DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus
Department of Physics and Atmospheric Science
PHYC 2515.03 – Modern Physics - Fall 2022

Instructor(s): Kimberley Hall Email: Kimberley.Hall@dal.ca

Lectures: Links to prerecorded lectures will be posted on the course website. Each module on average corresponds to a single 50 minute lecture taking into account the time spent for you to pause the video presentation and take notes in your own handwriting. After viewing the lectures and taking notes, if you have questions about the lecture material, please send me an email to ask for clarification.

Workshops/Tutorials/Help Sessions: Tuesdays/Thursdays 8:35 am -9:55 pm Dunn 304

Course delivery: Asynchronous prerecorded Lectures with synchronous in-person Workshops and Help Sessions. The in-person Workshops/Help Sessions will not be recorded.

Teaching Assistant: Grant Wilbur Email: gr450248@Dal.ca (for assignment help)

Course Prerequisites: PHYC 1190.03/1290.03 or PHYC 1300.06 or SCIE 1500.03 and a 1000 level Calculus course

Course Materials:

Textbook: *Modern Physics, 3rd Edition*, Serway, Moses and Mayer

Course website : *http://fizz.phys.dal.ca/~khall/phyc2515/*

Course Assessment:

ASSIGNMENTS: There will be 5 assignments, posted on the course website, with due dates as shown in the course schedule. For help with your assignments, two in-class help sessions will be hosted with dates as shown in the course schedule. For additional help, please contact Grant by email.

WORKSHOP QUIZES: There will be a quiz given during each workshop. The dates of the workshops are shown in the course schedule.

MIDTERM TEST: There will be a written midterm test to be held during class. The date of the midterm is provided in the course schedule.

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.

Marking Scheme: The weight (%) of each assessment component used in calculating your final mark is indicated in the table below. Your mark will automatically be calculated using both Marking Scheme 1 and Marking Scheme 2 and the larger of the two will be assigned as your final grade. Letter grades will be determined using the Faculty of Science grade conversions.

Component	Dates and Other Information	Weight (% of final grade) Marking Scheme 1	Weight (% of final grade) Marking Scheme 2
Assignments	Posted to course website – to be handed in by email to both the instructor and TA	35	35
Workshop Quizzes	Held during workshops – See Course Schedule for dates	15	15
Midterm	In-class – See Course Schedule	20	0
Final Exam	Date/Time TBD	30	50

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Course Policies: If you miss a midterm or exam for good reason, you must provide acceptable documentation. If you are not able to complete an assignment on time due to illness or other good reason, you must communicate the situation to the instructor prior to the due date and provide acceptable documentation. Extensions without late penalties will be provided at the discretion of the instructor. If an extension is not granted, assignments that are late will have 20% deducted per day after the due date, and no credit will be given for assignments that are not handed in prior to the solutions posting date. Working together on assignments is encouraged, however the work that you submit for assignments must be your own calculations and be written in your own words.

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 Content:

1. Relativity (Chapters 1,2)
(a) Special relativity: Postulates, Principles
(b) Michelson-Morley Experiment
(c) Lorentz Transformation
(d) Spacetime and causality
(e) Relativistic Form of Newton's laws
(f) Conservation laws
(g) General relativity

2. The Quantum Theory of Light (Chapter 3)
(a) Hertz's experiment
(b) Blackbody Radiation
(c) Planck's Law
(d) Light Quantization
(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 Experient

4. Matter Waves (Chapter 5)
(a) De Broglie's Proposal
(b) Wave Packets
(c) Uncertainty Principle
(d) 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

Course Objectives/Learning Outcomes:

Understand and apply concepts of special relativity
Apply conservation laws and mechanics for relativistic problems
Understand the principles of general relativity.
Identify and interpret significant historical experiments regarding the quantum theory of light
Understand and apply quantized models of the atom.
Use matter wave packets to describe the motion of free particles
Apply the uncertainty principle in quantum mechanics
Solve and interpret one-dimensional potential problems
Learn to predict the results of experiments using your solutions

DALHOUSIE COMMON GRADE SCALE

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

ACCOMMODATION POLICY FOR STUDENTS

Students may request accommodation as a result of barriers related to disability, religious obligation, or any characteristic protected under Canadian Human Rights legislation. The full text of Dalhousie's Student Accommodation Policy can be accessed here: http://www.dal.ca/dept/university_secretariat/policies/academic/student-accommodation-policy-wef-sep--1--2014.html

Students who require accommodation for classroom participation or the writing of tests and exams should make their request to the **Advising and Access Services Centre (AASC)** prior to or at the outset of the regular academic year. More information and the ***Request for Accommodation*** form are available at www.dal.ca/access.

A FULL LIST OF UNIVERSITY POLICIES, STATEMENTS, STUDENT RESOURCES AND SUPPORT SERVICES ARE PROVIDED ON THE COURSE WEBSITE