UNIVERSITY OF CALGARY
FACULTY OF SCIENCE

Department of Physics & Astronomy
Science B 605
403 220-5385
phasoffice@ucalgary.ca

COURSE OUTLINE

1. **Course:** PHYS 481, Computational Physics II - Fall 2019

   Lecture 01: T 15:30 - 16:20 in ST 026

Instructor	Email	Phone	Office	Hours
Dr David Feder	dfeder@ucalgary.ca	403 220-3638	SB 535	By appointment

   Please note that the PHYS 481 tutorials run T 1630-1720 and R 1530-1720. This means that the class effectively runs TR 1530-1720, and you should plan your time around this schedule accordingly. Computational Physics is an applied discipline and you learn by working on problems. The official lecture time will be largely spent reviewing the essential physics (or mathematics), while tutorial time will be devoted to active learning (via problem solving) using Python. It is therefore strongly recommended that all students attend all tutorials.

   Course Site:

   D2L: PHYS 481 L01-(Fall 2019)-Computational Physics II

   Note: Students must use their U of C account for all course correspondence.

2. **Requisites:**

   See section 3.5.C in the Faculty of Science section of the online Calendar.

   Prerequisite(s):
   Physics 381; and Mathematics 375 or 376; and Mathematics 367 or 377.

3. **Grading:**

   The University policy on grading and related matters is described in F.1 and F.2 of the online University Calendar. In determining the overall grade in the course the following weights will be used:

Component(s)	Weighting %	Date
Assignments	60	
Midterms (in class)	20 (10% each)	Oct. 15 and 17
Final	20	TBD

   Each piece of work (reports, assignments, quizzes, midterm exam(s) or final examination) submitted by the student will be assigned a grade. The student's grade for each component listed above will be combined with the indicated weights to produce an overall percentage for the course, which will be used to determine the course letter grade.

   The conversion between a percentage grade and letter grade is as follows.

	A+	A	A-	B+	B	B-	C+	C	C-	D+	D
Minimum % Required	94 %	90 %	86 %	82%	78%	74 %	70 %	66%	62%	58 %	54 %

   This course has a registrar scheduled final exam.

   Assignments comprise 60% of the course grade, which is higher than in most courses. This is because this topic is super applied and you will only learn if you have lots of opportunities to practice. The plan is to give you 10 assignments (about one each week, not including the midterm week or reading break). But, if it turns out that these assignments are more taxing then I expected (as this is the first time I am teaching this course), then I will reduce the number of them and give you more time to complete them.

   The midterm and final together constitute 40% of the course grade. When calculating the final grade, I will consider a 15-25, 20-20, and 25-15 split on the midterm and final, and choose the one that works out best for

you.

4. **Missed Components Of Term Work:**

   In the event that a student misses the midterm or any course work due to illness, supporting documentation, such as a medical note or a statutory declaration will be required (see Section M.1; for more information regarding the use of statuary declaration/medical notes, see FAQ). Absences must be reported within 48 hrs.

   The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in Section 3.6. It is the student's responsibility to familiarize themselves with these regulations. See also Section E.3 of the University Calendar.

   If you miss an assignment or a midterm, please contact me (David Feder) by email at dfeder@ucalgary.ca as soon as possible, to see if alternative arrangements can be made.

5. **Scheduled Out-of-Class Activities:**

   There are no scheduled out of class activities for this course.

6. **Course Materials:**

   Course notes, Python notebooks, assignments, assignment solutions, etc. will appear on the course D2L page, and can also be found on the google colab space (details below).

7. **Examination Policy:**

   The midterm and final exams will be written in the PJL computer room, so you will have access to the PJL computing environment and your assignments (if they are stored there), but the connection to the outside world will be blocked during the exam. The two midterm exams will be written during class time, on October 15 and 17.

   Students should also read the Calendar, Section G, on Examinations.

8. **Approved Mandatory And Optional Course Supplemental Fees:**

   There are no mandatory or optional course supplemental fees for this course.

9. **Writing Across The Curriculum Statement:**

   For all components of the course, in any written work, the quality of the student's writing (language, spelling, grammar, presentation etc.) can be a factor in the evaluation of the work. See also Section E.2 of the University Calendar.

10. **Human Studies Statement:**

    Students will not participate as subjects or researchers in human studies.

    See also Section E.5 of the University Calendar.

11. **Reappraisal Of Grades:**

    A student wishing a reappraisal, should first attempt to review the graded work with the Course coordinator/instructor or department offering the course. Students with sufficient academic grounds may request a reappraisal. Non-academic grounds are not relevant for grade reappraisals. Students should be aware that the grade being reappraised may be raised, lowered or remain the same. See Section I.3 of the University Calendar.

    a. **Term Work:** The student should present their rationale as effectively and as fully as possible to the Course coordinator/instructor within **10 business days** of either being notified about the mark, or of the item's return to the class. If the student is not satisfied with the outcome, the student shall immediately submit the Reappraisal of Graded Term work form to the department in which the course is offered. The department will arrange for a re-assessment of the work if, and only if, the student has sufficient academic grounds. See sections I.1 and I.2 of the University Calendar

    b. **Final Exam:**The student shall submit the request to Enrolment Services. See Section I.3 of the University Calendar.

12. **Other Important Information For Students:**

    a. **Mental Health** The University of Calgary recognizes the pivotal role that student mental health plays in physical health, social connectedness and academic success, and aspires to create a caring and supportive campus community where individuals can freely talk about mental health and receive supports when needed. We encourage you to explore the mental health resources available throughout the university

community, such as counselling, self-help resources, peer support or skills-building available through the SU Wellness Centre (Room 370, MacEwan Student Centre, Mental Health Services Website) and the Campus Mental Health Strategy website (Mental Health).

b. **SU Wellness Center:** The Students Union Wellness Centre provides health and wellness support for students including information and counselling on physical health, mental health and nutrition. For more information, see www.ucalgary.ca/wellnesscentre or call 403-210-9355.

c. **Sexual Violence:** The University of Calgary is committed to fostering a safe, productive learning environment. The Sexual Violence Policy (https://www.ucalgary.ca/policies/files/policies/sexual-violence-policy.pdf) is a fundamental element in creating and sustaining a safer campus environment for all community members. We understand that sexual violence can undermine students' academic success and we encourage students who have experienced some form of sexual misconduct to talk to someone about their experience, so they can get the support they need. The Sexual Violence Support Advocate, Carla Bertsch, can provide confidential support and information regarding sexual violence to all members of the university community. Carla can be reached by email (svsa@ucalgary.ca) or phone at 403-220-2208 .

d. **Misconduct:** Academic misconduct (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under Section K. Student Misconduct to inform yourself of definitions, processes and penalties. Examples of academic misconduct may include: submitting or presenting work as if it were the student's own work when it is not; submitting or presenting work in one course which has also been submitted in another course without the instructor's permission; collaborating in whole or in part without prior agreement of the instructor; borrowing experimental values from others without the instructor's approval; falsification/ fabrication of experimental values in a report. **These are only examples**.

e. **Assembly Points:** In case of emergency during class time, be sure to FAMILIARIZE YOURSELF with the information on assembly points.

f. **Academic Accommodation Policy:** Students needing an accommodation because of a disability or medical condition should contact Student Accessibility Services in accordance with the procedure for accommodations for students with disabilities available at procedure-for-accommodations-for-students-with-disabilities.pdf.

   Students needing an accommodation in relation to their coursework or to fulfill requirements for a graduate degree, based on a protected ground other than disability, should communicate this need, preferably in writing, to the Associate Head of the Department of Physics & Astronomy, Dr. David Feder by email phas.ahugrd@ucalgary.ca or phone 403-220-8127. Religious accommodation requests relating to class, test or exam scheduling or absences must be submitted no later than **14 days** prior to the date in question. See Section E.4 of the University Calendar.

g. **Safewalk:** Campus Security will escort individuals day or night (See the Campus Safewalk website). Call 403-220-5333 for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.

h. **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). Students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information, see Legal Services website.

i. **Student Union Information:** VP Academic, Phone: 403-220-3911 Email: suvpaca@ucalgary.ca. SU Faculty Rep., Phone: 403-220-3913 Email: sciencerep@su.ucalgary.ca. Student Ombudsman, Email: ombuds@ucalgary.ca.

j. **Internet and Electronic Device Information:** Unless instructed otherwise, cell phones should be turned off during class. All communication with other individuals via laptop, tablet, smart phone or other device is prohibited during class unless specifically permitted by the instructor. Students that violate this policy may be asked to leave the classroom. Repeated violations may result in a charge of misconduct.

k. **Surveys:** At the University of Calgary, feedback through the Universal Student Ratings of Instruction (USRI) survey and the Faculty of Science Teaching Feedback form provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses. Your responses make a difference - please participate in these surveys.

l. **Copyright of Course Materials:** All course materials (including those posted on the course D2L site, a course website, or used in any teaching activity such as (but not limited to) examinations, quizzes, assignments, laboratory manuals, lecture slides or lecture materials and other course notes) are protected by law. These materials are for the sole use of students registered in this course and must not be redistributed. Sharing these materials with anyone else would be a breach of the terms and conditions governing student access to D2L, as well as a violation of the copyright in these materials, and may be pursued as a case of student academic or non-academic misconduct, in addition to any other remedies available at law.

Additional Details:

There are many environments for running Python programs, including (but certainly not limited to) Anaconda, PyCharm, Syzygy, etc. I am assuming that, because you have already taken PHYS 381, you already have a favourite coding environment and intend to continue using this, but please consider the following:

This year, PHYS 481 is in the PJL Computer Lab which has 44 functional (linux-based) computers for your use. Peter Gimby has informed me that students can install the Python environment of their choice on these machines, though we'll check this on the first day of classes. Your software is tied to your account, not to the specific console that you are sitting in front of, so you will be able to access your codes at any desk. You can also run your PJL coding environment off-campus with an ssh connection with X tunneling turned on (usually via ssh -X on a Mac running XQuartz, or by adjusting the ssh settings in a client). The midterms and final exam will take place in the same room, so you will have access to your codes; however, for these exams, we will turn off access to the internet.

I am encouraging you to work on your assignments in small groups (preferably two people per group). It is acceptable if you prefer to work alone, or in the occasional group of three. You can self-enroll in your group on D2L, and we will set this up on the first day of classes. Assignments will be submitted to D2L by one group member, and the grades will automatically be applied to all group members. Unfortunately, D2L makes it complicated to change groups mid-term, so changes to the group compositions will be possible later in the term only under exceptional circumstances.

Group work requires close collaboration, and local Python environments cannot be shared. It turns out that Google recently launched a cloud-based Python environment called Colab. This naturally meshes with Google docs, and allows for multiple people to work on Python codes at the same time. Furthermore, I will post my lecture notes for each chapter on this platform. These notes will include both theory and sample (working) Python code. My intention is to share these chapter notes with all students, so that everyone can readily copy them into their own accounts and play with them. These notes also contain the assignment problems for each chapter. Likewise, I intend to post revised chapter notes with (my possibly idiosyncratic) assignment solutions after the deadline has passed. Thus, the Colab platform will take some precedence over the course D2L site, as I will only be posting static pdf's of the chapter notes (and other course materials) on D2L. I have made a throw-away Google account called **davidfederpython** where I am posting everything. I encourage you to likewise make a new Google account for this course, and to send the Google account name to me via email to dfeder@ucalgary.ca; I will then add this account to the Colab share list. It is important that you make a new Google account for your Colab work to prevent inadvertently sharing private information with me.

Syllabus:

1. Shuffling
    a. Lists in Python
    b. Cutting and shuffling a deck of cards
    c. Reversible mixing
2. Randomization
    a. Pseudo-random numbers
    b. Macrostates, Statistics, and Entropy
    c. Huffman coding: Lossless image compression
    d. Testing randomness
    e. Cellular automata

3. Randomized algorithms
    a. Random walks and Markov chains
    b. Interactions
    c. Temperature
    d. Pauli paramagnet
4. Magnets
    a. Ising model
    b. Correlation functions and order parameters
    c. Spin glasses
    d. Monte Carlo and Metropolis algorithms
5. Solving ODEs
    a. Finite differences and stencils
    b. Laplace’s equation
    c. Linear systems of equations
    d. Finite elements
    e. Fourier and spectral representations
6. Solving PDEs
    a. Implicit and explicit methods
    b. Stability
    c. Wave equation
    d. Schrödinger’s equation
    e. Gross-Pitaevskii equation

Course Incomes:

Students entering PHYS 481 are expected to be:

- Proficient with Python syntax and its coding environments, at an intermediate level;
- Familiar with solving a range of problems, such as root finding, curve fitting, numerical integration, and ordinary differential equations;
- Familiar with representing, plotting, and analyzing data (including applying linear regression) with Python;
- Able to simulate various problems in classical mechanics, such as simple and compound harmonic oscillators.

Course Outcomes:

- At the completion of the course, students will have gained experience:
- Working independently and in groups on numerical approaches to solving problems in physics, using Python;
- Solving ordinary and partial differential equations of physics by numerical methods;
- Exploring the limitations and power of randomization for solving problems in physics.

Department Approval: Electronically Approved Date: 2019-09-05 10:32