Salem Community College Course Syllabus

Course Title: Calculus Physics II

Course Code: PHY 222

Lecture Hours: 2

Laboratory Hours: 4

Credit: 4

Course Description:
This course studies electricity and magnetism through the use of calculus. Topics include electrostatics, DC circuits, magnetic forces, AC circuits, Maxwell's equations and electromagnetic waves. This course is recommended for transfer students planning to major in engineering, physics or mathematics. This is a state approved General Education Science elective course.

Pre-Requisite: PHY 221

Place in College Curriculum:
PHY 222 is a science or open elective for any program. This course is a requirement for science majors with a concentration in physics, pre-engineering, or mathematics.

Course Content Outline:

Chapter I Electric Charges and Forces

- A. Developing a charge Model
- B. Charge
- C. Insulators and Conductors
- D. Coulomb's Law
- E. The Concept of a Field

Chapter II The Electric Field

- A. Electric Field Models
- B. The Electric Field of Multiple Point Charges
- C. The Electric Field of a Continuous Charge Distribution
- D. The Electric Fields of Rings, Planes, and Spheres
- E. The Parallel-Plate Capacitor
- F. Motion of a Charged Particle in an Electric Field
- G. Motion of a Dipole in an Electric Field

Chapter III Gauss's Law

- A. Symmetry
- B. The concept of flux
- C. Calculation Electric Flux
- D. Gauss's Law
- E. Using Gauss's Law
- F. Conductors in Electrostatic Equilibrium

Chapter IV Current and Conductivity

- A. The Electron Current
- B. Creating a Current
- C. Batteries
- D. Current and Current Density
- E. Conductivity and Resistivity

Chapter V The Electric Potential

- A. Electric Potential
- B. The Potential Energy of Point Charges
- C. The Potential Energy of a Dipole
- D. The electric Potential
- E. The Electric Potential Inside a Parallel-Plate Capacitor
- F. The Electric Potential of a Point Charge
- G. The Electric Potential of Many Charges

Chapter VI Potential and Field

- A. Connecting Potential Field
- B. Finding the Electric Field from the Potential
- C. A Conductor in Electrostatic Equilibrium
- D. Sources of Electric Potential
- E. Connecting Potential and Current
- F. Capacitance and Capacitors
- G. The Energy Stored in a Capacitor

Chapter VII Fundamentals of Circuits

- A. Resistors and Ohm's Law
- B. Circuit Elements and Diagrams
- C. Kirchloff's Laws and Basic Circuit
- D. Energy and Power
- E. Series Resistors
- F. Real Batteries
- G. Parallel Resistors
- H. Resistor Circuits
- I. Getting Grounded
- J. RC Circuits

Chapter VIII Electromagnetic Induction

- A. Induced Currents
- B. Motional emf
- C. Magnetic Flux
- D. Lenz's Law
- E. Faraday's Law
- F. Induced Fields and Electromagnetic Waves
- G. Induced Currents: Three Applications
- H. Inductors
- I. *LC* Circuits
- J. *LR* Circuits

Chapter IX Electromagnetic Fields and Waves

- A. Electromagnetic Fields and Forces
- B. *E or B?* It Depends on Your Perspective
- C. Faraday's Law Revisited
- D. The Displacement Current
- E. Maxwell's Equations
- F. Electromagnetic Waves
- G. Properties of Electromagnetic Waves
- H. Polarization

Course Performance Objective1: The students will describe the relative strengths and direction of electric fields.
Learning Outcomes: The students will:
1. Describe the differences between insulators and conductors.
2. Apply Coulomb's Law.
3. Apply the definition of an electric field to solve problems.

Course Performance Objective 2: The students will find the electric field of various charge distributions.
Learning Outcomes: The students will:
1. Predict the motion of a charged particle in an Electric Field.
2. Distinguish between the linear charge density, and the surface charge density.
3. Calculate the electric field of various charge configurations.
4. Find the electric field inside a capacitor.
5. Predict the deflection or other motion of charged particles.

Course Performance Objective 3: The students will apply the concept of flux and determine the electric field.
Learning Outcomes: The students will:
1. Explain symmetry.
2. State Gauss' law and explain all its symbols.
3. List the properties of a conductor.
4. Explain the zero electric inside the conductor.

Course Performance Objective 4: The students will describe the electric potential of various charge distributions.
Learning Outcomes: The students will:
1. Relate electric potential energy to work done on a displaced charge.
2. Find the electric potential caused by one or more given point charges.
3. Calculate the electric potential associated with a point charge and continuous charge distributions.
4. Determine the electric field from the electric potential.
5. Use equipotential surfaces and field lines to visualize the potential.

Course Performance Objective 5: The students will determine the relationship between the potential and field.
Learning Outcomes: The students will:
1. Plot graphs of potential from field, and vice versa.
2. Determine the sources of an electric potential.
3. Determine the equivalent capacitance of capacitors.
4. Determine the energy stored in capacitors.

Course Performance Objective 6: The students will describe the characteristics of charge motion (current) in conductors.
Learning Outcomes: The students will:
1. Apply the definition of current.
2. Calculate the current density in problems involving conductors.
3. Apply the microscopic model of conduction to problem solving.
4. Solve problems involving the resistance and potential difference.

Course Performance Objective 7: The students will analyze various circuits.
Learning Outcomes: The students will:
1. State Ohm's Law.
2. Analyze a single-loop circuit.
3. Apply Kirchhoff's Law**s.**
4. Determine an equivalent resistance for the series or parallel combination of resistances.
5. Write the differential equation for a single RC loop.
6. Restate the equation for the current, charge or voltage of a capacitor as a function of time.

Course Performance Objective 8: The students will determine the characteristics of a magnetic field.
Learning Outcomes: The students will:
1. Write the Biot-Savart law and calculate the magnetic field of a moving charge.
2. Find the magnetic field B at the center of a current-carrying wire.
3. Write Ampere's law.
4. Solve for the magnetic force on conductors.

Course Performance Objective 9: The students will observe and demonstrate electromagnetic induction.
Learning Outcomes: The students will:
1. Create current from a moving magnetic field.
2. Calculate the magnetic flux
3.Describe Lenz's Law.
4.Write the equation for Faraday's law and define all terms with correct units.
5. Describe inductors
6. Distinguish between LC and LR circuits.

Course Performance Objective 10: The students will describe EM waves as closely intertwined.
Learning Outcomes: The students will:
1. Use Ampere's law to find the magnetic field produced by a changing electric field, or vice versa.
2. State Maxwell's equations.
3. List the properties of EM waves and solve for unknown values of variables.
4. Discuss the plane polarization of EM waves.

Course Performance Objective 11: The students will describe the sources of AC in the circuits.
Learning Outcomes: The students will:
1. Analyze an AC circuit using vector techniques.
2. Calculate the instantaneous inductor voltage.
3. Demonstrate and calculate the resonance frequency in the series RLC circuit.
4. Hypothesize that the power delivered by the source is the power dissipated by the resistor.
5. Illustrate phase relations in a given AC circuit.

Course Activities:
Students will learn from lectures, small group discussions, individual explorations, practice work, Discussion of assigned homework problems, laboratory exercises, laboratory activities, and in-class problems. Hands-on activities are included in almost every schedule class.

Outcomes Assessment:

A college-wide outcomes assessment program has been put into place to enhance the quality and effectiveness of the curriculum and programs at Salem Community College. As part of this assessment program, the learning outcomes for this course will be assessed. Assessment methods may include tests, quizzes, papers, reports, projects and other instruments. Copies of all outcomes assessments are available in an electronic assessment bank maintained by the Institutional Research and Planning Office.

Course Requirements and Means of Evaluation:
Please refer to the instructor's syllabus addendum (to be distributed in class) for specific information regarding the course requirements and means of evaluation.

Attendance Policy:
Regular and prompt attendance in all classes is expected of students. Students absent from class for any reason are responsible for making up any missed work. Faculty members establish an attendance policy for each course and it is the student's responsibility to honor and comply with that policy.

Academic Honesty Policy:
Students found to have committed an act of academic dishonesty may be subject to failure of this course, academic probation, and / or suspension from the college. See the Student Handbook for additional details.

ADA Statement:
If you have a 504 Accommodation Plan, please discuss it with your instructor. If you have any disability but have not documented it with the Disability Support coordinator at Salem Community college, you must do so to be eligible for accommodations. To contact the Disability Support Coordinator, call 856-351-2773, or email disabilitysupport@salemcc.edu to set up an appointment. To find out more information about disability support services at Salem Community College, visit www.salemcc.edu/students/student-success-programs/disability-support.

Section VII

Required Text(s): For textbook information, please see the Salem Community College Bookstore website.

Materials and Supplies: Graphing Calculator (TI – 83 or better)

Additional Cost: None unless equipment is abused