MISSOURI WESTERN STATE UNIVERSITY

COLLEGE OF LIBERAL ARTS AND SCIENCES

DEPARTMENT OF COMPUTER SCIENCE, MATHEMATICS, AND PHYSICS

COURSE NUMBER: PHY 101

COURSE NAME: Physics for the Liberal Arts

COURSE DESCRIPTION:

A comprehensive, descriptive study of the scientific principles of the physical world, including the history of science, motion, energy, cosmology, geophysics, etc. Designed to provide students without significant previous course work in the physical sciences with a solid introduction to the terminology and concepts required for further study. Three hours lecture and two hours laboratory per week.

PREREQUISITE:

None. Not open to the student with credit in PHY 107, PHY 110, or PHY 210.

TEXT:

Physics and Technology for Future Presidents: An Introduction to the Essential Physics Every World Leader Needs to Know, Muller, Edition 10, Perseus D
ISBN 9780691135045

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 goal for this course is to introduce students to the basic concepts and principles of the physical world and to involve them in hands-on laboratory experiences which convey the true nature of the scientific enterprise and which reinforce the underlying principles. In accomplishing these goals, the student will meet the following requirements:

1. State and explain basic principles of the physical world (VIII C).

2. Relate those principles to their application in practical situations (III A, III B, III C, VIII A, VIII B).

3. Become familiar with numerical and graphical methods for displaying data (III E, VII E).

4. Interpret graphical and numerical experimental data (I G, II D, III A, III B, VII C, VII D, VII E).

5. State and apply the basic components of the scientific method (VIII A, VIII B).

6. State and give examples of the applications of Newton's laws of motion (I G, VII E, VIII A, VIII B, VIII C, VIII D).

7. Define energy and momentum and distinguish between them, and explain situations in which these concepts are important (VIII A, VIII B, VIII C, VIII D).

8. Discuss and contrast the three major theories of the atom developed during the Twentieth Century and state the advantages of each model (VIII A, VIII B, VIII C, VIII D).

9. State and explain the postulates of the special theory of relativity (VIII A, VIII B, VIII C, VIII D).

10. Explain the consequences of the postulates of special relativity, including time dilation and length contraction (VIII A, VIII B, VIII C, VIII D).

11. State and discuss the basic laws of electricity and magnetism and the historical development of knowledge of electrical power (VIII A, VIII B, VIII C, VIII D).

12. State the postulate of the quantum theory of matter and the consequences for modern technological development (I A, VII D, VII E, VIII A, VIII B, VIII C).

13. Discuss the development of nuclear technology, including nuclear weapons and commercial nuclear power generation (I A, VIII A, VIII B, VIII C, VIII D).

14. Explain the nature of chemical bonding and chemical reactions (VIII A, VIII B, VIII C).

15. Understand humanity's responsibility to maintain the environment in a state that life will flourish on the earth (VIII A, VIII C, VIII E).

SPECIFIC COMPETENCIES:

Students who have met the objectives listed above will be competent to perform the following:

1. To identify problems where laws of physics are applicable and to apply those principles at an elementary level (I G, II D, II E).

2. To graphically analyze numerical and symbolic information and to draw accurate conclusions from that analysis (I G, III E).

3. To apply the laws of thermodynamics to practical situations encountered in daily experience and explain how those laws govern the physical world (VIII A, VIII B, VIII C).

4. To list the sources of energy used in the development of technology and the advantages and disadvantages of each type (I G, III E, VIII A, VIII B, VIII C).

5. To apply the concepts of energy and momentum conservation to particle collision problems (I G, III E, VIII A, VIII B, VIII C).

6. To apply Newton's three laws of motion to practical situations involving forces and accelerations of objects (I G, III E, VIII A, VIII B, VIII C).

7. To explain the application of atomic and nuclear physics to daily life, including military and commercial applications (I G, III E, VIII A, VIII B, VIII C, VIII D, VIII E).

8. To state the connections between quantum theory and common electron devices such as the diode and transistor (VIII A, VIII B, VIII C).

9. To discuss the connection between the consequences of the postulates of special relativity theory and futuristic concepts such as space travel and time travel (I G, III E, VIII A, VIII B, VIII C).

10. To discuss the role of chemical reactions in living organisms and in the transformation of energy used in commercial applications, i.e., gasoline burning (I G, III E, VIII A, VIII B, VIII C).

11. To relate greenhouse gases to a warming of the earth and the depletion of the earth's ozone layer to a rise in skin cancers (I G, III E, VIII A, VIII B, VIII C).

12. To explain how radioactive wastes are injurious to biological organisms (VIII A, VIII B, VIII C).

COURSE OUTLINE:

1. Energy
   - A. Types of Energy
   - B. Sources of Energy
   - C. Atoms and Molecules
   - D. Temperature and Expansion
   - E. Heat Engines
   - F. Laws of Thermodynamics

2. Motion

A. History of Motion
B. Newton's Laws and Forces
C. Momentum
D. Rotational Motion

3. Nuclear Physics
   A. Atomic Nuclei and Radioactive Decay
   B. Fission and Fusion
   C. Nuclear Power and Research

4. Electricity and Magnetism
   A. Electric Charge
   B. DC Circuits
   C. Magnetism
   D. AC Circuits

5. Waves and Optics
   A. Wave
   B. Light and Color
   C. Mirrors and Lenses
   D. Diffraction and Polarization

6. Global Warming Debate

7. Modern Physics
   A. Quantum Mechanics
   B. Quantum Applications
   C. Special Relativity
   D. General Relativity
   E. The Solar System
   F. The Universe

ASSESSMENT:

The stated course objectives and student competencies are assessed through the evaluation of internet research projects, reading 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.)

SUGGESTED READINGS:

Conceptual Physics, 6th ed., Paul Hewitt, Saunders 1991.

Special Relativity, A. L. Shadowicz, Dover 1987.

The Matter Myth, John Gribbin, Penguin 1992.

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**

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.