# Modern Physics I (PHYS 2604) Course Outline-Fall 2024

**Professor** Thomas Koffas (koffas@physics.carleton.ca)
Room 2410 Herzberg
(613) 520-2600 ext. 8996

**Office Hours** Wednesday 1:00 pm to 2:00 pm; Friday 1:00 pm to 2:00 pm
Outside office hours please contact me via email to arrange to meet

**Lectures** Wednesday-Friday 2:35 pm to 3:55 pm.
Lectures start on Wednesday September 4th.

**Labs** Instructors: Maria Paula Rozo Martinez(prmartin@physics.carleton.ca)
Igor Ivanovic (igor@physics.carleton.ca)
Session A2: Wednesday 8:35 am to 11:25 am
Session A4: Thursday 1:05 pm to 15:55 pm
Session A5: Tuesday 8:35 am to 11:25 am
Session A6: Friday 8:35 am to 11:25 am

All lab sessions will be held in Herzberg 3145. Labs begin on the week of September 9. The lab policy will be reviewed in the first lab period. The experiments schedule is shown in the table below.

| Week of | Experiment | Assessment Format | Weight |
|---|---|---|---|
| Sept. 9th | Introductory Session | In-class Activity | 5% |
| Sept. 16th | e/m Thomson Method | Write-up Script | 10% |
| Sept. 23rd | Curve Fitting Lesson | In-class Activity | 5% |
| Sept. 30th | Photoelectric Effect | Lab Report | 15% |
| Oct. 7th | | | |
| Oct. 14th | Millikan's Experiment | | |
| Oct. 21st | Fall Break | | |
| Oct 28th | Millikan's Experiment | Lab Report | 15% |
| Nov. 4th | Poisson Statistics | Lab Report | 15% |
| Nov. 11th | Rydberg Constant | Lab Report | 15% |
| Nov 18th | | | |
| Nov 25th | Radioactive Decay | Write-Up Script | 10% |
| Dec 2nd | Make-up Labs | | |

**Teaching Assistant** TBD

**Text** *Physics for Scientists and Engineers, A Strategic Approach 5e*, Randall D. Knight. Part VIII (Chapters 36-42) is what is required for this course. The materials for this course are delivered online by Pearson. To purchase online with a major credit card or PayPal, go to: **https://console.pearsoned.com/enrollment/m7vmnv.**
Once there, sign in or create a new Pearson account for:

**PHYS2604**
**Modern Physics I**
**Thomas Koffas**

The student online purchase price is $19.50. The course start date is 02-Sep-2024. The subscription is valid for 6 months after student registration.

**WebSite** BrightSpace PHYS 2604 site

**Communication Policy** All correspondence with the professor and teaching assistants should be carried using a valid Carleton University email account and with the student ID always provided in the title of the email message. Before sending any questions, please read this course outline thoroughly since it may already contain the answer to your question. Students will be fully responsible for reading and responding to all information distributed through the BrightSpace course page. Make sure you check the BrightSpace course page regularly.

**Electronic Device Policy** During the lecture ALL electronic devices including cell-phones, smart-phones, laptops, ipads, etc. MUST BE TURNED OFF!

**Prerequisites** PHYS 1001 and PHYS 1002, or PHYS 1003 and PHYS 1004 (PHYS 1007 and PHYS 1008 are also acceptable provided a minimum average grade of B- is presented); plus MATH 1004 and MATH 1104, or MATH 1002 (no longer offered) and MATH 1102 (no longer offered) or MATH 2052 and MATH 2152.

**Marks**

| | |
|---|---|
| Assignments | 15% |
| Midterm Exam | 15% |
| Final Exam | 30% |
| Laboratory | 40% |

In order to pass the course each one of your Theory (Assignments, Midterm exam, and Final Exam) and Laboratory grades must be above 50%.

Assignments: There will be eight assignments throughout the term and they will generally be due in class ten days after their distribution (or as announced in class). Late assignments will not be accepted without a valid reason such as illness. You are encouraged to discuss the problems on assignments with other students in this course; however, the work you turn in must be your own. Feel free to consult me when you have questions (either during office hours or by setting up an appointment). The assignments

are a critical part of the course and working through the problems yourselves 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**, 1.5 hours long, during the lecture period on **October 18.**
- The final exam will be 3 hours long, to be held during the final examination period in December.
- Both exams will be closed book. For the final exam only, an 8.5" x 11" crib sheet (not mechanically produced, i.e. hand-written) will be allowed. Exam formats will be discussed in advance.
- Deferred exam: If a deferred 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% (i.e. 6 out of 8) of the assignments and writing the midterm exam; the term mark must exceed 30 out of 60.

**Missing Exams**

Midterm Exam: If you miss the midterm exam, you must notify the Professor within 24 hours after the date of the exam. A make-up midterm will be permitted under two conditions: illness or bereavement. Documentation is required to schedule an alternative time for the midterm. If no documentation is provided you will receive a grade of zero for the midterm. If you do provide appropriate documentation within 24 hours after the date of the exam, the professor or teaching assistant will contact you to inform you of the location, time and date of the make-up midterm exam.

Final Exam: If you miss the final exam, you must contact the Registrar's Office within the time period specified in the university calendar. You will need to fully document your application. Students are encouraged to review the policies of deferred exams in the university calendar. A request to write a deferred exam will be granted only if adequate term work has been completed. In this context, adequate term work means completing and submitting 75% (i.e. 6 out of 8) of the assignments, writing the midterm exam and fulfilling the lab requirements as laid out in the lab policy; in addition, each of the student's assignment and lab term grades should be above 50%. The grade FND (Failure with no deferred final exam) will be assigned when the student has failed the course on the basis of inadequate term work. The grade FND is assigned 0.0 grade points.

**Exam Accommodations for PMC Students via Ventus**

Carleton University has launched a new academic accommodation management system, Ventus. With Ventus, course instructors can view up-to-date information on their student's academic accommodation requirements, and submit and manage exam booking requests with the McIntyre Exam Centre. Ventus provides students with more control over their accommodations on a per-course and per-test basis, and creates an improved user experience for students and faculty with real-time data in one shared web location. Students can request and manage their academic accommodations via the Ventus Student Portal. More information on using Ventus, with overviews of the student and faculty portals, can be found on VentusHelp.

**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
WDN = Withdrawn from the course
ABS = Student absent from final exam
DEF = Deferred (See above)
FND = (Failed, no Deferred) = student could not pass even with 100% on final exam

**Course Description**
In this course we will examine a variety of physics phenomena and through them we will derive the fundamental concepts of relativistic classical mechanics, the ultimate classical theoretical framework that describes the macroscopic universe. We will then present the limitations of the classical picture and we will gradually introduce the fundamentally original concepts of quantum mechanics. Through them we will study the smallest units of matter, the atoms and the sub-atomic particles and will establish a basic understanding of the laws of nature at the microscopic level. Many of the topics that will be covered in this course form the basis of a number of sciences such as chemistry, biology and geology and of every aspect of modern engineering as a discipline. The course material is organized in seven basic topics. A brief timeline (tentative) is given below:

**Special Relativity (Sep. 4, 6, 11, 13)**
1. Galilean Relativity; Einstein's Principle of Relativity; Relativity of Simultaneity
2. Time Dilation
3. Length Contraction
4. The Lorentz Transformations
5. Relativistic Momentum and Energy

**The Foundations of Modern Physics (Sep. 18, 20)**
1. Matter and Light; Emission and Absorption of Light; Cathode-Rays, X-rays
2. The Discovery of the Electron and the Nucleus; Limitations of Classical Physics

**Quantization (Sep. 25, 27, Oct. 2, 4, 9)**
1. The Photoelectric Effect; Photons
2. Matter Waves and Energy Quantization
3. Bohr's Model of Atomic Quantization
4. The Bohr Hydrogen Atom; The Hydrogen Spectrum

**Wave Functions and Uncertainty (Oct. 11, 16)**
1. Waves and Particles; The Wave Function; Normalization
2. Wave Packets; The Heisenberg Uncertainty Principle

**MidTerm Exam in Class, Oct. 18**

**One-Dimensional Quantum Mechanics (Oct. 30, Nov. 1, 6, 8, 13)**
1. The Shrödinger Equation

2. A Particle in a Rigid Box; The Correspondence Principle
3. Finite Potential Wells
4. The Quantum Harmonic Oscillator
5. Quantum Mechanical Tunneling

**Atomic Physics (Nov, 15, 20, 22, 27)**

1. The Hydrogen Atom
2. The Electron Spin
3. Multielectron Atoms and the Periodic Table of Elements
4. Excited States; Lifetimes; Stimulated Transitions and the Laser

**Nuclear Physics (Nov. 29, Dec. 4, 6)**

1. Nuclear Structure and Stability; The Strong Force; The Shell Model
2. Radiation and Radioactivity; Nuclear Decay Mechanisms
3. Biological Applications of Nuclear Physics

Please see above for information on assignments and exams.

## Academic Policies

**Academic Regulations, Accommodations, Plagiarism, Etc.:**
University rules regarding registration, withdrawal, appealing marks, and most anything else you might need to know can be found on the university's website, here: http://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/

**Academic Accommodations for Students with Disabilities:**
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 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*).

**Academic Integrity**
All work presented by a student must be her or his original work. This includes lab reports and the final exam. I have zero tolerance for cheating and plagiarism. The attention of all students is drawn to the Academic regulations of the University: https://carleton.ca/registrar/academic-integrity/.

Examples of actions that do not adhere to Carleton's Academic Integrity Policy include:

- Plagiarism
- Accessing unauthorized sites for assignments or tests
- Unauthorized collaboration on assignment and exams

In PHYS 2604 such offences will normally result in a mark of zero for the lab report or exam in question. In addition, a report will automatically be sent to the Dean of the student's Faculty, for possible further disciplinary action. I have no tolerance for cheating, and there are no second chances.

**Assistance for Students:**

Writing Services: http://www.carleton.ca/csas/writing-services/

Peer Assisted Study Sessions (PASS): https://carleton.ca/csas/group-support/pass/

Math Tutorial Centre: https://carleton.ca/math/math-tutorial-centre/

Science Student Success Centre: https://sssc.carleton.ca/

**Important Information:**

- Student or professor materials created for this course (including presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the author(s). They are intended for personal use and may not be reproduced or redistributed without prior written consent of the author(s).
- Students must always retain a hard copy of all work that is submitted.
- 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.
- Carleton University is committed to protecting the privacy of those who study or work here (currently and formerly). To that end, Carleton's Privacy Office seeks to encourage the implementation of the privacy provisions of Ontario's *Freedom of Information and Protection of Privacy Act* (FIPPA) within the university.
- In accordance with FIPPA, please ensure all communication with staff/faculty is via your Carleton email account. To get your Carleton Email you will need to activate your MyCarletonOne account through Carleton Central. Once you have activated your MyCarletonOne account, log into the MyCarleton Portal.