FALL 2022 Department of Physics & Astronomy, UGA
PHYS 8201 Advanced Electromagnetic Theory (as of Aug. 18/2022)
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, time-varying fields, conservation laws, radiating systems, and electromagnetic waves.**
Athena Title:	Adv EM Theory
Grading System:	A-F (Traditional)
Instructor:	Dr. Andrei Galiautdinov
Office:	Physics 220
Email:	ag1@uga.edu
Sections:	**25810** 09:35am – 10:50am (Rm. 254, TTH)
Office hours:	3:35pm – 4:35pm (TTH)
Main Text:	Your lecture notes
Texts (*will be used mainly for reference and for homework and exam problems*)**:**	**(J) J. D. Jackson**, *Classical Electrodynamics* **(3rd ed., Wiley, 1999)** **(L2) L. D. Landau & E. M. Lifshitz**, *Electrodynamics of Continuous Media*, 2nd edition (Course of Theoretical Physics, vol. 8; Pergamon Press, 1984) **(L1) L. D. Landau & E. M. Lifshitz**, *The Classical Theory of Fields* (Course of Theoretical Physics, vol. 2; Butterworth-Heinenann, 1996) **(Z) A. Zangwill**, *Modern Electrodynamics* (CUP, 2013) "Typos & Corrections" are available at http://www.prism.gatech.edu/~az2/
Prep Texts:	**D. J. Griffiths**, *Introduction to Electrodynamics*, 4th Edition (Pearson, 2013) **R. P. Feynman**, Lectures on Physics, vol. II, *Electromagnetism*
Additional Materials	Will be posted on the eLC-New, http://elcnew.uga.edu
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.*
Grades:	Your grades will be posted on the eLC-New, http://elcnew.uga.edu
Grading policy:	**80% HOMEWORK** (no make-up; must be submitted by the due date) **10% MIDTERM EXAM** (no individual re-scheduling or make-up) **10% FINAL EXAM** (no individual re-scheduling or make-up) _____ **100% TOTAL = 80% HOMEWORK + 10% MIDTERM + 10% FINAL**
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:	"Incompletes" will not be assigned in this class.
Hardship withdrawals:	If your course performance is significantly affected by issues beyond your control, please seek assistance promptly from Student Care and Outreach 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. 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 University's ability to provide appropriate support.
Mental Health and Wellness Resources:	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.

Topics planned for the Spring Semester:	Special Relativity Relativistic electrodynamics Boundary-value problems (*if time permits*) Macroscopic electrodynamics with rapidly changing fields (*if time permits*)

2022 Fall Schedule

Week	Day	Date	Reading (for those who like reading)	Topic
1	M	Aug. 15		
	T	Aug. 16		
	W	Aug. 17		
	R	Aug. 18	(J) I.1-6, 6.11	**Review of Maxwell's Theory** (in a vacuum)**:** Intro to This Course Charges, currents, and fields Charge conservation Discrete vs continuous charge distributions Operational definitions of the electric and magnetic fields Lorentz Force Law Maxwell's equations in a vacuum (in differential and integral forms) Systems of units Boundary conditions at interfaces
	F	Aug. 19		
2	M	Aug. 22		
	T	**Aug. 23**	(J) 1.1-5, 1.6 (surface distributions)	**Review of electrostatics** (in a vacuum)**:** Coulomb's Law Electrostatic field Maxwell's equations for electrostatic field Boundary conditions at interfaces Electrostatic potential Laplace & Poisson Equations **Drop/Add ends**
	W	Aug. 24		
	R	Aug. 25	Comp. to (J) 4.1	Multipole expansion of electrostatic potential
	F	Aug. 26		**HMWK 1 due (5pm)**
3	M	Aug. 29		
	T	Aug. 30	(J) 1.6 (double-layer) (L2) Sec. 23	Double-layer and its potential
	W	Aug. 31		
	R	Sep. 01	(J) 5.1-4	**Review of magnetostatics** (in a vacuum)**:** Experimental foundations, Oersted's experiment Electric charge & current densities Biot-Savart Law Ampere's Law Maxwell's equations for magnetostatic field Boundary conditions at interfaces Magnetostatic vector potential
	F	Sep. 02		
4	**M**	**Sep. 05**		**Labor Day**
	T	Sep. 06	(J) 5.6	Multipole expansion of magnetostatic vector potential Magnetic dipole moment
	W	Sep. 07		
	R	Sep. 08	(J) 6.1	**Maxwell's correction:** The need for Maxwell's correction Displacement current Examples
	F	Sep. 09		

5	M	Sep. 12		
	T	Sep. 13	(J) 5.15 (opt.; topic will be revisited in relativistic electrodynamics)	**Faraday's Law of Induction:** Faraday's experiments Faraday's Law of Induction Lenz's Rule Examples
	W	Sep. 14		
	R	Sep. 15		Self-inductance RL circuits Mutual inductance Transformers Demos Flying ring demo and its theoretical analysis
	F	Sep. 16		
6	M	Sep. 19		
	T	Sep. 20		(cont.)
	W	Sep. 21		
	R	Sep. 22	(J) 6.7 (assume vacuum)	**Energy in Electrodynamics** (in a vacuum)**:** **REVIEW:** Work-kinetic-Energy Theorem in Newtonian and relativistic mechanics Energy in electromagnetic universe Conservation of energy Energy density Poynting's vector field **Examples:** Charging a capacitor; energy dissipated in a wire with current
	F	Sep. 23		
7	M	Sep. 26		
	T	Sep. 27	(J) 1.11, 4.2	**Example: Energy in electrostatics** Electrostatic potential energy of a localized charge distribution Energy of a localized charge distribution placed in external electrostatic field; electrostatic force
	W	Sep. 28		
	R	Sep. 29	(J) 5.7, 5.16 (parts), 5.17	**Example: Energy in magnetostatics** Magnetic energy of stationary currents; self- and mutual inductance coefficients Energy of a localized current distribution placed in external magnetostatic field; magnetic force
	F	Sep. 30		
8	M	Oct. 03		
	T	Oct. 04		**ASIDE:** Conservation Laws in tensor form
	W	Oct. 05		
	R	Oct. 06	(J) 6.7	**Linear Momentum in Electrodynamics** (in a vacuum)**:** Linear momentum in electromagnetic universe Conservation of linear momentum Momentum density Momentum flux density Maxwell's stress tensor **Example:** monochromatic EM wave
	F	Oct. 07		
9	M	Oct. 10		
	T	Oct. 11	(J) 7.1 (assume vacuum) (L1)	**Plane Electromagnetic Waves** (in a vacuum)**:** Plane excitations and plain waves Plane EM waves
	W	Oct. 12		
	R	**Oct. 13**		**MIDTERM EXAM**
	F	Oct. 14		

10	M	Oct. 17		
	T	Oct. 18	(J) 6.2, 6.3, 6.4 (opt.)	**Electromagnetic potentials:** Electromagnetic potentials Gauge invariance Coulomb gauge Lorenz gauge Inhomogeneous wave equation for potentials Retarded potentials
	W	Oct. 19		
	R	Oct. 20	Compare to (J) Ch. 9	**Radiating systems** (in a vacuum, nonrelativistic case)**:** Multipole expansion for radiating systems
	F	Oct. 21		
11	**M**	**Oct. 24**		**W i t h d r a w a l d e a d l i n e**
	T	Oct. 25	Compare to (J) Ch. 9, 14.2 (nonrelativistic)	Electric dipole radiation and its properties (the ***E*** and ***B*** fields, differential intensity, radiation pattern, Larmor's Formula, a point charge, a system of particles with same q/m ratio)
	W	Oct. 26		
	R	Oct. 27		(cont.)
	F	**Oct. 28**		**F a l l B r e a k**
12	M	Oct. 31		
	T	Nov. 01	(J) 6.6 (parts)	**Review of macroscopic electrodynamics:** Macroscopic averaging Macroscopic charges, currents, and fields The auxiliary ***D***, ***P***, ***H***, ***M*** fields Macroscopic Maxwell's equations Constitutive relations (linear media without dispersion) Boundary conditions at interfaces
	W	Nov. 02		
	R	Nov. 03	(L2) Ch. I (parts)	**Electrostatics of ("perfect" metallic) conductors:** Maxwell's Equations Boundary conditions at interfaces
	F	Nov. 04		
13	M	Nov. 07		
	T	Nov. 08		**Example:** Conducting sphere in a uniform ***E***-field
	W	Nov. 09		
	R	Nov. 10	Comp. to (J) 4.3 (L2) Ch. II (parts)	**Electrostatics of dielectrics:** Maxwell's Equations Boundary conditions at interfaces Linear isotropic dielectrics "Refraction" of field lines at interface
	F	Nov. 11		
14	M	Nov. 14		
	T	Nov. 15	Comp. to (J) 4.4 (sphere)	**Example:** Dielectric sphere in a uniform ***E***-field
	W	Nov. 16		
	R	Nov. 17	(L2) Ch. III (parts)	**Steady current in "polarizable" conductors:** Maxwell's Equations Boundary conditions at interfaces "Refraction" of ***j***-field lines at interface
	F	Nov. 18		
15	M	Nov. 21		
	T	Nov. 22	(J) 5.8 (L2) Ch. IV (parts)	**Magnetostatics of magnetics:** Maxwell's Equations in magnetostatics Boundary conditions at interfaces Diamagnetic response (demo) Linear isotropic magnetics "Refraction" of field lines at interface

				Magnitudes of fields at the interface
	W	Nov. 23		
	R	Nov. 24		**T h a n k s g i v i n g**
	F	Nov. 25		
16	M	Nov. 28		
	T	Nov. 29	(J) 5.10-12 (parts)	**Example:** Magnetic sphere in a uniform ***B***-field
	W	Nov. 30		
	R	Dec. 01	(J) 6.7 (assume medium)	**Energy in macroscopic electrodynamics:** Poynting's Theorem in macroscopic electrodynamics
	F	Dec. 02		
17	M	Dec. 05		
	T	**Dec. 06**		**C l a s s e s E n d (Friday Schedule)**
	W	**Dec. 07**		**R e a d i n g D a y**
	R	**Dec. 08**		**FINAL EXAM (cumulative): 8:00 - 11:00 am**
	F	Dec. 09		
18	M	Dec. 12		
	T	Dec. 13		MASS FINAL EXAM (in PHYS 1112): 07:00pm - 10:00pm
	W	Dec. 14		
	R	Dec. 15		
	F	Dec. 16		Commencement
19	**M**	**Dec. 19**		**Grades due (12:00 PM)**
	T	Dec. 20		

Fall 2022 Based on 75 minute classes, 15 weeks of classes

Orientation	Aug. 15	Monday
Advisement	Aug. 15	Monday
Registration	Aug. 16	Tuesday
Classes Begin	Aug. 17	Wednesday
Drop / Add for undergraduate and graduate level courses	Aug. 17 – 23	Wednesday - Tuesday
Holiday: Labor Day - No Classes	Sept. 5	Monday
Midterm	Oct. 10	Monday
Withdrawal Deadline	Oct. 24	Monday
Fall Break	Oct. 28	Friday
Last Day of Classes prior to Thanksgiving Break	Nov. 22	Tuesday
Holiday: Thanksgiving - No Classes	Nov. 23– 25	Wednesday - Friday
Classes Resume	Nov. 28	Monday
Friday Class Schedule in Effect	Dec. 6	Tuesday
Classes End	Dec. 6	Tuesday
Reading Day	Dec. 7	Wednesday
Final Exams	Dec. 8 - 14	Thursday - Wednesday
Commencement	Dec. 16	Friday
Grades Due	Dec. 19	Monday, 12 PM