MISSOURI WESTERN STATE UNIVERSITY
COLLEGE OF LIBERAL ARTS AND SCIENCES
DEPARTMENT OF COMPUTER SCIENCE, MATHEMATICS, AND PHYSICS

COURSE NUMBER: PHY 210

COURSE NAME: University Physics I

COURSE DESCRIPTION:

This course is a comprehensive study of mechanics, oscillations, waves, and thermodynamics involving simulations, applications, and experimentation. Course assignments require the student to have a thorough knowledge of college algebra, trigonometry, and calculus. Three hours lecture, two hours computer-aided instruction laboratory, two hours experimentation laboratory. Offered fall semester.

PREREQUISITE:

MAT 167

TEXT:

Physics for Scientists and Engineers, Raymond Serway and John Jewett, 9th Edition, 2016, Cengage Learning, ISBN 9781305116429.

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 for this course is to introduce students to the basic concepts of physics using advanced calculation techniques. The primary teaching strategy is the development of problem-solving skills by example and experimentation. Students completing this course will have met the following objectives: (Note: The state-level goal and institutional competencies addressed by each course objective and student competency are identified in parentheses with a legend at the end of the syllabus).

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, 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, III A, III B, III C, III E, III F, VII A, VII B, VII E, 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, VII A, VII B, VII E, VIII A, VIII B, VIII C*).

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

7. Drive 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, VII A, VII B, VII E, 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, VII A, VII B, VII E, 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, VII A, VII B, VII E, 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, VII A, VII B, VII E, 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 intensify of sound from multiple sources (*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*).

COURSE OUTLINE:

I. Physics and Measurement
   - A. Units and Unit Conversions
   - B. Order of Magnitude Problems
   - C. Problem Solving Techniques

II. Kinematics and Dynamics
   - A. Motion in One Dimension
   - B. Motion in Two Dimensions
   - C. Newton's Laws of Motion
   - D. Work and Energy
   - E. Linear Momentum
   - F. Torque
   - G. Angular Momentum
   - H. Static Equilibrium

III. Gravitation
   - A. Newton’s Universal Law of Gravity
   - B. Gravitational Potential Energy
   - C. Kepler’s Laws of Motion

IV. Oscillations and Waves
   - A. Simple Harmonic Motion
   - B. Wave Properties

C. Sound Waves
D. Sound Intensity
E. Doppler Shift

V. Fluid Dynamics
A. Pressure and Density
B. Pascal's Principle
C. Archimedes' Principle and Buoyancy
D. Fluid Dynamics
E. Elasticity
F. Ideal Gas Law

VI. Thermodynamics
A. Temperature
B. Thermal Expansion
C. First Law of Thermodynamics
D. Second Law of Thermodynamics
E. Kinetic Theory of Gases
F. Heat Engines
G. Thermodynamic Work

ASSESSMENT:

The stated course objective and student competencies are assessed through the evaluation of homework exercises, lab reports, worksheets, quizzes, exams, and in-class participation as determined by the instructor.

LEGEND FOR STATE COMPETENCIES

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**

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.