Fair Lawn

Public Schools

Fair Lawn, NJ

Advanced Placement Physics C

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AP Physics is a high school science class which aligns to the College Board Guidelines.

Science Department

Fair Lawn School District

Committee Credits

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Advanced Placement Physics C

I. Course Synopsis

The A.P. Physics C Electricity and Magnetism course offered at our school is a one-year Calculus-based course that is similar to a first-year Calculus-based university course in physics. Students are required to have completed a one-year introductory course in either Honors Physics or A.P. Physics B prior to taking A.P. Physics C. Students should have also completed a one-year course in Calculus. The A.P. Physics C course meets for seven 45-minute periods per week.

The A.P. Physics C Mechanics course offered at our school is a one-year Calculus-based course that is similar to a first-year Calculus-based university course in physics. Students are required to have completed a one-year introductory course in either Honors Physics or A.P. Physics B prior to taking A.P. Physics C. Students should have also completed a one-year course in Calculus. The A.P. Physics C course meets for seven 45-minute periods per week.

Students are required to apply the concepts of introductory university physics to the solving of basic and advanced problems through the manipulation of various equations. Students will also apply those concepts to a weekly 90-minute hands-on laboratory.

II. Philosophy & Rationale

In a technologically-driven society, it is desirable for all students to develop skills like critical thinking, reasoning, and problem-solving skills that can be found prevalent in a science course. Physics, in particular, has a foundation in many other sciences and therefore can be considered “the most basic of sciences.”

In addition to learning the aforementioned skills that can be used in every day real-life applications, students will also begin to understand natural laws that govern our universe (and in many cases, those that they experience daily). Throughout inquiry labs, students can safely test their own ideas, solve problems, and developing the concepts related to physics on their own, using scientific method or learning cycle. Twenty-five percent of the course must be devoted to hands-on laboratory work, including the inquiry-based labs, according to the College Board.

III. Scope & Sequence

Unit 1: Kinematics *September*

Advanced Vector Mathematics
Motion in One Dimension
Motion in Two Dimensions

Unit 2: Dynamics *October (first 2 weeks)*

Newton's Three Laws of Motion
Applications of Newton's Laws

Unit 3: Work, Energy, and Power *October (second 2 weeks)*

Work and Work-Energy Theorem
Potential Energy and Kinetic Energy
Conservation of Energy
Power

Unit 4: Linear Momentum *November (first 2 weeks)*

Impulse and Momentum
Conservation of Linear Momentum
Collisions
Center of Mass

Unit 5: Circular Motion and Rotation *November (second 2 weeks)*

Uniform Circular Motion
Torque and Rotational Statics
Rotational Kinematics and Dynamics
Angular Momentum
Conservation of Angular Momentum

Unit 6: Gravitation and Oscillations *December - January (first 2 weeks)*

Newton's Law of Gravitation
Orbits of Planets and Satellites (Circular and Elliptical)
Simple Harmonic Motion (dynamics and energy relationships)
Oscillating Mass on a Spring
The Pendulum and Other Oscillations

Unit 1: Electrostatics *January (last 2 weeks)*

Electric Charge
Coulomb's Law of Electrostatics
Electric Fields and Electric Potential (including point charges)
Gauss's Law of Electrostatics
Electric Fields and Potentials of Other Charge Distributions

Unit 2: Conductors, Capacitors, and Dielectrics *February (first 2 weeks)*

Electrostatics with Conductors
Capacitors
a. Capacitance
b. Parallel-plate Capacitors
c. Spherical and Cylindrical Capacitors
Dielectrics

Unit 3: Electric Circuits *February (second 2 weeks)*

Current, Resistance, Electric Power
Steady-state Direct Current Circuits with Batteries and Resistors Only
Capacitors in Circuits
a. Steady-state
b. Transients in RC Circuits

Unit 4: Magnetic Fields *March*

Forces on Moving Charges in Magnetic Fields
Forces on Current-carrying Wires in Magnetic Fields
Magnetic Fields of Long Current-carrying Wires
Biot-Savart Law
Ampere's Law

Unit 5: Electromagnetism *April*

Electromagnetic Induction
a. Faraday's Law
b. Lenz's Law
Inductance
a. LR Circuits
b. LC Circuits
Maxwell's Equations

A.P. Physics C exam review for Mechanics and Electricity and Magnetism *May (first 2 weeks)*

Big Ideas (as described by the College Board)

1. Objects and systems have properties such as mass and charge. Systems may have internal structure.
2. Fields existing in space can be used to explain interactions.
3. The interactions of an object with other objects can be described as forces.
4. Interactions between systems can result in changes in those systems.
5. Changes that occur as a result of interactions are constrained by conservation laws.
6. Waves can transfer energy and momentum from on location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.

V. Course Materials

"Sears and Zemansky's University Physics" 13th Ed., by Young and Freedman
(2012, Pearson Education Inc., publishing as Addison-Wesley)
plus MasteringPhysics with eText – Access Card package

References: *"Physics for Scientists and Engineers" (8th Ed.) by Serway and Jewitt*
(Brooks/Cole, Cengage Learning)
"Physics for Scientists and Engineers" (4th Ed.) by Giancoli
***(**Pearson Education Inc.)*

ADVANCED PLACEMENT C MECHANICS PHYSICS EXPERIMENTS
Experiments for the course are taken from several sources including:
• "AP Physics Lab Guide" by J. Patrick Polley
(2003 College Entrance Examination Board)
• "CENCO AP Physics Lab Manual – A Guided Inquiry Approach" by Borislaw Bilash II
(2011 Borislaw Bilash II and VWR Education LLC)
• "Physics Laboratory Experiments" (7th Ed.) by Jerry D. Wilson
and Cecilia A. Hernandez-Hall
(2010 Brooks/Cole, Cengage Learning)
• "PASCO Laboratory Experiments" ***(manuals accompanying various physics laboratory equipment purchases)***
(PASCO Co.)
• "Physics with Vernier" by Kenneth Appel

(Vernier Software and Technology)

Experiments:
(Note: For most labs, students will either use graph paper to graph relationships by hand or they may use Microsoft Excel to graph relationships. In addition, students
may be using Vernier sensors and software such as Logger Pro 3 to take data and produce graphs.)
1. Experimental Uncertainty (Error) and Data Analysis
(Introductory "take-home lab" on statistical analysis, graphing, etc.)
2. Inquiry Lab on Relating Diameter and Circumference of a Circle
3. Using Measurement Instruments (Mass, Volume, and Density)
(Use of the micrometer and caliper to make measurements)
4. Uniformly Accelerated Motion on an Inclined Track (Galileo's Experiment)
5. Terminal Velocity and Air Resistance of Coffee Filters
6. The Addition and Resolution of Vectors: The Force Table
(Using the force table to find various equilibrant forces)
7. Newton's Second Law: The Atwood Machine
(Using a pulley system to find acceleration through F = ma)
8. Finding the Coefficient of Friction
9. Conservation of Spring Energy and Gravitational Potential Energy
(Using a PASCO track system to find and compare gravitational potential energy and spring potential energy)
10. Conservation of Linear Momentum in 1-D and 2-D Collisions
11. Power
(Students measuring their own horsepower by being timed as they run up a flight of stairs)
12. Conical Pendulum ("Flying Pig" lab)
13. Objects in Static Equilibrium (Ladder Problem)
14. Rotational Motion and Moment of Inertia
15. Finding the Mass of Jupiter
(Using AAPT's "Physics: Cinema Classics" disk or online software)
16. Hooke's Law for Series and Parallel Springs
17. Physical Pendulum

(The above is a tentative schedule. Experiments may take several lab periods to perform.
The instructor may add or delete experiments as he/she sees fit.
With the instructor's permission, students may modify an experiment to go beyond
what is required in order to have inquiry-based experiences.)

ADVANCED PLACEMENT C ELECTRICITY AND MAGNETISM PHYSICS EXPERIMENTS

Experiments for the course are taken from several sources including:
• "AP Physics Lab Guide" by J. Patrick Polley
(2003 College Entrance Examination Board)
• "CENCO AP Physics Lab Manual – A Guided Inquiry Approach" by Borislaw Bilash II
(2011 Borislaw Bilash II and VWR Education LLC)
• "Physics Laboratory Experiments" (7th Ed.) by Jerry D. Wilson
and Cecilia A. Hernandez-Hall
(2010 Brooks/Cole, Cengage Learning)
• "PASCO Laboratory Experiments" ***(manuals accompanying various physics laboratory equipment purchases)***
(PASCO Co.)
• "Physics with Vernier" by Kenneth Appel
(Vernier Software and Technology)

Experiments:
(Note: For most labs, students will either use graph paper to graph relationships by hand or they may use Microsoft Excel to graph relationships. In addition, students may be using Vernier sensors and software such as Logger Pro 3 to take data and produce graphs.)

1. Equipotentials and Electric Fields Mapping (with hands-on equipment and computer simulations)
2. Capacitor Circuits
3. Finding Resistivity of Wires
4. Ammeter-Voltmeter Method of Finding Resistance Using Ohm's Law
5. Wheatstone Bridge Method of Finding Resistance
6. Electric Power and Batteries
7. Analysis of Resistors in Series-Parallel Circuits
8. Finding Internal Resistances of Voltmeters and Ammeters
9. RC Time Constant with Multimeters
10. Finding the RC Time Constant Using an Oscilloscope
11. Magnetic Force on a Current-Carrying Wire
12. Measurement of Magnetic Field in a Solenoid
13. Faraday's Law of Induction
14. Phase Measurements and Resonance in AC Circuits (RL, LC, and RLC circuits) with Oscilloscope

(The above is a tentative schedule. Experiments may take several lab periods to perform. The instructor may add or delete experiments as he/she sees fit.

With the instructor's permission, students may modify an experiment to go beyond what is required in order to have inquiry-based experiences.)

Other resources may be referenced as well.

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

1. Students with special needs and ELL learners may be provided with key vocabulary terms prior to the unit beginning. In particular, the amount of key vocabulary terms should be reduced for ELL students.
2. ELL students may be provided with additional visual aids. For additional modifications, refer to Classroom Instruction that Works for ELL Learners *or the* SIOP protocol.
3. Gifted students may be challenged by asking them to form additional connections between biology, chemistry, and physics.

VI. Assessments

All students in A.P. Physics 1 will take a midterm exam, covering Units 1 – 6 inclusive, which
contain a "common aspect" among all students. There is no final exam as per FLBOE policy towards A.P. courses; however, there will be a 5th marking period project related to Units 7 – 11 inclusive. In addition, regular tests, quizzes, lab reports, homework assignments, class participation, etc. will be required throughout marking periods 1 – 4.

VII. Cross Curricular Aspects

The study of A.P. Physics 1 requires an understanding of Algebra, Trigonometry, and a little Statistics/Probability. On occasion, students in A.P. Physics 1 may be involved with physics-related applications to biology, medicine, and chemistry.

CCCS Literacy: Click on the link to the High School Evidence Statements to see expectations related to literacy for this unit. In addition, a focus of the course will be on the development of the LAL standards for science & technical subjects.

CCCS Math: Students will be expected to perform measurement, modeling, apply algebra, and geometry and statistics.

Interdisciplinary Connections and Alignment to Technology standards

Science classes in the Fair Lawn Public schools promote career-readiness skills related to Personal Financial Literacy (9.1) and Career Awareness, Exploration, and Presentation (9.2). Some course concepts from the Career and Technical Education Standards (9.3), but these are not directly correlated since our district is not a CTE program.

The Fair Lawn Public Schools District fosters an environment that promotes career-readiness skills in all content areas. Whereas Career Ready Practices are explored consistently, specific alignment to Personal Finance Literacy (9.1) and Career Awareness, Exploration, and Presentation Standards (9.2) are included in the district level document (below). When appropriate, the Career and Technical Education Standards (9.3) have been reviewed and aligned as well.

Examples: 9.2B: Career exploration in each unit of study.

In addition, every effort is made to integrate technology and engineering into our science classes. Educational Technology (8.1) and Technology Education, Engineering, Design, and Computational Thinking – Programming (8.2) standards are cross connected throughout our science programs.

Examples: 8.1A: Use spreadsheets to analyze & interpret data from laboratories, 6-12.
Use the internet to increase productivity and efficiency, 9-12.
8.1B,C: Use data to solve real-world problems, 6-12.
Use online platforms to collaborate & address global issues, 9-12.
8.1F: Collect and analyze data using internet and data simulations, 6-12.
8.2A: Become aware of the invention process, 3-5.
8.2B: Become aware of the global impacts on technology, 6-12.
8.2C: Apply the design process to pushes & pulls, K-2.
8.2D: Use tools to reduce work, K-2.

For additional detail on how these standards are integrated throughout the Fair Lawn Schools curriculum, review the Fair Lawn Public Schools District Alignment to Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix.