PHYS124

Particles and Waves

3 Credits

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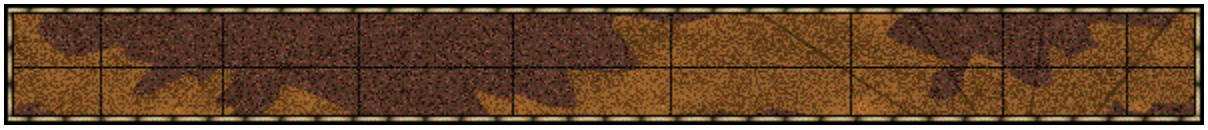
Created: 10/01/2008
Revised: 22/07/2015
Approval: 22/07/2015

The Implementation Date for this Outline is 01/09/2015

PHYS124 Version: 5



Particles and Waves

Calendar Description

Algebra-based course primarily for students in life, environmental, and medical sciences. It guides the student through two distinct types of motion: motion of matter (particles) and wave motion. Vectors, forces, bodies in equilibrium, review of kinematics and basic dynamics; conservation of momentum and energy; circular motion; vibrations; elastic waves in matter; sound; wave optics; black body radiation, photons, de Broglie waves. Examples relevant in environmental, life, and medical sciences will be emphasized.

Rationale

Introductory physics is intended for students interested in further study in pure science such as physics, chemistry, biology, mathematics and also for those who require a working understanding to achieve their career goals in medicine, engineering, geology, geophysics, agriculture and forestry, and environmental sciences. In addition, introductory physics is useful for non-science majors who enjoy science and look for scientific knowledge to heighten their awareness of the physical and material world.

Physics, as a science, is the study of matter and its motion, as well as their interactions in relation to energy, space and time. It deals with concepts such as mass, energy, charge, temperature, etc. It is an experimental science, and whose systems can be mathematically modeled. It provides a clearer understanding of other aspects of pure sciences. One of the joys of learning physics is the understanding of how the natural world applies in all aspects of our lives, from everyday activities like choosing color and type of material to wear in a given season to more far-reaching matters like information transmission through a wire-less network system. Much of the technological advancements witnessed today, including nanotechnology may be attributed to the theoretical and experimental researches in physics. Farmers, Medical doctors, Engineers, Pharmacists, Geologists, Geophysicists and some other professionals benefit in one way or the other from the study of physics.

Prerequisites

Pre-Calculus 30 or Math 30-1

Co-Requisites

None

Course Learning Outcomes

Upon successful completion of this course, students will be able to

1. explain the distinction between particle and wave motion, and understand the interaction of waves and matter.
2. apply concepts related to particles and waves in solving simple physical problems.
3. conduct laboratory experiments that exercise the skills necessary to perform experiments in particles and waves motions, analyze, interpret and report experimental data.
4. develop an appreciation for the basic principles of physics, and in addition confidence.

Resource Materials

***Required Texts*:**
Walker, James S. *Physics*. 2nd Custom ed. Pearson Education, 2012.

University Studies Department, Lakeland College. *Physics 124/126 Laboratory Manual*.

2013-2014. Print.

***Reference Texts*:**
Cutnell, John D., and Kenneth W. Johnson. *Physics*. 9th ed. Hoboken: John Wiley

& Sons Inc., 2012. Print.

Conduct of Course

This is a 3 credit course with 3 hours of lecture 3 hours of lab per week. (3-0-3).

Physics 124 students attend lectures, participate in discussion, and run experiments in the laboratory. The class meets for a total of three hours (lecture/discussion) per week. An additional hour may be scheduled if necessary. The class also meets once a week for a three hour laboratory and computer assisted learning session. The instructor uses transparencies, videos, and computers as educational aids.

If necessary, a proficiency test may be given at the beginning of the course to identify areas of weakness of the students. Students may be asked to provide answers to short quizzes at the beginning and end of some classes to assess the effectiveness of concepts delivery. The results are only to be used to tailor the course to student needs and will not contribute of affect students' grades.

Students are assigned problem sets and are also asked to do end-of-chapter questions as homework. The aim is to give students more practice to enhance their skills in problem solving that is so essential to doing well in this course. The results contribute to the final grade. Solution or solution guide to each assigned problem will be provided and discussed in class following assignment due dates.

Laboratory

There will be approximately 10 laboratory sessions (3 hours each), carried out on a session per week. Students are required to study the "theoretical considerations" of every experiment in advance of the laboratory and complete the section entitled "Advance Preparation" or “prelab assignment” where required before coming to the lab. This should be submitted before or at the start of the laboratory period. The "Prelab Assignment" is designed to help students understand the experiment and to give them step-by-step practice with calculations. Marks are given for its completion.

Students must hand-in their lab reports at the completion of the laboratory period. As a consequence, students should fully prepare themselves before their laboratory sessions.

There is a brief lecture (approximately 10 minutes) on experiments that need theoretical background not covered in the lectures as some lectures and labs schedule may not synchronize with one another. This is because it is often not possible to match the pace of lectures to topic changes in the lab.

Good quality lined note paper and 1 cm fine ruled graph paper (some of which is included at the end of the manual) are used for laboratory reports. A small electronic calculator, a small ruler, a pencil and pen, are also necessary.

In order to eliminate accidents in our laboratory, students are required to read and obey the rules of safety outlined in the manual. Potentially dangerous areas will be clearly marked and safety precautions observed.

Federal and Provincial Legislation (WHMIS) recognize the workers "right" to know about hazardous materials in the workplace. Students carrying out experiments in a lab are considered workers, and the lab is their workplace. Therefore, they need to identify dangerous materials/chemicals in the lab and be able to protect themselves. The required information is provided in what is called Material Safety Data Sheets (MSDS). Students are requested to consult the MSDS before running an experiment. Materials Safety Data Sheets (MSDS) of all chemicals used in the Lloydminster campus chemistry lab can be found in two locations:

1. One set is available in the library. Students can find them in the reference books section or ask the librarian for help.

2. The other set is in the Hazard Information Center in Room 1008 (chemistry lab).

Laboratory Schedule

The labs begin a week after classes start. There are about nine experiments and one lab exam as listed in the Course Units/Calendar section of this outline. These follow the same sequence as found in your lab manual.

Evaluation Procedures

The final grade is an aggregate of the following components:

Assignments	10%
Laboratory*	20%
Midterm Exam**	30%
Final Exam**	40%
Total	100%

* A student must obtain a passing grade of 50% or better in the laboratory to receive a passing grade for the course.

** Related dates will be announced during the first class session.

No supplemental assignments or examination re-writes are permitted in this course, unless in cases where a student is medically un-fit to write the examination at the scheduled date.

Grade Equivalents and Course Pass Requirements

A minimum grade of D (50%) (1.00) is required to pass this course.

Letter	F	D	D+	C-	C	C+	B-	B	B+	A-	A	A+
Percent Range	0-49	50-52	53-56	57-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-100
Points	0.00	1.00	1.30	1.70	2.00	2.30	2.70	3.00	3.30	3.70	4.00	4.00

Students must maintain a cumulative grade of C (GPA - Grade Point Average of 2.00) in order to qualify to graduate.

Attendance

Regular attendance is essential for success in any course. Absence for any reason does not relieve a student of the responsibility of completing course work and assignments to the satisfaction of the instructor. Poor attendance may result in the termination of a student from a course(s).

If you do not meet the established attendance requirements, your instructor will recommend that the Registrar withdraw you from the course. A failing grade of RW (Required to Withdraw) will appear on your transcript.

In cases of repeated absences due to illness, the student may be requested to submit a medical certificate.

Instructors have the authority to require attendance at classes.

Course Units/Topics

Session	Topics
I. General Principles	
1	Introduction, Physics and Measurement: length, mass and time
2	Dimensional analysis, estimates and order-of-magnitude; Significant Figures; Rounding Numbers
3	One dimensional kinematics: position, velocity, speed
4	Analysis Models: Constant / varying velocity, Acceleration (derivatives, motion diagrams)
5	Particle under constant acceleration – falling objects
6	Vectors: Coordinate systems, vector and scalar quantity
7	Components of a vector and unit vectors, properties of vectors
8	Two dimensional kinematics: displacement, velocity and acceleration vectors
9	Two dimensional motion with constant acceleration, projectile motion
II. Force, Work and Energy	
10	The laws of motion: Newton's laws, and the concept of force. Weight versus mass
11	Applications of Newton's laws: Forces of friction
12	Particle in uniform circular motion, tangential and radial acceleration
13	Non-uniform circular motion
14	Work and energy concepts: work done by a constant force
15	Potential and kinetic energies
16	Work done by varying force - integration
17	Conservative and non-conservative forces, relationship between conservative force and potential energy
18	Conservation of energy
19	Midterm Exam
20	Review of Midterm exam
III. Momentum, Motion of System of Particles and Oscillations	
21	Linear momentum and collisions
22	Two dimensional collisions, center of mass
23	Motion of system of particles
24	Rotation of a rigid object about a fixed point. Rotational kinematics
25	Rotational Dynamics and Static Equilibrium
26	Gravity: Universal gravitation, gravitational field and potential energy

27	Oscillatory motion: Motion of object attached to a spring, Simple Harmonic Motion (SHM)
IV. Waves and Quantum Physics	
28	Wave Motion; propagation of a disturbance, traveling wave
29	The speed of Waves on strings, Reflection and Transmission, and Energy Transfer
30	The linear wave equation. Sound waves
31	Doppler Effects
32	Superposition and Standing waves, Resonance
33	Waves in strings and tubes
34	Interference, Diffraction, Huygens Principles
35	Physical Optics: Nature of Light, Measurement of light
36	Electromagnetic Waves
37	Black Body Radiation, Photons
38	de Broglie Waves
39	Uncertainty Principles
40	**Final Examination**

Laboratory Schedule

Session	Topics
1	Graphical Analysis
2	Acceleration Due to Gravity
3	Non-Uniform Motion
4	Atwood's Pulley
5	Potential and Kinetic Energy
6	Collision of a Ball
7	Standing Waves
8	Speed of Sound in Air
9	Interference of Light
10	**Laboratory Test**

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