Course Outline: **PHYS 2004** Modern Physics for Engineers– Fall 2020

This course for Fall 2020 is online course where the instructor and students share information, ideas, and learning experiences in a virtual course space. Asynchronous courses do not have live, scheduled meetings online. However, students are expected to remain up to date with the deadlines and due dates provided by the instructor. These courses require high-speed Internet access and a computer.

*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 cuLearn 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.

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.

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Office Hours Monday 10:00 am to 11:00 am; Wednesday 10:00 am to 11:00 am.
Outside of office hours, contact me via e-mail to arrange a time to meet.

Lecture time Live lecture: Monday and Wednesday 8:30 am to 10:00 am (on-line)
Recorded lectures available Monday and Wednesday at 11:00 am
Classes start September 9, 2020.
Friday December 11, 2020 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.

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 cuLearn

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%
	Essay	5%
	Midterm exam	15%
	Final Exam	40%

Drop-In-Center Hour to be define for Fall 2020.
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 1 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 cuLearn. Students will be asked to upload their solutions (PDF format preferred) onto cuLearn. 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.

Essay: The essay need to be handed by November 6, 2020. Student will be asked to write an essay on an application or a topic related to modern physics. The subject will need to be set with the professor of the course before October 16, 2020. The essay will have to be written with a Word Processor (hand written essay will not be accepted). The essay should contains one page of text for a maximum total of two pages including mathematical formula, physics equations and figures. The general guideline is one page of text with 500-600 words (single spaced), plus supporting equations or figures.

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 November 2, 2020 at 8:30am. The students will have 45 minutes to answer the multiple choice questions and 45 minutes to provide a full detailed solution of the problem.
- The final exam (on-line) will be held during the final examination period in December 2020. It will contains two components: (1) ten multiple choice questions and (2) three problems. The student will have 90 minutes to answer the multiple choices question and 90 minutes to provide full solutions of the problems on a given date to be defined.
- All exams will be open book since examination will be on-line. It is suggested to keep an 8.5" x 11" crib sheet. Exam formats will be discussed in advance.
- 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, the term mark must exceed 20 out of 100.

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). Note that concepts of thermodynamics (thermal physics) and statistical physics are covered in PHYS2401. Modern Optics & Wave PHYS2202 covers optical and wave physics. Thus only basic aspects of optics will be covered in this course.

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			

Academic Regulations and Request for Academic Accommodations
https://students.carleton.ca/course-outline/#academic-accommodations-for-students-with-disabilities

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

Important dates and deadlines
https://carleton.ca/registrar/registration/dates-and-deadlines

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 may be used in your assessments, and requires the use of webcams, microphones, and/or smart phones.