J. Sargeant Reynolds Community College
Course Content Summary

Course Prefix and Number: PHY 201 **Credits: 4**

Course Title: General College Physics I

Course Description:

Covers classical mechanics and thermodynamics. Includes kinematics, Newton's laws of motion, work, energy, momentum, rotational kinematics, dynamic and static equilibrium, elasticity, gravitation, fluids, simple harmonic motion, calorimetry, ideal gas law, and the laws of thermodynamics. Part I of II. This is a UCGS transfer course. Prerequisite: MTH 161 or MTH 167 with a grade of C or better. Lecture 3 hour. Laboratory 3 hours. Total 6 hours per week. 4 credits.

General Course Purpose:

PHY 201 is the first semester of a two-semester algebra-based introductory physics with laboratory sequence. It provides students with a broad understanding of the general concepts and principles of the physical universe, and prepares the students for their future careers through development of skills in problem solving, critical thinking and quantitative reasoning, and an understanding of the methods of scientific inquiry and experiments.

Course Prerequisites and Co-requisites:

MTH 161 or MTH 167 with a grade of C or better

Student Learning Outcomes:
Upon completing the course, the student will be able to:

Measurements, Units, and Vectors

- Define base physical quantities and derived quantities
- Report measurements of physical quantities using the proper number of significant figures and units
- Convert different units in the same system, and different systems of units
- Differentiate between scalar and vector quantities
- Add and subtract vectors graphically and by resolving them into components
- Perform multiplications of vectors by scalars

Kinematics: Motion in One and Two Dimensions

- Define and calculate displacement, average velocity, and average acceleration
- Differentiate between average and instantaneous quantities
- Interpret and analyze kinematic graphs, and relate position, velocity and acceleration graphs to each other
- Identify and use appropriate equations of motion to describe motion in one dimension (including objects falling under the influence of gravity) and two dimensions (including projectile motion and uniform circular motion)

Newton's Laws of Motion

- Explain Newton's three laws of motion

- Differentiate among mass, weight, and apparent weight
- Draw free-body diagrams for a given physical system
- Describe general characteristics of static and kinetic friction
- Apply Newton's laws to a variety of systems including multiple bodies undergoing linear or circular motions involving horizontal, vertical and inclined planes, strings, and pulleys

Work and Energy

- Define and calculate work done by a constant force
- Calculate work done by a force from force vs position graphs
- Define kinetic energy, gravitational potential energy, and elastic potential energy
- Distinguish between conservative and non-conservative forces
- Apply the Work-Energy principle and the conservation of mechanical energy principle
- Define and calculate power

Collision and Linear Momentum

- Define and calculate linear momentum and impulse
- State the condition for conservation of momentum
- Define elastic, inelastic, and completely inelastic collisions
- Apply conservation of momentum and energy to systems in 1-D and 2-D collision and explosion
- Define and calculate center-of-mass of a system of many point masses

Kinematics and Dynamics of Extended Body Undergoing Rotation, Static Equilibrium, and Elasticity

- Define and calculate angular displacement, average angular velocity and average angular acceleration
- Differentiate between average and instantaneous quantities
- Relate linear and angular quantities to each other
- Define and calculate moment of inertia and rotational kinetic energy
- Find the moment of inertia of an extended body about an axis of rotation
- Apply conservation of energy to rotating rigid bodies
- Define and calculate torque and angular momentum
- Apply Newton's laws of motion to rotational systems
- Apply the conservation of angular momentum principle to rotational systems
- Explain and apply the conditions of static equilibrium
- Define and calculate different types of strain, stress, and modulus

Gravitation

- Explain Newton's law of gravitation
- Calculate the gravitational force between objects
- Define and calculate gravitational potential energy
- Calculate the speed and period of a satellite in a circular orbit
- Explain Kepler's laws of planetary motion

Oscillations

- Define oscillation and mathematically describe simple harmonic motion
- Define amplitude, frequency, period and phase of simple harmonic motion
- Apply conservation of energy principle in a simple harmonic motion
- Analyze the motion of a simple and physical pendulum

Fluid Mechanics

- Define density and pressure and calculate pressure in a fluid

- Explain and apply Pascal's and Archimedes' principles
- Describe and apply equation of continuity and Bernoulli's equation to fluids in motion
- Apply Poiseuille's law and Torricelli's theorem

Thermodynamics

- Describe various temperature scales and convert among different temperature scales
- Define and calculate linear and volume thermal expansion
- Identify the properties of an ideal gas
- Define the ideal gas law and how it relates pressure, volume and temperature
- Apply the ideal gas law to physical situations
- Define heat capacity and latent heats, calculate energy needed to change temperature of a substance and of phase change
- Apply calorimetry principle to thermal system
- Explain mechanisms of conduction, convection, and radiation and calculate heat transfer rates
- Identify the assumptions about the microscopic interactions of particles in an ideal gas
- Relate microscopic quantities of an ideal gas to macroscopic quantities
- Define heat transfer between systems and thermal equilibrium
- Define the first law of thermodynamics and its relation to conservation of energy
- Identify isothermal, isochoric, isobaric, and adiabatic processes
- Apply the first law of thermodynamics to individual thermodynamic processes and cycles
- Interpret P-V diagrams for thermodynamic processes

Laboratory Experience

- Connect topics discussed in lecture to the lab observations
- Work in the lab safely: follow instructions and proper safety procedures
- Recognize and be able to use basic laboratory equipment
- Report measurements using the correct units and number of significant figures
- Use technology for data acquisition and analysis
- Be able to create a graph/chart or diagram to report data
- Interpret graphs, tables, and charts
- Demonstrate written, visual and/or oral presentation skills to communicate scientific knowledge

Major Topics to Be Included:

- Measurements, Units, and Vectors
- Kinematics: Motion in One and Two Dimensions
- Newton's Laws of Motion
- Work and Energy
- Collision and Linear Momentum
- Kinematics and Dynamics of Extended Body Undergoing Rotation, Static Equilibrium, and Elasticity
- Gravitation
- Oscillations
- Fluid Mechanics
- Thermodynamics
- Laboratory Experience