EOSC250 — Geophysical Fields and Fluxes

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Course website: https://www.eoas.ubc.ca/academics/courses/eosc250

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Important basics: All the course materials will be on the course website listed above, don't bother looking on cavnas. We will use canvas for submission of assignemnts, homework, etc as well as for any online teaching if that becomes necessary. If you can't make office hours in any given week but need to see me, send me an email and we will find an alternative time on a case-by-case basis. I am teaching three courses this term so my flexibility in finding times may be limited.

Course outline: At the end of the course, you will be able to use scalar and vector calculus to model geophysical continuum problems. By continuum, we mean a medium in which physical quantities like mass, momentum and energy are not concentrated at points ('particles', billiard balls, . . .), but distributed spatially. This leads to the idea of a 'field' — a physical quantity whose value depends on position and time, like temperature in the atmosphere — while 'fluxes' describe the transport of such quantities. We will see how spatial variations in fields can be described by gradients, defined in terms of derivatives, and how these determine how a field behaves. We will focus on the physical meaning of calculus operations like differentiation and integration, and apply them to basic physical ideas like conservation of mass and energy to derive differential equation satisfied by geophysical fields.

- Introduction to fields and fluxes in earth sciences
- Review of calculus prerequisites
- Introduction to differential equations and separation of variables
- Simple physics-based differential equation models
- Physics of contuinua: densities
- Conservation laws: volume integrals and surface integrals
- Conservation laws: differential equation version and the divergence theorem
- Heat flow: Fourier's law and the gradient
- Steady heat flow: Poisson's equation and solution in simple geometries
- Point sources
- Force fields: conservative forces and the curl of a vector field
- Stokes' theorem
- Gravitation and electrostatics: Poisson's equation revisited

Grading: Provisionally, contributions to your final grade in this course will be allocated as follows:
Assignments 40 %
Mid-term exams 10 %
Final exam 40 %
Contribution in class, in-class quizzes, homework 10 %.
As the above suggests, you should try to attend class on a regular basis. If nothing else, you are likely to struggle to keep up with the course if you don't. Also, you will need to pre-read the notes for each class and typically answer a short set of questions about the reading ("homework" above)

Assignments: There will be somewhere between 4 and 6 assignments, posted on the course website (see above for the URL). **Note that assignments will contribute 40 % to your final grade, so take them seriously.** Assignments are due at 2pm (end of class) on the day indicated, and should be submitted in person or via the class canvas page. The usual UBC rules for self-assessment for emergency situations apply. If you miss an assignment, I will scale the remainder of your assignments where an emergency situation prevents you from completing an assignment; assignments will remain worth 40 % of your final mark. My recommendation would be to use the self-assessment option sparingly (well, only in case of genuine emergency), as it raises the stakes for the assignments that you do complete.
Also, note that I and the TA will not try to infer meaning in what you write: if we can't decipher your writing or work out the order in which it is meant to be read, you will get no marks. Please hand in logically structured and legibile material to maximize your score. Also, we will prioritize concise, correct answers over "writing something" when allocating points.
The usual rules regarding plagiarism also apply to this course. You can exchange ideas, but what you hand in has to be your own work. You cannot copy someone else's work. UBC also would like me to reference ChatGPT etc here — I doubt that ChaptGPT would be much use to you as it rarely gets technical answers spot-on. If you hand in strange answers that look like a computer wrote them for you, we will have a word with you and advise against it.

Homework: This is separate from assignments, and counts towards the 10 % homework / in-class quizzes etc mark. I am looking for effort put into homework, not for the right answers. Typically, homework will be set as part of pre-reading the notes that we will cover in a subsequent class. This is, unfortunately, not optional.

Midterms: We will have one midterm, date to be announced

Course materials: There is a complete set of course notes on the course website (see above). Useful supplementary text books are 'Div, grad, curl' by H. Schey, Schaum's outlines 'Vector Analysis' by M. Spiegel. You may also find standard texts on multivariable calculus (e.g., Stewart) and on differential equations (e.g., Boyce & DiPrima) useful.