

PHYS 41 Course Outline as of Fall 2023

CATALOG INFORMATION

Dept and Nbr: PHYS 41

Title: WAVES, OPTICS, THERMO

Full Title: Waves, Optics, and Thermodynamics for Scientists & Engineers

Last Reviewed: 1/23/2023

| Units | | Course Hours per Week | | Nbr of Weeks | Course Hours Total | |
|---------|------|-----------------------|------|--------------|--------------------|--------|
| Maximum | 4.00 | Lecture Scheduled | 3.00 | 17.5 | Lecture Scheduled | 52.50 |
| Minimum | 4.00 | Lab Scheduled | 3.00 | 8 | Lab Scheduled | 52.50 |
| | | Contact DHR | 0 | | Contact DHR | 0 |
| | | Contact Total | 6.00 | | Contact Total | 105.00 |
| | | Non-contact DHR | 0 | | Non-contact DHR | 0 |

Total Out of Class Hours: 105.00

Total Student Learning Hours: 210.00

Title 5 Category: AA Degree Applicable

Grading: Grade Only

Repeatability: 00 - Two Repeats if Grade was D, F, NC, or NP

Also Listed As:

Formerly: PHYS 4B

Catalog Description:
In this course, students will use calculus, algebra, and trigonometry to apply physics laws and principles to solve problems involving oscillations, waves, sound, heat, kinetic theory, thermodynamics, geometrical optics, interference, diffraction, and polarization of light.

Prerequisites/Corequisites:
Course Completion of PHYS 40

Recommended Preparation:
Course Completion or Concurrent Enrollment in MATH 1B

Limits on Enrollment:

Schedule of Classes Information:
Description: In this course, students will use calculus, algebra, and trigonometry to apply physics laws and principles to solve problems involving oscillations, waves, sound, heat, kinetic theory, thermodynamics, geometrical optics, interference, diffraction, and polarization of light. (Grade Only)
Prerequisites/Corequisites: Course Completion of PHYS 40
Recommended: Course Completion or Concurrent Enrollment in MATH 1B

Limits on Enrollment:

Transfer Credit: CSU;UC.

Repeatability: Two Repeats if Grade was D, F, NC, or NP

ARTICULATION, MAJOR, and CERTIFICATION INFORMATION:

| | | | | |
|-------------------|----------------------|--------------------------|-------------|-----------|
| AS Degree: | Area | | Effective: | Inactive: |
| | C | Natural Sciences | Spring 1983 | |
| CSU GE: | Transfer Area | | Effective: | Inactive: |
| | B1 | Physical Science | Spring 1983 | |
| | B3 | Laboratory Activity | | |
| IGETC: | Transfer Area | | Effective: | Inactive: |
| | 5A | Physical Sciences | Spring 1983 | |
| | 5C | Fulfills Lab Requirement | | |

CSU Transfer: Transferable Effective: Spring 1983 Inactive:

UC Transfer: Transferable Effective: Spring 1983 Inactive:

CID:
CID Descriptor:PHYS 200S Calculus-Based Physics for Scientists and Engineers: ABC
SRJC Equivalent Course(s): PHYS40 AND PHYS41 AND PHYS42 AND PHYS43

Certificate/Major Applicable:

Major Applicable Course

COURSE CONTENT

Student Learning Outcomes:

At the conclusion of this course, the student should be able to:

1. Analyze and solve problems by applying the laws of physics to oscillatory motion, wave propagation and interference, thermodynamics, and geometrical/wave optics.
2. Design and assemble apparatus to measure physical phenomena.
3. Analyze and make comparisons between experiment and theory.
4. Effectively communicate ideas and processes of physics.

Objectives:

At the conclusion of this course, the student should be able to:

1. Describe waves and solve problems relating to their properties and propagation in various media.
2. Be able to convert between temperature scales, solve problems related to coefficient of expansion, thermal equilibrium, and heat transfer.
3. Use the laws of thermodynamics and the kinetic theory of gases to solve problems related to ideal gases and various heat engines.
4. Explain propagation of light in media including reflection, refraction, and dispersion.
5. Explain image formation and draw ray diagrams for various optical devices including lenses, mirrors, microscopes, and telescopes.
6. Explain the formation of interference patterns of light from a single slit, a double slit, a diffraction grating, and thin films.
7. Describe polarization with filters and by reflection.

Lab Objectives:

1. Develop and conduct experiments that apply the scientific method and error analysis to explore principles in waves, sound, thermodynamics, and optics.
2. Use manual and computerized data collection techniques to measure and analyze parameters related to waves, sound, thermodynamics, and optics.
3. Plot, curve fit, and interpret data using a spreadsheet or other analysis tools.

Topics and Scope:

I. Oscillatory Motion

- A. Simple harmonic motion
- B. Wave equations
- C. Damped and forced oscillations

II. Wave Motion

III. Sound Waves

- A. Speed, frequency, power level, and intensity
- B. Doppler effect

IV. Superposition and Standing Waves

- A. Equations
- B. Interference and standing waves
- C. Beats

V. Temperature and the Zeroth Law of Thermodynamics

- A. Temperature scales
- B. Thermal expansion
- C. Ideal gas

VI. First Law of Thermodynamics

- A. Heat and thermal energy
- B. Specific heat and latent heat
- C. Work-heat relationship
- D. Thermal transfer methods

VII. Kinetic Theory of Gases

- A. Molecular and statistical models
- B. Molar specific heat of gas
- C. Thermal processes
- D. Equipartition theorem

VIII. Second Law of Thermodynamics

- A. Heat engines
- B. Entropy

IX. Light and Optics

- A. Nature of light
- B. Reflection and refraction of light
- C. Total internal reflection

X. Image Formation

- A. Mirrors and lenses
- B. Ray diagrams
- C. Optical instruments including the eye, camera, microscope, and telescope

XI. Interference of Light Waves

- A. Single and double slits
- B. Thin film interference
- C. Interferometers

XII. Diffraction

- A. Narrow single slit

- B. Double slits
- C. Diffraction gratings

All topics are covered in both the lecture and lab parts of the course.

Assignment:

Lecture-Related Assignments:

1. Homework problem sets (10-30)
2. Quizzes (5-15)
3. Exams (2-4)
4. Final exam

Lab and Lecture-Related Assignments:

1. Laboratory experiments and reports (12-16)

Methods of Evaluation/Basis of Grade:

Writing: Assessment tools that demonstrate writing skills and/or require students to select, organize and explain ideas in writing.

Lab reports

Writing
5 - 20%

Problem Solving: Assessment tools, other than exams, that demonstrate competence in computational or non-computational problem solving skills.

Homework problems sets; lab experiments

Problem solving
15 - 35%

Skill Demonstrations: All skill-based and physical demonstrations used for assessment purposes including skill performance exams.

None

Skill Demonstrations
0 - 0%

Exams: All forms of formal testing, other than skill performance exams.

Quizzes; exams; final exam

Exams
50 - 70%

Other: Includes any assessment tools that do not logically fit into the above categories.

Class participation

Other Category
0 - 5%

Representative Textbooks and Materials:

Physics for Scientists and Engineers. 10th ed. Serway, Raymond and Jewett, John. Cengage L. 2019.

Physics for Scientists and Engineers: A Strategic Approach with Modern Physics. 4th ed. Knight, Randell. Pearson. 2017 (classic).

Lab Manual and Instructor Prepared Materials

Open Educational Resource (OER) Material:

University Physics by OpenStax, S. J. Ling, J. Sanny, and W. Moebs, 2016 (classic).