

SYLLABUS

ATMOSSC 5950

Atmospheric Thermodynamics
Autumn 2025

COURSE OVERVIEW

Course information

- **Class periods:** Monday, Wednesday, Fridays, 9:10am – 10:05am (55 minutes)
- **Credit hours:** 3
- **Prerequisites:** MATH 1152, or graduate standing.
- **Classroom:** DB 70
- **Mode of delivery:** In Person
- **Textbooks (E-Books available on the Ohio State University Libraries' Catalog):**
 - (1) "Atmospheric Thermodynamics" by Craig Bohren and Bruce Albrecht, 2020 edition
 - (2) "Thermodynamics" by Enrico Fermi, 2012 edition.

Instructors

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

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

Graduate Teaching Assistant (GTA): Ashlee Ziegler

- Email: ziegler.323@buckeyemail.osu.edu
- Office hours: To be determined.
- Office hour location: To be determined.

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. The four specific objectives of this course are: (1) to understand the basic principles of thermodynamics as they apply to air and the phase changes of water; (2) understand the effects of water and phase changes on atmospheric motions; (3) to determine how thermodynamic processes generate the observed structure of the atmosphere; (4) to examine how thermodynamic processes affect the stability of portions of the atmosphere.

This class is a calculus-based course. As such, MATH 1152 (Calculus III), or graduate standing, is a pre-requisite to take this course.

To reinforce learning outcomes, this course has (a) 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), and,
3. Video recordings of lectures (MP4 format).

Weekly activities and materials: This course has thrice-a-week in-person classes.

Homeworks are due every 1~2 weeks on Mondays 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

This course is based on two textbooks. Electronic versions of these textbooks are freely available to Ohio State University students at no cost.

1. “Atmospheric Thermodynamics” by Craig Bohren and Bruce Albrecht, 2020 edition.
2. “Thermodynamics” by Enrico Fermi, 2012 edition.

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 and GTA will be roving between the groups to dispense guidance (if needed).

Homeworks: There will be 10 homeworks in this course (due every 1~2 weeks). These homework assignments 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	83–86.9: B
90–92.9: A-	80–82.9: B-
87–89.9: 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 and GTA. The instructor and GTA will generally reply to emails within **48 hours on days when class is in session at the university**. To help the instructor identify emails relating to the course, students should start their email's subject with "THERMO".

COURSE SCHEDULE

ATMOSSC 5950 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 (8/27) means Wednesday Aug 27th].

Wk	Date	Class Topic(s)
1	W (8/27) REMOTE	Course Overview
	F (8/27)	Atmospheric Constituents, Molar Fractions and Ideal Gas Laws
2	M (9/1)	Labor Day Holiday
	W (9/3)	Ways to Specify Water Vapor
	F (9/5)	In-Class Activities
3	M (9/1)	Kinetic Theory of Ideal Gases
	W (9/3)	Boltzmann and Maxwell-Boltzmann Distributions
	F (9/5)	In-Class Activities

4	M (9/8)	Molecular Energies & Equipartition Theorem
	W (9/10)	In-Class Activities (Dr Chan is out of town)
	F (9/12)	First Law of Thermodynamics: Internal Energy Form
5	M (9/15)	First Law of Thermodynamics: Enthalpy Form
	W (9/17)	Adiabatic Motions without Phase Change
	F (9/19)	Mid-Term 1
6	M (9/22)	Heating and Cooling under Constant Volume
	W (9/24)	Heating and Cooling under Constant Pressure
	F (9/26)	In-Class Activities
7	M (9/29)	Hydrostatic Balance
	W (10/1)	Pressure coordinates, Geopotentials, Sea Level Pressure
	F (10/3)	In-Class Activities
8	M (10/6)	Second Law of Thermodynamics I
	W (10/8)	Second Law of Thermodynamics II
	F (10/10)	The Clausius-Clapeyron Relation
9	M (10/13)	Phase Equilibria
	W (10/15)	In-Class Activities
	F (10/17)	Autumn Break
10	M (10/20)	Mid-Term 2
	W (10/22)	Saturated Adiabatic Processes
	F (10/24)	Saturated Adiabatic Processes
11	M (10/27)	In-Class Activities
	W (10/29)	Instabilities and Buoyancy
	F (11/1)	Skew T Log P Diagram – Theory
12	M (11/3)	Skew-T Diagrams: Special Levels and Usage
	W (11/5)	Convectively Available Potential Energy and Convective Inhibition

	W (11/7)	Mixing and Entrainment
13	M (11/10)	In-Class Activities
	W (11/12)	Free Energy
	F (11/14)	Vapor-liquid equilibrium of pure liquid drops
14	M (11/17)	Vapor-liquid equilibrium of solutions
	W (11/19)	Kohler theory
	F (11/21)	In-Class Activities
15	M (11/24)	Pathways for the Formation of Cloud Ice
	W (11/26)	Thanksgiving Break
	F (11/28)	Indigenous People's Day / Columbus' Day
16	M (12/1)	Freezing of a Pure Water Drop
	W (12/3)	Freezing of a Solution Drop
	F (12/5)	In-Class Exercises
17	M (12/8)	Final Review
	W (12/10)	Final Review

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