FALL 2021 Department of Physics & Astronomy, UGA
PHYS 8201 Advanced Electromagnetic Theory I (as of Jul. 23/2021)
The course syllabus is a general plan for the course; deviations announced to the class by the instructor may be necessary.

Course Description:	**A study of classical electrodynamics. Topics include development of Maxwell's electromagnetic field equations and the Lorentz force equation, electrostatics and magnetostatics.**
Athena Title:	Adv EM Theory
Pre or Corequisite:	PHYS 4202/6202 and PHYS 8402 + Good grounding in the following math subjects (in chronological order): 1. Vector Calculus (grad, dir. deriv., div, curl, Div. & Stokes Theorems)* (by Aug. 19) 2. Elem. Diff. Equations (linear, ordinary, up to second order) (by Aug. 26) 3. Linear Algebra (eigenvalue problems)* (by Sep. 07) 4. Complex Analysis (contour integration) & Fourier Transforms (by early November) + Ability to use MATLAB and/or *Mathematica* ** _____ * Highest importance ** For help with installation on your computer contact our IT guys: **Mike Caplinger**, Systems Administration Specialist mikecap@uga.edu 706-542-3622 **Jeff Deroshia**, Systems Administrator Associate deroshia@uga.edu 706-542-3622
Grading System:	A-F (Traditional)
Instructor:	Dr. Andrei Galiautdinov
Office:	Physics 220
Email:	ag1@uga.edu
Sections:	**25810** 09:35am – 10:50am (TTh)
Office hours:	TBD
Texts (will be used selectively)**:**	**J. D. Jackson**, *Classical Electrodynamics* (3rd ed., Wiley, 1999; other eds. OK) **L. D. Landau & E. M. Lifshitz**, *The Classical Theory of Fields* (Course of Theoretical Physics, vol. 2; Butterworth-Heinenann, 1996) **L. D. Landau & E. M. Lifshitz**, *Electrodynamics of Continuous Media* (Course of Theoretical Physics, vol. 8; Pergamon Press, 1984) **A. Zangwill**, *Modern Electrodynamics* (CUP, 2013) "Typos & Corrections" are available at http://www.prism.gatech.edu/~az2/
Useful Texts: (to be updated)	**D. J. Griffiths**, *Introduction to Electrodynamics*, 4th Edition (Pearson, 2013) **R. P. Feynman**, Lectures on Physics, vol. II, *Electromagnetism* **M. I. Mishchenko**, *Electromagnetic Scattering by Particles and Particle Groups: An Introduction*, (CUP, 2014) **M. I. Mishchenko, et al.**, *Scattering, Absorption, and Emission of Light by Small Particles* (CUP, 2002) **M. I. Mishchenko, et al.**, *Multiple Scattering of Light by Particles: Radiative Transfer and Coherent Backscattering* (CUP, 2006) (All three + "Typos & Corrections" are available in .pdf at http://www.giss.nasa.gov/staff/mmishchenko/books.html) **C. F. Bohren and D. R. Huffman**, *Absorption and Scattering of Light by Small Particles* (Wiley, 1983). **H. C. van de Hulst**, *Light Scattering by Small Particles* (Wiley, 1957; Dover, 1981) **S. A. Maier**, *Plasmonics: Fundamentals and Applications* (Springer, 2007) **M. Born and E. Wolf**, *Principles of Optics* (CUP, 1999)
Additional Materials	Will be posted on the eLC-New, http://elcnew.uga.edu

Math Main Texts (any edition):	**T. A. Garrity**, *All the Mathematics You Missed [But Need to Know for Graduate School]"* (CUP, 2002) **W. E. Boyce and R. C. DiPrima**, *Elementary Differential Equations and Boundary-Value Problems*, 7th ed. (Wiley, 2003) **Arfken, Weber, Harris**, *Mathematical Methods for Physicists*, 7th ed. (Elsevier, 2013)
Math Useful Texts (any edition):	**D. C. Lay**, *Linear Algebra and Its Applications*, 6th ed (Pearson, 2020) **G. Barton**, *Elements of Green's Functions and Propagation* (Clarendon Press, 1989) **D. G. Duffy**, *Green's Functions with Applications* (Chapman & Hall, 2001)
Academic Honesty:	As a University of Georgia student, you have agreed to abide by the University's academic honesty policy, "A Culture of Honesty," and the Student Honor Code. All academic work must meet the standards described in "A Culture of Honesty" found at: www.uga.edu/honesty. Lack of knowledge of the academic honesty policy is not a reasonable explanation for a violation. Questions related to course assignments and the academic honesty policy should be directed to the instructor. UGA Student Honor Code: "I will be academically honest in all of my academic work and will not tolerate academic dishonesty of others." A Culture of Honesty, the University's policy and procedures for handling cases of suspected dishonesty, can be found at www.uga.edu/ovpi.
Grades:	Your grades will be posted on the eLC-New, http://elcnew.uga.edu
Grading policy:	**90% Combination of homework and, possibly, exams**; **some exp. and/or theor. projects may also be assigned** (no make-ups; must be submitted before the deadline) **10% Final Exam** (no individual re-scheduling or make up)
Cut-offs:	F : [0, 60) D : [60, 68) C–: [68, 70) C: [70, 75) C+: [75, 78) B–: [78, 80) B: [80, 85) B+: [85, 88) A–: [88, 90) A: [90, 100] NOTE: No rounding; 89.99 = A–, etc.
Grade appeal:	Grade appeals are resolved by following our departmental due procedure as described here: https://www.physast.uga.edu/policies/policiesonstudentissues/grievance
Incompletes:	No "Incompletes" will be assigned in this class unless requested by the UGA Office of Student Support Services.* **You must remove the "I'' by the end of the semester subsequent to its assignment.*
Hardship withdrawals:	If your course performance is significantly affected by issues beyond your control, please seek assistance promptly from the Office of Student Support Services http://sco.uga.edu/ It is always easier to address exceptional circumstances when you raise these concerns as early as possible. Waiting until the end of the semester to take action may limit my ability to provide appropriate support.
Mental Health and Wellness Resources:	• If you or someone you know needs assistance, you are encouraged to contact Student Care and Outreach in the Division of Student Affairs at 706-542-7774 or visit https://sco.uga.edu. They will help you navigate any difficult circumstances you may be facing by connecting you with the appropriate resources or services. • UGA has several resources for a student seeking mental health services (https://www.uhs.uga.edu/bewelluga/bewelluga) or crisis support (https://www.uhs.uga.edu/info/emergencies). • If you need help managing stress anxiety, relationships, etc., please visit BeWellUGA (https://www.uhs.uga.edu/bewelluga/bewelluga) for a list of FREE workshops, classes, mentoring, and health coaching led by licensed clinicians and health educators in the University Health Center. • Additional resources can be accessed through the UGA App.

2021 Fall Main Schedule

Wk	Day	Date	Topic	Items
1	M	Aug. 16		
	T	Aug. 17		
	W	Aug. 18		

	R	Aug. 19	**1. Review of Maxwell's Theory** (in a vacuum)	Intro to This Course Charges, currents, and fields Charge conservation Operational definitions of the electric and magnetic fields Lorentz Force Law Maxwell's equations in a vacuum Systems of units
	F	Aug. 20		
2	M	Aug. 23		
	T	**Aug. 24**	**2.**	(cont.) **Drop/Add ends**
	W	Aug. 25		
	R	Aug. 26	**3. Electrostatics** (in a vacuum)	Review of electrostatics (in a vacuum) Coulomb's Law Electrostatic potential Laplace & Poisson Equations
	F	Aug. 27		
3	M	Aug. 30		
	T	Aug. 31	**4.**	Problem solving (by elementary means)
	W	Sep. 01		
	R	Sep. 02	**5.**	(cont.)
	F	Sep. 03		
4	**M**	**Sep. 06**		**Labor Day**
	T	Sep. 07	**6. Boundary-Value Problems in Electrostatics** (in a vacuum) **Method of Images**	Introduction to boundary-value problems (bvp) Classification of bvp Dirichlet, Neumann, mixed, and periodic boundary conditions Green's formulas Eigen-value problems (evp) for differential operators Examples Fourier method & Green's functions The Method of (electrostatic) Images Bvp for Laplace operator Bvp for Laplace operator in Cartesian coordinates Examples Legendre Polynomials Associated Legendre Functions Spherical Harmonics Bvp for Laplace operator in spherical coordinates Examples Bvp for Laplace operator in cylindrical coordinates Bessel functions Examples
	W	Sep. 08		
	R	Sep. 09	**7.**	(cont.)
	F	Sep. 10		
5	M	Sep. 13		
	T	Sep. 14	**8.**	(cont.)
	W	Sep. 15		

	R	Sep. 16	**9.**	(cont.)
	F	Sep. 17		
6	M	Sep. 20		
	T	Sep. 21	**10.**	(cont.)
	W	Sep. 22		
	R	Sep. 23	**11.**	(cont.)
	F	Sep. 24		
7	M	Sep. 27		
	T	Sep. 28	**12.**	(cont.)
	W	Sep. 29		
	R	Sep. 30	**13.**	(cont.)
	F	Oct. 01		
8	M	Oct. 04		
	T	Oct. 05	**14. Multipoles in Electrostatics**	Addition Theorem for Spherical Harmonics Multipole expansion of electrostatic potential
	W	Oct. 06		
	R	Oct. 07	**15.**	(cont.)
	F	Oct. 08		
9	M	Oct. 11		
	T	Oct. 12	**16. Magnetostatics** (in a vacuum)	Review of magnetostatics (in a vacuum) Electric charge & current densities Biot-Savart Law Ampere's Law Magnetostatic vector potential
	W	Oct. 13		
	R	Oct. 14	**17. Multipoles in Magnetostatics**	Multipole expansion of magnetostatic vector potential Magnetic dipole moment
	F	Oct. 15		
10	M	Oct. 18		
	T	Oct. 19	**18. Maxwell's correction**	Maxwell's correction Displacement current Examples
	W	Oct. 20		
	R	Oct. 21	**19. Faraday's Law of Induction**	Faraday's experiments Faraday's Law of Induction Lenz's Rule
	F	Oct. 22		
11	**M**	**Oct. 25**		**Withdrawal deadline**
	T	Oct. 26	**20. Faraday's Law of Induction (cont.)** **Miscellaneous topics**	Examples & Demos Invariance of electric charge Transformation of electric & magnetic fields (in the non-relativistic limit)
	W	Oct. 27		
	R	Oct. 28	**21. Complete system of Maxwell's equations** (in a vacuum)	Complete system of Maxwell's equations (in a vacuum) Units Looking ahead
	F	**Oct. 29**		**Fall Break**
12	M	Nov. 01		
	T	Nov. 02	**22. Energy in Electrodynamics**	Energy in electromagnetic universe Conservation of energy Energy density Poynting's vector field Examples ASIDE: Conservation Laws in tensor form
	W	Nov. 03		

	R	Nov. 04	**23. Linear Momentum in Electrodynamics**	Linear momentum in electromagnetic universe Conservation of linear momentum Momentum density Momentum flux density Maxwell's stress tensor Example (monochromatic EM wave)
	F	Nov. 05		
13	M	Nov. 08		
	T	Nov. 09	**24. Angular Momentum in Electrodynamics**	Angular momentum in electromagnetic universe Conservation of angular momentum Angular momentum density Angular momentum flux density Maxwell's stress tensor Electromagnetic mass & velocity Example (monochromatic EM wave)
	W	Nov. 10		
	R	Nov. 11	**25. Plane Electromagnetic Waves**	Plane EM waves
	F	Nov. 12		
14	M	Nov. 15		
	T	Nov. 16	**26. Electromagnetic Potentials**	EM potentials Gauge freedom in electrodynamics Lorenz gauge Coulomb (radiation) gauge Typical problems Examples
	W	Nov. 17		
	R	Nov. 18	**27. Dirac's Delta Function**	Physicists' approach to Dirac's delta-function Collection of important formulas involving Dirac's delta-function
	F	Nov. 19		
15	M	Nov. 22		
	T	Nov. 23	**28. Green's Function Method for Simple Harmonic Oscillator**	Equation of motion for SHO Solving SHO by the Green's function Method
	W	Nov. 24		
	R	Nov. 25		**Thanksgiving**
	F	Nov. 26		
16	M	Nov. 29		
	T	Nov. 30	**29. Green's Function Method in Electrodynamics** (in infinite space)	Inhomogeneous wave equation for EM potentials (in Lorenz gauge) Solving the wave equation by the Green's Function Method Causality Principle Retarded potentials
	W	Dec. 01		
	R	Dec. 02	**30.**	(cont.)
	F	Dec. 03		
17	M	Dec. 06		
	T	Dec. 07	**(Friday Schedule)**	**Classes End**
	W	Dec. 08		**Reading Day**
	R	Dec. 09		
	F	Dec. 10		
18	M	Dec. 13		
	T	**Dec. 14**		**Section 25810 FINAL: 08:00 - 11:00**
	W	Dec. 15		
	R	Dec. 16		
	F	Dec. 17		Commencement

	M	**Dec. 20**		**Grades due (12:00 PM)**
19	T	Dec. 21		

Fall 2021 Calendar **Based on 50 minute classes (MWF), 75 minute classes (TTH), 15 weeks of classes + Exams**		
Orientation	Aug. 16	Monday
Advisement	Aug. 16	Monday
Registration	Aug. 17	Tuesday
Classes Begin	Aug. 18	Wednesday
Drop / Add for undergraduate and graduate level courses	Aug. 18 – 24	Wednesday - Tuesday
Holiday: Labor Day - No Classes	Sept. 6	Monday
Midterm	Oct. 11	Monday
Withdrawal Deadline	Oct. 25	Monday
Fall Break - No Classes	Oct. 29	Friday
Last Day of Classes prior to Thanksgiving Break	Nov. 23	Tuesday
Holiday: Thanksgiving - No Classes	Nov. 24– 26	Wednesday - Friday
Classes Resume	Nov. 29	Monday
Friday Class Schedule in Effect	Dec. 7	Tuesday
Classes End	Dec. 7	Tuesday
Reading Day	Dec. 8	Wednesday
Final Exams	Dec. 9 - 15	Thursday - Wednesday
Commencement	Dec. 17	Friday
Grades Due	Dec. 20	Monday, 12 PM

Final Exam Schedule
Fall 2021

Regular Schedule - Fall 2021

Monday/Wednesday/Friday Classes		**Tuesday/Thursday Classes**	
Meeting Time	**Exam**	**Meeting Time**	**Exam**
8:00 am	Wed., Dec. 15 8:00 - 11:00 am	8:00 am	Thur., Dec. 9 8:00 - 11:00 am
9:10 am	Mon, Dec. 13 8:00 - 11:00 am	9:35 am	Tues., Dec. 14 8:00 - 11:00 am
10:20 am	Fri., Dec. 10 8:00 - 11:00 am	11:10 am	Thur., Dec. 9 12:00 - 3:00 pm
11:30 am	Wed., Dec. 15 12:00 - 3:00 pm	12:45 pm	Tues., Dec. 14 12:00 - 3:00 pm
12:40 pm	Mon., Dec. 13 12:00 - 3:00 pm	2:20 pm	Thur., Dec. 9 3:30 - 6:30 pm
1:50 pm	Fri., Dec. 10 12:00 - 3:00 pm	3:55 pm	Tues., Dec. 14 3:30 - 6:30 pm
3:00 pm	Wed., Dec. 15 3:30 - 6:30 pm	5:30 pm	Wed., Dec. 15 7:00 - 10:00 pm

Monday/Wednesday/Friday Classes		Tuesday/Thursday Classes	
Meeting Time	**Exam**	**Meeting Time**	**Exam**
4:10 pm	Mon., Dec. 13 3:30 – 6:30 pm	6:30 pm	Mon, Dec. 13 7:00 - 10:00 pm
5:20 pm	Fri., Dec. 10 3:30 - 6:30 pm	8:00 pm	Wed., Dec. 15 7:00 - 10:00 pm
6:30 pm	Fri., Dec. 10 7:00 - 10:00 pm	9:30 pm	Mon., Dec. 13 7:00 - 10:00 pm
6:50 pm	Tues., Dec. 14 7:00 - 10:00 pm		
7:55 pm	Tues., Dec. 14 7:00 - 10:00 pm		
9:00 pm	Thur., Dec. 9 7:00 - 10:00 pm		

Mass Exam Schedule - Fall 2021

Class Prefix	Class Number(s)	Exam
ACCT	2101	Thur., Dec. 9 7:00 - 10:00 pm
BIOL	1107, 1108	Fri., Dec. 10 7:00 – 10:00 pm
BUSN	4000	Wed., Dec. 15 7:00 - 10:00 pm
CHEM	1210, 1211, 1212, 1311H, 1411, 2211, 2212, 2311H, 2312H, 2411, 2412	Wed., Dec. 15 7:00 - 10:00 pm
CSCI	4050, 6050	Wed., Dec. 15 7:00 – 10:00 pm
ENGR	2120, 2120H	Mon., Dec. 13 7:00 – 10:00 pm
FINA	3000, 3000H, 3001	Fri., Dec. 10 7:00 – 10:00 pm
FREN	1001, 1002, 1110, 2001, 2002	Mon., Dec. 13 7:00 - 10:00 pm
GENE	3200	Fri., Dec. 10 7:00 – 10:00 pm
GRMN	1001, 1002, 2001, 2002	Mon., Dec. 13 7:00 - 10:00 pm
ITAL	1001, 1002, 1110, 2001, 2002	Mon., Dec. 13 7:00 - 10:00 pm
MARK	3000, 3001	Tues., Dec. 14 7:00 – 10:00 pm
MATH	1113, 2250	Tues., Dec. 14 7:00 – 10:00 pm
MGMT	3000, 3001	Thur., Dec. 9 7:00 – 10:00 pm
PHYS	1111, 1112, 1211, 1251, 1252	Thur., Dec. 9 7:00 - 10:00 pm
PORT	1001, 1002, 1110, 2001, 2002, 2120	Mon., Dec. 13 7:00 - 10:00 pm

Class Prefix	Class Number(s)	Exam
RUSS	1001, 2001	Mon., Dec. 13 7:00 - 10:00 pm