2020

Electromagnetism II

North Carolina Agricultural and Technical State University

NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

COURSE SYLLABUS

College Name: College of Science and Technology
Department Name: Physics
Course Name: Electromagnetism II

COURSE INFORMATION

- Course Number/Section: PHYS 416
- Term:
- Semester Credit Hours: 3
- Times and Days:
- Class Location:

INSTRUCTOR CONTACT INFORMATION

- Instructor:
- Office Location:
- Office Phone:
- Email Address:

Faculty must notify students of the approximate time and method they can expect to receive an answer to all communications (e.g., email, phone, course messages). Excluding holidays, the response should be provided within 48 hours.

If there's a graduate teaching assistant assigned to work with this course, please include their names also.

STUDENT HOURS

These are times students may visit the professor without an appointment to request the assistance they need.

NOTE: Students are responsible for reading, understanding, and following the syllabus.

: AM ☐ / PM ☐ – : AM ☐ / PM ☐

Monday ☐ Tuesday ☐ Wednesday ☐ Thursday ☐ Friday ☐

COURSE PREREQUISITES

PHYS 415

COURSE DESCRIPTION

This is the second semester of our two-semester sequence of junior-level classical electromagnetism. It uses the tools of vector calculus to analyze the dynamic properties of electromagnetic fields. The topics we will cover includes the study of electric fields and potentials, electric current and magnetic fields, in material media, solutions to Maxwell's equations, plane waves, polarization, propagation in media,

STUDENT LEARNING OBJECTIVES/OUTCOMES (SLO)

Learning outcomes should be specific, measurable, and focused on the content knowledge the students are expected to master and not what the faculty will teach.

If the course is a General Education Course, the SLO should be listed and labeled as "General Education."

SLO 1:

a. Explain dipoles – as point charges, and as generalized dipole vectors – for simple charge configurations.
b. Evaluate the dipole moment of a simple charge distribution.
c. Explain similarities and differences between a conductor and a dielectric (both shield E, conductor shields E completely, dielectric shields via fixed dipoles, conductor shields via mobile electrons).
d. Evaluate t whether a pattern of polarization will result in bound surface and/or volume charge
e. Explain the physical origin of bound charge.

SLO 2:

a. Evaluate the E field inside and outside a dielectric sphere placed in an electric field.
b. Explain what happens to a dielectric, when it is placed in an electric field.
c. Explain the difference between free and bound charge.
d. Evaluate the appropriate boundary conditions on D given its relationship to E and Qf.

SLO 3:

a. Explain the direction of D, P, and E for simple problems involving dielectrics
b. Evaluate the E field inside a dielectric when given epsilon and the free charge on the dielectric.
c. Explain the difference between a linear and nonlinear dielectric.
d. Evaluate Maxwell's equations (for electrostatics) in matter, when given the appropriate equations in vacuum.
e. Explain the differences in boundary conditions for fields (D) in matter versus a conductor (D).

SLO 4:

a. Evaluate the torque or the force on a magnetic dipole in a magnetic field
b. Explain the difference between para, dia, and ferromagnets, and predict how they will behave in a magnetic field.
c. Describe how magnetization will result in a bound surface and/or volume current, for simple magnetizations.

d. Describe a physical interpretation of bound surface and volume current, using Stokes' Theorem.
e. Evaluate H when given B or M
f. Explain and evaluate how to use H to calculate B when given Jf for an appropriately symmetric current distribution.
g. Describe in which physical situations it is useful to use H.
h. Explain the appropriate boundary conditions on H given its relationship to M and J_free.
i. Describe the relationship between M to B to H, given a magnetic susceptibility or permeability.

SLO 5:

a. Use Faradays law to calculate electromotive force
b. Calculate inductances of different systems
c. Calculate energy in magnetic fields
d. Use Maxwell's equations to understand the electromagnetic field
e. Understand and explain electromotive force, Ohm's law, atomic level explanation of resistance and resistivity
f. Explain the relationship between resistivity and conductivity
g. Explain Motional emf.

SLO 6:

a. Derive the wave equation
b. Derive the wave equation for B and E
c. Calculate reflection and transmission of electromagnetic waves in linear media and relate the ideas to optics
d. Understand electromagnetic waves in conductors
e. Explain the applications of wave guides

REQUIRED TEXTBOOKS AND MATERIALS

Any course-level subscriptions and tools linked in Blackboard Learn learning management system (LMS) should be listed here. The Blackboard LMS must have links to their student data privacy statement.

REQUIRED TEXTS:

1. Griffiths, D. J. (2017). *Introduction to electrodynamics.* Cambridge University Press.

REQUIRED MATERIALS:

SUGGESTED COURSE MATERIALS

SUGGESTED READINGS/TEXTS:

1. Reitz, J. R., Milford, F. J., & Christy, R. W. (1979). *Foundations of Electromagnetic Theory* (4th ed.). Addison-Wesley.
2. Wangsness, R. K. (n.d.). *Electromagnetic Fields* (3rd ed.). Wiley.

SUGGESTED MATERIALS:

GRADING POLICY

ASSIGNMENTS AND GRADING POLICY

94% and above	A		76% - 74%	C
93% - 90%	A-		73% - 70%	C-
89% - 87%	B+		69% - 67%	D+
86% - 84%	B		66% - 64%	D
83% - 80%	B-		63% - 0%	F
79% - 77%	C+			

For GRADUATE COURSES: See 2019-2020 Graduate Catalog p.38 for graduate grading scale and Non-Graded Courses

GRADING ALLOCATION

Course grades are based on a weighted grading scale of 100%. The breakdown for the course is as follows: *[Faculty, please adjust according to your course.]*

Category	# of Activities	Percentage Grade Weight
Assignments	11	22
Quizzes	9	18
Exams	3	30
Final Exam	1	20
Discussion Board	15	10
Total	**39**	**100%**

COURSE POLICIES

USE OF BLACKBOARD AS THE LEARNING MANAGEMENT SYSTEM

Blackboard is the primary online instructional and course communications platform. Students can access the course syllabus, assignments, grades, and learner support resources. Students are encouraged to protect their login credentials, complete a Blackboard orientation, and log in daily to the course.

Note: Uploading assignments through Blackboard presents a challenge for Chromebook users in locating the files for submission. If you use a Chromebook, please be sure you also have access to a Mac computer or Windows computer so you can fully participate in your Blackboard class. For more information about student computer recommendations, please visit https://hub.ncat.edu/administration/its/computer-recommendations.php.

MAKE-UP EXAMS

See << Update Academic Year >>*Undergraduate Bulletin:*

https://www.ncat.edu/provost/academic-affairs/bulletins/index.php

For GRADUATE STUDENTS: See 2019-20 Graduate Catalog p. 54

EXTRA CREDIT

LATE WORK

SPECIAL ASSIGNMENTS

For GRADUATE STUDENTS: FAILING TO MEET COURSE REQUIREMENTS (Graduate Catalog p.40)

For GRADUATE STUDENTS: CLASS ATTENDANCE (see 2019-20 Graduate Catalog p. 53-54)

Students are expected to attend class and participate on a regular basis in order to successfully achieve course learning outcomes and meet federal financial aid requirements (34 CFR 668.22). Class attendance in online courses is defined as active participation in academically-related course activities. Active participation may consist of course interactions with the content, classmates, and/or the instructor. Examples of academically-related course activities include, but are not limited to:

- Completing and submitting assignments, quizzes, exams, and other activities within Blackboard or through Blackboard (3rd-party products).
- Participating in course-related synchronous online chats, discussions, or meeting platforms such as Blackboard Collaborate in which participation is tracked.

CLASSROOM CITIZENSHIP

Courtesy, civility, and respect must be the hallmark of your interactions.

COMPLIANCE WITH THE AMERICANS WITH DISABILITIES ACT

North Carolina A&T State University is committed to following the requirements of the Americans with Disabilities Act Amendments Act (ADAAA) and Section 504 of the Rehabilitation Act.
If you need an academic accommodation based on the impact of a disability, you must initiate the request with the Office of Accessibility Resources (OARS) and provide documentation in accordance with the Documentation Guidelines at N.C. A&T. Once documentation is received, it will be reviewed. Once approved, you must attend a comprehensive meeting to receive appropriate and reasonable accommodations. If you are a student registered with OARS, you must complete the Accommodation Request Form to have accommodations sent to faculty.

OARS is located in Murphy Hall, Suite 01 and can be reached at 336-334-7765, or by email at accessibilityresources@ncat.edu. Additional information and forms can be found on the internet at https://www.ncat.edu/provost/academic-affairs/accessibility-resources/index.php.

Please note: Accommodations are not retroactive and begin once the Disability Verification Form is provided to faculty.

TITLE IX

North Carolina A&T State University is committed to providing a safe learning environment for all students—free of all forms of discrimination and harassment. Sexual misconduct and relationship violence in any form are inconsistent with the university's mission and core values, violates university policies, and may also violate federal and state law. Faculty members are considered "Responsible Employees" and are required to report incidents of sexual misconduct and relationship violence to the Title IX Coordinator. If you or someone you know has been impacted by sexual harassment, sexual assault, dating or domestic violence, or stalking, please visit the Title IX website to access information about university support and resources. If you would like to speak with someone confidentially, please contact Counseling Services at 336-334-7727 or the Student Health Center at 336-334-7880.

TECHNICAL SUPPORT

If you experience any problems with your A&T account, you may call Client Technology Services (formerly Aggie Tech Support and Help Desk) at 336-334-7195, or visit https://hub.ncat.edu/administration/its/dept/ats/index.php.

FIELD TRIP POLICIES / OFF-CAMPUS INSTRUCTION AND COURSE ACTIVITIES

If applicable:

Off-campus, out-of-state, foreign instruction, and activities are subject to state law and university policies and procedures regarding travel and risk-related activities. Information regarding these rules and regulations may be found at https://www.ncat.edu/campus-life/student-affairs/index.php.

STUDENT HANDBOOK

https://www.ncat.edu/campus-life/student-affairs/departments/dean-of-students/student-handbook.php

STUDENT TRAVEL PROCEDURES AND STUDENT TRAVEL ACTIVITY WAIVER

https://hub.ncat.edu/administration/student-affairs/staff-resources/studen_activity_travel_waiver.pdf

OTHER POLICIES *(e.g., Copyright Guidelines, Confidentiality, etc.)*

STUDENT HANDBOOK

https://www.ncat.edu/campus-life/student-affairs/departments/dean-of-students/student-handbook.php

Graduate Catalog

SEXUAL MISCONDUCT POLICY

https://www.ncat.edu/legal/title-ix/sexual-harassment-and-misconduct-policies/index.php

FAMILY EDUCATIONAL RIGHTS AND PRIVACY ACT (FERPA)

https://www.ncat.edu/registrar/ferpa.php

STUDENT COMPLAINT PROCEDURES

https://www.ncat.edu/current-students/student-complaint-form.php

STUDENT CONDUCT AND DISCIPLINE

North Carolina A&T State University has rules and regulations that govern student conduct and discipline meant to ensure the orderly and efficient conduct of the educational enterprise. It is the responsibility of each student to be knowledgeable about these rules and regulations.

Please consult the following about specific policies such as academic dishonesty, cell phones, change of grade, disability services, disruptive behavior, general class attendance, grade appeal, incomplete grades, make-up work, student grievance procedures, withdrawal, etc.:

- Undergraduate Bulletin
  https://www.ncat.edu/provost/academic-affairs/bulletins/index.php

- Graduate Catalog
  https://www.ncat.edu/tgc/graduate-catalog/index.php

- Student Handbook
  https://www.ncat.edu/campus-life/student-affairs/departments/dean-of-students/student-handbook.php

ACADEMIC DISHONESTY POLICY

Academic dishonesty includes but is not limited to the following:

1. Cheating or knowingly assisting another student in committing an act of cheating or other academic dishonesty;
2. Plagiarism (unauthorized use of another's words or ideas as one's own), which includes but is not limited to submitting exams, theses, reports, drawings, laboratory notes or other materials as one's own work when such work has been prepared by or copied from another person;
3. Unauthorized possession of exams or reserved library materials; destroying or hiding source, library or laboratory materials or experiments or any other similar actions;
4. Unauthorized changing of grades, or marking on an exam or in an instructor's grade book or such change of any grade record;
5. Aiding or abetting in the infraction of any of the provisions anticipated under the general standards of student conduct;
6. Hacking into a computer and gaining access to a test or answer key prior to the test being given. N.C. A&T reserves the right to search the emails and computers of any student suspected of such computer hacking (if a police report of the suspected hacking was submitted prior to the search); and
7. Assisting another student in violating any of the above rules.

A student who has committed an act of academic dishonesty has failed to meet a basic requirement of satisfactory academic performance. Thus, academic dishonesty is not only a basis for disciplinary action, but may also affect the evaluation of a student's level of performance. Any student who commits an act of academic dishonesty is subject to disciplinary action.

In instances where a student has clearly been identified as having committed an act of academic dishonesty, an instructor may take appropriate disciplinary action, including loss of credit for an assignment, exam, or project; or awarding a grade of "F" for the course, **subject to review and endorsement by the chairperson and dean**.

For GRADUATE STUDENTS: Reference for academic dishonesty – 2010-2020 Graduate Catalog, p.58-59

For GRADUATE STUDENTS: STUDENT RELIGIOUS OBSERVANCE (see Graduate Catalog, p.55)

ASSIGNMENTS AND ACADEMIC CALENDAR

Include topics, reading assignments, due dates, exam dates, withdrawal dates, pre-registration and registration dates, all holidays, and convocations.*

THE WEEK OF MM/DD/YY	SUBJECT	UNIT LEARNING OUTCOMES (ULO)	READING IN TEXT, ACTIVITY, HOMEWORK, EXAM
	Unit 1: Review of electrostatics and vector calculus	ULO 1: Use vector calculus in electrostatics. (SLO 1-4) ULO 2: Explain Coulombs Law and Gauss's law in vacuum apply vectors in calculating electric forces. (SLO 1-4) ULO 3: Explain the concept of electric field and use vectors to evaluate electric fields. (SLO 1-4) ULO 4: Evaluate electric fields for continuous charge distributions. (SLO 1-4)	1. **Read Textbook:** Griffiths, D. J. (2017). *Introduction to electrodynamics.* Cambridge University Press. a. Chapter 1: Vector Analysis b. Chapter 2: Electrostatics 2. Assignment #1 (ULO 1-4) 3. Discussion Board #1 (ULO 1-4)
	Unit 2: Polarization and the field of a Polarized Object	ULO 1: Evaluate dipoles and quadrupoles (SLO 1) ULO 2: Explain dielectrics, dipoles (SLO 1) ULO 3: Describe polarization and difference between bound and free charges (SLO 1) ULO 4: Explain Field inside a dielectric (SLO 1) ULO 5: Explain physical meaning of bound charges. (SLO 1)	1. **Read Textbook:** Griffiths, D. J. (2017). *Introduction to electrodynamics.* Cambridge University Press. a. Chapter 4: Electric Fields in Matter 2. Assignment #2 (ULO 1-5) 3. Discussion Board #2 (ULO 1-5) 4. Quiz #1 (Unit-1 ULO 1-5)
	Unit 3: The Electric Displacement Vector	ULO 1: Explain Boundary conditions. (SLO 2)	1. **Read Textbook:** Griffiths, D. J. (2017). *Introduction to electrodynamics.* Cambridge

		ULO 2: Evaluate Gauss's laws in the presence of a dielectric (SLO 2) ULO 3: Explain the displacement vector (SLO 2) ULO 4: Explain the difference between electric field in a dielectric and vacuum (SLO 2)	University Press. a. Chapter 4: Electric Fields in Matter 2. Assignment #3 (ULO 1-4) 3. Discussion Board #3 (ULO 1-4) 4. Quiz #2 (Unit-2 ULO 1-4)
	Unit 4: Linear Dielectric	ULO 1: Explain polarizability, susceptibility and dielectric constants (SLO 3) ULO 2: Explain the displacement vector (SLO 3) ULO 3: Evaluate Boundary value problems (SLO 3) ULO 4: Describe energy in dielectric systems (SLO 3) ULO 5: Evaluate forces on dielectrics. (SLO 3)	1. **Read Textbook:** Griffiths, D. J. (2017). *Introduction to electrodynamics.* Cambridge University Press. a. Chapter 4: Electric Fields in Matter 2. Assignment #4 (ULO 1-5) 3. Discussion Board #4 (ULO 1-5) 4. Quiz #3 (Unit-3 ULO 1-4)
	Unit 5: Review of Magnetism, Magnetization	ULO 1: Explain magnetic fields, forces due to magnets (SLO 4) ULO 2: Explain difference between diamagnetism, pap magnetism and ferromagnetism (SLO 4) ULO 3: Describe forces and torques on magnetic dipoles (SLO 4) ULO 4: Describe effects of magnetic fields on atomic orbitals (SLO 4) ULO 5: Describe Magnetization (SLO 4)	1. **Read Textbook:** Griffiths, D. J. (2017). *Introduction to electrodynamics.* Cambridge University Press. a. Chapter 5: Magnetostatics b. Chapter 6: Magnetic Fields in Matter 2. Assignment #5 (Unit-5 ULO 1-5) 3. Discussion Board #5 (ULO 1-5) 4. Quiz #4 (Unit-4 ULO 1-5)
	Unit 6: The Field of	ULO 1: Explain Bound and	1. **Read Textbook:** Griffiths, D.

	a Magnetized Object, The Auxiliary Field H	free currents (SLO 4) ULO 2: Evaluate magnetic field inside matter (SLO 4) ULO 3: Explain physical meaning of bound charges (SLO 4)	J. (2017). *Introduction to electrodynamics.* Cambridge University Press. a. Chapter 6: Magnetic Fields in Matter 2. Discussion Board #6 (ULO 1-3) 3. Exam #1: Unit 1-5 (All ULOs: Unit 1-5)
	Unit 07: Linear and Nonlinear Media and the Auxiliary Field H	ULO 1: Evaluate Amperes Law in Magnetic Materials (SLO 4) ULO 2: Explain magnetic Boundary conditions (SLO 4) ULO 3: Explain the difference between H and B (SLO 4) ULO 4: Explain magnetic susceptibility and permeability (SLO 4) ULO 5: Explain magnetic boundary conditions (SLO 4)	1. **Read Textbook:** Griffiths, D. J. (2017). *Introduction to electrodynamics.* Cambridge University Press. a. Chapter 6: Magnetic Fields in Matter 2. Assignment #6 (Unit-6 ULO 1-5) 3. Discussion Board #7 (ULO 1-5)
	Unit 08: Electromotive Force	ULO 1: Evaluate Ohm's law (SLO 5) ULO 2: Explain Electromotive force (SLO 5) ULO 3: Describe motional emf (SLO 5) ULO 4: Describe resistivity and conductivity (SLO 5)	1. **Read Textbook:** Griffiths, D. J. (2017). *Introduction to electrodynamics.* Cambridge University Press. a. Chapter 7: ElectrodynamicsAssignment #7 2. Assignment #7 (Unit-7 ULO 1-3) 3. Discussion Board #8 (ULO 1-4) 4. Quiz #5 (Unit-6 ULO 1-3)
	Unit 09: Electromagnetic Induction	ULO 1: Explain Faraday's Law and Lenz's Law (SLO 5) ULO 2: Evaluate induced magnetic field (SLO 5) ULO 3: Evaluate inductance (SLO 5)	1. **Read Textbook:** Griffiths, D. J. (2017). *Introduction to electrodynamics.* Cambridge University Press. a. Chapter 7: ElectrodynamicsAssignment #7 2. Assignment #8 (Unit-8 ULO 1-4)

		ULO 4: Describe energy in magnetic fields (SLO 5)	3. Discussion Board #9 (ULO 1-4) 4. Quiz #6 (Unit-7 ULO 1-4)
	Unit 10: Maxwell's Equations	ULO 1: Describe Maxwell's Equations (SLO 5) ULO 2: Describe how Maxwell modified Amperes law (SLO 5) ULO 3: Explain magnetic charges (SLO 5) ULO 4: Evaluate Maxwell's equation in Matter (SLO 5) ULO 5: Explain Boundary conditions (SLO 5)	1. **Read Textbook:** Griffiths, D. J. (2017). *Introduction to electrodynamics.* Cambridge University Press. a. Chapter 7: Electrodynamics 2. Discussion Board #10 (ULO 1-5) 3. Exam #2: Unit 6-9 (ULO: Unit 6-9)
	Unit 11: Electromagnetic Waves: Waves in One Dimension	ULO 1: Evaluate the wave equation in one dimension (SLO 6) ULO 2: Describe properties of waves: frequency, wavelength, wave number, amplitude (SLO 6) ULO 3: Explain boundary conditions for reflection and transmission (SLO 6) ULO 4: Explain polarization (SLO 6)	1. **Read Textbook:** Griffiths, D. J. (2017). *Introduction to electrodynamics.* Cambridge University Press. a. Chapter 9: Electromagnetic Waves 2. Assignment #9 (UNIT 10-ULO 1-5) 3. Discussion Board #11 (ULO 1-4) 4. Quiz #7 (UNIT 10-ULO 1-5)
	Unit 12: Electromagnetic Waves-Waves in Vacuum	ULO 1: Explain the wave equation for E and B (SLO 6) ULO 2: Evaluate the wave equation for plane waves (SLO 6) ULO 3: Explain energy and momentum of electromagnetic waves (SLO 6)	1. **Read Textbook:** Griffiths, D. J. (2017). *Introduction to electrodynamics.* Cambridge University Press. a. Chapter 9: Electromagnetic Waves 2. Assignment #10 (UNIT 10-ULO 1-5) 3. Discussion Board #12 (ULO 1-4) 4. Quiz #8 (UNIT 10-ULO 1-5)
	Unit 13: Electromagnetic Waves: Waves in Matter	ULO 1: Describe the propagation of waves in linear media (SLO 6)	1. **Read Textbook:** Griffiths, D. J. (2017). *Introduction to electrodynamics.* Cambridge University Press.

		ULO 2: Describe reflection and refraction of EM waves (SLO 6) ULO 3: Explain the laws of reflection and refraction (SLO 6) ULO 4: Express the difference between normal and oblique incidence (SLO 6)	a. Chapter 9: Electromagnetic Waves 2. Discussion Board #13 (ULO 1-4) 3. Exam #3: Unit 10-12 (ULO Unit 10-12)
	Unit 14: Electromagnetic Waves: Absorption and Dispersion	ULO 1: Explain Electromagnetic waves in conductors (SLO 6) ULO 2: Explain reflection of EM waves from conducting surfaces (SLO 6) ULO 3: Evaluate the frequency dependence of permittivity (SLO 6)	1. **Read Textbook:** Griffiths, D. J. (2017). *Introduction to electrodynamics.* Cambridge University Press. a. Chapter 9: Electromagnetic Waves 2. Assignment #11 (Unit-11 ULO 1-4, Unit-12 ULO 1-4) 3. Discussion Board #14 (ULO 1-3) 4. Quiz #9 (Unit-11 ULO 1-4, Unit-12 ULO 1-4)
	Unit 15: Electromagnetic Waves: Wave Guides	ULO 1: Explain wave guides (SLO 6) ULO 2: Explain waves in rectangular media (SLO 6) ULO 3: Evaluate the equations appropriate for a rectangular wave guide (SLO 6) ULO 4: Explain coaxial transmission lines (SLO 6)	1. **Read Textbook:** Griffiths, D. J. (2017). *Introduction to electrodynamics.* Cambridge University Press. a. Chapter 9: Electromagnetic Waves 2. Discussion Board #15 (ULO 1-4) 3. Final Exam: All Units (All ULO: Unit 1-15)

** These descriptions and timelines are subject to change at the discretion of the instructor.*