Physics of Technology II
A Model Course Guideline

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Foreword

Physics of Technology II Curricular Guidelines is a model designed to assist in developing a rigorous and relevant course of study for Physics of Technology II, a course approved in the Secondary Science Program of Study (*Bulletin 741: Louisiana Handbook for School Administrators, 1997-2000*). The model includes a brief outline and more detailed course guidelines that embrace the core content essential skills and understandings embodied in *Compliance Handbook 308: Louisiana Science Framework* (May 1997)(formerly *Bulletin 1962*). It also presents a discussion of standards-based curriculum, the use of technology, inquiry-based science, laboratory safety, assessment, and the concept of rigorous and relevant learning for *all students.*

The intended audience for this publication includes science teachers, science chairpersons, supervisors of science, local curriculum developers, and school administrators who are involved in secondary science curriculum development and committed to high quality science education.

Physics for Technology II

Course Description

Physics for Technology II explores physics concepts relevant to the technological workplace using an applied approach. Studies include momentum, waves and vibrations, energy connectors, transducers, radiation, optical systems, and time constants. Practical problem-solving techniques are primarily taught through experimental team explorations. Mathematical skills through geometry are used in problem solving.

Content Outline

I. Getting Started

- A. Cooperative Learning Strategies and Techniques
- B. Mathematical Preparation
- C. Measurement
- D. Lab Readiness

II. Momentum

- A. Momentum in Mechanical and Fluid Systems I
- B. Momentum in Mechanical and Fluid Systems II

III. Waves and Vibrations

- A. Characteristics of Waves
- B. Applications of Waves and Vibrations

IV. Energy Converters

- A. Mechanical Energy Converters
- B. Fluid Energy Converters
- C. Electrical Energy Converters
- D. Thermal Energy Converters

V. Transducers

- A. Transducers in Mechanical Systems
- B. Transducers in Fluid Systems
- C. Transducers in Electrical Systems
- D. Transducers in Thermal Systems

VI. Radiation

- A. Electromagnetic Radiation
- B. Nuclear Radiation

VII. Light and Optical Systems

A. Ray Optics: Reflections and Refraction
B. Wave Optics: Interference in Diffraction
C. Laser Light
D. Optical Systems

VIII. Time Constants

A. Time Constants in Mechanical and Fluid Systems
B. Time Constants in Electrical and Thermal Systems

Model Curriculum Guidelines

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TOPICS	BENCHMARKS
I. Basics	
A. Cooperative Learning Strategies and Techniques	
1. Determine and initiate the basic social strategies needed for cooperative learning groups	SI-H-A 1 SI-H-A 2
a. Establish and use basic classroom policies and procedures	SI-H-A 3 SI-H-A 4
b. Divide duties among group members	SI-H-A 5
c. Establish and evaluate actions of effective group members	SI-H-A 6 SI-H-A 7
2. Perform and rotate cooperative learning group tasks and activities in a variety of roles (facilitator/leader, recorder, materials manager, and clerk/time keeper)	
3. Work as a cooperative learning team to design, conduct, and present and/or report a solution to a variety of scientific investigations or explanations	
4. Communicate results after collecting and analyzing data	
B. Mathematical Preparation	SI-H-B3
1. Develop problem-solving skills	PS-H-A 1
2. Manipulate and analyze quantitative data using scientific calculators	PS-H-A 1
3. Apply and utilize scientific notation, significant digit, and appropriate units of measurement in both English and SI systems of measurements	PS-H-E2
4. Employ various methods of introduction of vectors	
C. Measurement	
1. Relate the metric (SI) and English systems of measurements to problem solving utilizing dimensional analysis	PS-H-A 1
2. Illustrate the graphical representation of data	SI-H-A3, SI-H-B3
3. Compute and discuss error analysis	PS-G-A 1

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TOPICS	BENCHMARKS
D. Lab Readiness 1. Review/develop safety guidelines using those procedures located in textbooks and lab manuals 2. Use appropriate measuring instruments to accurately measure substances in a variety of real-world applications 3. Demonstrate safe procedure for the use of laboratory equipment and materials 4. Produce and analyze graphical representation of data collected 5. Communicate results of investigations in reports (written or oral, formal or informal)	SI-H-A7 SI-H-A4, SI-H-B3 SI-H-B4 SI-G-A3, SI-H-A4 SI-H-B2, SI-H-B3 SI-H-A1, SI-H-A2 SI-H-A6, SI-H-B1 SI-H-B4, SI-H-B5
II. Momentum A. Momentum in Mechanical and Fluid Systems I 1. Define, measure, and calculate *linear momentum* and *impulse for solids and fluids* using appropriate English and SI units 2. Describe conversion of linear momentum in isolated systems 3. Identify workplace applications in which technicians measure or control linear momentum B. Momentum in Mechanical and Fluid Systems II 1. Define, measure, and calculate *angular momentum* and *impulse* and their interrelationship using appropriate English and SI units 2. Identify workplace applications in which technicians measure or control angular momentum	Benchmarks SI-H-A1-A7 and SI-H-B1-B5 are used throughout this unit. PS-H-F2, PS-H-A1 PS-H-F2 ESS-H-D7, SE-H-B5 PS-H-A1 ESS-H-D7, SE-H-B5
III. Waves and Vibrations A. Characteristics of Waves 1. Define the following terms as they relate to waves: a. Wavelength b. Frequency c. Period d. Amplitude e. Phase f. Wave speed	Benchmarks SI-H-A1-A7 and SI-H-B1-B5 are used throughout this unit. PS-H-G1

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TOPICS	BENCHMARKS
2. Explain phase difference as it relates to waves	PS-H-G2
3. Explain, measure, and calculate wave characteristics as they relate to longitudinal and transverse waves	PS-H-A1, PS-H-G3
4. Identify workplace applications in which technicians measure or control wave phenomena	ESS-H-D7, SE-H-B5
B. Applications of Waves and Vibrations	
1. Define and distinguish between *constructive* and *destructive interference* as they relate to the superposition principle	PS-H-G2
2. Define and distinguish between *natural frequency* and *resonance* and give examples	PS-H-G3
3. Identify workplace applications in which technicians measure or control waves and vibrations	ESS-H-D7, SE-H-B5
IV. Energy Converters	Benchmarks SI-H-A1-A7 and SI-H-B1-B5 are used throughout this unit.
A. Mechanical Energy Converters	
1. Describe how mechanical systems can convert their energy to different types of energy	PS-H-F2
2. Calculate the efficiency of various mechanical energy converters	PS-H-A1, PS-H-F1
3. Identify workplace applications in which technicians measure or control mechanical energy converters	ESS-H-D7, SE-H-B5
B. Fluid Energy Converters	
1. Describe how fluid systems can convert their energy to different types of energy	PS-H-F2
2. Calculate the efficiency of various fluid energy converters	PS-H-A1, PS-H-F1
3. Identify workplace applications in which technicians measure or control fluid energy converters	ESS-H-D7, SE-H-B5
C. Electrical Energy Converters	
1. Describe how electrical systems can convert their energy to different types of energy	PS-H-F2
2. Calculate the efficiency of various electrical energy converters	PS-H-A1, PS-H-F1
3. Identify workplace applications in which technicians measure or control electrical energy converters	ESS-H-D7, SE-H-B5

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TOPICS	BENCHMARKS
D. Thermal Energy Converters 1. Describe how thermal systems can convert their energy to different types of energy 2. Calculate the efficiency of various thermal energy converters 3. Identify workplace applications in which technicians measure or control thermal energy converters	PS-H-F2 PS-H-A1, PS-H-F1 ESS-H-D7, SE-H-B5
V. Transducers A. Transducers in Mechanical Systems 1. Define, calculate and measure the effects of mechanical transducers 2. Identify workplace applications where technicians use mechanical sensors B. Transducers in Fluid Systems 1. Define, calculate and measure the effects of fluid transducers 2. Identify workplace applications in which technicians use fluid sensors C. Transducers in Electrical Systems 1. Define, calculate and measure the effects of electrical transducers as they relate to ammeters and voltmeters 2. Identify workplace applications in which technicians use electrical sensors D. Transducers in Thermal Systems 1. Define, calculate and measure the effects of thermal transducers 2. Identify workplace applications in which technicians use thermal sensors	Benchmarks SI-H-A1-A7 and SI-H-B1-B5 are used throughout this unit. PS-H-A1, PS-H-F1 PS-H-F2 ESS-H-D7, SE-H-B5 PS-H-A1, PS-H-F1 PS-H-F2 ESS-H-D7, SE-H-B5 PS-H-A1, PS-H-F1 PS-H-F2, PS-H-G2 ESS-H-D7, SE-H-B5 PS-H-A1, PS-H-F1 PS-H-F2 ESS-H-D7, SE-H-B5

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TOPICS	BENCHMARKS
VI. Radiation A. Electromagnetic Radiation 1. Explain how wave characteristics apply to EM radiation 2. Solve speed and energy problems using EM radiation 3. Compare characteristics of visible light to other forms of EM radiation 4. Identify workplace applications in which technicians measure and control EM radiation B. Nuclear Radiation 1. Define and distinguish among the three main components of nuclear radiation 2. Define and distinguish among *element*, *isotope*, *nuclide*, *atomic number*, and *mass number* 3. Define and distinguish between *fission* and *fusion*. 4. Calculate energy using Einstein's equation 5. Describe safety procedures technicians must follow when using nuclear radiation 6. Identify workplace applications in which technicians measure and control nuclear radiation	Benchmarks SI-H-A1-A7 and SI-H-B1-B5 are used throughout this unit. PS-H-G1, PS-H-G2 PS-H-G3, PS-H-G4 PS-H-A1, PS-H-G1 PS-H-G2, PS-H-G3 PS-H-G4 ESS-H-D7, SE-H-B5 PS-H-D6, PS-H-G4, PS-H-B2 PS-H-B1, PS-H-B2 PS-H-B2, PS-H-G4 PS-H-D6 PS-H-A1, PS-H-F1 PS-H-G4 ESS-H-D7, SE-H-B5
VII. Light and Optical Systems A. Ray Optics: Reflection and Refraction 1. Define, measure, and distinguish between *reflection* and *refraction* 2. Explain how the following terms relate to mirrors and lens: a. Convex b. Concave c. Curvature d. Focal length e. Index of refraction 3. Identify workplace applications in which technicians use ray optics	Benchmarks SI-H-A1-A7 and SI-H-B1-B5 are used throughout this unit. PS-H-G1, PS-H-G3 PS-H-G1, PS-H-G3 ESS-H-D7, SE-H-B5

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TOPICS	BENCHMARKS
B. Wave Optics: Interference and Diffraction	
1. Explain how constructive and destructive interference and diffraction affect the following: a. Shadows b. Interference fringes c. Collimated light d. Diffraction grating e. Grating spectrometer	PS-H-G1, PS-H-G3
2. Identify workplace applications in which technicians use interference and diffraction	ESS-H-D7, SE-H-B5
C. Laser Light	
1. Identify and diagram the main components of a laser	PS-H-G1, PS-H-G2, PS-H-G3, PS-H-G4
2. List the three main types of lasers and their characteristics; include the four ways to put energy into a laser	PS-H-G1, PS-H-G2 PS-H-G3, PS-H-G4
3. Define and describe *coherent light*, *radiant power* and *power density*	PS-H-G1, PS-H-G2, PS-H-G3, PS-H-G4
4. Explain why lasers can produce extremely high power densities on targets	PS-H-G1, PS-H-G2 PS-H-G3, PS-H-G4
5. Identify workplace applications in which technicians use laser	ESS-H-D7, SE-H-B5
D. Optical Systems	
1. Describe how the human eye uses light to form an image and how lenses are used to correct optical image problems	PS-H-A1, PS-H-G3
2. Explain how a camera forms an image on film and how the terms "f-stop (number)" and "beam expander" change the image	PS-H-G1, PS-H-G2
3. Describe how optical systems using lasers and fiber optics can be used in hospitals, in space exploration, and in other applications such as welding	PS-H-G1, PS-H-G3 PS-H-G4, ESS-H-D7
4. Identify workplace applications in which technicians use optical systems	ESS-H-D7, SE-H-B5

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TOPICS	BENCHMARKS
VIII. Time Constants	Benchmarks SI-H-A 1-A7 and SI-H-B1-B5 are used throughout this unit.
A. Time Constants in Mechanical and Fluid Systems	
1. Identify, draw the curve, and relate the appropriate mathematical equation for linear, inverse, and exponential relationships	PS-H-A1, PS-H-E2
2. Explain how the completion of the exponential change process can be related to the five time constants	PS-H-F2
3. Identify workplace applications in which technicians use time constants in mechanical and fluid systems	ESS-H-D7, SE-H-B5
B. Time Constants in Electrical and Thermal Systems	
1. Draw the curve and predict the mathematical relationships among time constants, capacitance, inductors, and voltage	PS-H-A1, PS-H-G2 PS-H-G3
2. Draw the curve and predict the mathematical relationships between time constants and cooling rates of isolated containers	PS-H-A1, PS-H-F2 PS-H-D6
3. Explain why it's important to know the time constant of a thermocouple	PS-H-F2, PS-H-D6
4. Identify workplace applications in which technicians measure or control time constants	ESS-H-D7, SE-H-B5

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