COURSE OUTLINE

Course Number	Course Title	Credits
PHY 115	**University Physics I**	**4**
Hours: Lecture/Lab/Other 3/3/0	**Prerequisite: MAT 146 with grade C or better and One semester of high school or college physics. Co-requisite: MAT 151**	**Implementation Fall 2022**

Catalog description:
The first calculus-based physics course for students majoring in physics, engineering science, computer science, mathematics, and other areas. Topics include kinematics, dynamics, statics, energy, momentum, oscillations, gravity, as well as solid and liquid materials. The laws of physics are investigated and applied to problem solving.
3 lecture/3 laboratory hours

General Education Category:
Goal 3: Science

Course coordinator:
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Required texts & Other materials:

Fundamentals of Physics, volume 1
Halliday & Resnick
John Wiley & Sons
10th Edition
ISBN: 9781118233764

Physics 115 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 teamwork and communication skills

Units of study in detail – Unit Student Learning Outcomes:

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

Learning Objectives
The student will be able to:

- understand measurements, units, and significant figures
- apply trigonometry and basic calculus in analyzing one-, two-, and three-dimensional motions.
- improve problem solving skills by reading word problems and applying basic concepts.
- solve problems involving vectors.
- solve problems in the laboratory.
- learn modern data acquisition and data analysis system
- apply modern data acquisition and data analysis system
- understand and apply motion diagrams

Unit II [Forces] [Supports Course SLOs #1, #2, #3, #4, #5]

Learning Objectives
The student will be able to:

- understand gravity, tension, normal force, and friction
- understand and apply Newton's laws of motion.
- understand and apply force diagrams
- analyze complicated problems
- use Excel to analyze data
- use Excel to perform numerical differentiation and numerical integration.

Unit III **[Energy and Momentum] [Support Course SLOs #1, #2, #3, #4, #5]**

Learning Objectives
The student will be able to:

- understand energy and work
- solve problems using work, energy, and conservation of energy
- solve problems using momentum, impulse, and conservation of momentum.
- understand momentum, impulse, and the impulse-momentum theorem
- learn and apply vector dot and cross multiplications
- qualitatively and quantitatively understand Newton's Law of Universal Gravity
- relate gravity to gravitational constant employed in kinematics.
- relate gravity to circular motion

Unit IV **[More Motions and Forces] [Support Course SLOs #1, #2, #3, #4, #5]**

Learning Objectives
The student will be able to:

- understand and solve problems in rotational motions
- understand and solve problems in rotational equilibriums
- understand and solve problems in simple harmonic motions including pendulums and springs
- qualitatively and quantitatively understand Newton's Law of Universal Gravity
- relate gravity to gravitational constant employed in kinematics.
- relate gravity to circular motion
- understand states of matter
- solve problems regarding properties of solids and fluids

Laboratory experiments: [Support Course SLOs #3, #4, #5]

1. Measurements and Math overview

- Go over algebra and calculus required through problem solving
- Establish laboratory safety rules.
- Learn to use balances, Vernier caliper, stopwatch, and gated timer to measure mass, length, and time.
- Learn to record data and process data with proper significant digits
- Learn about the components of lab reports.

2. Velocity and Acceleration

- Measure velocity with rulers and timer
- Learn to use data acquisition tools
- Learn to use data acquisition software
- Learn to use motion sensors to measure velocity and acceleration
- Learn to perform numerical differentiation using Excel.
- Learn to use calculus to calculate velocity and acceleration

3. Free Fall & Vectors

- Study the free-fall motion with gated timer
- Learn to graph with Excel

- Learn to perform linear regression in Excel
- Learn to use force table to study vector addition and subtraction
- Learn to apply trigonometry in vector analysis

4. Projectile Motion

- Numerical simulation of pedestrian street crossing with a car approaching
- Measurements of projectile motions
- Apply trigonometry in vector analysis
- Apply calculus in analyzing the acceleration

5. Atwood Machine and Application of Newton's Laws

- Measure the acceleration of Atwood machine and compare with theoretical value
- Analyze the motion with constant acceleration using calculus

6. Friction and Application of Newton's Laws

- Measure the static friction coefficient by gradually raising the slope
- Use trigonometry for force analysis

7. Sustainable Energy Research & Presentation

- Research diverse types of sustainable energy and application.
- Learn to present
- Learn to be a good audience

8. Pendulum and Slide, Conservation of Energy

- Measure the horizontal and vertical displacement of a projectile motion
- Calculate the two-dimensional motion

9. Collision, Conservation of Momentum

- Learn to use motion sensor to record velocity data of an object on a track
- Calculate momentum using Excel
- Apply calculus in calculating velocity and momentum
- Apply calculus in calculating impulse

11. Rotational Motion

- Measure linear motion
- Numerical differentiation and integration using Excel
- Calculate angular motion using the recorded data of linear motion
- Study rotational motion dynamics

12. Rotational Equilibrium

- Learn about torque with real objects
- Measure the location and magnitude of force acting on a rigid body

13. Archimedes' Principle

- Measure mass
- Measure apparent mass

- Calculate the density of the material

14. Simple Harmonic Motion, Pendulum and Spring

- Learn to measure the period of pendulum with gated timer
- Learn to measure spring constants using static setup
- Learn to measure spring constants using dynamic setup of oscillating spring
- Apply calculus in calculating the period of the motion.

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 %	