

Electromagnetism

3 credits

Bulletin Description: Review of Maxwell's equations, radiation, collisions between charged particles, dynamics of relativistic particles and fields. Prerequisite: PHYS 361 or similar course

Instructor: Andrei Kryjevski, South Engineering 318D
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Meetings: Tu Th 11:00 AM -12:15 PM **Office Hours:** W 14:00-16:00
South Engineering 221 (or by arrangement)

Goal: To master the theoretical foundations and the basic practical applications of classical electrodynamics

Student Responsibilities: According to NDSU health regulations, a proper face covering must be worn for all face-to-face class activities.

Read assigned material in advance. Come prepared for discussion. Ask questions and give me feedback. Complete assignments on time.

Texts: J. Jackson, **Classical Electrodynamics**, 2nd edition (Wiley, 1975),
L. D. Landau, E.M. Lifshitz, **The Classical Theory of Fields: Volume 2**, 4th edition (Reed, 1987)

Major Topics:

- **Introduction:** Summary of experimental facts underlying classical electrodynamics, charge conservation, deduction of Maxwell equations
- **Electrostatics:** Gauss's law, scalar potential, Poisson and Laplace equations, Green function of Poisson equation, general solution for the scalar potential, Dirichlet and Neumann boundary conditions, Laplace equation in rectangular, spherical, cylindrical coordinates, multipole expansion (*Jackson, Ch. 1, 2, 3, 4*)
- **Magnetostatics:** Vector potential, Biot and Savart law, B-field of a localized current distribution, magnetic moment (*Jackson, Ch. 5*)
- **Time-dependent fields:** Maxwell equations, gauge transformations, Lorentz and Coulomb gauges, Green functions for the wave equation, energy of electromagnetic field, Poynting vector (*Jackson, Ch. 6*)
- **Electromagnetic waves and wave propagation:** Polarization, reflection and refraction (*Jackson, Ch. 7*)
- **Simple radiating systems:** Radiation from a localized oscillating source, electric dipole, magnetic dipole, electric quadrupole fields, scattering, diffraction (*Jackson, Ch. 9*)
- **Radiation by moving charges:** Lienard-Wiechert potentials and fields, Larmor's formula, Thompson scattering of radiation (*Jackson, Ch. 14*)

Evaluation: weekly homework assignments will be posted on Blackboard (55%); midterm exam (20%), comprehensive final exam (25%)

Homework and Lateness: Group discussion of homework is strongly encouraged, but written solutions must be your own. Late work will be accepted with a 20% penalty/day until next class.

Grading: A: 90-100%, B: 70-89.9%, C: 60-69.9%, D: 50-59.9%, F: < 50%

COVID-19-Related Course Requirements

- Students who are fully vaccinated may participate in all class activities as directed by CDC guidelines: <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/fully-vaccinated.html>. These guidelines are subject to change as pandemic conditions evolve.

- Students who are NOT vaccinated are required to follow CDC guidelines, which include wearing a mask in class (covering both the mouth and nose) and maintain physical distancing. Information on the CDC's guidelines for non-fully vaccinated individuals can be found here:

<https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html>.

Please note that these guidelines may also change as the pandemic evolves.

- Similar to other contagious infectious diseases, students should not come to class if they experience COVID-like symptoms. If a student is infected with COVID-19, or is a contact of an infected person, they should immediately inform their course instructor via an official means of communication, and isolate/quarantine at home according to CDC guidelines: <https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/quarantine.html>. Consistent with NDSU policies and procedures (including, but not limited to NDSU Policy 331.1: Course Syllabus, NDSU Policy 606: Guidelines for Student Requests for Reasonable Accommodation), faculty will offer the student a reasonable accommodation to maintain instructional continuity.

- Students that are considered at high risk of severe illness if infected with COVID-19 are encouraged to inform the course coordinator during the first week of class to request reasonable accommodations (if desired). For additional information, please see:

<https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html>.

- Do not come to class if you are sick. You will be allowed to view the lectures and ask any questions you have remotely.

- I will be flexible regarding deadlines for students who are experiencing illness or other challenges related to COVID-19. Please contact me as early as possible if you think you may not be able to complete an assignment or participate in the course due to illness.

- NDSU requires students to wear face coverings in classrooms. Wearing face coverings helps reduce the risk to others in case you are infected but do not have symptoms.

- You must properly wear a face covering (covering both the mouth and nose) for the entirety of the class.

- If you fail to properly wear a face covering, you will not be admitted to the classroom. However, you may choose to participate in the class remotely. The following will be used as needed: referral to Dean of Students Office or administrative removal from class.

- Students who cannot wear a face covering due to a medical condition or disability may seek accommodation through Disability Services (701-231-8463; <https://www.ndsu.edu/disabilityservices/>).
- Disinfecting supplies are provided for you to disinfect your learning space. You may also use your own disinfecting supplies.
- Students should observe social distancing guidelines whenever possible. Students should avoid congregating around instructional space entrances before or after class. Students should exit the instructional space immediately after the end of class to ensure social distancing and allow for the persons attending the next scheduled class to enter the classroom.
- In accordance with NDSU Policy 601, failure to comply with instructions, including this syllabus, may be handled according to the Code of Student Conduct resolution process and may result in disciplinary sanctions.

The academic community is operated on the basis of honesty, integrity, and fair play. NDSU Policy 335: Code of Academic Responsibility and Conduct applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the Office of Registration and Records. Informational resources about academic honesty for students and instructional staff members can be found at www.ndsu.edu/academichonesty.

Any students with disabilities who need accommodation in this course are encouraged to speak with the instructor as soon as possible to make appropriate arrangements.