Adopted: 1980
Reviewed: 1985, 2007, 2011
Revised: 1990, 1998, 2001, 2008, 2011, 2013

Alabama Department of Postsecondary Education

Representing Alabama's Public Two-Year College System

Jefferson State Community College

PHY 213S
General Physics with Calculus I

I. PHY 213 General Physics with Calculus I - 4 Semester Hours

II. **Course Description**
This course provides a calculus-based treatment of the principle subdivisions of classical
physics: mechanics and energy, including thermodynamics. Lab is required.

III. **Prerequisite**
MTH 125 and/or as required by program
Core Area III, ASCI TSCI (Lec 3 hrs, Lab 2 hrs)

IV. **Textbook**
Physics for Scientist & Engineers, 9th edition, Serway & Jewett, publisher Brooks/Cole, Cengage

V. **Course Objectives**
The student will:
A. Gain an understanding of the basic principles and concepts of physics presented.
B. Appreciate applications of physics to the real world.
C. Develop techniques of problem solving.
D. Acquire knowledge to be used in future courses.
E. Develop an aptitude for empiricism (the pursuit of knowledge through observation and experiment)

VI. **Course Outline of Topics**
A. Measurement and mathematical review
B. Vectors
C. Kinematics
D. Laws of motion
E. Work and energy
F. Linear momentum

G. Circular and rotational motion
H. Static equilibrium
I. Universal gravitation
J. Mechanic of solids and fluids
K. Temperature, thermal expansion, heat and gas laws
L. Thermodynamics – laws, kinetic theory of gases, heat engines, entropy
M. Oscillatory motion

Suggested Labs:

A. Graphing and error analysis
B. Measuring, density, area, and volume
C. Measurement of "g" by free fall
D. Ballistic pendulum
E. Projective motion
F. Force table
G. Centripetal force
H. Moment of inertia
I. Equilibrium
J. Young's modules
K. Specific heat
L. Linear expansion
M. Heat of vaporization
N. The gas laws
O. Archimedes principle
P. Hooke's Law – pendulum

VII. GENERAL COURSE COMPETENCIES

A. The student will be able to define the basic quantities of mechanics and will be able to solve problems dealing with these quantities using calculus when appropriate.
B. The student will be able to state and demonstrate an understanding of the two conditions required for equilibrium.
C. The student will acquire understanding of the concepts of linear motion, angular motion, projectile motion, and circular motion.
D. The student will acquire understanding of and be able to apply Newton's laws.
E. The student will acquire understanding of the concepts of energy and momentum and will be able to state and to apply the related conservation principles.
F. The student will demonstrate an understanding of the techniques required to observe carefully and to measure precisely.
G. The student will develop skills in reasoning logically and reporting results concisely from the data obtained.
H. The student will be able to apply the techniques required to understand physical laws and principles by actual experimentation.
I. The student will demonstrate an ability to use the basic tools of measurement as applied to distance, time, and mass.
J. The student will be able to apply the techniques of collecting and analyzing experimental data, including graphic and statistical analysis.

VIII. COURSE OBJECTIVES STATED IN PERFORMANCE TERMS

A. The student will be able to define the basic quantities of mechanics and will be able to solve problems dealing with these quantities using calculus when appropriate. The student will be able to:
   1.State the three quantities of mechanics

2. State the units of length, time, speed, area, volume, force and weight in both the metric and British systems.
3. Define the prefixes for powers of ten which relate to the conversion factors within the metric system.
4. Define force, weight, and mass.
5. Distinguish between a vector quantity and a scalar quantity.
6. Classify each of the following quantities as scalars or vectors: length or distance; displacement; area; time; speed; velocity; mass; force; and weight.
7. Define resultant vector.
8. Add several vectors graphically and analytically.
9. Subtract vectors graphically analytically.
10. Determine the equations of motion of a particle given its position, velocity or acceleration using calculus when appropriate given that $v = dx/dt$ and $a = dv/dt$.

B. The student will be able to state and demonstrate an understanding of the two conditions required for equilibrium. The student will be able to:
1. List and apply the two conditions required for equilibrium.
2. State Newton's laws of motion and be able to give examples of each.
3. Define the moment arm of a force about an axis.

C. The student will acquire understanding of the concepts of linear motion, angular motion, projectile motion, and circular motion. The student will be able to:
1. Solve projectile motion problems.
2. Define centripetal acceleration and force for circular motion.
3. Distinguish between the linear distance and arc length, and angular velocity.
4. Distinguish between linear and tangential velocity and the angular velocity.

D. The student will acquire understanding of and be able to apply Newton's laws. The student will be able to:
1. Distinguish between mass and weight.
2. State and apply Newton's second law.
3. State and apply Newton's law of universal gravitation.

E. The student will acquire understanding of the concepts of energy and momentum and will be able to state and to apply the related conservation principles. The student will be able to:
1. Relate work, energy, and force.
2. Calculate potential energy in the gravitational field.
3. State and apply Hooke's law and calculate the potential energy of the spring.
4. Relate work done by forces to the change in kinetic energy.
5. Relate power to the rate of doing work ($P = dW/dt$).
6. State and apply the principle of conservation of mechanical energy.
7. Define momentum.
8. State the principle of conservation of momentum and apply the principle to elastic and inelastic collisions.

F. The student will demonstrate an understanding of the techniques required to observe carefully and to measure precisely. The student will be able to:
1. Demonstrate correct graphing techniques with cartesian graph paper.
2. Apply various techniques to calculate the initial velocity of a projectile.
3. Apply Hooke's law and to relate this law to simple harmonic motion, both linear and rotational.
4. Observe the motion of simple and physical pendulums and will apply the scientific method to determine the interrelationships between the associated members.

G. The student will develop skills in reasoning logically and reporting results concisely from the data obtained. The student will be able to:
1. Construct a graph on the appropriate scales including units, clearly indicating data points and drawing the best fitting curve.

2.Demonstrate the technique for presenting and analyzing data by the submission of well written laboratory reports.

3.Include as a minimum:

(a) Data in a neat and clearly presented form.

(b) Graphs (where appropriate).

(c) Analysis - the student will discuss the results obtained from his/her collected data, comparing these to the theoretical relationships. In all cases, the student will explain any discrepancies between experimentally derived results and theoretical results.

H. The student will be able to apply the techniques required to understand physical laws and principles by actual experimentation. The student will be able to:

1. Calculate the densities of various materials based on appropriate measurements.
2. Calculate the acceleration due to gravity by both graphical and arithmetic means from the collected data of displacement and time.
3. Place a system of particles in equilibrium.

I. The student will demonstrate an ability to use the basic tools of measurement as applied to distance, time, and mass. The student will be:

1.Demonstrate facility in use of the apparatus by collecting and tabulating data to obtain results within 10% of accepted standards.

2.Correctly use instruments for linear measurement.

3.Collect data from free fall apparatus, inclined plane and the Atwood's apparatus.

4.Collect data on length, period, and mass of oscillating systems.

J. The student will be able to apply the techniques of collecting and analyzing experimental data, including graphic and statistical analysis. The student will be able to:

1.Correctly interpret these graphs and where possible give the algebraic equation derived from the graphs.

2.Produce the mathematical relations and the physical constants from the graphs of his/her data.

3.Interpret the relationships between variables by mathematical and graphical analysis.

4.Resolve forces into components along specified axes and to apply the rotational and translational equilibrium conditions to forces in laboratory situations.

5.Apply the concepts of friction to the solution of problems dealing with motion.

6.Calculate the force applied and the energy dissipated in collisions.

IX. CLASS ACTIVITIES

A. Lecture
B. Discussion
C. Experimentation
D. Demonstrations
E. Written examinations

. **Evaluation and Assessment**

Grades will be given based upon A = 90 – 100%, B = 80 – 89%, C = 70 – 79%, D = 60 – 69%, and F = below 60%.

XI. Attendance

Students are expected to attend all classes for which they are registered. Students who are unable to attend class regularly, regardless of the reason or circumstance, should withdraw from that class before poor attendance interferes with the student’s ability to achieve the objectives required in the course. Withdrawal from class can affect eligibility

for federal financial aid.

XII. Statement on Discrimination/Harassment

The College and the Alabama State Board of Education are committed to providing both employment and educational environments free of harassment or discrimination related to an individual's race, color, gender, religion, national origin, age, or disability. Such harassment is a violation of State Board of Education policy. Any practice or behavior that constitutes harassment or discrimination will not be tolerated.

XIII. Americans with Disabilities

The Rehabilitation Act of 1973 (Section 504) and the Americans with Disabilities Act of 1990 state that qualified students with disabilities who meet the essential functions and academic requirements are entitled to reasonable accommodations. It is the student's responsibility to provide appropriate disability documentation to the College. The ADA Accommodations office is located in FSC 300 (205-856-7731).