MISSOURI WESTERN STATE UNIVERSITY

COLLEGE OF LIBERAL ARTS AND SCIENCES

DEPARTMENT OF COMPUTER SCIENCE, MATHEMATICS, AND PHYSICS

COURSE NUMBER: PHY 107

COURSE NAME: Introduction to Physics

COURSE DESCRIPTION:

PHY 107 Introduction to Physics (4) Sp. A comprehensive, quantitative study of the concepts and laws of physics. Designed for students majoring in fields other than the physical sciences, mathematics, or engineering. Topics include motion, gravity, electromagnetism, atomic and nuclear physics, optics, and relativity. Three hours of lecture, two hours lab. Not open to the student with credit in PHY110 or PHY210. Prerequisite: ACT math score of 20 or higher or the equivalent.

PREREQUISITE:

Two years of high school algebra or a grade of C or better in MAT 095. Not open to the student with credit in PHY 110 or PHY 210.

TEXT:

Inquiry into Physics, Ostdiek, Edition 6th 08, Cengage L, ISBN 9780495119432
Physics, Webassign, Webassign, ISBN 9781928550204

COURSE OBJECTIVES:

This course is intended to serve as a course option in the natural sciences category of the general studies requirements for a baccalaureate degree. The primary objective of this course is to introduce students to the basic concepts of physics. The primary teaching strategy is the development of problem-solving skills by example and experimentation. Students who complete this course will have met the following objectives:

1. Relate basic physical principles to their application in quantitative and conceptual problem solving (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VII A, VII B, VII E, VIII A, VIII B, VIII C*).

2. Become intimately familiar with the fundamental laws of nature and be able to discuss these laws in "plain language" (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VII A, VII B, VII E, VIII A, VIII B, VIII C*).

3. Solve all problems involving kinematics of particles under the influence of a constant force (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VII A, VII B, VII E, VIII A, VIII B, VIII C*).

4. Understand, state, and give examples of Newton's laws of motion and gravitation and to solve complex quantitative problems involving these laws (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

5. Formulate and solve problems in the calculation of energy and work performed by various physical processes (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

6. Formulate and solve problems in the theory of thermodynamics and the kinetic theory of gases (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VII A, VII B, VII E, VIII A, VIII B, VIII C*).

7. To develop a working knowledge of the technological applications of physics (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

STUDENT COMPETENCIES:

In order to meet the above objectives, successful students will be competent to perform the following functions:

1. Identify and formulate complex problems in physics employing advanced mathematical techniques (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

2. Solve initial value problems involving projectile motion and freely falling bodies (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VII A, VII B, VII E, VIII A, VIII B, VIII C*).

3. Calculate the position of the center of mass of an arbitrary, well defined, three-dimensional solid (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

4. Calculate the work done in compressing an ideal gas, relating this work to the performance of thermodynamic engines (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VII A, VII B, VII E, VIII A, VIII B, VIII C*).

5. Explain and solve problems involving the concepts of heat and thermodynamics, including the ability to derive the universal gas law (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

6. Apply the principles of conservation of energy, momentum, and angular momentum to solve general dynamics problems (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

7. Derive the period of oscillation of the simple pendulum (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

8. Calculate the velocity and pressure of a fluid at any point if these quantities are known at one point (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).
9. Calculate the heat loss through barriers constructed of common materials (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

10. Calculate the efficiency of an ideal thermodynamic engine and to show what processes maximize this efficiency (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

11. Derive the entropy of a specific ensemble of elementary objects from first principles (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VII A, VII B, VII E, VIII A, VIII B, VIII C*).

12. Use the principle of super-position to calculate the intensity of sound from multiple sources (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*)..

13. Use the wave equation of longitudinal and transverse waves to calculate their velocity, frequency, and wavelength (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VII A, VII B, VII E, VIII A, VIII B, VIII C*).

14. Calculate the electric field of highly symmetric distributions of charge using Gauss' law (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VII A, VII B, VII E, VIII A, VIII B, VIII C*).

15. Calculate the electric potential of highly symmetric distributions of charge using Poisson's equation (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

16. Find the capacitance of symmetric arrays of conductors (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

17. Solve plane circuit diagrams for the current through, and potential across, each component using Kirchhoff's circuit laws (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

18. Calculate the magnetic field of given current distributions using the law of Biot-Savart (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

19. Find the inductance of symmetric current distribution (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

20. Derive the parameters of systems of mirrors and lenses using the law of reflection, Snell's law, and Brewster's law (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

21. Determine the transmission and absorption properties via interference of thin films of common materials (*I G, II A, II B, II C, III A, III B, III C, III E, III F, VIII A, VIII B, VIII C*).

COURSE OUTLINE:

I. Newtonian Revolution
   a. Describing Motion
   b. Projectile Motion
   c. Newton's Laws
   d. Circular Motion
   e. Energy
   f. Momentum
   g. Rotational Motion

II. Fluids and Heat
   a. Behavior of Fluids
   b. Temperature and Heat
   c. Heat Engines, 2nd Law of Thermodynamics

III. Electricity & Magnetism
   a. Electric Charge
   b. Electric Fields
   c. Electric Potential
   d. Electric Circuits
   e. Magnets
   f. Magnetic Fields

IV. Wave Motion and Optics
   a. Wave Characteristics
   b. Light Waves and Color
   c. Image Formation

V. The Atom and Its Nucleus
   a. Existence of the Atom
   b. Electrons
   c. Radioactivity
   d. Atomic Spectra and Bohr Model
   e. Quantum Mechanics Structure of the Atom
   f. Nucleus and Nuclear Energy

VI. Relativity and Beyond
   a. Relativity
   b. Elementary Particles
   c. Cosmology

ASSESSMENT:

The stated course objectives and student competencies are assessed through the evaluation of homework exercises, worksheets, quizzes, exams, and in-class participation as determined by the instructor. (Note: The state-level goal and institutional competencies addressed by each course objective and student competency are identified in italics.)

LEGEND

I. **Communicating**

Students will demonstrate the ability to. . .

A. make formal written and oral presentations employing correct diction, syntax, usage, grammar, and mechanics.
B. focus on a purpose (e.g., explaining, problem solving, argument) and vary approaches to writing and speaking based on that purpose.
C. communicate effectively in groups by listening, reflecting, and responding appropriately and in context.
D. use mathematical, statistical, standard quantitative, or various graphical methods to present information with clarity, accuracy, and precision.

II. **Higher-Order Thinking**

Students will demonstrate the ability to. . .

A. recognize the problematic elements of presentations of information and argument.
B. formulate questions for clarifying issues and solving problems.
C. use linguistic, mathematical, or other symbolic approaches to describe problems, identify alternative solutions, and make reasoned choices among those solutions.
D. analyze and synthesize information from a variety of relevant sources and use the results to address complex situations and problems.
E. defend conclusions using relevant evidence and reasoned argument.
F. reflect on and evaluate their critical-thinking processes.

III. **Managing Information**

Students will demonstrate the ability to. . .

A. assess and/or generate information from a variety of sources, including the most contemporary technological information services.
B. evaluate information for its currency, usefulness, truthfulness, and accuracy.
C. organize, store, and retrieve information efficiently.
D. reorganize information for an intended purpose, such as research projects.
E. present information clearly and concisely, using traditional and contemporary technologies.

IV. **Valuing**

Students will demonstrate the ability to. . .

A. recognize the ramifications of ones' value decisions on self and others.
B. recognize conflicts within and between value systems.

V. **Social and Behavioral Sciences**

Students will demonstrate the ability to. . .

A. explain social institutions, structures, and processes across a range of historical period.

VI. **Mathematics**

Students will demonstrate the ability to. . .

A. recognize and use connections within mathematics and between mathematics and other disciplines.
B. read, interpret, analyze, and synthesize quantitative data (e.g., graphs, tables, statistics, and survey data) and make reasoned estimates.
C. formulate and use generalizations based upon pattern recognition.
D. apply and use mathematical models (e.g., algebraic, geometric, statistical) to solve problems.

VII. **Life and Physical Sciences**

Students will demonstrate the ability to. . .

A. explain how to use the scientific method and how to develop and test hypotheses
B. evaluate scientific evidence and argument.
C. describe the basic principles of the physical universe.
D. describe concepts of the nature, organization, and evolution of natural systems.
E. explain the effect of human interactions with natural systems.