PELLISSIPPI STATE COMMUNITY COLLEGE  
MASTER SYLLABUS  
CALCULUS BASED PHYSICS II  
PHYS 2120

Class Hours: 3.0                       Credit Hours: 4.0
Laboratory Hours: 3.0                  Revised: Spring 2011

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 three hours of lecture and three 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:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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</table>
| 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: Refraction of Light, Refraction Index

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, Nuclear 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
II. Course Goals*:

The objective of this course is to familiarize students with the principles of modern physics that are often used in today's industry and technical equipment. At work sites, the graduates often need to work with equipment that works by the virtue of modern physics principles. Examples are X-ray machines, ultrasound equipment, blood pressure measurement devices, electronic and optical equipment, radioactive isotopes, etc. The examples and problems selected for the course give students the necessary knowledge and skills to read and analyze scientific data with proper understanding of the units involved and the type of physical quantity measured. The first few chapters lay down the foundation that is absolutely necessary to understand the wave phenomenon that appears in later chapters. On this basis, after finishing this course, students will be able to:

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 TBR’s general education goals.

III. Expected Student Learning Outcomes*:

The student will 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


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

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

IV. 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:

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

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

Tests count (80%), quizzes (10%), and homework (10%). The number of tests may vary from 5 to 7. The percentages given for tests, quizzes, and homework may vary depending 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.

\[
\text{Lab Grade} = \frac{\text{the sum of report grades}}{\text{the number of the reports}}
\]

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), (87-91: B+), (81-87: B), (77-81: C+), (70-77: C), and (60-70: D)

V. Policies:

A. 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 the Learning Division, 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 the Learning Division.

B. 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.

C. Accommodations for disabilities:

Students who 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 Services for Students with Disabilities (SSWD) in order to receive accommodations in this course. Services for Students with Disabilities may be contacted by going to Goins 127, 132, 134, 135, 131 or by phone: 539-7153 or TTY 694-6429. More information is available at www.pstcc.edu/departments/swd/.

D. Other:

Final Exam: Final Exam must be taken during the Final Exam Week. No early Final Exam will be given.

Lab Reports: No late lab report will be accepted and there are No Lab Make-ups

* Experiments:

1 Hooke's Law and Simple Harmonic Motion
2 Standing Waves in a String
3 Air Column Resonance and Speed of Sound
4 Reflection of Light (Flat Mirrors)
5 Reflection of Light (Spherical Mirrors)
6 Refraction of Light (Snell’s Law)
7 Refraction of Light (Thin Lenses)
8 Interference of Light Waves (Diffraction Grating)
9 Atomic Structure (The Hydrogen Atom)
10 Nuclear Radiation (The Chart of Nuclides)