UNSW Course Outline

MATH3261 Fluids, Oceans and Climate - 2024

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General Course Information

Course Code : MATH3261
Year : 2024
Term : Term 3
Teaching Period : T3
Is a multi-term course? : No
Faculty : Faculty of Science
Academic Unit : School of Mathematics & Statistics
Delivery Mode : Multimodal
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course introduces the mathematical modelling and theory of problems arising in the flow of fluids in the Earth's climate system. During lectures and tutorials, 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, turbulent boundary layers and stratification are also 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.

Course Aims

The aim of this course is 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.

Relationship to Other Courses

MATH5285 is the postgraduate version of MATH3261. The course content is the same, but students enrolled in MATH5285 will be asked to complete longer and/or harder assignments.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Demonstrate in-depth knowledge of the dynamical processes in the ocean and atmosphere.
CLO2 : Implement idealized and realistic computational models of atmosphere/ocean dynamics.
CLO3 : Apply appropriately approximated dynamical equations and their solutions to real-world systems including the atmosphere and ocean.
CLO4 : Communicate discipline specific information in a written form with appropriate referencing.

Course Learning Outcomes	Assessment Item
CLO1 : Demonstrate in-depth knowledge of the dynamical processes in the ocean and atmosphere.	• Final Exam • Assignments • Tutorial Presentation
CLO2 : Implement idealized and realistic computational models of atmosphere/ocean dynamics.	• Final Exam • Assignments
CLO3 : Apply appropriately approximated dynamical equations and their solutions to real-world systems including the atmosphere and ocean.	• Final Exam • Assignments
CLO4 : Communicate discipline specific information in a written form with appropriate referencing.	• Tutorial Presentation • Final Exam • Assignments

Learning and Teaching Technologies

Moodle - Learning Management System | Blackboard Collaborate

Learning and Teaching in this course

Pre-recorded videos and 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 videos and 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.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Final Exam Assessment Format: Individual	50%	Start Date: Final exam schedule will be posted later in the term. Due Date: Not Applicable
Assignments Assessment Format: Individual	45%	Start Date: Not Applicable Due Date: Assignments are due by noon on Monday of Weeks 4, 7, and 10.
Tutorial Presentation Assessment Format: Individual	5%	Start Date: Not Applicable Due Date: Students must present solutions in one of the online tutorials held in Weeks 2, 4, 8 or 10.

Assessment Details

Final Exam

Assessment Overview

The final exam is designed to summarise your learning and problem-solving skills on all topics delivered across the term, including material from lectures, tutorials and computer labs. The exam is typically 2hrs and consists of three longer questions requiring detailed mathematical calculations or derivations and one question short written or sketched answer responses. The examination will occur during the official university examination period. Feedback is available through inquiry with the course convenor.

Course Learning Outcomes

- CLO1 : Demonstrate in-depth knowledge of the dynamical processes in the ocean and atmosphere.
- CLO2 : Implement idealized and realistic computational models of atmosphere/ocean dynamics.
- CLO3 : Apply appropriately approximated dynamical equations and their solutions to real-world systems including the atmosphere and ocean.
- CLO4 : Communicate discipline specific information in a written form with appropriate referencing.

Detailed Assessment Description

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

Submission notes

The final exam will be a timed, in-person assessment

Assignment submission Turnitin type

This is not a Turnitin assignment

Generative AI Permission Level

Not Applicable

Generative AI is not considered to be of assistance to you in completing this assessment. If you do use generative AI in completing this assessment, you should attribute its use.
For more information on Generative AI and permitted use please see here.

Assignments

Assessment Overview

There are three assignments due in weeks 4, 7 and 10 worth 15% each. You will have 2-3 weeks to complete each assignment and provide written worked solutions. Marks will be awarded for approach, clarity of explanation, and, as required, appropriate referencing, not just the final answer. Detailed written feedback will be provided through Moodle, and additional feedback is available through inquiry with the course convenor. .

Course Learning Outcomes

- CLO1 : Demonstrate in-depth knowledge of the dynamical processes in the ocean and atmosphere.
- CLO2 : Implement idealized and realistic computational models of atmosphere/ocean dynamics.
- CLO3 : Apply appropriately approximated dynamical equations and their solutions to real-world systems including the atmosphere and ocean.
- CLO4 : Communicate discipline specific information in a written form with appropriate referencing.

Detailed Assessment Description

Throughout the course you will complete written assignments worth 45% of the final mark. Each assignment will be worth 15%. An additional 5% will be awarded based on participation in the presentation of assignment solutions in tutorials in Weeks 4, 8, or 10. Participation in these tutorials is a requirement of the course. Participation may be in-person, online, or a mixture --- but it must be *active* participation.

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 online via Moodle 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 5 days late will not be marked.

Submission notes

Submit online via Moodle.

Assignment submission Turnitin type

This is not a Turnitin assignment

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

Tutorial Presentation

Assessment Overview

In the tutorials in weeks 4, 8 and 10, students will be asked to present their solutions to the assignments. You will be expected to present in at least one of the tutorials. Marks will be awarded for clarity of discussion and presentation. Feedback is provided during the tutorial.

Course Learning Outcomes

- CLO1 : Demonstrate in-depth knowledge of the dynamical processes in the ocean and atmosphere.

- CLO4 : Communicate discipline specific information in a written form with appropriate referencing.

Detailed Assessment Description

An additional 5% will be awarded based on participation in the presentation of assignment solutions in tutorials in Weeks 4, 8, or 10. Participation in these tutorials is a requirement of the course. Participation may be in-person, online, or a mixture --- but it must be *active* participation.

Assignment submission Turnitin type

This is not a Turnitin assignment

Generative AI Permission Level

Not Applicable

Generative AI is not considered to be of assistance to you in completing this assessment. If you do use generative AI in completing this assessment, you should attribute its use.
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General Assessment Information

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 9 September - 15 September	Assessment	Assignment 1 posted.
	Lecture	Week 1 lectures: Rotating, stratified, and thin
	Online Activity	Python lab 1: Blinking vortex flow
Week 2 : 16 September - 22 September	Lecture	Week 2 lectures: Fluid fundamentals.
	Online Activity	Tutorial 1: Warm-up exercises
Week 3 : 23 September - 29 September	Lecture	Week 3 lectures: Geophysical fluid dynamics
	Online Activity	Python lab 2: Tracer advection
Week 4 : 30 September - 6 October	Assessment	Assignment 1 due. Assignment 2 posted.
	Lecture	Week 4 lectures: Shallow water model
	Online Activity	Tutorial 2: Solutions to Assignment 1
Week 5 : 7 October - 13 October	Lecture	Week 5 lectures: Linear wave theory
	Online Activity	Python lab 3: Water waves
Week 6 : 14 October - 20 October	Lecture	FLEXIBILITY WEEK: No lectures, labs, or tutorials.
Week 7 : 21 October - 27 October	Assessment	Assignment 2 due. Assignment 3 posted.
	Lecture	Week 7 lectures: Shallow water waves.
	Online Activity	Python lab 4: Rossby waves.
Week 8 : 28 October - 3 November	Lecture	Week 8 lectures: Quasigeostrophic theory.
	Online Activity	Tutorial 3: Solutions to Assignment 2.
Week 9 : 4 November - 10 November	Lecture	Week 9 lectures: Baroclinic instability.
	Online Activity	Python lab: Baroclinic instability.
Week 10 : 11 November - 17 November	Assessment	Assignment 3 due.
	Lecture	Week 10 lectures: Ocean circulation.
	Online Activity	Tutorial 4: Solutions to Assignment 3.

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

General Schedule Information

This is a blended learning course, with course materials presented in a combination of pre-recorded videos and lectures that you can attend in person or online via Blackboard. Lectures will also be recorded and made available for you to watch in your own time. We will also meet once per week online for two hours at the times indicated below, alternating between Python labs and tutorials/discussion sessions, plus individual consultations as needed.

Lectures (Weeks 1-5, 7-10):

Tuesday 16:00-18:00, Colombo-C

Thursday 10:00-11:00, ME-102

Computer labs (Weeks 1, 3, 5, 7, 9):

Thursday 16:00-18:00, Online via Blackboard

Tutorials (Weeks 2, 4, 8, 10):

Thursday 16:00-18:00, Online via Blackboard

NOTE: Week 6 will be a flexibility week. No lectures, tutorials or labs will be held in Week 6.

Course Resources

Recommended 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.

Course Evaluation and Development

Thanks to some of the material being delivered via pre-recorded videos, the lecture session will be interactive, with ample time for discussion with and feedback from students.

Formal feedback will be gathered at the end of the course, via the MyExperience survey. The course material and learning strategies have been incrementally improved in response to these surveys. This year, more time will be dedicated to going through worked solutions, which was the primary suggested imporvement from last year's survey.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
	Jan Zika					No	Yes

Other Useful Information

Academic Information

Upon your enrolment at UNSW, you share responsibility with us for maintaining a safe, harmonious and tolerant University environment.

You are required to:

- Comply with the University's conditions of enrolment.
- Act responsibly, ethically, safely and with integrity.
- Observe standards of equity and respect in dealing with every member of the UNSW community.
- Engage in lawful behaviour.
- Use and care for University resources in a responsible and appropriate manner.
- Maintain the University's reputation and good standing.

For more information, visit the UNSW Student Code of Conduct Website.

Academic Honesty and Plagarism

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. 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, plagiarism and the use of AI in assessments can be located at:

- The Current Students site,
- The ELISE training site, and
- The Use of AI for assessments site.

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

Submission of Assessment Tasks

Penalty for Late Submissions

UNSW has a standard late submission penalty of:

- 5% per day,
- for all assessments where a penalty applies,
- capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, and
- no permitted variation.

Any variations to the above will be explicitly stated in the Course Outline for a given course or assessment task.

Students are expected to manage their time to meet deadlines and to request extensions as early as possible before the deadline.

Special Consideration

If circumstances prevent you from attending/completing an assessment task, you must officially apply for special consideration, usually within 3 days of the sitting date/due date. You can apply by logging onto myUNSW and following the link in the My Student Profile Tab. Medical documentation or other documentation explaining your absence must be submitted with your application. Once your application has been assessed, you will be contacted via your student email address to be advised of the official outcome and any actions that need to be taken from there. For more information about special consideration, please visit: https://student.unsw.edu.au/special-consideration

Important note: UNSW has a “fit to sit/submit” rule, which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit to do so and cannot later apply for

Special Consideration. This is to ensure that if you feel unwell or are faced with significant circumstances beyond your control that affect your ability to study, you do not sit an examination or submit an assessment that does not reflect your best performance. Instead, you should apply for Special Consideration as soon as you realise you are not well enough or are otherwise unable to sit or submit an assessment.

Faculty-specific Information

Additional support for students

- The Current Students Gateway
- Student Support
- Academic Skills and Support
- Student Wellbeing, Health and Safety
- Equitable Learning Services
- UNSW IT Service Centre
- Science EDI Student Initiatives, Offerings and Guidelines

School-specific Information

School of Mathematics and Statistics and UNSW Policies

The School of Mathematics and Statistics has adopted a number of policies relating to enrolment, attendance, assessment, plagiarism, cheating, special consideration etc. These are in addition to the Policies of The University of New South Wales. Individual courses may also adopt other policies in addition to or replacing some of the School ones. These will be clearly notified in the Course Initial Handout and on the Course Home Pages on the Maths Stats web site. Students in courses run by the School of Mathematics and Statistics should be aware of the School and Course policies by reading the appropriate pages on the web site starting at: The School of Mathematics and Statistics assessment policies

The School of Mathematics and Statistics will assume that all its students have read and understood the School policies on the above pages and any individual course policies on the Course Initial Handout and Course Home Page. Lack of knowledge about a policy will not be an excuse for failing to follow the procedure in it.

Special Consideration - Short Extension Policy

The School of Mathematics and Statistics has carefully reviewed its range of assignments and projects to determine their suitability for automatic short extensions as set out by the UNSW

Short Extension Policy. Upon comprehensive examination of our course offerings that incorporate these types of assessments, we have concluded that our current deadline structures already accommodate the possibility of unexpected circumstances that may lead students to require additional days for submission. Consequently, the School of Mathematics and Statistics has decided to universally opt out of the Short Extension provision for all its courses, having pre-emptively integrated flexibility into our assessment deadlines. The decision is subject to revision in response to the introduction of new course offerings. Students may still apply for Special Consideration via the usual procedures.

Computing Lab

The main computing laboratory is room G012 of the Anita B.Lawrence Centre (formerly Red Centre). You can get to this lab by entering the building through the main entrance to the School of Mathematics (on the Mezzanine Level) and then going down the stairs to the Ground Level. A second smaller lab is Room M020, located on the mezzanine level through the glass door (and along the corridor) opposite the School's entrance.

For more information, including opening hours, see the computing facilities webpage. Remember that there will always be unscheduled periods when the computers are not working because of equipment problems and that this is not a valid excuse for not completing assessments on time.

School Contact Information

Please visit the School of Mathematics and Statistics website for a range of information.

For information on Courses, please go to “Student life & resources” and either Undergraduate and/or Postgraduate and respective "Undergraduate courses" and "Postgraduate courses" for information on all course offerings.

All school policies, forms and help for students can be located by going to the "Student Services" within “Student life & resources” page. We also post notices in "Student noticeboard" for your information. Please familiarise yourself with the information found in these locations. If you cannot find the answer to your queries on the web you are welcome to contact the Student Services Office directly.

Undergraduate

E: ug.mathsstats@unsw.edu.au

P: 9385 7011 or 9385 7053

Postgraduate

E: pg.mathsstats@unsw.edu.au

P: 9385 7053

Should we need to contact you, we will use your official UNSW email address of in the first instance. **It is your responsibility to regularly check your university email account. Please use your UNSW student email and state your student number in all emails to us.**