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:
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:
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 quantrum 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 Fussion.
   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.