J. Sargeant Reynolds Community College
Course Content Summary

Course Prefix and Number: <u>PHY 202</u> **Credits:** <u>4</u>

Course Title: <u>General College Physics II</u>

Course Description:

Covers waves, electromagnetism, optics, and modern physics. Includes mechanical waves, sound, electrostatics, Ohm's law and DC circuits, magnetic forces and magnetic fields, electromagnetic induction, ray optics, wave optics, and selected topics of modern physics. Part II of II. This is a UCGS transfer course. Prerequisite: PHY 201 with a grade of C or better and MTH 162 or MTH 167 with a grade of C or better. Lecture 3 hour. Laboratory 3 hours. Total 6 hours per week. 4 credits.

General Course Purpose:

PHY 202 is a second semester of a two-semester algebra-based introductory physics with laboratory sequence. It provides students with a broad understanding of the general concepts and principles of the physical universe, and prepares the students for their future careers through development of skills in problem solving, critical thinking, quantitative reasoning, and an understanding of the methods of scientific inquiry and experiments.

Course Prerequisites and Co-requisites:

PHY 201 with a grade of C or better and MTH 162 or MTH 167 with a grade of C or better.

Student Learning Outcomes:
Upon completing the course, the student will be able to:

Mechanical Waves and Sound
- Define periodic mechanical waves and describe different types of mechanical waves including sound waves
- Represent sinusoidal waves using a mathematical expression
- Calculate the speed of waves propagating in a stretched rope/string
- Calculate the intensity level of a sound wave from the intensity of the sound wave and vice versa
- Explain interference and superposition of mechanical waves
- Describe the basic properties of standing waves and beats and how they are generated
- Calculate the wavelengths and frequencies of standing waves on strings and pipes, and frequency of beats
- Apply the Doppler Effect to soundwaves.

Electrostatics
- Identify the two types of electrical charges and explain how they interact
- Define and apply Coulomb's law to find the force between charged particles in physical situations
- Identify the relationship between electric force and electric field
- Calculate the electric field for various charge distributions
- Define electric flux and Gauss's law
- Utilize Gauss's law to find electric field and electric flux based on charge distribution
- Define the potential energy between two point charges
- Relate electric potential energy to electric potential
- Calculate the electric potential for various charge distributions
- Relate the electric field lines to equipotential surfaces

Circuits

- Define capacitance and describe how it relates to charge and electric potential
- Calculate the capacitance of a parallel-plate capacitor using the geometry of the capacitor
- Calculate the equivalent capacitance for series and parallel combinations of capacitors
- Define current and relate it to the flow of charges
- Define resistance in terms of resistivity and geometry for a resistor
- Define and apply Ohm's law
- Identify ohmic and non-ohmic materials based on I-V graphs
- Calculate the equivalent resistance for series and parallel combinations of resistors
- Define batteries as sources of constant electric potential in a circuit
- Differentiate between ideal batteries and real batteries
- State Kirchhoff's laws and apply them to multiloop circuits
- Identify RC circuits and their mechanical equivalents
- Discuss how the electric potential and current varies with time in RC circuits

Magnetism

- Identify the poles of a magnet and relate them to the magnetic field
- Define the magnetic force acting on charged particles and current carrying wires, and calculate it for physical situations
- Identify the sources of magnetic fields
- Calculate magnetic fields based on currents
- Define Ampere's law and use it to relate currents and magnetic fields

Electromagnetic Induction

- Define magnetic flux and Faraday's law
- Apply Faraday's law to physical situations
- Relate the input and output voltage and current of transformers to the number of turns in their respective coils
- Define mutual and self-inductance and relate it to the geometry of the device
- Explain how an inductor affects the current in a circuit
- Identify RL and RLC circuit and their mechanical equivalents
- Discuss how the electric potential and current varies with time in RL and RLC circuits
- Differentiate between AC and DC

Electromagnetic Waves

- Define displacement current and how it relates to a changing electric field
- Explain how electric and magnetic fields form a wave
- Use Maxwell's equations to show that the speed of light is related to the permittivity and permeability of free space
- Describe the electromagnetic spectrum

Optics

- Identify the relationship between the incident angle, refracted angle and reflected angle when light hits a surface
- Identify and calculate how the path of light changes when refracting in a material
- Identify the conditions for total internal reflection and calculate the critical angle
- Define dispersion and its relationship to wavelength and index of refraction
- Use ray diagrams to form images using mirrors and lenses
- Determine the relationship between object distance, image distance, focal length, and magnification for mirrors and lenses
- Define diffraction for light and describe how wavelength and aperture size affects diffraction

- Identify how slit separation, wavelength, screen distance, and order number for Young's double slit experiment affect the interference pattern
- Calculate the location of the dark and bright fringes for Young's double slit experiment and single slit diffraction
- Differentiate between polarized and unpolarized light
- Apply Malus' law to determine the intensity transmitted through multiple polarizers

Modern Physics (Nuclear, Atomic)
- Explain blackbody radiation and how it led to the quantization of energy
- Explain the photoelectric effect and how it led to the particle interpretation of light (photon)
- Define the de Broglie hypothesis and use it to calculate the frequency and wavelength for particles
- Define Compton scattering and use it to calculate the change in momentum of a photon
- Describe Bohr's model of the atom and use it to calculate the energy of electron orbits and the energy of the photon released when an electron changes orbits for a hydrogen atom
- Explain atomic spectra of atoms
- Differentiate between alpha, beta and gamma radiation and explain how each type of radiation affects the mass of the nucleus and atomic number
- Calculate the number of nuclei remaining in a sample and the activity for a sample undergoing radioactive decay
- Define the binding energy for the nucleus of an atom
- Explain the processes of nuclear fission and fusion and how energy is produced in each

Laboratory Experience
- Connect topics discussed in lecture to the lab observations
- Work in the lab safely: follow instructions and proper safety procedures
- Recognize and be able to use basic laboratory equipment
- Report measurements using the correct units and number of significant figures
- Use technology for data acquisition and analysis
- Be able to create a graph/chart or diagram to report data
- Interpret graphs, tables, and charts
- Demonstrate written, visual and/or oral presentation skills to communicate scientific knowledge

Major Topics to Be Included:

- Mechanical Waves and Sound
- Electrostatics
- Circuits
- Magnetism
- Electromagnetic Induction
- Electromagnetic Waves
- Optics
- Modern Physics (Nuclear, Atomic)
- Laboratory Experience

Effective Date/Updated: February 1, 2023