

PHYS 1004
Introductory Electromagnetism and Wave Motion
Winter 2019

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 7-11, 2019). 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
14163	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: Wednesday 11:30-12:30 (after class) and Friday 13:30-14:30 (HP4130)
14164	B	Tuesday/Thursday 18:05pm – 19:25pm	Richcraft Hall 2200	Alan Madej Office: Herzberg 3360 amadej@physics.carleton.ca 613-520-2600 x7535 Office hours: Thursday and Friday 10:30 -11:30 (HP3349)
14165	C	Wednesday/Friday 1:05pm – 2:25pm	Ritchraft Hall 2200	Dag Gillberg Office: Herzberg 2404 dag@physics.carleton.ca 613-520-2600 x4201 Office hours: Wednesday and Friday 14:30-15:30 (HP2404)

4. Laboratory and Tutorial Timetable

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

* For the room # of each section, refer and check with CuLearn.

Room:

- Laboratory: Herzberg 4130 (all sections)
- Tutorial: Tory Building 210 (all sections)

Lab supervisors:

Maria Paula Rozo	HP 3368	prmartin@physics.carleton.ca
Etienne Rollin	HP 3304	erollin@physics.carleton.ca
Igor Ivanovic	HP 3346	igor@physics.carleton.ca
Alan Madej	HP 3360	amadej@physics.carleton.ca

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 “PolleEverywhere” 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 PolleEverywhere app. Students are required to register for a PolleEverywhere 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 14-18, 2019. 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 12–27, 2019. 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 2019 will be scheduled during May 17–29, 2019. 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

(i) Textbook:

The required book is Halliday, Resnick and Walker 9th Edition or 10th Edition or 11th Edition, Volume 2, Chapters 21-44. Publisher: J. Wiley & Sons. The textbook is available at the University Bookstore at the University Centre.

(ii) 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 / C	Lab sections B / D	Lab quiz closing date
1 (Dec 31- Jan 4)	NO TUTORIAL and NO LABORATORY		
2 (Jan 7-11)	Tutorial 0: Introduction and tools (for all sections)		
3 (Jan 14-18)	Lab 1: Electrostatics	Tutorial 1: Coulomb's Law and Electric Field Tutorial test 1: Lectures 1, 2	
4 (Jan 21-25)	Tutorial 1: Coulomb's Law and Electric Field Tutorial test 1: Lectures 1, 2	Lab 1: Electrostatics	Lab Quiz 1 Jan 25
5 (Jan 28-Feb 1)	Lab 2: DC Circuit	Tutorial 2: Gauss' Law and Potential Tutorial test 2: Lectures 3, 4, 5, 6	
6 (Feb 4-8)	Tutorial 2: Gauss' Law and Potential Tutorial test 2: Lectures 3, 4, 5, 6	Lab 2: DC Circuit	Lab Quiz 2 Feb 8
7 (Feb 11-15)	Lab 3: Oscilloscope	Tutorial 3: Capacitance, Current and Resistance Tutorial test 3: Lectures 7, 8, 9, 10	
8 (Feb 18-22)	Winter break		
9 (Feb 25-Mar 1)	Tutorial 3: Capacitance, Current and Resistance Tutorial test 3: Lectures 7, 8, 9, 10	Lab 3: Oscilloscope	Lab Quiz 3 Mar 1
10 (Mar 4-8)	Lab 4: Magnetic Balance	Tutorial 4: Circuit, Magnetism and Ampere's Law Tutorial test 4: Lectures 11, 12, 13, 14	
11 (Mar 11-15)	Tutorial 4: Circuit, Magnetism and Ampere's Law Tutorial test 4: Lectures 11, 12, 13, 14	Lab 4: Magnetic Balance	Lab Quiz 4 Mar 15
12 (Mar 18-22)	Lab 5: RLC Circuits	Tutorial 5: Induction and AC circuits Tutorial test 5: Lectures 15, 16, 17, 18	
13 (Mar 25-29)	Tutorial 5: Induction and AC circuits Tutorial test 5: Lectures 15, 16, 17, 18	Lab 5: RLC Circuits	Lab Quiz 5 Mar 29
14 (April 1-5)	No tutorials and no labs	No tutorials and no labs	
15 (April 8-12)	No tutorials and no labs	No tutorials and no labs	

7. Lecture schedule Lecture Sections A & C = Wed- Fri Lecture 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 9	January 8
2 Test 1	Chap 22: Electric Fields The Electric Field Electric Field Lines The Electric Field Due to a Point Charge	January 11	January 10
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 16	January 15
4 Test 2	Chap 23: Gauss' Law Flux Flux of an Electric Field Gauss' Law Gauss' Law and Coulomb's Law	January 18	January 17
5 Test 2	Chap 23: cont'd A Charged Isolated Conductor Gauss' Law: Cylindrical Symmetry Gauss' Law: Planar Symmetry Gauss' Law: Spherical Symmetry	January 23	January 22
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 25	January 24
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 30	January 29

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 1	January 31
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 6	February 5
10 Test 3	Review, catch-up	February 8	February 7
11 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 13	February 12
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 15	February 14
13 Test 4	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 27	February 26
14 Test 4	Chap 29: continue	March 1	February 28

15 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	March 6	March 5
16 Test 5	Chap 30: continue	March 8	March 7
17 Test 5	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 13	March 12
18 Test 5	Chap 31: continue	March 15	March 14
19	Chap 32: Maxwell's Equations Gauss' Law for Magnetic Fields Induced Magnetic Fields Displacement Current Maxwell's Equations	March 20	March 19
20	Chap 32: cont'd	March 22	March 21
21	Chap 33: Electromagnetic Waves Maxwell's Rainbow The Traveling EM Wave, Qualitatively The Traveling EM Wave, Quantitatively Energy Transport and the Poynting Vector	March 27	March 26
22	Chap 33: cont'd	March 29	March 28
23	Course review	April 3	April 2
24	Course review	April 5	April 4

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.