Synoptic Dynamic Meteorology (ATM 511)
Spring Semester 2021
Class Number: 9637, 10114 (3 credits)
Lecture: Tuesday & Thursday 9:00-10:20 in BB 141
http://www.atmos.albany.edu/daes/atmclasses/atm511

Instructor:
Professor Ryan Torn
Office: ES 229
Phone: 442.4560
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Office hours: Wednesday 1:00-2:30 (in person: 1:00-2:00, Zoom: 1:30-2:30), and by appointment

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.

Course Format:
The course will primarily consist of lectures. In order to promote a safe learning environment for
everyone, the lectures will be simulcast on Zoom, as well as being recorded, and posted to
Blackboard. Students may choose to attend some or all lectures virtually, rather than in-person.
Virtual and in-person office hours (hosted via Zoom) will be available for everyone in the course.
If the pandemic forces instruction to be entirely remote, all lectures will be synchronously
delivered via Zoom during the assigned lecture period (lectures will also be recorded).

Prerequisites:
ATM 500 or consent of the instructor.

Course Communication:
The primary communication method for the course will be through messages through Blackboard.
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 both the course web page
and the course Blackboard page. Students may communicate with each other through the
Blackboard message system. I will answer all emails within 24 h of receipt, except on weekends.

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 (Wednesday May 12, 8:00-10:00 AM): 25%
Grading: A-E

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)
Downstream Development (Class Notes)
Wave Breaking (Class Notes)
Global Energy Cycle (H8.4, HH10.4, Class Notes)

Attendance Policy:
Students are expected to attend each lecture, either in person or through Zoom. Absences are unavoidable; therefore, in those situations, students are expected to view the lecture online (Blackboard keeps track of who views each lecture). The instructor reserves the right to assign extra readings for students who have an excessive number of unexcused absences from either in-person or remote lectures.

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 the Disability Resource Center (CC 130, 442-5501, DRC@albany.edu ). Upon verification and after the registration process is complete, the DRC will provide you with a letter that informs the course instructor that you are a student with a disability registered with the DRC 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/registrar_assets/Religious_Calendar.pdf) well in advance. The instructor will work with the student to provide an alternative arrangement.

Academic Integrity:
Although students can work together, all projects must be completed independently. Assigned work that is substantially similar to other students will be given a zero for that assignment and referred for disciplinary action under the University’s policy on academic integrity (http://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.