



COURSE OUTLINE

1. **Course:** PHYS 365, Acoustics, Optics and Modern Physics (for students in Engineering) - Fall 2021

Lecture 01: TR 12:30 - 13:45 - Online

Instructor	Email	Phone	Office	Hours
Dr Jared Stang	jared.stang@ucalgary.ca	403 220-8073	SB 527A	T/W 11:00 - 11:50, Zoom (link from D2L/Communication/Zoom)

Coordinator(s)

Name	Email	Phone	Office	Hours
Dr Jared Stang	jared.stang@ucalgary.ca	403 220-8073	SB 527A	T/W 11:00 - 11:50, Zoom (link from D2L/Communication/Zoom)

Please use the D2L Discussion Forum for all questions about course content or logistics. By using the forum, your classmates can see and contribute to discussions about the course content to the benefit of everyone's learning. TAs and your instructor will monitor and respond to questions on the forum.

For personal issues only, please contact your instructor via email or in office hours. (Your instructor will not answer course content or general logistic questions via email.) Please expect a 5-business-day turnaround for email replies. Students must use their U of C account for contacting their instructor.

In Person Delivery Details:

The lab portion of this course is in-person. Please see details below.

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 is being offered online in real-time via scheduled meeting times, you are required to be online at the same time.

To help ensure Zoom sessions are private, do not share the Zoom link or password with others, or on any social media platforms. Zoom links and passwords are only intended for students registered in the course. Zoom recordings and materials presented in Zoom, including any teaching materials, must not be shared, distributed or published without the instructor's permission.

This course has a registrar scheduled, synchronous final exam. The writing time is 2 hours + 50% buffer time.

The lecture portion of this course is online. Lectures will be delivered via synchronous Zoom meetings. The link will be available on D2L under Communication / Zoom.

Course Site:

D2L: PHYS 365 L01-(Fall 2021)-Acoustics, Optics and Modern Physics (for students in Engineering)

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):

Mathematics 277 and Physics 259 and admission to a program in Engineering.

Antirequisite(s):

Credit for Physics 365 and 369 will not be allowed. Not open to Geomatics Engineering students.

Required for Electrical Engineering students. Open to all other engineering students, excluding geomatics.

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 / notes
Weekly minute paper	3	Due most weeks by 5 pm Friday. Ten minute papers graded for completeness; best 9 of 10 are counted.
Assignments (WileyPLUS)	10	Due most weeks by 5pm Friday. Ten assignments worth 1% each. Automatic 48h grace period on deadline.
Group homework assignment	3.5	Interference and diffraction group homework assignment.
Laboratory experiments	17.5	Five labs worth 3.5% each.
Test	10	In class (online), Thursday October 14
Midterm	20	Out of class (online), evening of Tuesday November 16
Final exam	32	To be scheduled by the registrar
Flexible midterm / exam points	4	Weight added to the better of your midterm or final exam

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 %

A weighted course percentage will be calculated for each student after the final exam is written. Values in the table above indicate the minimum percent required to achieve the given grade.

This course will have a final exam that will be scheduled by the Registrar. [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 2 hours.

The final exam will be administered using an on-line platform. Per section [G.5](#) of the online Academic Calendar, timed final exams administered using an on-line platform, such as D2L, will be available on the platform. Due to the scheduling of the final exams, the additional time will be added to **the end** of the registrar scheduled **synchronous** exam to support students. This way, your exam schedule accurately reflects the **start time** of the exam for any **synchronous** exams. E.g. If a **synchronous** exam is designed for 2 hours and the final exam is scheduled from 9-11am in your student centre, the additional time will be added to the **end** time of the **synchronous** exam. This means that if the exam has a 1 hour buffer time, a synchronous exam would start at 9 am and finish at 12pm.

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 labs

There will be no make-up labs, but your lowest score of the five labs (including zeros) will be replaced with your final exam score if it improves your grade (e.g., if you miss a lab that lab weight will effectively be moved to your final exam).

Missed assignments

WileyPLUS assignments have a built-in 48h grace period (i.e., you can submit your assignment up to 48h after the deadline, with no penalty). This policy is designed to account for the vast majority of late and missed assignment circumstances. If you are experiencing a circumstance or illness that impacts your ability to complete the assignments beyond the grace period, please contact the course coordinator, Dr. Jared Stang.

Missed minute papers

Minute papers are graded for completion (as long as an honest effort is evident, you will receive the points), and we will take your best 9 of 10 scores in computing your total (i.e., you can miss one without penalty). In general, no other accommodations will be made.

Missed test or midterm

If a student misses the test or midterm due to a medical or personal reason, they must submit a "Missed assessment" form (available under Content / Course information) to the D2L Dropbox "Missed assessments" within 24h of the test or midterm. If the form is complete, the weight of the test or midterm will be shifted to the final exam.

5. Scheduled Out-of-Class Activities:

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

Activity	Location	Date and Time	Duration
Midterm	Online	Tuesday, November 16, 2021 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", 11th Edition* Wiley.

- WileyPLUS license (see information about online Assignments below)
- An extensive set of supplemental Extra Notes will be posted on D2L (free of charge).
- Relevant textbook sections from the free Openstax textbook will be included in the topic outline.

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:

The test, midterm, and exam will consist of multiple choice and numerical response questions. These assessments will be delivered through D2L.

The test, midterm, and exam will be open book, with all course resources (including the textbook and those resources posted on D2L) available. These assessments are not open-internet (i.e., search engines and websites other than D2L are prohibited) and no collaboration is allowed (neither with other students in the course nor any other persons). Accessing any site other than D2L (e.g., Chegg, Course Hero, Slack, Facebook, Discord, etc.) during a quiz or the exam is academic misconduct and, if discovered, will be treated as such.

Any calculator may be used. An example formula sheet will be posted on D2L for reference.

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 www.ucalgary.ca/wellnesscentre or call [403-210-9355](tel: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 (syva@ucalgary.ca) or phone at [403-220-2208](tel:403-220-2208). The complete University of Calgary policy on sexual violence can be viewed at (<https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Sexual-and-Gender-Based-Violence-Policy.pdf>)
- d. **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](#)
[Research Integrity Policy](#)

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

e. 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.

f. 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.

g. Student Union Information: [VP Academic](#), Phone: [403-220-3911](tel:403-220-3911) Email: suvpaca@ucalgary.ca. SU Faculty Rep., Phone: [403-220-3913](tel:403-220-3913) Email: sciencerep@su.ucalgary.ca. [Student Ombudsman](#), Email: ombuds@ucalgary.ca.

h. 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.

i. 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.

LABORATORIES

Laboratories begin during the week of September 13; check the timetable below for the dates of your labs. Labs take place in-person. You must attend your lab and contribute to your group's lab write-up in order to receive points for it. There will be no make-up labs, but your lowest score of the five labs (including zeros) will be replaced with your final exam score if it improves your grade (e.g., if you miss a lab that lab weight will effectively be moved to your final exam).

Lab schedule

Week	Dates	Odd-numbered lab sections	Even-numbered lab sections
1	Sep 7 - 10	No lab	No lab
2	Sep 13 - 17	No lab	Lab 1
3	Sep 20 - 24	Lab 1	No lab
4	Sep 27 - Oct 1	No lab	No lab
5	Oct 4 - 8	Lab 2	No lab
6	Oct 11 - 15	No lab	Lab 2
7	Oct 18 - 22	Lab 3	No lab
8	Oct 25 - 29	No lab	Lab 3
9	Nov 1 - 5	Lab 4	No lab
10	Nov 15 - 19	No lab	Lab 4
11	Nov 22 - 26	Lab 5	No lab
12	Nov 29 - Dec 3	No lab	Lab 5
13	Dec 6 - 8	No lab	No lab

List of experiments

- Lab 1** Uncertainities
- Lab 2** Simple harmonic oscillations
- Lab 3** Standing waves on a wire
- Lab 4** Balmer series
- Lab 5** Electron diffraction

The weight of the five laboratory experiments adds up to 17.5% of your course grade (3.5% per experiment).

Lab write-ups

Lab write-ups are prepared by the Department of Physics and Astronomy and will be posted on D2L. Each student should download their own copy of each lab. Labs 1, 2, 4, and 5 will be template-style labs (with designated sections for students to complete), while lab 3 will be formal report-style lab.

At-home portion of labs

Each student completes the at-home portion of each lab individually. Students will set up their equipment and collect data for the lab as indicated in the lab write-up instructions. Each student will receive a lab kit from the library for the course, which contains the materials needed for the at-home portion of the lab. Students must complete the at-home portion of the lab and submit it to D2L before their scheduled lab session.

Lab sessions

During the lab session, students will work through the rest of the lab in groups, including the data analysis and interpretation. When you come to the first lab session, your lab section will be organized into groups of 4 which will remain the same throughout the term. The group will work as a team, discussing each person's data, working through the analysis, and making comparisons and interpretations together. For labs 1, 2, 4, and 5, the intention is to complete and submit the lab write-up during the three-hour lab session. For lab 3 (with a formal write-up), the analysis and plans for writing the lab report should be complete during the lab session.

Lab reports

For labs 1, 2, 4, and 5, your group write-ups (Part II of the lab) should be submitted as pdf files to the D2L Lab Report Dropbox by the end of the day of your lab session. For formal group report lab 3, the report is due one week after the end of your lab session. Your TA will download it and submit the feedback via D2L. For the formal group report, each member of the group will receive the same mark.

Lab grades

As your term work items accumulate, your marks will be posted on the course D2L website. Check this posting regularly. Missing or incorrectly posted term work scores should be reported to your TA not later than 10 business days after they have been posted. If the problem could not be resolved the course coordinator, Dr. Jared Stang, should be contacted. You should be prepared to produce the original work to verify the requested correction.

WileyPLUS ONLINE ASSIGNMENTS

Your textbook, "Fundamentals of Physics" by Halliday, Resnick, and Walker, is available in the bookstore. If you did purchase the book and WileyPLUS access last term for PHYS 259, you will not need another code as your access is still valid. A new textbook comes bundled with a code, which will give you access to the eBook and assignments. If you would like to purchase just WileyPLUS standalone (without the text), you can do so through the bookstore.

If you choose not to purchase a new book or the WileyPLUS standalone, you will be able to access the homework from an on-campus library computer (with no textbook or resources access). You need to register as directed below. When you click an assignment you will not be prompted to enter an access code if you are accessing from the on-campus library.

To register in WileyPLUS go to: www.wileyplus.com/go/login. If you have a WileyPLUS account already, login using the account you used previously. Once you have an account or you have logged into your existing account press "+Add Courses." Once in the course finder, enter the 6-digit Course ID provided by your instructor (find it on D2L) into the space provided. Once you enter your WileyPLUS course, click on one of the content links and you will be asked to verify your purchase using the code provided.

New users: If you are using WileyPLUS for the first time, please click Sign up and complete the form. Once you hit submit, check your email for an email from Noreply@wileyplus.com. The email will include a link titled "Click here." This link will take you to the password screen where you can create and set your WileyPLUS password. Once you create your password you will be taken to the course finder.

Assignment schedule

Assignments are due at 5pm on the due dates given in the table before. Assignments have a built-in 48h grace period, so that you can submit them within 48h of the deadline without losing points. No further extensions will be granted except in unique circumstances.

Assignment	Available	Due date
Assignment 1	September 7	September 17
Assignment 2	September 14	September 24
Assignment 3	September 21	October 1
Assignment 4	September 28	October 8
Assignment 5	October 5	October 15
Assignment 6	October 12	October 22
Group homework activity*	October 19	October 29
Assignment 7 (last common one)	October 26	November 5
Assignment 8	November 2	November 19
Assignment 9	November 16	November 26
Assignment 10	November 23	December 3

*Group homework activity (interference and diffraction) will be available on D2L. It is to be completed collaboratively with your lab group and submitted via the Dropbox on the D2L lab site.

COURSE SCHEDULE

Week	Dates	Topics	Notes	Main text reference*	Supp. texts^
1	Sep 7 - 10	Introduction; simple harmonic motion (SHM) of systems obeying Hooke's law; differential equation of SHM; superposition of SHMs of the same frequency.		HR 15.1, 15.4, 16.6	EN1 OSv1 15.1, 16.5
2	Sep 13 - 17	Phasors; phasor addition; phasor diagrams; phasors as complex quantities; travelling wave pulse: mathematical description and particle motion; partial derivatives; harmonic wave equation.		HR 16.1, 16.4, 16.6	EN1, EN2 OSv1 16.2

3	Sep 20 - 24	Principle of wave superposition; harmonic (sinusoidal) waves; mathematical description, particle motion, phase differences; complex representation of a travelling harmonic wave; speed of waves in real media: stretched string; sound waves as longitudinal waves in solids, liquids, and gases; speed of sound waves.		HR 16.2, 16.5, 16.6, 17.1-2	EN2, EN3 OSv1 16.5, 17.1, 17.2
4	Sep 27 - Oct 1	Energy transport by a harmonic wave; mechanical impedance; power transported by a wave; acoustical impedance.	UofC closed Thursday (National Day for Truth and Reconciliation)	HR 16.3	EN4 OSv1 15.2, 16.4
5	Oct 4 - 8	Sound intensity and sound intensity level (dB); sound field around point and line sources; inverse square law; acoustical attenuation; reflections at boundaries between two media; boundary conditions; amplitude reflection and transmission coefficients at a junction; energy reflection and transmission coefficients.		HR 17.4, 17.5, 16.7	EN4, EN5 OSv1 16.5, 16.6, 17.3, 17.4
6	Oct 12 - 15	Standing waves on a stretched string of fixed length: normal modes; acoustical standing waves: vibrations of air columns, normal modes; standing wave ratio; resonance.	UofC closed Monday (Thanksgiving) Test during class Thursday Oct 14	HR 16.7	EN6 OSv1 16.5, 16.6, 17.4, 17.5
7	Oct 18 - 22	Doppler effect; superposition of two harmonic waves of different frequencies: beats; coherent and incoherent sources; two-slit interference.		HR 17.6, 17.7, 33.4, 35.2, 35.3	EN7 OSv1 16.5, 17.6, 17.7 OSv3 3.1
8	Oct 25 - 29	Thin film interference; multiple reflections in a thin film; diffraction pattern of a single slit; circular aperture; resolving power.		HR 35.4, 36.1, 36.2, 36.3	OSv3 3.4, 4.1, 4.5
9	Nov 1 - 5	Emission and absorption of light; photoelectric effect; photon momentum and probability waves.		HR 38.1, 38.2, 38.4	OSv3 6.1, 6.2, 6.3, 7.1
	Nov 8 - 12		Term Break		
10	Nov 15 - 19	De Broglie waves; electron diffraction.	Midterm in evening, Tuesday Nov 16 (no class that day)	HR 38.5	OSv3 6.5
11	Nov 22 - 26	Schrodinger's equation; Heisenberg's uncertainty principle; energy and wave functions of a trapped electron.		HR 38.6, 38.7, 39.1, 39.2	OSv3 7.2, 7.3, 7.6
12	Nov 29 - Dec 3	An electron in a potential well; the hydrogen atom: Bohr model.		HR 39.3, 39.5	OSv3 6.4, 7.5, 7.6
13	Dec 6 - 9	The hydrogen atom: Schrodinger's equation; electrical properties of metals.		HR 39.5, 41.1	OSv3 6.2, 6.4, 7.3

*HR = Halliday Resnick (the course textbook)

^Supplementary texts: EN = Extra notes; OSv1 = Openstax University Physics Vol. 1; OSv3 = Openstax University Physics Vol. 3. Access the Openstax books at <https://openstax.org/details/books/university-physics>

INCLUSIVITY

PHYS 365 is a learning community that is welcoming of diverse backgrounds, experiences, and perspectives. This means that we strive for inclusivity in our classroom, virtual spaces, practices, and interactions. Mutual respect, civility, and the ability to listen to and observe others carefully are crucial; active, thoughtful, and respectful participation in all aspects of the course will make our time together as productive and engaging as possible. Please indicate if you have a preferred name that you'd like to be called. (You can update your preferred name in the "Personal Information" section of My UCalgary---this will appear as your Zoom name. See <https://www.ucalgary.ca/registrar/student-centre/updating-personal-information>.) You are also encouraged to help

others use your correct pronouns by including them in your Zoom display name. (If you're comfortable to do this, you can update your Zoom Profile settings at ucalgary.zoom.us.) Discrimination or harassment of any form will not be tolerated. I also welcome any suggestions for improving the learning environment.

If you have a particular need to facilitate your learning in this course, please contact Student Accessibility Services (details in section 12.e, above) as soon as possible to arrange accommodations.

Course Incomes

Students coming into PHYS 365 should be able to:

- Use trigonometric functions and identities as well as geometry to solve problems
- Employ algebraic manipulations (including solving the quadratic formula)
- Perform derivatives and integrals of functions as well as calculations using complex numbers
- Demonstrate ability to use vector algebra
- 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) and numerically (using appropriate values and their units)
- Obtain experimental data and relate them to predicted physical laws governing electricity and magnetism

Course Outcomes:

- By the end of the course, students will be expected to:
- Exploit and use mathematical representations to predict the behaviour of physical systems exhibiting simple harmonic oscillations or containing waves.
- Analyze and describe the effect of a system's physical properties (density, temperature, mechanical impedance, motion) on wave propagation (speed, reflection, transmission, resonance, and interference.)
- Compute properties and effects of electromagnetic radiation emitted and absorbed by physical systems.
- Extend understanding of classical concepts of particles and waves to the quantum domain.
- Carry out calculations symbolically (in terms of physical variables) and numerically (using appropriate values and their units).
- Obtain experimental data, estimate uncertainties and relate the results to physical laws governing wave behaviour of oscillating systems and waves.
- Collaborate effectively within a team environment and communicate laboratory results in written scientific format.

Electronically Approved - Aug 31 2021 16:10

Department Approval

Electronically Approved - Sep 01 2021 17:12

Associate Dean's Approval