EL CAMINO COLLEGE
COURSE OUTLINE OF RECORD – Approved

I. Course Information

Subject:	**PHYS**
Course Number:	**1C**
Descriptive Title:	**Electricity and Magnetism**
Division:	**Natural Sciences**
Department:	**Physics**
Course Disciplines:	**Astronomy, Physics**

Catalog Description:
This course details the mathematical and physical description of Coulomb's Law, electric field and potential, Gauss's Law, DC circuit analysis with Ohm's Law and Kirchhoff's Law, AC circuit analysis with phase diagrams, elementary electronics, capacitance, magnetic fields and their effect on moving charges and currents, magnetic fields produced by various current configurations, induced emf, mutual and self-inductance, basic theory of dielectrics, magnetic properties of materials and Maxwell's Equations in integral and differential form.

Conditions of Enrollment:
Prerequisite: Physics 1A with a minimum grade of C and Mathematics 220 with a minimum grade of C or concurrent enrollment in Mathematics 220.

Course Length: Full Term

Hours Lecture (per week):	3
3Hours Laboratory (per week):	3
Outside Study Hours:	6
Total Hours:	108

Course Units:	4

Grading Method:	Letter Grade only
Credit Status:	Credit, degree applicable

Transfer CSU:	Yes	Effective Date: Prior to July 1992
Transfer UC:	Yes	Effective Date:

General Education:
ECC: Area 1 - Natural Sciences
Term: **Other:**

CSU GE: Area B1 - Physical Universe and its Life Forms: Physical Science,
Area B3 - Physical Universe and its Life Forms: Laboratory Activity
Term: **Other:**

IGETC: Area 5A - Physical Science
Term: **Other:**

II. Outcomes and Objectives

A. Student Learning Outcomes (SLOs) (The course student learning outcomes are listed below.)

SLO #1 Applying Relevant Principles
Students can recognize the basic physical principles which are relevant in a given physical situation involving electricity, magnetism or electromagnetism in order to correctly answer conceptual questions.

SLO #2 Solving Physics Problems
Students can identify and apply the relevant laws of physics along with the necessary mathematics to successfully solve a problem dealing with electricity, magnetism or electromagnetism.

SLO #3 Data Collection & Analysis
Students can read and record, with appropriate units and uncertainties, measurements taken from a multimeter and a voltmeter. Students can interpret and analyze that data, including error analysis.

B. Course Objectives (The major learning objective for in this course are listed below)

1. Solve problems using differential and/or integral calculus as well as elementary aspects of vector calculus, to include the "del" operator as applied to divergence, gradient, and curl calculation.
2. Solve multiple-loop circuit problems using Kirchhoff's rules.
3. Demonstrate the ability to explain physical phenomena involving electricity, magnetism, and electronics conceptually and/or qualitatively.
4. Demonstrate the ability to make meaningful measurements using basic mechanical and electrical measuring devices, manipulate the collected data using basic error theories, report on the outcome of the experiment, and explain the result physically.

III. Outline of Subject Matter

(Topics should be detailed enough to enable an instructor to determine the major areas that should be covered to ensure consistency from instructor to instructor and semester to semester.)

Major Topics

I. Direct Current (DC) CIRCUITS (9 hours, lecture)

A. Current and current density
B. Resistance and Resistivity
C. Electromotive Force (EMF)
D. Ohm's and Kirchhoff's laws
E. Power
F. Capacitors as circuit elements
G. Resistor Capactor (RC) and Resistor Inductor (RL) circuits

II. Alternating Current (AC) CIRCUITS (5 hours, lecture)

A. Reactance
B. Impedance
C. Complex numbers and phase diagrams
D. Ohm's and Kirchhoff's Laws with phasors
E. Power and power factor

III. ELECTRONICS (2 hours, lecture)

A. Positive Negative (PN) junction
B. Junction diode and transistors

IV. ELECTRIC FIELD (14 hours, lecture)

A. Coulomb's Law
B. Electric field
C. Calculation of E for various charge distributions
D. Gauss's Law
E. Electrical potential and potential energy
F. Capacitance and properties of dielectrics
G. Displacement current

V. MAGNETIC FIELD (18 hours, lecture)

A. Forces on moving charges
B. Current carrying conductors
C. Torque on a current loop
D. Magnetic Moment
E. Hall effect
F. Biot-Savart Law for charges and wire elements
G. Ampere's Law
H. Displacement currents and magnetic fields
I. Induced EMF
J. Lenz's Law
K. Eddy currents
L. Motors/generators
M. Self and mutual inductance
N. RLC circuits
O. Magnetic properties of matter

VI. MAXWELL'S EQUATIONS (6 hours, lecture)

A. Gradient
B. Divergence
C. Curl
D. Maxwell's equations
E. Wave equation
F. Poynting vector

VII. LABORATORY EXERCISES (54 hours, lab)

A. D.C. Circuits
B. Wheatstone Bridge
C. Oscilloscope and RLC Circuits
D. Vacuum Tubes
E. Transistors
F. Measurements of Capacitance
G. Electric Fields
H. Measurements of e/m for an Electron
I. Measurements of Earth's Magnetic Field

Total Lecture Hours:	54
Total Laboratory Hours:	54
Total Hours:	108

IV. Primary Method of Evaluation and Sample Assignments

A. Primary Method of Evaluation (choose one):

2) Problem solving demonstrations (computational or non-computational)

B. Typical Assignment Using Primary Method of Evaluation

A circuit draws 330 W from a 110 V rms, 60 Hz line. A power factor is 0.60, and the current lags voltage. a) Find the value of C, the series capacitor, that will cause the power factor to be 1. b) What power will then be drawn from the power supply?

C. College-level Critical Thinking Assignments

Critical Thinking Assignment 1:

Three identical small Styrofoam balls (m = 2.00) are suspended from a fixed point by three non-conducting threads, each with a length of 50.0 cm and negligible mass. At equilibrium the three balls form an equilateral triangle with sides of 30.0 cm. What is the common charge "q" carried by each ball? Show all calculations.

Critical Thinking Assignment 2:

A disk of radius R meters has a total charge Q coulombs uniformly distributed over its surface. Find the electric field on the axis of the disk at point P, a distance y meters above the disk. (Hint: Divide the disk into rings of infinitesimal width, dr, and find dq on a ring). Show all calculations.

D. Other Typical Assessment and Evaluation Methods

Class Performance, Homework Problems, Laboratory Reports, Multiple Choice, Objective Exam, Quizzes, Written Homework

V. Instructional Methods

Instructional Methods:
Demonstration, Discussion, Lab, Lecture

If other:

Note: In compliance with Board Policies 1600 and 3410, Title 5 California Code of Regulations, the Rehabilitation Act of 1973, and Sections 504 and 508 of the Americans with Disabilities Act, instruction delivery shall provide access, full inclusion, and effective communication for students with disabilities.

VI. Work Outside of Class

Answer questions, Problem solving activity, Required reading, Study

If Other:

VII. Texts and Materials

A. Up-to-date Representative Textbooks: (Please use the following format: Author, Title, Edition, Publisher, Year. If you wish to list a text that is more than 5 years old, please annotate it as a "discipline standard".)

Young and Freedman. University Physics. 15th Edition ed. Addison-Wesley, 2020.

Wilson. PHYSICS 1C Electricity Lab Manual. El Camino College Bookstore, 2008.

Qualifier Text: Discipline Standard,

B. Alternative Textbooks: (Please use the following format: Author, Title, Edition, Publisher, Year. If you wish to list a text that is more than 5 years old, please annotate it as a "discipline standard".)

C. Required Supplementary Readings

D. Other Required Materials

VIII. Conditions of Enrollment

A. Requisites (Course Prerequisites and Corequisites) Skills needed without which a student would be highly unlikely to succeed.

Requisite: Prerequisite

Category: sequential

Requisite course(s): List both prerequisites and corequisites in this box.
Physics-1A and Mathematics-220

Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).
Ability to identify forces on an object (free body diagram), and to determine their effect on the motion of the object.

PHYS 1A - Analyze physical problems in order to draw a free-body-diagram.

PHYS 1A - Recognize all the physical principles required to solve the problem.

Ability to determine errors introduced with any measurement, and their effect on the results.

PHYS 1A - Define and use the basic concepts and equations in error theory. Recognize when to use the different equations.

PHYS 1A - Solve mechanics problems utilizing differential or integral calculus for a variety of physical situations.

Ability to use graphical techniques to analyze data - experimental and theoretical.

PHYS 1A - Analyze data graphically using linear, semi log, and log-log scales.

Be practiced in identifying what is and is not important in a problem, drawing meaningful diagrams to aid in problem solving, and constructing mathematical models of physics problems.

PHYS 1A - Isolate and model the physical principle underlying each part of the problem.

Ability to set up and solve differential and integral equations.

PHYS 1A - Derive formulas describing physical phenomena using differential or integral calculus.

Ability to manipulate equations symbolically.
PHYS 1A - Combine and solve the system of equations for the problem.

Apply vector caclulus methods to solving electricity and magnetism problems.
MATH 220- Ability to understand and apply gradient, divergence, curl, line integrals, surface integrals, volume integrals, Stokes' Theorem, Gauss's Theorem and tangent planes to surfaces.

B. Requisite Skills: (Non-Course Prerequisite and Corequisites) Skills needed without which a student would be highly unlikely to succeed.
Requisite:
Requisite and Matching Skill(s): Bold the requisite skill(s). If applicable

C. Recommended Preparations (Course) (Skills with which a student's ability to succeed will be strongly enhanced.)
Requisite course:
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).

D. Recommended Preparation (Non-Course) (Skills with which a student's ability to succeed will be strongly enhanced.)
Requisite:
Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). If applicable

E. Enrollment Limitations
Enrollment Limitations and Category:
Enrollment Limitations Impact:

Course Created by: T. Wilson, G. Karpel, M. Lehman, J. Platts on Date: 02/01/1965

Original Board Approval Date:

Last Reviewed and/or Revised by: Susan Stolovy Date: 05/13/2021

Last Board Approval Date: 06/21/2021