Danny Mattern
Science, Engineering, and Math Division

Revised Spring 2023
Implemented Fall 2023

COURSE OUTLINE
Physics 1

Course Description
PH 251. Physics 1. 5 credit hours. Prerequisite: MA 151 with a C or better. This course will enable the student to study a calculus treatment of the general principles of mechanics, heat, and sound. The student will participate in three hours of lecture / discussion and three hours of laboratory per week. This course is intended for those students who plan to major in physics, mathematics, engineering, or other fields of science requiring an in-depth introduction to physics. The learning outcomes and competencies detailed in this course outline meet or exceed the learning outcomes and competencies specified by the Kansas Core Outcomes Groups project for this course as approved by the Kansas Board of Regents. (Transfers as PHY1030).

Required Materials
For complete material(s) information, refer to https://bookstore.butlercc.edu

Butler-Assessed Outcomes
The intention is for the student to be able to do the following:
1. Demonstrate scientific methods.
2. Demonstrate knowledge of calculus-level math skills as it relates to physics.
3. Apply scientific reasoning to real world problems in physics.

Learning PACT Skills that will be developed and documented in this course
Through involvement in this course, the student will develop ability in the following PACT skill area(s):

Communication Skills
- Creation and delivery of messages - Through a variety of methods using the internet and/or computer, the student will produce a product to express findings for laboratory reports.

Technology Skills
- General computer use - Through electronic-facilitated research and manipulation of data, the student will develop basic computer skills.

Analytical Thinking Skills
- Critical thinking - Through the production of mathematical, graphical, experimental, and written assignments, the student will demonstrate scientific reasoning.

Major Summative Assessment Task(s)
These Butler-assessed Outcome(s) and Learning PACT skill(s) will be demonstrated by the following:
1. Writing (C-skill) and developing a portfolio of computer generated (T-skill) laboratory reports including purpose, procedures, observations, and critical analysis (A-skill) of the experiment using scientific reasoning.

Learning Units

I. Units and problem solving
   A. Define general definitions of physics
   B. Describe the system of units and explain its advantages
   C. Check for correctness of an equation using dimensional analysis
   D. Explain the reason for using significant digits, state the correct significant digits in a number, and write the number in scientific (power of 10) notation
   E. Work problems using unit conversions
   F. Apply the process for problem solving to the solution of exercises

II. 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

III. Vectors
   A. Define scalar quantities
   B. Define vector quantities
   C. Define and break down vector units
   D. Describe vector position, displacement, velocity, and acceleration
   E. Describe and give examples of relative motion

IV. Two-dimensional kinetics
   A. Solve two-dimensional motion problems
   B. Describe the characteristics of projectile motion

V. Newton's Law of Motion
   A. Define force and apply concept to problems
   B. Define mass
   C. Define and work problems using Newton's Laws of Motion

VI. Application of Newton's Laws
   A. Define friction and apply concept to problems
   B. Construct free body diagrams for various string problems
   C. Construct free body diagrams for various spring problems
   D. Define translational equilibrium
   E. Define centripetal force and apply concept to problems

VII. Work and kinetic energy
   A. Define work and apply concept to problems
   B. Define kinetic energy and apply concept to problems
   C. Manipulate the Work-Energy Theorem

D. Define power and apply concept to problems

VIII. Linear momentum and collisions
A. Define linear momentum and impulse and apply concept to problems
B. Describe the conservation of momentum
C. Examine collisions
D. Explore the center of mass

IX. Rotational kinetics and energy
A. Explore angular variables
B. Manipulate equations for rotational kinematics
C. Draw connections with linear variables
D. Describe rolling
E. Explore rotational kinetic energy

X. Rotational dynamics and static equilibrium
A. Define torque and apply concept to problems
B. Apply angular momentum
C. Discuss rotational work
D. Apply vectors in rotational motion

XI. Gravity
A. Explore Newton's Law of Universal Gravitation
B. Discuss Kepler's Laws of Planetary Motion
C. Examine gravitational potential energy

XII. Oscillations about equilibrium
A. Discuss periodic motion
B. Describe simple harmonic motion
C. Solve problems involving a mass on a spring
D. Solve problems using a pendulum
E. Use the conservation of energy
F. Discuss damped and driven oscillations and resonance

XIII. Wave and sound
A. Discuss the types of waves
B. Discuss the various aspects of sound waves
C. Describe superposition and interference in waves

XIV. Fluids
A. Describe density and apply concept to problems
B. Describe pressure and apply concept to problems
C. Examine fluid statics
D. Examine fluid dynamics

XV. Temperature and heat

A. Define temperature and heat
B. Examine thermal expansion
C. Work energy transfer problems
D. Discuss mechanisms of heat exchange

XVI. Phases and phase changes
A. Define and solve problems using the ideal gas equation
B. Discuss the mole
C. Explore the kinetic theory of gases
D. Discuss the mechanical properties of solids
E. Explore phase equilibrium
F. Define latent heat
G. Construct phase diagrams to illustrate the relationship of energy conservation

XVII. The laws of thermodynamics
A. Define and use the Zeroth Law of Thermodynamics
B. Define and use the First Law of Thermodynamics
C. Define and use the Second Law of Thermodynamics
D. Define and use the Third Law of Thermodynamics

Learning Activities
Learning activities will be assigned to assist the student to achieve the intended learning outcome(s) through lecture, instructor-led class discussion, guest speakers, group activities, drills/skill practice, labs, and other activities at the discretion of the instructor. These activities may be either face-to-face or online.

Grade Determination
The student will be graded on learning activities and assessment tasks. Grade determinants may include the following: daily work, lab reports, research papers, quizzes, chapter or unit tests, comprehensive examinations, projects, presentations, class participation, and other methods of evaluation at the discretion of the instructor.