GAVILAN COLLEGE
5055 Santa Teresa Blvd
Gilroy, CA 95023

Course Outline

COURSE: PHYS 4C DIVISION: 20 ALSO LISTED AS:

TERM EFFECTIVE: Spring 2022 CURRICULUM APPROVAL DATE: 05/10/2022

SHORT TITLE: PHYS FOR SCI & ENG III

LONG TITLE: Physics for Scientists and Engineers-Heat/Optics/Modern Physics

Units	Number of Weeks	Type	Contact Hours/Week	Total Contact Hours
4	18	Lecture:	3	54
		Lab:	3	54
		Other:	0	0
		Total:	6	108

Out of Class Hrs:	108.00
Total Learning Hrs:	216.00

COURSE DESCRIPTION:

An introduction to the principles of physics using calculus. Topics include waves, sound, optics, interference, diffraction, thermal energy, the Laws of Thermodynamics, the kinetic theory of gases, an introduction to special relativity and selected topics from modern physics. (C-ID: PHYS 210) (C-ID: PHYS 200S: Phys 4A + Phys 4B + Phys 4C) PREREQUISITE: Completion of PHYS 4A and MATH 1B with grades of 'C' or better. CO-REQUISITE: MATH 1C.

PREREQUISITES:

Completion of PHYS 4A, as UG, with a grade of C or better.
AND Completion of MATH 1B, as UG, with a grade of C or better.
AND Completion of MATH 1C, as UG, with a grade of C or better., Concurrent OK

COREQUISITES:

CREDIT STATUS: D - Credit - Degree Applicable

GRADING MODES

L - Standard Letter Grade

REPEATABILITY: N - Course may not be repeated

SCHEDULE TYPES:

02 - Lecture and/or discussion
03 - Lecture/Laboratory
04 - Laboratory/Studio/Activity
047 - Laboratory - LEH 0.7
05 - Hybrid
71 - Dist. Ed Internet Simultaneous
72 - Dist. Ed Internet Delayed
73 - Dist. Ed Internet Delayed LAB
737 - Dist. Ed Internet LAB-LEH 0.7

STUDENT LEARNING OUTCOMES:

By the end of this course, a student should:

1. Identify, describe, compare and contrast the thermodynamic state variables.
2. Apply conservation of energy to solve thermodynamics problems.
3. Describe, compare and contrast the zeroth, first, and second laws of thermodynamics.
4. Identify, describe, compare and contrast reflection, refraction, polarization, interference and diffraction.
5. Describe the formation of images geometrically.
6. Identify, describe, compare and contrast real and virtual images, magnification, plane and spherical mirrors, and plane and spherical lenses.
7. Identify, describe, compare and contrast longitudinal, transverse and sound waves.

COURSE OBJECTIVES:

By the end of this course, a student should:

1. Apply basic concepts of quantum mechanics to analyze basic physical setups, including a particle in a box and simple atomic models.
2. Apply concepts from special relativity to analyze physical situations, including time dilation, length contraction, and the Lorentz transformation. Solve basic problems involving relativistic momentum and energy.
3. Analyze real-world experimental data, including appropriate use of units and significant figures, and relate the results of experimental data to the physical concepts discussed in the lecture portion of the class.
4. Analyze basic physical situations involving reflection and refraction, and use this analysis to predict the path of a light ray.
5. Analyze situations involving interference and diffraction of light waves, and apply these to situations including double slits, diffraction gratings, and wide slits.

COURSE CONTENT:

Curriculum Approval Date: 05/10/2022

LECTURE CONTENT:

3 HOURS

1. Temperature and Heat

1.1 Temperature and Thermal Equilibrium

1.2 Thermometers and Temperature Scales

1.3 Thermal Expansion

1.4 Heat Transfer, Specific Heat, and Calorimetry

1.5 Phase Changes

1.6 Mechanisms of Heat Transfer

3 HOURS

2. The Kinetic Theory of Gases

2.1 Molecular Model of an Ideal Gas

2.2 Pressure, Temperature, and RMS Speed

2.3 Heat Capacity and Equi-partition of Energy

2.4 Distribution of Molecular Speeds

3 HOURS

3. The First Law of Thermodynamics

3.1 Thermodynamic Systems

3.2 Work, Heat, and Internal Energy

3.3 First Law of Thermodynamics

3.4 Thermodynamic Processes

3.5 Heat Capacities of an Ideal Gas

3.6 Adiabatic Processes for an Ideal Gas

3 HOURS

4. The Second Law of Thermodynamics

4.1 Reversible and Irreversible Processes

4.2 Heat Engines

4.3 Refrigerators and Heat Pumps

4.4 Statements of the Second Law of Thermodynamics

4.5 The Carnot Cycle

4.6 Entropy

4.7 Entropy on a Microscopic Scale

3 HOURS

5. Waves

5.1 Traveling Waves

5.2 Mathematics of Waves

5.3 Wave Speed on a Stretched String

5.4 Energy and Power of a Wave

5.5 Interference of Waves

5.6 Standing Waves and Resonance

COURSE CONTENT(CONTINUED):
LECTURE CONTENT(CONTINUED):
3 HOURS
6. Sound
6.1 Sound Waves
6.2 Speed of Sound
6.3 Sound Intensity
6.4 Normal Modes of a Standing Sound Wave
6.5 Sources of Musical Sound
6.6 Beats
6.7 The Doppler Effect
2 HOURS
7. Electromagnetic Waves
7.1 Maxwell’s Equations and Electromagnetic Waves
7.2 Plane Electromagnetic Waves
7.3 Energy Carried by Electromagnetic Waves
7.4 The Electromagnetic Spectrum
3 HOURS
8. The Nature of Light
8.1 The Propagation of Light
8.2 The Law of Reflection
8.3 Refraction
8.4 Total Internal Reflection
8.5 Dispersion
8.6 Huygens’s Principle
8.7 Polarization
3 HOURS
9. Geometric Optics and Image Formation
9.1 Images Formed by Plane Mirrors
9.2 Spherical Mirrors
9.3 Images Formed by Refraction
9.4 Thin Lenses
9.5 The Eye
9.6 The Camera
9.7 The Simple Magnifier
9.8 Microscopes and Telescopes
3 HOURS
10. Interference
10.1 Young's Double-Slit Interference
10.2 Mathematics of Interference
10.3 Multiple-Slit Interference
10.4 Interference in Thin Films
10.5 The Michelson Interferometer

COURSE CONTENT(CONTINUED):
LECTURE CONTENT(CONTINUED):
3 HOURS
11. Diffraction
11.1 Single-Slit Diffraction
11.2 Intensity in Single-Slit Diffraction
11.3 Double-Slit Diffraction
11.4 Diffraction Gratings
11.5 Circular Apertures and Resolution
11.6 X-Ray Diffraction
6 HOURS
12. Relativity
12.1 Invariance of Physical Laws
12.2 Relativity of Simultaneity
12.3 Time Dilation
12.4 Length Contraction
12.5 The Lorentz Transformation
12.6 Relativistic Velocity Transformation
12.7 Doppler Effect for Light
12.8 Relativistic Momentum
12.9 Relativistic Energy
3 HOURS
13. Photons and Matter Waves
13.1 Blackbody Radiation
13.2 Photoelectric Effect
13.3 The Compton Effect
13.4 Bohr’s Model of the Hydrogen Atom
13.5 De Broglie’s Matter Waves
13.6 Wave-Particle Duality
6 HOURS
14. Quantum Mechanics
14.1 Wave Functions
14.2 The Heisenberg Uncertainty Principle
14.3 The Schrodinger Equation
14.4 The Quantum Particle in a Box
14.5 The Quantum Harmonic Oscillator
14.6 The Quantum Tunneling of Particles through Potential Barriers
3 HOURS
15. Atomic Structure
15.1 The Hydrogen Atom
15.2 Orbital Magnetic Dipole Moment of the Electron
15.3 Electron Spin
15.4 The Exclusion Principle and the Periodic Table
15.5 Atomic Spectra and X-rays

COURSE CONTENT(CONTINUED):
LECTURE CONTENT(CONTINUED):
2 HOURS
16. Nuclear Physics
16.1 Properties of Nuclei
16.2 Nuclear Binding Energy
16.3 Radioactive Decay
2 HOURS
Final Exam

COURSE CONTENT(CONTINUED):

LAB CONTENT:

The Lab activities for the course will be divided as:

(a) Experimental activities or educational simulations (50%)

(b) Problem-Solving activities using computational tools and programming (50%)

6 HOURS

LAB: Basic Introduction to a high order programming language such as MATLAB or Octave.

3 HOURS

LAB: Calorimetry

3 HOURS

LAB: Phase transitions and Latent heat

3 HOURS

LAB: Thermal Expansion

3 HOURS

LAB: Ideal Gases

3 HOURS

LAB: Resonance

3 HOURS

LAB: Waves on a String - normal modes and harmonics

3 HOURS

LAB: Speed of Sound Lab

3 HOURS

LAB: Mirrors and Lenses

3 HOURS

LAB: Snell's Law

3 HOURS

LAB: Optical Instruments

3 HOURS

LAB: Interference

3 HOURS

Lab: Diffraction

3 HOURS

LAB: The Michelson Interferometer

3 HOURS

LAB: Blackbody radiation and Plancks constant

3 HOURS

LAB: The Photo-Electric Effect

3 HOURS

LAB: Radioactive Decay

METHODS OF INSTRUCTION:

Lecture, discussion. Laboratory exercises. Group projects.

OUT OF CLASS ASSIGNMENTS:

Required Outside Hours 40

Assignment Description

1. Regularly assigned homework that requires students to analyze and study pertinent text material, solved examples and lecture notes.

Required Outside Hours 40

Assignment Description

2. Regularly assigned homework that requires students to apply the principles and skills covered in class by solving related problems.

Required Outside Hours 28

Assignment Description

3. Regularly assigned homework that requires students to use computational tools and programming.

METHODS OF EVALUATION:

Writing assignments

Evaluation Percent 20

Evaluation Description

Lab Reports.

Problem-solving assignments

Evaluation Percent 20

Evaluation Description

Homework, quizzes, projects.

Objective examinations

Evaluation Percent 60

Evaluation Description

In-class written exams.

REPRESENTATIVE TEXTBOOKS:

Halliday, Resnick, Walker. Fundamentals of Physics. Wiley,2013.

ISBN: ISBN-10: 1118230728

Reading Level of Text, Grade: 12 Verified by: Jennifer Nari

University Physics Volume 1;2;3, Ling, Moebs and Sanny, OPENSTAX, 2021.

ISBN: ISBN-10: 1-947172-20-4; ISBN-10: 1-947172-21-2; ISBN-10: 1-947172-22-0

Rationale: OPENSTAX

12 Grade Verified by: David Argudo

Loyd, David. Physics Lab Manual 4th Edition, Cengage Learning (ISBN: 9781285650043)

RECOMMENDED OTHER TEXTBOOKS OR MATERIALS:

UCD: Physics 9B ? Waves, Sound, Optics, Thermodynamics, and Fluids by Tom Weideman: https://phys.libretexts.org/Courses/University_of_California_Davis/UCD%3A_Physics_9B__Waves_Sound_Optics_Thermodynamics_and_Fluids

ARTICULATION and CERTIFICATE INFORMATION

Associate Degree:
- GAV B1, effective 201270
- GAV B3, effective 201270

CSU GE:
- CSU B1, effective 201270
- CSU B3, effective 201270

IGETC:
- IGETC 5A, effective 201270
- IGETC 5C, effective 201270

CSU TRANSFER:
- Transferable CSU, effective 201270
- Not Transferable

UC TRANSFER:
- Transferable UC, effective 201270
- Not Transferable

SUPPLEMENTAL DATA:

Basic Skills: N
Classification: Y
Noncredit Category: Y
Cooperative Education:
Program Status: 1 Program Applicable
Special Class Status: N
CAN: XXXXXX
CAN Sequence: PHYS SEQ B
CSU Crosswalk Course Department: PHYS
CSU Crosswalk Course Number: 210
Prior to College Level: Y
Non Credit Enhanced Funding: N
Funding Agency Code: Y
In-Service: N
Occupational Course: E
Maximum Hours:
Minimum Hours:
Course Control Number: CCC000110763
Sports/Physical Education Course: N
Taxonomy of Program: 190200