

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

**Instructor:** Dr. Yi Deng

**Office:** 3248 Ford ES&T Building

**Office Hours:** Via appointment – in-person or virtual appointments both OK

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**Course Prerequisites:**

- MATH 2551
- MATH 2552

**\*\*\*It is strongly recommended that you have completed or concurrently enroll in EAS 2750: Physics of the Weather while taking this course\*\*\***

**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 describes 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 motions and determine the properties of 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.

**Learning Outcomes**

The following learning outcomes will be accomplished as a result of successful completion of this course (i.e., passing this course):

- 1) Answer questions on course problem sets and knowledge checks accurately, demonstrating successful application of math and physics theory toward atmospheric dynamics theory
- 2) Improve scientific communication skills through course participation assignments
- 3) Reflect on one’s own understanding and knowledge growth through self-reflection and self-assessment

- 4) Increase confidence in defending one's accomplishments within the course through mid-semester and final course assessments

### Assignments

- Participation – weekly assignments that are some combination of pre-class reading assignments and reflections on learning outcomes
- Problem sets – practice problems within atmospheric dynamics along with determining the learning outcomes associated with each assignment
- Knowledge checks – assessments to check in periodically throughout the semester regarding student understanding of course material
- Synoptic labs (EAS 6502 Students Only) – graduate students will complete 4 lab assignments (adapted from EAS 4656: Atmospheric Dynamics Practicum) that will teach students skills related to meteorological data analysis, Python programming and the use of MetPy tools and case study analysis

### Grading (4655)

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

- Class participation – 10% of grade
- Problem Sets – 50% of grade
- Knowledge Checks – 40% of grade

### Grading (6502)

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

- Class participation – 10% of grade
- Problem Sets – 30% of grade
- Synoptic Labs – 20% of grade
- Knowledge Checks – 40% of grade

### 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.**

### Academic Honesty

The best way to learn in this course is to participate in all aspects of the course, celebrate one's accomplishments throughout and to learn from one's mistakes, even at the risk of one's grade not being perfect on every assignment. Participation in activities such as copying answers from another student, using unauthorized resources, including the use of electronic devices or AI tools such as ChatGPT, posting solutions to course assignments and quizzes on the Internet, and/or any other activity that would be considered a method for shortcutting this course will prevent you from truly enjoying the experience that is Atmospheric Dynamics. Such methods above also lead to the development of habits that are hard to break and may reduce your success beyond class and in the "real world."

### Academic Honor Code

The instructor and students are expected to follow Georgia Tech's Academic Honor Code:

<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](mailto: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** | 2<sup>nd</sup> floor, Smithgall Student Services Building; You also may request assistance [here](#)
- [Counseling Center](#) | **404-894-2575** | Smithgall Student Services Building 2<sup>nd</sup> 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	Calculus, Vectors, Taylor Series Expansion, Other Fundamentals Review	Martin: Ch. 1 Holton: Ch. 1.1 and 1.2
Week 2	Lagrangian vs. Eulerian derivatives; Advection	Martin: Ch. 1.2.4 Holton: Ch. 2.1 <b>Problem Set 1 Due</b>
Week 3	2D Flow Kinematics	Martin: Ch. 1.4 Holton: n/a
Week 4	Fundamental Forces – Gravity; Pressure Gradient Force; Friction	Martin: Ch. 2.1, 2.2 Holton: Ch. 1.4 <b>EAS 6502 ONLY – Lab 1 Due</b> <b>Problem Set 2 Due</b>
Week 5	Fundamental Forces – Apparent Forces – Centrifugal, Coriolis; Conservation of Momentum	Martin: Ch. 2.1, 2.2 Holton: Ch. 1.4, 1.5 <b>Knowledge Check 1</b>
Week 6	Mass and Energy Conservation; Hydrostatic Balance; Thickness Equation	Martin: Ch. 3.1, 3.2.2 Holton: Ch. 1.6 <b>Problem Set 3 Due</b>

Week 7	Introduction to Isobaric Coordinates; Mass Continuity in Isobaric Coordinates	Martin: Ch. 3.1, 3.2, 4.1 Holton: Ch. 1.6, 2.5, 3.1 <a href="#">EAS 6502 ONLY – Lab 2 Due</a>
Week 8	Equations of Motion – Overview	Martin: Ch. 3.2, 4.1 Holton: Ch. 3.1 <a href="#">Problem Set 4 Due</a>
Week 9	Equations of Motion – Scale Analysis	Martin: Ch. 3.2 Holton: Ch. 2.2, 1.3 <a href="#">Midterm Assessment Due</a> <a href="#">Knowledge Check 2</a>
Week 10	Geostrophic Balance; Geostrophic vs. Ageostrophic Wind	Martin: Ch. 3.2 Holton: Ch. 2.4 <a href="#">EAS 6502 ONLY – Lab 3 Due</a> <a href="#">Problem Set 5 Due</a>
Week 11	Thermal Wind	Martin: Ch. 4.3 Holton: Ch. 3.4
Week 12	Balanced Flow in Natural Coordinates	Martin: Ch. 4.4 Holton: Ch. 3.2 <a href="#">Problem Set 6 Due</a>
Week 13	Balanced Flow in Natural Coordinates	Martin: Ch. 4.4 Holton: Ch. 3.2 <a href="#">Knowledge Check 3</a>
Week 14	Atmospheric Waves	Martin: n/a Holton: Ch. 7
Week 15	Atmospheric Waves	Martin: n/a Holton: Ch. 7 <a href="#">Knowledge Check 4 (Take-Home due at end of semester)</a>
Week 16	Synoptic Waves and Storm Tracks	Martin: n/a Holton: n/a <a href="#">EAS 6502 ONLY – Lab 4 Due</a>
<b>FINAL ASSESSMENT</b>	<b>FINAL ASSESSMENT</b>	<b>FINAL ASSESSMENT</b>

\*Course topics, readings and due dates subject to change