

PHYS 5P30: Advanced Electromagnetism

(Fall 2023)

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Brock calendar entry:

Electromagnetic wave propagation in vacuum, dielectrics, conductors, and ionized gases; wave guide and transmission line propagation; dipole and quadrupole radiation fields; relativistic transformation of the electromagnetic fields; radiation by moving charges.

Textbook:

There is no required textbook for the course. The main source of information will be the lecture notes. The students are encouraged to consult numerous textbooks on electricity and magnetism available in the library, e.g.

J. D. Jackson, *Classical Electrodynamics*, 3rd edition (Wiley, 1999).

J. Franklin, *Classical Electromagnetism* (Pearson, 2005).

D. J. Griffiths, *Introduction to Electrodynamics*, 4th edition (Pearson, 2013)

Note: In this course, we use Gaussian units, as in Franklin's book. The Griffiths and Jackson books use SI units.

Marking scheme:

3 assignments: 60% (20% each)

assignments must be submitted by 5pm on the due date; late assignments **will not be accepted**

final exam: 40%

you will need to pass the final exam to pass the course

Academic integrity policy:

<http://www.physics.brocku.ca/Courses/integrity.php>

Topics covered in the course:¹

- Review of mathematical tools: vectors and tensors; vector calculus; curvilinear coordinates; vector fields.
- Review of electrostatics and magnetostatics: electric fields in vacuum and in matter; conductors; magnetic fields in vacuum and in matter; magnets.
- Electrodynamics: Maxwell's equations in vacuum and in matter; scalar and vector potentials, gauge transformations; boundary conditions; conservation laws.
- Introduction to special relativity; covariant formulation of classical electromagnetism.
- Electromagnetic waves in vacuum and in matter; scattering and diffraction.
- Radiation of electromagnetic waves: potential of moving charges; dipole radiation, multipole radiation; synchrotron radiation.

¹This list is tentative. Some topics may be removed, while other topics may be added. The examinations will be only on the material actually covered in the lectures.