

Atmospheric Dynamics or Dynamics and Synoptic Meteorology
EAS 4655 or EAS 6502 (3 Credit Hours)
Fall 2021

Lecture Meeting Times: MW 9:30 – 10:45 AM

Lecture Location: L1175 Ford ES&T

Instructor: Dr. Zachary Handlos

Office: 1251 Ford ES&T Building

Office Hours: 3:15-4:15 PM TR and 2-3 PM W or via appointment (in-person or virtual)

Email: zachary.handlos@eas.gatech.edu

*****Statement about Wearing Masks*****

You are **strongly encouraged** to wear a mask within campus buildings **regardless of your vaccination status**.

*****COVID-19 Statement*****

The best way to protect yourself from COVID-19 is to get vaccinated; more information about vaccination opportunities on campus can be found here: <https://health.gatech.edu/coronavirus/vaccine>

If you are experiencing a fever (i.e., temperature over 100°F), cold-like symptoms, sore throat, dry cough, flu or any other type of illness, **DO NOT COME TO CLASS IN-PERSON**. Please inform the course instructor ASAP if you will miss class due to illness.

COVID-19 campus guidelines: <http://health.gatech.edu/coronavirus/campus-guidelines>

Please consider participating in asymptomatic COVID-19 testing: <https://mytest.gatech.edu/>

EAS 4655 Course Prerequisites:

- PHYS 2212 (ask Dr. Handlos about taking this course if you have not finished this course yet)
- MATH 2551
- MATH 2552

EAS 6502 Course Prerequisites:

- MATH 2552

Required Textbooks

- Holton, J. R. and G. J. Hakim (2012), *An Introduction to Dynamic Meteorology*; ISBN-13: 978-0123848666.
- Martin, J. E. (2006), *Mid-Latitude Atmospheric Dynamics: A First Course*; ISBN-13: 9780470864654.

Course Description

At the heart of all weather, climate and other atmospheric phenomena on Earth is that of fluid dynamics. It is dynamical theory that can describe the complexity of the atmosphere, how to best observe atmospheric motions and how to best predict such motion. It is vital that an atmospheric scientist develops an appreciation and sufficient understanding of the fluid atmosphere for their career, whether they pursue an academic path, work within the government sector focusing on protecting citizens from inclement weather and climate events or even that of the private sector, where an understanding of atmospheric motion can dictate the company and corporate logistics.

If you are enrolled within this course, you will likely have had some experience with weather and climate, whether it be from taking an introductory atmospheric science course or simply experiencing such phenomena within your daily life. This course will take your understanding of the atmosphere to the “next level” by helping you learn how to apply calculus and physics towards understanding of the fundamental laws and principles that govern the Earth’s atmosphere. While not the primary focus of this course, such dynamical concepts can readily be applied to Earth’s oceans as well as similar atmospheric and oceanic fluid bodies on other planets, moons and exoplanets.

Course Topics

- 1) Calculus review, including Lagrangian vs. Eulerian derivatives
- 2) Flow Kinematics
- 3) Fundamental forces
- 4) Mass, Momentum and Energy
- 5) Scale Analysis
- 6) Vertical Coordinate Systems
- 7) Circulation and Vorticity

Earth and Atmospheric Science Core Skill Development

The School of Earth and Atmospheric Sciences at Georgia Tech strives to meet several learning standards for all students within the undergraduate and graduate programs. These standards, and how they will be achieved in this course, are listed below:

- 1) Demonstrate **quantitative understanding** atmospheric dynamics theory
- 2) Develop **critical analysis** and **problem-solving skills** through course participation activities and assignments
- 3) Gain **practical experience** with **analyzing, interpreting and communicating** atmospheric dynamics material
- 4) Gain appreciation of the **interdisciplinary** nature of fluid dynamics
- 5) **Increase breadth of knowledge** within meteorology by developing foundational understanding of atmospheric dynamics theory

Grading – EAS 4655 Students Only

Your grade in this course will be based on your performance within the following categories:

- Option 1 – 60% of grade
 - Take-Home Quizzes (5 quizzes) – 30% of grade
 - Individual Quizzes (5 quizzes) – 30% of grade
- Option 2 – 60% of grade
 - Take-Home Quizzes (top 3 of 5 quizzes) – 18% of grade
 - Individual Quizzes (top 3 of 5 quizzes) – 18% of grade

- Cumulative Final Exam (drop 2 lowest quiz scores and replace with final exam) – 24% of grade
- Lecture Summaries – 20% of grade
- Participation Practice Problems – 20% of grade

Grading – EAS 6502 Students Only

Your grade in this course will be based on your performance within the following categories:

- Option 1 – 60% of grade
 - Take-Home Assignments (5 assignments) – 30% of grade
 - Quizzes (5 quizzes) – 30% of grade
- Option 2 – 60% of grade
 - Take-Home Assignments (top 3 of 5 assignments) – 18% of grade
 - Quizzes (top 3 of 5 quizzes) – 18% of grade
 - Cumulative Final Exam (drop 2 lowest take-home assignments and quiz scores and replace with final exam) – 24% of grade
- Synoptic Labs – 20% of grade
- Lecture Summaries – 10% of grade
- Participation Practice Problems – 10% of grade

Practice Participation Problems

Throughout the semester, in-class practice problems will be assigned. These are to be completed to the best of your ability and will help students with preparing for take-home assignments and quizzes. The best way to learn how to solve dynamics problems is to practice a lot!

Take-Home Assignments

Take-Home assignments are essentially problem sets that students will work on outside of class. The in-class practice problems will help you prepare for some of the take-home assignment problems. Due dates for each take-home assignment will be discussed in class.

Note that, if you opt to take the cumulative final exam and perform well, you may drop your two lowest take-home assignment scores and partially substitute in the final exam. The remainder of the final exam grade would then replace your two lowest quiz scores (see next section).

Quizzes

Quizzes will assess your understanding of recently discussed course material. These will be completed in class, typically on Wednesdays (quiz dates subject to change).

Note that, if you opt to take the cumulative final exam and perform well, you may drop your two lowest quiz scores and partially substitute in the final exam. The remainder of the final exam grade would then replace your two lowest take-home assignments (see previous section).

Cumulative Final Exam

The cumulative final exam is “optional.” You can choose to either take the final exam and potentially replace your two lowest take-home assignments AND two lowest quizzes, or you can opt out and keep all assignment and quiz scores. Furthermore, if you take the final exam and do not perform well, all assignment and quiz scores will be kept as if you had decided to drop the final exam. The final exam will

be administered on the final exam date for this course in person (subject to change depending on COVID-19 situation).

Lecture Summaries

Each week, one or more students will create a document or video summarizing lecture material from class. The summary can either be in one of two formats: a) create a summary no longer than 2 pages single-spaced to post to Canvas, or b) create a recording no longer than 10 minutes explaining the key concepts from lecture that week; recordings can be made using Bluejeans and the “share screen” function, and a link or video must be sent to the instructor for all to view.

Each student will complete 2 lecture summary assignments.

Synoptic Labs – EAS 6502 Students Only!

For any students enrolled in EAS 6502, you will complete an additional 4 lab assignments. These will help students improve their understanding of synoptic meteorology and the application of dynamics material to “real-world” meteorological phenomena.

Grading Scale

The **grading** for the course is as follows:

Grade	Percentage
A	100 – 90
B	89.99 – 80
C	79.99 – 70
D	69.99 – 60
F	<60

Depending on the distribution of student scores at the end of the course, the scores may be curved to reflect the scale described above (**up to the instructor’s discretion**).

Late Work Policy

An assignment turned in late will be deducted 20% of its total grade for each day it is late after submitted. This policy will only be waived in extreme circumstances (e.g., serious illness, family emergency, COVID-19). You must contact me at least 24 hours prior to the due date of any assignment if you anticipate any issues with submitting it on time.

Course Canvas Page

All relevant materials to this course will be posted on Canvas. The instructor will utilize Google Jamboard, rather than the white board within the classroom (unless necessary) to write out any handwritten notes; links to these will be posted on Canvas.

Cheating

Cheating will not be tolerated in this course. Cheating includes the following: 1) copying answers from another student, 2) using unauthorized resources to study for course quizzes and assessments, which includes the use of electronic devices, 3) posting solutions to course quizzes and assessments on the Internet, and/or 4) any other activity that would be considered “academic misconduct”.

To summarize, do not cheat; it is not worth jeopardizing your future because you wanted to look good doing something that you need to improve upon.

Academic Honor Code

The instructor and students are expected to abide by Georgia Tech's Academic Honor Code. Plagiarism of any kind (including the reproduction of materials found on the internet) is strictly prohibited and will be reported to the Office of Dean of Students for academic misconduct. The complete text of the Academic Honor Code may be found at:

<https://policylibrary.gatech.edu/student-affairs/academic-honor-code>

Access and Accommodations:

If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Office of Disability Services to explore reasonable accommodations.

The Office of Disability Services can be contacted by:

Phone: **404-894-2563**

Email: dsinfo@gatech.edu

Website: <https://disabilityservices.gatech.edu/>

Resources:

Academic Support

- [Center for Academic Success](#)
 - [1-to-1 tutoring](#)
 - [Peer-Led Undergraduate Study \(PLUS\)](#)
 - [Academic coaching](#)
- Residence Life's [Learning Assistance Program](#)
- [OMED Educational Services](#) - Group study sessions and tutoring programs
- [Communication Center](#) - Individualized help with writing and multimedia projects
- [Academic advisors](#) for your major

Personal Support

Georgia Tech Resources

- The [Office of the Dean of Students](#) | **404-894-6367** | 2nd floor, Smithgall Student Services Building; You also may request assistance [here](#)
- [Counseling Center](#) | **404-894-2575** | Smithgall Student Services Building 2nd floor
 - Services include short-term individual counseling, group counseling, couples counseling, testing and assessment, referral services, and crisis intervention.
 - *Students in crisis may walk in during business hours (8am-5pm, Monday through Friday) or contact the counselor on call after hours at 404-894-2204.*
- [Students' Temporary Assistance and Resources \(STAR\)](#)
 - Can assist with interview clothing, food, and housing needs.
- [Stamps Health Services](#) | **404-894-1420**
- [OMED Educational Services](#) | **404-894-3959**
- [Women's Resource Center](#) | **404-385-0230**
- [LGBTQIA Resource Center](#) | **404 385 4780**
- [Veteran's Resource Center](#) | **404-385-2067**
- [Georgia Tech Police](#) | **404-894-2500**

National Resources

- The [National Suicide Prevention Lifeline](#) | 1-800-273-8255
 - Free and confidential support 24/7 to those in suicidal or emotional distress
- The [Trevor Project](#)
 - Crisis intervention and suicide prevention support to members of the LGBTQ+ community and their friends
 - Telephone | **1-866-488-7386** | 24 hours a day, 7 days a week
 - [Online chat](#) | 24 hours a day, 7 days a week
 - Text message | Text “START” to **687687** | 24hrs day, 7 days a week

List of Course Topics*

Week	Topics	Course Readings and Due Dates
Week 1 (8/23/21 – 8/27/21)	Calculus, Vectors, Taylor Series Expansion, Other Math Review	Martin: Ch. 1 Holton: Ch. 1.1 and 1.2
Week 2 (8/30/21 – 9/3/21)	Lagrangian vs. Eulerian derivatives; Advection	Martin: Ch. 1.2.4 Holton: Ch. 2.1
Week 3 (9/6/21 – 9/10/21)	2D Flow Kinematics	Martin: Ch. 1.4 Holton: n/a Take-Home Assignment 1 Due (9/7/2021)
Week 4 (9/13/21 – 9/17/21)	Fundamental Forces – Gravity, PGF; Apparent Gravity	Martin: Ch. 2.1, 2.2 Holton: Ch. 1.4 Quiz 1 (9/13/2021) EAS 6502 ONLY – Lab 1 Due (9/17/2021)
Week 5 (9/20/21 – 9/24/21)	Fundamental Forces – PGF, Friction; Apparent Forces – Centrifugal, Coriolis	Martin: Ch. 2.1, 2.2 Holton: Ch. 1.4, 1.5 Take-Home Assignment 2 Due (9/24/2021)
Week 6 (9/27/21 – 10/1/21)	Atmospheric Mass; Hydrostatic Balance; Thickness Equation; Mass Continuity	Martin: Ch. 3.1, 3.2.2 Holton: Ch. 1.6 Quiz 2 (9/29/2021)
Week 7 (10/4/21 – 10/8/21)	Introduction to Isobaric Coordinates; Mass Continuity in Isobaric Coordinates; Start Equations of Motion	Martin: Ch. 3.1, 3.2, 4.1 Holton: Ch. 1.6, 2.5, 3.1 EAS 6502 ONLY – Lab 2 Due (10/8/2021)
Week 8 (10/11/21 – 10/15/21)	FALL BREAK (10/11-10/12); Equations of Motion Continued	Martin: Ch. 3.2, 4.1 Holton: Ch. 3.1 Take-Home Assignment 3 Due (10/15/2021)
Week 9 (10/18/21 – 10/22/21)	Equations of Motion – Spherical Coordinates; Scale Analysis	Martin: Ch. 3.2 Holton: Ch. 2.2, 1.3 Quiz 3 (10/20/2021)
Week 10 (10/25/21 – 10/29/21)	Geostrophic Balance; Geostrophic vs. Ageostrophic Wind	Martin: Ch. 3.2 Holton: Ch. 2.4

EAS 6502 ONLY – Lab 3 Due
(11/5/2021)

Week 11 (11/1/21 – 11/5/21)	Thermal Wind	Martin: Ch. 4.3 Holton: Ch. 3.4 Take-Home Assignment 4 Due (11/5/2021)
Week 12 (11/8/21 – 11/12/21)	Natural Coordinates	Martin: Ch .4.4 Holton: Ch. 3.2 Quiz 4 (11/10/2021)
Week 13 (11/15/21 – 11/19/21)	Circulation and Vorticity	Martin: Ch. 5 (specific sections TBD) Holton: Ch. 4 (specific sections TBD)
Week 14 (11/22/21 – 11/26/21)	THANKSGIVING BREAK (11/24-11/26); Circulation and Vorticity	Martin: Ch. 5 (specific sections TBD) Holton: Ch. 4 (specific sections TBD) Take-Home Assignment 5 Due (Tuesday, 11/24/2021)
Week 15 (11/29/21 – 12/3/21)	Atmospheric Waves	Martin: n/a Holton: Ch. 7 Quiz 5 (12/1/2021)
Week 16 (12/6/21)	TBD	Martin: TBD Holton: TBD EAS 6502 ONLY – Lab 4 Due (12/7/2021)
FINAL EXAM – FRIDAY, DECEMBER 10TH, 2021 8:00 – 10:50 AM	FINAL EXAM – FRIDAY, DECEMBER 10TH, 2021 8:00 – 10:50 AM	FINAL EXAM – FRIDAY, DECEMBER 10TH, 2021 8:00 – 10:50 AM

*Course topics, readings and due dates subject to change