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Physics (PHYS) 2222 General Physics II (Calculus) (4 Units) CSU:UC
[Formerly Physics 4B]

Prerequisite: Successful completion of Physics 2221 and Mathematics 2120 with grades of "C" or better or concurrent enrollment in Mathematics 2120

Prerequisite knowledge/skills:

Before entering the course the student should be able to:

1. understand the use of functional notation,
2. plot and interpret graphs of functions,
3. differentiate algebraic, trigonometric, exponential, logarithmic and hyperbolic functions,
4. apply derivatives, and
5. find the integrals of basic functions

Total Hours: 48 hours lecture; 48 hours lab (96 hours total)

Catalog Description: Demonstration lectures, problems and laboratory work in the fundamentals of electricity, including fields, circuits, magnetism and waves comprise this course, which is a continuation of Physics 2221.C-ID: PHYS 210 This is the second course in a series of three.

Type of Class/Course: Degree Credit

Texts: Young, Hugh and Roger Freedman. *University Physics Plus Modern Physics Technology Update, Books a la Carte Plus Mastering Physic with eText*. 14th ed., Addison-Wesley, 2016.

Lab Manual:

Sokoloff, David R., et al. *Real Time Physics Active Learning Laboratories Module 3 Electric Circuits*. 2nd ed., John Wiley & Sons, 2014.

Additional Required Materials: Scientific calculator required

Course Objectives:

By the end of the course, a successful student should be able to:

1. apply the laws and principles of classical electricity and magnetism to the solution of

problems of:

a. forces between point charges; electric force fields and potential fields produced by individual point charges and sets of point charges and by uniformly charged surfaces and volumes having plane, spherical or cylindrical charge symmetry (Gauss' Law); potential difference calculations; and capacitance, capacitors, arrays of capacitors, and the effect of dielectrics on capacitors,
b. current, resistance and electromotive force and direct current circuits and instruments,
c. the magnetic field and the force it exerts on moving electric charges or currents, its production by moving electric charges or currents, induced electromotive force in conductors and electric circuits, and the magnetic properties of matter,
d. mutual inductance and self inductance and, the basis of electrical machinery and the behavior of electric circuits involving resistance, inductance and capacitance in transient and (alternating circuit) conditions
e. electromagnetic waves

2. in all the subject areas of this course, be able to identify multiple applicable physical concepts (some of which will have been covered in prior chapters) and their use in an appropriate manner and sequence. Comprehend presentations in which calculus concepts are extended beyond those learned so far in the calculus course for specific physics needs, such as Gauss' Law, and be able to explain or reproduce the derivations and apply the results to problems,

3. perform assigned experiments in a reasonable manner, and prepare adequate experimental reports presenting the numerical results and analyzing the sources and significance of errors, and

4. list and discuss objectives of any experiment, the type of measurements made, why they were made, and how they entered into the determination of the desired result.

Course Scope and Content: (Lecture)

Unit I Electric Fields
- A. Properties of Electric Charges
- B. Coulomb's Law

Unit II Gauss's Law
- A. Electric Flux
- B. Applications of Gauss's Law

Unit III Electric Potential
- A. Electric Potential and Potential Difference
- B. Electric Potential of Continuous Charge Distributions

Unit IV Capacitance and Dielectrics
- A. Calculating Capacitance
- B. Capacitors with Dielectrics

Unit V Current and Resistance
- A. Electric Current

B. Resistance and Temperature

Unit VI Direct Current Circuits
- A. Electromotive Force
- B. Kirchhoff's Rules

Unit VII The Magnetic Field
- A. Magnetic Fields and Forces
- B. Torque on a Current Carrying Loop in a Uniform Magnetic Field

Unit VIII Sources of the Magnetic Field
- A. The Biot-Savart Law
- B. Ampere's Law

Unit IX Faraday's Law
- A. Motional Emf
- B. Lenz's Law

Unit X Inductance
- A. RL Circuits
- B. Mutual Inductance

Unit XI Alternating Current Circuits
- A. AC Sources
- B. Power in an AC Circuit

Unit XII Electromagnetic Waves
- A. Maxwell's Equations
- B. Energy Carried by an Electromagnetic Wave

Unit XIII Sound Waves
- A. Pressure Variations in Sound Waves
- B. The Doppler Effect

Unit XIV Special Relativity
- A. Invariance of Physical Laws
- B. Relativity of Time Intervals

Course Scope and Content: (Laboratory)

Unit I Batteries and Currents
- A. Circuit Diagrams
- B. Measuring Current and Voltage

Unit II Current in DC Circuits
- A. Series Connections
- B. Parallel Connections

Unit III Voltage in DC Circuits
- A. Potential Difference in a Circuit

B. Ohm's Law

Unit IV Kirchhoff's Laws
- A. Measuring Resistance
- B. Resistance Equivalence in Series and Parallel Circuits

Unit V Capacitors and RC Circuits
- A. Measuring Capacitance
- B. Time Dependence of Current in a Capacitor

Unit VI Inductors and LR Circuits
- A. Properties of Circuits with Inductors
- B. Time Dependence of Current in an Inductor

Unit VII AC Currents and Voltages
- A. Peak Voltage and Frequency for AC Signals
- B. Phase, Amplitude, Reactance, and Impedance in AC Circuits

Unit VIII AC Filters and Resonance
- A. Design of Capacitive and Inductive Filters
- B. Resonance in AC Circuits

Unit IX Coulomb's Law
- A. Inverse Square Relationship for Distance
- B. Application to Charged Spheres

Unit X Electric Field of A Line Charge
- A. Distance Relationship
- B. Force and the Electric Field

Unit XI Faraday's Law
- A. Magnetic Flux and Force
- B. Induced Current and Voltage in a Coil

Unit XII Magnetic Field in a Coil
- A. Application of Current in a Slinky
- B. Relationship of Magnetic Field and Current

Unit XIII Electrical Energy
- A. Power
- B. Efficiency of a Motor

Unit XIV Sound Waves and Beats
- A. Frequency and Period
- B. Amplitude

Unit XV Speed of Sound
- A. Sound Measurements with a Microphone
- B. Temperature and the Speed of Sound

Unit XVI Mathematics of Music
A. Fast Fourier Transforms
B. Structure of Chromatic Scale

Learning Activities Required Outside of Class:

The students in this class will spend a minimum of 6 hours per week outside of the regular class time doing the following:

1. Studying
2. Completing required reading
3. Problem solving activity or exercise
4. Written work

Methods of Instruction:

1. Lectures, demonstrations, class discussions, and sample problems solved by the instructor with student involvement to illustrate the application of physical principles
2. Laboratory experiments. The principal objectives of the laboratory work are the demonstration of fundamental physical phenomena and the development of physical intuition based on hands-on experience with equipment in exploring these physical phenomena. High accuracy of measurements and development of sophisticated laboratory techniques are not emphasized, but the crucial role of experimental inquiry in the development of physical theory and in the refinement of our knowledge of physical constants and the behavior and properties of matter necessary as a foundation for technological progress are stressed.
3. Problem solving sessions under the direction of the instructor using whatever portion of laboratory time remains after performance of the experiments.
4. In both lecture and laboratory, emphasis will be placed on the development of an understanding of physical principles, and on the development of the thinking skills necessary to analyze increasingly complex problems and select an appropriate set and sequence of physical principles to solve them. Rote memorization of "format" approaches to solve problems will typically be avoided.
5. Maximum use will be made, where appropriate, of the student's developing mathematical capabilities to increase the generality and transparency of the physical presentations. This will include, where essential, the heuristic introduction of certain mathematical techniques in advance of their treatment in the calculus course sequence. Gauss's law and other vector calculus treatments essential for Physics 2222 are examples.

Methods of Evaluation:

1. Substantial writing assignments, including:
    a. laboratory reports
    b. brief expositions as part of exams
2. Computational or non-computational problem-solving demonstrations, including:
    a. exams
    b. homework problems
    c. laboratory reports
    d. class discussions

Laboratory Category: Extensive Laboratory

Pre delivery criteria: All of the following criteria are met by this lab.

1. Curriculum development for each lab.
2. Published schedule of individual laboratory activities.
3. Published laboratory activity objectives.
4. Published methods of evaluation.
5. Supervision of equipment maintenance, laboratory setup, and acquisition of lab materials and supplies.

During laboratory activity of the laboratory: All of the following criteria are met by this lab.

1. Instructor is physically present in lab when students are performing lab activities.
2. Instructor is responsible for active facilitation of laboratory learning.
3. Instructor is responsible for active delivery of curriculum.
4. Instructor is required for safety and mentoring of lab activities.
5. Instructor is responsible for presentation of significant evaluation.

Post laboratory activity of the laboratory: All of the following criteria are met by this lab.

1. Instructor is responsible for personal evaluation of significant student outcomes (lab exercises, exams, practicals, notebooks, portfolios, etc.) that become a component of the student grade that cover the majority of lab exercises performed during the course.
2. Instructor is responsible for supervision of laboratory clean up of equipment and materials.

Supplemental Data:

TOP Code:	190200: Physics, General
SAM Priority Code:	E: Non-Occupational
Distance Education:	Not Applicable
Funding Agency:	Y: Not Applicable(funds not used)
Program Status:	1: Program Applicable
Noncredit Category:	Y: Not Applicable, Credit Course
Special Class Status:	N: Course is not a special class

Basic Skills Status:	N: Course is not a basic skills course
Prior to College Level:	Y: Not applicable
Cooperative Work Experience:	N: Is not part of a cooperative work experience education program
Eligible for Credit by Exam:	NO
Eligible for Pass/No Pass:	C: Pass/No Pass
Taft College General Education:	NONE