Butler County Community College
Behavioral Science, Math, Science, and Physical Education
Robert Carlson
Fall 2003

COURSE OUTLINE

Physics I

Course Description: PH251. Physics I. 5 hours credit. Prerequisite: MA151. This course is intended for those students who plan to major in physics, mathematics or other fields of science requiring a more in-depth introduction to physics. A calculus treatment of the general principles of mechanics, heat and sound is offered in this course. There are three single periods of lecture and two double periods of laboratory per week.

Course Relevance: The impact of physics in everyday life is phenomenal. The ability to see physics in action is necessary to develop a fuller knowledge and understanding of the world around us. Physics will enrich the student's appreciation of the world and help him/her better understand the studies of science and the scientific methods.

Required Materials:
Wolfsen. *Essential University Physics* (1st Ed.). Pearson

Learning Outcomes:
The intention is for the student to be able to analyze scientific materials in various forms demonstrating:

1. An understanding of the scientific method
2. An ability to read, communicate and understand scientific materials
3. Knowledge of basic math skills
4. An ability to apply scientific reasoning to real world problems

Primary Learning PACT Skill(s) that will be DEVELOPED and/or documented in this course:
Through the student involvement in this course, he/she will develop his/her ability in the following PACT skill areas:

1. Critical thinking
   - The student will demonstrate scientific reasoning through a variety of mathematical, graphical, experimental, and written assignments.
2. Writing
   - The student will write laboratory reports, which include observations, and analysis of the experiment.
   - The student will write a research paper on an approved topic in physics.

Secondary skills (developed but not documented)
Speaking
Computer literacy
Internet use
Teamwork

Ethical conduct

Major Summative Assessment Task(s):
These learning outcomes and the primary learning PACT skills will be demonstrated by:
1. Write laboratory reports, including purpose, procedural, observations, and analysis of the experiment using scientific reasoning
2. Writing a research paper or preparing a project upon a topic of physics as assigned by the instructor.
3. Final assessment of the course using the departmental final.

Course Content:
I. Themes - Key recurring concepts that run throughout the course:
   A. Scientific method
   B. Scientific reasoning
II. Issues - Key issues that will be addressed in this course: areas of conflict that must be understood in order to achieve the intended outcome:
   A. The balance between the conceptual and mathematical models
   B. The cumulative nature of science and the world
   C. The cumulative influence of scientific discoveries and the subsequent application of the discoveries
   D. The balance between lab physics and computer interfacing, collection and analysis of data
III. Concepts – Key concepts that must be understood to address the issues:
   A. Mathematics
   B. Visual/conceptual
   C. Scientific Methods
   D. Scientific Reasoning
   E. Modeling
   F. Scientific writing
   G. Scientific principles
   H. MLA writing format
   I. Word processing
   J. Excel spreadsheet
   K. Graphing
   L. Characteristics and impact of science in the world around them
IV. Skills/Competencies - Actions that are essential to achieve the course outcomes:
   A. Mathematics
   B. Writing
   C. Reading
   D. Speaking
   E. Computer Literacy
   F. Computer Spreadsheet/Graphing
   G. Internet Use
   H. Teamwork

Learning Units
I. Lecture

A. Units and Problem Solving
   1. define general definitions of physics
   2. describe the system of units and explain its advantages.
   3. check for the correctness of an equation using dimensional analysis. convert units within the SI system, the British system, and between the two systems.
   4. explain the reason for using significant digits, state the correct significant digits in a number and write numbers in scientific (power of 10) notation.
   5. work problems using unit conversions
   6. develop estimating skills
   7. apply the process for problem solving to the solution of exercises.

B. Kinematics
   a. Define position, distance and displacement
   b. Define speed and velocity
   c. Define acceleration
   d. Construct graphs of position versus time, velocity versus time and acceleration versus time
   e. Solve problems using the equations of motion
   f. Solve free fall problems

C. Vectors
   1. define scalar quantities
   2. define vector quantities
   3. define and break down vector units
   4. describe vector position, displacement, velocity, and acceleration
   5. describe and give examples of relative motion

D. Two Dimensional Kinetics
   1. solve two dimensions motion problems
   2. describe the characteristics of projectile motion

E. Newton's Law of Motion
   1. Define and work force problems
   2. define mass
   3. define and work problems using the three Newton's laws

F. Application of Newton's Laws
   1. define and work problems using friction
   2. construct free body diagrams for various string problems
   3. construct free body diagrams for various spring problems
   4. define translational equilibrium
   5. define and work problems using centripetal force

G. Work and Kinetic Energy
   1. define and solve work problems

2. define and solve problems using kinetic energy
3. manipulate the Work-Energy theorem
4. define and work power problems

H. Linear Momentum and Collisions
1. define and work problems using linear momentum and impulse
2. describe the conservation of momentum
3. examine collisions
4. explore the center of mass

I. Rotational Kinetics and Energy
1. explore angular variables
2. manipulate equations for rotational kinematics
3. draw connections with linear variables
4. describe rolling
5. explore rotational kinetic energy

J. Rotational Dynamics and Static Equilibrium
1. define and solve torque problems
2. apply angular momentum
3. discuss rotational work
4. apply vectors in rotational motion

K. Gravity
1. explore Newton's law of universal gravitation
2. discuss Kepler's laws of motion
3. examine gravitational potential energy

L. Oscillations about Equilibrium
1. discuss periodic motion
2. describe simple harmonic motion
3. solve problems with a mass on a spring
4. solve problems with a pendulum
5. Apply the conservation of energy
6. discuss damped and driven oscillations and resonance

M. Waves and Sound
1. discuss the types of waves
2. discuss the various aspects of sound waves
3. describe superposition and interference in waves

N. Fluids
1. describe and work problems in density
2. describe and work problems with pressure
3. examine fluid statics
4. examine fluid dynamics

O. Temperature and Heat
1. define temperature and heat
2. examine thermal expansion
3. work energy transfer problems
4. discuss mechanisms of heat exchange

P. Phases and Phase Changes
1. define and solve problems using the ideal gas equation
2. discuss the mole
3. explore the kinetic theory of gases
4. discuss the mechanical properties of solids
5. explore phase equilibrium
6. define latent heat
7. construct phase diagrams and the relationship of energy conservation

Q. The Laws of Thermodynamics
1. define and apply the zeroth law of thermodynamics
2. define and apply the first law of thermodynamics
3. define and apply the second law of thermodynamics
4. define and apply the third law of thermodynamics

II. Laboratory

A. Working in the laboratory in accordance with good laboratory practices
1. Dress in an appropriate manner as to promote safety in the laboratory.
2. Follow written directions accurately
3. Work safely and effectively, using equipment correctly
4. Demonstrate use of required safety and common laboratory techniques

B. Gather and record qualitative and quantitative data accurately
1. Acquire data using balances and various equipment
2. Make and record visual observations
3. Use computers, when appropriate, as data acquisition tools
4. List or describe experimental assumptions made and any deviations from the written experimental procedures

C. Handle and evaluate data in logical, productive, and meaningful ways
1. Create notebooks and laboratory reports that are clear, understandable, and accurately represent the date collected
2. Display computer data in a spreadsheet or graphically, as appropriate
3. Correlate observations with chemical or physical processes
4. Carry out suitable calculations with quantitative data, recognizing when data and calculates are within a reasonable range
5. Use observations of experimental data to present relevant conclusions pertaining to the experimental procedure

D. Correlate laboratory work with principal topics in General Physics I lecture

Learning Activities:
Independent and collaborative learning activities will be assigned within and outside the classroom and laboratory to achieve the intended course outcomes. Classroom discussion, lecture, and textbook reading assignments will also contribute to the learning process.

Grade Determination:
Grade determination may include tests, projects, quizzes, homework, written assignments and laboratory experiments. Other methods may be used at the discretion of the instructor.