

Grays Harbor College  
Syllabus

Phys& 221, 222, 223—Physics for Scientists and Engineers  
5 Credits Each

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## I. Course Description:

Prerequisites: Math& 152 or concurrent enrollment in Math& 152 or instructor permission (Math&153 or concurrent enrollment in Math& 153 required for Phys&222).

This sequence (phys& 221, 222, 223) covers a year-long introductory sequence in physics required for students majoring in the physical sciences or engineering. Topics covered include mechanics, thermodynamics, electromagnetism, fluid dynamics, waves, optics, and a brief introduction to modern physics including special relativity (time permitting) and quantum mechanics. Calculus is used and problem solving is emphasized. The main topic of physics 221 is Newtonian mechanics. The main topics of physics 222 include fluid dynamics, thermodynamics, and waves. The main topics of physics 223 include electromagnetism, optics, and modern physics. Satisfies science or lab requirement area E distribution requirement (physics 221) or specified elective for the AA degree (physics 221, 222, or 223).

5 lecture hours; 2 lab hours

## II. Aims and Objectives:

The major aims and objectives of this course are as follows:

- A. To develop critical thinking skills and to expose students to the scientific process and the scientific method.
- B. To help provide students the skills needed to continue learning throughout their lives.
- C. To provide the background in physics needed in the physical sciences and engineering.
- D. To develop an awareness and appreciation of some of the achievements and limitations of physics.

## III. Desired Student Abilities

### 1. Competency in the discipline

This course is designed for physics and engineering majors. Thus students will use the material covered in this course in their future studies and/or careers. Because of this competency in the discipline is considered the most important student ability student's should take away from this course. The various areas which are studied are noted in the section on course content below. These all relate to this area of desired student abilities.

### 2. Literacy

Physics provides many real world applications for the math they will have taken. Thus the many problems encountered in this course will provide students extensive practice in developing their quantitative and mathematical skills. In addition, it is essential for physicists or engineers to be able to communicate their work to others. Therefore, the organization and clarity of the students problem solving work, particularly on homework problem sets and the labs will be emphasized thus developing their literacy skills.

### 3. Critical thinking

Of all the desired abilities (other than competency in the discipline), critical thinking is perhaps the area which can be

best addressed in a science course. In many ways thinking scientifically is to think critically and thus the study of the scientific process and scientific method provides students exposure to critical thinking. In addition, many problems in physics can be solved in more than one way and one of the most important skills needed to become a good physicist or engineer is the ability to examine a problem and determine which approaches are likely to be useful in finding a solution (i.e. problem solving). This skill can best be developed only through extensive practice. Hence problem solving is emphasized both in homework problem sets as well as in class to give students practice developing this skill.

#### 4. Social and personal responsibility

In this class students are required to turn in various assignments on time and to be courteous of their fellow students (a small portion of the grade is based on “class citizenship” as noted below). In addition they will in general work with one or more lab partners in the lab portion of this course and, as discussed below, it is anticipated that several class days will be devoted to the students working in small groups to solve interesting physics problems. These exercises will give students experience working with others.

#### 5. Use of resources

It is not anticipated that this course will make extensive use of resources outside of the class. However, the students will be required to solve many problems in this class. These will require them to make extensive use of the textbook and class notes as resources. They will have to be able to discern which information is appropriate to help solve the problem at hand which will give them practice in using and evaluating information.

### **IV. Technique of Instruction:**

This course will meet for 5 one-hour lecture sessions and one 2 hour lab per week. This course will be taught using a combination of lectures, problem solving sessions and a weekly class discussion session in which the class will discuss an interesting application of the physics they are studying. A midterm and final will be given. Quizzes will be given about once a week and will be announced ahead of time. Weekly homework assignments will also be given.

### **V. Organization of Course Content:**

#### A. Physics 221—Mechanics

1. Measurement, standards of measure and units
2. Vector Analysis
  - Scalar and vector quantities
  - Vector addition and subtraction
  - Multiplication of a vector by a scalar; The dot and cross product
3. Particle kinematics in one dimension
  - Definition of displacement, velocity, and acceleration
  - One dimensional motion under constant acceleration
  - One dimensional motion under nonuniform acceleration
4. Motion in more than one dimension
  - Projectile motion
  - Circular and rotational Motion—and analogy with linear motion.
5. Particle dynamics
  - Newton’s laws
  - Statics
  - Friction
  - Harmonic motion
6. Gravity
  - Newton’s law of universal gravitation
  - Gravitational force from a spherical body
  - Gravitational field

## V. Organization of Course Content Continued:

### 7. Conservation Laws

- Energy
  - Work and the Work-Kinetic Energy Theorem
  - Conservative and nonconservative forces—concept of potential energy
  - Gravitational potential energy
  - Potential energy of a stretched spring
- Momentum
  - Momentum conservation in collisions

### 8. Rotational Dynamics

- Torque
- Moment of inertia
- Rotational Kinetic Energy
- Angular momentum
- Static Equilibrium

## B. Physics 222—Properties of matter, thermodynamics, waves and sound

### 1. Properties of solids and elasticity

- Stress and strain; Young's modulus, and the shear and bulk modulus
- Elastic vs. plastic deformation

### 2. Properties of liquids and fluid dynamics

- Concept of pressure; Variation of pressure with depth in a fluid
- Archimedes' Principle
- Equation of flow continuity
- Bernoulli's Equation

### 3. Waves

- Harmonic motion
- Types and properties of waves
- The Wave Equation
- Reflection, interference, and diffraction of waves
- Acoustic phenomena—sound

### 4. Properties of gases

- Ideal gas law and the kinetic theory of gases

### 5. Thermodynamics

- 0th law of thermodynamics and the definition of temperature
- Heat measurements and calorimetry
- Heat Transfer
- 3 laws of thermodynamics

## C. Physics 223—Light, Electricity and Magnetism, and Modern Physics

### 1. Electrostatics

- Charge and Coulomb's law
- Gauss's Law
- Electric Field and Electric Field Lines
- Electric Potential

### 2. DC Electrical Circuits

- Ohm's Law
- Resistors in series and in parallel
- Capacitors
- Capacitors in series and in parallel
- RC Circuits

## V. Organization of Course Content Continued:

### C. Physics 223—Light, Electricity and Magnetism, and Modern Physics

#### 3. Magnetism

- Definition of north and south magnetic poles; Magnetic Field; Earth's magnetic field.
- Behavior of electrical charges in a magnetic field.
- Generation of magnetic fields by electric charges—Ampere's Law
- Force between current carrying wires.
- Faraday's Law of induction
  - Generators and Motors
  - Inductors
  - Transformers

#### 4. AC Circuits

- Behavior of resistors in AC circuits
- Behavior of capacitors in AC circuits
- Behavior of inductors in AC circuits
- RLC Circuits
  - Impedance
  - Resonance in LC circuits
  - Analogy with mass-spring system

#### 5. Electromagnetic Waves

- Summary of Electromagnetic equations: Maxwell's Equations—Maxwell's addition to Ampere's Law
- Production and propagation of electromagnetic waves.
- Energy and momentum in electromagnetic waves.

#### 6. Optics

- Geometric Optics
  - reflection
  - refraction; Snell's Law
    - Optical phenomena: Rainbows, mirages
  - Forming images with lenses and mirrors—Ray tracing and the lens equation
- Optical instruments: Magnifying glass, compound microscope, telescope

#### 7. Quantum and Atomic Physics

- Historic Development of Quantum Mechanics
  - Blackbody Radiation
  - Photoelectric Effect
  - Atomic Spectra—the Bohr Atom
- Wave-particle duality
- Heisenberg Uncertainty Principle

## VI. Methods of Evaluation

The course grade will be determined based on the weekly quizzes, lab assignments, a midterm, final and “class citizenship.” Students will be guaranteed of getting at least the grades corresponding to the following percentage scores, they may be given higher scores:

		80–84%	B+	68–72%	C+	55–60%	D+
90–100%	A	76–80%	B	64–68%	C	50–55%	D
84–90%	A–	72–76%	B–	60–64%	C–		

The weight given to each area is as follows:

**Homework (15%):** At the end of the chapter in the textbook are two types of exercises. The first are conceptual questions and exercises which are qualitative in nature and explore your conceptual understanding of the material. The second are problems which are longer and generally require a mathematical solution. Homework will generally be assigned weekly on Tuesdays and will be due the following Tuesday (if this is modified the due date will be noted). These will consist of approximately 4 – 5 questions and 8 – 10 problems from the textbook. While it is fine to put your answers to the questions on the same page, your solution to the problems should begin at the top of a page, include a summary of the problem statement, and be well organized and neatly presented. Appropriate figures should be included. All steps in the solution should be provided and presented in a logical and clear manner. Homework will be accepted up to one day late for 75% credit but will not be accepted after that. In addition to the problems to be turned in, further problems may be assigned as exercises. These will not be turned in and graded but doing them will help develop your problem solving skills and thus I strongly suggest you examine them.

**Quizzes (15%):** Four quizzes are planned for the Wednesdays of the 3rd, 5th, 9th, and 11th weeks. These will take the entire period. The quizzes are closed book, However, you will be allowed to bring one 4" × 6" note card (written on one side) to the quizzes. The lowest quiz score will be dropped. No make-ups will be allowed unless you contact me *prior* to the quiz (or if you miss the quiz due to an unforeseen circumstance as soon as possible) with a legitimate excuse for missing the quiz. In addition, I will be very stringent on allowing makeups if you have already missed and made up a quiz.

**Laboratory Exercises (20%):** This portion of the grade will be determined from your laboratory reports and exercises.

**Midterm (15%):** One midterm will be given during a lab period. The midterm is closed-book. However, you will be allowed to bring one 4" × 6" note card (written on both sides) containing any information you wish to the test. As with the quizzes, no make-up will be allowed unless you contact me *prior* to the midterm (or if you miss the midterm due to an unforeseen circumstance as soon as possible) with a legitimate excuse for missing the exam.

**Final (30%):** The final will be comprehensive (covering all areas in the course). As with the midterm the final is closed-book but you may bring two 4" × 6" note cards containing any information you wish.

**“Class Citizenship” (5%):** This portion of the grade will depend on a number of factors. First and foremost it is expected that you will be considerate of your fellow students and me. You won’t come to class late, will be prepared when you arrive and won’t engage in behavior which disturbs the class hindering your fellow students’ ability to learn. You have all paid for the opportunity to be in this class, if you decide not to avail yourself of the opportunity to come to class, fine (attendance is not required), but do not prevent others from getting their money’s worth! If I have to warn you twice during a class to be quiet I will ask you to leave for the day. If I have to warn you three times during the quarter I may ask you to not come back to class permanently.

In addition to the above, cheating will not be tolerated. If you are caught cheating you may lose class citizenship points and at the very least you can expect to get a zero on the assignment and quite possibly for the course. Depending on the infraction additional disciplinary action may be sought.