Classical Electrodynamics (PHY 301)
Wisconsin Lutheran College, Spring 2024

The electromagnetic theory of light, introduced by Faraday and Maxwell, has proven very successful in understanding the nature of radiation and its interaction with matter. In this course, we will engage in a detailed study of Maxwell's equations, which form the basis for the classical theory of electromagnetic waves. 3 lec.

Instructor information and class times

Kerry Kuehn, Ph.D.
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Grade components

Homework Assignments	70%
Midterm exam (week 8)	10%
Final exam (week 16)	20%

Course times and location: The course will meet on Tuesday and Thursday morning from 8:00 - 9:20.

What are the textbook(s) for this course? The first text below is required for the course; the others are ones that you eventually might wish to add to your library.

Bekefi, G. and Barrett, A. H., *Electromagnetic Vibrations, Waves and Radiation*. The M.I.T. Press, 1990. This is the required textbook for PHY 302.

Purcell, E., *Electricity and Magnetism*, Berkeley Physics Course, 2nd edition. McGraw Hill, 1985. This is an introductory undergraduate textbook with many challenging problems and helpful insights.

Griffiths, D. J., *Introduction to Electrodynamics*, 3rd edition. Prentice Hall, 1999. This is an upper-level undergraduate textbook and is highly recommended for its clarity of notation and simple explanations of difficult concepts.

Jackson, J.D., *Classical Electrodynamics,* 2nd edition. John Wiley and Sons, 1975. This book has been the standard graduate level textbook in the United States for many years. It is very comprehensive.

Davalos, A. L. and Zanette, D., *Fundamentals of Electromagnetism.* Springer, 1999. This is a graduate level textbook which approaches electromagnetism from the vantage point of special relativity. The mathematical notation is quite modern.

Maxwell, J.C., *An Elementary Treatise on Electricity*, 2nd edition. Dover Publications, 2005. This is an introductory treatment of electricity, written by one of its most important theorists. It is very interesting and well-written, though it covers only a limited range of topics, and it is old.

Maxwell, J.C., *A Dynamical Theory of the Electromagnetic Field*. Wipf and Stock Publishers, 1996. This is a classic text by Maxwell, one of the founders . The mathematical notation is quite archaic (no vector calculus), and is rather difficult to follow.

Midterm and Final exam: There will be a midterm exam and a final exam. No calculators will be allowed on these exams. They will each be comprehensive exams that cover all previously learned material.

How will this course be run? Generally speaking, I will lecture ; the remaining one (or two) day(s) will be devoted to students working through assigned problems on the chalkboard. Here is how this will (generally) work: On the Monday, each student will be assigned one homework problem. ``First-pass" solutions will be presented by each student on Friday. The other students in the class can provide feedback and suggestions during this class period. On Monday of the next week, final solutions to assigned problems will be due. Every student must turn in hand-written solutions to all of the homework problems.

I strongly encourage you to work together on the homework problems. Nonetheless, each student must hand in his or her hand-written solutions. Homework solutions should be written or typed legibly. Illegible homework, as well as homework which does not provide adequate explanation and justification of numerical calculations will be marked down.

As a general rule, you should write out your homework solutions as if you were explaining your work to a new student trying to learn the subject. Full credit should not be expected for late homework.

Please refer to the Student Handbook for the College's policies on cheating and plagiarism. Suffice it to say here that you should never copy more than one or two words of text from a web page or any other source without specifically citing the source. Should you find it necessary to cite a web page, be sure to include the URL address and the date on which it was accessed.

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Week 1 (Jan. 17 - 19)		
	Topic	*The oscillator*
	HW	Ex. 1.1, 1.2, 1.3, 1.4
Week 2 (Jan. 22 - 26)		
	Topic	*The oscillator*
	HW	Ex. 1.6, 1.7, 1.8, 1.9, 1.10
Week 3 (Jan. 29 - Feb. 2)		
	Topic	*The oscillator*
	HW	Ex. 1.11, 1.12, 1.13, 1.14, 1.15
Week 4 (Feb. 5 - 9)		
	Topic	The wave
	HW	Ex. 2.1, 2.2, 2.3, 2.4, 2.5
Week 5 (Feb. 12 - 16)		
	Topic	The wave
	HW	Ex. 2.6, 2.7, 2.8, 2.9, 2.10
Week 6 (Feb. 19 - 23)		
	Topic	The electromagnetic field
	HW	Ex. 3.1, 3.2, 3.4
Week 7 (Feb. 26 - Mar. 1)		
	Topic	The electromagnetic field
	HW	Ex. 3.5, 3.6, 3.7, 3.8
Week 8 (Mar. 4 - 8) Midterm exam		
	Topic	Sources of radiation
	HW	Ex. 4.1, 4.2, 4.3, 4.4
Week 9 (Mar. 11 - 15) Spring Break; No class		
	Topic	
	HW	
Week 10 (Mar. 18 - 22)		
	Topics	Guided waves
	HW	Ex. 5.1, 5.2, 5.3, 5.4
Week 11 (Mar. 25 - 27); No class Thursday; Easter Break		

	Topics	Guided waves
	HW	5.5, 5.6, 5.7
Week 12 (Aprl 2 - 5)		
	Topic	Interaction of waves with matter
	HW	Ex. 6.1, 6.2, 6.3, 6.4
Week 13 (Apr. 8 - 12)		
	Topic	Interaction of waves with matter
	HW	6.5, 6.6, 6.7
Week 14 (Apr. 15 - 19)		
	Topic	Reflection, refraction and scattering
	HW	Ex. 7.1, 7.2, 7.3, 7.4
Week 15 (April 22 - 26)		
	Topic	Reflection, refraction and scattering
	HW	Ex. 7.5, 7.6, 7.7
Week 16 (April 29 - May 3)		
	Topic	Reflection, refraction and scattering
	HW	Ex. 7.5, 7.6, 7.7
Week 17 (May 6 - 10) Final examination		
	Topic	Reflection, refraction and scattering
	HW	Ex. 7.5, 7.6, 7.7