PELLISSIPPI STATE COMMUNITY COLLEGE

MASTER SYLLABUS

CALCULUS-BASED PHYSICS II
PHYS 2120

Class Hours: 3   **Credit Hours: 4**

Laboratory Hours: 3   **Revised: Fall 2017**

Catalog Course Description

For students majoring in engineering, mathematics, and physics. This is a calculus-based approach to topics in wave motion, optics, and modern physics. Course includes 3 hours of lecture and 3 hours of laboratory applications.

Prerequisites

PHYS 2110

Corequisites

None

Textbook(s) and Other Course Materials

University Physics, Revised Edition, by Harris Benson (Wiley) may be used as reference. The course material as well as related laboratory manuals are available at PSCC Website.

Week/Unit/Topic Basis

Week	Topics	Laboratory
1	**Chapter 15: Oscillations:** Simple Harmonic Motion (SHM), The Linear Spring, Mass-Spring Systems, The Calculus-based Approach, Energy in SHM, Simple Pendulum, Velocity and Acceleration, The "g" Measurement , and Damped and Forced Oscillations	Problems Session
2	**Chapter 16: Mechanical Waves:** Wave Characteristics, Types of Waves, Waves Speed, The Vibrating String, and Traveling Harmonic Waves	**Experiment 1:** Hooke's Law and SHM
3	**Chapter 16: Mechanical Waves, Continued....** Standing Harmonic Waves, Superposition, Resonance, The Wave Equation, and Energy Transport on a String	**Experiment 2:** Standing Waves on a String

Week	Topics	Laboratory
4	**Chapter 17: Sound:** Speed of Sound, Closed and Open Pipes, Resonance of Sound Waves in Pipes, The Doppler Effect, Interference in Time: Beats, Sound Intensity Level: Decibel, Velocity of Longitudinal Waves in a Fluid, and Fourier Series (optional)	**Experiment 3:** Air-Column Resonance: The Speed of Sound
5	**Chapter 35: Ray Optics:** Reflection, Real and Virtual Images, Image in Flat Mirrors, Image in Spherical Mirrors, Important Rays in Mirrors, Image in Converging Mirrors, The Mirror Formula, Magnification, and Image in Diverging Mirrors	**Experiment 4:** Reflection of Light: Flat Mirrors
6	**Chapter 36: Refraction of Light:** Refraction Index, Snell's Law of Refraction, Apparent Depth, Total Internal Reflection, Lenses, Important Rays in Lenses Image in Converging Lenses (6 cases), Thin Lens Formula, Image in Diverging Lenses (1 case) , The Lens Makers Formula, The Lens Power, The Convergence theorem, Telescope, Human Eye, Farsightedness, Nearsightedness, and Astigmatism, and Light Dispersion	**Experiment 5:** Reflection of Light Spherical Mirrors
7	**Chapter 37: Wave Optics (I):** Constructive and Destructive Interference, Coherence, Young's Double-Slit Experiment, Young's formula for Bright and Dark Fringes, Reflection of Waves at hard obstacles, Thin-Film Interference, Wavelength and Refraction Index, Air Wedge, Diffraction, Fresnel and Fraunhofer Diffraction, and Diffraction Grating	**Experiment 6:** Refraction of Light: (Snell's Law
8	**Chapter 38: Wave Optics (II):** The Wave-front: Huygens Principle, Snell's Law (The proof of), Diffraction, Single-Slit Diffraction (Fresnel and Fraunhofer), X-Ray Diffraction, Bragg's Formula, Polarization By Reflection, Selective Absorption, and Scattering	**Experiment 7:** Refraction of Light: Thin Lenses
9	**Chapter 39: Special Relativity:** Speed of Light, Relative Motion in One and Two Dimensions, The Galilean Transformation, Light Propagation in Free Space, The Michelson-Morley Experiment, The Contraction Hypothesis, The Lorentz Transformation, Einstein's Postulates for Special Relativity, Clocks Synchronization, The Relativity of Simultaneity,	Problems Session

Week	Topics	Laboratory
	Length Measurement, Time Dilation, Length Contraction, The Relativistic Doppler Effect, and The Twins Paradox	
10	**Chapter 40: Early Quantum Theory:** The Nature of Atom, The Emptiness of the Atom, The Calculation of the Radius of Hydrogen Atom (The Bohr Model), Emission and Absorption Spectra, Particles and Waves, The Photoelectric Effect, The Photoelectric Cell Formula, Wave-Particle Duality**:** de Broglie Wavelength, The Compton Effect, and Line Spectra	**Experiment 8:** Interference of Light Waves**:** (Diffraction Grating)
11	**Chapter 41: Wave Mechanics:** de Broglie Waves Electron Diffraction, Schroedinger's Wave Equation, Wave Function, Heisenberg Uncertainty Principle, and Wave-Particle Duality	Problems Session
12	**Chapter42: Atoms and Solids:** Quantum Numbers for Hydrogen Atoms, Electron Spin, Wave Functions for Hydrogen Atom, X-Rays and Moseley's Law, Pauli's Exclusion Principle and The Periodic Table	Problems Session
13	**Chapter 43: Nuclear Physics:** The Structure of Nucleus, The Cause of Radioactivity Binding Energy, Nuclear Stability, Isotopes of an Element, Types of Radiation, Radioactive Decay, C-14 Radioactive Dating Nuclear Energy, How Do Reactors Work ?, The Decay of a Radionuclide, Decay Rate, Half-life, Fission and Fusion	**Experiment 9:** Rydberg's Constant (The Hydrogen Atom)
14	**Chapter 44: Elementary Particles:** Antimatter, Exchange Forces, Classification of Particles, Symmetry And Conservation Laws, The Eightfold Way and Quarks	**Experiment 10:** Nuclear Radiation**:** The Chart of Nuclides
15	**Final Exam**	

Course Goals
NOTE: Roman numerals after course objectives reference the TBR general education goals**.**

The course will

A. Expand students' knowledge of physics principles in order to enhance their ability in applying scientific method as they pursue their goals and dreams in life. (V2, V3, V4, and V5)

B. Guide students in taking a logical approach in obtaining experimental data in order to make an objective analysis of the results. (V1, V2, and V3)

C. Enhance students' critical thinking ability and problem-solving skills. (V1 and V2)

D. Enhance students' verbal and writing skills as a result of evidence-based analysis. (V3)

E. Enhance effective use of mathematics. (V2)

F. Develop an understanding of the importance of life-long learning and personal development. (V4 and V5)

Expected Student Learning Outcomes
NOTE: Capital letters after Expected Student Learning Outcomes reference the course goals listed above.

The student will
1. Apply learned physics concepts to theoretical and practical situations. (A, through F)

2. Apply learned physics concepts to estimate an unknown parameter in a given practical situation by using the physics principle(s) involved. (A, through F)

3. Have an understanding of energy calculation to estimate energy cost in a given situation. (A, C, D, E, and F)

4. Apply calculus to obtain equations of oscillatory motion, velocity and acceleration. (A, C, and E)Calculate the potential and potential energy of point charges and parallel-plates capacitors. (A, C, and E)

5. Understand waves, wavelength, frequency, and wave speed. (A, C, D, E, and F)

6. Apply calculus to derive the energy transport by waves (E).

7. Have an understanding of standing and traveling waves, their superposition, resonance, and application. (A, C, and E)

8. Recognize the form of wave equation and understand its verification. (A, C, and E)

9. Apply the resonance concept in the measurement of waves speed. (A, C, and E)

10. Apply the concept of sound waves resonance in pipes to measure the speed of sound. (A, C, and E)

11. Learn how Doppler Effect is used in radars to measure the speed of a moving object. (A, C, and E)

12. Have an understanding of sound energy distribution in air as well as its intensity level. (A, C, and E)

13. Have an understanding of the straight line motion of light by learning how light reflects and refracts in mirrors and transparent media. (A, C, and E)

14. Solve geometric optics problems by making measurements in mirrors, lenses, and transparent media. (A, C, and E)

15. Have an understanding of apparent depth, total reflection, image in mirrors and lenses, refractor telescopes, the optics of human eye lens, and the dispersion phenomenon. (A, C, and E)

16. Have an understanding of the wave nature of light by experimenting the interference phenomenon and apply the interference concept in measuring the wavelength of an unknown source. (A, C, and E)

17. Have an understanding of diffraction, diffraction patterns, and the use of diffraction gratings in wavelength measurements. (A, C, and E)

18. Apply Huygen's principle (wave-front behavior of waves) to derive the Snell's refraction law. (C and E)

19. Have an understanding of how Bragg's formula is used to measure interatomic distances. (A, C, and E)

20. Have an understanding of Einstein's Theory of Relativity and how motion at high speeds affects our perception of time and length measurements. (A through F)

21. Have an understanding of how Michelson's experiment proved that light in vacuum travels at the same speed in all directions regardless of how fast its source moves. (A through F)

22. Have an understanding of time dilation, length contraction, the Relativistic Doppler Effect, and the Twins Paradox. (A through F)

23. Have an understanding of the nature of atoms and how empty they are compared to condensed matter, the way Bohr model is used to measure the radius of hydrogen atom, particles and waves, light generation, the photoelectric effect, Compton Effect, how particles have wavelike behavior, and vice versa. (A through F)

24. Have an understanding of the recent development in quantum mechanics and the behavior of the subatomic particles by learning electron diffraction, Shroedinger's Wave equation, and Heisenberg Uncertainty Principle. (A through F)

25. Have an understanding of radioactivity and its cause, isotopes, radiation types, radioactive decay, C-14 dating, nuclear energy, reactors, and the mathematics of radioactive decay. (A through F)

26. Have an understanding of the building blocks of the subatomic particle and how electron, protons, neutrons, and other particles are formed by quarks. (A through F)

Evaluation

Tests (Theory Portion)**:** 75% of the course grade

This 75% is calculated as

Theory Grade = 0.80 (Chapter Tests + Quizzes) + **0.20** (Comprehensive Final)

There will 4 to 6 tests each of which include problems as well as multiple-choice questions. There will one quiz on Chapter 40 and one on Chapter 43.

Laboratory Experiments**:** 25% of the course grade

Laboratory Grade = (the sum of reports grades) **/** (the number of the reports)**.** 11 experiments are designed for the course**.** Each experiment requires a report that must be at least spell-checked. Procedures for a standard lab report will be given by your instructor**.**

To avoid a ZERO Laboratory Grade, at least 6 reports must be turned in**. No late lab report(s) will be accepted and there are No Lab** Make-ups.

Field Work: _____% of grade

An instructor who finds an opportunity for site visits or field work may give a maximum of 10% to this evaluation measure by adjusting the percentage in Part A.

Grading Scale**:** 91 to 100**:** A**,** 87 to 91**:** B+**,** 81 to 87**:** B**,** 77 to 81**:** C+**,** 70 to 77**:** C**,** & 60 to 70**:** D**.**

Policies:

Attendance Policy

Pellissippi State expects students to attend all scheduled instructional activities. As a minimum, students in all courses (excluding distance learning courses) must be present for at least 75 percent of their scheduled class and laboratory meetings in order to receive credit for the course. Individual departments/programs/disciplines, with the approval of the vice president of Academic Affairs, may have requirements that are more stringent. In very specific circumstances, an appeal of the policy may be addressed to the head of the department in which the course was taken. If further action is warranted, the appeal may be addressed to the vice president of Academic Affairs.

Academic Dishonesty

Academic misconduct committed either directly or indirectly by an individual or group is subject to disciplinary action. Prohibited activities include but are not limited to the following practices:

- Cheating, including but not limited to unauthorized assistance from material, people, or devices when taking a test, quiz, or examination; writing papers or reports; solving problems; or completing academic assignments.

- Plagiarism, including but not limited to paraphrasing, summarizing, or directly quoting published or unpublished work of another person, including online or computerized services, without proper documentation of the original source.

- Purchasing or otherwise obtaining prewritten essays, research papers, or materials prepared by another person or agency that sells term papers or other academic materials to be presented as one's own work.

- Taking an exam for another student.

- Providing others with information and/or answers regarding exams, quizzes, homework or other classroom assignments unless explicitly authorized by the instructor.

- Any of the above occurring within the Web or distance learning environment.

Please see the Pellissippi State Policies and Procedures Manual, Policy 04:02:00 Academic/Classroom Conduct and Disciplinary Sanctions for the complete policy.

Accommodations for disabilities

Students that need accommodations because of a disability, have emergency medical information to share, or need special arrangements in case the building must be evacuated should inform the instructor immediately, privately after class or in her or his office. Students must present a current accommodation plan from a staff member in Disability Services (DS) in order to receive accommodations in this course. Disability Services (http://www.pstcc.edu/sswd/) may be contacted via Disability Services email or by visiting Alexander 130.