UNIVERSITY OF CALGARY
FACULTY OF SCIENCE
DEPARTMENT OF PHYSICS AND ASTRONOMY
COURSE OUTLINE

1. **Course:** PHYS 455 Electromagnetic Theory II        Fall 2017

   Dr. Jason Donev | SA 101A | (403) 210-6343 | jmdonev@ucalgary.ca | Office Hours: M 14:00-15:30, T 13:00 – 14:30, Friday 14:00-15:30

   Lecture Sections: LEC 1 | MWF 13:00 - 13:50 | SB 105

   **Course Website**: d2l.ucalgary.ca
   **Departmental Office**: SB 605, 403-220-5385, phasugrd@ucalgary.ca

2. **Prerequisites:** PHYS 255 or 323; and AMAT 309 or MATH 353 or 377. (Please see Calendar Description for more information)

3. **Grading:** The University policy on grading and related matters is described sections F.1 and F.2 of the online University Calendar.  In determining the overall grade in the course the following weights will be used:

   2 in-class tests (20% each): 40%
   In class activities 5%
   Assignments: 25%
   Final Examination (3 hours): 30% (To be scheduled by the Registrar)

   Percentage to letter grade conversion scale:

| > =  95 % | A + | > = 80 % | B + | > = 65 % | C + | > = 50 % | D + |
|---|---|---|---|---|---|---|---|
| > = 90 % | A | > = 75 % | B | > = 60 % | C | > = 45 % | D |
| > = 85 % | A - | > = 70 % | B - | > = 55 % | C - | < 45 % | F |

4. **Missed Components of Term Work:**  The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in Section 3.6. It is the student's responsibility to familiarize himself/herself with these regulations.  See also Section E.6 of the University Calendar.

5. **Scheduled out-of-class activities:** None.

   **REGULARLY SCHEDULED CLASSES HAVE PRECEDENCE OVER ANY OUT-OF-CLASS-TIME-ACTIVITY.**  If you have a clash with this out-of-class-time-activity, please inform your instructor as soon as possible so that alternative arrangements may be made for you.

6. **Course Materials:** *Introduction to Electrodynamics,* David J. Griffiths, 4th edition, Addison-Wesley (required)
   *DIV, Grad, Curl, and All That: An Informal Text on Vector Calculus*, Schey, 4th edition, Norton (rec.)
   *A Student's Guide to Maxwell's Equations*, Fleisch, Cambridge (recommended)
   **Online Course Components:** Some websites providing specific information about specific topics will be posted on D2L.

7. **Examination Policy**:  Non-programmable calculators will be allowed on all exams; students will be provided a formula sheet for both midterms and the final.  Students should also read the Calendar, Section G, on Examinations.

8. **Approved Mandatory and Optional Course Supplemental Fees**: None

9. **Writing across the curriculum statement:** In this course, the quality of the student's writing in laboratory reports will be a factor in the evaluation of those reports.  See also Section E.2 of the University Calendar.

10. **Human studies statement:** Students in the course will not be expected to participate as subjects or researchers.  See also Section E.5 of the University Calendar.

11. **OTHER IMPORTANT INFORMATION FOR STUDENTS:**

    (a) **Misconduct:**  Academic misconduct (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases.  A single offence may lead to disciplinary probation or suspension or expulsion.  The Faculty of Science follows a zero tolerance policy regarding dishonesty.  Please read the sections of the University Calendar under Section K. Student Misconduct to inform yourself of definitions, processes and penalties.

    (b) **Assembly Points:** In case of emergency during class time, be sure to FAMILIARIZE YOURSELF with the information on assembly points.

    (c) **Student Accommodations:** Students needing an Accommodation because of a Disability or medical condition should contact Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities available at http://www.ucalgary.ca/policies/files/policies/procedure-for-accommodations-for-students-with-disabilities_0.pdf. Students needing an Accommodation in relation to their coursework or to fulfill requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, preferably in writing, to the Associate Head of the Department of Physics and Astronomy, Dr. David Feder, by email (dfeder@ucalgary.ca) or by phone (403.220.3638).

    (d) **Safewalk:**  Campus Security will escort individuals day or night (http://www.ucalgary.ca/security/safewalk/). Call 220-5333 for assistance.  Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.

    (e) **Freedom of Information and Privacy:**  This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP).  As one consequence, students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page.  For more information see also http://www.ucalgary.ca/secretariat/privacy.

    (f) **Student Union Information:** VP Academic Phone: 220-3911 Email: suvpaca@ucagary.ca.
    SU Faculty Rep: Phone: 220-3913
    Email:  science1@su.ucalgary.ca, science2@su.ucalgary.ca and science3@su.ucalgary.ca
    Student Ombuds Office:  403 220-6420
    Email:  ombuds@ucalgary.ca; http://ucalgary.ca/provost/students/ombuds

    (g) **Internet and Electronic Device Information:**  You can assume that in all classes that you attend, your cell phone should be turned off unless instructed otherwise.  Also, communication with other individuals, via laptop computers, Blackberries or other devices connectable to the Internet is not allowed in class time unless specifically permitted by the instructor.  If you violate this policy you may be asked to leave the classroom. Repeated abuse may result in a charge of misconduct.

(h) **U.S.R.I.:**  At the University of Calgary, feedback provided by students through the Universal Student Ratings of Instruction (USRI) survey provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses (www.ucalgary.ca/usri). Your responses make a difference - please participate in USRI Surveys.

1. OTHER COURSE RELATED INFORMATION:

(a) **Course Description**
This is the first semester of the 3$^{rd}$ year course on electricity and magnetism. Magnetism and electricity play an unparalleled role in modern society, and is a beautifully complete physical theory. In order to explore this rich topic we will have lively classroom discussions about all aspects of electricity and magnetism. Students will work closely with other students, attacking problems that build the fundamental understanding of electric and magnetic phenomena.

(b) **Course Learning Outcomes**
This course will deepen student's understanding of both physical laws and mathematical techniques used by physicists.
- Students will explore physical laws relevant to electricity and magnetism. By the end of the course students should be able to:
    o Use Maxwell's equations for both electrostatics and magnetostatics
    o Exploit the interrelationship between the electric and magnetic potentials and fields.
    o Articulate and employ the uniqueness theorems as they pertain to electrostatics
    o Compare and contrast the behavior of electric and magnetic fields in matter and these fields in a vacuum.
    o Express the boundary conditions relevant for electric and magnetic fields.
- Students will deepen proficiency with mathematical techniques relevant to all areas of physics. By the end of this course students should be able to:
    o Employ vector analysis to show how electric and magnetic fields are vector fields.
    o Model and analyze electrostatic and magnetostatic configurations using Cartesian, spherical and cylindrical coordinate systems.
    o Solve partial differential equations with the standard techniques for physics.

(c) **Course Learning Incomes**
Students taking PHYS 455 are expected to have prior knowledge in vector calculus, differential equations and electromagnetism.

(d) **Course Information**

**How we'll spend classroom time:**

I believe in active learning and everyone participating in discussion; lectures will therefore follow the book closely and involve questions to keep students engaged. Education research based questions will be asked in class during the lectures to help students understand the material better.

Bring:
    A calculator
    Paper and pen/pencil and notebook to keep notes on the material
    Way of answering student response questions (clicker questions)

If you fall behind or have trouble, please come to me and we can figure out what can be done about it. The earlier in the course you approach me the more help I can be.

**Homework** & **Projects** – Homework will be keeping up with the questions, largely from the book.

**Assessments:**

1.  Homework Questions                Due: Once a week, most weeks                                Value: 25%

    You will be assigned questions to do outside of class. Some of these questions will be written specifically for this class, and some will come from the textbook. You will write up these questions and turn them at the beginning of the class period.

    Assessment Criteria: Punctuality of assignments (if late they will be marked down 20%/day they are late unless discussed specifically with the instructor).

2. In class activities                Due: Most class periods                                Value: 5%

    You will be doing work on various problems in class (worksheets, clicker questions etc.) which will be assessed in real time or turned in at the end of class.

    Assessment Criteria: Completion.

3. Midterm Exams                Date: Oct. 13$^{th}$, Nov 8$^{th}$                                Value: 40%

    Exams will cover material from the assignments and the book. The first exam will cover Chapters 1&2. The second exam will cover Chapters 3&4.

    Assessment Criteria: Clear demonstration of work done, neatness and readability, and the correct answer. A correct answer with no work, or indecipherable work will not receive full credit. If you have special requirements for exams, please let me know as soon as possible.

4.  Final Exam                Date: TBD by registrar                                Value: 30%

    The final exam will cover Chapters 1-6 with a focus on 5&6.

    Assessment Criteria: This exam will cover material from lecture, the assignments and the book. You'll be marked on material comprehension and how well you can communicate the material on the exams.

**Topics that will be covered in class:**

**Vector Analysis**
Vector Algebra: operations, component form, triple products
Differential Calculus: "del" operator, gradient, divergence, curl
Integral Calculus: line, surface, volume integrals
Curvilinear coordinates: spherical, cylindrical
Dirac delta function, vector fields

**Electrostatics**
Electric field, Coulomb's law, field lines, flux
Gauss's law, divergence, curl
Electric Potential, Poisson's equation, Laplace's equation
Work and energy: single charge, point charges, continuous distribution
Conductors: properties, induced charges, surface charge, capacitors

## Special techniques
Laplace's equation: 1D, 2D, 3D, boundary conditions, uniqueness theorem
Method of images: classic, induced surface charge, force and energy
Separation of variables: Cartesian, spherical
Multipole expansion: monopole, dipole, potentials at large distances

## Electric fields in matter
Polarization: dielectrics, induced dipoles, polar molecules
Polarized objects: bound charges, fields in dielectrics
Electric displacement D, Gauss's law, boundary conditions

## Magnetostatics
Lorentz force law: magnetic fields, forces, currents
Biot-Savart law: steady currents, magnetic fields
Divergence and curl: currents, Ampere's law
Magnetic vector potential: boundary conditions, multipole expansion

## Magnetic fields in matter
Magnetization: diamagnets, paramagnets, ferromagnets, magnetic dipoles
Magnetized objects: bound currents, fields inside matter
H field, Ampere's law in magnetized materials
Linear and nonlinear media, susceptibility and permeability


Department Approval_____Date_____