THE OHIO STATE UNIVERSITY

College of Arts and Sciences
Department of Geography

SYLLABUS

ATMOSSC 5501

Atmospheric Thermodynamics
Autumn 2026

COURSE OVERVIEW

Course information

- **Class periods:** Monday, Wednesday, Fridays, 9:10am – 10:05am (55 minutes)
- **Credit hours:** 3
- **Prerequisites:** MATH 1152, PHYSICS 1250, ATMOSSC 5201, or graduate standing.
- **Classroom:** DB 70
- **Mode of delivery :** In Person
- **Optional Textbook:** “Atmospheric Thermodynamics” by Craig Bohren and Bruce Albrecht, 2020 edition

Instructors

Instructor: Dr. Man-Yau (Joseph) Chan (address as Dr Chan)

- Email address: chan.1063@osu.edu – this is the best way to reach me.
- Office hours: Tuesdays TBD
- Office hour location: DB 1132

Note: The instructor’s preferred method of contact is via email.

Course description

The basic objective of this course is to provide students with knowledge of the fundamentals of atmospheric thermodynamics. Thermodynamics deals with energy transfers and transformations, spontaneity and phase change. Thus, thermodynamics influences the processes that create and change atmospheric systems (e.g., precipitation). Knowledge of the

basic principles of thermodynamics and their interactions will facilitate students' comprehension of meteorological processes that determine the weather and climate of the Earth. Understanding thermodynamic processes is critical to accurate assessment of the current state of the atmosphere and to accurate evaluation of the output from numerical models of weather and climate.

By the end of this course, students should be able to successfully:

1. Remember and understand the basic principles of thermodynamics and molecular theory for atmospheric constituents.
2. Apply thermodynamics to analyze and predict atmospheric motions, atmospheric stability, phase changes and atmospheric structure.
3. Formulate new relationships and quantities from the basic principles of thermodynamics.

To reinforce learning outcomes, this course has (a) 8 homeworks (due once every 1~2 weeks), (b) 2 written in-class Mid-Term Tests and (c) a written Final Examination.

HOW THIS COURSE WORKS

Mode of delivery: In-person, lecture-based.

Course materials: All course materials will be accessible from OSU's **Carmen Canvas** interface. These materials include:

1. Lecture notes (PDF format; released before class and updated after class),
2. Worksheets for assignments (PDF format)

Weekly activities and materials: This course has thrice-a-week in-person classes. ***Homeworks are due every 1~2 weeks on Fridays by 10:05 am.*** A weekly class schedule will be provided outlining content and assignments. ***The schedule is subject to change so students should be sure to retain the most current version.*** All scheduling changes will be articulated clearly to class via Carmen Announcements.

Credit hours and work expectations: This is a **3-credit-hour course**. According to Ohio State policy, students should expect around 3 hours/week of time spent on direct instruction (instructor content and Carmen activities, for example) in addition to **6 hours/week of homework** (assignments) to receive a passing grade.

Expectations of Students (Outside of Assignments and the Exam)

- **Attendance:** Students are expected to attend all classes and attendance will be tracked by use of **in-class activities**. These exercises contribute to the Participation category in calculating the final grade (see table under "Grading and Faculty Response"). ***Students are not penalized for making mistakes on these participatory in-class exercises.***

COURSE MATERIALS AND TECHNOLOGIES

Textbooks

"Atmospheric Thermodynamics" by Craig Bohren and Bruce Albrecht, 2020 edition. Available for free as an EBook from the Ohio State University Libraries.

Technologies

REQUIRED EQUIPMENT

- **Computer/Mobile Device (smartphone or tablet):** used to view course materials (lectures, assignment questions, etc) and submit assignments/tests/exams.
- **Webcam:** built-in or external webcam, fully installed and tested
- **Microphone:** built-in laptop or tablet mic or external microphone
- **Other:** a mobile device (smartphone or tablet) or landline to use for BuckeyePass authentication

REQUIRED SOFTWARE

- **A web browser (e.g., Google Chrome, Apple's Safari):** This is needed to view course materials (PDFs), watch recorded lectures, and access CarmenCanvas.
- **Zoom** (https://osu.zoom.us/) is the academic audio web conferencing solution for Ohio State and we will be using it for possible office hour options.
    - Getting started with CarmenZoom

Carmen: Accessibility, Help, Skills & Multi-Factor Authentication

ACCESSIBILITY OF CARMEN

This course requires use of Carmen (Ohio State's learning management system) and a web browser. If you need additional services to use these technologies, please request accommodations with your instructor.

- CarmenCanvas accessibility
- CarmenZoom accessibility

HELP WITH CARMEN (OR OTHER IT ISSUES)

For help with your password, university email, Carmen, or any other technology issues, questions, or requests, contact the Ohio State IT Service Desk. Standard support hours are available at ocio.osu.edu/help/hours, and support for urgent issues is available 24/7.

- **Self-Service and Chat support:** ocio.osu.edu/help
- **Phone:** 614-688-4357(HELP)
- **Email:** servicedesk@osu.edu
- **TDD:** 614-688-8743

Basic computer and web-browsing skills are expected, and navigating Carmen is an essential skill for this course. For questions about specific functionality, see the Canvas Student Guide.

REQUIRED TECHNOLOGY SKILLS SPECIFIC TO THIS COURSE

- CarmenZoom virtual meetings (e.g., for snow days)
- Uploading assignments on CarmenCanvas
- Using web browsers

CARMEN MULTI-FACTOR AUTHENTICATION

You will need to use BuckeyePass multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you take the following steps:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device help article for step-by-step instructions.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- Download the Duo Mobile application to all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4357 (HELP) and IT support staff will work out a solution with you.

GRADING AND FACULTY RESPONSE

How your grade is calculated (% breakdown)

ASSIGNMENT CATEGORY	% POINTS
Participation (ungraded in-class exercises)	10
Homeworks	30
Midterm Test 1 (End of Week 5)	15
Midterm Test 2 (End of Week 11)	15
Final Examination	30
Total	**100**

Assignment descriptions:

Participation: Every week, during one of the in-class sessions, students will be randomly assigned into groups of 2~3 and spend 20 minutes working together on a problem. These problems can involve sketching diagrams and curves, analytic mathematical derivations, numerical calculations, and coming up with explanations for phenomena. Each group is assigned a unique problem. After the 20 minutes are up, students will present their work to each other. Students will not be penalized for making mistakes, and the instructor will be roving between the groups to dispense guidance (if needed).

Homeworks: There will be 8 homework assignments in this course (due every 1~2 weeks). These homeworks are problem sets that should take students up to 3 hours/week to complete. These problems can involve sketching diagrams and curves, analytic mathematical derivations, numerical calculations, and coming up with explanations for phenomena. Students will submit their solutions to those problem sets in class. ***All submissions must be handwritten and hand drawn.*** Solutions to mathematical and numerical problems must include step-by-step mathematical working and calculations, with written explanations where appropriate. The submissions will be evaluated based on (1) accurate usage of thermodynamics principles and logic, (2) the accuracy of their calculations and derivations, and (3) the readability of their solutions. A solution is considered perfectly readable if every mathematical symbol used is either defined in the lecture or in the solution, every step of any mathematical derivation is shown, and handwritten explanations are legible. Students are permitted to use all resources available to them to complete homeworks, including the internet and AI tools. ***All usage of AI tools and external materials (e.g., Wikipedia) must be declared in the submission.*** While students are encouraged to work together on homework assignments, every student must submit his/her/their own work. Students are strongly encouraged to make use of the instructor's office hours.

Mid-Term Tests and Final Examination: To reinforce learning outcomes and to assess the students' mastery of the material, this course has two in-class Mid-Term Tests (50 minutes each) and an in-person Final Examination (90 minutes). The Final Examination (90 minutes) will take place during the Final Examinations week. For the Mid-Term Tests and Final Examination, students are permitted to bring in a scientific or graphing calculator, as well as a cheatsheet (no more than 2 sides of a piece of Letter paper). Other electronic devices (including cellphones, laptops, and smart watches) and communication are prohibited during the Mid-Term Tests and Final Examination. Solutions to mathematical and numerical problems must include step-by-step mathematical working and calculations, with written explanations where appropriate. The submissions will be evaluated based on (1) accurate usage of physical meteorology principles and logic, (2) the accuracy of their calculations and derivations, and (3) the readability of their solutions. A solution is considered perfectly readable if every mathematical symbol used is either defined in the lecture or in the solution, every step of any mathematical derivation is shown, and handwritten explanations are legible. The content tested is cumulative.

Late assignments

Please refer to Carmen for due dates. Late assignments will be penalized by 10% per day late (unless excused by the instructor), and only accepted up to a maximum of 4 days late. If students anticipate conflicts, they are expected to discuss with instructors ahead of time.

Grading scale

93–100: A
90–92.9: A-
87–89.9: B+
83–86.9: B
80–82.9: B-
77–79.9: C+
73–76.9: C
70 –72.9: C-
67 –69.9: D+
60 –66.9: D
Below 60: E

Instructor feedback and response time

Grading and feedback: Students can generally expect feedback within 14 days.

Email: Emails are the fastest way to contact the instructor. The instructor will generally reply to emails within **48 hours on days when class is in session at the university**.

COURSE SCHEDULE

ATMOSSC 5501 WEEKLY SCHEDULE*

Class Topics, Mid-Term Tests and Final Examination*

*Note: These topics and homework assignments are *subject to change*! Students will be advised of updates to the schedule on Carmen and should follow the version with the most current date.

Classes 3x/week (55 mins).
Dates are in day (month/day) format [e.g., W (08/26) means Wednesday Aug 26th].

Wk	Date	Class Topic(s)	Assignments
1	W (08/26)	Course Overview	
	F (08/28)	Atoms, Molecules, and Atmospheric Composition	
2	M (08/31)	Thermodynamic State Variables, and Historical Introduction to the General Ideal Gas Law	

	W (09/02)	Vapor Gas Law, Dry Air Gas Law, Moist Air Gas Law, Gas Densities, and Virtual Temperature	
	F (09/04)	**In-Class Activity 1**	HW 1 release
3	*M (09/07)*	*Labor Day Holiday*	
	W (09/09)	Internal Energy & its Conservation	
	F (09/11)	Enthalpy & its Conservation	HW 1 due. HW 2 release
4	M (09/14)	HW 1 Walkthrough & Partial Derivatives	
	W (09/16)	Applications of the 1st Law	
	F (09/18)	In-Class Activities 2	HW 2 due. HW 3 release
5	M (09/21)	HW 2 Walkthrough & Potential Temperature	
	W (09/23)	Applications of Potential Temperature	
	F (09/25)	In-Class Activity 3	HW 3 due.
6	M (09/28)	HW 3 Walkthrough & Hydrostatic Balance	
	W (09/30)	Buoyancy & Absolute Instability	
	F (10/02)	In-Class Activity 4 (Mid-Term 1 Review)	
7	**M (10/05)**	**MID-TERM 1**	
	W (10/07)	Mid-Term 1 Walkthrough	HW 4 release. (HW 4 is Mid-Term 1 corrections)
	F (10/09)	Entropy and the 2nd Law	
8	M (10/12)	State Functions and Entropy of Constant Composition Adiabatic Motions	
	W (10/14)	In-Class Activity 5	HW 4 due. HW 5 release
	F (10/16)	**Autumn Break**	
9	M (10/19)	Gibbs Free Energy & Clausius-Clapeyron	
	W (10/21)	Equilibrium Vapor Pressures for Flat Interphases	
	F (10/23)	In-Class Activity 6	HW 5 due. HW 6 release.
10	M (10/26)	HW 5 Walkthrough & Saturation Ratios	
	W (10/28)	Equivalent Potential Temperature & Conditional Instability	
	F (10/30)	In-Class Activity 7	HW 6 due.

11	M (11/02)	HW 5 Walkthrough & Skew-T Diagrams: Usage	
	W (11/04)	Skew-T Diagrams: Theory	
	F (11/06)	In-Class Activities 8 (review for Mid-Term 2)	
12	**M (11/09)**	**MID-TERM 2**	
	W (11/11)	Mid-term 2 Walkthrough	HW 7 release. (HW 7 is Mid-Term 2 corrections)
	F (11/13)	The Menagerie of Cloud Particles	
13	M (11/16)	Cloud Drop Formation: Homogeneous Vapor Nucleation is Improbable	
	W (11/18)	Cloud Drop Formation: Dissolution	
	F (11/20)	In-Class Activities 9	HW 7 due. HW 8 release.
14	M (11/23)	Cloud Drop Formation: Kohler Theory I	
	W (11/25)	**Thanksgiving Break**	
	F (11/27)	**Indigenous People's Day / Columbus' Day**	
15	M (11/30)	Cloud Drop Formation: Kohler Theory II	
	W (12/02)	Cloud Drop Formation: Kohler Theory III	
	F (12/04)	In-Class Activity 10	HW 8 due.
16	M (12/07)	HW 8 Walkthrough & Final Review	
	W (12/09)	Final Review II	

OTHER COURSE POLICIES

Discussion and communication guidelines

The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- **Writing style**: Students should use proper grammar, spelling, and punctuation. A more conversational tone is fine for non-academic topics in class discussion forums.
- **Tone and civility**: Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. ***Remember that sarcasm doesn't always***

come across online.

Academic integrity policy

- **Homework Assignments**: Working with other students is permitted, but ***every student must submit their own work.*** The use of AI tools and the internet is permitted as long as the student indicates that they have used them in their submission.
- **Reusing past work**: In general, students are prohibited in university courses from turning in work from a past class, even if modified. Students should discuss the situation with instructors in advance if there is any doubt.

Ohio State's Policies

Access the following website

Standard Syllabus Statements | Office of Undergraduate Education

to view the Ohio State University's policies regarding:

- Academic Misconduct
- Artificial Intelligence and Academic Integrity
- Religious Accommodations
- Disability Statement with Accommodations for Illness
- Intellectual Diversity
- Grievances and Solving Problems
- Creating an Environment Free from Harassment, Discrimination, and Sexual Misconduct

The following website

Optional Syllabus Statements | Office of Undergraduate Education

contains the Ohio State University's policies regarding:

- Copyright
- Counseling and Consultation Services / Mental Health Statement

- Content Warning Language
- Military-Connected Students