

Course Outline

PHYS 3807: Mathematical Physics I - Winter 2023

Course description

Instructor: Thomas Grégoire (he/him)
Email: thomasgregoire@cunet.carleton.ca
Office: HP 3310

Student Hours: Tu-Th, 11am-12pm in-person (Zoom available on request). Students can schedule an appointment (in-person or on Zoom) for help outside of student hours.

Course Modality: This course will be an in-person course only and is not suitable for remote learning. The lectures will be delivered mainly on the blackboard and will not be recorded. If a student cannot attend class for a limited period of time due to health issues, reference material will be provided.

Meeting times: Lectures: Wednesday and Friday 11:35 am - 12:55 pm, Tory 202
Tutorial, Friday 4:35pm-5:25pm, Southam 516
First class on Wednesday Jan 11, last class on Wednesday April 12, 2023.

Prerequisites: PHYS 2202 (Wave Motion and Optics), MATH 2004 (Multivariable Calculus for Engineering or Physics), MATH 3705 (Mathematical Methods I) . Some of these prerequisite can be waived with consent of the instructor.

Textbook: The lecture notes are based on: Susan M. Lea, *Mathematics for Physicists* , Thomson - Brooks/Cole, ISBN 0-534-37997-4. However this text book is out-of-print, but used copies can be found and the pdf of the book can be found on Brightspace

further reading:

- Copley, *Mathematics for the Physical Sciences*, de Gruyter.
Open access(<https://www.degruyter.com/viewbooktoc/product/449524>)
- Weber, Arfken and Harris, *Essential Mathematical Methods for Physicists*, 7th edition, Elsevier

Content of the course and learning objectives: The goal of this class is to present mathematical methods that are useful in a variety of physics problems. The main topics covered will be Sturm-Liouville theory, complex analysis and Green's functions. The course will roughly structured as follows:

- Review of second order linear differential equations: Power series solutions, Frobenius method.(chapters 3.2 and 3.3)
- Solutions to partial differential equations. Separation of variables, Fourier Series. (chapter 3.5 and part of chapter 4)
- Sturm-Liouville theory (chapter 8)
- Complex analysis (chapter 2)
- Green's function (Appendix C)

The learning objectives are:

- Solve second order linear differential equations using power series
- Understand the concept of a Sturm-Liouville problem and orthogonal functions.
- Use orthogonal functions to solve various partial equations such as Laplace equation, the heat diffusion equation and Schrodinger equation in Cartesian, cylindrical and spherical coordinates
- Understand the concept of analytical complex functions
- Derive the Taylor and Laurent series of complex functions and determine their radius of convergence.
- Solve various definite integrals using techniques from complex analysis.

Assessment

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

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

Homework assignments (40 %): One homework will be assign roughly every week in class. It will be due the following week in class. You are encouraged to discuss the concepts and strategies relative to the assignments together, but the work that is handed in **must be your own**. Late assignment will not be accepted without an acceptable reason. Note: Viewing or searching for solutions in any form before your assignment is submitted is forbidden and will be considered an academic offence. This includes solution manuals, worked problems on the internet, solutions written by other students, and solutions provided by course instructors in previous years.”

Midterm (20 %): There will be one hour midterm during the lecture of March 3. This will be a close book exam, and a formula sheet will be provided.

Final (40 %): The final exam will be 3 hours long and will be held during the final exam period. It will be a close book exam, and a formula sheet will be provided.

Useful informations

Website: Brightspace will be used as the course website.

Academic policy: 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/>

Plagiarism : Plagiarism is the passing off of someone else's work as your own and is a serious academic offence. For the details of what constitutes plagiarism, the potential penalties and the procedures refer to the policies on academic integrity <https://carleton.ca/secretariat/wp-content/uploads/Academic-Integrity-Policy.pdf>

What are the penalties for Plagiarism?

A student found to have plagiarized an assignment may be subject to one of several penalties including: expulsion; suspension from all studies at Carleton; suspension from full-time studies; and/or a reprimand; a refusal of permission to continue or to register in a specific degree program; academic probation; award of an FNS, Fail, or an ABS.

What are the Procedures?

All allegations of plagiarism are reported to the Dean' office. Documentation is prepared by instructors and/or departmental chairs. The Dean writes to the student and the University Ombudsperson about the alleged plagiarism. The Dean reviews the allegation. If it is not resolved at this level then it is referred to a tribunal appointed by the Senate.

Faculty of Science penalties for violation of the Carleton policies on academic integrity

- First offence: a grade of zero on the work(s) associated with the misconduct, and a deduction of up to three grade points from the final course grade (e.g. a grade of B could be reduced to a C.)
- Subsequent offences will result in increasingly severe sanctions ranging from
 - A final grade of F in the course
 - Suspension from studies for up to 3 semesters
 - Expulsion of enrolment from the University

Academic accommodation: Carleton University is committed to providing access to the educational experience in order to promote academic accessibility for all individuals. Academic accommodation refers to educational practices, systems and support mechanisms designed to accommodate diversity and difference. The purpose of accommodation is to enable students to perform the essential requirements of their academic programs. At no time does academic accommodation undermine or compromise the learning objectives that are established by the academic authorities of the University. More information can be found at: <https://students.carleton.ca/course-outline/>

Students with disabilities requiring academic accommodations

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). *The deadlines for contacting the Paul Menton Centre regarding accommodation for final exams for the the Winter exam period is March 15, 2023.

Addressing Human Rights Concerns

The University and all members of the University community share responsibility for ensuring that the University's educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the Department of Equity and Inclusive Communities at equity@carleton.ca.

Religious Obligations Please contact me with requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the Student Guide to Academic Accommodation (PDF, 2.1 MB) **Survivors of Sexual Violence** As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: <https://carleton.ca/sexual-violence-support/>

Accommodations for Missed Work Carleton recognizes that students may be experiencing greater stress and other life factors that are not in their control. As a result, Carleton has put into place a protocol for students to apply for accommodations using a self-declaration form in the event of missed work. The form can be found at: <https://carleton.ca/registrar/wp-content/uploads/self-declaration.pdf> Note that these forms should be used for short-term concerns related to missed work; if you are experiencing chronic, ongoing challenges which necessitate a broader solution, I recommend reaching out to the Paul Menton Centre and/or the Care Support team. In case of miss work, the following policies will apply to the various component of the course:

- Homework: In case of a missed homework, the corresponding mark will be dropped from the homework average. Regular homework are an important part of the course and are needed to meet the learning objective of the course, and as such, accommodation (for legitimate reasons) can be granted for a maximum of 3 homework.
- In the case of an accommodation for a missed midterm, the weight of the midterm will be transferred to the final exam.
- For the final exam, accommodation must be arranged through the registrar's office.

Pregnancy:

Please contact me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the Student Guide to Academic Accommodation (PDF, 2.1 MB).

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Student Rights & Responsibilities

Students are expected to act responsibly and engage respectfully with other students and members of the Carleton and the broader community. See the 7 Rights and Responsibilities Policy for details regarding the expectations of non-academic behaviour of students. Those who participate with another student in the commission of an infraction of this Policy will also be held liable for their actions. **Student Concerns**

If a concern arises regarding this course, your first point of contact is me: Email or drop in during student 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 Office of the Dean of Science.

Assistance for students: The following resources might be useful :

- Important dates and Deadlines: <https://calendar.carleton.ca/academicyear/>
- Academic and Career Development Services: <https://students.carleton.ca/departments/career-services/>
- Writing Services: <http://www.carleton.ca/csas/writing-services/>
- Peer Assisted Study Sessions (PASS): <https://carleton.ca/csas/group-support/pass/>
- Science Student Success Centre: <https://sssc.carleton.ca/>
- Math Tutorial Centre: <https://carleton.ca/math/math-tutorial-centre/>

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.