# Synoptic Dynamic Meteorology (ATM 511)
# Spring Semester 2024
# Class Number: 8610 (3 credits)

Lecture: Tuesday & Thursday 9:00-10:20 in ETEC 483
http://www.atmos.albany.edu/daes/atmclasses/atm511

## Instructor:

Professor Ryan Torn
Office: ETEC 496C
Phone: 442.4560
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Office hours: Wednesday 1:00-2:00, and by appointment

## Course Description:

Governing atmospheric physical laws; wind in relation to pressure; influence of friction; vertical structure of wind systems; atmospheric kinematics; circulation, vorticity and divergence theorems, fronts and frontogenesis; quasi-geostropic theory and application of basic atmospheric dynamics to the observed weather behavior; required readings and problems in these areas.

## Course Objective:

This course will apply the governing equations of the atmosphere to understand the dynamics of synoptic to planetary-scale features ($>$ 1000 km), such as fronts, jet streaks, and cyclones.

## Prerequisites:

ATM 500 or consent of the instructor.

## Text:

*An Introduction to Dynamic Meteorology* by J. R. Holton and G. J. Hakim, 5th ed. (HH)

## Supplementary reading:

*An Introduction to Dynamic Meteorology* by J. R. Holton, 4th ed. (H)
*Mid-Latitude Atmospheric Dynamics: A First Course*, by J. E. Martin
*Synoptic-Dynamic Meteorology in Midlatitudes*, by H. B. Bluestein

## Course Requirements:

4 Homework assignments 20%
2 Laboratory assignments 35%
Midterm exam (TBD): 20%
Final exam (Date TBD): 25%
Grading: A-E

## Course Format:

Students are expected to attend each lecture. In addition, lectures will be recorded when possible and posted to Brightspace, so students can review lectures afterward. **Watching lectures online**

**is not a substitute for attending lecture. If students start to watch lectures online instead of attending, I will discontinue recording.** Absences are unavoidable; therefore, in those situations, students are expected to view the lecture recording (Brightspace keeps track of who views each lecture).

## Course Communication:

The primary communication method for the course will be through messages through Brightspace. These messages will be archived on the course page and will automatically send to your UAlbany email address. All lecture materials and assignments will be placed on the course Brightspace page. Students may communicate with each other through the Brightspace discussion system. I will answer all emails within 24 h of receipt, except on weekends.

## Accommodating Disabilities Policy:

Reasonable accommodations will be provided for students with documented physical, sensory, systemic, cognitive, learning and/or psychiatric disabilities. If you believe you have a disability/disabilities requiring accommodation in this class, please notify Disability Access and Inclusion Student Services (CC 137, 442-5501, daiss@albany.edu). Upon verification and after the registration process is complete, the DAISS will provide you with a letter that informs the course instructor that you are a student with a disability registered with the DAISS and list the recommended reasonable accommodations.

## Religious Observance:

Students must notify the instructor of any lectures and assignment due dates that conflict with recognized religious observances (https://www.albany.edu/registrar/academic-calendar/religious-observances) well in advance. The instructor will work with the student to provide an alternative arrangement.

## Academic Integrity:

Although students can work together, all homework and lab assignments must be completed independently. Homework and lab assignments that are substantially similar to other students will be given a zero for that assignment. Copying from other students on exams may result in a zero for that work and referral for disciplinary action under the University's policy on academic integrity (https://www.albany.edu/undergraduate_bulletin/regulations.html). Every student has the responsibility to become familiar with the standards of academic integrity at the University. Claims of ignorance, unintentional error, or personal or academic pressures cannot be excuses for violation of academic integrity.

## Course Outline:

1. Introduction
    - Overview of Balanced Weather Systems
    - Review of Governing Equations of Atmosphere (H2+4, HH2+4, Martin 3+4)
2. Quasi-Geostrophic Dynamics and Potential Vorticity

- Derivation of Quasi-Geostrophic (QG) Equations (H6.2, HH6.2, Martin 5.4)
- QG Vorticity, Thermodynamic, and Energy Equations (H6.2, HH6.2, Martin 5.4)
- Potential Vorticity (H6.3, HH6.3, Martin 9.1-9.2)
- PV Inversion and Applications (H6.3, HH6.4, Martin 9.5, and class notes)

3. Vertical Motion

   - Omega Equation: Vorticity and Thermal Advection Form (H6.4.1, HH6.5, Martin 6.3)
   - Q Vectors and Application to Vertical Motion (H6.4.2, H6.5, Martin 6.4)

4. Frontogenesis

   - Kinematic and Dynamic Description of Frontogenesis (H9.2, HH9.2, Martin 7.1)
   - Vertical Motion at Fronts (Martin 7.2)
   - Semi-geostrophic Equations (Holton 9.2.2, HH9.2.2, Martin 7.3)
   - Upper-level Fronts (Martin 7.4, Class Notes)

5. Midlatitude Cyclogenesis

   - QG Height Tendency Equation (Holton 6.3.1, Martin 8.3)
   - Cyclogenesis from the QG Perspective (Martin 8.4, Class Notes)
   - Cyclogenesis from the PV Perspective (Martin 9.3, Class Notes)
   - "Flavors" of Midlatitude cyclones (Class Notes)

6. Atmospheric Waves and Instabilities

   - Atmospheric Waves (H7.2, HH5.2)
   - Baroclinic and Barotropic Instability (H8.4.3, HH7.4.3, Class Notes)
   - Role of Latent Heat Release (Class Notes)
   - Perturbations to the Waveguide and Downstream Development (Class Notes)
   - Wave Breaking (Class Notes)
   - Global Energy Cycle (H8.4, HH10.4, Class Notes)