PHYS R121: PHYSICS WITH CALCULUS 1

Originator
jwmiller

College
Oxnard College

Discipline (CB01A)
PHYS - Physics

Course Number (CB01B)
R121

Course Title (CB02)
Physics with Calculus 1

Banner/Short Title
Physics with Calculus 1

Credit Type
Credit

Start Term
Fall 2021

Catalog Course Description
This course is an introduction to classical mechanics and thermal physics. Topics include vectors, motion, force, energy, heat, fluids, waves, and sound. The laboratory provides students with opportunities to learn and apply the scientific method through investigations of the phenomena discussed in lecture. It also introduces students to methods of computer-assisted data analysis. The course is designed to meet the needs of students majoring in the biological sciences, although it may also be suitable for students in certain other majors. It is not appropriate for students planning to major in fields such as engineering, mathematics, the physical sciences, or computer science.

Taxonomy of Programs (TOP) Code (CB03)
1902.00 - Physics, General

Course Credit Status (CB04)
D (Credit - Degree Applicable)

Course Transfer Status (CB05) (select one only)
A (Transferable to both UC and CSU)

Course Basic Skills Status (CB08)
N - The Course is Not a Basic Skills Course

SAM Priority Code (CB09)
E - Non-Occupational

Course Cooperative Work Experience Education Status (CB10)
N - Is Not Part of a Cooperative Work Experience Education Program

Course Classification Status (CB11)
Y - Credit Course

Educational Assistance Class Instruction (Approved Special Class) (CB13)
N - The Course is Not an Approved Special Class

Course Prior to Transfer Level (CB21)
Y - Not Applicable

Course Noncredit Category (CB22)
Y - Credit Course

Funding Agency Category (CB23)
Y - Not Applicable (Funding Not Used)

Course Program Status (CB24)
1 - Program Applicable

General Education Status (CB25)
Y - Not Applicable

Support Course Status (CB26)
N - Course is not a support course

Field trips
Will not be required

Grading method
Letter Graded

Does this course require an instructional materials fee?
No

Repeatable for Credit
No

Is this course part of a family?
No

Units and Hours

Carnegie Unit Override
No

In-Class

Lecture
Minimum Contact/In-Class Lecture Hours
70
Maximum Contact/In-Class Lecture Hours
70

Activity

Laboratory
Minimum Contact/In-Class Laboratory Hours
52.5
Maximum Contact/In-Class Laboratory Hours
52.5

Total in-Class

Total in-Class
Total Minimum Contact/In-Class Hours
122.5
Total Maximum Contact/In-Class Hours
122.5

Outside-of-Class

Internship/Cooperative Work Experience

Paid

Unpaid

Total Outside-of-Class

Total Outside-of-Class
Minimum Outside-of-Class Hours
140
Maximum Outside-of-Class Hours
140

Total Student Learning

Total Student Learning
Total Minimum Student Learning Hours
262.5
Total Maximum Student Learning Hours
262.5

Minimum Units (CB07)
5
Maximum Units (CB06)
5

Prerequisites
MATH R120

Entrance Skills

Entrance Skills
Students are expected to understand aspects of Calculus used in class to derive expressions and to make connections between graphical analyses and derivatives/integrals. Students are also expected to make use of Calculus throughout the class regarding definitions of quantities and problem solving.

Prerequisite Course Objectives
MATH R120-Find the derivative of a function as a limit
MATH R120-Find the equation of a tangent line to a function
MATH R120-Compute derivatives using differentiation formulas
MATH R120-Use differentiation to solve applications such as related rate problems and optimization problems
MATH R120-Use implicit differentiation
MATH R120-Evaluate a definite integral as a limit
MATH R120-Evaluate integrals using the Fundamental Theorem of Calculus

Requisite Justification

Requisite Type
Prerequisite

Requisite
MATH R120

Requisite Description
Course not in a sequence

Level of Scrutiny/Justification
Required by 4 year institution

Student Learning Outcomes (CSLOs)

	Upon satisfactory completion of the course, students will be able to:
1	Calculate the acceleration produced on a given mass by consulting a force diagram.
2	Determine the centripetal force exerted on a mass rotating about a fixed axis.
3	Construct a graph of average velocities with respect to their corresponding time intervals and use the graph to determine the constant gravitational acceleration undergone by a mass in freefall.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1	Draw a diagram or cartoon that clearly and usefully depicts the salient features and characteristics of a mechanical or thermodynamic system, and is labeled or annotated so that known and unknown quantities can readily be determined by examination of the diagram and other written information that accompanies it.
2	Analyze a simple mechanical or thermodynamic system to identify applicable principles (e.g., conservation laws) that may be used to predict the future behavior or evolution of the system.
3	Solve conceptual and numerical problems related to the behavior or evolution of a mechanical or thermodynamic system by applying those principles identified above.
4	Employ appropriate mathematical tools, up to and including elementary derivatives and integrals, to solve a variety of equations encountered in the study of physics, including geometric/graphical approaches, approximation techniques, and/or numerical methods.
5	Apply the techniques listed in items A through D above to simple mechanical or thermodynamic problems involving biological systems (e.g., cells, muscles, blood vessels, etc.).
6	Argue for or against a scientific hypothesis, supporting his/her conclusions by describing how various physical principles might apply to a novel situation.
7	Identify the names and major contributions of notable historical and present-day physicists whose work has expanded humankind's understanding of mechanical and thermodynamic systems.

Course Content

Lecture/Course Content
Lecture topics:

1. Review of mathematics
   a. Significant figures and scientific notation
   b. Cartesian and polar geometry
   c. Summation and delta notations
   d. Algebra and trigonometry
   e. Problem solving strategies
   f. Limits, derivatives, integrals
2. The nature of physics
   a. Standards of mass, length, time, temperature (SI and others)
   b. Dimensions, units (base and derived), and unit conversions (dimensional analysis)
   c. Building blocks and forms of matter
3. Kinematics
   a. One dimensional motion: Variables, graphs, constant acceleration, free fall
   b. Two dimensional motion: Vectors and scalars, projectiles, trajectories
4. Classical dynamics
   a. Forces and Newton's laws
   b. Common forces: Weight, normal force, friction, elastic force, centripetal force
   c. Statics and equilibrium
5. Work and energy
   a. Definition of work (constant and varying forces)
   b. Kinetic energy and the work energy theorem
   c. Conservative forces: Potential energy, definition and conservation of mechanical energy

   d. Non conservative forces: Reexamination of work energy theorem and conservation of energy
   e. Power and work
6. Momentum
   a. Definition of momentum and impulse
   b. Conservation of momentum
   c. Elastic and inelastic collisions in one and two dimensions
7. Rotational motion
   a. Rotational kinematics: Angular variables, constant acceleration, relation to linear variables, centripetal acceleration
   b. Rotational dynamics: Centripetal force, torque, equilibrium, moment of inertia, definitions of angular momentum and rotational kinetic energy
   c. Conservation of angular momentum
   d. (As time permits) Application to planetary motion: Newton's law of universal gravitation, Kepler's laws
8. States of matter
   a. Solids: Density, elastic moduli, and stress and strain
   b. Fluids at rest: Density, pressure, Pascal's principle, elastic moduli, buoyant forces and Archimedes' principle
   c. Fluids in motion: Continuity, Bernoulli's equation (ideal fluid)
   d. (As time permits) Surface tension, capillary action, viscosity, Reynolds number
9. Elasticity, vibrations, and wave motion
   a. Hooke's law and simple harmonic motion: Elastic potential energy, kinematic relations, the simple pendulum
   b. Waves (general): Parameters, wave types, waves on a string, superposition, interference, reflection
   c. Sound waves: Production, characterization, speed, energy, intensity, Doppler effect, interference, standing waves, forced vibrations, resonance, beats, sound quality, the human ear
10. Thermal physics
   a. Temperature, temperature scales, and thermometers
   b. Thermal expansion of solids and liquids
   c. Ideal gases: Macroscopic definition, Avogadro's number, ideal gas law, kinetic theory
   d. Heat, energy, and work: Mechanical equivalent of heat, conservation of energy, specific heat
   e. Phase changes and latent heat
   f. Heat transfer: Conduction, convection, radiation
   g. Laws of thermodynamics
      i. The first law: work, heat, and internal energy
      ii. The second law: Heat engines, heat pumps, reversibility, Carnot cycle, entropy and disorder

Laboratory topics (typical):

1. Experimental uncertainty (error) and data analysis, including least-squares linear regression and computation of mean and standard deviation
2. Computer analysis of data
3. Measuring the height of a flagpole
4. The scientific method: The simple pendulum
5. Uniformly accelerated motion
6. The addition and resolution of vectors
7. Newton's second law: The Atwood machine
8. Conservation of linear momentum
9. Projectile motion: The ballistic pendulum
10. Centripetal force
11. Friction
12. Simple machines: Mechanical advantage and efficiency
13. Torques, equilibrium, and center of gravity
14. Hooke's law and simple harmonic motion
15. Archimedes' principle: Buoyancy and density
16. Air column resonance: The speed of sound in air
17. The thermal coefficient of linear expansion

Laboratory or Activity Content

1. Each week there will be a lab in which the students investigate current course materials by employing various equipment and methods to further verify the foundation for the laws of physics in a hands on setting. The students will be responsible for setting up equipment, gathering data, and drawing conclusions given detailed instruction. The lab will include a student report on the methods, observations, and conclusions regarding the experiment and theory.

The Labs to be considered are as follows:

1. Experimental Uncertainty and Data Analysis
2. Measurement Instruments
3. Uniformly Accelerated Motion
4. Projectile Motion
5. The Addition and Resolution of Vectors
6. The Atwood Machine
7. Friction
8. Work and Energy
9. Conservation of Linear Momentum
10. Centripetal Force
11. Torque and Equilibrium
12. Simple Harmonic Motion
13. Standing Waves
14. Air Column Resonance
15. Specific Heat of Metals
16. Archimedes' Principle

Methods of Evaluation

Which of these methods will students use to demonstrate proficiency in the subject matter of this course? (Check all that apply):

Problem solving exercises
Written expression

Methods of Evaluation may include, but are not limited to, the following typical classroom assessment techniques/required assignments (check as many as are deemed appropriate):

Computational homework
Essays
Laboratory activities
Laboratory reports
Objective exams
Problem-Solving Assignments
Problem-solving exams
Quizzes

Instructional Methodology

Specify the methods of instruction that may be employed in this course

Computer-aided presentations
Distance Education
Demonstrations
Instructor-guided interpretation and analysis
Laboratory activities
Lecture
Small group activities

Describe specific examples of the methods the instructor will use:

1. Computer aided presentation: The instructor may employ the computer to aid in the presentation of course materials which would include simulations of specific phenomena such as traveling waves and computerized graphical representations of aspects of a system such as changes in velocity.
2. Demonstrations: The instructor will demonstrate physical principles by employing equipment and other items such as catapults, oscillators, balls, and force tables. For instance, when studying projectile motion, launching a ball out of a catapult would be used so that students see the parabolic trajectory of the ball as well as other notions regarding projectile motion.
3. Distance Education (Lecture): When applicable, recordings of lectures will be used to convey subject matter. Also, the use of discussion boards and virtual meeting will be used to allow students to ask questions regarding the course and its material.
4. Distance Education (Lab): Laboratory activities, as noted below, will take place in a virtual setting. The experiments will be tailored to utilize computer simulations, prerecorded data acquisition, live online meetings, and message boards where questions can be asked and answered.
5. Instructor guided analysis: The instructor will work through physics problems during lecture that investigate a given system in which the students will follow along, answering questions posed by the instructor. This will also serve as a forum for students to ask particular questions regarding the logic and methods employed to come to certain conclusions regarding said problem/system.

6. Laboratory activities: Each week the students will preform an laboratory experiment investigating certain aspects of a system that has been discussed in lecture. These experiments will direct the students such that the intricacies of a given system are explored and compared to theoretical expectations. For instance, in the projectile motion lab students will launch a projectile and make measurements of displacements and time intervals to determine the initial velocity of the system. Results are then compared to the theory covered in class regarding projectile motion.
7. Lecture: The instructor will deliver the course subject matter via in person lectures to the students. For example, a lecture on Newton's Laws of Motion.
8. Small group activities (Lecture): These may be employed in the form of group quizzes where students work together in small groups to solve some physics problems regarding current material.
9. Small group activities (Lab): The students will work in small groups while preforming the experiments where applicable.

Representative Course Assignments

Writing Assignments

1. The homework includes conceptual questions, generally related to the physical principles discussed in the course, that require short-essay style responses to explain an issue or to justify or refute phenomena; for example, a question may ask a student how he/she would rule if he/she were a judge in a case involving a traffic accident, based on the claims of witnesses to the accident combined with known physical principles that would support or contradict the testimony.
2. Students may complete written reports of their participation in campus or community activities related to physics.
3. Laboratory reports, including a brief interpretation of experimental results, answers to conceptual questions from the laboratory manual, and/or a conclusion describing how (or whether) the experimental results supported theoretical principles, typically assigned weekly.

Critical Thinking Assignments

1. Answering a wide array of homework, quiz, and exam questions requiring the analysis of a given physical system or circumstance in order to come to the correct conclusion and/or answer regarding the question and/or desired outcome. For instance: Driving down the road at a constant rate of 20 m/s, you see that a large tree branch is breaking off of a tree. The tree is 35 m away from the front of your car and the branch is 15 m high relative to your car as it begins to fall. Your car has a length of 3.0 m can accelerate forward at a rate of 1.5 m/s^2 or slow down at a rate of 3.0 m/s^2. To avoid being hit by the branch should you speed up, slow down, or continue at a constant rate for the safest result? Justify your answer.

Reading Assignments

1. Regular textbook readings that reinforce the concepts discussed or demonstrated during the class meetings; these readings generally include theory and principles, descriptions of the results of important experiments, data tables, definitions, problem-solving examples, and practical applications of physics in everyday life and in specialized environments.

Skills Demonstrations

None

Other assignments (if applicable)

None

Outside Assignments

Representative Outside Assignments

1. Assigned reading from the textbook typically amounting to one chapter a week. This will amount to 2 hours per week of reading.
2. Assigned conceptual and problem solving based homework that further investigates and explores the notions and theories discussed throughout the course. Typically, homework sets will require 6 hours to fully complete and will be due on a weekly basis.
3. Studying and preparing for quizzes and exams.

Articulation

Comparable Courses within the VCCCD

PHYS V03A - General Physics I: Calculus-Based
PHYS V03AL - General Physics I Laboratory: Calculus-Based

District General Education

A. Natural Sciences

B. Social and Behavioral Sciences

C. Humanities

D. Language and Rationality

E. Health and Physical Education/Kinesiology

F. Ethnic Studies/Gender Studies

CSU GE-Breadth

Area A: English Language Communication and Critical Thinking

Area B: Scientific Inquiry and Quantitative Reasoning

Area C: Arts and Humanities

Area D: Social Sciences

Area E: Lifelong Learning and Self-Development

Area F: Ethnic Studies

CSU Graduation Requirement in U.S. History, Constitution and American Ideals:

IGETC

Area 1: English Communication

Area 2A: Mathematical Concepts & Quantitative Reasoning

Area 3: Arts and Humanities

Area 4: Social and Behavioral Sciences

Area 5: Physical and Biological Sciences

Area 6: Languages Other than English (LOTE)

Textbooks and Lab Manuals

Resource Type
Textbook

Description
Serway & Jewett (2013). *Principles of Physics, A Calculus-Based Text* (5th). Boston, Brooks-Cole.

Resource Type
Manual

Description
Miller, J.W. (2020). *Physics Lab Experiments*. Oxnard College, Justin Miller.

Resource Type
Other Resource Type

Description
Supplemental handouts on selected topics prepared by the instructor..

Distance Education Addendum

Definitions

Distance Education Modalities
Hybrid (51%–99% online)
Hybrid (1%–50% online)
100% online

Faculty Certifications

Faculty assigned to teach Hybrid or Fully Online sections of this course will receive training in how to satisfy the Federal and state regulations governing regular effective/substantive contact for distance education. The training will include common elements in the district-supported learning management system (LMS), online teaching methods, regular effective/substantive contact, and best practices.
Yes

Faculty assigned to teach Hybrid or Fully Online sections of this course will meet with the EAC Alternate Media Specialist to ensure that the course content meets the required Federal and state accessibility standards for access by students with disabilities. Common areas for discussion include accessibility of PDF files, images, captioning of videos, Power Point presentations, math and scientific notation, and ensuring the use of style mark-up in Word documents.
Yes

Regular Effective/Substantive Contact

Hybrid (1%–50% online) Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Other DE (e.g., recorded lectures)	The students will watch recorded lecture videos that go over the pertinent subject matter of the course.
Synchronous Dialog (e.g., online chat)	The students will join live, online meetings in which they will receive instruction, be reminded of all upcoming assignments/events, and be allowed to ask questions pertaining to the lecture and lab material. Recordings will be made available of all live meetings. Students may also be put into small groups to discuss a given class material.
Asynchronous Dialog (e.g., discussion board)	Students will have access to a discussion board in which they can ask questions regarding the course material.
Face to Face (by student request; cannot be required)	Face to face meetings can be arranged when needed.
Other DE (e.g., recorded lectures)	Recordings of data acquisition and/or simulation use regarding a given lab experiment may be used.

Hybrid (51%–99% online) Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Other DE (e.g., recorded lectures)	The students will watch recorded lecture videos that go over the pertinent subject matter of the course.
Synchronous Dialog (e.g., online chat)	The students will join live, online meetings in which they will receive instruction, be reminded of all upcoming assignments/events, and be allowed to ask questions pertaining to the lecture and lab material. Recordings will be made available of all live meetings. Students may also be put into small groups to discuss a given class material.
Asynchronous Dialog (e.g., discussion board)	Students will have access to a discussion board in which they can ask questions regarding the course material.
Face to Face (by student request; cannot be required)	Face to face meetings can be arranged when needed.

Other DE (e.g., recorded lectures)	Recordings of data acquisition and/or simulation use regarding a given lab experiment may be used.

100% online Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Other DE (e.g., recorded lectures)	The students will watch recorded lecture videos that go over the pertinent subject matter of the course.
Synchronous Dialog (e.g., online chat)	The students will join live, online meetings in which they will receive instruction, be reminded of all upcoming assignments/events, and be allowed to ask questions pertaining to the lecture and lab material. Recordings will be made available of all live meetings. Students may also be put into small groups to discuss a given class material.
Asynchronous Dialog (e.g., discussion board)	Students will have access to a discussion board in which they can ask questions regarding the course material.
Other DE (e.g., recorded lectures)	Recordings of data acquisition and/or simulation use regarding a given lab experiment may be used.

Examinations

Hybrid (1%–50% online) Modality
Online
On campus

Hybrid (51%–99% online) Modality
Online
On campus

Primary Minimum Qualification
PHYSICS/ASTRONOMY

Review and Approval Dates

Department Chair
09/02/2020

Dean
09/02/2020

Technical Review
09/23/2020

Curriculum Committee
09/23/2020

Curriculum Committee
11/25/2020

CCCCO
MM/DD/YYYY

Control Number
CCC000034708

DOE/accreditation approval date
MM/DD/YYYY