



South Central College

## PHYS 221 General Physics I

### Common Course Outline

#### Course Information

<b>Description</b>	This course will provide students with the principles of calculus based physics. The course has been designed for students who plan advanced study of science and/or engineering. The course will cover basic principles of mechanics including kinematics, statics, equilibrium and dynamics of particles, work and energy, rotational motion, gravitation, and oscillation. (MNTC 3: Natural Sciences) Prerequisite: Math 132 - Calculus II, with a "C" or better and High School Physics, PHYS 101 - Introductory Physics or PHYS 211 - Principles in Physics (lab).
<b>Total Credits</b>	4
<b>Total Hours</b>	80

#### Types of Instruction

##### Instruction Type

Credits/Hours

Classroom Presentation

On-Campus Lab

#### Pre/Corequisites

Prerequisite Math 132 - Calculus II with a "C" or better or by instructor permission

Prerequisite High School Physics, Introductory Physics PHYS 101 or Principles in Physics (lab) PHYS 211

#### Course Competencies

**1. Demonstrate proper laboratory safety procedures.**

**Learning Objectives**

Review laboratory safety procedures and practices.  
Demonstrate laboratory safety techniques.  
Understand workspace envelope.

**2. Use measurement, apply units of measurement, and study various physical quantities.**

**Learning Objectives**

Describe and use the International System (SI) of units.  
Develop the ability to convert SI and English units.  
Review length, area, volume, time and mass measurements and their units.  
Acquire an understanding and technique of how to accurately measure different physical characteristics.

**3. Demonstrate and analyze motion in a straight line.**

### **Learning Objectives**

Describe motion.

Identify basic components of position, distance, displacement, velocity and acceleration.

Identify instantaneous velocity and speed.

Describe acceleration and discuss constant acceleration.

Define and interpret average velocity and average speed.

Characterize free-fall acceleration.

Perform graphical representations and analysis of motion.

Review and summarize motion along a straight line.

## **4. Acquire an understanding of vector quantities and perform vector analysis.**

### **Learning Objectives**

Describe the components of vectors and relationship to the X, Y, and Z axis.

Identify vector applications, explain unit and scalar vector portion.

Demonstrate adding vectors geometrically.

Demonstrate adding vectors by their components.

Acquire an understanding of how to multiply vector representations.

## **5. Analyze motion in two and three dimensions.**

### **Learning Objectives**

Explain differences between average velocity and instantaneous velocity.

Explain differences between acceleration and instantaneous acceleration.

Describe and analyze projectile motion.

Discuss uniform circular motion.

Identify basics of relative motion and analyze relative motion in one and two dimensions.

## **6. Describe Newtonian Mechanics and show understanding of the interrelationships between force, motion and Newton's Laws.**

### **Learning Objectives**

Describe Newtonian Mechanics.

Analyze circular motion.

Explain the differences between mass and weight.

Identify the components and units of force.

Discuss and summarize Newton's First Law - Inertia.

Discuss and summarize Newton's Second Law -  $F = m a$ .

Discuss and summarize Newton's Third Law - Action/Reaction Forces.

Define and identify the properties of friction.

Acquire an understanding of drag force and terminal velocity.

## **7. Demonstrate knowledge of kinetic energy's ability to perform work.**

### **Learning Objectives**

Describe and define kinetic energy and provide application examples.

Demonstrate the application of force to accomplish work.

Review different types of energies.

Identify how work is accomplished by gravitational force.

Explain how work is accomplished by using spring force.

Acquire an understanding of power and how it is applied.

## **8. Demonstrate and analyze knowledge of potential energy and the relationship to the conservation of energy.**

### **Learning Objectives**

Describe potential energy and determine values for potential energy.

Explain conservation of mechanical energy.

Implement the reading and interpretation of a potential energy curve.

Study the amount of work done on a system by an external force.

Summarize and contrast potential energy versus kinetic energy.

## **9. Perform methods to determine the center of mass and explain linear momentum.**

### **Learning Objectives**

Describe and determine the center of mass.  
Explain Newton's Second Law for a system of particles.  
Obtain a working knowledge and perform analysis of linear momentum.  
Identify basic components of collisions.  
Explain the concepts of collision and impulse.  
Analyze momentum, impulse and the kinetic energies in collisions.  
Acquire an understanding of inelastic and elastic collisions in one dimension.  
Study and summarize collisions in two dimensions.

## **10. Explain rotation of rigid bodies.**

### **Learning Objectives**

Describe angular forces.  
Explain rotational variables.  
Discuss rotation with constant angular acceleration.  
Analyze and calculate rotational inertia.  
Define and discuss torque.  
Characterize Newton's Second Law as it relates to rotation.  
Study the relationship between work and rotational kinetic energy.

## **11. Study and analyze rolling, torque, and angular momentum.**

### **Learning Objectives**

Study rolling as translation and rotation combinations.  
Explain the kinetic energy of rolling objects.  
Analyze the angular momentum of a system of particles.  
Characterize the angular momentum of a rigid body rotating.  
Discuss the conservation of angular momentum.  
Acquire an understanding of the workings of a precision gyroscope.

## **12. Identify static and dynamics equilibrium and identify basics of elasticity.**

### **Learning Objectives**

Describe and explain static and dynamic equilibrium.  
Analyze examples of static equilibrium.  
Acquire an understanding of indeterminate structures.  
Combine the concept of equilibrium with compatibility of structures.  
Identify basics of elasticity.

## **13. Study gravitation and apply Newton's Law of Gravitation.**

### **Learning Objectives**

Analyze and describe gravitation.  
Explain and apply Newton's Law of Gravitation.  
Characterize gravitation and the principle of superposition.  
Study gravitation near the earth's surface and inside the earth.  
Analyze and study gravitational potential energy.  
Describe relationships of planet and satellite orbits with relation to Kepler's Laws.  
Review Einstein's gravitational concepts.  
Acquire an understanding of satellite orbits with relation to forces and energies.

## **14. Demonstrate fluids impacts on pressure by analyzing density.**

### **Learning Objectives**

Define fluids and describe the two types.  
Explain the relationship between density and pressure of fluids.  
Discuss Pascal's Principle and Archimede's Principle.  
Describe characteristics of fluids at rest.  
Characterize ideal fluids in motion.  
Explain and apply Bernoulli's Equation.

## **15. Explain oscillation motion and demonstrate harmonic motion.**

**Learning Objectives**

Explain simple harmonic motion.

Apply the force law to simple harmonic motion.

Describe the energies in simple harmonic motion.

Utilize and analyze angular simple harmonic motion oscillator.

Contrast and summarize simple harmonic motion and uniform circular motion.

Analyze dampened simple harmonic motion.

Identify the basics of forced oscillations and resonance.