

## COURSE OUTLINE

### MATH 449/549: Scientific Computing

#### Instructor

Boualem Khouider, Professor

**Research Area** Climate modeling, Geophysical fluid dynamics, Numerical methods for partial differential equations.

**Email** [khouider@uvic.ca](mailto:khouider@uvic.ca)<sup>1</sup>

**Phone** 250-721-7439 (Use only in case of emergency)

**Office** David Turpin Building A550

#### General Course Information

**Number of Units** 1.5

**Pre-requisites** One of M348, CSC 349A, permission of the department

#### Office Hours and Assistance

**Monday** 4:00 pm to 5:30 pm, DTB A550

**Thursday** 10:00 am to 12:00 pm, DTB A550

or By appointment (send email to book one)

**Math Club** Students in Undergraduate Mathematics and Statistics (SUMS) was founded in 2014 as the reincarnation of a previous undergraduate course union that had been inactive for a few years. Please see <http://www.uvic.ca/science/math-statistics/undergraduate/sums/index.php> for more information.

#### Learning Objectives

- Comprehensive understanding of state-of-the-art numerical methods used to solve real life problems in science and engineering
- Basic programming skills to develop own efficient and accurate computer codes and acquiring basic visualization tools
- Effective use of available software to tackle complex computing tasks in science and engineering
- Basic theoretical tools to assess performance (efficiency and accuracy) of basic numerical methods

---

<sup>1</sup>I may not respond to email after 6 pm. Will answer as soon as possible, typically within 24 hours.



## Course Material and Online Resources

**Textbook** Scientific Computing and Differential Equations, G. H. Golub and J. M. Ortega, Academic Press. (Recommended).

**Course Pack** Complementary (class) notes will be posted on course webpage

**Course webpage** Got to <http://www.uvic.ca/science/math-statistics/future-students/undergraduate/courses/index.php> then click on MATH449/549

**Matlab resources** Matlab primer, by K. Sigmon:

<http://www.math.ucsd.edu/~bdriver/21d-s99/matlab-primer.html>

You may also find a PDF version posted on the net just by googling “matlab primer”.

Online Documentation:

<http://www.mathworks.com/access/helpdesk/help/techdoc/matlab.shtml>

Other recommended texts:

Finite Difference Methods for Ordinary and Partial Differential Equations: Steady State and Time Dependent Problems, by Randall J. LeVeque, Society for Industrial and Applied Mathematics (SIAM), Philadelphia, Softcover / ISBN 978-0-898716-29-0 xiv+339 pages July, 2007.

**Scientific Computing World:** <https://www.scientific-computing.com/>

**Intro to Scientific Computing:** [https://www5.in.tum.de/lehre/vorlesungen/sci\\_comp/ws03/material/slides01.pdf](https://www5.in.tum.de/lehre/vorlesungen/sci_comp/ws03/material/slides01.pdf)

**Scientific Computing Jobs:** <https://ca.indeed.com/Scientific-Computing-jobs>

## Class Meetings

Class meets twice a week, Mondays and Thursdays from 8:30 to 9:50 am, in Cle C109.

## Topics and Course Schedule (Dates are approximate)

Week of	Lecture
11/9/17	Initial value problem: one step methods and multi-step methods
18/9/17	Interpolation, Stability, convergence and stiff equations, (Last day for adding courses that begin in the first term: 22/9/17)
25/9/15	Nonlinear equations and systems $F(X) = 0$
02/10/17	Cubic Splines and Numerical Integration
09/10/17	Boundary Value Problems: Finite differences (Thanksgiving, no class: 12/10/15)
16/10/17	Boundary Value Problems: Other methods (Shooting, projection and spline approximation)
23/10/15	Least Square Approximation (Last day for withdrawing from first-term courses without penalty of failure: 31/10/15)
30/10/15	Linear systems: factorization methods, Condition number, Eigenvalues, and Iterative methods, singular value decomposition and empirical orthogonal functions
06/10/17	Intro to Data Assimilation
13/11/17	Partial differential equations (Heat equation); Reading Break (No class on Monday)
20/11/17	Wave equation and extension to higher dimensions
27/11/17	Finite difference and finite volume method for transport and conservation laws.
04/11/17	Exam period begins. Class project presentations—maybe scheduled outside regular class hours



## Evaluation and Grading

### Homework assignments:

There will be homework assignments involving a computer programming component, roughly every two weeks. Students are free to use their favourite programming language. For those who do this for the first time, matlab is highly recommended for them as an easy and efficient way to learn. Sometimes matlab routines will be provided. A substantial part of the homework will be theoretical.

### Assigned Projects (required for Graduate Students:)

Students enrolled in Math 549 (i.e, graduate students) will be required to do a class project. The undergraduates are welcome to choose this option but it is not mandatory for them (see grading below). In the middle of the term or so, a list of project topics will be made available and each concerned student will be asked to choose her/his project from the list. They have to produce a paper (about 5 to 10 pages of taped text with a reasonable font size) and make a short presentation of about 15 minutes in front of the class, at the end of the semester.

### Final exam:

There will be a take home final exam, consisting of a set of comprehensive problems. Handed out during the last week of classes.

Your final percentage grade will be computed according to the following scheme.

### Undergraduate Students

Homework Assignments Bi-weekly	Final Last week of class
60%	40%

### Graduate Students

Homework Assignments Bi-weekly	Class project End of Nov.	Final Last week of class
40%	20%	40%

**Accessibility** Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the Centre for Accessible Learning (CAL: <http://www.uvic.ca/services/cal/selfserve/about/index.php>), formerly, the Resource Centre for Students with a Disability (RCSD) as soon as possible. The CAL staff are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations. The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.

**Grading** Percentage scores will be converted to letter grades and grade point values (for GPA calculation) according to the university-wide standard table (<http://web.uvic.ca/calendar2016-09/undergrad/info/regulations/grading.html>)

**Final Examination** Off-schedule final examinations (i.e., deferred examinations) are given only in accordance with the university policy as outlined in the Calendar. If you are unable to write a final examination due to illness, accident or family affliction, please refer to the following webpages for detailed instructions how to proceed:

- Undergraduate students: <http://www.uvic.ca/science/math-statistics/current-students/undergraduate/course-policies/index.php>
- graduate students <http://www.uvic.ca/science/math-statistics/current-students/graduate/course-policies/index.php>



Students are **strongly advised not to make plans for travel or employment during the final examination period** as special arrangements will not be made for examinations that conflict with such plans.

**Supplemental Examinations.** The Department of Mathematics and Statistics does not award 'E' grades or offer Supplemental Examinations in any of its courses.

## Policies and Ethics

**Attendance** The university Calendar states 'Students are expected to attend all classes in which they are enrolled.' (see <http://web.uvic.ca/calendar2016-09/undergrad/info/regulations/attendance.html#>). Our courses are conducted on that basis. If you miss an announcement (information concerning midterms, corrections to assignment, etc.) because you did not attend class, you must accept the consequences of not having learned of the change.

**Guidelines on Religious Observances** Where classes or examinations are scheduled on the holy days of a religion, students may notify their instructors, at least two weeks in advance, of their intention to observe the holy day(s) by absenting themselves from classes or examinations. Instructors will provide reasonable opportunities for such students to make up work or missed examinations.

**Missing work** Homework assignments must be completed on due date. If you know that you will be unable to complete a homework assignment on the due date, because of illness for example, please let me know (by email or in person) as soon as possible. Requests made only one or two days before the assignment due date may NOT be granted. If you miss up to two assignments with a justification, then the remaining ones will count for the totality of your homework grade.

**Academic Integrity** Academic integrity is intellectual honesty and responsibility for academic work that you submit individually or in groups. It involves commitment to the values of honesty, trust, and responsibility. It is expected that students will respect these ethical values in all activities related to learning, teaching, research, and service. Therefore, plagiarism and other acts against academic integrity are serious academic offences.

### **The responsibility of the institution**

Instructors and academic units have the responsibility to ensure that standards of academic honesty are met. By doing so, the institution recognizes students for their hard work and assures them that other students do not have an unfair advantage through cheating on essays, exams, and projects.

### **The responsibility of the student**

Plagiarism sometimes occurs due to a misunderstanding regarding the rules of academic integrity, but it is the responsibility of the student to know them. If you are unsure about the standards for citations or for referencing your sources, ask your instructor. Depending on the severity of the case, penalties include a warning, a failing grade, a record on the students transcript, or a suspension.

It is your responsibility to understand the University's policy on academic integrity: <http://web.uvic.ca/calendar2016-09/undergrad/info/regulations/academic-integrity.html#>

## How to Succeed in This Course

Work hard. Do the homework assignments on your own or in groups but make sure you understand and can reproduce every step on your own. Do not wait until last minute to do your homework. Read the textbook and any other class material provided to you. Come to class and take notes. Ask questions in class. Come to class prepared. Seek help when needed (come to office hours, ask a friend, send me an email).

