PHYS 43 Course Outline as of Summer 2022

CATALOG INFORMATION

Dept and Nbr: PHYS 43 Title: MODERN PHYSICS
Full Title: Modern Physics for Scientists and Engineers
Last Reviewed: 1/23/2023

Units		Course Hours per Week		Nbr of Weeks	Course Hours Total	
Maximum	3.00	Lecture Scheduled	3.00	17.5	Lecture Scheduled	52.50
Minimum	3.00	Lab Scheduled	0	6	Lab Scheduled	0
		Contact DHR	0		Contact DHR	0
		Contact Total	3.00		Contact Total	52.50
		Non-contact DHR	0		Non-contact DHR	0

Total Out of Class Hours: 105.00 Total Student Learning Hours: 157.50

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 4D

Catalog Description:
This is a modern physics course intended for scientists and engineers and includes special relativity, atomic theory, quantum physics, and nuclear processes.

Prerequisites/Corequisites:
Course Completion of PHYS 41 and PHYS 42; AND Course Completion or Concurrent Enrollment in MATH 2

Recommended Preparation:

Limits on Enrollment:

Schedule of Classes Information:
Description: This is a modern physics course intended for scientists and engineers and includes special relativity, atomic theory, quantum physics, and nuclear processes. (Grade Only)
Prerequisites/Corequisites: Course Completion of PHYS 41 and PHYS 42; AND Course Completion or Concurrent Enrollment in MATH 2
Recommended:
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:
CSU GE:	**Transfer Area**			Effective:	Inactive:
	B1	Physical Science		Spring 1984	
IGETC:	**Transfer Area**			Effective:	Inactive:
CSU Transfer:	Transferable	Effective:	Spring 1984	Inactive:	
UC Transfer:	Transferable	Effective:	Spring 1984	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. Use laws of physics to solve problems related to special relativity, atomic and quantum theory, and nuclear processes.
2. Describe the historical development of modern physics.
3. Explain how theories of modern physics resolved the shortcomings in classical physics.

Objectives:
During the course students will:
1. State the postulates of Einstein's theory of Special Relativity and solve problems involving space-time transformations.
2. Describe the historical development of quantum theory and solve problems involving black body radiation, photoelectric effect and Compton scattering.
3. Explain the Bohr model and reproduce the derivation of the Rydberg formula for the spectral emission lines of atomic hydrogen.
4. Describe the shell and subshell structure of orbital electrons relating this structure to the periodic table.
5. Explain and solve problems regarding wave-particle duality for both photons and electrons.
6. Derive and solve problems using the Heisenberg principle.
7. Solve problems using the one-dimensional nonrelativistic Schroedinger wave equation to determine probabilities and expectation values of physically measurable quantities.
8. Write radioactive decay equations and solve problems involving half-lives and Q values.
9. Explain and solve problems involving cross sections in nuclear reactions.
10. Write equations for nuclear interactions and calculate threshold energies and Q values.
11. Sketch and describe the significance of the curve of binding energy per nucleon versus mass number.
12. Describe the components of and processes occurring in fission and fusion nuclear reactors and bombs.

13. List the fundamental particles and interactions included in the Standard Model of physics.

Topics and Scope:

I. Special Relativity
   A. Transformation of space and time coordinates
   B. Length contraction and time dilation
   C. Relativistic momentum and energy
   D. Relativistic addition of velocities
II. Early Quantum Physics
   A. Black body radiation and Max Planck
   B. The photoelectric effect and the photon
   C. Compton scattering
III. The Bohr Model of the Atom
   A. Quantization of angular momentum
   B. Energy levels and spectra
   C. The periodic table and electron shells and subshells
IV. Early Wave Mechanics
   A. De Broglie hypothesis and electron diffraction
   B. Heisenberg uncertainty principle
   C. Particle-wave duality
V. The Schroedinger Wave Equation
   A. Solution of infinite square well potential & hydrogen atom.
   B. Probability and expectation values (square well, quantum oscillator, hydrogen atom)
VI. Nuclear Processes
   A. Nuclear structure, binding energy
   B. Radioactive decay: half-life, decay modes, Q values, cross-sections
   C. Fission nuclear reactors, fission products
   D. Fusion reactions: fusion reactors
VII. Elementary Particles
   A. Accelerators and detectors
   B. The Standard Model - leptons, quarks, mesons and baryons
VIII. Other topics as time allows (condensed matter physics introduction, lasers, superconductivity,
   cosmology, general relativity, etc.)

Assignment:

1. Homework problem sets (8-15)
2. Quizzes (5-15)
3. Mid-term exams (2-4)
4. Final exam
5. Special project (optional) 15-20 minute oral presentation which may include a written report

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 problem sets	Problem solving 15 - 25%

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, midterms, final exam	Exams 75 - 85%

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

Special project may include writing	Other Category 0 - 10%

Representative Textbooks and Materials:
Physics for Scientists and Engineers, Volume 5. 9th ed. Serway, Raymond and Jewett, John. Thomson. 2013 (classic)
Modern Physics for Scientists and Engineers. 4th ed. Thornton, Stephen and Rex, Andrew. Cengage Learning. 2013 (classic)