

GEOL680: Geodynamics

Tuesday/Thursday, 11:00 AM –12:15 PM, TBD

Syllabus

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Course Information

Meeting times and locations

Lectures :

Tuesdays and Thursdays, 11:00 AM – 12:15 PM, location SYM0209; Make-up classes may take place in CSS3256 (time TBD)

Labs

There are no labs associated with this class.

Credit

The course is offered for 3 Credits only.

Instructor

Dr. Laurent G. J. Montési

Associate Professor, Department of Geology

Office: CSS 3231

Tel: 5-7534

email: montesi@umd.edu

Office hours: TBD

Don't hesitate to send me an email at the address above. It is the most reliable way to contact me. I am happy to contact you outside of office hours. Send me an email to setup an appointment.

Website

A website for the class is available through the University ELMS/blackboard 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 GEOL680 in your list of classes and access the website that way (it may take 24h for ELMS to update).

The website will contain lecture notes as a PDF and, when appropriate, scanned book chapters or links to external websites. Lectures will be mostly conducted on a blackboard. Therefore, there complete transcripts of lectures will not be available on ELMS.

Text

Required:

- *Geodynamics 2nd edition*, by Donald L. Turcotte and Gerald Schubert, Cambridge University Press, 2012, ISBN-13: 978-0521666244

Although not required, the following are good resources to complement the class. These are fairly general texts so you may be able to access equivalent books. These are the ones I personally use.

- *Introduction to the Mechanics of a Continuous Medium*, by Lawrence E. Malvern, Prentice Hall, 1977, ISBN 978-0134876030
- *Elasticity, Fracture and Flow*, 3rd edition, by Jaeger, J. C., 1969, Springer, ISBN: 978-0412208904
- *A Treatise on the Mathematical Theory of Elasticity*, by A.E.H. Love, 2011, Dover books on Engineering, ISBN: 978-0486601748.
- *Fundamentals of Rock Mechanics*, 4th edition, by Jaeger, J. C., N. C. Cook, and R. Zimmerman, 2007, Wylie-Blackwell, ISBN: 978-0632057597.
- *An Introduction to Fluid Dynamics*, by Batchelor, G. K., 2000, Cambridge University Press. ISBN: 978-0521663960.

Reading assignments may also consist on selected articles from major scientific journals, such as the Annual Review of Earth and Planetary Sciences, Space Science Review, Planetary and Space Science, Earth and Planetary Science Letters, Icarus, Journal of Geophysical Research, Reviews of Geophysics, Science, and Nature, all of which can be accessed electronically through the UMD library system.

Material for discussion will be available as PDF on ELMS.

Course Requisites

Prerequisites

Permission of CMNS-Geology department
OR Must have completed MATH241, MATH462, and GEOL446

Recommended

Familiarity with MATLAB or MATHEMATICA

Technology

Occasionally, homework may require access to Internet tools, computer calculation and simple programming. All the problems can be solved with Matlab. Computer labs with the required software are available from OIT:

CSS Lab Hours (rooms 3330 & 3332):
Mon. through Thurs. open 8:00 am - 10:00 pm.
Fri. open 8:00 am - 5:00 pm
Closed on Sat. & Sun.

Method for Communication with Students Outside the Classroom

Email, send through the ELMS website will be the preferred means of communication with students outside the classroom. Please make sure that forwarding to any non-UMD email address is fully functional. Student are responsible for receiving the messages sent through ELMS.

Emergency Protocol

In the event of an emergency that closes the University for an extended period of time, lectures will be recorded by the instructor and posted on ELMS.

CORE/GED

This class does not fulfill CORE or GED requirement.

Course Description, Goals, and Expectation

General Description

The mechanics and dynamics of the Earth's interior and their applications to problems of Geophysics. This course considers several rheological descriptions of Earth materials (brittle, elastic, linear and nonlinear fluids, and viscoelastic) and emphasizes analytical solutions to simplified problem.

Learning Outcomes:

- Students will gain an in-depth understanding of the mechanics of the lithosphere, deformation, stress, fluid mechanics as it applies to the Earth's interior, including thermal convection. (GEOL - Geophysics)
- Students will derive analytical solution to simplified problems that reveal the fundamental characteristics of more complex geodynamical models and provide a toolkit to interpret geological observations (PC-4 Knowledge of advanced mathematics, typically including differential equations, linear algebra, complex variables, and discrete mathematics)
- Students will understand the relation between physics concept, especially continuum mechanics and (laminar) fluid dynamics, and geological observations (Interdisciplinary understanding)

Course Sequence (subject to change; makeup dates to be announced)

Date	Lecture topic	Homework Due
09/02/2014	Introduction	
09/04/2014	Continuum mechanics	
09/09/2014	Stress	
09/11/2014	Stress representations	1: Mathematical Refresher
09/16/2014	Strain	
09/18/2014	Geodesy	2: Stress
09/23/2014	Elasticity	
09/25/2014	Elastic moduli	3: Strain + dikes
09/30/2014	Tectonic symmetry	
10/02/2014	Elastic Dislocations	4: Elasticity
10/07/2014	Elastic Flexure	
10/09/2014	Plate flexure	

10/14/2014	Plate buckling	
10/16/2014	Examples of plate flexure	5: Plates
10/21/2014	Fluids	
10/23/2014	Navier Stokes Equation	
10/28/2014	Basic Flow Solutions	
10/30/2014	Stream Function	6: Asthenospheric flow
11/04/2014	Corner Flow	
11/06/2014	Rayleigh-Taylor	7: Isostatic rebound
11/11/2014	Heat Equation	
11/13/2014	Steady temperature solutions	
11/18/2014	Heat waves	
11/20/2014	Plate cooling	8: Heat
11/25/2014	Stefan problem	
11/27/2014	Thanksgiving	
12/02/2014	Convective instability	
12/04/2014	Plate tectonics	9: Thermal catastrophe
12/09/2014	Rock Rheology	
12/11/2014	Basic nonlinear flows	
12/16/2014	Nonlinear corner flow	

Expectation of students

GEOL 680 is a graduate level course in geology. A strong understanding of geology will be essential to identify pertinent questions for discussion and to fulfill class expectations. For that reason, permission of the instructor is required for students not enrolled in a graduate program in Geology.

We will derive several mathematical relations and describe their usage in Earth sciences. Familiarity with calculus and differential equations is essential to follow the course material.

Students should never hesitate to contact the instructor with any question or request for clarification. Email is the preferred contact methods. Posting on ELMS is equally acceptable, especially in a way that enables other students to listen in on the conversation. One-on-one meetings can be arranged, subject to instructor and student availability. Always request such a meeting by email

Grading Procedures

General instructions

As there is no TA for the class, students need to talk to me (Dr. Montesi) when they encounter any problem. Please don't be shy! I am here to help you, and I hope you will

come and seek help if you have any difficulty. I am not interested in correcting wrong or incomplete homework, so do come and ask me before it's too late!

You are welcome to discuss with each other the problem set but you need to write the answers yourself.

Problem sets will be available through the ELMS website. You can choose whether to submit your answers online or on papers. Grades and corrected versions will be posted online hopefully by the next class.

Precision and neatness is important for all the work done in this class. Any graph is expected to be done on a computer, or, if by hand, the student is expected to use rulers and protractors, as necessary. Axes must always be labeled by a caption and units must be specified whenever possible. Text answers must be argued. Numerical answers must be accompanied by an explanation of how the result was achieved. Points will be removed for insufficient explanations and for imprecise drawings.

Homeworks (60 pts)

Problem sets will be assigned most weeks, due the following week. See the detailed schedule for the current plan.

There will be no make-up homework because of the high frequency of assignments. You will receive a 0 mark for any late homework. However, at least one homework grade (the lowest) will be dropped to accommodate unavoidable difficulties. Request for delays must be received at least by 3 pm on the day before the homework is due, and be accompanied with a justification.

Geodynamics Virtual Conference (20 pts)

Each student will read up on a topic related to the class and produce a poster. The posters will be available on ELMS during the final week of class. Each student will post questions and answers to all the other posters. Both the presenters and the questioners will be evaluated.

Final exam (20 pts)

A take-home exam will be assigned during the Standard Final Examination assigned by the University. It will consist of a series of related problems that cover several portions of the course. I will not respond to requests for help for the final (although I will correct typos or missing information if they are found)

Grade calculation

Letter grades will be assigned based on the following scale. Standard rounding will be used, with final scores rounded to the nearest integer percentage, such that a 69.4 would be a D+ and a 69.5 a C-.

100-97%	A+	96-94%	A	93-90%	A-
89-87%	B+	86-84%	B	83-80%	B-
79-77%	C+	76-74%	C	73-70%	C-
69-67%	D+	66-64%	D	63-60%	D-
<60%	F				

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.

Course Procedures and Policies.

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 www.testudo.umd.edu/soc/atedasse.html. It provides several cases for which student absence is excused. Any request to be excused must be submitted in writing and with appropriate documentation.

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.*

If a homework due date falls on a religious holiday, students following that holiday will be allowed to turn in the homework by the following class time.

Students will be responsible to study the material missed during the religious holiday, using class handouts and the textbook. As always, these students are encouraged to post questions and requests for clarification on ELMS.

Inclement Weather

If the University Maryland is closed due to inclement weather, or a delayed opening overlaps with class time, the instructor will record a lecture and post it on ELMS. Any assignment due that day will be postponed until the following class. However, the schedule of subsequent assignments will remain unchanged, with the consequence that later homework may be separated by less than a week.

Absences due to illness

For every medically necessary absence from class, a reasonable effort should be made to notify the instructor in advance of the class. When returning to class, students must bring a note identifying the date of and reason for the absence, and acknowledging that the information in the note is accurate.

If a student is absent more than 3 time(s), the instructor may require documentation signed by a health care professional.

If a student is absent on a day an assignment is due, the student will need to post the assignment on ELMS or deliver it to the professor's mailbox in the Geology building by 3pm the same day. If a longer extension is needed, the student needs to contact the professor by email before 3pm, including a note identifying the date of and reason for the absence. Any request for extension that extends beyond the next scheduled class must be accompanied by documentation signed by a health care professional.

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 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

Electronic devices

To avoid unnecessary distractions during lectures, use of cell phones, including texting, is allowed only in case of emergency. If you choose to use a computer to take notes, do so in a manner that does not distract other students. You may have to stop if, for example, people around you start to look at your screen instead of the lecture. Text messaging is forbidden at all time during the lectures.

Class evaluation

Every student for any class in which more than five students are registered is expected to complete a course evaluation using the [CourseEvalUM](#) system. This is YOUR chance to anonymously evaluate this class. Please use it!

[CourseEvalUM](#) will be open for students at the end of the semester to complete their evaluations. Students can go directly to the <http://www.courseevalum.umd.edu> website to complete their evaluations. You will be alerted via your official University account. Students who complete evaluations for all of their courses in the previous semester (excluding summer), can access the posted results via Testudo's CourseEvalUM Reporting link for any course on campus that has at least a 70% response rate.

If less than 5 students are registered for GEOL680, class evaluations will be conducted as an anonymous survey on ELMS.

If you have any issue with the class, I would appreciate you contact me so that we discuss and hopefully resolve it.

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 Susquehanna Hall (<http://www.counseling.umd.edu/DSS/>). 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. Please provide evidence of eligibility before the end of September

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