Electricity and Magnetism (PHY 4435)

Fall 2022

11:00-11:50 a.m., MWF, 318 MSCX

TEXT: Introduction to Electrodynamics by David J. Griffiths, 4th edition

INSTRUCTOR: *Dr. Govind Menon* (gmenon@troy.edu)
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Chair, Dept. of Chemistry and Physics
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OFFICE HOURS: 2:00-4: 00 p.m. MWF. If you try to see me at my office and do not find me in, leave a note and make sure you see me the next class period.

TOPICS COVERED
Vector Analysis
Electrostatics
Potentials
Electric Fields in Matter
Magnetostatics (if time permits)

ASSIGNMENTS: There will be take home problems given on a regular basis. It is up to the student to complete the assigned problems in a timely manner. Additionally, the student is expected to attend all classes and to participate in-class discussion, and ask questions regarding any aspect of the course that is unclear.

TEST SCHEDULE:

TEST TYPE	ADVANCE NOTICE	POINT VALUE	NO. OF TESTS
Major exam	1 week	80%	4
Final Exam	12/13/22 (8:00-10:00 a.m.)	20%	1

GRADE SCALE

90-100%	A
80-89.9%	B
70- 79.9%	C
60-69.9%	D
Less than 60%	F

MAKING UP MISSED EXAMS: If you have a university excused absence for the missed day of exam, and if you notify me at least one week in advance, I will reschedule the exam for you at an earlier time and date. Under no circumstance will the exam be given after the originally scheduled time.

AMERICANS WITH DISABILITY ACT (ADA): Troy University supports Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990, which insure that postsecondary students with disabilities have equal access to all academic programs, physical access to all buildings, facilities and events, and are not discriminated against on the basis of disability. Eligible students, with appropriate documentation, will be provided equal opportunity to demonstrate their academic skills and potential through the provision of academic adaptations and reasonable accommodations. Further information, including appropriate contact information, can be found at the link for Troy University's Office of Human Resources at http://www.troy.edu/humanresources/index.html.

ADDITIONAL SERVICES: Students who have or may be dealing with a disability or learning difficulty should speak with the instructor, contact the Office of Adaptive Needs Program, or call 670-3220/3221. Various accommodations are available through the Adaptive Needs Program.

DISCLAIMER: The syllabus is only tentative and is subject to change.

The daily lecture schedule below is rough in that I may need an extra day or two to cover the material. Nonetheless, this is exactly how the course will progress. In the past, I have never been able to make a serious dent into chapter 5.

Lecture Schedule

Chapter 1: Vector Analysis

Day 1 Assignment: Syllabus
Vector Addition
Watch the following videos before the next class:
Vector Algebra in component form: https://www.youtube.com/watch?v=mjiOlS6KIqc
Dot Product, Cross Product Video: https://www.youtube.com/watch?v=O1b0RNHnGvI
Triple Products: https://www.youtube.com/watch?v=ehn07a9i4Qk&index=9&list=PLDDEED00333C1C30E

Day 2: Cartesian Coordinates Line Element, Area Vector, Volume element, Divergence and Curl, Line integration example.

Day 3: Divergence theorem example and discussion

Day 4: Stokes Theorem example and discussion.

Day 5: Spherical coordinate System: Line Element, Area Vector, Volume element, Divergence and Curl

Day 6: Example of divergence theorem in spherical coordinate system. Cylindrical coordinate System: Line Element, Area Vector, Volume element, Divergence and Curl
Watch the following videos before the next class:
An example of Stokes Theorem in Cylindrical and Spherical coordinate system:
https://www.youtube.com/watch?v=4fdvK556Y4M
Divergence in Cylindrical coordinates video: https://www.youtube.com/watch?v=6YYF5Wmviko

The derivation of Curl in cylindrical coordinates is assigned as homework.

Day 7: Dirac Delta Function 1: 1-D

Day 8: Dirac Delta Function 2: Spherical coordinate System

Day 9: Helmholtz's Theorem
Watch the following videos to get Chapter 2 Started:
Introduction to Electrostatics: https://www.youtube.com/watch?v=CCOTc6jN93c
Coulomb's Law: https://www.youtube.com/watch?v=hyn6XrQQbWk
The Electric Field: https://www.youtube.com/watch?v=ezaz9CupLdw&spfreload=10

Chapter 2: Electrostatics

Day 1: Expression for the Electric field for discrete and continuous charges.
Watch the following videos before the next class:
Electric Field due to point charges example: https://www.youtube.com/watch?v=DqnM3KbMydM

Day 2: Integration example for electric field.
Watch the following videos before the next class:
Electric Field Due to a line Charge: https://www.youtube.com/watch?v=WmZ3G2DWHlg
Electric Field Due to a ring Charge: https://www.youtube.com/watch?v=80mM3kSTZcE

Day 3: Gauss's Theorem and examples

Day 4: Electric Potential: Theory 2.2.4 and 2.3.3

Day 5: Electric Potential: Theory 2.3.4 and 2.3.5

Day 6: Boundary conditions for the electric field and potential

Day 7: Work and Energy.
In chapter 3, up to 3.1.3 is assigned as reading.
Watch the following videos before the next class: https://www.youtube.com/watch?v=3VHLvAn0CO4. This is problem 2.34.

Day 8: Capacitors

Chapter 3: Potentials

Day 1: Average law for potentials and the uniqueness theorems.

Day 2: Earnshaw's theorem, Method of Images: Charge above a grounded conducting plane.

Day 3: Method of Images: Charge near a spherical conductor. Assign 2.5.1 and 2.5.2 as reading.
Day 4: Solving Laplace's Equation by Separation of Variables: Cartesian coordinates, ex 3.3

Day 5: Solving Laplace's Equation by Separation of Variables.

Day 6: Solving Laplace's Equation by Separation of Variables. Spherical coordinates

Day 7: Solving Laplace's Equation, Spherical coordinates, ex 3.8

Day 8: Solving Laplace's Equation, Spherical coordinates, ex 3.9

Day 9: Multipole Expansion.

Day 10: Multipole Expansion. Problem 3.27.

Chapter 4: Electric Fields in Matter

Day 1: Force and Torque on a dipole and problem 4.5

Day 2: Section 4.2. Polarization charge densities. Assignment: section 4.2.2 as reading

Day 3: Section 4.3 Gauss's Law in Dielectrics, 4.3.2-4.3.3 Problem 4.16.

Day 4: Section 4.4: Dielectric Constants

Day 5: Section 4.4: Boundary Value Problems with Dielectrics

Day 6: Boundary Value Problems with Dielectrics

Day 7: Energy in Dielectric Systems I

Day 8: Energy in Dielectric Systems: II

Chapter 5: Magnetostatics

Day 1:
Line, surface and volume current density
Biot-Savart's Law

Day 2: Divergence and Curl of B (section 5.3.1)
Day 3: Divergence and Curl of B (section 5.3.2) (may take another day)

Day 4: Ampere's Law 5.3.3, ex 5.8

Day 5:
Show by explicit construction that the z component of the Magnetic field goes to 0 infinitely far away from a solenoid.
Ex. 5.9
Assignment problem 5.46
Read example 5.10.

Day 6: Vector potential (5.4.1)

Day 7: Vector potential continued assign ex 5.12

Day 8: Boundary Conditions

Day 9: Multipole Expansion