

# SYLLABUS

# ATMOSSC 4194

Group Studies: Physical Meteorology  
Spring 2025

## COURSE OVERVIEW

### Course information

- **Class periods:** Tuesday, Thursday, 12:45pm – 2:05pm (80 minutes)
- **Credit hours:** 3
- **Prerequisites:** ATMOSSCI 5950 (or equivalent) and MATH 2153 (or equivalent)
- **Classroom:** DB 140
- **Mode of delivery:** In Person
- **Textbooks**
  - (1) “An Introduction to Atmospheric Radiation”, 2<sup>nd</sup> Edition, by K. N. Liou\*
  - (2) “Atmospheric Thermodynamics” by Craig Bohren and Bruce Albrecht\*
  - (3) “Physics and Chemistry of Clouds” by Dennis Lamb and Johannes Verlinde\*

*\*Available as E-Books through the Ohio State University Libraries’ Catalog*

### Instructors

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

- Email address: [chan.1063@osu.edu](mailto:chan.1063@osu.edu) – this is the best way to reach me.
- Office hours: Thursdays 2:30pm to 4:30pm (2 hours).
- Office hour location: DB 1132

## Course description

Radiation physics, cloud physics, and atmospheric chemistry are important for modern meteorology, especially for making weather predictions. Even now, computer weather models can only handle these processes approximately (via parameterization schemes). As such, it is important to understand and appreciate these fundamental processes, and to know where our understanding and models are deficient.

ATMOSSCI 4194 introduces students to the fundamental principles underlying radiation physics, cloud physics and physical chemistry (a part of atmospheric chemistry). This includes the principles underlying phase changes (e.g., condensation of cloud droplets), radiation processes (e.g., energy quantization), and chemical reaction rates. By the end of the semester, students will not only be conversant with these principles, but also how they influence weather.

This class is a calculus-based course that builds off the knowledge obtained in an atmospheric thermodynamics course. As such, the prerequisites are (1) ATMOSSCI 5950 (Atmospheric Thermodynamics) or equivalent, and (2) MATH 2153 (Calculus III) or equivalent.

***To reinforce learning outcomes, this course has (a) homeworks (due once every 2 weeks), (b) a mid-term test and (c) a Final Exam.*** All tests/exams in this course are take-home and untimed (students just need to submit the exam by 11.59pm of the day it is assigned) and ***students can use their notes, textbooks, and the internet during the examination.*** Students are forbidden from communicating with anyone (except the instructor) about the tests/exam until after the tests/exam completion deadline.

## Course-based Goals

By the end of the semester, students will:

1. **Remember** and **understand** fundamental concepts essential for explaining physical processes in the atmosphere. These concepts include (i) molecular/atomic energies, (ii) photons, (iii) free energies, (iv) reaction kinetics, and (v) stochastic collection.
2. **Apply** those fundamental principles to explain processes and phenomena relevant to physical meteorology. These processes and phenomena include (i) atmospheric optical phenomena (e.g., colors of the sky), (ii) the formation of atmospheric aerosols and pollutants, (iii) the formation and growth of liquid water and ice in clouds, and (iv) drop size distributions.

3. **Analyze** and **evaluate** (i.e., critique) computer weather models and observationally retrieved data products.

## 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 twice-a-week in-person classes.

**Assignments are due every 1~2 weeks on Fridays by 11:59 p.m.** 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 quizzes contribute to the In-Class Activity category in calculating the final grade (see table under “Grading and Faculty Response”). ***Students are not penalized for making mistakes on these in-class activities.***

## COURSE MATERIALS AND TECHNOLOGIES

## Textbooks

There are three required textbooks for this course. Electronic versions of these textbooks are freely available to Ohio State University students at no cost.

1. "An Introduction to Atmospheric Radiation", 2<sup>nd</sup> Edition, by K. N. Liou\*
2. "Atmospheric Thermodynamics" by Craig Bohren and Bruce Albrecht\*
3. "Physics and Chemistry of Clouds" by Dennis Lamb and Johannes Verlinde\*

*\*Available as E-Books through the Ohio State University Libraries' Catalog*

## 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](#)
- **TopHat:** We will use TopHat to deliver quizzes during lecture for synchronous student response.

## 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](https://ocio.osu.edu/help/hours), and support for urgent issues is available 24/7.

- **Self-Service and Chat support:** [ocio.osu.edu/help](https://ocio.osu.edu/help)
- **Phone:** 614-688-4357(HELP)
- **Email:** [servicedesk@osu.edu](mailto: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
In-Class Activities	10
Homeworks	55
Midterm Test (Week 10)	15
Final Exam	20
<b>Total</b>	<b>100</b>

### Assignment descriptions:

**In-Class Activities:** Each class will be accompanied by an in-class activity (typically involves solving a problem). These activities will reinforce the course material covered during the class. ***In-class activities are not graded – simply attempting them in-class is sufficient.***

**Homeworks:** There will be 6 homeworks in this course (due every 2 weeks). These homework assignments are problem sets that should take students up to 6 hours to complete. Students will submit their worked answers to those problem sets on CarmenCanvas and are permitted to use all resources available to them, 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 Exam:** To reinforce learning outcomes and to assess the students' mastery of the material, this course has one take-home mid-term tests and a take-home Final Exam. Students will be given up to 24 hours to complete each test/exam and are permitted to consult their past work, notes, textbooks, the Internet, and AI tools. However, **students are forbidden to communicate with anyone (except the instructor) about the test/exam until after the deadline.** All usage of **AI tools and external materials must be declared in the test/exam.** The content tested is cumulative. Students will submit their worked answers to the test/exam questions on CarmenCanvas.

## Late assignments

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

## Grading scale

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

## 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.** To help the instructor identify emails relating to the course, students should start their email's subject with "Phys Met".

## COURSE SCHEDULE

## ATMOSSC 4194 WEEKLY SCHEDULE\*

### Class Lecture Topics, Homework Assignments, Mid-term Tests and Final Exam\*

\*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 2x/week (80 mins).

HA stands for Homework Assignment. Dates are in day (month/day) format [e.g., T (8/20) means Tuesday Aug 20<sup>th</sup>, R (8/22) means Thursday Aug 22<sup>nd</sup>].

Wk	Date	Class Topic(s)	Assignment
1	T (1/7)	Course Introduction	Homework 1 assigned (due on Fri 1/24)
	R (1/9)	Overview of Cloud Microphysics	
2	T (1/14)	No Class	
	R (1/16)	No Class	
3	T (1/21)	Kinetic Theory for Ideal Gases I: Pressure and Molecular Kinetic Energy	
	R (1/23)	Kinetic Theory for Ideal Gases II: Flux Density of Molecules on a Surface	
4	T (1/28)	Kinetic Theory for Ideal Gases III: Maxwell-Boltzmann Distribution	Homework 2 assigned (due on Mon 2/10)
	R (1/30)	Review of Thermodynamics: Internal Energy	
5	T (2/4)	Review of Thermodynamics: Enthalpy and Entropy	



	R (2/6)	Gibbs' Free Energy and Clausius-Clapeyron	Homework 3 assigned (due on Fri 2/21)
6	T (2/11)	Surface Tension and Solute Effects	
	R (2/13)	Nucleation of Cloud Droplets	
7	T (2/18)	Nucleation of Ice Particles	
	R (2/20)	Growth of Hydrometeors from Vapor	Homework 4 assigned (due on Mon 3/10)
8	T (2/25)	Growth of Hydrometeors from Collection	
	R (2/27)	Microphysics Parameterization	
9	T (3/4)	<b>Spring Break</b>	
	R (3/6)	<b>Spring Break</b>	
10	T (3/11)	Molecular Energies & Blackbody Radiation	<b>Midterm Test on Wed 3/12</b>
	R (3/13)	Radiative Transfer Without Scattering	Homework 5 assigned (due on Fri 3/28)
11	T (3/18)	Solid Angles, Scattering Phase Function, and Spherical Harmonics	
	R (3/20)	Scattering by Molecules (Rayleigh Scattering)	
12	T (3/25)	Scattering by Spherical Particulates (Lorentz-Mie, Geometric & Diffraction)	
	R (3/27)	Radiative Transfer With Scattering	Homework 6 assigned (due on Fri 4/11)

13	T (4/1)	Radiative Transfer With Scattering	
	R (4/3)	Remote Sensing via Satellites	
14	T (4/8)	Remote Sensing via Satellites	
	R (4/10)	Inverse Methods	
15	T (4/15)	Inverse Methods	
	R (4/17)	Inverse Methods	

## 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

- **Mid-term Tests and Final Exam:** During the Mid-term Tests and Final Exam, students are permitted to consult their past work, notes, textbooks, the Internet, and AI tools. However, students are forbidden to communicate with anyone (except the instructor) about the test/exam until after the deadline. All usage of AI tools and external materials must be declared in the student's submission.

- **Homeworks:** Working with other students is permitted, but *every student must submit their own work*. The use of AI tools and external material is permitted as long as those uses are declared in the homework 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 academic integrity policy

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-48.7 (B)). For additional information, see the Code of Student Conduct.

## Copyright disclaimer

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

## Statement on diversity

The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.

## Statement on Title IX

Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at <http://titleix.osu.edu> or by contacting the Ohio State Title IX Coordinator at [titleix@osu.edu](mailto:titleix@osu.edu).

## Your mental health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting [ccs.osu.edu](http://ccs.osu.edu) or calling 614--292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614--292--5766 and **24 hour emergency help is also available 24/7 by dialing 988 to reach the Suicide and Crisis Lifeline.**

## **ACCESSIBILITY ACCOMMODATIONS FOR STUDENTS**

### **Requesting accommodations for disabilities**

The university strives to maintain a healthy and accessible environment to support student learning in and out of the classroom. If you anticipate or experience academic barriers based on your disability (including mental health, chronic, or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that

you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion.

If you are ill and need to miss class, including if you are staying home and away from others while experiencing symptoms of a viral infection or fever, please let me know immediately. In cases where illness interacts with an underlying medical condition, please consult with Student Life Disability Services to request reasonable accommodations. You can connect with them at [slds@osu.edu](mailto:slds@osu.edu); 614-292-3307; or [slds.osu.edu](http://slds.osu.edu).

## **Requesting religious accommodations**

Ohio State has had a longstanding practice of making reasonable academic accommodations for students' religious beliefs and practices in accordance with applicable law. In 2023, Ohio State updated its practice to align with new state legislation. Under this new provision, students must be in early communication with their instructors regarding any known accommodation requests for religious beliefs and practices, providing notice of specific dates for which they request alternative accommodations within 14 days after the first instructional day of the course. Instructors in turn shall not question the sincerity of a student's religious or spiritual belief system in reviewing such requests and shall keep requests for accommodations confidential.

With sufficient notice, instructors will provide students with reasonable alternative accommodations with regard to examinations and other academic requirements with respect to students' sincerely held religious beliefs and practices by allowing up to three absences each semester for the student to attend or participate in religious activities. Examples of religious accommodations can include, but are not limited to, rescheduling an exam, altering the time of a student's presentation, allowing make-up assignments to substitute for missed class work, or flexibility in due dates or research responsibilities. If concerns arise about a requested accommodation, instructors are to consult their tenure initiating unit head for assistance.

A student's request for time off shall be provided if the student's sincerely held religious belief or practice severely affects the student's ability to take an exam or meet an academic requirement and the student has notified their instructor, in writing during the first 14 days after

the course begins, of the date of each absence. Although students are required to provide notice within the first 14 days after a course begins, instructors are strongly encouraged to work with the student to provide a reasonable accommodation if a request is made outside the notice period. A student may not be penalized for an absence approved under this policy.

If students have questions or disputes related to academic accommodations, they should contact their course instructor, and then their department or college office. For questions or to report discrimination or harassment based on religion, individuals should contact the Office of Institutional Equity. (Policy: Religious Holidays, Holy Days and Observances)