Modern Physics I

Catalog: An introduction to special relativity and elementary quantum mechanics. Topics include space-time, relativistic energy and momentum, the uncertainty principle, Schrödinger's equation, observables and operators, bound states, potential barriers, and the hydrogen atom.

Hours: 3 credit hours (3 lecture/0 lab)

Prerequisites: University Physics II, Calculus III or Differential Equations (Co-requisite)

Campus Numberings:

Midwestern State University	PHYS 3343	Texas A&M University-Corpus Christi	PHYS 3312
Prairie View A&M University	PHYS 3183	Texas A&M University-Kingsville	PHYS 3343
Tarleton State University	PHYS 334	Texas Southern University	PHYS 332
Texas A&M University-Commerce	PHYS 321	West Texas A&M University	PHYS 3310

COURSE LEARNING OBJECTIVES:

Upon completion of this course, students will	**Assessment**
1. know how experimental observations and Einstein's postulates lead to the special theory of relativity and be able to use the Lorentz transformation equations to convert the world-view of one moving observer into that of another .	Embedded course assessment
2. be able to work problems involving the relativity of space and time; including those involving length contraction, time dilation, simultaneity, the Doppler effect, and the Twin Paradox.	Embedded course assessment
3. be able to work problems involving the relativity of mass, energy, and momentum; including those involving mass-energy conversion and binding energy.	Embedded course assessment
4. know how special relativity leads to an invariant view of reality where such things as events, the spacetime continuum, intervals, and four-vectors are independent of the observer and be able to use spacetime diagrams to work problems involving these invariants.	Embedded course assessment
5. be able to explain why gravity is incompatible with special relativity, why general relativity requires spacetime to be curved, what Einstein's gravitational field equation implies, how gravity causes the path of light rays to be bent, and why the gravitational redshift phenomena occurs.	Embedded course assessment
6. know about, and be able to work problems involving the quantization of mass, charge, light, and energy; including problems involving Avogadro's number, black-body radiation, photoelectric effect, and Compton scattering.	Embedded course assessment
7. be able to describe the various models of the atom proposed through history and explain why each was proposed and why all were rejected except for the quantum model.	Embedded course assessment
8. be able to explain the wave-particle duality of quantum mechanics and work problems involving the uncertainty principle.	Embedded course assessment
9. know the eigenvalue equation of quantum mechanics and be able to use it to calculate the eigenvalues of various operators and the expectation values of the corresponding observables.	Embedded course assessment
10. know the Schrödinger equation in one dimension and be able to work problems involving the quantum particle in a box, a well, the simple harmonic oscillator, and the transmission and reflection of waves..	Embedded course assessment
11. know the Schrödinger equation in three dimension and be able to work problems involving the separation of variables, quantization of orbital angular momentum, electron spin, spin-orbit coupling, and total angular	Embedded course assessment

momentum.	
12. be able to work problems involving the wave functions of the hydrogen atom and explain the organization of the periodic table of the elements.	Embedded course assessment
13. know the classical Maxwell-Boltzmann distribution and be able to use it with the equipartition theorem to solve problems involving the speed distribution of the molecules of an ideal gas and the classical heat capacity of gases and solids.	Embedded course assessment
14. know the quantum Bose-Einstein and Fermi-Dirac distributions and be able explain how they differ from one another, what causes the Pauli exclusion principle, and how they can be used to predict the properties of liquid helium, B-E condensates, photon gases, and Fermi gases.	Embedded course assessment