DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus
Department of Physics and Atmospheric Science
PHYC 2515.03 – Modern Physics - Fall 2020

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

Lectures: To be posted on course website

Tutorials: To be posted on course website

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 2005

Course website : *ultrafast.physics.dal.ca/phyc2515/*

Course Assessment:

ASSIGNMENTS: There will be 6 assignments, posted on the course website, with due dates as shown in the table below.

TESTS: There will be five tests given during the semester. These tests will be carried out during one-on-one sessions with each student. These will be scheduled during the weeks indicated below, with exact dates/times to be determined in collaboration with each student by email. These tests will be carried out using the Zoom software platform. In case of an internet connection failure, phone contact will be used as backup (student phone number to be provided when the test is scheduled).

FINAL EXAM: There will be a final exam to 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. Letter grades will be determined using the Faculty of Science grade conversions.

Component	Dates and Other Information	Weight (% of final grade)
Assignments	Posted to course website – to be handed in by email to both the instructor and TA Assignment 1 – Due Sept 16 Assignment 2 – Due Sept 30 Assignment 3 – Due Oct 14 Assignment 4 – Due Oct 28 Assignment 5 – Due Nov 18 Assignment 6 – Due Dec 2	40
Tests	5 Tests, to be scheduled one-on-one with each student and held during the following weeks Test 1 – Sept 21-25 Test 2 – Oct 5-9 Test 3 – Oct 19-23 Test 4 – Nov 2-6 Test 5 – Nov 23-27	35

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Final Exam	Scheduled by Registrar	25

Course Policies:

If you are not able to complete an assignment 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. The work that you submit for assignments must be your own calculations and be written in your own words. If needed due to illness or other good reason, the one-on-one tests may be rescheduled in consultation with the instructor provided that the instructor is contacted and the test/exam is rescheduled in advance of the original date/time. In case of internet failure during a test/exam, the instructor will call the student on the phone number provided to complete the test.

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. A tutorial is offered.

Course Content:

1. Relativity (Chapters 1,2)
(a) Special relativity: Postulates, Principles
(b) Michelson-Morley Experiment
(c) Lorentz Transformationb
(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
(b) Applications

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
Solve one-dimensional tunneling 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