COURSE OUTLINE

Course Number	Course Title	Credits
PHY 215	**University Physics II**	**4**
Hours: Lecture/Lab/Other 3/3/0	**Pre-requisite PHY 115 with grade C or better & MAT151 with grade C or better**	**Implementation Fall 2022**

Catalog description:
The second 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 2
Halliday & Resnick
John Wiley & Sons
10th Edition
ISBN: 978-1118230732

Physics 215 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 [Electricity] [Supports Course SLOs #1, #2, #3, #4, #5]

Learning Objectives
The student will be able to:

- Understand electrical charges, capacitor, electrical fields, and electrical potential
- Learn and apply resistor properties
- Apply Coulomb's law to solve problems
- solve problems using Gauss' Law
- apply physics knowledge in preserving natural resources

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

Learning Objectives
The student will be able to:

- Understand the circuit elements, resistors, capacitors, inductors, as well as power source and switches.
- generate and interpret circuit diagrams.
- solve problems applying Ohm's Law
- Learn and apply circuit design and testing tools including multisim.com
- Learn and test grounding, switching, and wiring
- Learn to use meters including voltage meter, current meter, capacitor meter, and multimeters.

Unit III **[Magnetism] [Supports Course SLOs #1, #2, #3, #4, #5]**

Learning Objectives
The student will be able to:

- Understand magnetic field, induction, and inductance
- Solve problems related to electricity generation
- Apply physics knowledge in preserving natural resources
- Learn and use lab equipment to determine the earth's magnetic field strength.
- Learn and use morning data acquisition system
- Learn to use Excel for contour plot

Unit IV **[Electromagnetic oscillations and waves] [Support Course SLOs #1, #2, #3, #4, #5]**

Learning Objectives
The student will be able to:

- Understand how electromagnetic fields are generated
- Measure the strength of electromagnetic field
- Understand the various electromagnetic fields in the environment
- Understand the different forms of electromagnetic waves
- Solve problems applying the wave properties
- Understand the environmental elements related to the electromagnetic waves.

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

1. Math Overview

- Go over algebra and calculus required by solving problems
- Learn to record data and graph using Excel
- Establish laboratory safety rules.
- Learn about lab report rules

2. Electric Field

- Learn to draw electric field diagram of isolated charge, parallel plates, and pair of point charges
- Learn to construct a circuit for measuring electric potential of a grid
- Learn to measure and record electric potential of a grid using a voltmeter
- Apply calculus in deriving electric field from electric potential.
- Apply calculus in understanding that the electric field lines are perpendicular to the electric equipotential lines.

3. Equipotential Surface

- Learn to construct a circuit for measuring electric potential of a grid
- Learn to measure and record electric potential of a grid using a voltmeter
- Use Excel to analyze equipotential data and generate three-dimensional contour plots.

4. Circuit Diagram & Construction

- Learn to identify basic circuit elements in circuit diagram
- Learn to construct simple circuits with lab equipment
- Always use a circuit breaker for safety and conservation of energy

5. Capacitors

- Use capacitor meter to measure isolated capacitance
- Use capacitor meter to measure capacitors connected in series or parallel
- Use capacitor meter to study the relationship between capacitance and the plate separation
- Use Excel to graph the capacitance and plate separation relationship
- Use Excel to analyze the relationship between capacitance and plate separation

6. Ohm's law

- Ammeter and voltmeter measurements
- Data acquisition and analysis
- Use Excel to process graphing and linear regression

7. Wheatstone bridge

- Learn to read multi-loop circuit diagram
- Learn to construct multi-loop circuits
- Learn to analyze circuits
- Learn to use Galvanometer, move slider, and find zero balance

8. Kirchhoff's law

- Understand multi-loop circuit
- Calculate multi-loop circuit

9. RC circuit

- Use data acquisition system
- Learn to construct a circuit to charge a capacitor
- Learn to construct a circuit to discharge a capacitor
- Learn to use a voltage sensor to record the voltage on the capacitor
- Calculate RC time constant based on resistance and capacitance
- Introduce the transition from static circuits to oscillating circuits

10. e/m ratio

- Understand magnetic field generation using electric current
- Understand generating free electrons
- Understand how to accelerate free electrons
- Circular motion of electrons in a magnetic field

11. 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
- Learn to orient the compass so that the magnetic field generated by the wire loops will be perpendicular to the natural magnetic field of the earth on the horizontal surface
- For the center of the wire loop, calculate the magnitude of the magnetic field

12. Induced voltage

- Use GLX and voltage sensor
- Measure the induced voltage
- Drop a bar magnet and let it fall through a solenoid
- Record the voltage data of the generated electricity

- Record data with different initial height
- Record data with magnetic initial orientation
- Apply calculus in interpreting the change of magnetic flux and induced voltage.

13. Current balance

- Learn high voltage safety
- Review and apply rotational equilibrium
- Practice designing experiments

14. Magnetic Field detection

- Use GLX and magnetic field sensor
- Apply calculus in interpreting the magnetic field

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 %	