

PHYS 3122 – Electro & Magnetostatics – Syllabus

1. General Information

Class Time:	Mon., Wed. & Fri. 11.15am–12.05pm
Class Location:	Howey Physics Building, L-5
Instructor:	Dr. Martin Mourigal, Assistant Professor
Research:	Condensed Matter Physics, Quantum Materials, Magnetism, Scattering
Office Hours:	Mon. & Wed. 4.05pm–5.30pm, after class (until 12.30pm), or by appointment
Office Location:	Howey Physics Building, C-202
Contact:	mourigal@gatech.edu ; I welcome you to contact me outside of class. Please include [3122] in your email title and allow 24 hours for an answer
TAs:	Mr. Shashank Markande & Mr. Jonathan Michel, Graduate Students
TAs Office Hours:	Thurs. 3.00pm-5.00pm (Jonathan) and Fri. 3.00pm-5.00pm (Shashank)
TAs Location:	Boggs Building, B-77 (Jonathan) & B-54 (Shashank)
TAs Contact:	markande@gatech.edu & jmichel6@gatech.edu

2. Course content and materials

Textbook:	David J. Griffiths, <i>Introduction to Electrodynamics</i> , 4th Edition
Publisher:	Pearson (2013) or Cambridge University Press (2017)
Course Website:	http://mourigal.gatech.edu/F3122.php , password given in class
Lecture Notes:	Handwritten notes will be available on the course website after class
Pre-Requisites:	PHYS 2212 or PHYS 2232 or equivalent.

Overview: This is an **advanced undergraduate course in electromagnetism**, one of the most beautiful and successful theory in Physics. In this course, we will work within the realm of **classical mechanics** to construct a theory of electromagnetism applicable to **vacuum and matter**. The fundamental problem we hope to solve can be formulated simply¹: “*I hold up a bunch of electric charges here (and maybe shake them around); what happens to some other charge, over there?*”. As we will see, the solution is best formulated in terms of a **field theory** which is the study of **Maxwell’s equations** using the powerful mathematical tool of **vector analysis**. This semester in PHYS 3122, we will be primarily concerned with physical situations in which charges are static or traveling at constant velocity, namely **electro and magnetostatics**. Next semester, you may choose to study the case of accelerating charges in **electrodynamics** (PHYS 3123). Electromagnetism is a gateway to advanced **theoretical physics** but also an ubiquitous tool for **applied sciences** with deep ramifications in electrical & computer engineering, materials science, atmospheric sciences, aerospace engineering, and more. I hope you will find the course enjoyable, fun and useful for your future career as scientist or engineer.

Topics: The course will cover the following topics, corresponding to chapters 1 to 7 in Griffiths:

1. *Vector Analysis*: Differential and integral calculus, curvilinear coordinates, delta function.
2. *Electrostatics*: Electric field, electric potential, work and energy.
3. *Potentials*: Laplace’s equation, method of images, multipole expansions.
4. *Electric Fields in Matter*: Polarization, dielectrics, electric displacement, linear media.
5. *Magnetostatics*: Magnetic field, magnetic force, vector potential
6. *Magnetic Fields in Matter*: Magnetization, auxiliary field, susceptibility, ferromagnetism.
7. *Electrodynamics*: Maxwell’s equations, electromagnetic induction.

¹See Introduction in D. J. Griffiths textbook

3. Course Requirements and Grading

Grading:	Homework ($n - 1$ best scores out of n assignments)	40 points
	Quizzes	30 points
	Final exam	30 points
	Class attendance (extra credit)	5 points
	Total	105 points
Letter Grades:	A: 90 points or more, B: 80–89, C: 70–79, D: 60–69, F: 59 or less	
	Final score rounded to the next integer: 89.58 \rightarrow 90(A), 79.42 \rightarrow 79(C)	
Homework:	Homework will be assigned in class on Wednesdays.	
	Homework will be due the following Wednesday in class or in office hours.	
	There will be $n \approx 10$ homework assignments, see schedule below.	
	Your $n - 1$ best scores will be kept when calculating your homework average.	
Quizzes:	Quizzes will be scheduled during regular class time. There will be 3 quizzes.	
Attendance:	I strongly value class participation and I will evaluate it via a daily sign-in sheet.	
	Attendance $> 50\%$ will count for extra credit: $> 90\%$ (5 points), 80 – 89% (4), ...	
Reading:	Reading the text before class is very important. Lecture is to clarify your understanding and to help you make sense of the material.	

4. Course Expectations and Guidelines

Group Work: You can discuss homework assignments with each other, but the solutions have to be executed and submitted individually. I strongly suggest you start homework by yourself (and that means really making an extended effort on *every* problem) Then work with a group, and finally, finish up on your own by writing up your own work, in your own way.

Late Assignments & Missed Exams: No late homework will be accepted without advance notice. Absence for a quiz will lead to a 0% grade for that particular quiz. If you anticipate missing a quiz or not being able to turn an assignment in-time, please contact me at least a week in advance. The reason for your extension request or quiz absence must be reasonable.

Academic Integrity: Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Visit <http://www.catalog.gatech.edu/rules/18/> for information on Georgia Tech's Academic Honor Code. Any student suspected of cheating or plagiarizing on a quiz, final exam, or homework assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Students with Disabilities: If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at <http://disabilityservices.gatech.edu/> or (404)894-2563, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible.

5. Course Schedule

Please visit <http://mourigal.gatech.edu/F3122.php> for an up-to-date schedule of reading assignments and lecture topics. The schedule below lists the assigned and due dates for the homework

as well as the anticipated dates for in-class quizzes. Note that I reserve the possibility to move a quiz scheduled on a Wednesday to a Friday depending on progress with the lectures. There is no homework due in a given quiz week.

Week	Day	Date	Lecture	Homework Assigned	Homework Due
1	M	08/21	L00		
1	W	08/23	L01	HW1	–
1	F	08/25	L02		
2	M	08/28	L03		
2	W	08/30	L04	HW2	HW1
2	F	09/01	L05		
3	M	09/04	[<i>Labor Day</i>]		
3	W	09/06	L06	HW3	HW2
3	F	09/08	L07		
4	M	09/11	L08		
4	W	09/13	L09	–	HW3
4	F	09/15	L10		
5	M	09/18	L11		
5	W	09/20	Quiz 1	HW4	–
5	F	09/22	L12		
6	M	09/25	L13		
6	W	09/27	L14	HW5	HW4
6	F	09/29	L15		
7	M	10/02	L16		
7	W	10/04	L17	HW6	HW5
7	F	10/06	L18		
8	M	10/09	[<i>Fall Break</i>]		
8	W	10/11	L19	–	HW6
8	F	10/13	L20		
9	M	10/16	L21		
9	W	10/18	Quiz 2	HW7	–
9	F	10/20	L22		
10	M	10/23	L23		
10	W	10/25	L24	HW8	HW7
10	F	10/27	L25		
11	M	10/30	L26		
11	W	11/01	L27	HW9	HW8
11	F	11/03	L28		
12	M	11/06	L29		
12	W	11/08	L30	–	HW9
12	F	11/10	L31		
13	M	11/13	L32		
13	W	11/15	L33	HW10	–
13	F	11/17	Quiz 3		
14	M	11/20	L34		
14	W	11/22	[<i>Thanksgiving</i>]	–	–
14	F	11/24	[<i>Thanksgiving</i>]		
15	M	11/27	L35		
15	W	11/29	L36	–	HW10
15	F	12/01	L37		
16	M	12/04	L38 (Review)		
16	F	12/08	Final (8.00-10.50am)		