Course Outline

Atmospheric and Oceanic Dynamics

General Information

Course #	ATOC 512
Section #	1
Term	Fall
Year	2020
Course pre-requisite(s)	Math 314, MATH 315
Course co-requisite(s)	None
Course schedule (day and time of class)	Tuesday, Thursday: 0235-0355 pm
Number of credits	3

Instructor Information

Name and Title	(Peter) M.K. Yau, professor
E-mail	Peter.yau@mcgill.ca
Virtual office hours	Appointment by email
Communication plan	Email or Zoom

TA Information (**if applicable**) TBA

Course Overview

Atmospheric & Oceanic Sciences : Introduction to the fluid dynamics of large-scale flows of the atmosphere and oceans. Stratification of atmosphere and oceans. Equations of state, thermodynamics and momentum. Kinematics, circulation, and vorticity. Hydrostatic and quasi-geostrophic flows. Brief introduction to wave motions, flow over topography, Ekman boundary layers, turbulence.

Instructor Message Regarding Remote Delivery

The remote learning context presents new challenges. The instructor will do his best to provide a supportive learning environment. There will be links posted in myCourses to Student-specific Guidelines for Remote Teaching and Learning and Remote Learning Resources to support the student's learning.

Learning Outcomes

By the end of this course students will learn the basics of atmospheric and oceanic dynamics and be able to solve problems in dynamics at the advanced undergraduate and beginning graduate level.

Instructional Method

The method of instruction is as follows:

a) Lectures will be posted on myCourses at least a day before the scheduled hours on Tuesdays and Thursdays. The lectures will contain exercises for you to discover some of the material yourself.

b) The scheduled hours on Tuesdays and on Thursdays will be devoted to Q&A sessions, discussion of more difficult concepts, and homework problems. If possible, these sessions will make use of Zoom online meetings; otherwise email discussion will be utilized.

Expectations for Student Participation

Although not mandatory, participation in the online Zoom sessions and/or email discussion sessions will help the student to learn the course material.

Recordings of Sessions

There will be no recording of sessions.

Required Course Materials

Reference text

Essentials of Atmospheric and Oceanic Dynamics by Geoffrey K. Vallis – available as ebook on Amazon.ca or ebooks.com.

Course Content

- **1. The Lagrangian time derivative**
- **2. Rotating coordinates and the Coriolis force**
- **3. The governing equations**
- **4. Vorticity, divergence, strain, streamfunctions and velocity potentials.**
- **5. The Navier-Stokes equation**
- **6. The Brunt-Vaisala (or buoyancy) frequency**
- **7. The Boussinesq equations**
- **8. The hydrostatic (or primitive) equations**
- **9. Geostrophy, thermal wind, and the gradient wind balance**
- **10. The Ekman layer and Ekman pumping**
- **11. The rotating shallow water equations**

- **12. Potential vorticity**
- **13. The quasigeostrophic equations**
- **14. Geostrophic adjustment and introduction to waves**

A description of the means of evaluation to be used in the course:

a) Homework: (4-5 for a total of 40%)

b) Three 1.5-hour tests (20% each). Each test covers the material since the previous test. The last test will be during the final exam period.

McGill Policy Statements

Language of Submission

"In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded. This does not apply to courses in which acquiring proficiency in a language is one of the objectives."

Academic Integrity

"McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures" (see McGill's guide to academic honesty for more information).