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

1. **Course:** Physics 255, Electromagnetic Theory I   Winter 2018

    Instructor: Dr. Christoph Simon | SB 313 | 403.220.7007 | csimo@ucalgary.ca | Office Hour: Th 4-5

    Lecture Sections: L01: TuTh, 11:00-12:15, ENA 103

    Course Website: d2l.ucalgary.ca

    Departmental Office: SB 605, 403-220-5385, phasugrd@ucalgary.ca

2. **Prerequisites:** Physics 211 or 221 or 227; Applied Mathematics 217 or Mathematics 249 or 251 or 265 or 275. See
    http://www.ucalgary.ca/pubs/calendar/current/physics.html#6030
    Note: The Faculty of Science policy on pre- and co-requisite checking is outlined in the 2015-2016 Calendar. A student
    may not register in a course unless a grade at least" C-" has been obtained in each pre-requisite course; it is the
    responsibility   of   students   to   ensure   that   their   registrations   are   in   order.   See
    http://www.ucalgary.ca/pubs/calendar/current/sc-3-5.html for details.

3. **Grading:** The University policy on grading and related matters is described in 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:

Assignments (approximately bi-weekly)	30%
Labs	10%
Midterm test (Feb 15, in class)	20%
Final Examination	40% (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 -	< 40 %	F

    Assignments are due on the given due date. Late assignments will be considered only in well-documented emergencies
    (e.g. a doctor's note should be provided in case of illness).

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

6. **Course Materials:** *"Matter and Interactions"*, 4th Edition, Volume II, by Chabay and Sherwood, Wiley

    Online Course Components: Assignments are completed using WileyPLUS. The WileyPLUS system is free to access if
    you are using a campus computer (for example at the Taylor Digital Library). This will give you no access to the on-line

textbook, however. If you wish to also have access to an e-text, then you can purchase WileyPLUS + textbook as a bundle. Instructions for accessing WileyPLUS can be found on the course D2L page. The assignments are all multiple choice. You are expected to work on assignments on your own. You can keep returning to the assignment as long as it is posted, and it will remember your previous responses, which can be changed up until the due date. Assignments will not be accessible after the due date.

7. **Examination Policy**: Exams will be closed book. Calculators are allowed, but no networked devices. Students should also read the Calendar, Section G, on Examinations.

8. **Course fees**: none

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

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

   (a) **Academic 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.

12. OTHER COURSE RELATED INFORMATION:

(a)   **Course Description**

Electrostatics, DC circuits, calculation of magnetic intensity from currents, motion of charged particles in electric and magnetic fields, electromagnetic induction, transient effects in capacitors and inductors, electric and magnetic properties of materials.

(b)   **Course Learning Outcomes**

Primary outcomes

At the end of this course, students should be able to:
- Solve basic problems using the concepts of electric and magnetic field, the associated forces, and the electric potential.
- Solve basic problems using Gauss's Law, Faraday's Law and Ampere's Law.
- Explain how Maxwell's equations describe electro-magnetic radiation.
- Recognize how the basic principles of electro-magnetism apply in a laboratory setting.

Secondary outcomes

The course also contributes to teach students to:
- Apply mathematical techniques including vectors, derivatives and path integrals to physical problems.
- Make physically motivated approximations.

(c)   **Course Learning Incomes**

Some previous exposure to the concepts of electromagnetism (e.g. charges, electric fields) and to the basic mathematical techniques that are used (vectors, calculus) will certainly be helpful.

(d)   **Syllabus**

1. **Electric Field.**
Electric charge and force.
Electric field of a point charge.
Superposition of electric fields.
The electric field of a dipole.

2. **Electric Fields and Matter.**
Charged particles in matter.
Polarization of insulators and conductors.

3. **Electric Potential.**
Potential energy.
Potential difference in uniform and non-uniform fields.
Path independence.
Energy density and electric field.

4. **Magnetic Field.**
Biot-Savart Law for single moving charges and currents.
Current loops and magnetic dipole moment.
Atomic structure of magnets.

5. **Electric Field and Circuits.**
Electric field and current.
What charges make the electric field in the wires?
Surface charge and resistors.
Capacitors. Charging and discharging.

6. **Magnetic Force.**
Force on moving charge and current-carrying wire.
Combining electric and magnetic forces.
Magnetic torque.
Potential energy for a magnetic dipole.

7. **Patterns of Field in Space.**
Electric Flux.
Gauss's Law.
Applications of Gauss's Law.
Gauss's Law for Magnetism.
Ampere's Law.

8. Faraday's Law.
Curly electric fields.
Faraday's Law.
Superconductors.
Lenz's Rule.

9. Electromagnetic Radiation
Maxwell's Equations.
Fields travelling through space.
Accelerated charges produce radiation.
Energy and momentum in radiation.

Effects of radiation on matter.

10. Waves and Particles
Interference for classical light.
Photo-electric effect. Photons.
Single-photon interference.

11. Preview of Relativity
Lorentz transformations (space/time, energy/momentum, electric and magnetic fields)

(e)   Lab Schedule

See also http://pjl.ucalgary.ca/courses/physics255.html

Week 1 (Jan 8 - 12) No Labs
Week 2 (Jan 15 - 19) No Labs
Week 3 (Jan 22 - 26) Electric Charges and Forces
Week 4 (Jan 29 – Feb 2) Electric Potential Mapping
Week 5 (Feb 5 - 9) Magnetic Field of a current-carrying wire
Week 6 (Feb 12 - 16) Midterm Review
Week 7 (Feb 23-Mar 2) No Labs
Week 8 (Mar 5 - 9) Magnetic Fields and Forces
Week 9 (Mar 12 - 16) No Labs
Week 10 (Mar 19 - 23) Charge to Mass Ratio of the Electron
Week 11 (Mar 26 - Mar 30) Gauss's Law
Week 12 (Apr 2 - 6) Faraday's Law
Week 13 (Apr 9 - 13) Final Review