

Physics 3926F: Computer Simulations in Physics Course Outline

1. Course Information

Physics 3926F, Fall 2026

Lectures/Labs: T 2:30-4:30 pm, **PAB 327** (in-person; see p3)

Lectures/Labs: W 2:30-4:30 pm, **PAB 327** (in-person; see p3)

List of Prerequisites:

Prerequisite(s): (Physics 1202A/B, Physics 1402A/B, Physics 1502A/B or the former Physics 1302A/B); one of Calculus 2303A/B, Mathematics 2500A/B, Numerical and Mathematical Methods 2276A/B, Numerical and Mathematical Methods 2277A/B, the former Applied Mathematics 2276A/B, the former Applied Mathematics 2277A/B, the former Calculus 2503A/B. Integrated Science 1001X with a minimum mark of 60% can be used in place of Physics 1202A/B. Pre-or Corequisite(s): Applied Mathematics 2402A/B or Numerical and Mathematical Methods 2270A/B or the former Applied Mathematics 2270A/B; and Physics 2110A/B or Applied Mathematics 2814A/B or Statistical Sciences 2864A/B.

Unless students have either the prerequisites for this course or written special permission from the Department of Physics and Astronomy to enroll in it, they may be removed and withdrawn from this course in accordance with university policy. This may be done after the add/drop deadline of the academic term, and the course will be marked as withdrawn (WDN) on their academic record. This decision may not be appealed.

2. Instructor Information

Course Instructor: Prof. Gonca Erdemci-Tandogan

Pronouns: she/her/hers

Email: gerdemci@uwo.ca

Note: If you have a question or would like to talk with me, you can send an email (**must be from your Western email**) or visit me during student hours. Please include "Physics 3926F" in the subject line of your email.

Student (Office) Hours: Mondays and Thursdays 9am-10am, in-person (PAB 213) or via Zoom (when needed due to sickness). If any changes happen for certain weeks, it will be announced.

Office Location: PAB 213

Phone: (519) 661-2111 ext. 82739

Course TAs:

Brian Duong

Pronouns: he/him/his

Email: bduong2@uwo.ca

Anthony Corrado Girmenia

Pronouns: he/him/his

Email: agirmen@uwo.ca

Ethan Taylor

Pronouns: he/him/his

Email: etaylo69@uwo.ca

What are 'Student Hours'?

Student hours are dedicated times through the week for the course instructor and TAs to meet with YOU. Pop in to introduce yourself, ask questions about the course, or discuss content from the course.

Inclusive teaching statement:

I am committed to fostering an environment for learning that is inclusive for everyone regardless of gender identity, gender expression, sex, sexual orientation, race, ethnicity, ability, age, class, etc. It is my hope that our class will support diversity of experience, thought, and perspective.

Names/pronouns: I welcome emails or in-person communications to let me know your preferred name or pronouns.

Land Acknowledgement:

We acknowledge that Western University is located on the traditional lands of the Anishinaabek, Haudenosaunee and the Lūnaapéewak, on lands connected with the Dish with One Spoon Covenant Wampum between the Anishinaabeg and Haudenosaunee and the London Township and Sombra Treaties of 1796. With this, we respect the longstanding relationships that Indigenous Nations have to this land, as they are the original caretakers. We acknowledge historical and ongoing injustices that Indigenous Peoples (First Nations, Métis and Inuit) endure in Canada, and we accept responsibility as a public institution to contribute toward revealing and correcting miseducation as well as renewing respectful relationships with Indigenous communities through our teaching, research and community service.

3. Course Syllabus, Schedule, Delivery Mode

Welcome to Computer Simulations in Physics!

"The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform." -Ada Lovelace, 1843

"The purpose of (scientific) computing is insight, not numbers." -Richard Hamming, 1962

"All models are wrong, but some are useful." -George Box, 1979

This is a lab- and project-oriented computation course using applications of numerical methods to problems in classical physics, quantum physics, biophysics, materials science, medical physics, atmospheric physics and astrophysics. Projects will involve choosing a physical problem, posing scientific questions, and implementing a computer simulation. Techniques for programming, analysis, and presentation will be developed.

Learning Outcomes: At the end of the course, students will be able to:

1. Create Python programs that use the core language and NumPy and SciPy modules, following best practices for scientific computing
2. Explain when and how computer simulations are used in physics research
3. Apply knowledge of Python to creating programs that analyze and/or simulate physical systems
4. Visualize the results of data analysis and numerical simulations through the creation of appropriate graphics
5. Compare, contrast, and apply numerical methods of solution for the ordinary and partial differential equations that commonly arise in physics and astronomy
6. Synthesize the solution of computational physics problems by documenting their physical basis, numerical solution, and graphical visualization

This course is about using computers to do physics and astrophysics. Some previous experience with Python is helpful but not mandatory. After reviewing the basics of Python we will learn how to use it to analyze and present data and to solve complex (astro)physical problems. We will apply computer simulations to examples from several branches of physics and astronomy. Along the way, we will learn how to develop realistic numerical models of physical systems and some of the practical aspects of how to solve and interpret these models.

Topic Outline

Learning Python (with application to ODEs; Chapters 1, 2, and 10): weeks 1-4

- Arrays and data structures
- Plots
- Control structures, advanced data structures
- Functions versus scripts, good programming practice
- Writing/maintaining good documentation

Applications (Chapters 3, 6, 7): weeks 5-7, 9-13

- Ordinary differential equations (orbital motion, oscillators)
- Partial differential equations (diffusion, advection, waves)

Data analysis (Chapters 4 and 5): week 8, 9

- Interpolation and curve fitting
- Linear algebra
- Statistical descriptions of data
- Fourier methods

Introduction to Version Control: weeks as time permits from the above topics.

Introduction to Finite Difference Method (FDM) and Finite Element Methods (FEM): weeks as time permits from the above topics.

Classes begin: September 9, 2026

Reading Week: Oct 10-18, 2026

Classes end: December 9, 2026

*Although the Tuesday class session is listed as “lab” and the Wednesday session as “lecture”, in practice **both sessions will be largely lab sessions**. This is a very student-centered course. There will be course lectures at the beginning of both sessions which will proceed as lab sessions, with the instructor and TA available for help.*

4. Course Materials

Required Textbook:

Numerical Methods for Physics, Second Edition, Revised (Python) by Alejandro L. Garcia (2017, CreateSpace Independent Publishing, [Amazon link](#) and [Bookstore link](#)), ISBN 978-1548865498. The textbook costs ~\$25. We will follow this text closely and use its examples and programming projects. You must have access to this textbook. Note that the text uses Python version 2.7 but the course will

use different Python version; there are several important differences between versions that you need to be aware of.

A weekly checklist of activities and links to other resources will be posted to the OWL Brightspace (<https://westernu.brightspace.com/>) associated with this course. Students are responsible for checking the website on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class.

Technical requirements: a laptop computer running any of Windows, Linux or MacOS.

If students need assistance with the course OWL Brightspace site, they can seek support on the [OWL Brightspace Help](#) page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

5. Methods of Evaluation

Research about learning strongly suggests that the most important factor in learning is doing the work of reading, writing, recalling, practicing, synthesizing, and analyzing. Learning happens best when people actively engage material on a consistent basis, and that is why we have high standards in this course. We are confident that, with appropriate effort, you all can meet those standards.

We also make an effort to reduce unintentional bias in grading by, for example and when possible, grading assignments one question at a time (grading all of question 1 before grading any of question 2), grading anonymously, and using rubrics.

Your course grade will be computed as follows:

Component	Weight
Lab assignments (best 9 of 11)	26%
Midterm Exam (In person) Wednesday, October 21, 2:30-4:30pm, location TBA	20%
Project 1	8%
Project 2	9%
Project 3	11%
Final Exam (In person) TBA	26%

The Department of Physics and Astronomy may in rare circumstances adjust the course final grades to conform to Departmental policies.

Essential Learning Requirements

The following are essential to earn a passing grade in this course:

- **A minimum of 7 of 11 completed labs**, to ensure students demonstrate sufficient mastery of the hands-on coding, debugging, and troubleshooting skills developed through the laboratory component. (See *Laboratory Assignments* below for full details.)
- **Submission of at least 2 of 3 projects**, to satisfy the Senate requirement that students demonstrate minimal competence in essay writing, as this course is designated an essay course. (See *Projects* below for full details.)

When a student has NOT demonstrated proficiency in an essential learning requirement listed above, they will be withdrawn (WDN) from the course. The student may appeal to the Associate Dean (Academic) for reinstatement with an Incomplete (INC) standing. Where an appeal for INC is granted, their maximum course load may be reduced during the term in which they complete the outstanding course requirements.

In this course, Labs, Projects, and the Midterm are all designated as Flexible Completion assessments; no Academic Consideration request is needed or accepted for missed or incomplete work in these components (see the specific sections below for each). The Final Exam is the only assessment in this course that falls outside Flexible Completion; it remains subject to the general Academic Consideration policy and requires supporting documentation submitted through the Student Absence Portal (SAP).

Information for Each Course Component and Missed Coursework

LABORATORY ASSIGNMENTS

Eleven (11) laboratory assignments are scheduled weekly, each with two in-person sessions (Tuesday and Wednesday). **Attendance at both sessions is required** to receive credit for that week's lab. Given the hands-on, real-time nature of the skills being developed — writing, debugging, and troubleshooting code with instructor and TA support available — **these skills are essential to the course.**

Attendance requirement: Attendance at both sessions is required and students are expected to be on time for classes at 2:30pm. To receive credit for the Initial Submission, students must arrive **no later than 15 minutes** after the start of the session and remain until the session ends, for both the Tuesday and Wednesday sessions in a given week.

A student who arrives after the 15-minute window, or who leaves before a session ends, will not have their Initial Submission accepted for credit for that session. The Initial Submission portion (80%) of that week's lab will be recorded as zero. Such a student may still submit a Polished Submission for that week to earn credit for the 20% Polished Submission component, provided it meets the standard requirements and deadline described below.

A student who misses both sessions in a given week entirely has missed that lab in full. Both the Initial Submission and Polished Submission for that week will be recorded as zero, and no makeup lab session is offered.

A student who attends only one of the two sessions in a given week will have their credit for that week determined by the instructor or TA based on the work completed (not more than 50% of the mark of that week). Regardless of partial credit awarded, any missed session counts toward the student's overall limits described below (the 7-lab completion threshold to pass the course).

Lab Grading Structure:

- **Initial Submission (80%):** Based on in-person sessions on Tuesday and Wednesday. Work must be submitted by the end of each session; late submissions are not accepted for this component.
- **Polished Submission (20%):** Due by 11:59 pm on Friday of the same week. Students may submit this component up to 48 hours late (until 11:59 pm Sunday) without penalty. Submissions after this No-Late-Penalty Period will not be accepted.
 - Why the polishing component matters: Research on learning shows that deep understanding comes not only from completing tasks but also from revisiting and reflecting on them. The polishing step ensures that you engage with your own work beyond the initial submission, practicing the skills of debugging, improving code clarity, and articulating what you learned. This reflection-and-revision cycle is a critical part of mastering scientific programming.

Essential Component Requirement: The skills assessed in labs are essential to this course. They cannot be assessed through tests or final exam. **Students must complete at least 7 of the 11 labs to meet the essential requirements of this course.** A lab is considered "completed" if the student earns credit for either the Initial Submission or the Polished Submission for that week (see above). Missed labs are simply recorded as zero, and no academic consideration request or makeup lab session is available for them. A student who completes fewer than 7 labs has not met the essential requirements of the course. **When a student has not demonstrated proficiency in an essential learning requirement listed above, they will be withdrawn (WDN) from the course.** The student may appeal to the Associate Dean (Academic) for reinstatement with an Incomplete (INC) standing. Where an appeal for INC is granted, their maximum course load may be reduced during the term in which they complete the outstanding course requirements.

Flexibility: While there is no makeup lab session and no academic consideration process for individual missed labs, this policy has **flexibility built in:** the lab grade is calculated from best 9 of 11 scores (see Lab Grade Calculation below).

Lab Grade Calculation: Your **9 highest lab grades (out of 11 total)** will count toward your final grade. Because lab skills are essential and cannot be assessed elsewhere in the course, there is no reweighting of missed lab grades toward the midterm or final exam.

PROJECTS

All three projects are carried out individually, with a written report and Python code as needed.

Essential Component Requirement: The skills assessed in projects are essential to this course. They cannot be assessed through tests or final exam. This course is essay-designated; per Senate policy, students must demonstrate minimal competence in essay writing to pass. **Students must submit at least 2 of 3 projects. A student who submits fewer than 2 has not met the essential requirements of the course. When a student has not demonstrated proficiency in an essential learning requirement listed above, they will be withdrawn (WDN) from the course.** The student may appeal to the Associate Dean (Academic) for reinstatement with an Incomplete (INC) standing. Where an appeal for INC is granted, their maximum course load may be reduced during the term in which they complete the outstanding course requirements.

Projects are due 11:59 pm Friday. **No makeup or extension is offered beyond the flexibility already built into the deadline: students may submit up to 4 days late (until 11:59 pm Tuesday) without penalty or Academic Consideration.** Submissions after this window will not be accepted. Because project skills are essential and satisfy the Senate essay-writing requirement, there is no reweighting of a missed or late project's weight toward the Midterm or Final Exam. A project not submitted within the no-late-penalty period will be recorded as zero.

MIDTERM

This course has **one midterm test** and a **cumulative final exam**. There is no makeup test for a missed midterm. If a student misses a midterm, its weight will shift automatically to their final exam grade. They do not need to request Academic Consideration for a missed midterm; the reweighing will be done automatically.

The only exception is an early sitting, offered solely for a university-sanctioned schedule conflict (e.g., conflict of two midterms, Varsity competitions) or a religious accommodation that prevents a student from writing the midterm at its scheduled time. If a student requires this accommodation, they must notify their instructor in writing no later than one week before the test. No other circumstance, including illness, qualifies for an early sitting or makeup; these are addressed through the automatic reweighting described above.

If a student wrote the midterm exam and student's final exam grade is higher than their midterm grade, the final exam grade will replace the midterm's weight in their overall grade.

FINAL EXAM

The final exam will be in person and cumulative (details to be announced during the term).

Special Examination

Per university policy, Academic Consideration requests with supporting documentation are required for the final examinations scheduled during official examination periods by the Registrar's Office.

If the student has been approved by the Academic Advising Office to write a Special Examination (SPC) and the final exam is their only outstanding course component, an SPC will be assigned to them and scheduled by the instructor per university policy.

If the student misses their SPC exam and is approved for Academic Consideration, they will be withdrawn from the course without academic penalty. If they experienced extenuating circumstances such as prolonged illness, they may appeal to the Associate Dean (Academic), on a case-by-case basis, for the opportunity to write the final exam the next time the course is offered. An outstanding SPC will reduce their course load for the term in which the exam is deferred, as outlined in the [Definitions of Types of Examinations](#) policy.

If the student misses their SPC exam and Academic Consideration is not approved, or was not requested, they will receive a grade of zero on the exam.

More Information about Missed Coursework

Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs*, posted on the Academic Calendar: https://uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf,

This policy does not apply to requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person. The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult [Accessible Education](#).

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar's webpage: https://registrar.uwo.ca/academics/academic_considerations/ All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

Use of Generative AI Tools

The assignments/projects/exams that you submit for this course **must be original work produced by the individual student**.

Unless otherwise stated, the use of generative AI tools (e.g., ChatGPT, Microsoft Copilot, Claude, Google Gemini, or similar platforms) is **not permitted** in the completion of any course assessments, including but not limited to: assignments, lab reports, presentations, tests, and final examinations.

Using such tools for content generation, code writing, problem solving, translation, or summarization—when not explicitly allowed—will be treated as a **scholastic offence**.

If the use of generative AI is permitted for a particular assessment, the conditions of use will be specified by the instructor in advance. If no such permission is granted, students must assume that use is prohibited. It is your responsibility to seek clarification before using any AI tools in academic work.

6. Additional Statements

6.1 Religious Accommodation

When a recognized religious holiday either requires a student to be absent from the University, or requires or prohibits an activity that makes it impossible for them to complete an academic requirement scheduled that day, they are entitled to accommodation. No student will be penalized for an absence for religious reasons, and an alternative means of satisfying the requirement will be arranged. This accommodation is provided in accordance with the University's policy on Accommodation for Religious Holidays:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

The student should submit their requests through the Student Absence Portal (SAP), identifying the conflict and the specific course component(s) affected (e.g., test, midterm, exam).

Midterms and Tests: If a religious observance conflicts with a midterm test, they must submit their request no later than **one week** before the test. Their instructor will arrange an early sitting of the test. As set out above, no makeup test is offered for any other reason; this early sitting is available specifically for this accommodation.

Final Examinations: If a religious observance conflicts with the final exam, the student must submit their request no later than **two weeks** before the exam. Their instructor will arrange a Special Examination to take place no later than one month after the end of the examination period.

Students are responsible for finding out what was covered in any class they miss due to a religious observance, and for taking the appropriate steps to keep up with the course.

If a suitable arrangement cannot be reached between a student and their instructor, they should consult the Undergraduate Chair of the department offering the course, and if necessary, the Associate Dean (Academic) of the Faculty of Science.

For a list of recognized religious observances, please visit the calendars posted on the Equity, Diversity & Inclusion website - <https://www.edi.uwo.ca> (About Us – Resources – Additional Resources – Calendars).

6.2 Academic Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and

cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Accommodation_disabilities.pdf.

6.3 General Academic Policies

The website for Registrar Services is <https://www.registrar.uwo.ca/>.

Use of @uwo.ca email: In accordance with policy, https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf, the centrally administered e-mail account provided to students will be considered the individual's official university email address. It is the responsibility of the account holder to ensure that emails received from the University at their official university address are attended to in a timely manner.

Requests for Relief (formally known as "appeals")

Policy on Request for Relief from Academic Decision:

https://uwo.ca/univsec/pdf/academic_policies/appeals/requests_for_relief_from_academic_decisions.pdf

Procedures on Request for Relief from Academic Decision (Undergraduate):

https://uwo.ca/univsec/pdf/academic_policies/appeals/undergrad_requests_for_relief_procedure.pdf

Procedures on Request for Relief from Academic Decision (Graduate):

https://uwo.ca/univsec/pdf/academic_policies/appeals/graduate_requests_for_relief_procedure.pdf

6.4 Scholastic Offences

Policy on Scholastic Offences:

https://uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_offences.pdf

Procedures on Scholastic Offences (Undergraduate):

https://uwo.ca/univsec/pdf/academic_policies/appeals/undergrad_scholastic_offence_procedure.pdf

Procedures on Scholastic Offences (Graduate):

https://uwo.ca/univsec/pdf/academic_policies/appeals/graduate_scholastic_offence_procedure.pdf

Use of Electronic Devices During Assessments

In courses offered by the Faculty of Science, the **possession** of unauthorized electronic devices during any in-person assessment (such as tests, midterms, and final examinations) is strictly prohibited. This includes, but is not limited to: mobile phones, smart watches, smart glasses, hidden cameras and wireless earbuds.

Unless explicitly stated otherwise in advance by the instructor, the presence of any such device at a student's desk, on their person, or within reach during an assessment will be treated as a scholastic offence, **even if the device is not in use**.

Effective September 2026, the typical penalty for this offence is a failing grade in the course AND a 12-month prohibition on retaking the course.

Only devices expressly permitted by the instructor (e.g., non-programmable calculators) may be brought into the assessment room. It is their responsibility to review and comply with these expectations.

Use of Generative AI Tools

The assignments/projects/exams that you submit for this course **must be original work produced by the individual student**.

Unless otherwise stated, the use of generative AI tools (e.g., ChatGPT, Microsoft Copilot, Claude, Google Gemini, or similar platforms) is **not permitted** in the completion of any course assessments, including but not limited to: assignments, lab reports, presentations, tests, and final examinations.

Using such tools for content generation, code writing, problem solving, translation, or summarization—when not explicitly allowed—will be treated as a **scholastic offence**.

If the use of generative AI is permitted for a particular assessment, the conditions of use will be specified by the instructor in advance. If no such permission is granted, students must assume that use is prohibited. It is your responsibility to seek clarification before using any AI tools in academic work.

Use of Software for Assessments

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

Computer-marked multiple-choice tests and exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

All required papers/assignments/codes may be subject to submission for similarity review by other software such as MOSS or Gradescope.

6.5 Support Services

Academic Advising. Please visit the Science & Basic Medical Sciences Academic Advising webpage for information on adding/dropping courses, academic considerations for absences, requests for relief, exam conflicts, and many other academic-related matters: <https://www.uwo.ca/sci/advising/>.

Mental Health Support. Students who are in emotional/mental distress should refer to Mental Health@Western (<https://uwo.ca/health/>) for a complete list of options about how to obtain help.

Gender-Based and Sexual Violence. Western is committed to reducing incidents of gender-based and sexual violence (GBSV) and providing compassionate support to anyone who has gone through these traumatic events. If a student has experienced GBSV (either recently or in the past), they can find information about support services for survivors, including emergency contacts, at:

https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Accessibility for Coursework. A student may contact the course instructor if they require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to them. If they have any questions regarding accommodations, they may also contact Accessible Education at http://academicsupport.uwo.ca/accessible_education/index.html

Learning Development and Success. Learning-skills counsellors at Learning Development and Success (<https://learning.uwo.ca>) are ready to help students improve their learning skills. The facility offers strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Student Councils.

Student-run support services are offered by the University Students' Council (<https://westernusc.ca/services/>) and the Science Students' Council (<https://www.westernssc.ca>).