I. GENERAL COURSE INFORMATION

Subject and Number: Physics 3B
Descriptive Title: General Physics with Calculus
Course Disciplines: Physics/Astronomy
Division: Natural Sciences

Catalog Description:
This course is a calculus-based survey of electricity, magnetism, light, geometric and physical optics, special relativity, and atomic and nuclear physics. This course is designed for life science majors requiring a calculus-based physics program.

Conditions of Enrollment:
Prerequisite: Physics 3A with a minimum grade of C

Course Length:	**X Full Term**	**Other (Specify number of weeks):**
Hours Lecture:	**4.00 hours per week**	**TBA**
Hours Laboratory:	**3.00 hours per week**	**TBA**
Course Units:	**5.00**	

Grading Method: Letter
Credit Status: Associate Degree Credit

Transfer CSU: X Effective Date: 12/08/1997
Transfer UC: X Effective Date: Fall 1998

General Education:

El Camino College:
1 – Natural Sciences
Term: Other:

CSU GE:
B1 - Physical Science
Term: Fall 1998 Other:
B3 - Laboratory Sciences
Term: Fall 1998 Other:

IGETC:
5A - Physical Science with Lab
Term: Fall 1999 Other:

II. OUTCOMES AND OBJECTIVES

A. COURSE STUDENT LEARNING OUTCOMES (The course student learning outcomes are listed below, along with a representative assessment method for each. Student learning outcomes are not subject to review, revision or approval by the College Curriculum Committee)

1. **Applying Relevant Principles**: Students can identify the physical principles which are relevant in a given physical situation involving electricity, magnetism, electromagnetism, optics or modern physics in order to correctly answer conceptual questions.
   Other exams
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, electromagnetism, optics or modern physics.
   Other exams
3. **Data Collection and Analysis**: Students can read and record, with appropriate units and uncertainties, measurements taken multimeter. Students can interpret and analyze that data, including error analysis.
   Laboratory Reports

B. Course Student Learning Objectives (The major learning objective for students enrolled in this course are listed below, along with a representative assessment method for each)

1. Derive relationships and properly set up differential and integral relationships involving basic concepts in physics.
   Other exams
2. Solve problems, at the level of general physics, requiring the use of elementary differential and integral calculus.
   Quizzes
3. Analyze physical problems in order to:
   a. recognize all the physical principles required to solve the problem,
   b. isolate and model the physical principle(s) underlying each part of the problem,
   c. formulate the equation(s) for each part,
   d. combine and solve the system of equations for the problem, and
   e. assess the physical reality of the result in terms of the data given, for a variety of physical situations involving simple electric circuits, electric and magnetic fields, behavior of charges in fields, geometrical optics, wave optics, and radioactive decay.
   Multiple Choice
4. Explain, conceptually and/or quantitatively, physical phenomena perhaps too difficult for realistic mathematical modeling at the level of trigonometry based physics.
   Written homework
5. Demonstrate the ability to:
   a. construct simple electrical and optical systems,
   b. make meaningful measurements using basic electrical and optical measuring devices such as ammeters, voltmeters, oscilloscopes, and spectrometers
   c. manipulate the collected data using basic error theories,
   d. report the outcome of the experiment, and
   e. explain the results physically.
   Laboratory reports

III. OUTLINE OF SUBJECT MATTER (Topics are detailed enough to enable a qualified instructor to determine the major areas that should be covered as well as ensure consistency from instructor to instructor and semester to semester.)

Lecture or Lab	Approximate Hours	Topic Number	Major Topic
Lecture	16	I	ELECTRICITY A. Electrification of Bodies, conductors and Insulators B. Coulomb's Law C. Electric Field D. Potential Difference E. Capacitance, Dielectrics F. Electrical Energy G. Resistance and Ohm's Law, Current, Electric Power H. Kirchhoff's Laws, Series and Parallel circuits, Analysis of an electric circuit I. Ammeters and voltmeters, Wheatstone Bridge, Potentiometer
Lecture	14	II	ELECTROMAGNETISM A. Magnetic Field B. Magnetic Force on a moving charge and Magnetic force on a current segment C. Measurement of the strength of a magnetic field D. Sources of Magnetic Field, Earth's Magnetism E. Induced EMF and Magnetic Flux, Meters, Motors, Generators, Back EMF and torque, Transformers F. Impedance of a coil, Series Resonance G. Cathode-Ray Tube, H. Power in an AC circuit, RMS values
Lecture	22	III	ELECTROMAGNETIC WAVES AND OPTICS A. Electromagnetic wave B. Radio C. Source of Radiation D. Huygens's Principle E. Reflection and Refraction F. Thin Lenses and Mirrors, Objects and Images - ray tracing G. Interference - grating and Michelson interferometer H. Polarization of light I. Camera-lens aberration, Human eye, Magnifier, Compound microscope, Telescope J. Spectroscope - prism and grating
Lecture	20	IV	RELATIVITY, ATOMIC STRUCTURE, AND NUCLEAR PHYSICS A. Time Dilation, Length Contraction, Mass increase, Mass and energy, Lorentz Transformation, Relative velocity B. Photoelectric effect C. Electron microscope D. Uncertainty Principle E. Wave Mechanics F. Atomic Structure, Emission Spectra, Bohr Theory for the Hydrogen Atom and its limitations

			G. Quantum Mechanics H. Coherent Light - laser I. Quantum Numbers, Electron Spin, Pauli Exclusion Principle, Periodic Table of the Elements J. X-rays, Nuclear Structure, Radioactive Decay K. Fission and Fusion L. Particle Accelerators, Colliding Beams, Cosmic Rays
Lab	54	V	LABORATORY WORK Choose from the following. Those marked with an asterisk (*) are mandatory. A. Reflection and Refraction of Light Rays (*) B. Curved Mirrors C. Thin Lenses (*) D. Young's Double Slit Experiment and Diffraction Grating (*) E. Polarization F. Electric Fields and Equipotentials (*) G. Capacitors (*) H. Batteries and Ohm's Law (*) I. Circuits in Series and Parallel (*) J. Magnetic Field K. Electric Motor and Faraday's Law (*) L. Oscilloscope
Total Lecture Hours		72	
Total Laboratory Hours		54	
Total Hours		126	

IV. PRIMARY METHOD OF EVALUATION AND SAMPLE ASSIGNMENTS

A. **PRIMARY METHOD OF EVALUATION:**
Problem solving demonstrations (computational or non-computational)

B. TYPICAL ASSIGNMENT USING PRIMARY METHOD OF EVALUATION:
Example of one of the problems:

Solve the following problem in the space provided:
A bird stands on an electric transmission line carrying 2500 Amperes. The line has $2.5 \times 10^{-5}\ \Omega$ resistance per meter and the bird's feet are 4.0 cm apart. What voltage does the bird feel?

C. COLLEGE-LEVEL CRITICAL THINKING ASSIGNMENTS:

1. Answer the following question in the space provided:
   How can you see a round drop of water on a table even though the water is transparent and colorless?

2. Answer the following question in the space provided:
   Suppose that the electron in an H-atom obeyed classical mechanics rather than quantum mechanics. Write an explanation of why such a hypothetical atom would emit a continuous spectrum rather than the observed line spectrum.

3. Answer the following questions in the space provided:
   A battery has an emf ξ and internal resistance r. A variable resistor R is connected across the terminals of the battery. Find the value of R such that

   a) the potential difference across the terminals is a maximum,
   b) the current in the circuit is a maximum, and
   c) the power delivered to the resistor is a maximum.

D. **OTHER TYPICAL ASSESSMENT AND EVALUATION METHODS:**
   Performance exams
   Other exams
   Quizzes
   Laboratory reports
   Class Performance
   Homework Problems
   Multiple Choice
   True/False

V. INSTRUCTIONAL METHODS

Demonstration
Laboratory
Lecture

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

Study
Answer questions
Required reading
Problem solving activities

Estimated Independent Study Hours per Week: 8

VII. TEXTS AND MATERIALS

A. **UP-TO-DATE REPRESENTATIVE TEXTBOOKS**
   Young and Freedman. University Physics. 14 ed. Pearson, 2016.
   Leonardo/Prieto. Physics 2B/3B Laboratory Manual. El Camino College, 2009. (Discipline Standard)

B. **ALTERNATIVE TEXTBOOKS**

C. **REQUIRED SUPPLEMENTARY READINGS**

D. **OTHER REQUIRED MATERIALS**

VIII. CONDITIONS OF ENROLLMENT

A. Requisites (Course and Non-Course Prerequisites and Corequisites)

Requisites	Category and Justification
Course Prerequisite Physics-3A	Sequential

B. Requisite Skills

Requisite Skills
Familiarity with calculus notation as applied to Newton's Laws, Energy, Fluids, and Heat. PHYS 3A - Solve problems, at the level of general physics, requiring the use of elementary differential calculus.
Ability to derive simple relationships and properly set-up differential and integral relationships involving basic concepts in calculus based physics. PHYS 3A - Analyze physical problems in order to: a. Recognize all the physical principles required to solve the problem, b. Isolate and model the physical principle(s) underlying each part of the problem, c. Formulate the equation(s) for each part, d. Combine and solve the system of equations for the problem, e. Assess the physical reality of the result in terms of the data given, for a variety of physical situations involving displacement, velocity, acceleration, center of mass, rotational inertia, rotational kinematics and dynamics, work, and impulse.
Ability to perform simple differentiations and integrations. PHYS 3A - Solve problems, at the level of general physics, requiring the use of elementary differential calculus.
Be practiced in i: identifying what is and is not important in a problem ii: drawing meaningful diagrams to aid in problem solving and iii: constructing mathematical models of physics problems involving Newton's Laws, Energy, Fluids, and Heat. PHYS 3A - Explain conceptually and/or quantitatively, physical phenomena at the level of Physics 3A.
Experience reporting the outcome of an experiment and analyzing the collected data using basic error theories PHYS 3A - Manipulate collected data using basic error theories. PHYS 3A - Report the outcome of an experiment and explain the results physically.

C. Recommended Preparations (Course and Non-Course)

Recommended Preparation	Category and Justification

D. Recommended Skills

Recommended Skills

E. Enrollment Limitations

Enrollment Limitations and Category	Enrollment Limitations Impact

Course created by Leon Leonardo on 09/01/1997.

BOARD APPROVAL DATE: 12/08/1997

LAST BOARD APPROVAL DATE: 01/22/2019

Last Reviewed and/or Revised by: Susan Stolovy **Date:** Sept. 29, 2018

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