Miami-Dade Community College
PHY2049 – Physics with Calculus II
3 credits, 4 contact hours

Course Description: This is the second semester of a foundation course with calculus for science and engineering majors, covering: electric fields, basic DC circuits, magnetic fields, basic AC circuits, Maxwell's equations, electromagnetic waves and optics.

Prerequisite: Physics 2048 and Calculus I
Corequisites: Calculus II
Course Competencies:

Note: In all the following, the application of each topic will include:
- solving problems, using the methods of algebra and calculus;
- performing units conversions as necessary to obtain a consistent set of units of measure for a particular problem;
- drawing a sketch or graph when needed;
- associating each concept and formula with practical aspects of everyday life and current technology;

with a strong emphasis on problem solving.

Competency 1: The Student will demonstrate an understanding of electric charges by:
a. explaining electrostatic interactions between charges;
b. calculating the resultant force exerted on a charge by other charges.

Competency 2: The Student will demonstrate an understanding of electric fields by:
a. calculating the resultant electric field at a point which results from one or more point charges;
b. calculating the resultant electric field at a point which results from a distribution of charges which leads to a simple analytical expression;
c. calculating the acceleration of a charged particle in a uniform electric field;
d. finding the net force and torque acting on a dipole in an electric field;
e. using Gauss's law to find the electric field near a symmetrical distribution of charge.

Competency 3: The Student will demonstrate an understanding of electric potential by:
a. calculating the electric potential at a point in the vicinity of one or more point charges;
b. calculating the electric potential at a point in the vicinity of a continuous distribution of charges;
c. finding the electric field in a region where the electric potential is known as a function of position;
d. finding the change in potential energy which occurs when a charge is moved from one point to another in an electric field.

Competency 4: The Student will demonstrate an understanding of capacitance by:

a. calculating the equivalent capacitance for two or more capacitors connected in series or parallel;
b. calculating the energy and energy density within a capacitor;
c. explaining the effects produced by a dielectric material between the plates of a capacitor.

Competency 5: The Student will demonstrate an understanding of the concepts of electric current and resistance by:

a. calculating the quantity of charge transferred by a given current;
b. finding the resistance of a conductor of known material and dimensions;
c. finding the current and power in various elements of a network of resistors connected in series and/or parallel;
d. finding the current at various points of a multi-loop circuit;
e. finding the charge, current, power and energy as a function of time in a circuit with resistance and capacitance.

Competency 6: The Student will demonstrate an understanding of the magnetic field by:

a. finding the magnetic force on a charged particle in motion;
b. finding the magnetic force on a current-carrying wire;
c. calculating the torque on a current loop in a uniform magnetic field;
d. using Biot-Savart's law for a current element to calculate magnetic fields with a simple analytical expression;
f. using Ampere's law to find the magnetic field near a symmetrical distribution of currents.

Competency 7: The Student will demonstrate an understanding of electromagnetic induction by:

a. finding the magnetic flux across a surface;
b. using Faraday's Law to find the induced electromotive force in a loop;
c. determining th direction of the induced current by utilizing Lenz's law
d. explaining the operating principle of an AC generator;
e. calculating the induced electric field associated to a changing magnetic flux;
f. finding the self- and mutual inductance of symmetric configurations of conductors;
g. finding the current and power as a function of time in a circuit with resistance and inductance;
h. describing the oscillations of current and voltage in a circuit with capacitance and inductance.

Competency 8: The Student will demonstrate an understanding of alternating current (AC) by:

a. using the concept of root-mean-square averages in AC circuits;
b. finding the resistance, reactance and impedance, of simple AC combinations of resistors, capacitors and inductors;
c. explaining the wave nature of light using Maxwell's equations

d. calculating the voltage, current and power in basic AC circuits;
e. explaining resonance in an LRC series circuit;
f. using the basic equations describing an ideal transformer.

Competency 9:	The Student will demonstrate an understanding of Maxwell's equations by:

a . noticing the symmetry of the equations, and the presence of the displacement current;
b. calculating the speed of light in vacuum from the electric and magnetic constants;
c. using the Poynting vector to calculate the radiation flux;
d. finding the radiation momentum and pressure.

Competency 10:	The Student will demonstrate an understanding of ray optics by:

a. explaining the propagation of light in a homogeneous medium;
b. using the laws of reflection and refraction of light at the boundary between two media;
c. explaining total internal reflection;
d. describing the images formed by plane and spherical mirrors;
e. using the thin-lens equation to find the images formed by simple combinations of lenses.

Competency 11:	The Student will demonstrate an understanding of wave optics:

a. explaining the wave interference patterns generated by thin films and narrow slits;
b. finding the maxima and minima of interference created by two slits and finding the minima of diffraction created by a single slit;
c. finding the maxima created by a diffraction grating;
f. using the Rayleigh criterion to find the resolution limit;
g. explaining polarization of light, and the effects of polarizers.