COURSE OUTLINE

Course Number	Course Title	Credits
PHY 109	Fundamentals of Physics	**3**
Hours: Lecture/Lab/Other 2/2/0	**Pre-requisite** MAT 038 or MAT 042	**Implementation Fall 2022**

Catalog description:
An introduction to the fundamental principles - underlying science and technology - of physics. Intended for the health fields, life sciences, and other areas requiring basic physics literacy. Topics of emphasis include Newtonian mechanics, work and energy, electricity and magnetism, electromagnetic waves, optics, atomic and nuclear physics. *2 lecture/2 laboratory hours*

General Education Category:
Goal 3: Science

Course coordinator:
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Required texts & Other materials:

Inquiry into Physics
Ostdiek & Bord
Thomson Brooks/Cole
7th Edition
ISBN13: 9781133104681

PHY109 Laboratory Manual
By Kenneth Klouda
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 [Mechanics] [Support Course SLOs #1, #2, #3, #4, #5]

Learning Objectives
The student will be able to:

- Use proper scientific notation in computation and laboratory reports.
- Use the SI units (and their metric prefixes) in the solution of problems.
- Know and apply Newton's laws of motion in the measurement and computation of velocity, acceleration, and force.
- Know and apply the Law of Conservation of Energy and the Work Energy Theorem in the measurement and computation of work, energy, and mechanical power.
- Recognize simple machines and compute their effect on force and work.
- Construct graphs and analyze graphs of motion. Calculate and analyze the meaning of the slope in graphs of motion. Use Excel to produce graphs for the laboratory data.

Unit II [Electricity and Magnetism] [Support Course SLOs #1, #2, #3, #4, #5]

Learning Objectives
The student will be able to:

- Use the First Law of Electrostatics and Coulombs Law to predict (qualitatively and quantitatively) the behavior of electrical charges.
- Construct and analyze simple electrical circuits including series and parallel circuits.

- Measure and compute voltage, current, resistance, and power using Ohm's law and the electrical power equation.
- Use the right-hand rules to describe and predict the motion of charges in the presence of magnetic fields.
- Demonstrate an understanding of electromagnetic induction through the construction of a simple motor, generator, transformer, and speaker.
- Measure and compute amplitude, frequency, and period using AC currents. Understand diodes and rectification of AC current.

Unit III [Electromagnetic Radiation and Waves] [Support Course SLOs #1, #2, #3, #4, #5]

Learning Objectives
The student will be able to:

- Identify and describe various regions of the electromagnetic spectrum in terms of frequency, energy, and wavelength. Provide examples of applications for each region. Identify ionizing and non-ionizing regions of the spectrum. (SLO #2)
- Understand and calculate basic wave properties of amplitude, frequency, wavelength, period, and velocity of propagation. (SLO #1, #2)
- Construct and use ray diagrams to understand reflection, refraction, diffraction, image production, and magnification. (SLO #2)

Unit IV [Atomic and Nuclear Nature of Matter] [Support Course SLOs #1, #2, #3, #4, #5]

Learning Objectives
The student will be able to:

- Describe the structure of the atom in proper scale. Use periodic table to determine number of protons and neutrons in elements and isotopes. (SLO #1, #2)
- Describe the Photoelectric Effect. Use Planck's constant to calculate energy. (SLO #1, #2)
- Describe the Bohr Model of the atom. Construct energy level diagrams. Understand the origin of spectral lines and measure their wavelength. (SLO #1, #2)
- Describe alpha, beta, and gamma decay and balance nuclear decay reactions. (SLO #2, #3, #4, #5)
- Describe, measure, and graph (including semi-log graphs) radioactive decay rates and half-life. Characterize the units of radioactive decay, Becqurel and Curie; and radioactive dose,Grey, RAD, Rotogen, REM, and Sievert. (SLO #2, #4)
- Understand absorber thickness. Measure and graph ½ thickness for gamma radiation. (SLO #2, #4)

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

1. Measurement and graphing

- Go over arithmetic and algebra required through problem solving
- Establish laboratory safety rules.
- Learn to use balances, Vernier caliper, stopwatch, and gated timer to measure mass, length, and time.
- Introduction to data analysis using Excel

2. Free fall motion

- Study the free-fall motion with gated timer
- Learn to graph with Excel
- Learn to perform linear regression in Excel

3. Projectile motion

- Measurements of projectile motions

4. Automated data acquisition

- Data acquisition and data processing system
- Motion sensor
- Data Studio software

5. Conservation of energy

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

6. Ohm's law

- Ammeter and voltmeter measurements
- Circuit construction and circuit diagram
- Data acquisition and analysis

7. Electric speaker

- Application of circuits

8. Earth's magnetic field

- Learn about earth's magnetic field.
- Research the magnitude and direction of the earth's magnetic field at the location of the lab

9. Calorimeter and specific heat

- Learn to use a calorimeter
- Learn to measure specific heat by heating metal shots and mixing them with colder water
- Learn to analyze possible sources of error

10. Heat of fusion

- Learn to use calorimeters for more accurate measurements
- Measure the heat transfer by mixing ice with water
- Learn to analyze unaccounted source of heat

11. Reflection and refraction

- Use pins and plastic blocks to study light refraction
- Laser safety
- Use laser and plastic block to study light reflection
- Study total internal reflection

12. Mirrors

- Study spherical mirrors
- Optical diagram

13. Lenses

- Study converging and diverging lenses
- Optical diagram

14. Atomic spectrum and Radiation

- Learn to align the spectrometer, sample, and light source
- Learn to observe first and second order spectral lines
- Radiation safety
- Learn to use Geiger counter
- Learn to measure radiation from beta source

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 %	