

GEOL 789M Computational Geodynamics

Spring 2015 Syllabus

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Instructor:

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Office hours: Upon appointment

Don't hesitate to send me an email at the address above. It is the most reliable way to contact me.

Lectures

Lectures in Plant Sciences PLS1117
Tuesday, Thursday, 12:30 – 1:45 PM

3-hour lab sessions will be held at a time TBD in CSS 3332.

Class Description and Outline

An introduction to the techniques used to model geodynamics processes. The focus is on understanding and applying techniques, not on proving their worth and programming. You will become conversant in Finite Element, Boundary Elements, and Finite Differences modeling, although we will not explore these topics the rigor expected by Applied Mathematics.

Class Materials

Text

There is no text that covers the material with the right focus for the class. Detailed class notes will be distributed. However, the following text is *required* for the class as it covers succinctly the basic numerical concepts that are the foundation of the techniques presented in class

Numerical Methods for Scientists and Engineers by R.W. Hamming (Dover, ISBN 9780486652412)

We will use Matlab extensively for the class. Of the many introductory books on matlab, I *recommend* the following

Matlab: Introduction with applications by A. Gilat (Wiley Publishers, 4th edition ISBN 9780470767856)

Additional information can be found in the following books

Geodynamic, By D.L. Turcotte and G. Schubert (Cambridge U. Press)

Introduction to Applied Mathematics, by G. Strang (Wellesley Cambridge Press)

A Multigrid Tutorial, by W. Briggs, V.E. Henson, and S.F. McCormick (SIAM)

Finite Element Procedures, by K.-J. Bathe (Prentice-Hall)

Whenever possible, lecture notes will be posted in advance to the class so that you can be better prepared for the lectures.

Website

A website for the class is available through the University ELMS/canvas system.

Follow the link to <https://elms.umd.edu/>, enter your directory ID and password.

If you are registered, you should be able to see GEOL 789M in your list of classes and access the website that way. Class notes and other materials will be posted on the website.

Software

The class is designed to give you some hands-on experience with several software. Matlab is going to be key to do most of the exercises in class. In addition, lab sessions will be organized to learn how to use Coulomb (Boundary Elements), Comsol Multiphysics (Finite Elements) and LAYER (Finite Elements too).

All these software are available in the Geodynamics lab. We are also working on installing them in the IT Computer lab in CSS 3332. We will try to hold a few lab sessions in that lab. Matlab is also installed in several other labs on campus (<http://www.oit.umd.edu/wheretogo>). If you intend to use Matlab intensively for your research, you might want to secure a license through your advisor or purchase a student version. For students in the department of Geology, contact Phil Piccoli.

It may be possible to use Octave or Scylab, which is advertised as free Matlab-like solution, but because the instructor has no experience with this software, he may not be able to help. Not every matlab functionality is available in these packages.

You are welcome to install *COMSOL Multiphysics*TM on any computer you have access to. As *COMSOL Multiphysics*TM is a commercial software, you should request the license from Pr. Montési.

Coulomb is a freely available software that is built on top to Matlab. It can be downloaded at <http://quake.usgs.gov/research/deformation/modeling/coulomb/index.html>

Grades and credits

I anticipate that a grade of A corresponds to 90 points, B to 80, C to 70, D to 60, and F below 60 points. Do not wait for the last week to contact me if you feel you need to improve on your performance!

Your grade will be determined from your performance on homeworks, lab reports, and a research project.

Homeworks (35pts)

There will be four homeworks. Each can be seen as a mini-project. You will need to write matlab scripts that use a specific numerical technique. You will be given one week to do the homework. Be aware that these may be quite lengthy. You should always save your work as a script and attach the script to the homework.

Labs (25pts)

We will organize five lab sessions each containing a tutorial for a specific software. The session will last ~3h at a mutually agreeable time and replace the lectures that week. You will be given a series of activities to perform with the software. A few questions and exercises will be asked as part of the tutorial, which will be collected. Depending on how we progress, you may need to finish the tutorial on your own time.

Project (40pts)

You are expected to work on a semester-long project. You may want to code a specific geodynamic problem, using one of our techniques, or solve it using the software provided by the class. The project needs to be relevant to your own research. However, this project needs to be significantly different from your main research project, and ideally use different numerical tools.

We will follow four steps to make sure your project is moving forward.

Introductory Essay (5pts)

You should write a short essay on how geodynamics modeling is used in your research field. This will be used to identify an appropriate topic to work on during the semester. The essay is due one week after the initial lecture on the principles of modeling.

Project Definition (5pts)

You should describe here of what your project will consist, the end goals of the modeling activity, and the methods and platform on which you intend to conduct the computation.

Project (20pts)

This will be the code or model that you generate. You will need to show me the actual script or model that you produce. We may need to sit down one-on-one to explore this model together and make sure it performs the tasks expected.

Oral Presentation (10pts)

You will present to the class the software or code that you produced and the main result of the project. A 15-minute presentation will take place during the last week of class.

Appeal of grades

You may appeal your grade on any exam prior to the posting of final course grades. In this as in all college courses, you should retain all graded items until proper grades have been recorded on your transcript.

CORE

This class is at graduate level. It does not fulfill CORE requirements.

Expectation of students***Prerequisite knowledge***

GEOL 789M will involve discussion of Applied Mathematics concepts. Comfort with Differential Equations (ideally Partial Differential Equations) and Linear Algebra are essential for this class. We will have time for only the most basic review of these topics. Also, your work will focus on applications to geodynamics problems that may not always be described in sufficient detail for someone new to the field. Therefore, it is *recommended* that you take an introduction to Geophysics and/or geodynamics course before GEOL 789M.

Academic integrity

The Student Honor Council observes that:

The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit <http://www.shc.umd.edu>.

To further exhibit your commitment to academic integrity, remember to sign the Honor Pledge on all examinations and assignments: "I pledge on my honor that I have not given or received any unauthorized assistance on this examination (assignment)."

You are allowed to discuss any assignment for this course with friends or even work on them in a group if you like. However any written report must be your own. *Do not write reports as a group or copy other people's assignments*: work submitted under your name must be exclusively your own. Any evidence of dishonesty on any exam or assignment will result in a referral to the Office of Student Conduct.

You are expected to take the Student Honor Pledge
<http://www.studentconduct.umd.edu/aca/honorpledge.html>

I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/examination

The pledge will be implied to all the assignments that you will submit for credit in this class.

Attendance

Attendance to the lectures is highly recommended, as provided by University Policy: *"The University expects each student to take full responsibility for his or her academic work and academic progress. The student, to progress satisfactorily, must meet all of the requirements of each course for which he or she is registered. Students are expected to attend classes regularly, for consistent attendance offers the most effective opportunity open to all students to gain command of the concepts and materials of their courses of study."*

The full attendance policy is available at <http://www.umd.edu/catalog/index.cfm/show/content.section/c/27/ss/1584/s/1540>. It provides several cases for which student absence is excused. Any request to be excused must be submitted in writing and with appropriate documentation.

Electronic devices

To avoid unnecessary distractions, cell phones be used only in case of emergency. Best is to turn them off. Usage of computers for note-taking is discouraged. If you choose to use a computer, do so in a manner that does not distract other students. You may have to stop if, for instance, people around you start to look at you screen instead of the lecture. Text messaging is forbidden as it leads to distractions.

Class evaluation

Every student is expected to complete a course evaluation using the [CourseEvalUM](#) system. This is YOUR chance to anonymously evaluate this class. Please use it! Here is from the Provost:

Your participation in the evaluation of courses through CourseEvalUM is a responsibility you hold as a student member of our academic community. Your feedback is confidential and important to the improvement of teaching and learning at the University as well as to the tenure and promotion process. CourseEvalUM will be open for you to complete your evaluations starting about two weeks prior to the last day of the term before exams begin. Please go directly to the website (www.courseevalum.umd.edu) to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing online evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations. You can access results at <http://www.CourseEvalUM.umd.edu>, the same link you use to submit your evaluations. Click [View Past Results](#) instead.

Use the CourseEvalUM URL and choose Take Evaluations to discover upcoming evaluation dates: www.CourseEvalUM.umd.edu

If you feel this course was outstanding, you may want to consider nominating your instructor for *Dean's Award for Excellence in Teaching* in the College of Computer, Mathematical and Physical Sciences. That award is given to one faculty member each year who demonstrates outstanding qualities as a teacher. Candidates are nominated by students. For information, call extension 5-2677.

If you have any issue with the class, I would appreciate you contact me so that we discuss them...

Special Needs

I will make every possible effort to accommodate your request for special accommodations, when justified. However, any requests must be submitted as soon as possible and no later than the end of the schedule adjustment period. *Do not wait!*

Students with Disabilities

If you have a documented disability, you should contact Disability Support Services at 0126 Shoemaker Hall. Each semester, students with documented disabilities should apply to DSS for accommodation request forms, which you can provide to your professors as proof of your eligibility for accommodations. The rules for eligibility and the types of accommodations a student may request can be reviewed on the DSS web site.

Religious Observances

The University System of Maryland policy provides that students should not be penalized because of observances of their religious beliefs, students shall be given an opportunity, whenever feasible, to make up within a reasonable time any academic assignment that is

missed due to individual participation in religious observances. *It is the responsibility of the student to inform the instructor of any intended absences for religious observances in advance.*

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