PHYS 1004
Introductory Electromagnetism and Wave Motion
Winter 2018

Course Outline

This course is designed to provide an introduction to electricity, magnetism, circuits, electromagnetic induction, and electromagnetic waves from a physics perspective for students in engineering programs. The associated laboratory and tutorial sessions are during alternate weeks starting in the first week of the term (January 8-12, 2018). It is important that each student keep track of the location (room and building) of the laboratory and tutorial sessions. Student evaluations will be based on labs, tutorial tests given during each tutorial session, and a final exam.

Course Coordinator: Alain Bellerive (alainb@physics.carleton.ca) HP3310

1. Calendar description

This calculus-based course introduces electricity, magnetism, oscillations and waves. The laboratory is an essential and autonomous part of the course.

Precludes additional credit for PHYS 1002, PHYS 1008 and BIT1204.

2. Pre-requisites

- You must have successfully completed **MATH 1004** Calculus for Engineering or Physics

- PLUS, either be concurrently registered in **ECOR 1101** Mechanics I
- or else have passed PHYS 1003 Introductory Mechanics and Thermodynamics
- or PHYS 1001 Foundations of Physics I
- or PHYS 1007 Elementary University Physics I (with a grade of at least B-)
- or BIT1203 Physics for Photonics I

If you do not have both of these requirements you must contact your Undergraduate Advisor in Engineering in order to obtain permission of the Physics Department to take this course. If you withdraw from ECOR 1101 during the term, you will be required to also withdraw from PHYS 1004.

3. Lecture timetable and locations

CRN	Section	Time	Location	Instructor
14061	A	Wednesday/Friday 10:05am – 11:25am	Richcraft Hall 2200	Andrew Robinson Office: Herzberg 3368 andrew.robinson@carleton.ca 613-520-2600 x3212 Office hours: Tuesday 14.30-15.30, Friday 11.30-12.30 (HP3349)
14062	B	Tuesday/Thursday 7:35pm – 8:55pm	Richcraft Hall 2200	Kenneth Moats Office: Herzberg 3313 kenneth.moats@carleton.ca 613-520-2600 x3212 Office hours: Tuesday/Thursday at 18:30-19:30
14063	C	Wednesday/Friday 1:05pm – 2:25pm	Rithcraft Hall 2200	Dag Gillberg Office: Herzberg 2404 dag@physics.carleton.ca 613-520-2600 x7535 Office hours: Wednesday/Friday 14:30-15:30

4. Laboratory and Tutorial Timetable

	Monday	Tuesday	Wednesday	Thursday	Friday
8:35am to 11:25am	**L1** **A** – E. Rollin **B** – I. Ivanovic	**L2** **A** – E. Rollin **B** – MP. Rozo	**L9** **D** – A. McCann	**L3** **A** – MP. Rozo **B** – I. Ivanovic	**L8** **D** – MP. Rozo
11:35am to 2:25pm	**L7** **A** – E. Rollin **B** – MP. Rozo	**L5** **A** – E. Rollin **B** – MP. Rozo		**L9** **A** – A. McCann **B** – I. Ivanovic	
2:35pm to 5:25pm	**L4** **A** – MP. Rozo **B** – I. Ivanovic		**L6** **A** – A. McCann **B** – MP. Rozo		**L8** **A** – MP. Rozo **B** – I. Ivanovic

* For the room # of each section, refer to CuLearn.

Room:

- Laboratory: Herzberg 4130 (all sections)
- Tutorial: check your schedule (all sections have a different room)

Lab supervisors:

Maria Paula Rozo	HP 3304	prmartin@physics.carleton.ca
Etienne Rollin	HP 3368	erollin@physics.carleton.ca
Igor Ivanovic	HP 3346	igor@physics.carleton.ca
Andrew McCann	HP 3313	amccann@physics.carleton.ca

5. Course components and marking scheme

a. Marks and passing conditions

The marking scheme is as follows:

Theory (total 66%)	
• Tutorials mini tests (best 4 of 5)	32%
• In-lecture quizzes and participation	4%
• Final Exam	30%
Lab Experiments	34%
Course total	100%

In order to pass the course, your overall mark must be greater than 50%, AND you must achieve 40% or above on **BOTH** the Theory (≥ 26.4/66) AND the Lab Experiments (≥ 13.6/34) components of the course.

Attendance at the labs is required; if you miss a lab due to illness you must bring a doctor's note to your lab supervisor in order to take a make-up lab.

b. Lectures

There are three hours of lecture per week. Refer to Section 7 for a detailed schedule of the delivery of the material, as well as for the content and chapters covered every week. The textbook is an important tool to learn the scientific material. The book identifies the learning objectives, explains the fundamental concepts and solves quantitative problems.

c. Tutorials

There are 6 tutorials during the term. They start on the week of January 8-12, 2018. They take place in the time and location as indicated on Carleton Central scheduling and cuLearn. The tutorials are usually in alternating weeks with the labs. The lab and tutorial schedule is given later in Section 6 of this document. In the first week of class, everyone has a tutorial (Tutorial 0). From January 16 – March 31, each lab and each tutorial are scheduled over a two-week period. It is important to keep track of the location (room and building) of your labs and tutorials.

In advance of the tutorials, the instructor will post a set of 20 recommended problems from the textbook on CuLearn. These will be quantitative problems of varying difficulty that are taken from the chapters of the textbook that are covered in that two-week period. Students should attempt to solve those problems on their own. During the first hour of the tutorial, TA's will review important concepts and solve problems on the board that are similar to the 20 recommended problems taken from the book. During the next hour, students will work in groups on other problems from this set.

For the last 5 tutorials (Tutorial 1 through 5, inclusively) there will be a 45-minute test at the end of the tutorial session. These Tutorial Tests will consist of two multiple-choice questions and one long-answer problem. The test problems will be similar to the 20 recommended problems.

What to bring for the tutorial session: Bring your student ID card, writing instruments, and a non-programmable calculator, plus a ruler if you want. Bring along a textbook to the tutorial sessions. A formula sheet, which will be posted on CuLearn, will be provided to you with the Tutorial Tests. No other aids are allowed for the Tutorial Tests

Attend your own Tutorial section only. To be able to write the Tutorial Tests in a different section, you must obtain written permission from your lab supervisor. Such permission will usually be granted only for emergencies or medical reasons, or official activities such as Engineers Without Borders. If you miss a Tutorial Test, immediately contact your lab supervisor and explain why. If the reason is illness, a doctor's note is required. Students with valid reasons will be given written permission to write the Test in a different section later the same week or the week after if possible. Note that you need to contact your lab supervisor and get permission at the time you miss the test or as soon as you are back at school after an illness or accident.

d. In-lecture (in-class) quizzes

To encourage students to read the textbook material prior to the lectures, and therefore be better prepared to learn the course material, weekly in-class quizzes will be during the lecture. The in-class polling software "PollEverywhere" will be used to ask questions during the lectures. You will be able to respond to questions through the use of a web browser on your computer, tablet or smartphone, by SMS texting, or by downloading the PollEverywhere app. Students are required to register for a PollEverywhere account in order to participate. Instructions and a registration link will be posted on CuLearn. You must use your Carleton email address when registering for an account in order to obtain marks for participating.

Go to: https://www.polleverywhere.com/signup?arlt=signupbutton&usrc=signup_button

A total of 4% of the final mark will be awarded for participating and for in-class quizzes. Marks will be based on both participation and percentage of correct answers. The marking scheme is based on participation and the correctness (correct answers).

	Correctness		
Participation	<33%	33-66%	>66%
0-33%	**0**	**0**	**0**
33-66%	**1**	**2**	**3**
>66%	**2**	**3**	**4**

e. Labs: laboratory experiments, reports and lab-quizzes

Labs start the week of January 15-19, 2018. Bring a copy of the lab instructions posted on cuLearn for the laboratory experiments (see Section 6). Also bring your lab notebook with you to each lab. Instructions on writing lab reports will be given during the lab and the format can be found in the lab instruction. Lab reports will be written up and handed in before the end of the lab period. The details of these in-lab write-ups will be given during the introduction tutorial orientation session. Note that there will be lab quizzes on CuLearn that need to be done before you attend the lab session. The lab quizzes must be completed before the deadline listed in Section 6 below.

For students repeating this course, you may request to be exempt from the lab (and have your lab mark carried forward from before) if you have completed all the lab experiments with an overall lab mark of at least 60%. You must contact your lab supervisor and obtain explicit permission to be exempt from the lab. Note that you will not be exempted from the Tutorials, which meet in alternate weeks during your lab period.

f. Final Exam

The Final Exam will be held during the Winter exam period, April 14–26, 2018. The university will announce the date of the final exam by mid-February. All three lecture sections will write the Final Exam together. You may bring only writing implements, a calculator, and a ruler to the Final Exam. The formula sheets that make up the last two pages of this course outline will be provided. The Final Exam has multiple choice questions and problems requiring written solutions, from which there will be a choice. The multiple choices questions will include a few questions relevant to the laboratory. The final covers all the lectures (see Section 7).

g. Deferred Exams

If you miss the Final Exam for a valid reason such as illness, you may apply for a Deferred Exam through the registrar's office. A Deferred Exam replaces only the Final Exam portion of your mark. Deferred Exams for Winter 2018 will be scheduled during May 18–29, 2018. In order to be eligible for a Deferred Exam, you must have earned enough mark to pass the course based on points accumulated during the term on both the theory and laboratory components of the course.

5. Required textbook and materials

1. Textbook**:**

The required book is Halliday, Resnick and Walker 9th Edition or 10th Edition, Volume 2, Chapters 21-44. Publisher: J. Wiley & Sons. The textbook is available at the University Bookstore at the University Centre.

2. Lab Manual:

Laboratory material for each laboratory experiment will be distributed as PDF file on CuLearn for each laboratory experiment. Bring to each lab the PDF instruction for the laboratory experiment.

6. Lab and tutorial schedule.

Week	Lab sections A / D	Lab sections B	Lab quiz closing date
1 (Jan 1-5)	No class, no tutorials and no labs		
2 (Jan 8-12)	Tutorial 0: Introduction (for all sections)		
3 (Jan 15-19)	Lab 1: Electrostatics	Tutorial 1: Coulomb's Law and Electric Field Tutorial test 1: Lectures 1, 2	
4 (Jan 22-26)	Tutorial 1: Coulomb's Law and Electric Field Tutorial test 1: Lectures 1, 2	Lab 1: Electrostatics	Lab Quiz 1 Jan 26th
5 (Jan 29-Feb 2)	Lab 2: DC Circuit	Tutorial 2: Gauss' Law and Potential Tutorial test 2: Lectures 3, 4, 5, 6	
6 (Feb 5-9)	Tutorial 2: Gauss' Law and Potential Tutorial test 2: Lectures 3, 4, 5, 6	Lab 2: DC Circuit	Lab Quiz 2 Feb 9th
7 (Feb 12-16)	Lab 3: Oscilloscope	Tutorial 3: Capacitance, Current, Resistance and Circuits Tutorial test 3: Lectures 7, 8, 9	
8 (Feb 19-23)	Winter break		
9 (Feb 26-Mar 2)	Tutorial 3: Capacitance, Current, Resistance and Circuits Tutorial test 3: Lectures 7, 8, 9	Lab 3: Oscilloscope	Lab Quiz 3 Mar 2nd
10 (Mar 5-9)	Lab 4: Magnetic Balance	Tutorial 4: Magnetism and Ampere's Law Tutorial test 4: Lectures 10, 11, 12	
11 (Mar 12-16)	Tutorial 4: Magnetism and Ampere's Law Tutorial test 4: Lectures 10, 11, 12	Lab 4: Magnetic Balance	Lab Quiz 4 Mar 16th
13 (Mar 19-23)	Lab 5: RLC Circuits	Tutorial 5: Induction and AC circuits Tutorial test 5: Lectures 13, 14, 15, 16, 17	
14 (Mar 26-30)	No tutorials and no labs		
15 (April 2-6)	Tutorial 5: Induction and AC circuits Tutorial test 5: Lectures 13, 14, 15, 16, 17	Lab 5: RLC Circuits	Lab Quiz 5 April 6th
16 (April 9-13	No tutorials and no labs		

7. Lecture schedule Sections A & C = Wed- Fri Section B = Tue - Thu

Lecture	Topic Item with (*) will be covered summarily	Lecture Date (Sections A&C)	Lecture Date (Section B)
1 Test 1	Course intro, Chap 21: Coulomb's Law Electric Charge Conductors and Insulators Coulomb's Law Charge Is Quantized Charge Is Conserved	January 10th	January 9th
2 Test 1	Chap 22: Electric Fields The Electric Field Electric Field Lines The Electric Field Due to a Point Charge	January 12th	January 11th
3 Test 2	Chap 22: cont'd Electric Field Due to an Electric Dipole Electric Field Due to a Line of Charge Electric Field Due to a Charged Disk A Point Charge in an Electric Field A Dipole in an Electric Field	January 17th	January 16th
4 Test 2	Chap 23: Gauss' Law Flux Flux of an Electric Field Gauss' Law Gauss' Law and Coulomb's Law	January 19th	January 18th
5 Test 2	Chap 23: cont'd A Charged Isolated Conductor Gauss' Law: Cylindrical Symmetry Gauss' Law: Planar Symmetry Gauss' Law: Spherical Symmetry	January 24th	January 23rd
6 Test 2	Chap 24: Electric Potential Electric Potential Energy Electric Potential Equipotential Surfaces Calculating the Potential from the Field Potential Due to a Point Charge	January 26th	January 25th
7 Test 3	Chap 24: cont'd Potential Due to a Group of Point Charges Potential Due to an Electric Dipole Potential Due to a Continuous Charge Distribution Calculating the Field from the Potential Electric Potential Energy of a System of Point Charges Potential of a Charged Isolated Conductor	January 31st	January 30th

8 Test 3	Chap 25: Capacitance Capacitance Calculating the Capacitance Capacitors in Parallel and in Series Energy Stored in an Electric Field Capacitor with a Dielectric Dielectrics: An Atomic View Dielectrics and Gauss' Law	February 2nd	February 1st
9 Test 3	Chap 26: Current and Resistance Electric Current Current Density Resistance and Resistivity Ohm's Law A Microscopic View of Ohm's Law Power in Electric Circuits	February 7th	February 6th
10 Test 4	Chap 27: Circuits "Pumping" Charges Work, Energy, and Emf Calculating Current Single-Loop Circuit Other Single-Loop Circuits Potential Difference Between Two Points Multiloop Circuits The Ammeter and the Voltmeter RC Circuits	February 9th	February 8th
11	Review, catch-up	February 14th	February 13th
12 Test 4	Chap 28: Magnetic Fields What Produces a Magnetic Field? The Definition of B Crossed Fields: Discovery of the Electron Crossed Fields: The Hall Effect A Circulating Charged Particle Cyclotrons and Synchrotrons (*) Magnetic Force on a Wire Torque on a Current Loop The Magnetic Dipole Moment (*)	February 16th	February 15th
13 Test 5	Chap 29: Magnetic Fields due to Currents Magnetic Field Due to a Current Force Between Two Parallel Currents Ampere's Law Solenoids and Toroids A Coil as a Magnetic Dipole	February 28th	February 27th
14	Chap 29: cont'd	March 2nd	March 1st
15	Review, catch-up	March 7th	March 6th

16 Test 5	Chap 30: Induction and Inductance What Is Physics? Two Experiments Faraday's Law of Induction Lenz's Law Induction and Energy Transfers Induced Electric Fields Inductors and Inductance Self-Induction RL Circuits Energy Stored in a Magnetic Field Energy Density of a Magnetic Field Mutual Induction (*)	March 9th	March 8th
17	Chap 30: cont'd	March 14th	March 13th
18	Chap 31: Electromagnetic Oscillations and Alternating Current LC Oscillations, Qualitatively The Electrical–Mechanical Analogy LC Oscillations, Quantitatively Damped Oscillations in an RLC Circuit Alternating Current Forced Oscillations Three Simple Circuits The Series RLC Circuit Power in Alternating-Current Circuits Transformers	March 16th	March 15th
19	Chap 31: cont'd	March 21th	March 20th
20	Chap 32: Maxwell's Equations Gauss' Law for Magnetic Fields Induced Magnetic Fields Displacement Current Maxwell's Equations	March 23rd	March 22nd
21	Chap 32: cont'd	March 28nd	March 27th
22	Chap 33: Electromagnetic Waves Maxwell's Rainbow The Traveling EM Wave, Qualitatively The Traveling EM Wave, Quantitatively Energy Transport and the Poynting Vector Radiation Pressure (*)	April 4th	March 29th
23	Chap 33: cont'd	April 6th	April 3rd
24	Course review	April 11th	April 5th
25	Course review	-	April 10th

8. University policies

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

a. Pregnancy Accommodations: write any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website: http://www.carleton.ca/equity/

b. Religious Accommodations: write any requests for academic accommodation due to religious obligations during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website (as above).

c. Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send your Letter of Accommodation to your instructor at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, students should meet with their instructor to ensure accommodation arrangements are made. Please consult the **PMC website** for the deadline to request accommodations for the formally-scheduled exam (if applicable).

d. Copying, plagiarism, and other forms of cheating: Students should read and be familiar with the university's policies on academic integrity, given in Section E.12 of the Academic Regulations of the University:
http://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/academicintegrity/

In this course, these rules are relevant mainly for lab reports (do not copy someone else's) and tutorial tests and the final exam (do not attempt to use unauthorized materials or collaborate with other students). A report will automatically be sent to the Dean of your Faculty, for possible further disciplinary action.

e. Request for Documentation in Accessible Format: This document is available in a variety of accessible formats upon request. A request can be made on the Carleton University website at:
http://www.carleton.ca/accessibility/request

The course outline will be posted on the cuLearn website. We reserve the right to amend the course outline on the cuLearn website, and will inform you if that version changes. In the event of any discrepancy between this document, and the version currently posted on the website, then the website version on cuLearn will be taken as the definitive version.