Modern Physics Syllabus

Department of Physics and Atmospheric Science

PHYC 2515.01 Fall 2026

Dalhousie University operates in the unceded territories of the Mi'kmaw, Wolastoqey, and Peskotomuhkati Peoples. These sovereign nations hold inherent rights as the original peoples of these lands, and we each carry collective obligations under the Peace and Friendship Treaties. Section 35 of the Constitution Act, 1982, recognizes and affirms Aboriginal and Treaty rights in Canada.

We recognize that African Nova Scotians are a distinct people whose histories, legacies, and contributions have enriched the part of Mi'kma'ki known as Nova Scotia for over 400 years.

Course Instructor(s)

Name	Email	Office Hours
Alaaedeen Abu Zir	xu946682@dal.ca	10:30 am -11:30 am, Tuesday and Thursday, Dunn 209
Deep Gajera	deep.gajera@dal.ca	TBD

Course Description

This course introduces two physics revolutions: Einstein's theory of special relativity and the theory of quantum mechanics. Important early experiments are considered throughout the course. We consider length contraction, time dilation, and relativistic kinematics. Then, to account for wave-like properties of matter, we introduce complex wave functions in one-dimension and show how they lead to energy quantization, Schrodinger's equation, and penetration into classically forbidden regions. Other topics of modern physics, such as random walks (transport theory) may be introduced.

Course Prerequisites

PHYC 1190.03/1290.03 or PHYC 1300.06 or SCIE 1500.03, and a 1000 level calculus course.

Course Exclusions

Student Resources

There will be two office hours per week conducted by the instructor from 10:30 am -11:30 am, Tuesdays and Thursdays, in Dunn 209. Students can also seek help from the TA during his office hours. Students can also refer to the help page and communications through the course's Brightspace page.

For important information and communications related to the course, please check your Dalhousie e-mail. If you need more help in the course, please communicate with your instructor through e-mail.

Course Structure

Course Delivery

Lectures

Tuesdays and Thursdays, 8:30 am – 10:00 am, Dunn 304

Laboratories

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Tutorials

Q&A sessions may be offered before the assignment due dates at the same lecture time.

The course will be delivered in person. There will be no recorded lectures. Teaching will be conducted through PowerPoint slides for each chapter. PDFs of all slides will be made available on the Brightspace page prior to lectures. It is important that the students write down any derivations or solved examples, which will be made by the instructor on the conventional board.

Course Materials

Required textbook: "Modern Physics, 3rd Edition, by Serway, Moses and Mayer", Cengage Learning, Inc. ISBN: 9781133377023. The Dalhousie bookstore has copies of this textbook and you can find an online version available for download.

Brightspace page: PHYC2515 - Modern Physics (Sec 01) - 2026/2027 Fall

Learning Objectives

Knowledge:

• Describe the basic principles of special relativity and their consequences.

- Interpret significant historical experiments regarding the quantum theory of light.

- Describe the basics of quantum mechanics such as the wave function, probability density and the physical meaning of Schrodinger equation.

- Use matter waves packets to describe the motion of free particles

- Understand and apply quantized models of the atom.

Skills:

- Apply the uncertainty principle in quantum mechanics.
- Apply conservation laws and mechanics for relativistic problems.

- Solve and interpret one-dimensional potential problems.

- Learn to predict the results of experiments using your solutions.

Assignments

There will be four homework assignments which will be posted on the Brightspace page, the list of all the homework assignments are shown below

HW 1	10% of final grade	Start: September 29, 2026	Due: Oct. 13, 2026
HW 2	10% of final grade	Start: October 15, 2026	Due: Oct. 29, 2026
HW 3	10% of final grade	Start: Nov. 03, 2026	Due: Nov. 17, 2026
HW 4	10% of final grade	Start: Nov. 19, 2026	Due: Dec. 03, 2026

Tests/quizzes

Quizzes

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Tests

Midterm Test: There will be a 90-minute written midterm test to be held during class (Oct. 27, 2026). The midterm test will cover Chapter 1, 2, and 3. The midterm test will carry 20% of final grade.

Final Exam: There will be a written final exam. The exam will be carried out during the final exam period. It will be scheduled by the registrar. The final exam will carry 40 % of the final grade.

Other course requirements

Conversion of numerical grades to final letter grades follows the **undergraduate*** Dalhousie Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (0-49)
A- (80-84)	B- (70-72)	C- (55-59)	

Course Policies on Missed or Late Academic Requirements

• Students are expected to use the Student Declaration of Absence (SDA) form for late assignments. The form may be used 2 times in this course.

. • If solutions to assignments are handed in up to 1 week late and no SDA was submitted, the grade will be deducted (50% of final grade of the assignment).

• If solutions to assignments are handed in more than 1 week after the due date and no SDA was submitted, they will count zero.

Course Policies related to Academic Integrity & Artificial Intelligence

Students can discuss assignment problems as a group. However, it is an academic offense to copy the solution of someone else or to use generative AI and large language models (e.g., ChatGPT). Allegations will be submitted to an Academic Integrity Officer of the Faculty of Science for evaluation and possible sanction. The minimum sanction is zero point on the assignment. If Microsoft 365 Copilot Chat is used, make sure to cite your work using in-text citations and/or in a References/Work Cited list.

Course Accessibility

The Student Accessibility Centre is Dalhousie's center of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre (https://www.dal.ca/campus_life/academic support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html).

Course Content

1. Relativity (Chapter 1 and 2)

(a) Special relativity: Postulates, Principles

(b) Michelson-Morley Experiment

(c) Consequences of Special Relativity

(d) Galilean and Lorentz Transformation

(e) Spacetime and causality

(f) Relativistic Momentum

(g) Relativistic Energy

(h) Mass as a Measure of Energy

(i) Conservation of Relativistic Momentum and Energy

(j) General Relativity

2. The Quantum Theory of Light (Chapter 3)

(a) Hertz's experiment

(b) Blackbody Radiation

(c) Light Quantization

(d) The Compton Effect and X-Rays

(e) Wave-Particle Duality

3. The Particle Nature of Matter (Chapter 4)

(a) Atomic Nature of Matter

b) Rutherford and Bohr models of the atom

(c) Correspondence Principle

(d) Franck-Hertz Experiment

4. Matter Waves (Chapter 5)

(a) De Broglie's Proposal

(b) The Davisson–Germer Experiment

(c) Wave Groups and Dispersion

(d) Uncertainty Principle

(e) Wave-Particle Duality revisited

5. Quantum Mechanics in 1D (Chapter 6)

(a) Born Interpretation

(b) Free particle wavefunction

(c) Particle in a box

(d) Quantum Oscillator

(e) Expectation Values

(f) Observables and Operators

6. Tunneling (Chapter 7)

(a) The square barrier

Week	Date	Lesson Topic(s)	Reading/Assessment
1	Sept. 08, 2026	Introduction to the class-Syllabus	Reading
1	Sept. 10, 2026	Ch 1&2: (a) - (c)	Reading
2	Sept. 15, 2026	Ch 1&2: (a) - (c)	Reading
2	Sept. 17, 2026	Ch 1&2: (d) - (f)	Reading
3	Sept. 22, 2026	Ch 1&2: (d) - (f)	Reading
3	Sept. 24, 2026	Ch 1&2: (g) - (h)	Reading
4	Sept. 29, 2026	Ch 1&2: (i) - (j)	Start: HW 1
4	Oct. 01, 2026	Review of Ch 1 and 2-Tutorial/Probl. Solving	Reading
5	Oct. 06, 2026	Ch 3: (a)-(b)	Reading
5	Oct. 08, 2026	Ch 3: (c)-(e)	Reading
6	Oct. 13, 2026	Ch 3: (c)-(e)	HW 1 Due Date
6	Oct. 15, 2026	Review of Ch 3-Tutorial/Probl. Solving	Start: HW 2
7	Oct. 20, 2026	Ch 4: (a)-(b)	

7	Oct. 22, 2026	Ch 4: (c)-(d)	
8	Oct. 27, 2026	Midterm Exam in Ch 1,2, and 3	Midterm Exam in class
8	Oct. 29, 2026	Midterm results discussion	HW 2 Due Date
9	Nov. 03, 2026	Ch 5: (a)-(b)	Start: HW 3
9	Nov. 05, 2026	Ch 5: (c)-(e)	Reading
10	Nov. 10, 2026	Fall Break	Reading-Fall Break
10	Nov. 12, 2026	Fall Break	Reading-Fall Break
11	Nov. 17, 2026	Ch 5: (c)-(e)	HW 3 Due Date
11	Nov. 19, 2026	Ch 6: (a)-(c)	Start: HW 4
12	Nov. 24, 2026	Ch 6: (a)-(c)	
12	Nov. 26, 2026	Ch 6: (d)-(f)	
13	Dec. 01, 2026	Ch 6: (d)-(f)	
13	Dec. 03, 2026	Ch 7:(a)	HW 4 Due Date
14	Dec. 08, 2026	Course Review	
14	Dec. 10, 2026	Break before exams	Break before exams

Syllabus Appendix

(Formerly University Policies and Statements)

Students should consult the link below to guide them toward student supports, university policies, and guidelines.

https://dalu.sharepoint.com/sites/learn-teach/SitePages/syllabus-appendix.aspx