PHY 251
GENERAL PHYSICS I

COURSE DESCRIPTION:

Prerequisites: RED 090 or satisfactory score on placement test and MAT 271
Corequisites: MAT 272

This course uses calculus-based mathematical models to introduce the fundamental concepts that describe the physical world. Topics include units and measurement, vector operations, linear kinematics and dynamics, energy, power, momentum, rotational mechanics, periodic motion, fluid mechanics, and heat. Upon completion, students should be able to demonstrate an understanding of the principles involved and display analytical problem-solving ability for the topics covered. Laboratory experiments, some of which are computer-based, and computer-based tutorials enhance and consolidate the basic principles discussed in the theoretical section of the course. *This course has been approved to satisfy the Comprehensive Articulation Agreement for the general education core requirement in natural sciences-mathematics.* Course Hours Per Week: Class, 3. Lab, 3. Semester Hours Credit, 4.

COURSE OBJECTIVES:

Upon completion of this course, the student will demonstrate basic knowledge in the following:

a. Basic international units of physics.
b. Vectors.
c. Motion.
d. Laws of motion.
e. Circular motion.
f. Work and energy.
g. Linear momentum.
h. Rotation of rigid bodies.
i. Angular momentum.
j. Static equilibrium
k. Oscillatory motion
l. Universal gravitation.
m. Mechanics of solids and fluids.
n. Wave motion.
o. Sound waves.
p. Superposition and standing waves.
q. Temperature, thermal expansion, and ideal gases.
r. Heat and the first law of thermodynamics.
s. Kinetic theory of gases.
t. Heat engines and entropy.

OUTLINE OF INSTRUCTION:

I. Measurement
   A. Standards of length, mass and time
   B. Dimensional analysis
   C. Calculations and significant figures

II. Vectors
   A. Coordinate systems
   B. Vectors and scalars
   C. Properties of vectors
   D. Vector components

III. Motion
   A. Velocity
   B. Acceleration
   C. Freely falling bodies
   D. Motion in two-dimensions
   E. Projectile motion
   F. Uniform circular motion
   G. Relative velocity and acceleration

IV. Laws of motion
   A. Force
   B. Newton's first law - inertia
   C. Mass
   D. Newton's second law - weight
   E. Newton's third law - action-reaction
   F. Applications of Newton's laws
   G. Friction

V. Circular motion
   A. Fundamental forces
   B. Newton's second law and uniform circular motion
   C. Nonuniform circular motion

VI. Work and energy
   A. Work
   B. Kinetic energy
   C. Power
   D. Potential energy
   E. Conservation of mechanical energy
   F. Gravitational potential energy
   G. The work-energy theorem
   H. Spring potential energy

VII. Linear momentum

A. Linear momentum and impulse
B. Conservation of linear momentum
C. Collisions in one and two dimensions
D. Center of mass
E. Motion of a system of particles

VIII. Rotation of a rigid body
A. Angular velocity and acceleration
B. Rotational kinematics
C. Relationships between angular and linear quantities
D. Rotational kinetic energy
E. Moments of inertia
F. Torque
G. Work and energy in rotational motion

IX. Angular momentum
A. Vector product and torque
B. Angular momentum of a particle
C. Conservation of angular momentum

X. Static equilibrium
A. Conditions of equilibrium
B. Center of gravity
C. Rigid bodies in equilibrium

XI. Oscillatory motion
A. Simple harmonic motion
B. Mass on a spring
C. Energy of the simple harmonic oscillator
D. The pendulum

XII. Universal gravitation
A. Newton's law of gravity
B. Measurement of the gravitational constant
C. Weight and the gravitational force
D. Kepler's laws
E. Gravitation and planetary motion
F. Gravitational potential energy
G. Energy in planetary motions

XIII. Mechanics of solids and fluids
A. Elastic properties
B. States of matter
C. Density and pressure
D. Pressure measurements
E. Buoyant force and Archimede's principle

F. Laminar and turbulent flow
G. Bernoulli's equation

XIV. Wave motion
A. Types of waves
B. Traveling waves
C. Superposition and interference of waves
D. Velocity of waves on strings
E. Reflection and transmission of waves
F. Energy transmitted by harmonic waves

XV. Sound waves
A. Velocity of sound waves
B. Harmonic sound waves
C. Energy and intensity of harmonic sound waves
D. Spherical and plane waves
E. The Doppler effect

XVI. Superposition and standing waves
A. Superposition and interference of harmonic waves
B. Standing waves
C. Resonance
D. Standing waves in air columns

XVII. Temperature, thermal expansion and ideal gases
A. Temperature and its measurement
B. Thermal expansion of liquids and solids
C. Macroscopic description of an ideal gas

XVIII. Heat and the first law of thermodynamics
A. Heat and thermal energy
B. Heat capacity and specific heat
C. Latent heat
D. Heat transfer
E. The mechanical equivalent of heat
F. Work and heat in thermodynamic processes
G. The first law of thermodynamics

XIX. Kinetic theory of gases
A. Molecular model for pressure of an ideal gas
B. Molecular interpretation of temperature
C. Heat capacity for an ideal gas
D. Adiabatic process for an ideal gas
E. Sound waves in a gas
F. The equipartition of energy

XX. Heat engines and entropy
   A. Heat engines and the sound law of thermodynamics
   B. Reversible and irreversible processes
   C. The Carnot engine
   D. The gasoline engine
   E. Heat pumps and refrigerators
   F. Degradation of energy and entropy
   G. Entropy changes in irreversible processes

REQUIRED TEXTBOOK AND MATERIALS:

Serway, R. A., and Jewett, J. W. Jr. Physics for Scientists and Engineers, with PhysicsNow and Info Trac. Volume 1. 6th ed. Belmont: Thomson Learning, Inc., publishing as Brooks/Cole, 2004.

Gordon, J. R., McGrew, R. V., and Serway, R. A. Student Solutions Manual & Study Guide. Volume 1. 6th ed. Belmont: Thomson Learning, Inc., publishing as Brooks/Cole, 2004.

Programmable scientific calculator.

SUGGESTED REFERENCES, PERIODICALS, AND VISUAL AIDS:

Numerous supplementary texts, programmed materials, and audiovisual packages are available in the Educational Resources Center. These materials may be utilized to reinforce the lecture and lab material or to provide material for independent study by the student.

STATEMENT OF STUDENTS WITH DISABILITIES:

Students who require academic accommodations due to any physical, psychological, or learning disability should request assistance from the Disability Services Coordinator within the first two weeks of class. Likewise, students who potentially require emergency medical attention due to any chronic health condition are encouraged to disclose this information to the Disability Services Coordinator within the first two weeks of class. The Coordinator can be contacted by calling 686-3652, (V/TT), or by visiting the Student Services Office, Room 23, of the White Building.