PHYS670: Electromagnetic Theory I

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CATALOGUE DESCRIPTION

Course Summary: Maxwell?s equations, plane waves in isotropic and anisotropic dielectrics, conducting media, wave guides and plasmas, dipole radiation and diffraction.

Prerequisites: PHYS 570, or consent of department.

CONTACT

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CLASS MEETINGS

Weekly on Tuesdays and Thursdays from 3:30 to 4:45 pm.

COURSE DESCRIPTION & OUTCOME

This course provides students with a modern approach to electromagnetism theory at the graduate level. Students will develop problem-solving techniques and acquire skills necessary to apply electromagnetism theory. The lectures incorporate discussion/solving sessions and practical applications of electromagnetism in various branches of Physics.

TEXTBOOK

Required textbook: *Modern Electrodynamics* by A. Zangwill (Cambridge University Press); ISBN: 978-0-521-89697-9. THe corresponding chapter are referred as Z.*x* in the Syllabus below.
Optional textbooks: Interested reader may consider consulting the following

- *Classical Electrodynamics* by J.D. Jackson, 3rd edition, Wiley, 1999, ISBN 0-471-30932-X.
- *Electrodynamics and Classical Theory of Fields and Particles* by O. Barut (Dover Books on Physics).
- *The Classical Theory of Fields: Volume 2 (Course of Theoretical Physics Series)* by L. D. Landau and E.M. Lifshitz, 4th edition, ISBN-13: 978-0750627689.

ASSESSMENT & GRADING

The assessment will consist of biweekly homework, a midterm and final exams. The grading will be as follows:

Homework	40% of overall grade
MidTerm	30% of overall grade
Final.	30% of overall grade

The numeric averaged grade will be computed given the above Table and a letter grade will be assigned following the table below.

Letter grade	Percentage points.
A	$\geq 85\%$
A-	$\geq 80\%$
B+	$\geq 75\%$
B	$\geq 70\%$
B-	$\geq 65\%$
C+	$\geq 60\%$
C	$\geq 55\%$
D	$\geq 50\%$
F	$< 50\%$

Further information on NIU grading system can be found at:
http://www.niu.edu/regrec/grading/gradingfaqs.shtml

STUDENT RESPONSIBILITIES

The students are expected to be engaged researchers carrying their work safely and with highest integrity.

ACCESSIBILITY

If you need an accommodation for this class, please contact the Disability Resource Center (RDC) 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 (V) or drc@niu.edu. Also, please contact me privately as soon as possible so we can discuss your accommodations. The sooner you let us know your needs, the sooner we can assist you in achieving your learning goals in this course.

SYLLABUS

Introduction

- Lesson 1: Course organization, New Physics (Z.2)
- Lesson 2: Mathematical background I: (Z.1)
  general definitions, Levi-Civitá's and Kronecker's symbols

- Lesson 3: Mathematical background II: (Z.1)
  generalized Dirac function, Fourier Transforms
- Lesson 4: Maxwell's equations, Boundary Conditions (Z.2)

Review of electrostatics (Z.3)

- Lesson 5: Coulomb's and Gauss' law, scalar potential
- Lesson 6: Electrostatic energy and stress tensor

Review of magnetostatics (Z.10)

- Lesson 7: Biot and Savart's law, Ampère's law
- Lesson 8: magnetic scalar and vector potentials
- Lesson 9: Magnetic energy and stress tensor

Multipole expansion

- Lesson 10: in electrostatics (Z. 4)
- Lesson 11: in magnetostatics (Z. 11)

Types of Matter

- Lesson 12: Conductors (Z. 5)
- Lesson 13: Dielectric (Z. 6)
- Lesson 14: Magnetic material (Z. 13)

Spring break (3/12/18 to 3/16/18)

Green's functions approach

- Lesson 15: in electrostatics (Z. 8)
- Lesson 16: other applications

MidTerm Exam

- Lesson 17: Exam (3/27/2018)
- Lesson 18: Solutions/discussion

General electromagnetic field (Z.15)

- Lesson 19: Electromagnetic potentials
- Lesson 20: Conservation laws

Wave in Vacuum (Z.16)

- Lesson 21: Wave equation, plane wave, polarization, Helmoltz equations
- Lesson 22: Other types of waves, optical beams, force on particles

Wave in matter (Z.17-18)

- Lesson 23: reflection, refraction
- Lesson 24: anisotropic matter
- Lesson 25: dispersive matter

Guided & confined waves (Z.19)

- Lesson 27: transmission lines & waveguides
- Lesson 28: dielectric waveguides
- Lesson 29: resonators

Course review

- Lesson 30: Review for final exam
