**ATMOSSC 5601 (Dynamic Meteorology I)**

Autumn 2026

**Course Syllabus**

*Class Meetings:* Tu/Th 12:45 - 2:05 pm
*Classroom:* Derby Hall 0070
*Instructor:* Dr. Christopher Hartman
*Office:* Derby Hall 1140
*Office hours:* Tu/Th 2:15 – 3:45, or by appointment
*Email:* hartman.870@osu.edu

**Course Prerequisites**
A grade of C- or above in ATMOSSC 5501, Math 2153 and Physics 1250. Not open to students with credit for ATMOSSC 5951.

**Course Objectives**
The basic objective of this course is to provide students with knowledge of the fundamentals of atmospheric dynamics. The knowledge will facilitate students' comprehension of meteorological processes that determine the weather and climate. This increased comprehension of important physical processes will improve students' ability to analyze and to forecast the state of the atmosphere.

**Course Structure**
The class will meet two days per week for 80 minutes each day. Lectures present material on dynamic processes and their application to atmospheric situations. Important equations are derived and the implications of assumptions discussed. Examples of meteorological problems are discussed.

**Textbook**
Martin, J., 2006: Mid-Latitude Atmospheric Dynamics: A First Course. John Wiley & Sons, Ltd.
eBook Available through OSU Library

**Course Requirements**
The grade for this course will be determined using the following weighted components:

a. In-class Problems – 10%
b. Homeworks – 20%
c. Midterm Exam #1 – 20%
d. Midterm Exam #2 – 20%
e. Final Exam (Cumulative) – 30%

**Detailed Requirements**
*In-class Problems* - On random days, I will assign a problem (or short problems) for you to work on in class. The goal of these problems is to review or reinforce something that was just taught and to give you an opportunity to get feedback from me. These problems will serve as

participation points, so they need not be correct for you to get full credit on them, so long as you are working on them and giving them your best effort.

*Homeworks:* There will be a total of five homework assignments throughout the semester (one for each chapter) due at the start of class. The homework assignments are designed to accomplish two goals. The first goal is to give students some experience solving basic dynamic problems using concepts introduced in class. A second goal is to make students think about the dynamic processes that occur in certain atmospheric phenomena. More challenging problems may require students to combine dynamic principles to arrive at the solution to the problem. To ensure fairness, graduate students will have extra, more challenging problems assigned in each problem set. Undergraduate students may get bonus points for completing the graduate student problems.

*Exams:* Each examination will begin with a series of terms to define in one or two sentences. The remainder of the examination will consist of short essay questions and problems like the problems that will be assigned as homework. The examinations are designed to test your comprehension and understanding of the material, as well as your ability to recall basic dynamic principles. You may use a scientific or graphing calculator on the exams. Cell phone calculators are not permitted during exams. Complete responses to short answer questions include explanations of relevant dynamic principles. To ensure fairness, the point values for problems will be weighted more heavily towards the more challenging problems for graduate students.

**Other Policies**

*Units:* Numerical answers are incomplete unless they are accompanied by the correct simplified units. Points will be deducted on examinations and homework assignments if units are incorrect, unsimplified, or missing.

*Late policy:* Homework assignments are due at the start of class on the day they are due. Late homework will not be accepted unless you have permission from the instructor in advance. Refer to the course schedule posted on CarmenCanvas for all due dates.

*Academic Misconduct:* All examination and homework answers are expected to be the work of the student whose name appears on them. Copying another student's work is plagiarism and is considered to be academic misconduct. The use of ChatGPT or any other form of AI on homework assignments is also considered academic misconduct.

**University Policies**

- Academic Misconduct
- Religious Accommodations
- Accommodations for Disability and Illness
- Intellectual Diversity
- Grievances and Solving Problems
- Creating an Environment Free from Harassment, Discrimination, and Sexual Misconduct
- Copyrights
- Content Warnings
- Mental Health Support
- Resources for Military-Connected Students
- Campus-wide Class Cancellations

*Note: We might diverge from the order of individual sections listed here. Please refer to the course schedule on CarmenCanvas for the dates each topic is covered!*

**List of Topics**

**1 Introduction and Review of Mathematical Tools**
1.1 Fluids & the Nature of Fluid Dynamics
1.2 Review of Useful Mathematical Tools
- 1.2.1 Elements of Vector Calculus
- 1.2.2 The Taylor Series Expansion
- 1.2.3 Centered Difference Approximations to Derivatives
- 1.2.4 Temporal Changes of a Continuous Variable

1.3 Estimating with Scale Analysis
1.4 Basic Kinematics of Fluids (Pure vorticity, divergence, stretching & shearing deformation)
1.5 Mensuration (SI Units)

**2 Fundamental and Apparent Forces**
2.1 Fundamental Forces (Pressure Gradient, Gravitational, & Frictional Forces)
2.2 Apparent Forces (Centrifugal & Coriolis "Forces")

**3 Mass, Momentum, and Energy: The Fundamental Quantities of the Physical World**
3.1 Mass in the Atmosphere (Hydrostatic & Hypsometric Equations)
3.2 Conservation of Momentum: The Equations of Motion
- 3.2.1 The Equations of Motion in Spherical Coordinates
- 3.2.2 Conservation of Mass (Continuity Equation)

3.3 Conservation of Energy: The Energy Equation

**4 Applications of the Equations of Motion**
4.1 Pressure as a Vertical Coordinate
4.2 Potential Temperature as a Vertical Coordinate
4.3 Thermal Wind Balance
4.4 Natural Coordinates & Balanced flows
- 4.4.1 Geostrophic Flow
- 4.4.2 Inertial Flow
- 4.4.3 Cyclostrophic Flow
- 4.4.4 Gradient Flow

4.5 The Relationship between Trajectories & Streamlines

**5 Circulation, Vorticity, and Divergence**
5.1 The Circulation Theorem & its Physical Interpretation
5.2 Vorticity & Potential Vorticity
5.3 The Relationship between Vorticity & Divergence
5.4 The Quasi-Geostrophic (QG) System of Equations