Linwood Holton Governor's School Syllabus
Principles of Physics I and II, PHY 121-122
Fall 2008-Spring 2009
8 hours college credit

Instructor: Dr. Steve Rapp

Location: Linwood Holton Governor's School at the Southwest Virginia Higher Education Center, second floor, One Partnership Circle, P.O. Box 1987, Abingdon, VA 24210

Web Site: http://www.hgs.k12.va.us or http://steverapp.pageout.net

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Textbook: *College Physics, 5th Edition* by Raymond Serway and Jerry Faugh, 2006, ISBN: 0-534-99723-6.
Companion web site for the text: Physics Now (physics tutorials and self-assessments on the web): http://www.cp7e.com. Also student resources can be found at http://physics.brookscole.com.

Pre-requisites for the Course: Algebra I and II, Geometry

Course Description:
PHY 121 covers fundamental principles of physics. It includes mechanics, gravitational and motion phenomena, work and energy, kinetic theory, elasticity of solids, gas laws and thermal physics. The student will receive 4 hours college credit for successful completion.

PHY 122 covers fundamental principles of physics. It includes electricity, magnetism, light, optics, vibrations, waves, atomic physics, nuclear physics, and relativity theory. The student will receive 4 college credits for successful completion.

Course Delivery:
This course will be taught via the Internet with daily on-line discussion sessions. Tests will be administered on-line and homework will be collected via email.

Materials:
Scientific Calculator, Windows 98 or later, Microsoft Word 97 or later, Microsoft Excel 97 or later, Ilink 7.0, and other materials to be announced at a later date

Grade Distribution:
Exams: 50%
Lab work: 50%

Event Schedule:

For detailed information on weekly schedule and assignments visit: http://steverapp.pageout.net .

Policies:

Academic Dishonesty: Collaboration on examinations, in class assignments, and homework assignments is forbidden except where specifically specified as "Team" activities. In general, one team may not collaborate with another team on "Team" activities. Students violating this policy will be subject to disciplinary action and a failing grade in the class.

Field Trips: Students must maintain a C average to participate in field trips.

Assignments: ALL ASSIGNMENTS SHOULD BE COMPLETED ON TIME AND TURNED IN ON THE DUE DATE. ASSIGNMENTS WILL BE ACCEPTED UP TO 3 DAYS LATE, BUT THERE WILL BE A PENALTY OF 10 POINTS FOR EVERY DAY LATE. THIS MEANS THE MAXIMUM SCORE THAT CAN BE RECEIVED IS 70%. AFTER 3 DAYS A GRADE OF ZERO WILL BE RECORDED. MAKE SURE YOU EMAIL YOUR ASSIGNMENT FAR ENOUGH AHEAD SO THAT IT REACHES ME BY THE DEADLINE.

Grading System: **The regular university grading scale will be used:**

90-100 = A; 80-89 = B; 70-79 = C; 60-69 = D; 59 or below = F.

Course Objectives: PHY121

1. **To increase student understanding of natural laws by emphasizing the basic principles of physics.**
2. **To develop the analytical skills critical for success in both educational undertakings and lifetime decision making through emphasizing the unity of physics.**
3. **To develop an understanding of the scientific process through the concept of a model and the steps of developing a theory, stating assumptions, recording observations, refining the model, and improving overall understanding.**
4. **To show students that physics is a dynamic, exciting field in order to prepare them for the 21st century when the need for scientific understanding will be greater than ever.**
5. **To present classical physics from a contemporary perspective.**

Curriculum Framework: PHY 121

Part 1: MECHANICS.

1. Introduction.

Standards of Length, Mass, and Time. The Building Blocks of Matter. Dimensional Analysis. Uncertainty in Measurement and Significant Figures. Conversion of Units.

Estimates and Order-of-Magnitude Calculations. Coordinate Systems. Trigonometry. Problem-Solving Strategy.

2. Motion in One Dimension.
Displacement. Velocity. Acceleration. Motion Diagrams. One-Dimensional Motion with Constant Acceleration. Freely-Falling Objects.

3. Vectors and Two-Dimensional Motion.
Vectors and Their Properties. Components of a Vector. Displacement, Velocity and Acceleration in Two Dimensions. Motion in Two Dimensions. Relative Velocity.

4. The Laws of Motion.
Forces. Newton’s First Law. Newton’s Second Law. Newton’s Third Law. Applications of Newton’s Laws. Forces of Friction.

5.Energy.
Work. Kinetic Energy and the Work-Energy Theorem. Gravitational Potential Energy. Spring Potential Energy. Systems and Energy Conservation. Power. Work Done by a Varying Force.

6. Momentum and Collisions.
Momentum and Impulse. Conservation of Momentum. Collisions. Glancing Collisions. Rocket Propulsion.

7. Rotational Motion and the Law of Gravity.
Angular Speed and Angular Acceleration. Rotational Motion Under Constant Angular Acceleration. Relations Between Angular and Linear Quantities. Centripetal Acceleration. Newtonian Gravitation. Kepler’s Laws.

9. Solids and Fluids.
States of Matter. The Deformation of Solids. Density and Pressure. Variation of Pressure with Depth. Pressure Measurements. Buoyant Forces and Archimedes's Principle. Fluids in Motion. Other Applications of Fluid Dynamics. Surface Tension, Capillary Action, and Viscous Fluid Flow. Transport Phenomena.

Part 2: THERMODYNAMICS.
10. Thermal Physics.
Temperature and the Zeroth Law of Thermodynamics. Thermometers and Temperature Scales. Thermal Expansion of Solids and Liquids. Macroscopic Description of an Ideal Gas. The Kinetic Theory of Gases.

11. Energy in Thermal Processes.
Heat and Internal Energy. Specific Heat. Calorimetry. Latent Heat and Phase Change. Energy Transfer. Global Warming and Greenhouse Gases.

12. The Laws of Thermodynamics.
Work in Thermodynamic Processes. The First Law of Thermodynamics. Heat Engines and the Second Law of Thermodynamics. Entropy. Human Metabolism.

Lab Work

Lab 1.1: Dancing Raisins
Lab 1.2: Measuring Stuff
Lab 2.1: How Do I Get There From Here?
Lab 2.2: g!! How Fast Can You React?
Lab 3.1: The Softball Toss
Lab 3.2: Mousetrap Racer
Lab 4.1: Measuring Static and Kinetic Friction
Lab 4.2: Kites, Surface Area and Newton's 3rd Law
Lab 5.1: Student Power
Lab 6.1: Air Track Collisions
Lab 7.1: Moons of Saturn
Lab 10.1: How do Objects Reach Thermal Equilibrium?
Lab 10.2: Are Ideal Gases Really Ideal?
Lab 11.1: Heat of Fusion of Ice
Lab 12.1: Zippity Do-Dah Ice Cream

Course Objectives: PHY 122

1. **To increase student understanding of natural laws by emphasizing the basic principles of physics.**
2. **To develop the analytical skills critical for success in both educational undertakings and lifetime decision making through emphasizing the unity of physics.**
3. **To develop an understanding of the scientific process through the concept of a model and the steps of developing a theory, stating assumptions, recording observations, refining the model, and improving overall understanding.**
4. **To provide students with a thorough coverage of modern physics so that they will better comprehend the important public policy issues facing them as citizens.**
5. **To show students that physics is a dynamic, exciting field in order to prepare them for the 21st century when the need for scientific understanding will be greater than ever.**
6. **To present classical physics from a contemporary perspective.**
7. **To treat modern physics thoroughly**

Curriculum Framework: PHY 122

Part 3: VIBRATIONS AND WAVES.
13. Vibrations and Waves.
Hooke's Law. Elastic Potential Energy. Comparing Simple Harmonic Motion with Uniform Circular Motion. Position, Velocity, and Acceleration as a Function of Time.

Motion of a Pendulum. Damped Oscillations. Waves. Frequency, Amplitude, and Wavelength. The Speed of Waves on Strings. Interference of Waves. Reflection of Waves.

14. Sound.
Producing a Sound Wave. Characteristics of Sound Waves. The Speed of Sound. Energy and Intensity of Sound Waves. Spherical and Plane Waves. The Doppler Effect. Interference of Sound Waves. Standing Waves. Forced Vibrations and Resonance. Standing Waves in Air Columns. Beats. Quality of Sound. The Ear.

Part 4: ELECTRICITY AND MAGNETISM.
15. Electric Forces and Electric Fields.
Properties of Electric Charges. Insulators and Conductors. Coulomb's Law. The Electric Field. Electric Field Lines. Conductors in Electrostatic Equilibrium. The Millikan Oil-Drop Experiment. The Van de Graaff Generator. Electric Flux and Gauss's Law.

17. Current and Resistance.
Electric Current. A Microscopic View: Current and Drift Speed. Current and Voltage Measurements in Circuits. Resistance and Ohm's Law. Resistivity. Temperature Variation of Resistance. Superconductors. Electrical Energy and Power. Electrical Activity in the Heart.

19. Magnetism.
Magnets. Earth's Magnetic Field. Magnetic Fields. Magnetic Force on a Current-Carrying Conductor. Torque on a Current Loop and Electric Motors. Motion of a Charged Particle in a Magnetic Field. Magnetic Field of a Long, Straight Wire and Ampère's Law. Magnetic Force Between Two Parallel Conductors. Magnetic Fields of a Current Loop and Solenoids. Magnetic Domains.

Part 5: LIGHT AND OPTICS
22. Reflection and Refraction of Light.
The Nature of Light. Reflection and Refraction. The Law of Refraction. Dispersion and Prisms. The Rainbow. Huygens's Principle. Total Internal Reflection.

23. Mirrors and Lenses.
Flat Mirrors. Images Formed by Spherical Mirrors. Convex Mirrors and Sign Conventions. Images Formed by Refraction. Atmospheric Refraction. Thin Lenses. Lens and Mirror Aberrations.

25. Optical Instruments.
The Camera. The Eye. The Simple Magnifier. The Compound Microscope. The Telescope. Resolution of Single-Slit and Circular Apertures. The Michelson Interferometer.

Part 6: MODERN PHYSICS
26. Relativity.
Introduction. The Principle of Galilean Relativity. The Speed of Light. The Michelson-Morley Experiment. Einstein's Principle of Relativity. Consequences of Special Relativity. Relativistic Momentum. Relativistic Addition of Velocities. Relativistic Energy and the Equivalence of Mass and Energy. Pair Production and Annihilation. General Relativity.

28. Atomic Physics.
Early Models of the Atom. Atomic Spectra. The Bohr Theory of Hydrogen. Modification of the Bohr Theory. De Broglie Waves and the Hydrogen Atom. Quantum Mechanics and the Hydrogen Atom. The Spin Magnetic Quantum Number. Electron Clouds. The Exclusion Principle and the Periodic Table. Characteristic X-Rays. Atomic Transitions. Lasers and Holography. Energy Bands in Solids. Semiconductor Devices.

29. Nuclear Physics.
Some Properties of Nuclei. Binding Energy. Radioactivity. The Decay Processes. Natural Radioactivity. Nuclear Reactions. Medical Applications of Radiation. Radiation Detectors.

Lab Work
Lab 13.1: By Hooke or Crook
Lab 13.1: Tick Tock, Tick Tock
Lab 14.1: Sound Off!
Lab 15.1: Electric Field Line Tracer
Lab 15.2: Getting Charged Up
Lab 15.3: Building an Electroscope
Lab 17.1: Ohm’s Law: Can You Resist?
Lab 19.1: Constructing an Electric Motor
Lab 22.1: Now You See It, Now You Don’t
Lab 23.2: Spherical Reflections
Lab 25.1: Build Your Own Telescope
Lab 28.1: Too Hot To Handle
Lab 29.1: Operating a Virtual Tokamak Fusion Reactor
Lab 30.1:Building Your Own Airplane