Las Positas College
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Course Outline for PHYS 1C

GENERAL PHYSICS III

Effective: Fall 2017

I. CATALOG DESCRIPTION:
PHYS 1C — GENERAL PHYSICS III — 5.00 units

Introduction to electricity and magnetism, circuits, Maxwell's equations and electromagnetic waves.

4.00 Units Lecture 1.00 Units Lab

Prerequisite
PHYS 1A - General Physics I
with a minimum grade of C
and

MATH 3 - Multivariable Calculus
(May be taken concurrently)

Grading Methods:
Letter Grade

Discipline:

	MIN
Lecture Hours:	72.00
Lab Hours:	54.00
Total Hours:	126.00

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

III. PREREQUISITE AND/OR ADVISORY SKILLS:
Before entering the course a student should be able to:

A. PHYS1A
  1. Construct vectors in three dimensions to model physical phenomena, and perform algebraic calculations with these vectors.
  2. Use algebra, trigonometry, geometry, and calculus to model physical phenomena and calculate relevant physical parameters.
  3. Predict the future trajectory of an object moving in two dimensions with uniform acceleration.
  4. Analyze a physical situation with multiple constant forces acting on a point mass using Newtonian mechanics.
  5. Analyze a physical situation with multiple forces acting on a point mass or extended object using concepts of work and energy.
  6. Analyze a physical situation with multiple forces acting on an extended object using the concept of torque.
  7. Calculate the moment of inertia and angular momentum of an extended object or system of objects, using calculus if necessary.
  8. Analyze collisions of point masses and extended objects using the concept of conservation of linear and angular momentum.
  9. Analyze situations in which the gravitational acceleration changes as a function of distance using Newton's Law of Universal Gravitation.
  10. Design, perform, analyze, and assess the effectiveness of simple experiments to demonstrate physical phenomena.
  11. Operate standard laboratory equipment and analysis tools, including digital data acquisition systems, spreadsheet programs, and plotting programs.
  12. Analyze real-world experimental data, including appropriate use of error propagation, units and significant figures.
  13. Relate the results of experimental data to the physical concepts discussed in the lecture portion of the class.
  14. Write comprehensive laboratory reports that describe the scientific basis of the experiment, clearly explain the experimental procedure, present a complete mathematical analysis of data and uncertainties, and evaluate the effectiveness of the experiment based on calculated uncertainties.

B. MATH3
  1. Perform vector algebra in two and three space and interpret the results geometrically especially the dot and cross products and apply them to problems in space geometry (e.g., orthogonal projection, vector equations of lines and planes);
  2. Transform points and equations among rectangular, cylindrical, and spherical coordinates and sketch their graphs as well as quadric surfaces;
  3. Sketch the graphs of functions of two variables using level curves, traces in coordinate planes, symmetry, etc.;
  4. Extend the concepts of limits, continuity, differentiability and differential of single variable functions to functions of two or more variables;
  5. Compute limits, partial derivatives, total differential, gradient, directional derivatives and interpret them geometrically and in terms of rate of change;

6. Compute double and triple integrals directly or using change of variables and explain the geometric interpretation of Jacobians;
7. Apply differential operators, gradient, divergence, curl and Laplacian to scalar and vector field and interpret the results;
8. Interpret the theorems of Green, Stokes and divergence physically as well as mathematically (as the generalizations of the Fundamental Theorem of Calculus), and use them to compute line and surface integrals;
9. Find scalar potentials for conservative vector fields.

IV. MEASURABLE OBJECTIVES:

Upon completion of this course, the student should be able to:

A. Analyze simple static charge distributions and calculate the resulting electric field and electric potential.
B. Analyze simple current distributions and calculate the resulting magnetic field.
C. Explain the physical location and motions of charged particles within objects in the presence of an electric or magnetic field.
D. Predict the trajectory of charged particles in uniform electric and magnetic fields.
E. Analyze situations in which the electric or magnetic field is changing in time using Faraday's Law and/or Maxwell's equations.
F. Analyze DC and AC circuits in terms of current, potential difference, and power dissipation for each element.
G. Design, perform, analyze, and assess the effectiveness of simple experiments to demonstrate physical phenomena.
H. Operate standard laboratory equipment and analysis tools, including digital data acquisition systems, spreadsheet programs, and plotting programs.
I. Analyze real-world experimental data, including appropriate use of units and significant figures.
J. Relate the results of experimental data to the physical concepts discussed in the lecture portion of the class.

V. CONTENT:

A. Electric Fields
   1. Properties of Electric Charges
   2. Charging Objects by Induction
   3. Coulomb's Law
   4. The Electric Field
   5. Electric Field of a Continuous Charge Distribution
   6. Electric Field Lines
   7. Motion of Charged Particles in a Uniform Electric Field
B. Gauss's Law
   1. Electric Flux
   2. Gauss's Law
   3. Application of Gauss's Law to Various Charge Distributions
   4. Conductors in Electrostatic Equilibrium
   5. Formal Derivation of Gauss's Law
C. Electric Potential
   1. Potential Difference and Electric Potential
   2. Potential Differences in a Uniform Electric Field
   3. Electric Potential and Potential Energy Due to Point Charges
   4. Obtaining the Value of the Electric Field from the Electric Potential
   5. Electric Potential Due to Continuous Charge Distributions
   6. Electric Potential Due to a Charged Conductor
   7. The Millikan Oil-Drop Experiment
   8. Applications of Electrostatics
D. Capacitance and Dielectrics
   1. Definition of Capacitance
   2. Calculating Capacitance
   3. Combinations of Capacitors
   4. Energy Stored in a Charged Capacitor
   5. Capacitors with Dielectrics
   6. Electric Dipole in and Electric Field
   7. An Atomic Description of Dielectrics
E. Current and Resistance
   1. Electric Current
   2. Resistance
   3. A Model for Electrical Conduction
   4. Resistance and Temperature
   5. Superconductors
   6. Electrical Power
F. Direct Current Circuits
   1. Electromotive Force
   2. Resistors in Series and Parallel
   3. Kirchhoff's Rules
   4. RC Circuits
   5. Electrical Meters
   6. Household wiring and Electrical Safety
G. Magnetic Fields
   1. Magnetic Fields and Forces
   2. Magnetic Force acting on a Current-Carrying Conductor
   3. Torque on a Current Loop in a Uniform Magnetic Field
   4. Motion of a Charged Particle in a Uniform Magnetic Field
   5. Applications Involving Charged Particles Moving in a Magnetic Field
   6. The Hall Effect
H. Sources of the Magnetic Field
   1. The Biot-Savart Law
   2. The Magnetic Force Between Two Parallel Conductors
   3. Ampère's Law
   4. The Magnetic Field of a Solenoid
   5. Magnetic Flux
   6. Gauss's Law in Magnetism
   7. Displacement Current and the General Form of Ampère's Law
   8. Magnetism in Matter
   9. The Magnetic Field of the Earth
I. Faraday's Law
   1. Faraday's Law of Induction
   2. Motional emf
   3. Lenz's Law

4. Induced emf and Electric Fields
5. Generators and Motors
6. Eddy Currents
7. Maxwell's Equations

J. Inductance
1. Self-Inductance
2. RL Circuits
3. Energy in a Magnetic Field
4. Mutual Inductance
5. Oscillations in an LC Circuit
6. The RLC Circuit

K. Alternating Current Circuits
1. AC Sources
2. Resistors in an AC Circuit
3. Inductors in an AC Circuit
4. Capacitors in an AC Circuit
5. The RLC Series Circuit
6. Power in an AC Circuit
7. Resonance in a Series RLC Circuit
8. The Transformer and Power Transmission
9. Rectifiers and Filters

L. Electromagnetic Waves
1. Maxwell's Equations and Hertz's Discoveries
2. Plane Electromagnetic Waves
3. Energy Carried by Electromagnetic Waves
4. Momentum and Radiation Pressure
5. Production of Electromagnetic Waves by and Antenna
6. The Spectrum of Electromagnetic Waves

VI. METHODS OF INSTRUCTION:

A. **Lecture** -
B. **Discussion** -
C. **Lab** -
D. Problem solving
E. Internet and other computer based simulations and instructional multi-media
F. **Demonstration** -

VII. TYPICAL ASSIGNMENTS:

A. Weekly or bi-weekly homework assignments with an average of 10-15 word problems per assignment.
B. Weekly or bi-weekly practice problems may be worked on collaboratively during class, for practice only.
C. Weekly laboratory activities take place which may involve direct experimentation, computer analysis, theoretical calculations, and written lab reports.

VIII. EVALUATION:

A. **Methods**
1. Exams/Tests
2. Quizzes
3. Papers
4. Oral Presentation
5. Class Participation
6. Class Work
7. Home Work
8. Lab Activities

B. **Frequency**
1. 3-5 exams per semester
2. quizzes weekly or bi-weekly, between exams, if desired
3. special topic research paper once per semester, if desired
4. oral presentations on lab work a few times per semester, if desired
5. daily class participation and classwork, if desired
6. weekly or bi-weekly homework assignments
7. weekly lab activities, with lab report papers assigned every few weeks

IX. TYPICAL TEXTS:

1. Young, Hugh, and Roger Freedman. *University Physics.* 14th ed., Pearson Education, 2016.
2. Knight, Randall. *Physics for Scientists and Engineers: A Strategic Approach with Modern Physics.* 4th ed., Pearson Education, 2017.
3. Halliday, David, Robert Resnick, and Jearl Walker. *Fundamentals of Physics (Extended).* 10th ed., Wiley, 2013.
4. Las Positas College Physics 8B Laboratory Manual, available online in PDF format.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

A. A programmable scientific calculator capable of graphing
B. A campus print card