J. Sargeant Reynolds Community College
Course Content Summary

Course Prefix and Number: PHY 242 **Credits: 4**

Course Title: University Physics II

Course Description:

Covers waves, electromagnetism and optics. Includes mechanical waves and sound, electrostatics, Ohm's law and DC circuits, magnetic forces and magnetic fields, electromagnetic induction, AC circuits, ray optics, and wave optics. Part II of II. This is a UCGS transfer course. Prerequisite: PHY 241 with a grade of C or better and MTH 264 with a grade of C or better. Part II of II. Lecture 3 hour. Laboratory 3 hours. Total 6 hours per week. 4 credits.

General Course Purpose:

PHY 242 is the second semester of a two-semester calculus-based introductory physics with laboratory sequence. It provides the student with a broad understanding of the general concepts and principles of the physical universe, and prepares the student for advanced study in physical sciences and engineering through development of skills in problem solving, critical thinking and quantitative reasoning, and an understanding of the methods of scientific inquiry and experiments.

Course Prerequisites and Co-requisites:

PHY 241 with a grade of C or better and MTH 264 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 properties of waves on a stretched rope/string
- Calculate the intensity of sound waves in decibel
- Explain interference and superposition of mechanical waves
- Discuss properties of standing waves on a string and in pipes
- Analyze normal modes of a wave on a string and in pipes

Electrostatics

- Describe nature of electric charges, differences between conductors and insulators, and explain induction and polarization of charges
- Explain Coulomb's law
- Calculate electrostatic force for a collection of charges
- Define electric field, and calculate electric field due to one or more charges at a point in space
- Explain properties of electric field lines
- Calculate the electric field due to a uniform distribution of charges on a straight line, on a ring, on a disk and other standard geometric shape

- Define and calculate electric flux
- Explain the importance of Gauss's law
- Apply Gauss's law to find the electric field due to uniform distribution of charges along a line, on a surface etc.
- Discuss implication of Gauss's law on the distribution of charges on a conductor
- Define and calculate electric potential energy and electric potential
- Explain properties of equipotential lines (surfaces) and their relationship with electric field lines
- Calculate the electric field and potential due to a uniform distribution of charges on a straight line, on a ring, on a disk and other standard geometric shape
- Discuss electric dipole and calculate the torque experienced and electric potential energy stored by an electric dipole under the influence of an external electric field
- Describe capacitors and their role in electrical system
- Determine the equivalent capacitance of capacitors connected in series and in parallel
- Describe the role of dielectric material in a capacitor
- Calculate energy stored in a capacitor

Ohm's Law and DC Circuits

- Define electric current and current density
- State Ohm's law and define resistance and resistivity of materials
- Analyze simple circuits and define power dissipated through a resistor
- Discuss underlying rules and calculate equivalent resistance of series and parallel combinations of resistors
- State and apply Kirchhoff's rules to analyze multiloop circuits
- Correctly connect voltage and current measuring devices in a circuit
- Discuss and analyze R-C circuit

Magnetism

- Describe the properties of magnets and magnetic fields
- Define the magnetic flux and application of Gauss's law for magnetic flux
- Describe the motion of a charged particle when placed in electric and magnetic field and applications
- Describe the magnetic field due to a moving charged particle
- Calculate the magnetic field generated by a moving charge
- Use Biot-Savart law to calculate the magnetic field due to different configurations of current carrying wires
- Calculate magnetic force on a current carrying wire in a uniform magnetic field as well as force and torque on a current carrying loop
- Calculate force between two parallel current carrying conductors.
- Describe and apply Ampere's law to calculate magnetic field due to different current carrying wire configurations

Electromagnetic Induction and AC Circuits

- State Faraday's law and Lenz's law
- Calculate the induced and motional electromagnetic force (EMF)
- Define and calculate mutual inductance and self-inductance
- Describe properties of an inductor
- Calculate energy stored in an inductor
- Analyze R-L and L-C circuits
- Define phasor and describe a phasor diagram
- Define and calculate reactance of an inductor and a capacitor
- Analyze the L-R-C series circuits with an AC source
- Describe role of transformer in electrical systems

Electromagnetic Waves

- Describe Maxwell's equations
- Explain how electromagnetic waves are produced and travel through space
- Describe the electromagnetic wave spectrum
- Describe the EM waves mathematically and calculate the intensity of EM waves

Ray Optics

- Describe the nature of light and propagation of light in terms of rays
- Define the index of refraction of a medium
- Describe and apply the laws of reflection and refraction (Snell's law)
- Explain the conditions necessary for total internal reflection
- Describe dispersion and polarization
- Use ray diagrams to form images using plane and spherical mirrors and thin lenses
- Use image formation equations and describe the nature of images
- Describe image formation by optical instruments including human eye, camera, telescope, and microscope

Wave Optics

- Describe interference of light from coherent sources and Young's double slit experiment
- Describe and apply the conditions for destructive and constructive interference
- Calculate wavelength of light and film thickness due to thin films interference
- Describe diffraction of light from a single slit and conditions for dark and bright fringes and calculate the width and intensity of bright fringe from a single slit
- Calculate the location of the dark and bright fringes from a diffraction grating
- Explain the impact of circular aperture and calculate the resolving power of a disk

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
- Ohm's Law and DC Circuits
- Magnetism
- Electromagnetic Induction and AC Circuits
- Electromagnetic Waves
- Ray Optics
- Wave Optics
- Laboratory Experience

Effective Date/Updated: February 1, 2023