Course Outline: **PHYS 2604** Modern Physics I – Fall 2023

Modern Physics for physicists and engineering physicists. ***This course for Fall 2023 is an IN-PERSON WITH ON-CAMPUS ATTENDANCE.*** *It is a real-time synchronous course where the professor and students meet simultaneously at the scheduled days and times. The Professor share information, key ideas, theories, problems and concepts in an in-person course environment. Participation in* ***synchronous*** *courses requires students to be on campus. All the lecture material will be posted on Brightspace to engage the participants.*

Lecture sessions in of PHYS 2604 will be recorded and made available only to those within the class. Sessions will be recorded to enable access to students who may have conflicting commitments or cannot attend the in-person lecture. Please note that the lecture notes and the recordings are protected by copyright. Students are not permitted to reproduce or distribute lecture notes publicly for commercial or non-commercial purposes. The recordings are for your own educational use, but you are not permitted to publish to third party sites, such as social media sites and course materials sites. If you have concerns about being recorded, please email me directly so we can discuss these.

Standing in a course is determined by the course instructor subject to the approval of the Faculty Dean. This means that grades submitted by the instructor may be subject to revision. No grades are final until they have been approved by the Dean of the Faculty of Science.

All students in the class, the instructor, and any guests should be treated with respect during all interactions. With the growing use of social platforms on campuses, it is important to keep in mind that university codes of conduct still apply to the behaviours of students online.

Professor A. Bellerive (alainb@physics.carleton.ca)

Office Hours Wednesday 14:30 to 15:30; Friday 14:30 to 15:30.
Outside of office hours, contact me via e-mail to arrange a time to meet.

Lecture time Wednesday and Friday 13:00 to 14:30
Classes start September 6, 2023; and end December 6, 2023.
Note that Friday December 8, 2023 follows a Monday schedule.
The lectures of October 11 & 13 will be online.

The Course The word 'modern' is a very relative word. Essentially this course covers the exciting period of physics at the start of the 20th century, where new phenomena were found that could not be explained with the older, classical physics of Maxwell, Rayleigh, and Newton. Classical Physics was not 'overthrown', but became the macroscopic limit with which the new quantum theory had to agree, upon extrapolation. The course core is constituted of topics such as photoelectric effect, special theory of relativity, wavelike properties of particles, Schrödinger equation, Rutherford-Born model of the atom and atomic structure. Necessary prerequisites for understanding the content of this course include standard vector and calculus-based algebra used to described concepts of mechanics, electrostatics, magnetism, E&M waves, thermal physics and probability & statistics.

Labs **Lab superintendents:**
Maria Rozo Martinez (prmartin@physics.carleton.ca)
Jesse Lock (jlock@physics.carleton.ca)
Igor Ivanovic (igor@physics.carleton.ca)

Format: Labs are in-person
Room: 3125/3145 Herzberg

Labs begin the week of September 11, 2023. Schedule, lab policy and other details of the lab will be provided by the lab superintendents.

Texts **Required:** Kenneth S. Krane, "Modern Physics", 4th edition, Wiley, 2019. The book is available as a print copy ISBN 9781119495550 or eText ISBN 9781119495468. It can be found at the Carleton University Bookstore.

Complementary Reading: Physics for Scientists and Engineers with Modern Physics , 10th Edition Raymond A. Serway and John W. Jewett ISBN-10: 1-337-55329-8 or ISBN-13: 978-1-337-55329-2, book used in PHYS1001 and PHYS1002.

Website Brightspace (https://carleton.ca/brightspace/)

Prerequisites PHYS1001 & PHYS1002, or PHYS1003 & PHYS1004 (PHYS1007 & PHYS1008 are acceptable provided a grade of B- or better); plus MATH1004 & MATH1104, or MATH1007 & MATH1107, or MATH1002 & MATH1102. Or, by permission of the department. Students who do not have these prerequisites **must** check with the course instructor and obtain permission of the Physics Department to remain in the course.

Marks

Assignments	20%
Quizzes	5%
Midterm exam	15%
Laboratory	30%
Final Exam	30%

In order to pass the course, your laboratory and theory grades must both be over 50%.

Drop-In-Center Hours and location: https://physics.carleton.ca/drop-in-centre

Course description
This course covers a variety of topics in modern physics, with particular emphasis on topics related to special relativity and quantum mechanics. Taking a historical and practical approach, we will look at how classical physics came into conflict with experiment, thus prompting the development of the modern theories of physics. First, we will secure some concepts of chapters 15, 16, 17, 33, 34, 36 and 37 of Serway (Physics for Scientists and Engineers with Modern Physics used in PHYS1001 & PHYS1002). **Then, we will roughly cover the material in chapters 2 through 7 of the textbook by Krane.** However, the course content is defined by the lectures and some material not contained in the textbooks will be included in the lecture notes. The material of chapters 8, 10, 12 and 14 will be surveyed to give the student a prospective on the structure of matter and more insight about relativistic kinematics.

We will cover most of the material presented in the book by Krane:

1. Ch 1: Some Deficiencies of Classical Physics
2. Ch 2: The Special Theory of Relativity (plus extra lecture notes)
3. Ch 3: The Particle-Like Properties of Electromagnetic Radiation
4. Ch 4: The Wavelike Properties of Particles
5. Ch 5: The Schrödinger Equation
6. Ch 6: The Rutherford-Bohr Model of the Atom
7. Ch 7: The Hydrogen Atom in Wave Mechanics
8. Ch 8: Many Electron Atoms and Ch. 10: Statistical Physics (in brief)
9. Ch. 12: Nuclear Structure and Radioactivity and Ch. 14: Elementary Particles (in brief)

Reading in text books (in order):

- Survey of sections 15.1, 15.2, 15.3; sections 16.1, 16.2, 16.5; sections 17.1, 17.7 (Serway)
- Survey of sections 34.1, 34.2; sections 36.1, 36.2, 36.3; sections 37.1, 37.2 (Serway)
- Review of sections 33.3, 33.6 and 33.7 (Serway)
- Chapter 1 of Krane (all sections - read only)
- Chapter 2 of Krane (all sections - plus selected problems)
- Chapter 3 of Krane (all sections - plus selected problems)
- Chapter 4 of Krane (all sections - plus selected problems)
- Chapter 5 of Krane (all sections - plus selected problems)
- Chapter 6 of Krane (all sections - plus selected problems)
- Chapter 7 of Krane (sections 7.1 to 7.7 - plus selected problems)
- Chapter 8 of Krane (periodic table and lasers)
- Chapter 10 of Krane (survey of concepts)
- Chapter 12 of Krane (briefly with applications)
- Chapter 14 of Krane (briefly with applications and selected problems)

Extra reading will be provided to complement Chapter 2 of Krane (*e.g.* book "Special Relativity" by A.P. French). Note that concepts of thermodynamics (thermal physics) and statistical physics are covered in PHYS2401 (Fall term 2023). Modern Optics & Wave PHYS2202 is during Winter 2024. Thus, only basic aspects of optics & wave will be covered in this course.

THE MIDTERM EXAMS WILL BE ON REVIEW CONCEPTS and PART OF CHAPTERS 2 and 3.
THE FINAL EXAMS WILL BE MAINLY CONCERNED WITH CHAPTERS 2, 3, 4, 5, 6, and 7.

Assignments: There will be weekly assignments throughout the term, and they will generally be due one week after their distribution. Assignments will be posted on Brightspace. Students will be asked to upload their solutions (PDF format preferred) onto Brightspace. Late assignments will not be accepted without an acceptable reason such as illness. The work you turn in must be your own. The assignments are a critical part of the course and working through the problems yourself is essential to learn the material. Your homework solutions should be thorough, self-contained, and logical, with all steps explained. Assignments must be deemed legible by the marker. Late assignments will lose 10% per day. An assignment can no longer be submitted 9 days following its initial deadline.

Quizzes: There will be online quizzes posted on Brightspace on key topics. Quiz will be randomized for each student and each attempt. The student will have at most two attempts to complete each quiz, and plenty of time to complete each attempt (two hours), but please note that your work will count even if you would exceed this time. All quizzes will count towards your final mark.

Exams

- There will be one midterm exam (in-person). The midterm will consist of problems. The midterm exam will be in class on Friday October 20, 2023 at 13:00. The students will have 90 minutes to answer and provide a full detailed solution of the problems in an exam booklet. **The midterm exam will be in-person and closed book.**
- The final exam (in-person) will be held during the final examination period in December 2023. It will consist of problems. The student will have 180 minutes to answer and provide full solution of the problems in an exam booklet. T**he final exam will be in-person and closed book**.
- The midterm and finals exam will be with a detailed formula sheet provided by the instructor.
- No deferred exam will be set for the midterm exam. A deferred exam will be scheduled only for the final exam. If a deferred final exam is necessary for a student, that exam will replace only the final exam component of the course mark and will only be granted if adequate term work has been completed. In this context, adequate term work means completing and submitting 75% of the assignments and fulfilling the lab requirements; the term mark before the final exam must exceed 20 out of 70.

This is the experiment schedule for PHYS2604 this Fall 2023 term.

Week of	Experiment	Assessment Format	Weight
Sept. 11th	Introductory Session	In-class Activity	5%
Sept. 18th	e/m Thomson Method	Write-up Script	10%
Sept. 25th	Curve Fitting Lesson	In-class Activity	5%
Oct. 2nd Oct. 9th	Photoelectric Effect	Lab Report	15%
Oct. 16th	Millikan's Experiment		
Oct. 23rd	Fall Break		
Oct 30th	Millikan's Experiment	Lab Report	15%
Nov. 6th	Radioactive Decay	Write-Up Script	10%
Nov. 13th	Poisson Statistics	Lab Report	15%
Nov 20th Nov 27th	One of: - Rydberg constant - Franck-Hertz Experiment - X – rays - Two Slit Interference	Lab Report	15%
Dec 4th	Make-up Labs		

Online: * special days *midterm / lecture October 11 and lecture October 13, 2023

Day	Mark your agenda	Format
Friday Oct. 20th, 2023	Closed book exam 1pm	In-person (in class)
Wednesday Oct. 11 & 13, 2023	Virtual lecture 1pm	Online (Zoom)

University Policies

Grade Definition: In accordance with the Carleton University Undergraduate Calendar Regulations, the letter grades assigned in this course will have the following percentage equivalents:

A+ = 90-100	B+ = 77-79	C+ = 67-69	D+ = 57-59
A = 85-89	B = 73-76	C = 63-66	D = 53-56
A- = 80-84	B- = 70-72	C- = 60-62	D- = 50-52
F = <50			

Important dates and deadlines
https://calendar.carleton.ca/academicyear/

September 19, 2023 is the last day to withdraw from this courses with a full fee adjustment. The last day for academic withdraw is November 15, 2023.

Self-declaration form
https://carleton.ca/registrar/wp-content/uploads/self-declaration.pdf

To request any academic accommodation for missed course work including exams, quizzes and assignments, please fill the self-declaration form. Hence, if you miss a test or do not submit an assignment or miss a lab quiz: immediately contact your instructor, or lab instructor, and explain why. If the reason is illness, in place of a doctor's note or medical certificate, students are asked to complete the self-declaration form available on the Registrar's Office website.

Paul Menton Centre for Students with Disabilities (PMC)

The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). Requests made within two weeks will be reviewed on a case-by-case basis. After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled exam (if applicable).

Academic Regulations and Request for Academic Accommodations

https://students.carleton.ca/course-outline/

Student Concerns

If a concern arises regarding this course, your first point of contact is me: Email or see me during office hours and I will do my best to address your concern. If I am unable to address your concern, the next points of contact is the departmental undergraduate advisor or the chair of the department.