Syllabus: Honors Physics

Instructor : Dr. Manju Prakash **Year:** 2009-2010

"What we need is not the will to believe but the will to find out"
- - - Bertrand Russell

"The more I practice, the luckier I get"
- - - Golfer Gary Player.

Course Goals & Philosophy:

This course is for students who have already taken conceptual physics and physical science and would like to pursue further study of Physics, but who do not wish to take a course at an AP level. Students will learn scientific vocabulary to describe a physical phenomenon, translate their conceptual understanding to equations, and solve these equations to obtain final answer. The mathematics requirement for this course is algebra, trigonometry, and Pythagorean Theorem.
This course does not follow the rigor of an AP course. However, students will learn problem solving strategies. Students will be actively engaged in various activities to enhance their understanding of physical concepts. Laboratory work will reinforce students' understanding of physical laws through exploration and investigation .

What Should I do to Succeed in the Course?

You should be an active participant in the learning process. With persistent and diligent work you will meet the goals of this course. To succeed in this course with good grade you should follow these guidelines:

- Keep asking questions. Chances are very good that others are in the same situation as you.
- Take your homework seriously.
- Prepare your lab reports thoroughly. This will enable you to develop strong scientific vocabulary to describe physical phenomena.
- Try to identify key concepts while reading the textbook regularly and carefully.
- Focus on developing strong problem solving skills.

Course Requirements:

- Textbook, Glencoe Science, Physics: Principles and Problems
- Large classroom notebook
- Large 3-ring binder (homework)
- Laboratory notebook
- Netbook & Scientific Calculator
- Open mind, alertness, and consistent work

Grading Procedure:

- Your end of the year grade will be determined as follows:

First Trimester: 15%
Second Trimester: 25%

Third Trimester: 35%
Mid-term exam: 10%
Final cumulative exam: 15%

●Each Trimester has a grade breakdown scheme as follows:

Laboratory: 15%
Out of Class Assessments: 10%
Quizzes: 30%
Tests: 45%

The grade-scale scheme is as follows:

A+: 97-100	D+: 67-69
A: 93-96	D: 63-66
A-: 90-92	D- 60-62
B+: 87-89	F: 0-59
B: 83-86	
B- 80-82	
C+: 77-79	
C: 73-76	
C-: 70-72	

Dates for quizzes and tests will be announced a week before they are scheduled. All students are required to take SAT II Physics Exam.

Homework Policies:

- Make a reasonable attempt at all assigned problems.
- Homework will be assigned everyday and will be due next day.
- Student groups can be effective. However, when a student submits an assignment, she is stating that the material submitted has been fully comprehended. Therefore, joint submissions and plagiarism are unacceptable.

Lab Reports:

● Organized lab reports must be prepared.

●When returned, homework and all other submitted items (tests, quizzes, labs etc.) are to be saved in your 3-ring binder.

All submitted assignments must begin with the student's name and the title of work.

Classroom Policies:

● Please do not talk during the lecture-it is rude and disturbs others.
● Be punctual, late arrival puts you at disadvantage and distracts others.
● Cell phones, pagers, and iPods are not allowed during the classroom instruction.
● Come prepared and take charge of your learning process.

●Cheating or plagiarism may result in failing grade for the assessment. Such incidents may be reported to Honor Council.

Trimester 1

Week (#)	Chapters	Topics
1	1	Scientific Process, Units, Dimensions, Graphing (Physics Toolkit)
2	2,3	Vectors, Kinematics in 1- dimension
3	3,4	Kinematics and Forces in 1- dimension
4	5	Forces in 2- dimensions
5	6	Motion in 2-dimensions, projectile, circular motion
6	7	Gravitation
7	8	Rotational Motion
8	9	Momentum and Conservation Laws
*****	**Parents Weekend**	**********
9	10	Energy & Work
10	11	Conservation of Energy
11	12	Thermal Energy

Trimester 2

Week	Chapters	Topics
1	13	States of Matter
2	14	Wave Properties
3	15,16	Sound and Light
4	16	Fundamentals of Light
5	17, 18	Light Reflection, Mirrors, Refraction and Lenses
6	19	Interference and Diffraction of Light
7	20	Static Electricity
8	21	Electrical Field and Forces
9********	Mid-Year Exam and	Review*******
10	22, 23	Electrical Circuits, Series and Parallel
11	24	Magnetic Field and Force
12	25	Electromagnetic Induction

Trimester 3

Week	Chapters	Topics
1	27	Quantum Theory
2	27	Quantum Theory
3	28	The Atom
4	28, 29	Atomic and Nuclear Physics
5	All	SAT Review
6	All	SAT Review
7	All	SAT Review
8	All	SAT Review/SAT
9	29	Solid State Electronics
10	29	Solid State Electronics
11	Hand-out	Nanotechnology
12	**29**	Final Test

Tentative Outline of Topics

1. Motion

A. Units & Measurements
- (a) Metric Units: Fundamental and Derived
- (b) Metric Prefixes
- (c) Significant Digits: Data and Arithmetic
- (d) Mass, Weight, and Density

B. Vectors and Graphing
- (a) Vectors vs. Scalars
  - i. Vector Addition: Perpendicular Component Method
  - ii. Vector Multiplication: scalar and Vector Product
  - iii. Basic Graphing: Scales, Slopes, Direct and Indirect Proportions
- (b) One- Dimension and Two- Dimensions Kinematics
  - i. Kinematic Vectors: Displacement, Velocity, Acceleration
  - ii. Average vs. Instantaneous Quantities
  - iii. Equations of Motion and their Application: Constant Acceleration
  - iv. Graphical Analysis of Motion in Time

C. Forces and Equilibrium
- (a) The Laws of Newton
  - i.The Law of Galileo in contrast to Aristotle
  - ii. Force and Acceleration
  - iii. Action-Reaction Forces
- (b) Friction and Normal Forces
- (c) Mechanical Equilibrium: Force Diagrams or Free-Body Diagrams
  - i. Resultant Force on Point Masses
  - ii. The Inclined Plane
  - iii. Static vs. Dynamic Equilibrium

3. Motion and Forces in Two-Dimensions

A. Projectile Motion

B. Circular Motion
- (i) Uniform Circular Motion
- (ii) Centripetal Forces

4. Gravitation

A. Gravitational Force
- (a) Universal Gravitation: The Inverse-Square Law
- (b) Orbiting Objects as Falling
- (c) Planetary Motion: Laws of Kepler

(d) Satellite and Planetary Motion, Escape Velocity
(e) Calculation of Acceleration of Gravity in terms of Universal Gravitational Constant

5. Torque and Rotational equilibrium

(a) Different Units for Rotational Speed
(b) Rotational Kinematics
(c) Resultant torque on rigid body
(d) Rotational Equilibrium
(e) Angular Momentum and Conservation

6. Momentum:

(a) Classical and Newtonian Definitions of Linear Momentum
(b) Linear Momentum Conservation & Collisions
(c) Impulse

7. Energy

A. Work & Energy
(a)Work
(b)Power
(c) Kinetic Energy
(d)Potential Energy
(e)Elastic and Gravitational Energy

B. Conservation of Mechanical Energy
(a) Energy Transformation for Freely Falling Object
(b) Energy transformation When an Object Moves Along an Inclined Plane (with/without friction)
(c) Work-Energy Theorem

8. Gas Laws & Thermodynamics

A. Gas Laws
(a) Relation Between Pressure, Volume, and Temperature
(b) Ideal Gas Laws
(c) Kinetic-Molecular Theory-Interpretation of Temperature

B. Heat
(a) Mechanical Equivalent of Heat
(b) Phase Transformation and Phase Diagrams
(c) Heat Transfer Processes: Conduction, Convection, & Radiation
(d) Thermal Expansion

C. Thermodynamics
(a) First Law
(b) Types of Thermodynamic Processes
i. Adiabatic

ii. Isothermal
iii. Isochoric

(c) Pressure -Volume Work of a Gas

(d) Second Law of Thermodynamics: Entropy

i. Entropy: Disorder

ii Efficiency of Heat Pumps

9. Fluids

A. Hydrostatic Pressure

B. Buoyancy

C. Fluid Flow Continuity

D. Bernoulli's Equation

10. Waves and Oscillations

A. Simple Harmonic Motion (SHM)

(a) Hooke's Law

(b) Comparison of SHM with Uniform Circular Motion

(c) SHM: Period of oscillation

(d) Time-dependent Position, Velocity, and Acceleration of an Oscillator

(e) Elastic Potential Energy and Energy Conservation

(f) The Simple Pendulum

(g) Resonance: The Swing

B. Waves

(a) Longitudinal and Transverse waves

(b) Relationship between wavelength, frequency, and speed

(c) Sound Wave: Medium-dependent Speed

(d) Intensity, Pitch, Loudness & Doppler Effect

(e) Standing Waves & Musical Instruments

11. Light

A. What is Light?

(a) Light as Electromagnetic Wave

(b) The Electromagnetic Spectrum

B. Geometrical Optics

(a) Plane Mirrors

(b) Concave & Convex Mirrors

(c) Laws of Reflection & Refraction

(d) Total Internal Reflection, Critical Angle

(e) Dispersion and Rainbow

(g) Lenses
(i) Concave Lens
(ii) Convex Lens

C. Physical Optics
(a)Diffraction Through Slits
(b) Interference
(c)Thin Films
(d) Polarization

D. Image Formation in Lenses and Mirrors

12. Electromagnetism

A. Electrostatics
(a) Electric Charge
(b) Electrostatic Forces (Coulomb's Law)
(c) Electric Lines of Force
(d) Conductors & Insulators
(e) Induced Charge
(f) Parallel Plate Capacitor

B. Electric Fields & Potential
(a) Electric fields & Electrical Work
(b) Electric Potential Energy
(c) Equi-potential surfaces Grounded Conductors
(d) Particle Dynamics within a Capacitor
(i) Cathode Ray Tube
(ii) Milikan Oil Drop Experiment

C. Direct Circuits
(a) Mechanical Analogy of a Circuit: EMF, Current, Resistance
(b) Current, Electrical Work, and Electric Power
(c) Ohm's Law
(d) Heat Dissipated in a Resistor: Calorimetry Connection
(e) Energy Stored in a Capacitor
(f) Resistors and Capacitors in Series and Parallel
(g) Kirchhoff's Two Laws

(h) Home Consideration, Parallel Circuits and
i. Circuit Breakers
ii. Multi-loop circuits
iii. Connecting Ammeters, Voltmeters, and Cells

D. Magnetism
(a) Sources of Magnetic Field Lines: Moving Charges
(b) Field Lines about Bar Magnets, Horseshoe Magnets and the Earth

(c) Field lines about a Wire and a Coil: Biot-Savart Law
(d) Electromagnets
(e) Atomic Theory of Magnetism: Electron Spins and Domains
(f) Magnetic Forces
i Point Charges: Lorentz Law
ii Forces between Parallel Wires
(g) Magnetic Torque on a Current Loop
(h) Magnetic Devices
i. Electromagnetic Motor
ii. Mass Spectrometer

E Electromagnetic Induction
(a) Generation of Electromotive Force
(b) Faraday's Law
(c)Electric Generator & Motor
(d) Transformers

13. Atomic & Nuclear Structure

A. Atomic Theory & Quantum Mechanics

(a) Radioactivity: alpha, beta, and gamma radiation
(b) Cathode Ray Tubes and The Raisin Cake Model of the At
(c) Rutherford: The Gold Foil Experiment
(d) Bohr: Postulates of Atomic Structure
i Electrons are confined to certain quantized orbits
ii Contrary to Maxwell, electrons do not emit energy while in stationary orbits
iii These orbits are of quantized angular momentum
(e) Bohr: Conclusions
i. Interpretation of Line Spectra (qualitative)
ii. Derivation of Quantized Electron Energy Values
iii. Agreement with Line Spectra (quantitative)

B. Quantum Theory: Physical Laws at Atomic Scale

(a) Experimental Evidence suggesting the need for a new theory
i. Line Spectra
ii The Photoelectric Effect
(b) Early Theoretical Work
i. Einstein and Planck: Quantization of EMR
ii. de Broglie: Photon Momentum, Matter Waves, & Wave- Particle Duality
iii Heisenberg: The Uncertainty Principle
(c) Current Quantum-Mechanical Model of The Atom
(d) Electronic Energy Level Diagrams

C. Nuclear Reactions

(a) Balancing Nuclear Reactions
(b) Alpha, Beta, & Gamma Decay
(c) First-Order Decay Processes: Half-Lives and Decay Sequences
(d) Power Sources: Fission & Fusion

14. Electronics and Nanotechnolgy

A. Miniaturization and Nanotechnology

List Of Labs:

Lab # 1: Acceleration due to Gravity
Lab # 2: Constant Acceleration Down an Incline
Lab # 3: Newton's Second Law
Lab # 4: Atwood's Machine
Lab # 5: Conservation of Momentum
Lab # 6: Heat Transfer
Lab # 7: Simple Harmonic Motion
Lab # 8: Sound Waves
Lab # 9: Light Intensity vs. Position
Lab # 10: Optical Bench
Lab # 11: Ohm's Law
Lab # 12: Kirchhoff's Laws with Multimeters and Circuit Boards
Lab # 13: Circuit
Lab # 14: Magnetic Field
Lab # 15 : Magnetic Induction

Other Suggested Experiments

- Determine Density
- Determine g.
- Coefficient of Friction
- Centripetal Force
- Conservation of Energy
- Specific Heat
- Period of a Pendulum
- Resistor Addition