UNIVERSITY OF CALGARY
FACULTY OF SCIENCE

Department of Physics & Astronomy
Science B 605
403 220-5385
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COURSE OUTLINE

1. **Course:** PHYS 369, Acoustics, Optics and Radiation (for students in Engineering) - Fall 2020

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

Instructor	Email	Phone	Office	Hours
Dr Christopher Cully	cmcully@ucalgary.ca	403 220-6088	SB 631	TR 14:00-15:00

   Coordinator(s)

Name	Email	Phone	Office	Hours
Dr Jared Stang	jared.stang@ucalgary.ca	TBA	ONLINE	TW 11:00 - 11:50

   Please use Piazza (linked from D2L) for all questions about course content or logistics.

   For personal issues, please contact your instructor via email. Students must use their U of C account for contacting their instructor.

   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.

   This course will include both asynchronous and synchronous online components organized in two-week cycles.

   The asynchronous online components will consist of video lectures. A new set of video lectures will be posted on D2L for each two-week cycle. Each set of video lectures will consist of several topic-specific videos.

   50-minute online synchronous classes will be conducted on Tuesday September 8th and Thursdays 12:30-1:20. These sessions will be conducted via Zoom (link from D2L), and will provide an opportunity for students to work in groups on problems related to the current topics.

   Online quizzes will take place bi-weekly on Tuesdays. The quizzes, delivered via D2L, will consist of several multiple choice questions and one written response problem. The quizzes are planned for a 50-minute period; to account for possible technical issues, 75 minutes will be given once students begin the quiz. Students must begin the quiz between 12:30-1:00. Students accessing the course from a time zone where this quiz time is at an unreasonable hour or who are registered with Student Accessibility Services should contact the course coordinator, Dr. Jared Stang, to discuss accommodations.

   The course schedule is provided below.

   Course Site:

   D2L: PHYS 369 L01-(Fall 2020)-Acoustics, Optics and Radiation (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 369 and 365 will not be allowed. Not open to Electrical 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
Top Hat	5	
Assignments (WileyPLUS)	10	
Laboratory experiments	20	
Quizzes (best 5 of 6)	40	
Final examination	25	To be scheduled by the registrar

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 has a registrar scheduled final exam.

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, then the percentage weight of the legitimately missed assignment could also be pro-rated among the components of the course.

Missed labs
Please fill in the Make-up lab request form (should be saved as an Excel file) posted on D2L (Folder: Missed course components) and submit it to the Dropbox: Missed Labs. Requests submitted more than 48h after the date of the missed lab will not be considered.

Students are not allowed to come to a lab section different than their own. Make-ups for all labs will be scheduled during the 13th week of classes. You can make up one lab. In case of special circumstances, please contact the course coordinator, Dr. Jared Stang.

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 in-class quiz
Your final quiz grade will be calculated as the average of the best five of six quizzes (including zeros or missed quizzes). This policy is designed to account for the vast majority of missed or impacted quiz circumstances. If you are experiencing a circumstance or illness that causes you to miss two or more quizzes, please contact the course coordinator, Dr. Jared Stang, within 48h of the second missed quiz. If the absence is approved, then the weight of the missed quiz(zes) will be shifted to the final exam. Please note that accommodations will only be provided in the case of legitimate absences for two or more quizzes. (E.g., if you miss Quiz 2 with no legitimate reason and then are ill and miss Quiz 4, no accommodation will be provided.)

Missed Top Hat
Top Hat questions are completed during the Thursday synchronous class sessions. To account for illness, missed classes, lost connections, and other circumstances, there will be a 20% grace policy on Top Hat questions. That is, answering 80% of the Top Hat questions through the term will give you full points. In general, no further accommodations will be provided for missed Top Hat questions. Students for whom personal circumstances make attending the synchronous class sessions impossible should contact the course coordinator, Dr. Jared Stang, to discuss accommodations.

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

   There are no scheduled out of class activities for this course.

6. **Course Materials:**

   Recommended Textbook(s):

   Jearl Walker, "*Fundametals of Physics, Halliday, Resnick*", *10th Edition* Wiley.

   - WileyPLUS license (see information about online Assignments below)
   - A TopHat license (free for U of C students at https://tophat.com/) and a response device such as a phone, laptop, or tablet.
   - An extensive set of supplemental Extra Notes will be posted on D2L (free of charge).

7. **Examination Policy:**

   The quizzes and final examination will consist of multiple choice and written questions. Quizzes and the exam will be delivered through D2L. Multiple choice questions will be answered on D2L, while written questions will be completed on paper and then scanned and uploaded to D2L. (Alternatively, written questions could be completed on a tablet or tablet computer, and then saved and uploaded to D2L.)

   Quizzes and the exam will be open book, with all course resources (including the textbook and those resources posted on D2L) available. Quizzes and the exam are <u>not</u> open-internet (i.e., search engines and websites other than D2L are prohibited) and <u>no collaboration</u> 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. A 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. <u>Non-academic grounds are not relevant for grade reappraisals</u>. 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:** For more information, see www.ucalgary.ca/wellnesscentre 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 at (https://www.ucalgary.ca/policies/files/policies/sexual-violence-policy.pdf)

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. **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.

f. **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.

g. **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.

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 8 (for odd-numbered Thursday lab sections) and in weeks 2 and 3 for all other sections. Check the timetable below for the dates of your labs. Synchronous lab sessions take place online via Zoom (linked from D2L). Make-up labs will be during the last week of classes.

Lab schedule

Week	Dates	Odd-numbered Tuesday/Wednesday lab sections	Odd-numbered Thursday lab sections	Even-numbered lab sections
1	Sep 8 - 11	No lab	**Lab 1**	No lab
2	Sep 14 - 18	No lab	No lab	**Lab 1**
3	Sep 21 - 25	**Lab 1**	**Lab 2**	No lab
4	Sep 28 - Oct 2	No lab	No lab	**Lab 2**
5	Oct 5 - 9	**Lab 2**	**Lab 3**	No lab
6	Oct 12 - 16	No lab	No lab	**Lab 3**
7	Oct 19 - 23	**Lab 3**	**Lab 4**	No lab
8	Oct 26 - 30	No lab	No lab	**Lab 4**
9	Nov 2 - 6	**Lab 4**	**Lab 5**	No lab
10	Nov 16 - 20	No lab	No lab	**Lab 5**
11	Nov 23 - 27	**Lab 5**	**Lab 6**	No lab
12	Nov 30 - Dec 4	No lab	No lab	**Lab 6**
13	Dec 7 - 9	**Lab 6**	No lab	No lab

List of experiments

- **Lab 1** Uncertainites
- **Lab 2** Simple harmonic oscillations
- **Lab 3** Standing waves on a wire
- **Lab 4** Interference and diffraction
- **Lab 5** Thin lenses
- **Lab 6** Polarization

The weight of the laboratory experiments adds up to the total of 20% for the lab component of the course (3.33% 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 6 will be template-style labs (with designated sections for students to complete; completed individually), while labs 3 and 5 will be formal report-style labs (completed as a group).

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 <u>before</u> their scheduled synchronous online lab session.

Synchronous online lab session

During the synchronous online lab session (via Zoom at their designated lab time), 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 6, the intention is to complete and submit the lab write-up during the three-hour synchronous lab session. For labs 3 and 5 (with formal write-ups), the analysis and plans for writing the lab report should be complete during the lab session.

Lab reports

For labs 1, 2, 4, and 6, individual write-ups should be submitted as pdf files to the D2L Lab Report Dropbox by the end of the synchronous online lab session. For formal group report labs 3 and 5, the report is due 48h after the end of your synchronous lab session. Your TA will download it and submit the feedback via D2L. For formal group reports, 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 bundled with a WileyPLUS code. If you did not take PHYS 259, you must obtain the book or WileyPLUS standalone and keep this code, as it will be used to access the online homework system. If you did buy the book last term and used your code, you will <u>not</u> need another code as it is still valid.

To register, please go to www.wileyplus.com and logon with your U of C email address and your password, which is your student ID. If you changed your password to something different than your student ID last year, the change will remain intact. For any technical support issues, go to www.wileyplus.com/support and choose the live chat option.

A new textbook comes bundled with a code, which will give you acess to the eBook, Assignments, Tutorials, Videos, Animations, and Orion, an adaptive learning self-practice system. If you would like to purchase just WileyPLUS by itself (without the text), you can do so through the bookstore or else from www.wileyplus.com.

Lastly, if you choose not to purchase a new book or the WileyPLUS standalone, you will be able to access the homework from your home computer. You will not have access to any of the e-text or other WileyPLUS materials, but can upgrade at any time. You need to register as directed above and choose the free option.

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 8, 2020	September 16, 2020
Assignment 2	September 15, 2020	September 23, 2020
Assignment 3	September 22, 2020	September 30, 2020
Assignment 4	September 29, 2020	October 7, 2020
Assignment 5	October 6, 2020	October 14, 2020
Assignment 6	October 13, 2020	October 21, 2020
Assignment 7	October 20, 2020	October 28, 2020
Assignment 8	October 27, 2020	November 4, 2020
Assignment 9	November 3, 2020	November 25, 2020
Assignment 10	November 24, 2020	December 2, 2020

TOP HAT

As a vehicle to encourage class participation and student interaction, the Top Hat system will be employed. Each lecture section will have its own Top Hat 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. The Top Hat questions will be graded for participation, and a grace policy of 20% is included. (I.e., if you answer 80% or more of the questions through the term, you will get full points.) The Top Hat marks are worth 5% of the total course grade.

COURSE SCHEDULE

Week	Dates	Topics	Synchronous sessions*	Text reference^
1	Sep 8 - 11	Introduction; uncertainties in measurement; simple harmonic motion (SHM) of systems obeying Hooke's law; differential equation of SHM; superposition of SHMs of the same frequency.	T: Class R: Class	EN1, HR15.1, HR15.4, HR 16.6

Week	Dates	Topics	Synchronous sessions*	Text reference^
2	Sep 14 - 18	Phasors; phasor addition; phasor diagrams; phasors as complex quantities; travelling wave pulse: mathematical description and particle motion; partial derivatives; harmonic wave equation.	R: Class	EN1, EN2, HR16.1, HR16.4, HR 16.6
3	Sep 21 - 25	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.	T: Quiz 1 R: Class	EN2, EN3, HR 16.2, HR 16.5, HR 16.6, HR 17.1-2
4	Sep 28 - Oct 2	Energy transport by a harmonic wave; mechanical impedance; power transported by a wave; acoustical impedance; 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.	R: Class	EN4, HR 17.4, HR 17.5
5	Oct 5 - 9	Amplitude reflection and transmission coefficients at a junction; energy reflection and transmission coefficients; standing waves on a stretched string of fixed length: normal modes; acoustical standing waves: vibrations of air columns, normal modes; standing wave ratio; resonance.	T: Quiz 2 R: Class	EN4, EN6, HR 16.7
6	Oct 13 - 16	Doppler effect; superposition of two harmonic waves of different frequencies: beats; coherent and incoherent sources; two-slit interference.	R: Class	EN7, HR 17.6, HR 17.7, HR 33.4, HR 35.2, HR 35.3
7	Oct 19 - 23	Thin film interference; multiple reflections in a thin film; diffraction pattern of a single slit; circular aperture; resolving power.	T: Quiz 3 R: Class	HR 35.4, HR 36.1, HR 36.2, HR 36.3
8	Oct 26 - 30	Nature of light; wavefronts, ray approximation; laws of reflection and refraction, index of refraction; total internal reflection; fibre optics and waveguides; imaging by reflection at a spherical surface.	R: Class	HR 33.1, HR 33.5, HR 33.6, HR 34.1, HR 34.2
9	Nov 2 - 6	Graphical methods for spherical mirrors; lateral magnification; imaging by refraction at a spherical interface.	T: Quiz 4 R: Class	HR 34.2, HR 34.3
10	Nov 16 - 20	Multi-surface problems; virtual object; derivation of the thin lens equation; graphical methods for thin lenses; multi-lens systems, cameras, the eye; magnifiers, microscopes, telescopes.	R: Class	HR 34.4, HR 34.5, HR 38.4, HR 38.5
11	Nov 23 - 27	Light as a transverse electromagnetic wave; plane and circular polarization; Malus' law; elliptical polarization; polarization by reflection: Brewster's angle; doubly refracting materials; Huygen's principle.	T: Quiz 5 R: Class	EN9, HR 33.4, HR 35.1
12	Nov 30 - Dec 4	Resolving power, irradiance; radiometric quantities; solid angle; point sources; irradiance due to an extended source; Lambert's law; plane source effects; radiance; absorptance, reflectance; thermal equilibrium; blackbody radiation, Planck's law; Stefan-Boltzmann law; emissivity; heat transfer; Wien displacement law.	R: Class	EN10
13	Dec 7 - 9	Review and last quiz	T: Quiz 6	

*All synchronous sessions (both classes and quizzes) begin at 12:30. New lecture videos for asynchronous content will be posted in weeks without quizzes.

^EN = Extra notes; HR = Halliday Resnick (the course textbook)

COURSE INCOMES

Students coming into PHYS 369 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 behavior 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.
- Solve problems in geometric optics, incorporating reflection and refraction from multiple curved surfaces.
- 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 predicted physical laws governing wave behavior of oscillating systems and waves.
- Collaborate effectively within a team environment and communicate laboratory results in written scientific format.

Electronically Approved - Aug 24 2020 11:00

Department Approval