MERCER COUNTY COMMUNITY COLLEGE
COURSE OUTLINE
Revised Spring 2008

PHY101	**College Physics I**
COURSE NUMBER	COURSE TITLE
Science & Allied Health	**15 Weeks**
DIVISION	LENGTH OF SEMESTER

4	**3**	**3**
CREDITS	CLASS HOURS	LAB HOURS

TEXT:

TITLE: COLLEGE PHYSICS
AUTHOR: Serway and Vuille
PUBLISHER: Thompson-Brooks-Cole
EDITION: 8th

TITLE: Experiments in College Physics
AUTHOR: Cioffari
PUBLISHER: D.C. Heath
EDITION: 10th

CATALOG DESCRIPTION:
The first of a two-semester non-calculus sequence intended for engineering technology and related majors. Topics covered include mechanics, heat, sound, and properties of matter. Students who have not taken high school physics may wish to take PHY120 as a preparatory course.

PREREQUISITES: None

COREQUISITES: MAT115

Reading Level: High Writing Level: High

Dominick Misciascio
Course Coordinator

This course is to be divided into three units of five weeks each.

General Objectives:

a. The students will learn that development of classical physics began with Newton about 1600 A.D. and will several other physicists contributed to the experimental mathematical approach to the explanation of natural phenomenon.
b. The students will be taking a parallel non-calculus physics course that is given in most four-year colleges and universities for non-engineering physical science students.
c. The student is expected to have previous knowledge of algebra and will learn how to use calculators, and a previous knowledge of simple trigonometry would be helpful but a concurrent course in trigonometry is acceptable.
d. The students will learn to solve physics problems by applying mathematical logic and methods to prove natural laws of physics and definitions.
e. The student will come to realize that physics is not a course that depends on memorization, that is a course in logic and he/she will be expected to demonstrate this by solving physics problems using mathematical logic and methods.

Specific Objectives:

UNIT I Fundamental Quantities, Kinematics, Dynamics, Statics
(5 weeks)

I. Fundamental Quantities

a. The student will be able to differentiate between fundamental quantities and derived quantities.
b. The student will learn that the three fundamental quantities in physics are mass, length and time.
c. The students will learn that there are three systems of measurement: Metric (M.K.S.), Gaussian (C.G.S.) and British (F.P.S.) and will have to be able to convert from one system to another.
d. The student will come to realize that the metric and gaussian systems are based on decimals and powers of ten, and for these reasons are preferred by the scientific communities.
e. The student will learn the common prefixes used in the Metric systems (deci, centi, milli, micro, kilo) and their scientific notation equivalents.

II. Structure and Properties of Matter

a. The student will learn the nature of matter and the atomic structure of matter.
b. The student will learn the mathematical definitions of density and specific gravity, and be able to solve problems using these definitions.

III. Kinematics – The description of motion

a. The student will learn the mathematical definition of velocity and its units in the three systems of measurement.
b. The student will be able to solve problems dealing with velocity as a vector and speed as a scalar quantity.
c. The student will learn the principle of vector addition and subtraction by solving problems dealing with velocity and displacement by graphical method.
d. The student will learn the mathematical definition and dimension of acceleration in the three systems and to solve problems dealing with acceleration.

e. The student will be able to solve (one-dimensional motion-constant acceleration) problems using the following formula and mathematical logic methods:

1. $v_f = v_o + at$
2. $s = \left(\frac{v_f + v_o}{2} \right) \times t$
3. $v_f{}^2 = v_o{}^2 + 2as$
4. $s = v_o t + 1/2 at^2$

f. The student will be able to solve free-falling bodies

1. $v_f = v_o + gt$
2. $s = \left(\frac{v_f + v_o}{2} \right) \times t$
3. $v_f{}^2 = v_o{}^2 + 2gs$
4. $s = v_o t + 1/2 gt^2$

Where g = -980 cm/sec^2, -9.8M/sec^2, or -32ft/sec^2.

g. The student will be able to use the components of vectors in solving problems dealing with the x- and y- components of velocities and displacements.

h. The student will be able to solve problems dealing with horizontal projection and trajectory motion problems.

IV. Dynamics

a. The student will learn the three laws of Newton and their importance as the foundation of dynamics and physics.

b. The student will learn the mathematical form of Newton's Second Law of Motion. F = Ma.

c. The student will learn the units of force in the three systems of measurement.

d. The student will be able to distinguish the difference between mass and weight.

e. The student will learn the principle of isolating bodies in solving motion problems. (Atwood's machine, elevator, and frictionless incline plane)

f. The student will learn the mathematical formula for Newton's Law of Gravitation:

$$F = \frac{GM_1M_2}{D^2}$$

UNIT ONE <u>TEST</u> SHOULD BE GIVEN AT THIS POINT.

V. Statics and Friction

a. The student, while using the principle of isolating bodies and $F_x = 0$ and $F_y = 0$, will be able to solve simple statics equilibrium problems.

b. The student will learn the definition of center of gravity and apply it to solve static equilibrium problems.
c. The student will learn the mathematical definitions of torque and use it to solve equilibrium of a rigid body problem.
d. The student will learn that the force due to friction which opposed motion and is directly proportional to the normal force and will be able to solve motion problems involving sliding friction.

UNIT II. Conservation of Momentum, and Energy, Rotation, Elasticity and Vibrations (5 weeks)

I. Momentum and Impulse

a. The student will learn the definition of momentum and impulse and their units in the three systems of measurements.
b. The student will learn the law of conservation of momentum and apply the law to solve collision problems.
c. The student will also learn that momentum and impulse are vector quantities and vector analysis will be applied to solve problems.

II. Work, Energy and Power

a. The student will learn the definition of work and energy and their dimensions in the three systems of measurements and that these quantities are scalar.
b. The student will learn the law of conservation of energy and solve problems dealing with this principle.
c. The student will learn the definition of power and its dimensions in the three systems of measurements.

III. Rotation

a. The student will be able to realize that there is a parallel concept between linear motion and rotary motion, and by replacing velocity, acceleration, mass, etc. with rotation symbols and their dimensions in radians, be able to solve problems using the following formula:

	Linear Motion	Rotary Motion
1.	$v_f = v_o + at$	$\omega = \omega_o + \alpha t$
2.	$s = \left(\frac{v_o + v_f}{2} \right) \times t$	$\theta = \left(\frac{\omega_o + \omega_f}{2} \right) \times t$
3.	$s = v_o t + 1/2 a t^2$	$\theta = \omega_o t + 1/2 \alpha t^2$
4.	$v_f{}^2 = v_o{}^2 + 2as$	$\omega_f{}^2 = \omega_o{}^2 + 2\alpha\theta$

b. The parallel dimensions for linear and angular rotations are as follows:

	Linear Metric	Rotations
Distance	S = meters	θ = radians
Velocity	V = m/sec	W = rad/sec
Acceleration	a = m/sec^2	α = rad/sec^2
Mass	M = kg	I = $kg\text{-}m^2$
Force-Torque	F = Newtons	τ = Newton-Meter

c. The student will learn the mathematical definition of centripetal acceleration and force and solve problems dealing with this concept. The types of problems are vertical and horizontal springs, circular motions, and simple pendulum.
d. The student will learn the laws of conservation of rotary energy and rotary momentum and problems dealing with these concepts will be solved.

UNIT TWO TEST SHOULD BE GIVEN AT THIS POINT.

UNIT III Wave Motion

a. The student will learn Hooke's Law in its mathematical form and solve problems dealing with this concept.
b. The student will learn the definition of stress and strain and solve problems dealing with stretch and shear.
c. The student will learn the meaning of simple harmonic motion and will be able to solve problems dealing with this concept. The types of problems are vertical and horizontal springs, circular motions, and simple pendulum.
d. The student will learn the definition of period and frequency as it is used in simple harmonic motion.

II. Sound

a. The student will learn that there are two types of waves: Transverse and longitudinal, and will be able to find the velocity of the wave.
b. The idea of superposition, resonance of wave, beat and standing wave are to be learned by the students and they should be able to solve problems dealing with these concepts.
c. The student will learn the concept of Doppler effect, and to solve problems dealing with this concept.

III. Fluids

a. The student will learn the definition of pressure and its dimension in the three systems of measurement.
b. The student will learn Archimede's principle using these concepts.
c. The student will learn the concept of surface tension.

UNIT THREE TEST SHOULD BE GIVEN AT THIS POINT.

UNIT IV. Heat and Thermodynamics

I. Temperature and Expansion
a. The student will learn to understand the idea of temperature and its application to the four different temperature scales (Fahrenheit, Centigrade, Kelvin and Rankin) and should be able to convert from one temperature scale to another.
b. The students will be taught to do thermal expansion problems involving solids, liquids and gases.

II. Heat and Heat Transfer

a. The student will learn that heat is a form of energy and using the concept of conservation of energy, should be able to solve problems of heat equilibrium in a closed system and its dimensions – calories and BTU.

b. The student will learn that there are three phases of matter, the heat of fusion and heat of vaporization and use these concepts to solve thermal equilibrium problems.

c. The students will learn the three methods of transferring heat (convection, conduction, and radiation) and learn to be able to solve problems dealing with these concepts.

III. The Theory of Heat and Gases

a. The student will learn the definitions of absolute temperature, relative humidity, triple point, boiling point, and general gas laws, and apply them to problems involving these definitions.

b. The students will learn the Carnot cycle as a theoretical engine and refrigerator and how it limits the efficiency of an ideal engine.

UNIT FOUR <u>TEST</u> SHOULD BE GIVEN AT THIS TIME.

EXPERIMENTS

GENERAL OBJECTIVES

I. The student will learn to write a lab report and will be able to collect data in the proper manner.
II. The student will learn to draw graphs and be able to use slope-intercept method to analyze data.
III. The student will learn to write conclusions and make error analysis of his experimental results.
IV. The student will learn to use the micrometer and vernier caliper as part of his/her collecting data.

SPECIFIC OBJECTIVES

I. Measurement

a. The student will learn to use the micrometer and vernier calipers in taking measurement of different regular solids.
b. The students will weigh the objects on a balance scale and find the density of different materials.

II. Free Fall

a. The student will learn from a demonstration experiment how to write a lab report and analyze data.
b. The student will learn the proper way of plotting a graph and use the slope-intercept method to calculate "g".

III. Force Table and Slide Rule II

a. The student will learn vector addition by finding the equilibrium force on a force table. (graphically and mathematically)
b. The student will learn that for static equilibrium:

$F_x = 0$ and $F_y = 0$

IV. Atwood Machine

a. The student will learn to prove Newton's Second Law of Motion to analyze a free body diagram experimentally.
b. The student will be able to plot a graph and by using the slope-intercept method, find the value of "g".

V. Friction

a. The student will be able to find the coefficient of friction of wood against wood by three methods (horizontal broad, incline plane, and critical angle).
b. The student will learn that μ = F/N

VI. Statics

a. The student will find the center of gravity of a rigid body.
b. The student will prove within experimental error the conditions for statics equilibrium is:

$F_x = 0, \quad F_y = 0, \quad T = 0$

VII. Linear Momentum

a. The student will be able to prove the Law of Conservation of momentum within experimental error.
b. The student will be able to apply the Law of Conservation of energy to find the velocity of particles before and after impact.

VIII. Rotation

a. The student will be able to find the value of moment of inertia of a rotating body by experimental and mathematical methods.

IX. S.H.M. and Simple Pendulum

a. The student will be able to use the principle of S.H.M. motion to determine the spring constant by a second method.

X. Velocity of Sound and Standing wave

a. The student will be able to find the velocity of sound in air by using a variable resonance tube.

b. The student will be able to find the frequency of a string vibrator by analysis of a graph of string tension versus wavelength squared.

XI. Hydrostatics

a. The student will be able to prove "Archimede's Principle" in this experiment.

b. The student will be able to determine the specific gravity and density of solids and liquids by applying the "Principle of Hydrostatics."

XII. Coefficient of Linear Expansion

a. The student will be able to find the coefficient of linear expansion of different rods by using the Coefficient of Linear Expansion Apparatus.

XIII. Specific Heat

a. The student will use the principle of conservation of heat energy to find the specific heat of different metals.

XIV. Heat of Fusion and Vaporization

a. The student will be able to determine the value of Heat of Fusion and Vaporization of water by the method of calorimetry.

XV. Mechanical Equivalent of Heat

a. The student will be able to determine the value of Joule's constant by using the conservation of energy theorem in this experiment.

UNIT ONE EXPERIMENTS ARE I THROUGH V.

UNIT TWO EXPERIMENTS ARE VI THROUGH X.

UNIT THREE EXPERIMENTS ARE XI THROUGH XV.

ASSESSMENT

Grading

Unit Tests and Class work	75%
Final Examination (optional)	
Laboratory Work	25%

The above is a recommendation only.

Films in our media center which may be used in this course are:

1. Change of Scale
2. Measurement
3. Time is
4. Time and Clocks
5. Periodic Motion
6. Simple Wave
7. Universal Gravitation

Method of Instruction

Three one hour sessions (1 hr. lecture 2 hrs. recitation) with a maximum of 32 students (10% override) and three hours laboratory sessions with 24 student maximum. Visual and audio aids will be used where applicable. The participation of students in recitation sessions and laboratory sessions is appreciated and welcome. Problems will be assigned and time will be allowed to complete homework before recitation periods are scheduled.

TEXT:	TITLE:	COLLEGE PHYSICS
	AUTHOR:	Serway and Vuille
	PUBLISHER:	Thompson-Brooks-Cole
	EDITION:	8th Ed.

Textbook Assignment

Unit One:	Chapters one to four (3 weeks)
Unit Two:	Chapters five, six, seven, eight (4 weeks)
Unit Three:	Chapters nine to eleven (4 weeks)
Unit Four:	Chapters Twelve to Fourteen (3 weeks)

The above are recommendations only.

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