Course Outline

MATH3261/5285
Fluids, Oceans & Climate

Faculty of Science
School of Mathematics & Statistics

Semester 2, 2018

Cricos Provider Code: 00098G

1. Staff

Position	Name	Email	Consultation times and locations	Contact Details
Lecturer and Course Convenor	Dr Shane Keating	s.keating@unsw.edu.au	Available on Course Moodle site	Room 2081 Red Centre (Centre wing)

2. Course information

Units of credit: 6

Pre-requisite(s): 12 units of credit in Level 2 Maths courses including (MATH2011 or MATH2111) and (MATH2120 or MATH2130 or MATH2121 or MATH2221), or (both MATH2019 (DN) and MATH2089), or (both MATH2069 (DN) and MATH2099)

Teaching times and locations: (see http://www.timetable.unsw.edu.au)

Lectures (Weeks 1-9,10-12): Tuesday 12:00-14:00 Old Main Building OMB-229

Tutorials (Weeks 2, 4, 6, 8, 10, 12): Wednesday 15:00-17:00 Red Centre Room RC-4082

Labs (Week 1): Wednesday 15:00-17:00 Red Centre Room M020

Labs (Weeks 3, 5, 7, 9, 11): Wednesday 15:00-17:00 Red Centre Room G12A

2.1 Course summary

The mathematical modelling and theory of problems arising in the flow of fluids, the oceans, and the global climate; Cartesian tensors, kinematics, mass conservation, vorticity, Navier-Stokes equation; topics from inviscid and viscous fluid flow, gas dynamics, sound waves, water waves.

The dynamics underlying the circulation of the atmosphere and oceans are detailed using key concepts such as geostrophy, the deformation radius and the conservation of potential vorticity. The role of Rossby waves, shelf waves, turbulent boundary layers and stratification is discussed. The atmosphere-ocean system as a global heat engine for climate variability is examined using models for buoyant forcing, quasi-geostrophy and baroclinic instability.

2.2 Course aims

This course aims to provide a solid foundation for the analysis of geophysical flows that arise in the study of the ocean, the atmosphere, and their interactions in the climate system. This course introduces the fundamental equations of motion and conservation laws that govern the fluid dynamics of the atmosphere and the ocean. These equations are then systematically simplified and solved to quantitatively model key phenomena selected from the enormously rich variety of atmospheric and oceanic flows.

A key skill to be developed in this course is a physical understanding of fluid flows. Students will study and perform numerical experiments of simplified geophysical systems in order to see beyond the mathematical formalism and gain a robust understanding of the sometimes counter-intuitive behaviour of geophysical flows.

2.3 Course learning outcomes (CLO)

At the successful completion of this course you (the student) should be able to:

1. Model and describe common dynamical processes in the ocean and atmosphere using appropriately approximated dynamical equations and their solutions
2. Communicate discipline specific information in a written form with appropriate referencing

2.4 Relationship between course and program learning outcomes and assessments

Course Learning Outcome (CLO)	LO Statement	Related Tasks & Assessment
CLO 1	Model and describe common dynamical processes in the ocean and atmosphere using appropriately approximated dynamical equations and their solutions	Assessments, tutorials, labs, final exam
CLO 2	Communicate discipline specific information in a written form with appropriate referencing	Assessments, final exam

3. Strategies and approaches to learning

3.1 Learning and teaching activities

Lectures deliver the bulk of the course content and tutorials and computer labs include the opportunity for guided problem solving and experimentation. We believe that effective learning is best supported by a climate of inquiry in which students are actively engaged in the learning process. Hence this course is structured with a strong emphasis on problem-solving tasks in lectures, tutorials, labs, and assessments. Students are expected to devote the majority of their study time to the solving of such tasks.

New ideas and skills are first introduced in the lectures, and then students develop these skills by applying them to specific tasks in tutorials, labs and assessments. This course has a major focus on research, inquiry and analytical thinking as well as information literacy. An exam tests the ability of the students to integrate and apply the facts, concepts, and theory discussed in lectures.

4. Course schedule and structure

Week	Topic	Activity	Related CLO
Week 1	Fundamentals of Fluid Dynamics	Lab 1	1
Week 2	Fundamentals of Fluid Dynamics	Tutorial 1	1,2
Week 3	Rotation and stratification	Lab 2	1
Week 4	Rotation and stratification	Tutorial 2	1,2
Week 5	Shallow water model	Lab 3	1
Week 6	Shallow water model	Tutorial 3	1,2
Week 7	Geophysical fluid dynamics	Lab 4	1
Week 8	Geophysical fluid dynamics	Tutorial 4	1,2
Week 9	Atmospheric circulation	Lab 5	1
Week 10	Atmospheric circulation	Tutorial 5	1,2
Week 11	Ocean circulation	Lab 6	1
Week 12	Ocean circulation	Tutorial 6	1,2

5. Assessment

5.1 Assessment tasks

Throughout the course you will complete 4 assignments worth 50% of the final mark.

The 3rd year component (MATH3261) and the graduate component (MATH5285) may have different assessments: MATH5285 students will occasionally be asked to solve slightly longer and/or harder problems.

The assessment of the assignments is based on the written worked solutions that you submit according to the timetable below.

Marks will be awarded for approach, clarity of explanation, and, as required, appropriate referencing, not just the final answer.

All assignments must be submitted to the School of Mathematics and Statistics main office (Red Centre, 3rd floor) by 12 noon on the due date. Assignments handed late incur a 10% reduction in the mark per late day. Assignments handed in more than 7 days late will not be marked.

Assessment task	Release date	Due date	Weight
Assessment 1: Assignment 1	Tuesday week 4	Tuesday week 6	12.5%
Assessment 2: Assignment 2	Tuesday week 6	Tuesday week 8	12.5%
Assessment 3: Assignment 3	Tuesday week 8	Tuesday week 10	12.5%
Assessment 4: Assignment 4	Tuesday week 10	Tuesday week 12	12.5%

5.2 Final exam

The final exam will test all topics covered in the course. It will be worth 50% of the final mark.

Further information

UNSW grading system: https://student.unsw.edu.au/grades

UNSW assessment policy: https://student.unsw.edu.au/assessment

6. Academic integrity, referencing and plagiarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.

Further information about referencing styles can be located at https://student.unsw.edu.au/referencing

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits**:** honesty, trust, fairness, respect, responsibility and courage.[1] At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.

Further information about academic integrity and **plagiarism** can be located at:

- The *Current Students* site https://student.unsw.edu.au/plagiarism*,* and
- The *ELISE* training site http://subjectguides.library.unsw.edu.au/elise/presenting

The *Conduct and Integrity Unit* provides further resources to assist you to understand your conduct obligations as a student: https://student.unsw.edu.au/conduct.

7. Readings and resources

Recommended textbooks

You are not required to buy a textbook for this course: the lecture notes are complete. However, if you would like another reference, here are some excellent textbooks on fluid dynamics and atmosphere-ocean science.

Atmospheric and Oceanic Fluid Dynamics: Fundamentals and Large-Scale Circulation
G.K. Vallis

- Excellent and comprehensive text on geophysical fluid dynamics and large-scale circulation of the atmosphere and ocean.

Atmosphere, Ocean, and Climate Dynamics: an Introductory Text
J. Marshall and R.A. Plumb

- Good mid-level text based on undergraduate course taught at MIT.

Introduction to Geophysical Fluid Dynamics
B. Cushman-Roisin

- Introductory level text, particularly good for physical understanding.

8. Administrative matters

For information about Additional Assessments and other Administrative matters relating to your course please consult the School of Mathematics and Statistics web page at http://www.maths.unsw.edu.au/currentstudents/assessment-policies

[1] International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013.

Additional support for students

- The Current Students Gateway: https://student.unsw.edu.au/
- Academic Skills and Support: https://student.unsw.edu.au/academic-skills
- Student Wellbeing, Health and Safety: https://student.unsw.edu.au/wellbeing
- Disability Support Services: https://student.unsw.edu.au/disability-services
- UNSW IT Service Centre: https://www.it.unsw.edu.au/students/index.html