Program Matrix - Subject Area
Physics 6-12 (DOE Code 291)
University of Florida

Science Education (Physics)		Program Requirements				
Subject Area Competencies and Skills (22nd Edition)		**ESE 6344** Classroom Practices in Secondary Education	**SCE 6338** Secondary Science Methods and Assessment	**TSL 5143** Secondary ESOL Strategies	**Florida Teacher Certification Exam (FTCE)** - Subject Area Examination	**Undergraduate Coursework (3.0 GPA)**
Physics 6-12		**"C" below indicates where content is covered through coursework**				
1. Knowledge of the nature of scientific investigation and instruction in physics						
1.	Identify the characteristics and processes of scientific inquiry.	C	C			
2.	Identify potentially hazardous situations in a physics laboratory and classroom, methods of prevention, and corrective actions.	C				
3.	Select the appropriate laboratory equipment for specific scientific investigations.				C	C
4.	Relate the historical development of the major concepts, models, and investigations in physics to current knowledge (e.g., force and motion, conservation principles, fields, quantum theory).	C	C		C	C
5.	Distinguish between scientific theories and laws in terms of their specific roles and functions.	C	C		C	C
6.	Identify elements of guided inquiry (e.g., engaging through questioning, eliciting prior knowledge, engaging in thoughtful discussion, engaging in exploration, fostering data-based argumentation, providing for application) in the physics classroom and laboratory.	C	C			
7.	Identify the areas of teacher liability and responsibility in science-related activities, including accommodations for diverse student populations.	C		C		
2. Knowledge of the mathematics of physics						
1.	Determine the validity of a formula based on dimensional analysis.				C	C
2.	Combine vectors using graphic and trigonometric methods.				C	C
3.	Determine the dot product and cross product of two vectors.				C	C
4.	Convert between units of a given quantity (e.g., length, area, volume, mass, time, temperature).				C	C
5.	Identify prefixes in the metric system and standard units of measure (e.g., newtons, meters, kilowatt-hours, teslas, electron volts, calories, horsepower).				C	C
6.	Estimate the order of magnitude of a physical quantity.				C	C
7.	Interpret the slope of a graph or area under the curve in relation to physical concepts.				C	C
8.	Apply the concepts of accuracy, precision, uncertainty, and significant figures to measurements and calculations.				C	C

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3. Knowledge of thermodynamics						
1.	Relate changes in length, area, or volume of a system to changes in temperature.				C	C
2.	Distinguish between the three methods of heat transfer (i.e., conduction, convection, radiation).				C	C
3.	Determine the amount of heat transferred by conduction or radiation.				C	C
4.	Interpret segments of graphs of temperature versus heat added or removed (e.g., latent heats, specific heats).				C	C
5.	Analyze pressure, volume, and temperature relationships using the ideal gas law.				C	C
6.	Apply the first law of thermodynamics (i.e., energy conservation) to physical systems.				C	C
7.	Calculate work done by or on a gas from pressure versus volume diagrams.				C	C
8.	Interpret pressure versus volume diagrams (e.g., identify isobaric, isothermal, and adiabatic processes).				C	C
9.	Determine the specific heat, latent heat, or temperatures of a substance, given appropriate calorimetric data.				C	C
10.	Apply the second law of thermodynamics (i.e., entropy increase) to physical processes.				C	C
11.	Relate temperature or pressure to kinetic molecular theory.				C	C

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4. Knowledge of mechanics						
1.	Analyze the motion of an object moving in one dimension, given a graph (e.g., displacement versus time, velocity versus time, acceleration versus time).				C	C
2.	Determine distance traveled, displacement, speed, velocity, acceleration, or time of travel for objects moving in one dimension.				C	C
3.	Determine distance traveled, displacement, speed, velocity, acceleration, or time of travel for objects moving in two dimensions (e.g., projectile motion).				C	C
4.	Apply Newton's laws of motion to problems involving linear motion of a body.				C	C
5.	Apply Newton's laws of motion to problems involving circular motion of a body.				C	C
6.	Identify action-reaction pairs of forces between two bodies.				C	C
7.	Apply conservation of momentum to problems in one or two dimensions.				C	C
8.	Analyze problems using the impulse-momentum theorem.				C	C
9.	Analyze problems using Newton's universal law of gravitation (e.g., orbital motion).				C	C
10.	Analyze problems involving static or kinetic frictional forces.				C	C
11.	Apply conservation of mechanical energy.				C	C
12.	Use Newton's second law to analyze problems involving two connected masses (e.g., Atwood machine, Atwood machine on inclined plane, blocks, massless pulley).				C	C
13.	Analyze problems involving torque (e.g., equilibrium, rotational dynamics).				C	C
14.	Apply conservation of angular momentum and conservation of energy to problems involving rotational motion.				C	C
15.	Analyze problems involving work done on mechanical systems (e.g., power, work-energy theorem).				C	C
16.	Analyze problems involving the relationships between depth, density of fluid, and pressure.				C	C
17.	Analyze problems involving the buoyant force on a submerged or floating object (i.e., Archimedes' principle).				C	C
18.	Analyze problems involving moving fluids (e.g., mass conservation, Bernoulli's principle).				C	C
19.	Analyze problems involving center of mass.				C	C
20.	Use free-body diagrams to analyze static or dynamic problems in two or three dimensions.				C	C
21.	Analyze characteristics and examples of simple harmonic motion (e.g., oscillating springs, vibrating strings, pendula).				C	C

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5. Knowledge of waves and optics						
1.	Identify characteristics of waves (e.g., velocity, frequency, amplitude, wavelength, period, pitch, intensity, phase, nodes, antinodes, transverse waveforms, longitudinal waveforms).				C	C
2.	Analyze the motion of particles in a medium in the presence of transverse and longitudinal waves.				C	C
3.	Identify factors that affect wave propagation and wave speed.				C	C
4.	Analyze problems involving the superposition, or interference, of waves (e.g., beats, standing waves, interference patterns).				C	C
5.	Analyze problems involving standing waves (e.g., open or closed tube, vibrating string).				C	C
6.	Analyze the Doppler effect due to the motion of a source or receiver.				C	C
7.	Analyze waves, using either graphical or mathematical representations.				C	C
8.	Analyze reflection and refraction problems using the law of reflection and Snell's law).				C	C
9.	Interpret the relationships between wavelength, frequency, and speed of light.				C	C
10.	Analyze the effects of linear polarizing filters on the polarization and intensity of light.				C	C
11.	Analyze the geometric optics of thin lenses and mirrors.				C	C
12.	Analyze patterns produced by diffraction and interference of light (e.g., single-slit, double-slit, diffraction gratings).				C	C
13.	Identify the use and characteristics of various optical instruments (e.g., eye, spectroscope, camera, telescope, microscope, corrective lenses).				C	C
14.	Apply the relationship between intensity and distance from a point source (i.e., inverse-square law).				C	C
15.	Compare qualitative features of the ranges of the electromagnetic spectrum.				C	C

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6. Knowledge of electricity and magnetism						
1.	Determine the electric force on a point charge due to one or more other charges.				C	C
2.	Determine the electric potential difference between two points in an electric field.				C	C
3.	Analyze problems involving capacitance, with or without dielectrics.				C	C
4.	Analyze the electric field due to a charge distribution.				C	C
5.	Apply Gauss's law to determine or characterize an electric field.				C	C
6.	Analyze charge distributions in conductors and nonconductors.				C	C
7.	Simplify series and parallel combinations of resistors or capacitors.				C	C
8.	Solve problems using Ohm's law.				C	C
9.	Apply Kirchhoff's laws to analyze DC circuits.				C	C
10.	Determine the power dissipated through one or more elements of a DC circuit.				C	C
11.	Relate the resistance of a conductor to its geometry and resistivity.				C	C
12.	Analyze problems involving the direction and magnitude of the magnetic force acting on moving charges (e.g., mass spectrometer).				C	C
13.	Apply the laws of electromagnetic induction (i.e., Faraday's law, Lenz's law).				C	C
14.	Analyze problems involving AC circuits (e.g., transformers, peak current, root-mean-square voltage, frequency, reactance, resonant frequency, impedance).				C	C
15.	Identify principles and components involved in the operation of motors and generators.				C	C
16.	Predict the magnetic fields associated with current-carrying conductors (e.g., long straight wires, loops, solenoids).				C	C

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7. Knowledge of modern physics						
1.	Analyze problems based on the energy of a photon (e.g., photoelectric effect, E = hf).				C	C
2.	Apply Einstein's theory of special relativity (e.g., light postulate, length contraction, time dilation).				C	C
3.	Apply Einstein's mass-energy equivalence (E = mc2).				C	C
4.	Determine the allowed energies of quantum atomic states or of transitions between such states.				C	C
5.	Compare the characteristics of alpha, beta, and gamma radiation.				C	C
6.	Predict outcomes of radioactive decay processes (e.g., balancing a nuclear equation).				C	C
7.	Calculate the age of a radioactive source, given data (e.g., half-life, activity, remaining mass, decayed fraction).				C	C
8.	Differentiate between fission and fusion processes and their applications.				C	C
9.	Analyze problems involving Heisenberg's uncertainty principle (e.g., momentum versus position, energy versus time).				C	C
10.	Differentiate between historical models of the atom (e.g., Thomson's plum pudding, Rutherford, Bohr, electron cloud).				C	C
11.	Identify characteristics of subatomic and elementary particles (e.g., protons, neutrons, electrons, photons, neutrinos, quarks, antiparticles).				C	C
12.	Distinguish between the four fundamental forces of nature in terms of the particles they act upon, the relative distances over which they act, and their relative strengths.				C	C
13.	Identify characteristics of the dual (i.e., wave and particle) nature of light and matter.				C	C