FALL 2019 PHY350

ELECTRICITY and MAGNETISM I
COMPUTATIONAL PROJECTS

MIRON KAUFMAN

DEPARTMENT OF PHYSICS
CLEVELAND STATE
UNIVERSITY
CLEVELAND OH.44115

Electricity and Magnetism I PHY350

Instructor: Professor Miron Kaufman, Office: SI-116, TEL. 6872436

Email: m.kaufman@csuohio.edu

Course information and enriching materials will be available on the web page:

http://www.csuohio.edu/sciences/dept/physics/physicsweb/kaufman/phyem.html

Prerequisites: Calculus I, Calculus II, Calculus III, University Physics I, University Physics II, Introduction to Modern Physics.

Class Meeting Times and Location:

LECTURE: M, W 6:00 - 7:15PM, SI-147 or SI-117A

OFFICE HOUR: M, W 3:00 – 3:50PM, SI-116

REQUIRED MATERIALS:

- D. J. GRIFFITHS: INTRODUCTION TO ELECTRODYNAMICS 4'th Edition;
- M. KAUFMAN: ELECTRICITY AND MAGNETISM *COMPUTATIONAL PROJECTS*;
- CD/memory stick

You may find helpful to use, beside Griffiths' book, another book on electricity and magnetism such as Halliday, Resnick,Walker Fundamentals of Physics part 3, Feynman, Lectures on Physics, volume 2 or any other of the numerous library holdings on the subject.

SUBJECT OF THE COURSE: We study the laws of Electro**statics** and Magneto**statics**, the Maxwell equations, and their applications to the physics of dielectrics and magnetic materials.

TENTATIVE SCHEDULE:

- WEEK #1, 2 REVIEW OF VECTOR ALGEBRA and CALCULUS CH.1;
- WEEK #3, 4 ELECTROSTATICS: COULOMB LAW, GAUSS LAW, POTENTIAL CH.2;
- WEEK #5, 6 POISSON AND LAPLACE EQUATIONS CH.3;
- WEEK #7, 8 POLARIZATION, DIELECTRICS CH.4;
- WEEK #9, 10, 11, 12 MAGNETOSTATICS: LORENTZ FORCE, BIOT-SAVART LAW, AMPERE LAW; MAGNETIC MATERIALS CH.5; 6
- WEEK #13, 14 OHM LAW, DRUDE MODEL; FARADAY INDUCTION; MAXWELL EQUATIONS CH.7;
- WEEK #15 CONSERVATION LAWS: CHARGE (CONTINUITY EQUATION), ENERGY (POYNTING EQUATION) CH.8.

IMPORTANT DATES:

LAST DAY TO WITHDRAW FROM THE COURSE: F NOVEMBER 1.

NO CLASS: M SEPTEMBER 2, W OCTOBER 16.

EXAM #1: M OCTOBER 14.

FINAL EXAM: W DECEMBER 11.

GRADING:

The final grade is a weighted average of:

- ✓ Homework, Quizzes 10%
- ✓ Computer Project 25%
- ✓ Exam #1 30%
- ✓ Final Exam 35%

Grading Scale: A 91-100; A- 86-90; B+ 81-85; B 76-80; B- 71 - 75;

C+ 66 - 70; C 56 - 65; D 41 - 55; F 0 - 40.

Other Information:

- There will be weekly homework assignments and two quizzes. The homework assignments, quizzes and exams are not multiple-choice and are graded by hand. Derivations of the results have to be presented. No electronic devices with internet access are allowed during exams and quizzes.
- Integral part of this course is the computer lab. We will meet in the Physics Department Computer Lab from 6pm to 7:30pm in SI-117A on: W September 4, W September 18, W October 2, W October 30, W November 13 and W November 27. We will work problems in electricity and magnetism by using the software MathCad. You should save your work on the memory stick. On W December 4 each student will give me the memory stick with all the programs and a printout of the results. Attendance of all lab sessions is **obligatory** and is **included in the grading** of the project.
- All exams must be taken. Otherwise the final grade will be F regardless of the numerical grades.
- Attending the lectures is essential for the proper understanding of the material. The students are responsible for all the material discussed in class. Attendance requirements are stated in the CSU Undergraduate Bulletin.
- Educational access is the provision of classroom accommodations, auxiliary aids and services to ensure equal educational opportunities for all students regardless of their disability. Any student who feels he or she may need an accommodation based on the impact of a disability should contact the Office of Disability Services at (216)687-2015. The Office is located in MC 147. Accommodations need to be requested in advance and will not be granted retroactively.

ELECTRICITY and MAGNETISM I PHY350 CALENDAR

	Monday 6:00-7:15PM SI-147 or SI-117A	**Wednesday SI-147 or SI-117A**
Week 1		
Week 2	**Sept.2, no class**	**Sept.4, 6:00-7:30PM Comp. Lab. 1**
Week 3		
Week 4		**Sept.18, 6:00-7:30PM Comp. Lab. 2**
Week 5		
Week 6		**Oct.2, 6:00-7:30PM Comp. Lab. 3**
Week 7		
Week 8	**Oct.14, Exam I**	**Oct.16, no class**
Week 9		
Week 10		**Oct.30, 6:00-7:30PM Comp. Lab. 5**
Week 11		
Week 12		**Nov.13, 6:00-7:30PM Comp. lab. 6**
Week 13		
Week 14		**Nov.27, 6:00-7:30PM Comp. Lab. 7**
Week 15		**Dec.4, comp. proj. due**
Week 16		**Dec.11, 6:00-8:00PM, Exam II**

HOMEWORK #1

Griffiths Ch.1, Problems: 3, 7, 11, 13, 15, 18; Examples: 9, 10, 11

- Using the Cartesian unit vectors **x**, **y**, **z,** write the vector **V** pointing from (2, -4, 1) to (0, -2, 0). Find its magnitude |**V**| and the angle it makes with the z axis.
- Given **V1 =** 3**x** +5**y** –**z; V2 =**-2**x** +**y** –3**z; V3 =** 6**x** +5**y** -3**z,** compute: **V1*V2; V1xV3; V1*(V2xV3); (V1xV2)xV3.** Check that **(V1xV2)xV3 = -V1(V2*V3) + V2(V1*V3).**
- Consider a cube. Calculate the angle between the cube's diagonal and the face diagonal adjacent.
- Given $\mathbf{V} = y^2z\mathbf{x} + z^2x\mathbf{y} + x^2y\mathbf{z}$, verify: $\nabla *(\nabla x\mathbf{V}) = 0$;

$\nabla x (\nabla x\mathbf{V}) = \nabla (\nabla *\mathbf{V}) - \nabla^2\mathbf{V}$

DUE: WEDNESDAY, SEPTEMBER 4, 2019

HOMEWORK #2

Griffiths Ch.1, Problems: 44, 45, 49.

Griffiths Ch.2, Problems: 2.

- Calculate the electric flux generated by a uniform field **E =** E**x** through the faces of a cube of side size a.

DUE:

HOMEWORK #3

- Two charges $-q_0$ and $-aq_0$ are at a distance L apart. They are free to move but they do not because of a third charge. Compute the third charge and its location.

Griffiths Ch.2, Problems: 3, 4, 5, 6.

DUE:

HOMEWORK #4

Griffiths Ch.2, Problems: 9, 11, 12, 13, 15, 16.

DUE:

HOMEWORK #5

Griffiths Ch.2, Problems: 21, 22, 23, 24.

DUE:

HOMEWORK #6

Griffiths Ch.2, Problems: 14, 25, 38, 39, 43, 52.

- The electrostatic potential is V(x,y,z) = axy. What are the SI units for the constant a? Calculate: (a) the electric field **E**; (b) ∇ x**E;** Is V a possible electrostatic potential ? ; (c) the charge density ρ; (d) the energy density

DUE:

HOMEWORK #7

Griffiths Ch.2, Problems: 31, 32, 34, 36.

o The electrostatic potential is $V(x,y,z) = a(x^2 - y^2)$. What are the SI units for the constant a? Calculate: (a) the electric field **E**; (b) ∇ x **E;** Is V a possible electrostatic potential? ; (c) the charge density ρ; (d) the energy density.

DUE:

HOMEWORK #8

Griffiths Ch.3 Problems: 13, 15, 33, 34, 36.

DUE:

HOMEWORK #9

1. For the physical dipole of Griffiths Example 3.10 find the first three terms in the potential multipole expansion: monopole, dipole, quadrupole (see also Griffiths, Problem 3.31).

2. A circular ring of radius R, centered on origin and laying in the xy plane, carries a uniform linear charge density λ. Find the first two terms in the potential multipole expansion: monopole, dipole (see also Griffiths, Problem 3.28).

DUE:

HOMEWORK #10

Griffiths Ch.4 Problems: 18, 19, 20, 21.

DUE:

HOMEWORK #11

Griffiths Ch.5 Problems: 1, 2, 3, 4.

DUE:

HOMEWORK #12

Griffiths Ch.5 Problems: 9, 14, 15; Example 5.8.

DUE:

HOMEWORK #13

Griffiths Ch.7 Problems: 1, 2, 5.

DUE:

HOMEWORK #14

Griffiths Ch.7 Problems: 7, 8, 10.

DUE: