I. GENERAL COURSE INFORMATION

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

Catalog Description:
This course is part of a one year general survey of the basic principles of physics including kinematics, dynamics, statics, momentum, energy, rotation, gravitation, and planetary motion. Elasticity, fluids, vibration, wave motion, sound, the kinetic theory of gases and thermodynamics will also be discussed. This course is designed for life science majors requiring a calculus-based physics program.

Conditions of Enrollment:
Prerequisite: Mathematics 160 or Mathematics 190 with a minimum grade of C in prerequisite

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: 05/19/1997
Transfer UC: X Effective Date: Fall 1997

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

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

IGETC:
5A - Physical Science with Lab
Term: Fall 1998 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 mechanics, heat, fluids or sound 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 mechanics problem.
   Other exams
3. **Data Collection and Analysis**: Students can read and record, with appropriate units and uncertainties, measurements taken from a Vernier caliper and a micrometer caliper. 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. Solve problems, at the level of general physics, requiring the use of elementary differential calculus.
   Written homework

2. 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.
   Other (specify)
   Problem-solving exams

3. Explain conceptually and/or quantitatively, physical phenomena at the level of Physics 3A.
   Homework Problems

4. Construct simple mechanical systems.
   Laboratory reports

5. Utilize basic mechanical measuring devices to make meaningful measurements.
   Laboratory reports

6. Manipulate collected data using basic error theories.
   Laboratory reports

7. Report the outcome of an experiment and 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	14	I	KINEMATICS A. Uniform motion in a straight line B. Average and instantaneous velocity C. Uniform accelerated motion D. Acceleration due to gravity E. Vectors F. Relative velocity G. Projectile Motion
Lecture	22	II	DYNAMICS A. Forces B. Equilibrium C. Newton's Three Laws of Motion D. Uniform Circular Motion E. Gravitation and Planetary Motion F. Work Done by a Constant or Variable Force G. Potential and Kinetic Energy H. Momentum and Collisions I. Power J. Torque and Rotational Dynamics K. Angular Momentum
Lecture	9	III	SOLIDS AND FLUIDS A. States of Matter B. Elastic properties C. Density and Pressure D. Buoyancy E. Fluids in motion F. Bernoulli's equation G. Viscosity
Lecture	13	IV	THERMODYNAMICS A. Temperature and temperature scales B. Thermal expansion C. Internal energy D. Heat and Work E. The First Law of Thermodynamics F. Specific Heat Capacity G. The Ideal Gas Law H. Conservation of Energy I. Latent Heat J. Heat Transfer by Conduction, Convection, and Radiation
Lecture	9	V	VIBRATIONS AND WAVES A. Simple Harmonic Motion B. Waves and Disturbances C. Longitudinal and Transverse Waves D. Sinusoidal Waves

			E. Superposition F. Interference G. Resonance Phenomena H. Vibrating Strings
Lecture	5	VI	SOUND A. Physical Origin of Sound B. Beats C. Doppler Effect D. Vibrating Air Columns
Lab	54	VII	LABORATORY WORK Choose from the following. Those marked with an asterisk (*) are mandatory. A. Measurements (*) B. Graphs of Velocity, Acceleration, and Displacement vs. time (*) C. Newton's Second Law (*) D. Vector Quantities and the Force Table (*) E. Simple Machines F. Ballistic Pendulum (*) G. Center of Gravity and Rotational Equilibrium (*) H. Uniform Circular Motion I. Simple Harmonic Motion and Hooke's Law J. Acceleration Due to Gravity and Terminal Velocity K. Kinetic Friction L. Density and Archimedes' Principle (*) M. Coefficient of Linear Expansion N. Specific Heat O. Heat of Fusion, Vaporization, and Sublimation P. Standing Waves in Strings (*) Q. Velocity of Sound in Air by Resonance
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:
Read the chapter on Newton's laws in your text. For homework, following the format learned in class, solve the following problems. The assignment will be submitted on your own paper stacked together and stapled in the upper left corner. (8-10 problems selected by the instructor; each problem typically takes 20 to 50 minutes for the average student.)
Examples of the problems are:

1. A plumb bob hangs from the roof of a passenger car. (a) Find the angle of inclination of the cord with the vertical when the car has a forward acceleration of 1.3 m/s^2. (b) What is the general expression for the angle when the acceleration is *a*?

2. You are standing on a bathroom scale in an elevator in a tall building. The speed of the elevator varies with time according to the equation $v(t) = (3.0m / s^2)t + (0.20m / s^3)t^2$. What weight in pounds would the scale read at t = 3.00 s?

C. COLLEGE-LEVEL CRITICAL THINKING ASSIGNMENTS:

1. Following the format learned in class, solve the following problem. Include free-body diagrams for each of the masses.
   Block B, with mass m_B, rests on the top of block A, with mass m_A. The coefficient of kinetic friction between block A and the horizontal surface on which it moves is μ_k, and the coefficient of static friction between block A and block B is μ_{st}. The combination is dragged along a level surface by a horizontal force F applied to block A.
   (a) Determine the maximum force F that can be applied if both blocks travel together.
   (b) Determine the force F if the blocks move at constant velocity.
   (see attached files)

2. Following the format learned in class, solve the following problem. Include diagrams illustrating both the initial and final situations.
   A solid, uniform ball rolls without slipping up a hill. The initial speed of the ball at the bottom of the hill is V and the height of the hill is H. At the top of the hill the ball rolls horizontally before falling off a vertical cliff. (a) How far(X) from the foot of the cliff does the ball land and what is its speed just before it lands? (b) What is the net change in the translational kinetic energy of the ball during this process? (c) Is your result from (b) consistent with conservation of mechanical energy? Explain in clearly written sentences.
   (see attached files)

D. OTHER TYPICAL ASSESSMENT AND EVALUATION METHODS:

Performance exams
Other exams
Quizzes
Laboratory reports
Class Performance
Homework Problems
Multiple Choice
(specify): Written problems requiring several steps in their solution; 3 or 4 in an hour-long exam.

V. INSTRUCTIONAL METHODS

Demonstration
Discussion
Group Activities
Laboratory
Lecture
Multimedia presentations

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. 14th ed. Pearson, 2016.
Physics Faculty. Physics 2A/3A Laboratory Manual. El Camino College, 2007. (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 Mathematics-160 or	Standard Requisite
Course Prerequisite Mathematics-190	Standard Requisite

B. Requisite Skills

Requisite Skills
Determine the slope of the tangent to a curve by using the "delta process" and be able to define the derivative of a function in words and symbols. MATH 190 - Evaluate limits of functions symbolically, graphically, and numerically, and describe the continuity/discontinuity of a function. MATH 160 - Find the derivative of functions using the limit definition of the derivative.
Answer questions relating to slopes of straight lines and determine equations of lines. MATH 190 - Evaluate limits of functions symbolically, graphically, and numerically, and describe the continuity/discontinuity of a function. MATH 160 - Find the derivative of functions using the limit definition of the derivative.
Find the derivatives of algebraic functions and relations using the rules for products, quotients, powers, implicit differentiation, and the chain rule. MATH 190 - Calculate derivatives of algebraic and transcendental functions symbolically using rules and using the definition of the derivative, as well as estimating derivatives graphically and numerically. MATH 160 - Find the derivative of algebraic, exponential and logarithmic functions using basic rules of differentiation, including the power rule, the product rule, the quotient rule, and the chain rule. MATH 160 - Find derivatives using implicit differentiation.

When given a function F, determine, if possible a function whose derivative is F through the process of antidifferentiation. MATH 190 - Anti-differentiate functions, using the method of substitution when appropriate. MATH 160 - Find indefinite integrals by using the basic rules of integration and integration by substitution.
Find the area under a curve by approximating with rectangles, by the limit process, and by the Fundamental Theorem of Integral Calculus. MATH 190 - Calculate definite integrals, both using evaluating the limit of Riemann sums and using the fundamental theorem of calculus. MATH 160 - Use the Fundamental Theorem of Calculus to find areas between curves.
Solve simple, separable, differential equations. MATH 190 - Anti-differentiate functions, using the method of substitution when appropriate. MATH 160 - Find indefinite integrals by using the basic rules of integration and integration by substitution.

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 02/01/1997.

BOARD APPROVAL DATE: 05/19/1997

LAST BOARD APPROVAL DATE: 01/22/2019

Last Reviewed and/or Revised by: Susan Stolovy **Date:** Sept. 28 2018

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