UNBC Department of Physics
Physics 410 - Classical Electromagnetism II
Winter 2025

Course Outline

This is the second part of an intermediate-level course in classical electrodynamics (PHYS 310 and PHYS 410). Topics covered in PHYS 410 include review of Maxwell's equations, conservation laws in electrodynamics, properties and propagation of electromagnetic waves, wave guides, electromagnetic potentials, electromagnetic radiation, relativity, relativistic mechanics, and relativistic electrodynamics.

- Prerequisites: Phys 310

- Credit hours: 3

- Instructor: Dr Elie Korkmaz
  - E-mail: korkmaz@unbc.ca
  - Office: T&L Building, Room 10-2006
  - Home page: http://web.unbc.ca/~korkmaz/korkmaz.html
  - Office hours: Tuesdays and Thursdays 10:00 am – 2:00 pm or via zoom. Please request an appointment be email.

- Textbook: *Introduction to Electrodynamics*, by David Griffiths, 4th edition

- Lectures: TR 2:30 -3:50 pm, Room 5-178
  - The lectures will be delivered in person or via zoom. The zoom links will be posted in Moodle well before lecture time.
  - The lecture notes will be available on *Moodle*. I recommend you get a hard copy of the lecture notes prior to lecture time.
  - Some material or details in the text may not be covered in the lectures (simply not enough time). However, you are responsible for all the sections in the text that are covered in the lectures (see timetable below).

- Assignments: 7 homework assignments to be posted/updated on M*oodle*.
  - Assignments should be submitted in pdf format to the appropriate folder in Moodle under *Assignment Submission* (Assignment #1, Assignment #2, etc ...)
  - Assignment solutions will be posted on *Moodle* the evening of the due date.
  - 30% of total grade.

- Midterm exam: Date and time TBA.
  - Take-home (24 hours); covers chapters 8, 9, and 10
  - 30% of total grade.

- Final exam: Date and time TBA.
  - Take-home; comprehensive
  - 40% of total grade.

Approximate Timetable

Dates	Topics	Sections in text
Jan 7	Introduction and review of Maxwell's equations	
Jan 9, 14, 16	Chapter 8: conservation laws in electrodynamics, conservation of energy, Poynting's theorem, conservation of momentum, Maxwell stress tensor	8.1, 8.2
Jan 21, 23, 28	Chapter 9: electromagnetic waves, wave properties, the e.m. wave equation, e.m. plane waves in vacuum, e.m. wave energy and momentum, wave polarization, e.m. spherical waves	9.1, 9.2
Jan 30, Feb 4	Chapter 9: e.m. waves in linear media, wave reflection and transmission, e.m. waves in conductors, dispersion	9.3, 9.4
Feb 6, 11	Chapter 9: wave guides, transmission lines, resonant cavities	9.5
Feb 17-21	Winter break – no classes	
Feb 13, 25, 27	Chapter 10: electromagnetic potentials, potential formulation of Maxwell's equations, potentials wave equations, potentials and fields of charge distributions and point charges	10.1, 10.2, 10.3
Mar 6	Midterm exam	
Mar 4, 11	Chapter 11: e.m. radiation, electric dipole radiation, magnetic dipole radiation, radiation from any source, Larmor formula, higher-order radiation fields	11.1
Mar 11, 13	Chapter 11: radiation by a point charge, the Lienard's formula, linear and circular acceleration radiation, radiation reaction, radiation damping	11.2
Mar 18, 20	Chapter 12: special relativity, Einstein's postulates and consequences, Lorentz transformations, space-time four vectors and diagrams, invariant interval, light cones, and causality	12.1
Mar 25, 27	Chapter 12: relativistic mechanics, proper time and velocity, relativistic energy and momentum, relativistic dynamics, Minkowski forces	12.2
Apr 1, 3	Chapter 12: relativistic electrodynamics, magnetism as a relativistic phenomenon, electric and magnetic fields transformation rules, electromagnetism in tensor notation, the field tensor(s), current-density, Maxwell's equations, the Lorentz force, and e.m. potentials in relativistic four-vector notation	12.3
TBA	Final exam	

Homework Assignments
(Tentative schedule)

Set #	Problems from chapter	Due date
1	8	Jan 21
2	9	Feb 4
3	9	Feb 18
4	10	Mar 4
5	11	Mar 18
6	12	Mar 27
7	12	Apr 3