



COURSE OUTLINE

1. **Course:** PHYS 259, Electricity and Magnetism (for students in Engineering) - Winter 2023

Coordinator(s)

Name	Email	Phone	Office	Hours
Shahpoor Moradi	moradis@ucalgary.ca	403 220-3041	SB 130	TBA

Section(s)

Lecture 01 : T 13:00 - 14:50 in ICT 217

Instructor	Email	Phone	Office	Hours
Dr. Shabir Barzanjeh	shabir.barzanjeh@ucalgary.ca	403 589-6606	SB 507	Thursday 3 pm to 4 pm

Lecture 02 : T 15:00 - 16:50 in ICT 114

Instructor	Email	Phone	Office	Hours
Dr. Shabir Barzanjeh	shabir.barzanjeh@ucalgary.ca	403 589-6606	SB 507	Thursday 3 pm to 4 pm

Lecture 03 : M 15:00 - 16:50 in ENG 03

Instructor	Email	Phone	Office	Hours
Dr Timothy Andrew	timothy.andrew@ucalgary.ca	please email	SB 603	TBA

Lecture 04 : M 13:00 - 14:50 in ENG 224

Instructor	Email	Phone	Office	Hours
Shahpoor Moradi	moradis@ucalgary.ca	403 220-3041	SB 130	TBA

Lecture 05 : R 13:00 - 14:50 in ENE 123 and 13:00 - 14:50 in ENE 127

Instructor	Email	Phone	Office	Hours
Mohammadreza Karamad	TBA	TBA	TBA	TBA
Shahpoor Moradi	moradis@ucalgary.ca	403 220-3041	SB 130	TBA

Lecture 06 : M 08:00 - 09:50 in ICT 217

Instructor	Email	Phone	Office	Hours
Robert Gillies	TBA	TBA	TBA	TBA

Lecture 07 : M 10:00 - 11:50 in ICT 114

Instructor	Email	Phone	Office	Hours
Shahpoor Moradi	moradis@ucalgary.ca	403 220-3041	SB 130	TBA

Lecture 08 : R 08:00 - 09:50 in ENG 03

Instructor	Email	Phone	Office	Hours
Dr Maryam Butt	maryam.butt@ucalgary.ca	TBA	TBA	TBA

Lecture 09 : R 10:00 - 11:50 in ENG 224

Instructor	Email	Phone	Office	Hours
Mohammadreza Karamad	TBA	TBA	TBA	TBA

Lecture 10 : T 10:00 - 11:50 in ENE 123 and 10:00 - 11:50 in ENE 127

Instructor	Email	Phone	Office	Hours
Shahpoor Moradi	moradis@ucalgary.ca	403 220-3041	SB 130	TBA

Lecture 11 : R 10:00 - 11:50 in ENC 201

Instructor	Email	Phone	Office	Hours
Dr Maryam Butt	maryam.butt@ucalgary.ca	TBA	TBA	TBA

Lecture 12 : M 13:00 - 14:50 in ENC 201

Instructor	Email	Phone	Office	Hours
Robert Gillies	TBA	TBA	TBA	TBA

To account for any necessary transition to remote learning for the current semester, courses with in-person

lectures, labs, or tutorials may be shifted to remote delivery for a certain period of time. In addition, adjustments may be made to the modality and format of assessments and deadlines, as well as to other course components and/or requirements, so that all coursework tasks are in line with the necessary and evolving health precautions for all involved (students and staff).

In Person Delivery Details:

During the weekly synchronous classes, students will be sitting in their groups and there will be 2 Lecture TAs present to help the instructor. When the students are working on a task (TopHat and group activity), the instructor and the TAs will be around the rooms helping the groups and answering any questions they have.

Re-Entry Protocol for Labs and Classrooms:

To limit the spread of COVID-19 on campus, the University of Calgary has implemented safety measures to ensure the campus is a safe and welcoming space for students, faculty and staff. The most current safety information for campus can be found [here](#). **Online Delivery Details:**

This course does not follow a scheduled meeting pattern.

The students will watch three asynchronous videos on the D2L before the week of the in-person activity class. Recording of all lecture materials will be placed on D2L in the respective folders.

Course Site:

D2L for Lectures: PHYS 259 All Lectures (Winter 2023)-Electricity and Magnetism (for students in Engineering)

D2L for Labs: PHYS 259 Labs B01-B12 (Winter 2023)-Electricity and Magnetism (for students in Engineering)

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

Equity Diversity & Inclusion:

The University of Calgary is committed to creating an equitable, diverse and inclusive campus, and condemns harm and discrimination of any form. We value all persons regardless of their race, gender, ethnicity, age, LGBTQIA2S+ identity and expression, disability, religion, spirituality, and socioeconomic status. The Faculty of Science strives to extend these values in every aspect of our courses, research, and teachings to better promote academic excellence and foster belonging for all.

The Physics and Astronomy EDI Committee acknowledges there are persistent barriers that prevent such accessibility and hinder our progress towards EDI. Our representatives (faculty, postdocs, graduate and undergraduate students) are committed to addressing any concerns and work towards proactive solutions that enact necessary change within the department. To submit anonymous questions, comments or concerns regarding EDI related issues, please reach out to our Associate Head EDI, Claudia Gomes da Rocha (claudia.gomesdarocho@ucalgary.ca)

2. Requisites:

See section [3.5.C](#) in the Faculty of Science section of the online Calendar.

Prerequisite(s):

Mathematics 211 and 3 units from Mathematics 265 or 275 and admission to the Schulich School of Engineering.

Antirequisite(s):

Credit for Physics 259 and either 255 or 355 will not be allowed.

Applied Mathematics 217 or Mathematics 265 or 275 and Mathematics 211.

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:

Course Component	Weight	Due Date (duration for exams)	Modality for exams	Location for exams
Assignments (online) ¹	12%	Ongoing		
Labatorials ²	18%	Ongoing		
In class activities ³	15%	Ongoing		
Midterm examination ⁴	20%	Mar 14 2023		
Registrar Scheduled Final Exam	35%	Will be available when the final exam schedule is released by the Registrar	in person	Will be available when the final exam schedule is released by the Registrar

¹ 12 weekly (Wiley Plus) assignments will open on Wednesdays at 5:00 PM and close next Sunday at 11:59 PM.

² 6 labs in total beginning the week of January 16

³ 10 group activities (10%) held during every session beginning the week of January 16; TopHat questions (5%) asked during lectures.

⁴ In-person exam on March 14 from 7:00 PM to 9:00 PM.

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 %

This course will have a Registrar Scheduled Final exam that will be delivered in-person and on campus. [The Final Examination Schedule](#) will be published by the Registrar's Office approximately one month after the start of the term. The final exam for this course will be designed to be completed within 3 hours.

The University of Calgary offers a [flexible grade option](#), Credit Granted (CG) to support student's breadth of learning and student wellness. Faculty units may have additional requirements or restrictions for the use of the CG grade at the faculty, degree or program level. To see the full list of Faculty of Science courses where CG is not eligible, please visit the following website: <https://science.ucalgary.ca/current-students/undergraduate/program-advising/flexible-grading-option-cg-grade>

4. Missed Components Of Term Work:

The university has suspended the requirement for students to provide evidence for absences. Please do not attend medical clinics for medical notes or Commissioners for Oaths for statutory declarations.

In the event that a student legitimately fails to submit any online assessment on time (e.g. due to illness etc...), please contact the course coordinator, or the course instructor if this course does not have a coordinator to arrange for a re-adjustment of a submission date. Absences not reported within 48 hours will not be accommodated. If an excused absence is approved, one possible arrangement is that the percentage weight of the legitimately missed assignment could also be pro-rated among the components of the course. This option is at the discretion of the coordinator and may not be a viable option based on the design of this course.

Missed midterm

If a student misses the midterm, they must fill out the Missed Midterm form on D2L and submit it to the appropriate dropbox **within 2 days of the missed midterm**. If the request is approved, the weight of the missed midterm will be shifted to the final exam. A missed midterm that does not have an approved accommodation from the course coordinator will result in a zero for that midterm.

Missed labs

There is no make-up or deadline extension for the missed labs, instead, the best 5 grades of the labs out of 6 will be counted toward your final grade accommodating for missing one lab.

Missed group activities

There is no make-up or deadline extension for the missed group activities, instead, the best 8 grades of the activity sheets out of 10 will be counted toward your final grade accommodating for missing two group activities.

Missed WileyPlus assignments

The deadline for the online assignments will not be extended, instead, the best 10 grades of the assignments out of 12 will be counted toward the final grade accommodating for missing two assignments.

Missed Top Hat

There will be no make-up for a missed Top Hat. Instead, the final grade for Top Hat is adjusted at the end of the term in order to accommodate for any Top Hat questions you might occasionally miss due to different circumstances. Each grade (greater than 70%) is divided by 0.8 and capped at 100%. For example, if your grade is 85%, your adjusted grade will be 100% ($85\%/0.8 = 106\%$, capped at 100%). If your final grade is 76%, your adjusted final grade will be 95% ($76\%/0.8 = 95\%$).

5. Scheduled Out-of-Class Activities:

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

Activity	Location	Date and Time	Duration
Midterm examination	in-person, TBA	Tuesday, March 14, 2023 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):

- Jearl Walker, "Fundamentals of Physics, Halliday, Resnick", 12th Edition: Wiley
- WileyPlus license for online assignments (information about the registration is on D2L)
- A TopHat license (free for UC students at tophat.com) and a response device such as a phone, laptop or tablet.
- Recorded lectures will be posted on D2L (free of charge).

In order to successfully engage in their learning experiences at the University of Calgary, students taking online, remote and blended courses are required to have reliable access to the following technology:

- A computer with a supported operating system, as well as the latest security, and malware updates;
- A current and updated web browser;
- Webcam/Camera (built-in or external);
- Microphone and speaker (built-in or external), or headset with microphone;
- Current antivirus and/or firewall software enabled;
- Stable internet connection.

For more information please refer to the UofC [ELearning](#) online website.

7. Examination Policy:

No aids are allowed on tests or examinations.

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 Services:** For more information, see their [website](#) or call [403-210-9355](#).
- c. **Sexual Violence:** 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](#). The complete University of Calgary policy on sexual violence can be viewed [here](#).
- d. **Student Ombuds Office:** A safe place for all students of the University of Calgary to discuss student related issues, interpersonal conflict, academic and non-academic concerns, and many other problems.
- e. **Student Union Information:** [SU contact](#), Email your SU Science Reps: science1@su.ucalgary.ca, science2@su.ucalgary.ca, science3@su.ucalgary.ca,
- f. **Academic Accommodation Policy:**

It is the student's responsibility to request academic accommodations according to the University policies and procedures listed below. The student accommodation policy can be found at: <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Student-Accommodation-Policy.pdf>

Students needing an accommodation because of a disability or medical condition should communicate this need to Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities: <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Accommodation-for-Students-with-Disabilities-Procedure.pdf>.

Students needing an accommodation in relation to their coursework or to fulfil requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, by filling out the [Request for Academic Accommodation Form](#) and sending it to Dr. David Feder by email phas.ahugrd@ucalgary.ca preferably 10 business days before the due date of an assessment or scheduled absence.

- g. **Misconduct:** Academic integrity is the foundation of the development and acquisition of knowledge and is based on values of honesty, trust, responsibility, and respect. We expect members of our community to act with integrity. Research integrity, ethics, and principles of conduct are key to academic integrity. Members of our campus community are required to abide by our institutional [Code of Conduct](#) and promote academic

integrity in upholding the University of Calgary's reputation of excellence. Some examples of academic misconduct include but are not limited to: posting course material to online platforms or file sharing without the course instructor's consent; submitting or presenting work as if it were the student's own work; submitting or presenting work in one course which has also been submitted in another course without the instructor's permission; borrowing experimental values from others without the instructor's approval; falsification/fabrication of experimental values in a report. Please read the following to inform yourself more on academic integrity:

[Student Handbook on Academic Integrity](#)
[Student Academic Misconduct Policy](#) and [Procedure](#)
[Faculty of Science Academic Misconduct Process](#)
[Research Integrity Policy](#)

Additional information is available on the [Student Success Centre Academic Integrity page](#)

- h. **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.
- i. **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPPA). 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.
- j. **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.

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

LABORATORIALS (18%)

Laboratorials begin on Monday, Week of Jan 16, 2023 (see course schedule table below). Please note that lab groups will be formed during the first lab session. In general, the format of the laboratorials 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. Laboratorials typically involve a class demonstration, computer simulations, or some apparatus, and the tasks presented to students vary accordingly. The Laboratorials workbook documents will be available on D2L. Students are to print out their own copies (or bring a tablet with a pen) and take them to their Laboratorials section to do their work.

TOP HAT (5%)

As a vehicle to encourage class participation and student interaction, as well as to provide instructors with rapid, real-time feedback, the Top Hat student response system will be employed. Detailed instructions on how to register for an account will be provided via D2L. Each lecture section will have its own Top Hat course name, which will be given to you by your instructor. The Top Hat questions are graded for 50% participation and 50% correctness.

Make sure you are using your correct **UCID** and your **ucalgary.ca email** address for your Top Hat enrollment, otherwise the grade for TopHat will not be counted towards your final.

IN-CLASS ACTIVITIES (10%)

There will be 10 in-class activities that will consist of questions posed by the team of instructors based on applications of the course material from the recorded lectures (see course schedule table below). These questions and problems are to be worked on in groups, while the instructor and TAs are available to answer questions and assess understanding. Attendance at and participation during these activities is mandatory to receive credit for them.

WILEYPLUS ONLINE ASSIGNMENTS (12%)

12 weekly assignments on WileyPLUS will open on Wednesdays at 5:00 PM. There will be multiple attempts per question and no marks will be deducted for multiple attempts. **No deadline extensions are granted on assignments.** Detailed instructions on how to purchase a code and register will be provided via D2L.

Make sure you are using your correct **UCID** and your **ucalgary.ca email address** for your WileyPLUS enrollment, otherwise the grade for your assignments will not be counted towards your final.

Assignment #	Available to Students (5:00 PM)	Due date (11:59 PM)
1	Wed 11-Jan-23	Sunday 22-Jan-23
2	Wed 18-Jan-23	Sunday 29-Jan-23
3	Wed 25-Jan-23	Sunday 05-Feb-23
4	Wed 01-Feb-23	Sunday 12-Feb-23
5	Wed 08-Feb-23	Sunday 19-Feb-23
6	Wed 15-Feb-23	Sunday 26-Feb-23
7	Wed 01-Mar-23	Sunday 12-Mar-23
8	Wed 08-Mar-23	Sunday 19-Mar-23
9	Wed 15-Mar-23	Sunday 26-Mar-23
10	Wed 22-Mar-23	Sunday 02-Apr-23
11	Wed 29-Mar-23	Sunday 09-Apr-23
12	Wed 05-Apr-23	Wed 12-Apr-23

Week Dates	Textbook Ref.	Asynchronous Lecture/ Topics	Synchronous Lecture Topics/Activities/Labs
Week 1 Jan 9 - Jan 13	21.1-21.3	Lec 1 Charges, and Polarization	Intro to the course, E&M intro
	22.1, 22.2	Lec 2 Coulomb's Law & Vector Review	No Labs
	22.3	Lec 3 Coulomb's Law in 2D & Superposition	
Week 2 Jan 16 - Jan 20	22.4	Lec 4 Symmetry, Electric Force from the line of charge	Lec 7: review the main concepts of week 2 recorded lectures, TopHat 1, activity 1
	22.5	Lec 5 Limiting cases & Electric Fields	Lab #0 Intro to labs and group formation
	22.6	Lec 6 Electric Fields and Forces	
Week 3 Jan 23 - Jan 27	22.7	Lec 8 Electric Forces & Torque on a dipole	Lec 11: review on the main concepts of week 3 recorded lectures, TopHat 2, activity 2
	23.1, 23.2	Lec 9 Flux; Gauss' Law - Calculating Flux	Lab #1: Electric Charges and Forces Between Them
	23.2, 23.4	Lec 10 Gauss' Law - spherical symmetry, cylindrical symmetry	
Week 4 Jan 30 - Feb 3	23.5, 23.6	Lec 12 Superposition	Lec 15: review the main concepts of week 4 recorded lectures, TopHat 3, activity 3
	24.1	Lec 13 Electric potential energy	Lab #2 Electric Fields of Charge Configurations
	24.3, 24.4	Lec 14 Electric potential	
Week 5 Feb 6 - Feb 10	24.5, 24.7	Lec 16 Calculation of the potential for insulators	Lec 19: review the main concepts of week 5 recorded lectures, TopHat 4, activity 4
	24.2, 24.6	Lec 17 Equipotential surfaces, potential gradients	No labs
	23.3	Lec 18 Charges on conductors	
Week 6 Feb 13 - Feb 17	24.8, 25.1	Lec 20 Charges on conductors continued, Intro to capacitance	Lec 23: review the main concepts of week 6 recorded lectures, TopHat 5, activity 5
	25.2-25.4	Lec 21 Gauss' Law to get capacitance, energy storage	Lab #3 Capacitors
	25.5	Lec 22 Dielectrics	
Term Break.	Feb 20 - Feb 24	No Classes	
Week 7 Feb 27 - Mar 3	26.1, 26.2	Lec 24 Electric current, current density	Lec 27: review the main concepts of week 7 recorded lectures, TopHat 6, activity 6
	26.3, 26.4	Lec 25 resistance, resistivity, molecular view of Ohm's Law	ST building Data Collection Electron Charge to Mass Ratio
	27.4	Lec 26 RC circuits	
Week 8 Mar 6 - Mar 10	28.1, 28.2	Lec 28 Magnetic fields, motion of charged particles in magnetic fields	Lec 31: Midterm review, TopHat 7, activity 7
	28.4, 28.5	Lec 29 Cyclotrons and mass spectrometer	Lab# 4 ENG Lab Analysis Electron Charge to Mass Ratio
	28.3, 28.6	Lec 30 Magnetic force on a current-carrying conductor, Hall effect	
Week 9 Mar 13 - Mar 17	28.7, 28.8	Lec 32 Force and torque on a current loop (plus magnetic dipole)	Lec 35: review the main concepts of week 9 recorded lectures, TopHat 8, activity 8
	29.1, 29.2	Lec 33 Magnetic field of a current element	Lab #5: Electric Resistivity of Play-Doh
	29.5	Lec 34 Biot-Savart Law: circular arc, finite line of current	
Week 10 Mar 20 - Mar 24	29.3	Lec 36 Ampere's Law	Lec 39: review the main concepts of week 10 recorded lectures, TopHat 9, activity 9
	29.3	Lec 37 Coaxial cable, superposition	ST building Data Collection Magnetic Field in a Slinky
	29.4	Lec 38 Solenoids and toroids	
Week 11	30.1	Lec 40 Faraday's Law & Lenz's Law	Lec 43: review the main concepts of week 11 recorded lectures, TopHat 10, activity 10

Mar 27 - Mar 31	30.2 30.3	Lec 41 Examples and applications (motional EMF) Lec 42 Examples and applications (motional EMF)	Lab 6 # ENG Lab Analysis Magnetic Field in a Slinky
Week 12 Apr 3 - Apr 7	30.4, 30.5 30.7, 30.8 30.6	Lec 44 Inductors, self-inductance Lec 45 Magnetic field energy Lec 46 RL circuits	Lec 47: review the main concepts of week 12 recorded lectures, TopHat 11, Final Exam Review Part 1
Week 13 Apr 10 - Apr 12	N/A N/A	No recorded lectures for Week 13	Lec 48: Final Exam Review Part 2

COURSE INCOMES:

Students coming into PHYS 259 should be able to:

- Demonstrate ability to solve the quadratic formula
- Use trigonometry and basic geometry to solve problems
- Employ basic algebraic manipulations
- Perform derivatives and integrals

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;
- Carry out calculations symbolically in terms of physical variables;
- Carry out calculations numerically, using appropriate values and their units;
- Obtain experimental data and relate them to predicted physical laws governing electricity and magnetism;
- and communicate and collaborate effectively within team environments.

Electronically Approved - Jan 02 2023 16:28

Department Approval

Electronically Approved - Jan 06 2023 13:53

Associate Dean's Approval