

PHYS 4D Course Outline as of Spring 1984**CATALOG INFORMATION**

Dept and Nbr: PHYS 4D Title: PHYS FOR SCI & ENGN

Full Title: Physics for Scientists & Engineers

Last Reviewed: 1/23/2023

Units		Course Hours per Week		Nbr of Weeks	Course Hours Total	
Maximum	2.00	Lecture Scheduled	2.00	17.5	Lecture Scheduled	35.00
Minimum	2.00	Lab Scheduled	0	17.5	Lab Scheduled	0
		Contact DHR	0		Contact DHR	0
		Contact Total	2.00		Contact Total	35.00
		Non-contact DHR	0		Non-contact DHR	0

Total Out of Class Hours: 70.00

Total Student Learning Hours: 105.00

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:

Catalog Description:

Special relativity, atomic structure and quantum physics, nuclear processes, high energy physics.

Prerequisites/Corequisites:

Phys 4B with a grade of "C" or better, Math 2B completed or in progress.

Recommended Preparation:**Limits on Enrollment:****Schedule of Classes Information:**

Description: Modern physics. (Grade Only)

Prerequisites/Corequisites: Phys 4B with a grade of "C" or better, Math 2B completed or in progress.

Recommended:

Limits on Enrollment:

Transfer Credit: CSU;UC. (CAN PHYS 4D+PHYS 4A+PHYS 4C+PHYS 4B=PHYS SEQ C)

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:
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CSU Transfer:	Transferable	Effective:	Spring 1984	Inactive:
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UC Transfer:	Transferable	Effective:	Spring 1984	Inactive:
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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:
Not Certificate/Major Applicable

COURSE CONTENT

Outcomes and Objectives:

Upon completion of the course, the student should be able to:

1. State the Einstein postulates of special relativity.
2. Transform coordinates in space & time between a moving system & a fixed system; give equations for length contraction & time dilation & apply them to transform lengths & time intervals between a fixed & moving system; solve problems involving lack of agreement on simultaneity of events.
3. Write equations for relativistic momentum & energy & use them in problem solving; explain the relationship between mass & energy in special relativity.
4. Solve problems involving the relativistic addition of velocities.
5. Sketch the spectral distribution curve for black body radiation & describe Planck's role in introducing quantum theory through finding an equation for the curve.
6. Describe the photoelectric effect, the failure of classical physics to explain the effect, & its explanation by Einstein using the concept of the photon; write equations for the energy of a photon & the photoelectric effect & use them in problem solving.
7. Solve problems involving the Compton scattering of photons.
8. State the postulates made by Bohr in developing the Bohr model of the atom; draw energy level diagrams for hydrogen-like atoms; calculate electron energy levels & energies, wavelengths & frequencies of emitted or absorbed photons.
9. Explain the relationship between electron energy levels in atoms & emission & absorption spectra.
10. Describe the subshell & shell structure of orbital electrons in atoms; indicate how many electrons occupy each shell & subshell; & explain the relationship between electron shell structure & the periodic table of elements.
11. Give the deBroglie relationship between the wavelength & momentum of

- a particle; cite experimental evidence for the existence of matter waves; & explain what is meant by wave-particle duality.
12. Write 2 expressions of the Heisenberg uncertainty principle & apply them in problem solving.
 13. Write the one-dimensional nonrelativistic Schroedinger wave equation; prove that given wave functions are solutions to the wave equations for particular potential energy functions & find the energy associated with the wave function: use the wave function to determine the probability of finding a particle in a particular region of space; use wave functions to find expectation values of physically measurable quantities.
 14. Define terms involving atomic nuclei such as atomic number, mass number, nucleon, isotope & atomic weight; calculate nuclear binding energies.
 15. Explain the concepts of the decay constant & half-life in radioactive decay & use these concepts in problem solving.
 16. Write equations for radioactive decay by alpha emission, negatron emission, positron emission, electron capture & spontaneous fission, & calculate Q values for the decay processes.
 17. Explain the concept of a cross-section as it applies to nuclear interactions & use the concept in problem solving; calculate threshold energies & Q values for nuclear interactions.
 18. Sketch the curve of binding energy per nucleon versus mass number & explain the significance of this curve for nuclear fission & fusion.
 19. Write equations for nuclear fission processes & calculate the energy released in the process.
 20. List the components of a nuclear reactor & describe the characteristics of materials used for each of the components.
 21. Write equations for nuclear fusion reactions; calculate the energy released in fusion processes; & explain the processes of magnetic confinement & inertial confinement.
 22. Indicate the properties (spin, lepton number, baryon number, number of constituent quarks) of leptons, mesons & baryons; identify conservation laws which apply in interactions or decays of each of these classes of particles.
 23. List the fundamental forces in nature; indicate their relative strength, the field particles associated with each of the forces, & the types of particles which can be involved in each of these interactions.

Topics and Scope:

1. 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
2. Early Quantum Physics.
 - a. black body radiation and Max Planck
 - b. the photoelectric effect and the photon
 - c. Compton scattering
3. 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
- 4. Early Wave Mechanics.
 - a. DeBroglie hypothesis and electron diffraction
 - b. Heisenberg uncertainty principle
 - c. wave-particle duality
- 5. The Schroedinger Wave Equation.
 - a. solution of infinite square well potential
 - b. probability and expectation values (square well, quantum oscillator)
 - c. barrier penetration
- 6. Radioactive Decay.
 - a. decay constant and half-life
 - b. modes of decay and Q values
- 7. Nuclear Interactions.
 - a. cross-sections
 - b. Q values
- 8. Nuclear Fission and Fusion.
 - a. energy released
 - b. nuclear reactors
- 9. Elementary Particles.
 - a. accelerators and detectors
 - b. leptons, quarks, mesons and baryons
- 10. Other Topics as Time Allows (Solid State Intro, Lasers, Superconductivity, etc.).

Assignment:

- 1. No less than 8 sets of homework problems.
- 2. Three mid-term exams.
- 3. Final exam.

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, Exams

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.

Multiple choice, PROBLEMS TO SOLVE

Exams
75 - 85%

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

None

Other Category
0 - 0%

Representative Textbooks and Materials:
MODERN PHYSICS by Serway, Moses, & Moyer.