Course Outline: **PHYS 2004** Modern Physics for Engineers– Fall 2021

*Modern Physics for engineers. This course for Fall 2021 is an IN-PERSON WITH FLEXIBLE ONLINE/ON-CAMPUS ATTENDANCE. The format is called **HYFLEX**. It is a real-time course where the professor and students meet simultaneously in room HSB 1301 and online via the web conferencing tool **BigBlueButton**, at scheduled days and times. The Professor share information, key ideas, theories, problems and concepts in an in-person and virtual course environment simultaneously.*

Lecture sessions of PHYS 2604 will be recorded and made available only to those within the class. Sessions will be recorded to enable access to students with internet connectivity problems, who are based in different time zone, and/or who have conflicting commitments. If students wish not to be recorded, they need to leave their camera and microphone turned off.

*The **BigBlueBotton** lectures that are taking place at scheduled days and times will be recorded and will be the basis of the PHYS 2004 **asynchronous** delivery of this course. **All the lecture material** will be posted on Brightspace to engage the participants.*

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. You may be expected to use the video and/or audio and/or chat during web conferencing sessions for participation and collaboration. 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.

Professor A. Bellerive (alainb@physics.carleton.ca)
Room 3316 Herzberg

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 Live lecture: Wednesday and Friday 16:00 to 17:30 (HYFLEX)
Room: Health Science Building 1301
Classes start September 8, 2021.
Friday December 10, 2021 follows a Monday schedule.

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, electromagnetism, optics, thermal physics and probability & statistics.

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: Halliday, Resnick & Walker 9th Edition or 10th Edition or 11th Edition, Volume 1 & 2, Chapters 1-44. Publisher: J. Wiley & Sons., book used in PHYS1003 and PHYS1004.

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

Prerequisites

Prerequisites: PHYS 1002 or PHYS 1004 or PHYS 1008 with a grade of B- or better, plus MATH 1004 and MATH 1104 or equivalent. Restricted to B.Eng. students not in the Engineering Physics program. Students in programs other than B.Eng. must obtain permission of the Department.

Marks

Assignments	40%
Midterm exam	20%
Final Exam	40%

Drop-In-Center Hour to be define for Fall 2021.
https://physics.carleton.ca/current-undergraduate-students/physics-drop-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, 35 and 36 of Halliday, Resnik & Walker (Fundamentals of Physics). 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)

Assignments: There will be roughly weekly assignments throughout the term and they will generally be due one week after their distribution. Assignment 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.

Exams

- There will be one midterm exam (on-line). The midterm will contain two components: (1) five multiple choice questions and (2) one problem. The midterm exam will be on Wednesday November 3, 2021 at 16:00. The students will have 90 minutes to answer the multiple-choice questions and to provide a full detailed solution of the problem. The midterm exam will be open book. Students will be given the possibility to write the exam in the classroom.
- The final exam (on-line) will be held during the final examination period in December 2021. It will contain two components: (1) ten multiple choice questions and (2) three problems. The student will have 180 minutes to answer the multiple choices question and to provide full solutions of the problems on a given date to be defined.
- The final exam will be with a detailed formula sheet provided by the instructor. Exam formats will be discussed in advance. The final exam will be e-proctored and closed book.
- 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 must exceed 20 out of 70.

Reading in text books (in order):

- Survey of sections of Chapter 15; sections of Chapter 16; sections of Chapter 17 (Halliday)
- Survey of sections Chapter 34; sections of Chapter 36; sections of Chapter 37 (Halliday)
- Review of sections of Chapter 33 (Halliday)
- Chapter 1 of Krane (all sections - read only)
- Chapter 3 of Krane (Sections 3.1 and 3.2 – plus selected problems)
- 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).
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.

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/

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/

https://carleton.ca/edc/teachingresources/administrative-pedagogy/academic-accommodations/

Use of official university e-Proctoring

This course has timed written assessments, which may consist of midterms and final examinations. The Carleton University e-Proctoring system will be used in your assessments, and requires the use of webcams, microphones, and/or smart phones.