or irreversible.
- Distinguish between macrostate and microstate and solve problems involving the statistical interpretation of entropy.

**Course Content Outline:**

The following is an outline of the material covered during the course. The study of nearly every topic involves the critical evaluation of the pertinent theories and concepts as well as the critical evaluation of data in sample problems concerning each of the following topics.

**Measurements. (Chapter 1)**

A) Physical quantities, standards, and units.
B) Systems of units: length, time, mass.
C) Vectors and scalars.
D) Addition of vectors: geometrical and analytical methods.

**Describing motion. (Chapter 2 and 3)**
A) Velocity: average and instantaneous.
B) Acceleration.
C) Motion with constant acceleration.
D) Freely falling bodies.
E) Projectile motion.

**The laws of motion. (Chapter 4 and 5)**
A) Newton's laws of motion.
B) Force as related to motion.
C) Frictional forces.
D) Conditions for objects to be in equilibrium.

**Work and energy. (Chapter 6)**
A) Work done by a constant force.
B) Kinetic energy and potential energy.
C) Conservation of energy.
D) Conservative and non-conservative forces.
E) Power.

**Momentum. (Chapter 7)**
A) Impulse and momentum.
B) Conservation of linear momentum.
C) Collisions.
D) Center of mass.

**Rotational motion. (Chapter 8)**
A) Angular velocity and angular acceleration.
B) Rotation with constant angular acceleration.
C) Centripetal acceleration.
D) Torque and angular acceleration.
E) Rotational inertia and kinetic energy.
F) Angular momentum.
G) The law of gravity and satellite motion.

**Properties of matter. (Chapter 9 and 10)**
A) Elastic properties of solids.
B) Fluids: pressure vs. depth.
C) Buoyant forces: Archimedes' principle.
D) Surface tension.
E) Fluid flow.

**Vibrations and waves. (Chapter 11)**
A) Hooke's law.
B) Simple harmonic motion.
C) Wave motion: types of waves.
D) Velocity, frequency, wavelength, and amplitude.
E) Superposition and interference of waves.

**Sound. (Chapter 12)**
A) Characteristics of sound waves.
B) The speed of sound.
C) Energy and intensity of sound waves.
D) Resonance and standing waves.
E) The Doppler effect.
F) Beats.
G) Sound quality and hearing.

**Heat and thermodynamics. (Chapter 13 ~ 15)**
A) Temperature and thermal expansion.
B) Ideal gas and the kinetic theory.
C) Heat/energy/specific heat.
D) Heat transfer: conduction, convection, radiation.
E) First and second laws of thermodynamics.
F) Heat engines.

**Student Performance Objectives:**
As a result of successful completion of this course, a student will be able to:
a. Write and describe the basic laws used to analyze the phenomena studied.
b. Use these laws to formulate methods for the solution of problems (given a verbal or written definition of such problems).
c. Carry the problem solution through to a quantitative answer where appropriate.
d. State and explain the simplifying assumptions made in analyzing such problems.
e. Write lab reports describing experiments and the phenomena being investigated, critically analyze the results, and state what conclusions may or may not be drawn.
f. Estimate the uncertainties in the measured quantities and their effects on the results.
g. Use a variety of equipment such as vernier calipers, micrometers. Thermometers, timers, balances, and other equipment used in a physics laboratory.