Physics 470/570 – Electricity and Magnetism II – Fall 2017

Class Meetings: M,W,F 9:00 – 9:50 in La Tourette 227.

Instructor: Prof. S. Martin
214 La Tourette `spmartin@niu.edu`

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 I am often not around, especially after 11:00.)

Course web page: `http://www.niu.edu/spmartin/phys470`
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.

Catalog Description: Maxwell's equations; propagation, reflection and transmission of electromagnetic waves; wave guides; dipole radiation; radiation by point charges; electrodynamics in special relativity. PRQ: PHYS 300 and PHYS 370, or consent of department. Credits: 3.

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 two pages of notes in your own original handwriting, and you will be given a formula sheet for coordinate systems and vector derivatives, as at `http://www.niu.edu/spmartin/formulas.pdf`
No electronic devices are allowed.

Midterm Exam: Friday, October 27, 2017, 9:00-10:00 AM.
Final Exam: Wednesday, December 13, 2017, 8:00-10:00 AM.

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: If you need an accommodation for this class, please contact the Disability Resource Center as soon as possible. The DRC coordinates accommodations for students with disabilities. It is located on the 4th floor of the Health Services Building, and can be reached at 815-753-1303 or `drc@niu.edu`.

Also, please contact me privately as soon as possible so we can discuss your accommodations. Please note that you will not be required to disclose your disability, only your accommodations. The sooner you let me know your needs, the sooner I can assist you in achieving your learning goals in this course.

Topics to be covered:

- One-week review of Physics 370 (Griffiths, Chapters 1-6)
- Electromotive Force (EMF)
    - Ohm's Law, batteries and circuits
    - Motional EMF
- Electromagnetic Induction
    - Faraday's Law
    - Lenz's Law
    - Induced electric fields
    - Self inductance and mutual inductance
- Maxwell's Equations
    - Maxwell's displacement current correction to Ampere's Law
    - Maxwell's equations in matter
    - Boundary conditions for Maxwell's equations
- Conserved quantities in electrodynamics
    - Local conservation of charge
    - Poynting vector and relation to energy, momentum and angular momentum in electromagnetic fields
- Waves
    - Wave equation in one dimension
    - Wave length, wave number, period, frequency, angular frequency, amplitude
    - Complex notation for sinusoidal waves
    - Reflection and transmission
    - Polarization
- Electromagnetic waves in vacuum
    - Wave equations for $\vec{\mathbf{E}}$ and $\vec{\mathbf{B}}$
    - Monochromatic electromagnetic plane waves
    - Light as an electromagnetic wave

- The electromagnetic wave spectrum

- Electromagnetic waves in matter
  - Propagation in linear media
  - Index of refraction
  - Reflection and transmission at boundaries; optics
  - Absorption and dispersion
  - Rainbows

- Guided waves
  - Propagation of electromagnetic waves in waveguides
  - Rectangular waveguides
  - Coaxial transmission lines

- Potentials for electrodynamics
  - V and $\vec{\mathbf{A}}$ for time-varying fields
  - Gauge transformations; Coulomb gauge and Lorentz gauge
  - Retarded potentials
  - Liénard-Wiechert potential and fields for a moving point charge

- Electromagnetic Radiation
  - Electric dipole radiation
  - Magnetic dipole radiation
  - Radiation by point charges
  - Radiation by arbitrary sources
  - Radiation reaction
  - Radiated power and the Larmor formula

- Special relativity and electrodynamics
  - The principle of relativity and universal speed of light
  - Time dilation, Lorentz contraction, Lorentz transformations
  - 4-vectors and four-dimensional formulation of electrodynamics