PETERS TOWNSHIP SCHOOL DISTRICT

CORE BODY OF KNOWLEDGE (CBK)

AP PHYSICS C: MECHANICS AND ELECTRICITY & MAGNETISM

GRADES 11, 12

For each of the sections that follow, students may be required to understand, apply, analyze, evaluate or create the particular concepts being taught.

COURSE DESCRIPTION

AP Physics C: Mechanics and Electricity & Magnetism together represent a rigorous, year-long second year course of study in physics designed primarily for seniors, and select juniors, in high school. Students are expected to have completed either Honors Physics (A/B grade) or Academic Physics (A grade) before taking this course. Since AP Physics C: Mechanics and Electricity & Magnetism utilizes both algebraic manipulations and differential and integral calculus for problem solving throughout the course, calculus must be at least a co-requisite of this course. The study of mechanics occurs from the start of school through January while studies of electricity and magnetism occur from late January through early May. There is usually one week provided strictly for review for the AP Exam. Following the exam in May we usually have about three weeks of school during which time students continue to develop their critical thinking and problem solving skills as they pursue and present research and/or projects on additional physics topics covered in second semester college course and/or areas of interest.

This course emphasizes a thorough understanding of physical principles and concepts and the advanced placement physics student is expected to develop sophisticated problem solving skills through which he/she is able to apply physics principles and concepts to varied situations. The primary objectives of the course are as follows: to read, understand and interpret physical information; to explain the sequence of steps used in the analysis of a particular physical phenomenon or problem; to use mathematical reasoning in a physical situation or problem and to perform experiments and to interpret the results of observations. Upon completion of the course, the student should have an appreciation of the world in which he/she finds him/herself, a working knowledge of physical principles and concepts and an ability to think critically in problem solving situations.

This course meets daily Monday through Friday for a total of seven forty-one minute periods per week. On three days the periods are forty-one minutes and on two days there are double lab periods of eighty-two minutes. As there is a significant laboratory component to this course at least one of the double period classes is devoted to laboratory activities. Class periods include interactive lecture demonstrations, discussions - both small group and whole class, problem solving sessions, whiteboard and inquiry activities as well as additional appropriate activities. The advanced placement physics student is expected to take an active role in his/her learning of physics; small class size and a flexible room setting and schedule provides the student with many varied opportunities for participation in inquiry based activities and small group interaction which foster the development of critical thinking and problem solving skills needed to be successful.

STUDY SKILLS

- Effective and efficient reading skills (to reinforce/clarify unit concepts)
- Review Textbook and Lecture Notes (on a regular basis)
- Seek out Additional Resources (beyond the course text and handouts)
- Complete assigned problems and review instructor provided solutions to effectively self critique work
- Create study groups (to provide an opportunity for peer to peer teaching)
- Manage time effectively
- Take good notes (create a resource that enhances understanding when studying)
- Apply laboratory experiences to enhance conceptual understanding

MAJOR UNIT THEMES

1. MEASUREMENT AND ERROR ANALYSIS

- Physics is the fundamental science
- Systems of measurement
- Techniques for error analysis
- Techniques for graphing and graphical analysis

2. MOTION IN ONE DIMENSION

- Introduction to differential and integral calculus
- Describe motion in terms of position, velocity and acceleration
- Motion diagrams and position vs. time, velocity vs. time and acceleration vs. time graphs
- Equations of uniformly accelerated motion
- Free fall

3. VECTORS AND MOTION IN TWO DIMENSIONS

- Vector vs. scalar quantities
- Graphical and trigonometric methods of vector analysis
- Unit vectors
- Dot and cross product
- Equations of two dimensional motion
- Projectile motion including Trajectory Project PBL
- Motion along a curved path

4. NEWTON'S LAWS OF MOTION AND THEIR APPLICATIONS

- Nature of forces
- Newton's Three Laws of Motion
- Friction
- Applications of Newton's Second Law
- Uniform circular motion

- Nonuniform circular motion
- Kepler's Laws of Motion
- Motion in the presence of resistive forces

5. WORK, ENERGY AND POWER

- Work done by constant and variable forces
- Power
- Forms of energy and their transformations
- Work kinetic energy theorem
- Conservative vs. nonconservative forces
- Potential energy functions
- Law of Conservation of Mechanical Energy

6. LINEAR MOMENTUM AND COLLISIONS

- Linear momentum and the impulse-momentum relationship
- Collisions in one and two dimensions
- Law of Conservation of Linear Momentum
- Center of mass

7. ROTATIONAL MOTION AND ROTATIONAL EQUILIBRIUM

- Rotational quantities and equations
- Rotational kinetic energy and moment of inertia
- Torque and Newton's Second Law for Rotation
- Rolling motion
- Angular momentum and the Law of Conservation of Angular Momentum
- Static equilibrium

8. ELASTICITY AND OSCILLATORY MOTION

- Elastic properties of solids
- Simple harmonic motion
- Mass-spring systems
- Pendulums simple, physical and torsional
- Damped and driven oscillations

9. UNIVERSAL GRAVITATION AND SATELLITE MOTION

- Law of Universal Gravitation
- Gravitational field
- General form of gravitational potential energy
- Energy considerations in planetary and satellite motion

10. THE NATURE OF CHARGES, COULOMB'S LAW AND THE ELECTRIC FIELD

- The nature of charge
- Conductors, insulators and semiconductors
- Coulomb's Law
- The electric field
- Electric flux
- Gauss's Law for electrostatics

11. ELECTRIC POTENTIAL AND CAPACITANCE

- Electric potential difference
- Electric potential energy
- Millikan Oil Drop Experiment
- Applications of electrostatics
- Capacitance and capacitors
- Networks of capacitors
- Energy storage in capacitors
- Use of dielectrics

12. CURRENT, RESISTANCE AND DC CIRCUITS

- Batteries
- emf
- Model of electrical conduction
- Ohm's Law
- Resistance
- Series, parallel and series-parallel circuits
- Kirchoff's rules for multi-loop circuits
- RC circuits
- Electrical meters
- Electric safety

13. MAGNETIC FORCES AND MAGNETIC FIELDS

- The nature of the magnetic force
- Magnetic fields
- Effects of the magnetic field on moving charges, current carrying wires and loops
- The Earth's magnetic field
- Hall effect
- Biot-Savart Law
- Ampere's Law
- Gauss's Law for Magnetism
- The nature of magnetic materials

14. ELECTROMAGNETIC INDUCTION

- Faraday's Law of Electromagnetic Induction
- Motional emf
- Lenz's Law
- Induced emf and electric fields
- Motors and generators
- Maxwell's equations
- Inductance
- RL, LC and RLC circuits

Following the exam in May additional topics of study may include but need not be limited to Optics, fluids, heat and/or modern physics. Students are encouraged to investigate areas of interest.

MATERIALS (and Supplemental materials used in course)

- <u>Physics for Scientists and Engineers</u>, 8th Edition; Serway and Jewett; Brooks Cole/Cengage Learning; 2010
- <u>Physics for Scientists and Engineers</u>, 8th Edition; *Student Solutions Manual and Study Guide*, Volumes I and II; Brooks Cole/Cengage Learning; 2010
- <u>www.collegeboard.org</u> This site provides sample and practice AP free response and multiple choice questions.
- Released copies of previous AP exams; College Board
- Selected videos from the "Mechanical Universe" series
- phet.colorado.edu This site provides simulation labs and activities.
- Learnapphysics.com This site provides students with many different resources for study and review

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