



UNIVERSITY OF CALGARY

DEPARTMENT OF GEOSCIENCE COURSE OUTLINE WINTER 2017

1. **Course:** GOPH 599.09/699.09, Computational Methods for Geophysicists
http://geoscience.ucalgary.ca/geoscience_info/courses/w17

Lectures: L01: W 17:00-19:45, ST 061
Labs: B01: M 17:00-19:45, ES 254

2. **Instructional Team**

Instructor: Dr. Brandon Karchewski, ES 108, T: 403-220-6678, E: brandon.karchewski@ucalgary.ca
Office hours by appointment

Teaching Assistants: **TBA**

Geoscience Department: ES 118, T: 403-220-5841, W: geoscience.ucalgary.ca, E: geoscience@ucalgary.ca

3. **Prerequisites:** MATH 211 (Linear Methods I) AND one of the following:

- MATH 331 (Multivariate Calculus)
- MATH 367 (University Calculus III) and AMAT 311 (Differential Equations I)
- MATH 375 (Differential Equations for Eng and Sci) and MATH 377 (Vector Calculus for Eng and Sci)

AND one of the following:

- CPSC 215/217 (Introduction to Computer Science for Multidisciplinary Studies I)
- CPSC 231 (Introduction to Computer Science for Computer Science Majors I)
- CPSC 235 (Advanced Introduction to Computer Science)

OR permission of the instructor.

Antirequisites: Credit in GOPH 419 will not be given to those who have completed one of the following:

- AMAT 491 (Numerical Analysis I) and AMAT 493 (Numerical Analysis II)
- PHYS 381 (Computational Physics I) and PHYS 481 (Computational Physics II)

4. **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, discrete Fourier transforms, numerical differentiation and integration, numerical solution of ODEs, introduction to PDE solvers.

3. **Learning Objectives:**

By the end of this course, students should be able to:

- 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.
- Perform** error analyses of approximate numerical solutions and **discuss** whether the solutions are acceptable.
- Explain** the advantages and limitations of the numerical techniques examined in the course.
- Distinguish** between and **select** the most applicable of available numerical techniques for an analysis task in geophysics.
- Use** software packages (spreadsheet tools such as MS Excel and programming languages such as Matlab) to compute numerical solutions.
- Communicate** the results of numerical analysis to peers in the scientific community and **critically evaluate** the work of peers.

5. Course Materials:

Course Text: S. Chapra and R. Canale. (2014). *Numerical Methods for Engineers*, 7th ed. New York: McGraw-Hill, ISBN: 978-1259170546.

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 or Excel). You can obtain a student license for Matlab for your personal computer by visiting the University of Calgary IT Software Distribution website (<https://iac01.ucalgary.ca/SDSWeb/>) and following the instructions provided.

6. Grading: The University policy on grading and related matters is described in sections F.1 and F.2 of the online University Calendar.

For those registered in **GOPH 599.09**, the overall grade in the course will be based on the following grading scheme:

Grade Component	Weight	Notes
iRAT/tRAT Quizzes*	20%	
Lab Assignments/Reports* (5)	25%	See Course Schedule for due dates
Midterm Exam	25%	In lab Monday, February 13
Final Exam**	30%	SCHEDULED BY THE REGISTRAR

*Lowest mark will be dropped in assessing these grade components

**Students must achieve a minimum of 50% on the final exam to obtain a passing grade.

For those registered in **GOPH 699.09**, the overall grade in the course will be based on the following grading scheme:

Grade Component	Weight	Notes
iRAT/tRAT Quizzes*	15%	
Lab Assignments/Reports* (5)	15%	See Course Schedule for due dates
Term Project**	20%	See Term Project description on D2L
Midterm Exam	20%	In lab Monday, February 13
Final Exam**	30%	SCHEDULED BY THE REGISTRAR

*Lowest mark will be dropped in assessing these grade components

**Students must achieve a minimum of 50% on the term project and the final exam to obtain a passing grade.

Individual elements of the course (i.e. labs, exams) will be assigned a percentage score. Final percentage grades for the overall course will be calculated based on the grade weighting scheme indicated above and will be rounded to the nearest integer and converted to a letter grade as follows:

Letter Grade	Percent	Letter Grade	Percent
A+	95-100	C+	67-69
A	90-94	C	63-66
A-	85-89	C-	60-62
B+	80-84	D+	55-59
B	75-79	D	50-54
B-	70-74	F	0-49

7. Format of the Course:

Lectures: The course will involve one (1) weekly lecture period (3 hours), where the instructor will lead the students through a discussion of the topic for that week. The instructor will post the material for that week at least one week prior. Students are expected to review this content prior to the lectures.

In a typical week, the first part of the lecture period will involve a team-based learning activity centred on a pair of Readiness Assurance Tests, one individual quiz (iRAT) and one team quiz (tRAT). The content of the quiz will draw from the content from the previous week. The iRAT will be completed individually at the beginning of the lecture period and should take approximately 20 minutes. The tRAT will be the same quiz, but you will be able to discuss the questions with a team of your peers. The tRAT should also take approximately 20 minutes and at its conclusion the instructor will take up the correct answers to the quiz questions.

The teams will be organized at the beginning of the term by your instructor based on the results of a self-scored questionnaire on your level of background knowledge and practical experience relevant to the course content, as well as your attitude toward working in teams.

Labs: There will be one (1) weekly lab period (3 hours). In the computer labs, you will complete assignments in which you will implement a numerical solution to a geophysics application problem in Matlab. There will be a total of five (5) lab assignments and you will have 2-3 lab periods to complete each assignment. Your submission of these assignments will include both the code that you used to generate your solution and a brief scientific report summarizing the background theory, methods, results and conclusions of the assignment. You can complete these assignments on your own or in pairs at your discretion. In assessing your lab assignment grade, the lowest mark will be dropped.

Term Project (for GOPH 699.09 students only): To obtain graduate credit for the course, you will be required to complete an additional term project that will draw on your knowledge of the entire course content to solve a substantial problem in computational geophysics and present your results in a scientific report. You are encouraged to select a topic based on your own interests, subject to instructor approval. You are also encouraged to discuss the topic with your graduate advisor, as it is likely possible to align this project with the research goals of your thesis. The project will be due at the end of the term, but you will have the opportunity to discuss your progress with the instructor throughout the term. The format of the report will be posted on D2L.

8. **Missed Components of Term Work:** 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 himself/herself with these regulations. See also [Section E.6](#) of the University Calendar.
9. **Scheduled out-of-class activities:** There are not any scheduled out-of-class activities for this course. There will be a 2.5-hour midterm exam held during the scheduled lab time. This will occur on **Monday, February 13**.

REGULARLY SCHEDULED CLASSES HAVE PRECEDENCE OVER ANY OUT-OF-CLASS-TIME-ACTIVITY. If you have a conflict with this out-of-class activity, please inform your instructor as soon as possible so that alternative arrangements may be made for you.

10. **Examination Policy:** The midterm and final exams will be open book, open notes and you will be allowed to use a lab computer or a personal laptop. 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.
11. **Writing across the curriculum statement:** In this course, the quality of the student's writing in laboratory reports will be a factor in the evaluation of those reports. See also [Section E.2](#) of the University Calendar.

12. OTHER IMPORTANT INFORMATION FOR STUDENTS:

- (a) **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
- (b) **Assembly Points:** In case of emergency during class time, be sure to FAMILIARIZE YOURSELF with the information on [assembly points](#).
- (c) **Student Accommodations:** 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 http://www.ucalgary.ca/policies/files/policies/procedure-for-accommodations-for-students-with-disabilities_0.pdf. Students needing an Accommodation in relation to their coursework or to fulfil 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 Geoscience, Dr. E.S. Krebs by email krebs@ucalgary.ca or phone 403-220-5850.
- (d) **Safewalk:** Campus Security will escort individuals day or night (<http://www.ucalgary.ca/security/safewalk/>). Call 220-5333 for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.
- (e) **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). As one consequence, 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 also <http://www.ucalgary.ca/secretariat/privacy>.
- (f) **Student Union Information:** VP Academic Phone: 403 220-3911 Email: suvpaca@ucalgary.ca SU Faculty Rep. Phone: 403 220-3913 Email: science1@su.ucalgary.ca, science2@su.ucalgary.ca and science3@su.ucalgary.ca; Student Ombuds Office: 403-220-6420 Email: ombuds@ucalgary.ca; <http://ucalgary.ca/provost/students/ombuds>

- (g) **Internet and Electronic Device Information:** You can assume that in all classes that you attend, your cell phone should be turned off unless instructed otherwise. Also, communication with other individuals, via laptop computers, Blackberries or other devices connectable to the Internet is not allowed in class time unless specifically permitted by the instructor. If you violate this policy you may be asked to leave the classroom. Repeated abuse may result in a charge of misconduct.
- (h) **U.S.R.I.:** At the University of Calgary, feedback provided by students through the Universal Student Ratings of Instruction (USRI) survey provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses (www.ucalgary.ca/usri). Your responses make a difference – please participate in USRI Surveys.

Department Approval: ORIGINAL SIGNED

Date: Nov 28/16