PHYS R131: PHYSICS FOR SCIENTISTS AND ENGINEERS 1

Originator
jwmiller

College
Oxnard College

Discipline (CB01A)
PHYS - Physics

Course Number (CB01B)
R131

Course Title (CB02)
Physics for Scientists and Engineers 1

Banner/Short Title
Science/Engineering Physics 1

Credit Type
Credit

Start Term
Fall 2021

Catalog Course Description
This course is an introduction to the statics and dynamics of rigid bodies and ideal fluids. Central topics include Newton's laws; conservation of energy, linear momentum, and angular momentum; equilibrium of rigid bodies; and oscillatory motion. Although the course emphasizes conceptual understanding, students also learn to apply mathematical techniques such as vector algebra, differential and integral calculus, Taylor series, and linear differential equations to the solution of problems. The laboratory provides students with opportunities to learn and apply the scientific method through investigations of the phenomena discussed in lecture. The course is appropriate for students majoring in the physical sciences, engineering, mathematics, computer science, and related fields.

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
265.5
Total Maximum Student Learning Hours
265.5

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

Prerequisites
MATH R120

Advisories on Recommended Preparation
PHYS R101

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-Graph functions using methods of calculus
MATH R120-Evaluate a definite integral as a limit
MATH R120-Evaluate integrals using the Fundamental Theorem of Calculus

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Entrance Skills
It is recommended that students have had some exposure to the subject and understand the basic concept of modeling the behavior of a given physical system. While not required, it is helpful regarding student success for an elementary physics course to have been taken previous to PHYS R131 as this course is much more indepth.

Prerequisite Course Objectives
PHYS R101-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.

PHYS R101-Solve conceptual and numerical problems related to the behavior or evolution of a mechanical or thermodynamic system by applying those principles identified above.
PHYS R101-Employ appropriate mathematical tools to solve a variety of equations encountered in the study of physics, including geometric/graphical approaches, approximation techniques, and/or numerical methods.
PHYS R101-Argue for or against a scientific hypothesis, supporting their conclusions by describing how various physical principles might apply to a novel situation.

Requisite Justification

Requisite Type
Prerequisite

Requisite
MATH R120

Requisite Description
Course not in a sequence

Level of Scrutiny/Justification
Required by 4 year institution

Requisite Type
Advisory

Requisite
PHYS R101

Requisite Description
Course in a sequence

Level of Scrutiny/Justification
Content review

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 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 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 system by applying those principles identified above.
4	Employ appropriate mathematical tools, up to and including differential and integral calculus, Taylor series, and linear differential equations, to solve a variety of equations encountered in the study of physics, including geometric/graphical approaches, approximation techniques, and/or numerical methods.
5	Argue for or against a scientific hypothesis, supporting his/her conclusions by describing how various physical principles might apply to a novel situation.

6	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. Measurement systems and dimensional analysis
   a. International System (SI)
   b. English (traditional) units
   c. Unit conversions
2. Vectors and vector algebra
   a. Comparison of vectors and scalars
   b. Comparison of and conversion between rectangular form (components) and polar form (magnitude and direction)
   c. Unit vectors
   d. Addition and multiplication (scalar and vector products)
3. Kinematics
   a. Position and displacement
   b. Average and instantaneous velocity and speed
   c. Variable and constant (including free-fall) acceleration
   d. Use of vectors to describe two- and three-dimensional motion
      i. Projectile motion
      ii. Uniform circular motion
      iii. Relative motion
4. Newton's laws of motion and law of universal gravitation
   a. Force, mass, and acceleration
   b. Friction and drag forces
   c. Centripetal forces and uniform circular motion
   d. Fundamental forces of nature
   e. Universal gravitation, the gravitational constant, and “weighing” the Earth by finding G
   f. Gravitation of the Earth: inside the surface, near the surface, and far from the surface
   g. Application of Kepler's laws to planets and satellites
   h. Equivalence principle of gravity and acceleration
5. Work, kinetic energy, and power
   a. Work performed by constant and variable forces
   b. Work performed by a spring
   c. Kinetic energy
   d. Power
6. Potential energy, internal energy, and conservation of total energy
   a. Work and potential energy
      i. Determining potential energy
      ii. Using a potential energy curve
   b. Mechanical energy
   c. Conservative and nonconservative forces
   d. Work performed by frictional forces
   e. Conservation of total energy
7. Conservation of linear momentum
   a. Systems of particles and center of mass
   b. Linear momentum of a single particle and of a system of particles
   c. Restatement of Newton's second law in terms of linear momentum
   d. Conservation of linear momentum
   e. Applications to elastic/inelastic collisions in one and two dimensions, rockets, and other systems
8. Rotational motion and conservation of angular momentum
   a. Rotational kinematics and relations between linear and angular variables
   b. Rotational kinetic energy
   c. Rotational inertia (scalar moment of inertia)
   d. Torque and the application of Newton's second law to rotation

   e. Rotational work and power
   f. Rolling systems
   g. Definition and computation of angular momentum for a rigid body rotating about a fixed axis
   h. Conservation of angular momentum
9. Systems in static and dynamic equilibrium
   a. Equilibrium
   b. Center of gravity
   c. Indeterminate structures
   d. Elasticity and deformations
10. Oscillations and simple harmonic motion
    a. Force laws, particularly Hooke's law
    b. Energy considerations
    c. Angular oscillations and pendulums
    d. Simple harmonic motion and uniform circular motion
    e. Damped oscillators
    f. Forced oscillators
11. Mechanics of ideal fluids
    a. Definition of a fluid
    b. Density and pressure
    c. Fluid statics
    d. Pascal's principle and Archimedes' principle
    e. Fluid dynamics
       i. Streamlines and continuity
       ii. Bernoulli's equation
       iii. Flow of real fluids

Laboratory or Activity Content

Labs will include detailed investigations of typical physical systems. Written reports for the labs will include explanations of the theory, the set up, the procedure, data and observations, graphs, and conclusions based on the results.

Labs to be completed:

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. Uniformly accelerated motion
4. The addition and resolution of vectors
5. Newton's second law: The Atwood machine
6. Conservation of linear momentum
7. Projectile motion: The ballistic pendulum
8. Centripetal force
9. Friction
10. Simple machines: Mechanical advantage and efficiency
11. Torques, equilibrium, and center of gravity
12. Rotational motion and moment of inertia
13. Hooke's law and simple harmonic motion
14. The simple pendulum
15. Archimedes' principle: Buoyancy and density

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
Group projects
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
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 collisions 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 meetings 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 perform a 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 performing 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.
2. Library and other research needed to complete homework problems and/or projects.

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

C-ID Descriptor Number

PHYS 205

Status

Approved

Comparable Courses within the VCCCD

PHYS M20A - Mechanics of Solids and Fluids
PHYS M20AL - Mechanics of Solids and Fluids Laboratory
PHYS V04 - Mechanics for Scientists and Engineers
PHYS V04L - Mechanics Laboratory for Scientists and Engineers

District General Education

A. Natural Sciences

A2. Physical Science

Approved

B. Social and Behavioral Sciences

C. Humanities

D. Language and Rationality

E. Health and Physical Education/Kinesiology

F. Ethnic Studies/Gender Studies

Course is CSU transferable

Yes

CSU Baccalaureate List effective term:

Fall 1999

CSU GE-Breadth

Area A: English Language Communication and Critical Thinking

Area B: Scientific Inquiry and Quantitative Reasoning

B1 Physical Science
Approved

B3 Laboratory Activity
Approved

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:

UC TCA

UC TCA
Approved

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 5A: Physical Science
Approved

Area 5C: Laboratory Science
Approved

Area 6: Languages Other than English (LOTE)

Textbooks and Lab Manuals

Resource Type
Manual

Description
Miller, J.W. (2020). *Physics 131 Laboratory Experiments*. Oxnard, Justin Miller

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Resource Type
Textbook

Description
Serway, R.A., and Jewett, J.W. (2019). *Physics for Scientists and Engineers with Modern Physics.* (10th). Belmont, Brooks/Cole.

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 problem.
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)	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.

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 problem.
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)	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.

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. Recordings of data acquisition and/or simulation use regarding a given lab experiment may be used.
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 problem.
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)	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.

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

DTRW-I
MM/DD/YYYY

Curriculum Committee
11/25/2020

Board
MM/DD/YYYY

CCCCO
MM/DD/YYYY

Control Number
CCC000197567

DOE/accreditation approval date
MM/DD/YYYY