

## Physics 370 – Electricity and Magnetism I – NIU Spring 2014

**Class Meetings:** M,W,F 9:00 – 9:50 in Faraday 237

**Instructor:** Prof. S. Martin

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**Office hours:** M,T,W 10:00 – 10:50 or any time you can find me. (Right after class is usually good, but before class is not. Thursdays after 11:15 I am often not around.)

**Course web page:** <http://zippy.physics.niu.edu/phys370.html>

There is no “Blackboard” web page for this course. Everything relevant will be handed out on real paper (as well as linked to as pdf on the web page above).

**Textbook:** *Introduction to Electrodynamics*, D.J. Griffiths, **4th edition**, ISBN 0321856562.

**Grading:** Your numerical score in this class is weighted according to 45% homework, 20% midterm exam, 35% final exam. Grades will be assigned according to your numerical score as a percentage, with the low cutoff for each grade as follows:

A	89%,	A-	85%,	B+	82%,	B	77%,
B-	73%,	C+	66%,	C	55%,	D	45%.

I reserve the right to amend the above grading scale to be more lenient, but it is guaranteed not be made more strict. To obtain a D or better, you **must also** score at least 50% on the homework portion alone, regardless of your overall score; this requirement will not be changed. No C- or D+ or D- grade will be assigned.

**Homework policies:** Late penalty: 10% off for each day late up to 5 days; 100% off for > 5 days. I prefer homework papers to be turned in at the end of class, but they are considered on time if turned in by 5:00 PM on the due date. You can turn them in to my mailbox in the Physics main office if I’m not around. Homework papers should be written neatly, single-sided on paper, and stapled. **Electronic submission of homework is not allowed.** You are encouraged to consult with each other on the homework. However, each of you must turn in only your own work. Do not turn in anything that you have copied, or anything that you do not truly understand.

**Exam policies:** Exams will be closed book, but you may bring one page of notes in your own original handwriting, and you will be given a formula sheet for coordinate systems and vector derivatives, as at <http://zippy.physics.niu.edu/formulas.pdf>  
No electronic devices are allowed.

**Midterm Exam:** Friday, March 7, 2014, 9:00-9:59 AM. On chapters 1,2,3 in Griffiths.

**Final Exam:** Wednesday, May 7, 2014, 8:00-9:59 AM. Comprehensive.

**Suggestions:** It is very strongly suggested that you do attend class and take notes, even though we will mostly stick close to the textbook. If you are stuck, please do come to my office for help. The best way to prepare for exams is to study homework problems and the concepts that they involve.

**Accessibility Statement:** Northern Illinois University is committed to providing an accessible educational environment in collaboration with the Disability Resource Center (DRC). Any student requiring an academic accommodation due to a disability should let his or her faculty member know as soon as possible. Students who need academic accommodations based on the impact of a disability will be encouraged to contact the DRC if they have not done so already. The DRC is located on the 4th floor of the Health Services Building, and can be reached at 815-753-1303 (V) or drc@niu.edu.

**Topics to be covered:**

Chapter 1. Vector Analysis and Vector Calculus

- Vector algebra and vector fields
- Vector derivatives: gradient, divergence, curl, product rules
- Integral calculus for vectors: line integrals, surface integrals, volume integrals, Gradient Theorem, Divergence Theorem, Stokes' Theorem
- Spherical and cylindrical coordinates
- The Dirac delta function

Chapter 2. Electrostatics

- The electric field  $\vec{E}$ , Coulomb's Law, the superposition principle
- Point charges and continuous charge distributions
- Field lines, Gauss' Law, divergence and curl of  $\vec{E}$
- The electric potential, Poisson's equation, Laplace's equation
- Boundary conditions and electrostatics problems
- Energy and work in electrostatics
- Conductors and induced charges
- Capacitors and capacitance

Chapter 3. Special Techniques for Calculating Potentials

- Solving Laplace's equation, uniqueness theorems
- Image charge methods
- Separation of variables methods
- Multipole (large distance) expansion
- Electric dipoles

Chapter 4. Electrostatic Fields in Matter

- Polarization, induced dipoles, dielectrics
- Bound charges, fields inside and outside of polarized objects and dielectrics
- The electric displacement  $\vec{D}$ .
- Susceptibility, permittivity, linear dielectrics, dielectric constants
- Problems involving dielectrics: fields, forces, energy, and capacitance

Chapter 5. Magnetostatics

- Magnetic fields, magnetic forces, the Lorentz force law
- Force exerted on a current by a magnetic field
- Biot-Savart Law (magnetic field of a steady current)

- Divergence and Curl of  $\vec{\mathbf{B}}$ , Ampère's Law
- Magnetic vector potential  $\vec{\mathbf{A}}$
- Multipole expansion for magnetic potential, field
- Magnetic dipoles

#### Chapter 6. Magnetostatic Fields in Matter

- Torques and forces on magnetic dipoles
- Magnetization, bound currents, magnetic fields in matter
- The magnetic field  $\vec{\mathbf{H}}$  and Ampère's Law
- Paramagnetism and diamagnetism, magnetic susceptibility and permeability
- Ferromagnetism, domains, and hysteresis

#### Chapter 7 (up to page 338). Electrodynamics

- Electromotive force (emf) and Ohm's law
- Electromagnetic induction, inductance, Faraday's Law
- Simple circuits with inductance and resistance
- Maxwell's Equations