UNIVERSITY OF CALGARY
FACULTY OF SCIENCE

Department of Geoscience
ES 118
403 220-5841
geoscience@ucalgary.ca

COURSE OUTLINE

1. **Course:** GOPH 419, Computational Methods for Geophysicists - Winter 2021

   Lecture 01: TR 11:00 - 12:15 - Online

Instructor	Email	Phone	Office	Hours
Dr Brandon Karchewski	brandon.karchewski@ucalgary.ca	403 220-6678	ES 108	By Appointment

   Teaching Assistant:
   Meghan Sharp, E: meghan.sharp@ucalgary.ca

   Online Delivery Details:

   Some aspects of this course are being offered in real-time via scheduled meeting times. For those aspects you are required to be online at the same time.

   To help ensure Zoom sessions are private, do not share the Zoom link or password with others, or on any social media platforms. Zoom links and passwords are only intended for students registered in the course. Zoom recordings and materials presented in Zoom, including any teaching materials, must not be shared, distributed or published without the instructor's permission.

   This course has a registrar scheduled, asynchronous final exam. The writing time is 2 hours + 50% buffer time, but the exam can be written any time in a 24-hour window.

   Lectures: The lectures will be online synchronous at the registrar-scheduled time (TuTh 11:00AM - 12:15PM Mountain/Calgary Time) via Zoom (links available via course D2L page). These will also be recorded and available on the course D2L page (usually within 24 hours after the class) in case you are unable to attend class at the scheduled time for any reason. You are encouraged to attend the online synchronous class sessions as they will involve interaction/discussion about the content.

   Labs: The labs will be online asynchronous. You do not need to attend live lab sessions at a regularly scheduled time each week, however the teaching assistant may setup regular office hours via Zoom at which there may be demonstrations relevant to the lab assignments and opportunity to discuss/collaborate on the assignments with your peers. The lab descriptions/exercises/assignments will be uploaded to D2L for you to work through at your own pace. As you work through the labs, you are welcome to ask questions of the instructor and/or TA via email or schedule an online Zoom meeting to discuss.

   Assessments: All course assessments will be online asynchronous. Lab assignments will be submitted electronically via the Dropbox on D2L (see course schedule on D2L page for due dates). Quizzes will be posted to D2L throughout the term and you will typically have one week to complete multiple attempts of each quiz. The final exam will be scheduled by the Registrar for a "2 hour" timeslot and will be due for electronic submission to a D2L Dropbox at the end of this time period. However, to facilitate asynchronous completion of the exam, it will be made available 24 hours before the deadline.

   Course Site:

   D2L: GOPH 419 L01-(Winter 2021)-Computational Methods for Geophysicists

   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):
   Mathematics 211; and Geophysics 351 or 355; and 3 units from Computer Science 217, 231, 235 or Data Science 211; and 3 units from Mathematics 331, 367 or 377.

   Antirequisite(s):
   Credit for Geophysics 419 and any of 619, 599.09 or 699.09 will not be allowed.

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
Quizzes	30%	See Schedule, posted on D2L
Lab Assignments/Reports	35%	See Schedule, posted on D2L
Final Exam	35%	Scheduled by Registrar, posted on D2L 24 hrs prior

The course is divided into 8 modules or topics (see course schedule on D2L). Each module will consist of 3-4 synchronous class periods introducing the module content and completing practice problems/examples. There will also be additional opportunity to see examples during TA office hours for the labs. Following each module, a quiz will be posted on D2L and you will have one week to complete multiple attempts (highest attempt score will count as your quiz mark). This modular format is designed to give students appropriate background and practice with each of the course topics. There will also be three (3) lab assignments (approx. every 2-3 modules), which will include significant computation and a written report. There are no Registrar-scheduled lab sessions, but there will be regularly scheduled TA office hours for the labs and you are encouraged to seek guidance from the course instructor, TA, and/or your peers while working through the lab assignments. Discussion boards will be available on D2L to encourage appropriate collaboration with your peers on the labs and quizzes. Please be mindful of the academic code of conduct with regard to collaboration on coursework. Discussion of theory and methods with your peers is encouraged, but all calculations, code, and report writing should be completed independently to ensure that each individual achieves the best learning outcomes from the course.

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	95 %	90 %	85 %	80%	75%	70 %	65 %	62%	60%	55 %	50 %

This course will have a final exam that will be scheduled by the Registrar. The Final Examination Schedule will be published by the Registrar's Office approximately one month after the start of the term. The final exam for this course will be designed to be completed within 2 hours.

The final exam will be administered using an on-line platform. Per section G.5 of the online Academic Calendar, timed final exams administered using an on-line platform, such as D2L, will be available on the platform where the additional time will be added to the beginning of the registrar scheduled exam. E.g. If an exam is designed for 2 hours and the final exam is scheduled from 9-11am in your student centre, the additional time will be added to the start time of the exam. This means that if the exam has a 1 hour buffer time,

- the latest you should start an asynchronous exam would be 8 am in order to be able to submit the exam at 11am and have the full 3 hours.

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

The university has suspended the requirement for students to provide evidence for absences. Please do not attend medical clinics for medical notes or Commissioners for Oaths for statutory declarations.

In the event that a student legitimately fails to submit any online assessment on time (e.g. due to illness etc...), please contact the course coordinator, or the course instructor if this course does not have a coordinator to arrange for a re-adjustment of a submission date. Absences not reported within 48 hours will not be accommodated. If an excused absence is approved, then the percentage weight of the legitimately missed assignment could also be pro-rated among the components of the course.

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

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

6. **Course Materials:**

Recommended Textbook(s):

Chapra, S. and Canale, R., *Numerical Methods for Engineers (8th Edition)*: McGraw Hill.
Downey, A.B., *Think Python 2e*: Green Tea Press.

This text will be the reference for the content of this course, and it is recommended, but not required. The instructor will post supplemental notes on D2L (https://d2l.ucalgary.ca/login.asp). You will be expected to stay up-to-date with the online content of the course on a weekly basis.

For in-class quizzes and term tests, you may use course notes, online reference and any calculator (including Matlab, Python, or Excel). You can obtain a license for a current version of Matlab through the UofC IT Software page (https://iac01.ucalgary.ca/SDSWeb/). Python 3 (and matplotlib, NumPy, SciPy, and other packages) are free, open-source, and available from a variety of sources. A recommended distribution is the Anaconda Individual Edition (https://www.anaconda.com/products/individual), which includes Python 3 with many useful packages for scientific computing pre-loaded and a package manage built-in for installing other Python packages. The Anaconda distribution also includes multiple development environment (IDE) options. We will mostly use Jupyter notebooks for in-class demonstrations and you are welcome to submit your assignments as Jupyter notebook (.ipynb) files. Anaconda also includes the Spyder development environment, which has a similar "look-and-feel" to the Matlab environment and you can submit your assignments as .py files developed using Spyder (or any other IDE of your choice) if you prefer.

Information, examples, and tutorials for both Matlab and Python will be provided in-class and during TA office hours. You can find additional information about Matlab functions (including more examples) via the Mathworks website and you are
encouraged to use this resource regularly to get in the habit of understanding the tools you are using. You should already have some background with Python 3 from your introductory computer science course (CPSC 217 or equivalent), but if you need a refresher the text Think Python 2e by A.B. Downey provides a concise and clear overview of Python for general scientific computing. Best of all, it can be downloaded for free in PDF format from the author/publisher's webpage (https://greenteapress.com/wp/think-python-2e/). This is a "recommended" text and is not strictly required for the course, but it provides additional descriptions, examples, and exercises to help you develop greater proficiency with Python and numerical methods.

In order to successfully engage in their learning experiences at the University of Calgary, students taking online, remote and blended courses are required to have reliable access to the following technology:

- A computer with a supported operating system, as well as the latest security, and malware updates;
- A current and updated web browser;
- Webcam/Camera (built-in or external);
- Microphone and speaker (built-in or external), or headset with microphone;
- Current antivirus and/or firewall software enabled;
- Stable internet connection.

For more information please refer to the UofC ELearning online website.

7. **Examination Policy:**

The midterm and final exams will be open book, open notes and you will be allowed to use any calculator including software such as Matlab, Python, and Excel. Internet access will be allowed, but verbal, written or electronic communication is not allowed during the exam.

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 **ten 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 submit the Reappraisal of Graded Term work form to the department in which the course is offered within 2 business days of receiving the decision from the instructor. The Department will arrange for a reappraisal of the work within the next ten business days. The reappraisal will only be considered if the student provides a detailed rationale that outlines where and for what reason an error is suspected. 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 Services:** For more information, see www.ucalgary.ca/wellnesscentre or call 403-210-9355.

    c. **Sexual Violence:** 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. The complete University of Calgary policy on sexual violence can be viewed at (https://www.ucalgary.ca/policies/files/policies/sexual-violence-policy.pdf)

    d. **Misconduct:** Academic integrity is the foundation of the development and acquisition of knowledge and is based on values of honesty, trust, responsibility, and respect. We expect members of our community to act with integrity. Research integrity, ethics, and principles of conduct are key to academic integrity. Members of our campus community are required to abide by our institutional Code of Conduct and promote academic integrity in upholding the University of Calgary's reputation of excellence. Some examples of academic misconduct include but are not limited to: posting course material to online platforms or file sharing without the course instructor's consent; submitting or presenting work as if it were the student's own work; submitting or presenting work in one course which has also been submitted in another course without the instructor's permission; borrowing experimental values from others without the instructor's approval; falsification/fabrication of experimental values in a report. Please read the following to inform yourself more on academic integrity:

        Student Handbook on Academic Integrity
        Student Academic Misconduct Policy and Procedure
        Research Integrity Policy

        Additional information is available on the Student Success Centre Academic Integrity page

    e. **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 Teaching Professor of the Department of Geoscience, Jennifer Cuthbertson by email cuthberj@ucalgary.ca or phone 403-220-4709. 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.

f. **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.

g. **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.

h. **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.

i. **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.

Calendar Description:
Topics in numerical analysis emphasizing geophysics applications. Topics will include error analysis, Taylor series, root finding algorithms, linear system solver algorithms, LU decomposition, curve fitting, numerical differentiation and integration, numerical solution of ODEs, introduction to PDE solvers.

Learning Objectives:
By the end of this course, students should be able to:
1. ***Explain*** and ***implement*** numerical solution algorithms to some of the most fundamental problems in applied mathematics (root finding, solution of linear systems, numerical integration, solution of ODEs/PDEs), applied within a geophysics context.
2. ***Perform*** error analyses of approximate numerical solutions and discuss whether the solutions are acceptable.
3. ***Explain*** the advantages and limitations of the numerical techniques examined in the course.
4. ***Distinguish*** between and select the most applicable of available numerical techniques for an analysis task in geophysics.
5. ***Use*** software packages (spreadsheet tools such as MS Excel and programming languages such as Matlab and Python 3) to
compute numerical solutions.
6. ***Communicate*** the results of numerical analysis to peers in the scientific community and***critically evaluate*** the work of peers.

Electronically Approved - Jan 07 2021 22:32

Department Approval