UNIVERSITY OF CALGARY
FACULTY OF SCIENCE

Department of Physics & Astronomy
Science B 605
403 220-5385
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REVISED COURSE OUTLINE FOR REMOTE LEARNING

To account for the necessary transition to remote learning from March 13 onward, adjustments have been made to assessment deadlines and requirements so that all coursework tasks are in line with the necessary and evolving health precautions for all involved (students and staff). If you are unable to meet the deadlines or requirements specified, please connect with your course instructor to work out alternative dates/assessments.

1. **Course:** PHYS 223, Introductory Electromagnetism, and Thermal Physics - Winter 2020

Lecture 01: MWF 12:00 - 12:50 - Remote Learning (check with your instructor or coordinator for details)

Instructor	Email	Phone	Office	Hours
Dr. Anna Harlick	anna.harlick@ucalgary.ca	403 220-8648	SB 533	Monday, Tuesday, Thursday, Friday, 10:00 am - 11:00 am

Lecture 02: TR 12:30 - 13:45 - Remote Learning (check with your instructor or coordinator for details)

Instructor	Email	Phone	Office	Hours
Dr. Sean Stotyn	sean.stotyn@ucalgary.ca	403 210-7594	SA 101B	Mondays and Wednesdays 12:30–1:30 PM

Lecture 03: MWF 16:00 - 16:50 - Remote Learning (check with your instructor or coordinator for details)

Instructor	Email	Phone	Office	Hours
Dr Andrew Yau	yau@ucalgary.ca	220-8825	SB 623	M 08:00

Coordinator(s)

Name	Email	Phone	Office	Hours
Dr. Marzena Kastyak-Ibrahim	phascrscoord@ucalgary.ca	403 220-8073	SB 527A	Fridays 10:00-11:00

When communicating with the instructors and course coordinator please allow 2 work days for a response to messages and e-mail inquires.

Course Site:

D2L: PHYS 223 L01-L03 - (Winter 2020) - Introductory Electromagnetism, and Thermal Physics

PHYS 223 B01-B36 - (Winter 2020) - Labatorials

Note: Students must use their U of C account for all course correspondence.

2. **Requisites:**

See section 3.5.C in the Faculty of Science section of the online Calendar.

Prerequisite(s):
Physics 211 or 221 or 227.

3. **Grading:**

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

Component(s)	Weighting %	Date
Assignments (Mastering Physics)	12	Due on Wednesdays 11:59 pm (open for two weeks, aim to complete them during the first week they are open)
Labatorials (8)	10	Beginning the week of January 27; Lab 6 (March 16 - 19) has been cancelled, Labs 7 and 8 do not have an experimental part and will be completed by students submitting lab write-ups individually via D2L Dropboxes (videos of Demonstration for Lab 7 are posted and TA will grade your submissions for completion); TAs available via D2L Discussion forums. Lab grade will calculated as an average based of the grades you have obtained from the labs you have attended for Lab 1-6 (no need to submit Make-up Lab requests), Lab 7 & 8 (Dropboxes will be open from Wed when the write-up becomes available till Friday of the week of the lab; due to the online delivery no accommodations for Lab 7 & 8 will be provided).
End-of-Lab Problems	5	Submitted by the end of your lab section. Grade will be calculated based on End-of-Lab Problems 1-6 you have completed.
Pre-reading quizzes	5	Due on Mondays 11:30 am, submitted as D2L quizzes; two lowest grades will be dropped when calculating your final Pre-reading quizzes grade.
In-class work sheets	5	To be submitted via D2L Dropbox by Monday 11:59 pm of the following week (graded based on completion). Two lowest grades will be dropped when calculating your final WS grade.
In-class Top Hat	3	For weeks 9-12,TopHat questions will be open weekly for the duration of the week; Please note you only need 80% of the grade to get a full mark (result will be divided by 0.8 and caped at 100%);
Weekly Quizzes (best 10 of 11)	10	In-class on Mondays/ Tuesdays, administered via TopHat; There is be NO TopHat quiz next week (March 16 &17); the remaining three quizzes will be open for 1 h (during your scheduled class time and will contain 5 questions); two lowest grades will be dropped when calculating your final weekly quiz grade
Midterm examination	20	Tue, Feb 25, 2020; 19:00-21:00, rooms TBA
Magnetism Quiz	10	Thu April 2nd (noon) - Friday April 3rd (5 pm), on-line via D2L (quiz will cover Magnetism, weeks 6-8); quiz will be open for the time indicated, but you will have one attempt which will have a time limit. Additional time will be provided as for students registered with SAS according to the information provided in the forms.
Final examination	20	Final exam will be administered on-line via D2L. Please plan to complete it during the original time slot (Friday April 24, 3:30-6:30 pm), but there will be a time buffer, so you could start your attempt at a time more convenient for you the day of the exam (details will be provided later). Additional time will be provided as for students registered with SAS according to the information provided in the forms. No feedback will be provided until after the exam has closed. Any questions or concerns can be submitted to Final Exam Feedback Dropbox which will open with the exam. If you envision any technical challenges, please notify us by submitting a PDF file to the D2L Dropbox: “Final exam” listing any concerns. The Dropbox will close on April 9 at noon.

Each piece of work (reports, assignments, quizzes, midterm exam(s) or final examination) submitted by the student will be assigned a grade. The student's grade for each component listed above will be combined with the indicated weights to produce an overall percentage for the course, which will be used to determine the course letter grade.

The conversion between a percentage grade and letter grade is as follows.

	A+	A	A-	B+	B	B-	C+	C	C-	D+	D
Minimum % Required	95 %	90 %	85 %	80%	75%	70 %	65 %	60%	55%	50 %	45 %

As your term work items (labs, assignments and exams) accumulate, the marks for students in Phys 223 will be posted on D2L. The marks that appear on this website are the marks that will be used to determine each student’s overall course grade. Check your marks frequently. **Missing or incorrectly posted term work marks should be reported to your Instructor as soon as they are noticed.** You should be prepared to produce the original work to verify the requested correction.

4. **Missed Components Of Term Work:**

The University has suspended requirements for students to provide evidence for reasons for absences so please do not attend medical clinics for medical notes or Commissioners for Oaths for statutory declarations. Please let your instructor know immediately if you are ill and cannot meet the deadlines specified.

Missed quiz

There is be NO TopHat quiz next week (March 16 &17); the remaining three quizzes will be open for 1 h (during your scheduled class time and will contain 5 questions); two lowest grades will be dropped when calculating your final weekly quiz grade.

Missed Magnetism quiz

Please contact the course coordinator if you missed the quiz via Magnetism Quiz Dropbox.

Missed midterm

Students who miss the midterm for a valid reasons, will be granted an excused absence by the Course Coordinator provided that alleged problems are supported in writing. A supporting document should be provided. Students must notify the Course Coordinator by submitting the form: Missed midterm (Folder: Missed course components) to the D2L Dropbox: Missed midterm the day after the midterm, at the latest. Once the claim is substantiated, the weight of the midterm will be shifted to the final exam.

Missed Labatorials

Lab grade will calculated as an average based of the grades you have obtained from the labs you have attended for Lab 1-6 (no need to submit Make-up Lab requests), Lab 7 & 8 (Dropboxes will be open from Wed when the write-up becomes available till Friday of the week of the lab; due to the online delivery no further accommodations for Lab 7 & 8 will be provided).

Missed assignments

The lowest Assignment grade will not count towards your final grade. Most of the Assignments are open for two weeks, but you should be able to complete them a week after they open (the second week is added so you could plan around your other commitments). Students who miss more than one Assignment for a valid reasons should contact the Course Coordinator (preferably come to office hours) if you have a legitimate reason for missing a deadline for an assignment. Forgetting about the deadline etc. is NOT considered a legitimate reason.

5. **Scheduled Out-of-Class Activities:**

The following out of class activities are scheduled for this course.

Activity	Location	Date and Time	Duration
Midterm Exam	Will be posted in D2L one week before the Midterm Exam	Tuesday, February 25, 2020 at 7:00 pm	2 Hours

REGULARLY SCHEDULED CLASSES HAVE PRECEDENCE OVER ANY OUT-OF-CLASS-TIME-ACTIVITY. If you have a conflict with the out-of-class-time-activity, please contact your course coordinator/instructor no later than **14 days prior** to the date of the out-of-class activity so that alternative arrangements may be made.

6. **Course Materials:**

Recommended Textbook(s):

R.D. Knight, *Physics for Scientists and Engineers: A Strategic Approach, 4th Edition, : Addison-Wesley* . : Wiley.

- Mastering Physics license (see information about on-line Assignments below).
- A TopHat license (free for UC students at tophat.com) and a response device such as a phone, laptop or tablet.
- Lectures will be posted on D2L (free of charge).

7. **Examination Policy:**

No aids are allowed on tests or examinations. Closed book in -class quizzes with formula sheet provided; calculator allowed.

Students should also read the Calendar, Section G, on Examinations.

8. **Approved Mandatory And Optional Course Supplemental Fees:**

There are no mandatory or optional course supplemental fees for this course.

9. **Writing Across The Curriculum Statement:**

For all components of the course, in any written work, the quality of the student's writing (language, spelling, grammar, presentation etc.) can be a factor in the evaluation of the work. See also Section E.2 of the University Calendar.

10. **Human Studies Statement:**

    Students will not participate as subjects or researchers in human studies.

    See also Section E.5 of the University Calendar.

11. **Reappraisal Of Grades:**

    A student wishing a reappraisal, should first attempt to review the graded work with the Course coordinator/instructor or department offering the course. Students with sufficient academic grounds may request a reappraisal. Non-academic grounds are not relevant for grade reappraisals. Students should be aware that the grade being reappraised may be raised, lowered or remain the same. See Section I.3 of the University Calendar.

    a. **Term Work:** The student should present their rationale as effectively and as fully as possible to the Course coordinator/instructor within **ten business days** of either being notified about the mark, or of the item's return to the class. If the student is not satisfied with the outcome, the student shall submit the Reappraisal of Graded Term work form to the department in which the course is offered within 2 business days of receiving the decision from the instructor. The Department will arrange for a reappraisal of the work within the next ten business days. The reappraisal will only be considered if the student provides a detailed rationale that outlines where and for what reason an error is suspected. See sections I.1 and I.2 of the University Calendar

    b. **Final Exam:**The student shall submit the request to Enrolment Services. See Section I.3 of the University Calendar.

12. **Other Important Information For Students:**

    a. **Mental Health** The University of Calgary recognizes the pivotal role that student mental health plays in physical health, social connectedness and academic success, and aspires to create a caring and supportive campus community where individuals can freely talk about mental health and receive supports when needed. We encourage you to explore the mental health resources available throughout the university community, such as counselling, self-help resources, peer support or skills-building available through the SU Wellness Centre (Room 370, MacEwan Student Centre, Mental Health Services Website) and the Campus Mental Health Strategy website (Mental Health).

    b. **SU Wellness Center:** The Students Union Wellness Centre provides health and wellness support for students including information and counselling on physical health, mental health and nutrition. For more information, see www.ucalgary.ca/wellnesscentre or call 403-210-9355.

    c. **Sexual Violence:** The University of Calgary is committed to fostering a safe, productive learning environment. The Sexual Violence Policy (https://www.ucalgary.ca/policies/files/policies/sexual-violence-policy.pdf) is a fundamental element in creating and sustaining a safer campus environment for all community members. We understand that sexual violence can undermine students' academic success and we encourage students who have experienced some form of sexual misconduct to talk to someone about their experience, so they can get the support they need. The Sexual Violence Support Advocate, Carla Bertsch, can provide confidential support and information regarding sexual violence to all members of the university community. Carla can be reached by email (svsa@ucalgary.ca) or phone at 403-220-2208 .

    d. **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. Examples of academic misconduct may include: submitting or presenting work as if it were the student's own work when it is not; submitting or presenting work in one course which has also been submitted in another course without the instructor's permission; collaborating in whole or in part without prior agreement of the instructor; borrowing experimental values from others without the instructor's approval; falsification/ fabrication of experimental values in a report. **These are only examples**.

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

    f. **Academic Accommodation Policy:** 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 procedure-for-accommodations-for-students-with-disabilities.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 & Astronomy, Dr. David Feder by email

phas.ahugrd@ucalgary.ca or phone 403-220-8127. Religious accommodation requests relating to class, test or exam scheduling or absences must be submitted no later than **14 days** prior to the date in question. See Section E.4 of the University Calendar.

g. **Safewalk:** Campus Security will escort individuals day or night (See the Campus Safewalk website). Call 403-220-5333 for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.

h. **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). 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 Legal Services website.

i. **Student Union Information:** VP Academic, Phone: 403-220-3911 Email: suvpaca@ucalgary.ca. SU Faculty Rep., Phone: 403-220-3913 Email: sciencerep@su.ucalgary.ca. Student Ombudsman, Email: ombuds@ucalgary.ca.

j. **Internet and Electronic Device Information:** Unless instructed otherwise, cell phones should be turned off during class. All communication with other individuals via laptop, tablet, smart phone or other device is prohibited during class unless specifically permitted by the instructor. Students that violate this policy may be asked to leave the classroom. Repeated violations may result in a charge of misconduct.

k. **Surveys:** At the University of Calgary, feedback through the Universal Student Ratings of Instruction (USRI) survey and the Faculty of Science Teaching Feedback form provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses. Your responses make a difference - please participate in these surveys.

l. **Copyright of Course Materials:** All course materials (including those posted on the course D2L site, a course website, or used in any teaching activity such as (but not limited to) examinations, quizzes, assignments, laboratory manuals, lecture slides or lecture materials and other course notes) are protected by law. These materials are for the sole use of students registered in this course and must not be redistributed. Sharing these materials with anyone else would be a breach of the terms and conditions governing student access to D2L, as well as a violation of the copyright in these materials, and may be pursued as a case of student academic or non-academic misconduct, in addition to any other remedies available at law.

FORMATIVE ASSESSMENTS

The following course components are designed to help you and the instructors assess your comprehension, learning needs, and academic progress during the course.

LABATORIALS

Labatorials begin on Monday Jan 27, 2020. They take place in ST 034, 036 and 038, and students will have been assigned to a particular room by the Registrar's Office when enrolling in Physics 223. In general, the format of the labatorials is as follows: Working in groups, students make their way through a carefully written workbook crafted to help students ponder, discuss, and learn concepts being covered in their lectures. TAs offer assistance and guidance, and check student understanding periodically throughout the session, and evaluates one of the write-ups per group per each checkpoint. The discussion follows the evaluation of the write up and consists of 20% of the checkpoint's grade. Labatorials typically involve a class demonstration, computer simulations, or some apparatus, and the tasks presented to students vary accordingly.

The Labatorials workbook documents will be available on D2L. Students are to print out their own copies and take them to their Labatorials section to do their work.

ALTERNATIVE DELIVERY FORMAT UPDATE:

Lab grade will calculated as an average based of the grades you have obtained from the labs you have attended for Lab 1-6 (no need to submit Make-up Lab requests), Lab 7 & 8 (Dropboxes will be open from Wed when the write-up becomes available till Friday of the week of the lab; due to the online delivery no accommodations for Lab 7 & 8 will be provided).

Lab TAs will still be available for questions. You can ask your Lab TA a question via D2L Forum (Communication/ Discussions/ Lab section forum). In order to gain access, please self-enroll in a group (PHYS 223 Lab sections, e.g. if you are in Lab section B01, you should enroll in Group: Lab_section_B 1 by going to Communication/ Groups on

D2L Lab site).

PHYS 223 Labatorial schedule

Week	Dates	Labatorial
1	Jan 13-17	NO LABATORIALS
2	Jan 20-24	NO LABATORIALS
3	Jan 27-31	Labatorial 1
4	Feb 3-Feb 7	Labatorial 2
5	Feb 10-14	Labatorial 3
6	Feb 24-28	NO LABATORIALS (Midterm week)
7	Mar 2-Mar 6	Labatorial 4
8	Mar 9-13	Labatorial 5
9	Mar 16-20	Cancelled
10	Mar 23-27	Labatorial 7 (online delivery)
11	Mar 30-Apr 3	Labatorial 8 (online delivery)
12	Apr 6-9	Cancelled
13	Apr 14-15	NO LABATORIALS

Labatorial 1 Electric Charges and Forces
Labatorial 2 Electric Fields
Labatorial 3 Equipotential Lines
Labatorial 4 Electric Circuits
Labatorial 5 Magnetic Field in a Slinky
Labatorial 6 Charge to mass ratio experiment
Labatorial 7 Pressure and Density
Labatorial 8 First Law of Thermodynamics

On-line ASSIGNMENTS

On-line assignments are due by 23:59 on Wednesday nights. The first graded assignment is due Wednesday, January 29th, 2020. Please note that a new assignment opens every week and the assignments remain open for two weeks. At any given point two assignments will be open. A practice, not for credit, MP assignment will be made available for students to attempt (Assignment 0). Please see detailed schedule of the assignments below.

PHYS 223 Assignment schedule

Assignment	Available	Due Date
Assignment 0	January 13, 2019	N/A practice
Assignment 1	January 15, 2020	January 29, 2020
Assignment 2	January 22, 2020	February 5, 2020
Assignment 3	January 29, 2020	February 12, 2020
Assignment 4	February 5, 2020	February 26, 2020
Practice midterm	February 12, 2020	No due date
Assignment 5	February 26, 2020	March 11, 2020
Assignment 6	March 4, 2020	March 18, 2020
Assignment 7	March 11, 2020	March 25, 2020
Assignment 8	March 18, 2020	April 1, 2020
Assignment 9	March 25, 2020	April 8, 2020
Assignment 10	April 1, 2020	April 15, 2020
Practice Final	April 8, 2020	No due date

Please see D2L folder Content/ On-line Assignments for detailed visual instructions how to access MP if:

- You have a Pearson account from Fall 2019
- You don’t know if you have a Pearson account or forgot the password for your account
- You don’t have a Pearson account but you want to register the code that came with your copy of the package from the bookstore.
- You don’t have a Pearson account but you only want access to the assignments without purchasing access to the extra study resources or the eText.

Pre-reading Quizzes

The goal of the Pre-reading Material and Quizzes is to help to focus on important background materials before

classes. The Quizzes are worth 5% and will be administered via D2L; will be due on Mondays (11:30 am) and will open a week before they are due. Two lowest grades will be dropped when calculating your final Pre-reading Quizzes grade.

Worksheet (WS) Problems

The goal of the Worksheet (WS) Problems is to provide opportunity to practice problem solving in-class and test understanding of key physical concepts. Completed Worksheet (WS) Problems are to be submitted via D2L Dropbox on Monday at 11:59 pm of the following week. They are going to be marked for completeness and are worth 5% of your final grade. Two lowest grades will be dropped when calculating your final WS grade.

Work Along Problems (WAP)

The goal of the Work Along Problems (WAP) is to provide opportunity to “follow along” more complex derivations or computational solutions in-class. They are not graded, but complete solutions will be posted during the week following a given module.

Top Hat Questions

The goal of the Top Hat Questions is to provide “quick testing" and feedback of one’s understanding of physical concepts in class. Short sessions of (typically) multiple choice (MC) questions, to be answered in real time in class via Top Hat. Grading of theTopHat Questions (worth 3% of your final grade) will emphasize participation (which will carry a larger weight than correct answer).

For Weeks 9-12, TopHat questions will be open weekly for the duration of the week; Please note you only need 80% of the grade to get a full mark (result will be divided by 0.8 and caped at 100%);

Each lecture section will have its own TopHat course name which will be given to you by your instructor. The type and number of response questions you will encounter over the semester is at the sole discretion of your instructor.

SUMMATIVE ASSESSMENTS

The following course components are designed to assess your learning progress weekly (Quizzes), mid-course (Midterm) and at the end of the course (Final exam).

QUIZZES

Weekly quizzes will take place on on Mondays/Tuesdays, except the week of the Midterm. Each quiz is designed to be 10 minutes long administered at the beginning of the class using TH system.

There is be NO TopHat quiz next week (March 16 &17); the remaining three quizzes will be open for 1 h (during your scheduled class time and will contain 5 questions); two lowest grades will be dropped when calculating your final weekly quiz grade

MIDTERM TEST

The Midterm test will be a multiple-choice exam scheduled out-of-class on February 25th, 2020, 7-9 pm.

MAGNETISM QUIZ

Magnetism quiz will be administered on-line via D2L. Quiz is to be completed individually as an open book exam, but no assistance from other people. The quiz will open on Thu April 2nd at noon and needs to be completed by Friday April 3rd by 5 pm. You will have one attempt which will be time limited (the quiz would normally take 1 h, you will be given 2h). No feedback will be provided until after the quiz has closed. Any questions or concerns can be submitted to Magnetism Quiz Dropbox which will open with the quiz. You have one hour after you have completed the quiz to submit the feedback. Quiz will cover Magnetism, (weeks 6-8).

FINAL EXAM

Final exam will be administered on-line via D2L. Please plan to complete it during the original time slot (Friday April 24, 3:30-6:30 pm), but there will be a time buffer, so you could start your attempt at a time more convenient for you the day of the exam (details will be provided later). Additional time will be provided as for students registered with SAS according to the information provided in the forms. No feedback will be provided until after the exam has closed. Any questions or concerns can be submitted to Final Exam Feedback Dropbox which will open with the exam.

If you envision any technical challenges, please notify us by submitting a PDF file to the D2L Dropbox: “Final exam” listing any concerns. The Dropbox will close on April 9 at noon.

PHYS 223 DETAILED LECTURE SCHEDULE

PHYS 223 Lecture schedule

Week	Dates	Text	Topic
1	Jan 13-17	22.1-5, 23.1 –2	Coulomb’s law. Electric field of a point charge.
2	Jan 20-24	23.2-3	Distributions of point charges. Electric field of continuous charge distributions. Parallel plate capacitors.
3	Jan 27-31	23. 6, 25.1 - 5	Motion of charged particles in E fields. Electric potential energy of point charges. Electric Potential. V in a capacitor.
4	Feb 3-Feb 7	25. 6-7, 26.1 - 4	V due to point charges. The connection between E and V. E fields of charged conductors.
5	Feb 10-14	26.5, 27.1 - 5, 28.1 - 7	Capacitance and Capacitors. Resistance and Ohm’s law. DC circuits.
6	Feb 24-28	29.1 - 5	Introduction to magnetism. Currents and magnetic fields.
7	Mar 2-Mar 6	29.7 - 9	Lorentz force. Cyclotron motion. Hall Effect. Magnetic forces on straight wires and current loops.
8	Mar 9-13	30.1 - 5	Induced current. Motional emf. Magnetic flux. Lenz’s Law. Faraday's Law.
9	Mar 16-20	14.1 - 3, 18.1 - 5	Concepts of Pressure. Gauge Pressure. Thermodynamic state variables. Temperature. Phase changes.
10	Mar 23-27	18.6 – 7, 19.1 - 3	Ideal gases. Ideal gas processes. pV diagrams. Work in ideal gas processes. Heat.
11	Mar 30-Apr 2	19.4 - 7	First Law of thermodynamics. Thermal properties of matter. Calorimetry. Specific heats of gases.
12	Apr 6-9	20 1-.4	Gas particle collisions and resulting temperature and pressure. Thermal energy and Specific Heat.
13	Apr 14-15	N/A	Review.

COURSE INCOMES:

Students coming into PHYS 223 should be able to:

- Perform basic derivatives and integrals
- Apply vector notation and algebra in one and two dimensions
- Develop mathematical models of physical situations

Course Outcomes:

- By the end of the course, students will be expected to: Exploit and use symmetry to simplify physical problems in electricity and magnetism;
- Apply the principle of superposition to calculate the electric and magnetic fields of extended objects;
- Develop mathematical models of physical situations for electromagnetism and thermal physics;
- Carry out calculations symbolically (in terms of physical variables) and numerically (using appropriate values and their units);
- Obtain experimental data and relate them to predicted physical laws governing electricity and magnetism;
- Communicate and collaborate effectively within a team environment.

Electronically Approved - Mar 18 2020 18:56

Department Approval

Electronically Approved - Mar 19 2020 08:36

Associate Dean's Approval for alternate final examination arrangements or remote learning and out of regular class-time activity