

PHYSICS 542-01

Electromagnetic Radiation

Spring 2022

NS 306

MW 12:00 pm – 1:15 pm

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<i>Office hours:</i>	Monday, 10:00 am - 11:00 am Tuesday, 3:00 pm - 4:00 pm Wednesday, 10:00 am – 11:00 am
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<i>Web:</i>	http://www.physics.louisville.edu/cldavis/phys542/spring22/index.html
<i>Text:</i>	Electromagnetic Fields by Roald K. Wangsness 2nd edition. Published by Wiley

INTRODUCTION

This course is the second of two senior level electricity and magnetism courses. Both courses (541 and 542) are required for the Physics BS professional concentration. Only the first semester (541), is required for the Physics BA and the Physics BS with the Astronomy and Astrophysics and Applied concentrations. The material to be covered in these courses does not lend itself well to a 50/50 split. According to the UofL catalog, the first semester course (541) should cover all classical electricity and magnetism, up to and including the development of Maxwell's equations. This course should include the development of electromagnetic waves from Maxwell's equations followed by a description of certain properties of this radiation. In my opinion, attempting to cover all E&M up to and including Maxwell's equations to a level appropriate for a final year undergraduate course in a single 14 week semester is foolhardy. There is just too much material, much of which, although conceptually relatively easy, is practically quite difficult. Therefore, in developing this course I have treated the two-semester sequence as a single unit. Assuming all has gone according to plan, much of the formulation of Maxwell's equations (Chapters 1-19 excl. 11 of the text) will have been completed in Physics 541. This semester, Physics 542 will start with the completion of the formulation of Maxwell's equations, discuss some special methods in electrostatics and continue with a description of some of the properties of electromagnetic waves and radiation. A detailed description of the intended coverage for this course may be found at the end of this syllabus.

You are strongly urged to **read** the chapter or sections slated for coverage **before** each class. Ideally, you should treat the lectures as a review of what you have already read. You will gain most from the lectures if you can concentrate on what I am saying not on what I am writing and this can only be achieved if you have some idea of what I am talking about in the first place.

Most of the lectures will be spent in a formal development of the topic of discussion. Only on rare occasions will there be time to completely solve any of the homework (or other problems). You are encouraged to make use of worked examples in the text, discussion with fellow class members and the instructor's office hours to solve assigned problems.

GRADING

Grades will be determined from the overall percentage obtained by the following weighting, where the numbers in brackets represent the distribution of the weight between the “in-class” and “take-home” sections of the tests.

	Undergraduate	Graduate
Test 1 (Feb. 23)	40% (27, 13)	25% (17, 8)
Test 2 (Apr. 25 or May 3)	40% (27, 13)	25% (17, 8)
Final (Apr. 25 or May 3)	-	25% (17, 8)
Homework	20%	25%

The dates given above are tentative. There will be no make-ups.

It is expected that letter grades will be assigned according to the scale indicated below. These grade boundaries will not be raised. However, the instructor reserves the right to lower the grade boundaries if deemed necessary.

		A	≥	73%
73%	>	A-	≥	68%
68%	>	B+	≥	63%
63%	>	B	≥	58%
58%	>	B-	≥	53%
53%	>	C+	≥	48%
48%	>	C	≥	43%
43%	>	C-	≥	38%
38%	>	D+	≥	35%
35%	>	D	≥	30%
30%	>	F		

TESTS

Each test will have an "in-class" and a "take-home" section. The tests will include only material covered during the regular class meetings unless otherwise specified. The "in-class" test problems will, by necessity, require less time to solve than the typical homework problems. But this does not mean that they will be easy. You will be provided with a formula sheet for the in-class tests. Nevertheless, in order to solve the problems you will need to be completely familiar with the appropriate material. In other words, time will be a factor. The "take-home" problems will typically be more difficult than the "in-class" problems, but will not be more difficult than the most difficult homework problems. There will, of course, be more time available to solve the "take-home" problems; the exact limitation will be announced prior to the test. Solutions of “take-home” problems *must be* your own work. If it is clear that there has been collaboration between students on “take-home” problems scores will be adjusted in the same manner as described in the Homework section below.

According to my projected timetable the first test will include all of the material described on the last page of this syllabus from Chapters 11, 20-22 and Appendix A. The second test will be based on material covered in

Chapters 24, 25, 28 and 29. The second test is not comprehensive. That is, it will include only material covered since the first test. However, if you are classified as a graduate student or wish to earn graduate credit as an undergraduate, in addition to the second test described above, you will be required to take an additional comprehensive test, having equal weight to tests 1 and 2, but including all the material covered in the semester.

HOMEWORK

Homework will be assigned at the completion of each chapter of the text. Unless specified otherwise it must be completed *one week from the date of assignment*. All homework will be collected, graded and returned as soon as possible, hopefully within one week. At the end of the semester your total homework score will be converted to a percentage and included as part of your overall grade in the manner described above.

I will almost always assign odd numbered problems, since the answers to these problems may be found in the text. Often knowing the answer can be of assistance in developing a solution. But remember that since the answer is given merely stating it will gain no credit, you must show me how the answer is obtained.

If a chapter takes one class to complete there will likely be 3 or 4 problems assigned from that chapter and this will constitute one homework assignment. If a chapter takes two classes to complete you can expect 5-7 problems in that chapter's homework assignment. Each assigned **problem** will be worth ten points, therefore, all homework assignments will not carry equal weight. Partial credit will be awarded. This means that you should always submit your attempt at a solution even if you were unable to arrive at the final answer. Also, look out for questions that have several parts, the ten points will be divided between the parts. If you make no attempt at one part you will automatically lose the points assigned to that part. In a similar vein, if the second part of a problem requires the answer to the first part of the problem, which you were not able to evaluate, you should make an attempt at the second part using the answer to the first part given in the text. Since problem solving time in class will be limited, when your graded homework is returned, attached to it will be worked solution of every assigned problem that you were unable to solve. Together with your correct solutions the homework problems will form a valuable study aid for the tests.

In addition to the "required" homework, for most assignments there will be several "extra credit" problems. Extra credit problems will be graded in the same way as required problems. A maximum of 5 additional percentage points towards your final grade will be available through extra credit. For example, if the semester includes a total of 20 extra credit problems and you earn 50 points from these problems, your extra credit score would be $50/200 = 25\%$ so that $0.25 \times 5 = 1.25\%$ will be added to your final percentage score. Extra credit is only available for undergraduate students. *The extra credit problems are part of the required homework for graduate students.*

Late homework will not be accepted. As you can see homework constitutes a significant part of the grading scheme. My recommendation is to make a first pass attempt at each homework assignment as soon as is practically possible after receiving the assignment. If you identify potential difficulties you will then have plenty of time to work on them before the due date. I will be very sympathetic to requests for guidance several days before an assignment is due. My sympathy will decrease quite quickly as the due date approaches. By all means discuss the problems with fellow class members, this can be beneficial to all involved. However, I expect individual solutions. A single solution submitted by several individuals is blatantly obvious and will be considered a **single** solution. That is, each individual will receive a fraction of the total points awarded for the solution equal to the reciprocal of the number of individuals submitting the solution.

Finally, please take pride in your work. I will not grade your "scratch-pad". Each step in a solution should follow logically. Do not be afraid to explain your terms, include sketches where necessary and show all your working.

CLASS PARTICIPATION

When a course follows a text closely, as is the case for this course, there is a tendency to think that lectures are unnecessary. It is true that certain individuals are able to learn physics solely from a textbook. However, for most of us, more explanation is needed than that which appears in a typical textbook. When learning new material, lectures provide the opportunity to ask questions as well as clarifying explanations. In order to ensure that you avail

yourself of this opportunity class participation will be monitored throughout the semester. Participation does not mean that you are required to ask questions or be otherwise vocal in class; attendance in and of itself is a type of participation.

The following criteria will be followed; your final grade will be reduced by one \pm letter grade for every complete multiple of 5 (unexcused) class absences. If you arrive more than 15 minutes late for class you are deemed to be absent. For example, if at the end of the semester you earn a B+ from tests and homework, but missed a total of 12 class meetings, your grade will be reduced by 2 \pm letter grades. Your final grade will be a B-.

MATERIAL TO BE COVERED

The material covered will closely follow the chosen text. The proposed schedule, together with the homework problems is described below.

Month	Date	Chapter/Section	Topic
Jan	10	20.1 – 20.2	Magnetism and matter 1
	12	20.3 – 20.4	Magnetism and matter 2
	17	MLK Holiday	
	19	20.5 – 20.7	Magnetism and matter 3
			HW: Ch.20 #3,5,9,17,19,25 EC: Ch.20 #7,27
	24	21.1 – 21.5, App A	Maxwell's equations, Motion of charged particles
			HW: Ch.21 #1,3,9 EC: Ch.21 #7,12
	26	App A	Motion of charged particles
			HW: App.A #1,3,5,9 EC: App A #11
	31	11.2	Method of images
Feb	2	11.4 – 11.6	Laplace's equation
	7	11.4 – 11.6	Laplace equation
	9	11.6	Poisson's equation
			HW: Ch.11 #3,5,9,17,25,31 EC: Ch.11#13,27, Ch.20 #23
	14	22.1 – 22.3	Potentials
	16	22.1 – 22.3	Potentials
			HW: Ch.22 #2,5,7 EC: Ch.22 #8
	21	24.1, 24.2, 24.3	EM plane waves 1
	23	Test 1	
	28	24.5, 24.6, 24.7	EM plane waves 2
			HW: Ch.24A #3,5,13,17,19 EC: Ch.24A #9,15,31
Mar	2	25.1, 25.2, 25.3	Reflection and refraction of EM waves 1
	7	25.4, 25.5	Reflection and refraction of EM waves 2
			HW: Ch.25A #3,5,7,9 EC: Ch.25A #1
	9	24.3	EM plane waves in a conductor
			HW: Ch.24B #7,11
	14	Spring Break	
	16	Spring Break	
	21	25.6	Reflection and refraction of EM waves in

			conductors
	23	25.6	Reflection and refraction of EM waves in conductors
			HW: Ch.25B #11,12,16,17 EC: Ch.25B #13
	28	28.1, 28.2	EM radiation 1
	30	28.3, 28.4	EM radiation 2
Apr	4	28.5	EM radiation 3
	6	28.5, 29.1	EM radiation 3, EM and Relativity 1
			HW: Ch.28 #1,3,5,6,7,8,11,16,17 EC: Ch.28 #4,9,12,13
	11	29.2, 29.3	EM and Relativity 2
	13	29.4	EM and Relativity 3
			HW: Ch.29A #3,5,7,15 EC: Ch.29A #9,13,17
	18	29.5	EM and Relativity 4
	20	29.6	EM and Relativity 5
			HW: Ch.29B #21,23,25,27 EC: Ch.29B #29,31
	25	Test 2 ?	
May	3	Test 2 ?	

TITLE IX STATEMENT

*Sexual misconduct (including sexual harassment, sexual assault, and any other nonconsensual behavior of a sexual nature) and sex discrimination violate University policies. Students experiencing such behavior may obtain **confidential** support from the PEACC Program (852-2663), Counseling Center (852-6585), and Campus Health Services (852-6479). To report sexual misconduct or sex discrimination, contact the Dean of Students (852-5787) or University of Louisville Police (852-6111). Disclosure to **University faculty or instructors** of sexual misconduct, domestic violence, dating violence, or sex discrimination occurring on campus, in a University-sponsored program, or involving a campus visitor or University student or employee (whether current or former) is **not confidential** under Title IX. Faculty and instructors must forward such reports, including names and circumstances, to the University's Title IX officer. For more information, see the Sexual Misconduct Resource Guide (<http://louisville.edu/hr/employeerelations/sexual-misconduct-brochure>).*

DISABILITY RESOURCE CENTER

Individuals with disabilities who need reasonable modifications to complete assignments and course criteria successfully are encouraged to meet with the instructor as early in the course as possible to identify and plan specific accommodations. Students requesting an accommodation will be asked to supply a letter from the Disability Resource Center (DRC) or other documentation that will assist in planning modifications. The instructor will not recognize requested

accommodations without DRC approval/endorsement. The DRC is located in Stevenson Hall. Its staff can be reached by telephone at (502) 852-6938 or online at <http://louisville.edu/disability/>