



MERCER
COUNTY COMMUNITY COLLEGE

COURSE OUTLINE

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|---|---|---|
| Course Number PHY 101 | Course Title College Physics I | Credits 4 |
| Hours: Lecture/Lab/Other 3/3/0 | Pre-requisite MAT038 or MAT044 with grade C or better | Implementation Fall 2022 |

Catalog description:

This is the first part of a two-semester sequence of algebra-based physics. Topics include kinematics, dynamics, heat, sound, and properties of matter. Algebra and trigonometry are applied throughout the course. *Lecture 3 hours/lab 3 hours.*

General Education Category: **Goal 3: Science**

Course coordinator:
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Required texts & Other materials:

College Physics, volume I
10th edition
Serway & Vuille
Cengage
ISBN: 978-1285737034

Physics 101 Laboratory
Jing Huang
MCCC Book Store

Scientific Calculator

Course Student Learning Outcomes (SLO):

Upon successful completion of this course the student will be able to:

1. demonstrate understanding of the physics concepts, laws, and principles [Supports ILG #3; PLO #1]
2. Solve theoretical problems by applying physics concepts, laws, and principles. [Supports ILG #2, #3, #10, and #11; PLO #2]
3. Solve laboratory problems by applying their knowledge and experience with modern equipment. [Supports ILG #3, #4, and #11; PLO #3]
4. Demonstrate their knowledge and experience with modern equipment. [Supports ILG #3, #4; PLO #4]
5. Demonstrate ability to communicate effectively [Supports ILG#1, #3, and #4; PLO #5]

Course-specific Institutional Learning Goals (ILG):

Institutional Learning Goal 1. Written and Oral Communication in English. Students will communicate effectively in both speech and writing.

Institutional Learning Goal 2. Mathematics. Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.

Institutional Learning Goal 3. Science. Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.

Institutional Learning Goal 4. Technology. Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.

Institutional Learning Goal 10. Information Literacy: Students will recognize when information is needed and have the knowledge and skills to locate, evaluate, and effectively use information for college level work.

Institutional Learning Goal 11. Critical Thinking: Students will use critical thinking skills understand, analyze, or apply information or solve problems.

Program Learning Outcomes for Physics (PLO)

1. Students are expected to develop a framework of knowledge, including concepts, laws, and principles
2. Students are expected to develop problem-solving skills for theoretical problems
3. Students are expected to develop hands-on problem-solving skills
4. Students are expected to develop hands-on experience with modern laboratory equipment
5. Students are expected to develop communication skills

Units of study in detail – Unit Student Learning Outcomes:

Unit I [Kinematics] [Supports Course SLOs #1, #2, #3, #4, #5]

Learning Objectives

The student will be able to...

- understand measurements, units, and significant figures
- apply algebra and trigonometry in analyzing one and two dimensional motions
- improve problem solving skills by reading word problems and apply basic concepts.
- solve problems involving vectors.

Unit II [Dynamics and Conservation Laws] [Supports Course SLOs #1, #2, #3, #4, #5]

Learning Objectives

The student will be able to...

- understand and apply Newton's laws of motion
- solve problems using work, energy, and conservation of energy
- solve problems using momentum, impulse, and conservation of momentum.

Unit III [Circular Motion and Rotational Motion] [Supports Course SLOs #1, #2, #3, #4, #5]

Learning Objectives

The student will be able to...

- reinforce knowledge on vector in learning circular and rotational motions.
- reinforce problem solving in two dimensional motions.
- understand the basic concepts involved in circular motion and rotational motion
- relate the angular motion to linear motion
- reinforce dynamic through solving problems using torque.

- understand the important concept of equilibrium.

Unit IV [Gravitation] [Supports Course SLOs #1, #2, #3, #4, #5]

Learning Objectives

The student will be able to...

- qualitatively and quantitatively understand Newton's Law of Universal Gravitation
- relate gravity to gravitational constant employed in kinematics.
- relate gravity to circular motion

Unit V [Solids and Fluids] [Supports Course SLOs #1, #2, #3, #4, #5]

Learning Objectives

The student will be able to...

- understand states of matter
- solve problems regarding properties of solids and fluids
- apply the physics principals in understanding the environment.
- apply physics knowledge in environmental protection
- apply physics knowledge in preserving natural resources

Unit VI [Oscillations and Waves] [Supports Course SLOs #1, #2, #3, #4, #5]

Learning Objectives

The student will be able to...

- understand simple harmonic motion and resonance
- quantitatively understand the wave properties, frequency, wavelength, and speed
- understand standing waves
- understand sound waves, intensity, speed
- relate to music in term of wave properties
- understand Doppler effect

Laboratory experiments [Supports Course SLOs #3, #4, #5]

1. Math overview and Measurements
 - Go over arithmetic and algebra required through problem solving
 - Establish laboratory safety rules.
 - Learn to use balances, Vernier caliper, and gated timer to measure mass, length, and time.
 - Use phone to measure time.
 - Learn to record data with proper significant digits
 - Learn to calculate and report results with proper significant digits
 - Learn about the components of lab report.
2. Velocity, acceleration, and free fall motion
 - Measure velocity with rulers and timer
 - Learn to use data acquisition controller and sensors
 - Learn to use data acquisition software
 - Learn to use motion sensor to measure velocity and acceleration
3. Free fall Motion
 - Study the free-fall motion with gated timer

- Learn to graph with Excel
 - Learn to perform linear regression in Excel graphing
4. Two-dimensional vectors: simulation of street-crossing, experiment on projectile motion, force table
 - Numerical simulation of pedestrian street crossing with a car approaching
 - Measurements of projectile motions
 - Learn addition and subtraction of two dimensional vectors with force tables
 5. Atwood machine, Measurements of friction
 - Measure the acceleration of Atwood machine and compare with theoretical value
 - Measure the static friction coefficient by gradually raising the slope
 - Use phone to measure the angle of a slope
 6. Conservation of energy: Slides
 - Measure the horizontal and vertical displacement of a projectile motion
 - Calculate the two dimensional motion
 7. Momentum and Impulse
 - Learn to use motion sensor to record velocity data of an object on a track
 - Calculate the Momentum
 8. Rotational kinematics and dynamics
 - Measure linear motion
 - Calculate angular motion using the recorded data of linear motion
 - Study the rotational motion dynamics
 9. Equilibrium Conditions of a rigid body
 - Learn about torque with real object
 - Measure the location and magnitude of force acting on a rigid body
 10. Archimedes' Principle
 - Measure mass
 - Measure apparent mass
 - Calculate the density of the metal material
 11. Sustainable energy research and presentation
 - Learn the different forms of sustainable energy
 - Research on one form of sustainable energy as a group
 - Learn to make a presentation using power point, poster, or the board
 - Learn to present
 - Learn to ask questions as audience and give constructive feedback
 12. Calorimeter, Specific Heat, and Heat of Fusion
 - Learn to use a calorimeter
 - Learn to measure specific heat by heating metal shots and mix them with colder water
 - Learn to analyze primary sources of error
 - Learn to use calorimeter for more accurate measurements
 - Measure the heat transfer by mixing ice with water
 - Learn to analyze unaccounted source of heat
 13. Simple Harmonic Motions: pendulum and spring
 - Learn to measure the period of pendulum with gated timer
 - Learn to measure the spring constant using static setup
 - Learn to measure the spring constant using dynamic setup of oscillating spring
 14. Air column and sound

- Measure resonance and standing wave using air column using tuning forks
- Record sound intensity using sensors and data acquisition software

Evaluation of student learning:

Students are expected to attend all lectures and laboratory sessions. The evaluation will be based on performance and participation. Tests and quizzes cover both lecture and laboratory materials.

| Course Component | Weight | Notes |
|-------------------|--------|---|
| Tests | 20 % | There is no makeup test. Drop one lowest score. |
| Final, cumulative | 30 % | |
| Laboratory | 20 % | There is no makeup lab. Drop one lowest score. |
| Quizzes | 30 % | |
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