

PELLISSIPPI STATE TECHNICAL COMMUNITY COLLEGE  
MASTER SYLLABUS

**CALCULUS BASED PHYSICS II**  
**PHYS 2120**

**Class Hours: 3.0**

**Credit Hours: 4.0**

**Laboratory Hours: 3.0**

**Revised: Spring 05**

**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.

**Entry Level Standards:**

Students taking this course must either have completed 3 semesters of physics or a sequence of engineering statics and dynamics along with one semester of electricity and magnetism. Two semesters of calculus is a must; four semesters of it is preferred.

**Prerequisite:**

PHYS 2110

**Textbook(s) and Other Course Materials:**

*University Physics*, Revised Edition by Harris Benson, Wiley  
*Physics 2120 Lab Manual*

**I. Week/Unit/Topic Basis:**

<b>Week</b>	<b>Topic</b>
1	Lecture: Chapter 15: Oscillations 15.1 Simple Harmonic Oscillation(SHM) 15.2 The Block-Spring System 15.3 Energy in SHM 15.4 Pendulums 15.5,6 Damped and Forced Oscillations Lab: Group Problems Session
2	Lecture: Chapter 16: Mechanical Waves 16.1 Wave Characteristics 16.2 Superposition of Waves 16.3 Speed of a Pulse on a String 16.4 Reflection and Transmission Lab: Group Experiment #1: Hooke's Law and SHM TEST 1
3	Lecture: Chapter 16: Continued... 16.5-7 Traveling and Standing Waves

- 16.8 Standing Waves on a String
  - 16.9 The Wave Equation
  - 16.10 Energy Transport on a String
  - 16.11 Velocity of Waves on a String
  - Lab: Group Experiment #2: Standing Waves on a String
- 4
- Lecture: Chapter 17: Sound
  - 17.1 The Nature of Sound Waves
  - 17.2 Resonant Standing Sound Waves
  - 17.3 The Doppler Effect
  - 17.4 Interference in Time; Beats
  - 17.5 Velocity of Longitudinal Waves in a Fluid
  - 17.6 Sound Intensity
  - 17.7 Fourier Series(Optional)
  - Lab: Group Experiment #3: Air-Column Resonance: The Speed of Sound
  - TEST 2
- 5
- Lecture: Chapter 35: Reflection & Refraction
  - 35.1 Ray Optics
  - 35.2,3 Reflection and Refraction
  - 35.4 Total Internal Reflection
  - 35.5 The Prism and Dispersion
  - 35.6 Images Formed by Plane Mirrors
  - 35.7 Spherical Mirrors
  - 35.8 The Speed of Light
  - Lab: Group Experiment # 4: Reflection of Light, Flat Mirrors
- 6
- Lecture: Chapter 36: Lenses & Optical Instruments
  - 36.1 Lenses
  - 36.2 The Simple Magnifier
  - 36.3 The Compound Microscope
  - 36.4 Telescopes
  - 36.5 The Eye
  - 36.7 Lens Maker's Formula
  - TEST 3
  - Lab: Group Experiment # 5: Reflection of Light, Spherical Mirrors
- 7
- Lecture: Chapter 37: Wave Optics (I)
  - 37.1 Interference
  - 37.2 Diffraction
  - 37.3 Young's Experiment
  - 37.4 Intensity of Double-Slit Patterns
  - 37.5 Thin Films
  - 37.6 Michelson Interferometer
  - 37.7 Coherence
  - Lab: Group Experiment # 6: Diffraction Grating: Wavelength Measurement
- 8
- Lecture: Chapter 38: Wave Optics (II)
  - 38.1 Fraunhofer & Fresnel Diffraction
  - 38.2 Single-Slit Diffraction
  - 38.3 The Rayleigh Criterion
  - 38.4 Gratings
  - 38.5 Multiple Slits
  - 38.6 Single-Slit Diffraction Intensity
  - TEST 4

Lab: Group Experiment # 7: Refraction of Light, Thin Lenses

- 9           Lecture: Chapter 39: Special Relativity  
            39.1 Introduction  
            39.2 The Michelson-Morley Experiment  
            39.3 Covariance  
            39.4 The Two Postulates  
            39.5 Some Preliminaries  
            39.6 Relativity of Simultaneity  
            39.7 Time Dilation  
            39.8 Length Contraction  
            39.9 The Relativistic Doppler Effect  
            39.10 The Twin Paradox  
            39.11 The Lorentz Transformation  
            Lab: Group Experiment #8: Interference of Light Waves, Diffraction Grating
- 10          Lecture: Chapter 40: Early Quantum Theory  
            40.1 Blackbody Radiation  
            40.2 The Photoelectric Effect  
            40.3 The Compton Effect  
            40.4 Line Spectra  
            40.5 Atomic Models  
            40.6 The Bohr Model  
            40.7 Wave-Particle Duality of Light  
            40.8 Bohr's Correspondence Principle  
            Lab: Group Experiment # 9: Atomic Structure, The Hydrogen Atom  
            TEST 5
- 11          Lecture: Chapter 41: Wave Mechanics  
            41.1 De Broglie Waves  
            41.2 Electron Diffraction  
            41.6 Heisenberg Uncertainty Principle  
            41.7 Wave-Particle Duality  
            Lab: Group Problems Session
- 12          Lecture: Chapter 42: Atoms and Solids  
            42.1 Quantum Numbers of Hydrogen  
            42.2 Spin  
            42.5 Pauli Exclusion Principle  
            Lab: Group Problems Session  
            TEST 6
- 13          Lecture: Chapter 43: Nuclear Physics  
            43.1 The Structure of Nucleus  
            43.2 Binding Energy, Nucl. Stability  
            43.3 Radioactivity  
            43.4 The Radioactive Decay Law  
            43.5 Nuclear Reactions  
            43.6,7 Fission and Fusion  
            Lab: Group Experiment # 10: Nuclear Radiation, The Chart of Nuclides
- 14          Lecture: Chapter 44: Elementary Particles  
            44.1 Antimatter  
            44.2 Exchange Forces  
            44.3 Classification of Particles

44.4 Symmetry and Conservation Laws  
44.5 The Eightfold Way and Quarks  
44.6 Color  
44.7 Gauge Theory  
44.8 The Electroweak Interaction  
44.9 The New Quarks  
44.10 Quantum Chromodynamics  
44.11 Grand Unified Theory  
Lab: Group Problems Session

15 Final Exam (Comprehensive)

## II. Course Objectives\*:

- A. Explain metric and American units and systems and perform various conversions between the two, (The gauges at work sites often use both types of units). V.1 & V.3
- B. Describe oscillatory motion, simple harmonic motion, mass-spring system, simple pendulum, and damped and forced oscillation and calculate the parameters involved in motions classified as being oscillatory. V.1, V.4
- C. Define wave, explain wave characteristics, superposition of waves, waves on strings, and wave reflection and transmission. V.3, V.4
- D. Explain the traveling and standing waves, wave velocity, energy, and related equations. V.3, V.4
- E. Explain types of waves, sound waves, resonance, the Doppler effect applied to mechanical waves, interference, and beats. V.3, V.4
- F. Describe the straight-line-motion behavior of light through ray optics using the reflection and refraction phenomena in mirrors and lenses. V.3, V.4
- G. Explain how speed of light may be measured by use of ray optics. V.3, V.4
- H. Realize the use of mirrors and lenses in optical instruments such as microscopes, telescopes, cameras, human eye, etc. V.5
- I. Calculate simple problems involving flat and spherical mirrors as well as ray-optics instruments. V.3, V.4
- J. Explain the wave-like behavior of light through the interference, diffraction, single-slit diffraction, and multi-source interference. V.3, V.4
- K. Explain the special relativity, the Lorentz transformation, time dilation and length contraction as an introduction to modern physics. V.2, V.3, V.4
- L. Describe black-body radiation, the photoelectric effect, the Compton effect, and line spectra of atoms as verifications of particle-like behavior of light. V.2, V.3, V.4
- M. Explain the Bohr model of the atomic configuration and related formulas. V.2, V.3, V.4
- N. Explain De Broglie waves, electron diffraction, and the Heisenberg uncertainty principle as well as wave-particle duality. V.2, V.3, V.4

- O. Explain the quantum numbers in atomic structure. V.2, V.3, V.4
- P. Describe the structure of the nucleus, binding energy, radioactivity, nuclear fission and fusion. V.2, V.3, V.4
- Q. Have an understanding of the most recent developments in atomic structure and subatomic particles. V.4

\*Roman numerals after course objectives reference goals of the university parallel program.

### III. Instructional Processes\*:

Students will:

1. Learn in a cooperative mode by working in small groups with other students and exchanging ideas within each group (or sometimes collectively) while being coached by the instructor who provides assistance when needed. *Active Learning Strategy*
2. Learn by being a problem solver rather than being lectured. *Active Learning Strategy*
3. Explore and seek the solutions to the given problems which measures his/her level of accomplishment. *Active Learning Strategy*
4. Visit industry sites or will be visited by a person from industry who applies the concepts being learned at his/her work site. *Transitional Strategy*
5. Gradually be given higher- and higher-level problems to promote his/her critical thinking ability. *Active Learning Strategy*
6. Search for the solution to the assigned projects by examining the available software and resources. *Transitional Strategy*
7. Get engaged in learning processes such as projects, mentoring, apprenticeships, and/or research activities as time allows. *Transitional Strategy*
8. Use computers with appropriate software during class or lab as a boost to the learning process. *Technological Literacy Outcome*

\*Strategies and outcomes listed after instructional processes reference TBR' s goals for strengthening general education knowledge and skills, connecting coursework to experiences beyond the classroom, and encouraging students to take active and responsible roles in the educational process.

### IV. Expectations for Student Performance\*:

Upon successful completion of this course, the student should be able to:

1. Apply the physics concepts to theoretical and practical situations. A-Q
2. Estimate an unknown parameter in a given practical situation by using the physics principles involved. B, D, E, F, G, H, I, J, L, M, N
3. Perform necessary conversions between metric and non-metric units and systems. A
4. Calculate the variables in simple harmonic motion and analyze the period of oscillations with regard to mass and spring stiffness in mass-spring systems. B
5. Analyze and solve problems on wave motion and calculate the necessary parameters

- involved such as wavelength, frequency, amplitude, phase, etc. B, C, D, E
6. Solve problems involving ray optics in mirrors and lenses and calculate the image size, position, and magnification. F
  7. Analyze and solve problems explained by the refraction phenomenon and calculate the parameters involved. F
  8. Know how to calculate the speed of light by at least one method. F, G
  9. Apply mirror, lens, and refraction formula to solve telescope, camera, and the human-eye problems. F, G, H
  10. Apply the Young's double-slit formula to measure an unknown wavelength by measuring other simple parameters. J
  11. Use a diffraction grating to measure the wavelength of an unknown source. J
  12. Learn Einstein's relativity postulates to apply the necessary formulas where relativistic considerations become important. K
  13. Apply the photoelectric and Compton effects where particle energy is vital to initiate electron release or movement. L
  14. Explain the Bohr model of atomic structure and calculate the radius of the hydrogen atom. M
  15. Use the De Broglie wavelength for different masses moving at different speeds. N
  16. Write the atomic structure of different atoms. O
  17. Explain nuclear structure, binding energy, short-range forces, radioactivity, fission, fusion, and calculate the mass loss in nuclear reactions. P
  18. Briefly explain new development in atomic structure and subatomic particles. Q

\*Letters after performance expectations reference the course objectives listed above.

## V. Evaluation:

### A. Testing Procedures:

Students are primarily evaluated on the basis of test/quiz type assessments and homework as outlined on the syllabus supplement distributed by the instructor. The following formula is used to evaluate the course grade:

$$\text{Course Grade} = (0.75) \times (\text{Theory Grade}) + (0.25) \times (\text{Lab Grade})$$

$$\text{Theory Grade} = 0.80 (\text{Tests} + \text{Quizzes} + \text{H.W.}) + 0.20 (\text{Comprehensive Final})$$

(80%)    (10%)    (10%)

The number of tests vary from 5 to 7. The quizzes and homework percentages depends on the instructor.

### B. Laboratory Expectations:

Ten experiments are designed for the course. Each experiment requires a word-processed report which must be at least spell-checked. Procedures for a standard lab report will be given by your lab 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.

Lab Grade = (the sum of report grades) / (the number of the reports)

C. Field Work:

Site Visits: The necessary site visits will be announced as the arrangements are made. Evaluation will be based on of attendance as well as the visit report.

D. Other Evaluation Methods:

N/A

E. Grading Scale:

91-100 : A	77-81 : C+
87- 91 : B+	70-77 : C
81- 87 : B	60-70 : D

**VI. Policies:**

A. Attendance Policy:

Pellissippi State Technical Community College expects students to attend all scheduled instructional activities. As a minimum, students in all 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 and Student Affairs, may have requirements that are more stringent.

B. Academic Dishonesty:

Plagiarism, cheating, and other forms of academic dishonesty are prohibited. Students guilty of academic misconduct, either directly or indirectly through participation or assistance, are immediately responsible to the instructor of the class. In addition to other possible disciplinary sanctions which may be imposed through the regular Pellissippi State procedures as a result of academic misconduct, the instructor has the authority to assign an F or a zero for the exercise or examination or to assign an F in the course.

C. Accommodations for disabilities:

If you need accommodation because of a disability, if you have emergency medical information to share, or if you need special arrangements in case the building must be evacuated, please inform the instructor immediately. Privately after class or in the instructor's office.

To request accommodations students must register with Services for Students with Disabilities: Goins 127 or 131, Phone: (865) 539-7153 or (865) 694-6751 Voice/TDD.