PHYS R132: PHYSICS FOR SCIENTISTS AND ENGINEERS 2

Originator
jwmiller

College
Oxnard College

Discipline (CB01A)
PHYS - Physics

Course Number (CB01B)
R132

Course Title (CB02)
Physics for Scientists and Engineers 2

Banner/Short Title
Science/Engineering Physics 2

Credit Type
Credit

Start Term
Fall 2021

Catalog Course Description
This course is an introduction to electricity and magnetism along with thermodynamics, with emphasis on understanding field theory, the behavior of simple electrical circuits, heat exchange, the laws of thermodynamics and thermodynamic processes. Central topics include gravitational, electric, and magnetic fields; the laws of Coulomb, Gauss, Ohm, Kirchhoff, Ampere, Biot-Savart, and Faraday; simple circuit analysis; Maxwell equations; heat, entropy, thermodynamic processes, and the thermodynamic laws. Although the course emphasizes conceptual understanding, students also learn to apply mathematical techniques such as vector algebra, vector differentiation and integration, binomial approximations, 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
May 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
PHYS R131 and MATH R121

Entrance Skills

Entrance Skills
Students are expected to have knowledge depicting and solving physical systems by use of diagrams, proper mathematics, and the laws of physics.

Prerequisite Course Objectives
PHYS R131-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.
PHYS R131-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.
PHYS R131-Solve conceptual and numerical problems related to the behavior or evolution of a mechanical system by applying those principles identified above.
PHYS R131-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.
PHYS R131-Argue for or against a scientific hypothesis, supporting his/her conclusions by describing how various physical principles might apply to a novel situation.
PHYS R131-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.

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 R121-Evaluate definite and indefinite integrals using a variety of integration formulas and techniques
MATH R121-Apply integration to areas and volumes, and other applications such as work or length of a curve
MATH R121-Graph, differentiate and integrate functions in polar and parametric form

Requisite Justification

Requisite Type

Prerequisite

Requisite

PHYS R131

Requisite Description

Course in a sequence

Level of Scrutiny/Justification

Required by 4 year institution

Requisite Type

Prerequisite

Requisite

MATH R121

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	Students will be able to determine the resultant Electric Field vector at a location in the proximity of a distribution of point charges.
2	Students will be able to define and use Kirchhoff's Rules on multi-loop circuits.
3	Students will be able compute the net work done by a heat engine in a given thermodynamic cycle.

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 electromagnetic and thermodynamic systems, 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 simple thermodynamic and electromagnetic systems 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 thermodynamic or electromagnetic system by applying those principles identified above.
4	Employ appropriate mathematical tools, up to and including vector differentiation and integration, binomial approximations, 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 electromagnetic and thermodynamic systems.

Course Content

Lecture/Course Content

Lecture topics:

1. Electrostatics
    a. Coulomb's law
    b. Electric field E near point, sphere, line, and surface charges
    c. Gauss's law, electric flux, calculation of electric fields using Gauss's law
    d. Lines of force
    e. Integration methods for computing the electric field
2. Electric potential
    a. Definition of electric potential
    b. Integration methods for computing the electric potential
    c. Use of the gradient to obtain the electric field from the potential
3. Capacitance
    a. Definition of capacitance
    b. Dielectrics
        i. Polarization
        ii. Gauss's law as applied to dielectrics
    c. Capacitor circuits
4. Electric current, resistance, and DC circuits
    a. Definitions of current, resistance, and resistivity
    b. Ohm's law and electric power
    c. DC circuits and Kirchhoff's laws
        i. Multiloop circuits
        ii. RC circuits
5. Magnetic fields and forces
    a. Definitions of magnetic field and magnetic flux
    b. Motion of charged particles in magnetic fields and comparison with motion in electric fields
6. Sources of the magnetic field
    a. Calculating the magnetic field for simple geometries
        i. Ampere's law
        ii. The Biot-Savart law
    b. Magnetic force between current-carrying conductors
7. Electromagnetic induction and inductance
    a. Faraday's law
    b. Lenz's law
    c. Inductance, self-inductance, and back-EMF
    d. (Optional) Diamagnetic, paramagnetic, and ferromagnetic materials
8. Electromagnetic oscillations and AC circuits
    a. LC circuits
    b. RLC circuits
        i. Damped and driven
        ii. Resonance and power
9. The Maxwell equations and electromagnetic waves
    a. The Ampere-Maxwell law and displacement current
    b. The Maxwell equations
    c. Production of electromagnetic waves by accelerating charges
    d. The electromagnetic spectrum
    e. The Poynting vector and intensity
    f. Radiation force and pressure
    g. Light
        i. Speed measurements
        ii. Doppler effect
10. Thermal physics

a. Heat vs. temperature
b. Thermal expansion of matter
c. Heat, work, and thermal conduction
d. Kinetic theory of gases
e. Thermodynamic processes
f. Heat engines
    i. The Carnot cycle
    ii. Entropy
g. The laws of thermodynamics

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.
Laboratory topics include:

1. Electrostatics investigations
2. Visualizing fields
3. Electric field mapping and equipotentials
4. The voltmeter, ammeter, and multimeter
5. Capacitors
6. Ohm's law
7. Resistances in series and parallel
8. Multiloop circuits: Kirchhoff's rules
9. The RC time constant
10. Electromagnetic induction
11. Electric motors and generators
12. Measurement of e: Millikan experiment
13. Introduction to the oscilloscope
14. Phase measurements and resonance in AC circuits
15. The thermal coefficient of linear expansion
16. Specific heat

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
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 electric field contours due to specific charge distributions.
2. Demonstrations: The instructor will demonstrate physical principles by employing equipment and other items such as a Van de Graaff and Whilmhurst machine to show the effects of a collection of charge.
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.
7. 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, when studying Ohm's Law, students will construct a resistive DC circuit and make direct measurements of the current through a given resistor and the potential difference across the resistor to verify Ohm's law.
8. Lecture: The instructor will deliver the course subject matter via in-person lectures to the students. For example, a lecture on the net electric field due to a distribution of point charges.
9. 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.
10. Small group activities (Lab): The students will work in small groups while performing the experiments where applicable.

Representative Course Assignments

Writing Assignments

1. Answers to short explanatory (conceptual) questions from the textbook, often assigned from among those at the end of each chapter or posed by the instructor, generally assigned weekly; a typical question might be "Explain how the capacitance of a parallel plate capacitor changes when either the plate area or the distance between the plates is varied."
2. 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

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, given 5 resistors of 1000 Ohms each and a capacitor of 470 micro Farads, what configuration of the resistors would produce an RC time constant nearest 1.00 seconds and what is the actual time constant of the configuration?

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 210

Status

Approved

Comparable Courses within the VCCCD

PHYS M20B - Thermodynamics, Electricity, and Magnetism
PHYS M20BL - Thermodynamics, Electricity, and Magnetism Laboratory
PHYS V05 - Electricity and Magnetism for Scientists and Engineers
PHYS V05L - Electricity and Magnetism 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

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
Textbook

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

Resource Type
Manual

Description
Miller, J.W. (2020) *Physics 132 Laboratory Experiments*. Oxnard, Justin Miller

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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)	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 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)	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 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)	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

DTRW-I

MM/DD/YYYY

Curriculum Committee

11/25/2020

Board

MM/DD/YYYY

CCCCO

MM/DD/YYYY

Control Number

CCC000335577

DOE/accreditation approval date

MM/DD/YYYY