PHYS 41 Course Outline as of Fall 2006

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	17.5	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:
This is a course intended for scientists and engineers and will include oscillations, mechanical waves and sound, heat, kinetic theory, thermodynamics, geometrical optics, interference, diffraction and polarization of light.

Prerequisites/Corequisites:
Course Completion of PHYS 40 (or PHYS 4A)

Recommended Preparation:

Limits on Enrollment:

Schedule of Classes Information:
Description: This is a course intended for scientists and engineers and will include oscillations, mechanical waves and sound, heat, kinetic theory, thermodynamics, geometrical optics, interference, diffraction and polarization of light. (Grade Only)
Prerequisites/Corequisites: Course Completion of PHYS 40 (or PHYS 4A)
Recommended:
Limits on Enrollment:

Transfer Credit: CSU;UC. (CAN PHYS14)(PHYS 4A+PHYS 42+PHYS 41=PHYS SEQ B)(PHYS 43+PHYS 4A+PHYS 42+PHYS 41=PHYS SEQ C)
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

Outcomes and Objectives:
Upon completion of the course, the student should be able to:
1. Explain what a wave is and define common terms used in describing waves.
2. Write an equation for a one-dimensional wave traveling in the positive or negative direction, differentiate to find velocity and acceleration and solve problems involving these relationships.
3. Solve problems involving velocity, energy and power of waves in stretched strings.
4. Explain the concepts of superposition of waves, constructive interference, destructive interference and beats and solve problems involving the superposition of two or more waves.
5. Explain the Doppler effect and solve Doppler effect problems.
6. Explain what the intensity of a wave measures, relate it to sound level in decibels, and solve problems involving intensity and sound level.
7. Sketch standing wave patterns for vibrating strings and air columns, explain/describe overtones and resonance, and solve problems involving standing waves in strings and air columns.
8. Give values for the freezing and boiling points of water on the Absolute, Celsius, and Fahrenheit scales and convert temperatures from one scale to another.
9. Describe what a coefficient of expansion represents and solve problems

involving thermal expansion in 1, 2, and 3 dimensions.

10. Write the equation of state for an ideal gas and solve problems using the relationship.
11. Explain the concepts of specific heat and latent heat and solve problems using the first law of thermodynamics and these quantities.
12. List the 3 methods of heat transfer, explain the concepts of temperature gradient and thermal conductivity, and solve problems involving heat transfer by conduction and by radiation.
13. Use the kinetic theory of gases including the concepts of equiparition of energy and degrees of freedom to provide values for molar specific heats at constant volume and constant pressure for monatomic, diatomic and triatomic molecules at low, mid and high temperatures.
14. Describe what occurs in isothermal, isobaric, isovolumic and adiabatic processes, sketch changes of state involving these processes on a P-V diagram, and solve problems involving these processes.
15. Given a distribution of molecular speeds, calculate the average speed, most probable speed and root-mean-square speed.
16. State the second law of thermodynamics, describe the Carnot cycle, and solve problems involving various thermodynamic cycles.
17. Explain what entropy is and calculate changes in entropy for various thermal processes.
18. Give a value for the speed of light in a vacuum, state the wavelength range of the visible spectrum, and relate speed, frequency and wavelength of light waves.
19. State two rules for reflection of light and explain the difference between specular and diffuse reflection.
20. Explain the refraction of light at the interface between two transparent media and the concepts of index of refraction, critical angle and internal reflection, and solve problems using Snell's law.
21. Explain what dispersion is, why a prism forms a spectrum of colors, the minimum angle of deviation and solve problems involving refraction of light through a prism.
22. Explain the terms real, virtual, erect and inverted, and describe the image forming properties of converging and diverging spherical mirrors and thin lenses.
23. Solve problems involving object distance, image distance, focal length and linear magnification for single and multiple mirror/thin lens systems.
24. Draw ray diagrams to determine image locations and magnifications for single and combinations of spherical mirrors and thin lenses.
25. Solve problems using the lens maker's equation, problems involving refraction at spherical surfaces, and problems involving thick lenses.
26. Describe the configuration of lenses in, draw ray diagrams for and do calculations involving a simple microscope, opera glass and astronomical telescope.
27. Explain the formation of a double slit interference pattern, describe the effect of wavelength and slit separation on the pattern, and solve problems involving double slit interference.
28. Explain the formation of spectra by diffraction gratings and solve problems involving spectra formed by diffraction gratings.
29. Explain interference in thin films and solve problems involving thin film interference.

30. Explain the formation of the single slit diffraction pattern and solve problems involving single slit diffraction.
31. Describe at least three methods by which light can be polarized and solve problems involving the intensity of light transmitted through multiple polarizing filters, Brewster's angle, and polarization by reflection.

Topics and Scope:

Topics covered include:
1. Waves in elastic media.
2. Sound waves.
3. Superposition of waves and standing waves in strings and air columns.
4. Temperature and conversion of temperature scales.
5. Thermal expansion.
6. The ideal gas law.
7. Specific heat, latent heat, & the first law of thermodynamics.
8. The kinetic theory of gases and molar specific heats.
9. Isothermal, isobaric, isovolumic, and adiabatic processes.
10. Heat engines, refrigerators, heat pumps and the second law of thermodynamics.
11. Entropy.
12. Reflection and refraction of plane light waves incident on plane surfaces.
13. Image forming properties of spherical mirrors and thin lenses.
14. Interference of light: double slit interference, thin film interference, diffraction gratings.
15. Single slit diffraction.
16. Polarization of light.

Lab work includes:
1. Using computers with motion detectors and force probes to make measurements on systems vibrating with simple harmonic motion and to develop concepts of simple harmonic motion.
2. Using computers with microphones, force probes, etc. to make measurements of sound waves and waves in strings and springs and to develop concepts such as frequency, period, and interference of waves
3. Making measurements in thermal systems including using computers with temperature probes.
4. Making measurements in optical systems.
5. Using spreadsheets to record data and to calculate experimental results.
6. Constructing graphs using computer graphing programs.
7. Error analysis.
8. Numerical and graphical analysis of data.

Assignment:

1. No less than 10 sets of homework problems (one for each chapter covered).
2. Five to fifteen quizzes.
3. No less than 12 laboratory experiments.
4. No less than three mid-term exams.

5. Final exam.
6. Lab Reports.

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.

None, This is a degree applicable course but assessment tools based on writing are not included because problem solving assessments are more appropriate for this course.	Writing 0 - 0%

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

Homework problems, Experiments.	Problem solving 10 - 30%

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.

Multiple choice, Physics problems to solve, quizzes and exams.	Exams 50 - 70%

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

LAB REPORTS	Other Category 20 - 30%

Representative Textbooks and Materials:
PHYSICS FOR SCIENTISTS AND ENGINEERS by Serway.6th ed.,2003