

**University of Puerto  
Rico Río Piedras  
Campus  
Faculty of Natural Sciences, Department of  
Physics Undergraduate Programme**

**Course** Electromagnetism I

**Code** PHYS 4068

**Number of Credits** 3

**Number of Hours** 3 hours of classroom lecture per week

**Prerequisites** MATH 3152, PHYS 3171-3172

**Effective date of the syllabus** First Semester, 2019-2020 academic year

**Instructor** Lutful Bari Bhuiyan  
Office Natural Sciences II, C-350  
Class period: Tuesdays and Thursdays, 11:30-12:50 PM, Room C-312  
Office hours: Mondays and Wednesdays, 8 am – 1 pm, 2 pm – 3.30 pm  
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### **Description**

This is the first part of the one year course in Electromagnetism for Physics majors, which covers electrostatics and magnetostatics: Electrostatic potential, divergence and curl of electric fields, electric potential; Conductors, boundary value problems and techniques for calculating potentials; Dipole and multipole expansion of the electric potential, the electrostatics of dielectric materials; Electric current, Ohm's law, continuity equation; Magnetic fields, the Lorentz force law, the Biot-Savart and Ampere's laws; The differential equations of magnetostatics, the vector potential; Magnetized media, the susceptibility and permeability, nonlinear media and hysteresis.

### **Objectives**

After completing this course the student

- will understand the basic concepts and fundamental principles of electrostatics, magnetostatics, and the interaction of currents and fields
- will be able to apply these to actual physical situations and setup the corresponding mathematical problem. The student will also have practiced and mastered the application of mathematical techniques to solve such problems.

## Course Contents

- **Week 1** Basic concepts. Brief resume of electrostatics. The Coulomb's law and the concept of the electric field
- **Week 2-3** Calculation of electric fields for simple charge distributions. Divergence and curl of the electric field and the concept of electrostatic potential. Relation between the electric field and the potential.
- **Week 4-5** Calculation of the electrostatic potential in simple situations. The Laplace and Poisson equations. Boundary value problems and the techniques for calculating potentials. The classical image problem.
- **Week 6-7** Capacitance, electric field in a dielectric medium, electrostatic energy. Electric current, continuity equation, Ohm's law, electric power
- **Week 8-10** Concept of the magnetic induction field, Lorentz force, Biot-Savart and Amper's laws, Magnetic vector potential
- **Week 11-12** Magnetic properties of materials, magnetic susceptibility, permeability, and hysteresis
- **Week 13-15** Electromagnetic induction, The Faraday's and Lenz's laws, self and mutual inductances, magnetic energy, electromagnetic energy density of charge systems

## Instructional Strategy

The main instructional tool in this class is lecturing. The students are trained to apply the techniques of basic electromagnetism to simple physical situations and setting up the problem mathematically, which is then solved using standard mathematical methods. A fair part of the lecturing effort is thus dedicated to the demonstration of solution of problems of electromagnetism.

## Student Evaluation

The grading is based on four exams, each of which has a weight of 25% of the final grade.

- Exam 1. Will include the materials covered in Weeks 1-3.
- Exam 2. Will include materials covered in Weeks 4-7
- Exam 3. Will include materials covered in Weeks 8-10
- Exam 4. Will include materials covered in Weeks 11-15.

The exams will be based on examples done in class, suggested problems, and exercises given throughout the course. The dates of the partial exams will be agreed to in classes.

## **Grading system**

The student completing the course work will be graded according to the standard scale A to F.

**Text** *Introduction to Electrodynamics*, David J. Griffiths, 4th Edition, Pearson 2013, ISBN 10:0-321-85656-2.

**Bibliography** Classic reference *Foundations of Electromagnetic Theory*, John R. Reitz, Frederick J. Milford, and Robert W. Christy, 4<sup>th</sup> Edition, Addison Wesley 2008, ISBN-13-978-0321581747

**Additional learning resources** <https://www.khanacademy.org> Wikipedia

## **Rights of Students with Disabilities**

UPR complies with all federal and state laws and regulations regarding discrimination, including the Americans with Disabilities Act 1990 (ADA) and the Commonwealth of Puerto Rico Law 51. Students receiving services through Rehabilitaci3n Vocacional must contact the professor at the beginning of the semester in order to plan for a reasonable accommodation and any required support equipment according to the recommendations given by the Oficina de Asuntos para las Personas con Impedimentos (OAPI) of the Dean of Students. Likewise, students with special needs that require some type of accommodation must contact the professor.

## **Acomodo Razonable**

La Universidad de Puerto Rico cumple con todas las leyes federales, estatales y reglamentos concernientes a discriminaci3n, incluyendo "The American Dissabilities Act" (Ley ADA) y la Ley 51 del Estado Libre Asociado de Puerto Rico. Los estudiantes que reciban servicios de rehabilitaci3n vocacional deben comunicarse con el (la) profesor(a) al principio del semestre para planificar el acomodo razonable y equipo de apoyo necesario conforme a las recomendaciones de la Oficina de Asuntos para las Personas con Impedimento (OAPI) del Decanato de Estudiantes. Una solicitud de acomodo razonable no exime al estudiante de cumplir con los requisitos academicos del curso.

## **Academic Integrity**

La Universidad de Puerto Rico promueve los m1s altos est1ndares de Integridad acad3mica y cient3fica. El Art3culo 6.2 del Reglamento General de estudiantes de la UPR (Certificaci3n N1m. 13, 2009-2010, de la Junta de S3ndicos) establece que "la deshonestidad acad3mica incluye, pero

no se limita a: acciones fraudulentas, la obtención de notas o grados académicos vallándose de falsas o fraudulentas simulaciones, copiar total o parcialmente la labor académica de otra persona, plagiar total o parcialmente el trabajo de otra persona copiar total o parcialmente las respuestas de otra persona o las preguntas de un examen, haciendo o consiguiendo que otra tome en su nombre cualquier prueba o examen oral o escrito, así como la ayuda o facilitación para que otra persona incurra en la referida conducta” . Cualquiera de estas acciones estará sujeta a sanciones disciplinarias en conformidad con el procedimiento disciplinario establecido en el Reglamento general de Estudiantes de la UPR vigente.

### **Disciplinary Action in case of academic dishonesty**

Grade D will be given.

### **Hostigamiento**

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