

# Physics 350 Heat and Thermodynamics

Spring 2024

## COURSE MEETING TIME AND PLACE:

| Meeting Time           | Location          |
|------------------------|-------------------|
| TuTh 12:30 pm- 1:45 pm | Science North 192 |

## INSTRUCTOR INFORMATION:

Dr. Shawn H. Pfeil

e-mail: [spfeil@wcupa.edu](mailto:spfeil@wcupa.edu) (please include course in subject line)

phone: (610) 430-4084

office: SECC 363

## OFFICE HOURS:

My scheduled office hours as of the first day of class are listed below. I reserve the right to adjust this schedule to reflect unforeseen circumstances.

|                      | Monday   | Tuesday  | Wednesday    | Thursday | Friday                                 |
|----------------------|----------|----------|--------------|----------|--|
| SECC 363 (my office) | 10-11 am | 10-11 am | 11 am – 1 pm | 10-11 am | Research Day<br><b>NO OFFICE HOURS</b> |

My scheduled office hours as of the first day of class are listed below. I reserve the right to adjust this schedule to reflect unforeseen circumstances.

## OPEN DOOR POLICY:

- If it is office hours, and I am not helping another student, I will stop whatever I am doing and help you.
- If it is not office hours and my office door is open, I will finish whatever task I am engaged in (the e-mail I am writing etc.) and then I will help you.
- If my door is closed, I have a deadline and cannot help you right now. Please come back.
- You might find a note on my door saying I am in my research space. It is one floor down...come find me.

*Office hours are available by appointment for students with an ongoing conflict with my scheduled hours.*

## REQUIRED COURSE MATERIALS:

Thermal Physics, Daniel V. Schroeder

## COURSE DESCRIPTION:

Equations of state, first and second laws of thermodynamics, ideal and real gases, entropy, and statistical mechanics.  
Pre / Co requisites: **PHY 350** requires prerequisite of **PHY 240**, **PHY 275** and **MAT 261**.

## COURSE OBJECTIVES:

As a course for majors **PHY 350** addresses the following physics program student learning outcomes:

- A. Knowledge and understanding of the concepts and principles of physics:** The particular concepts and principles of physics we aim to understand in this course are:

- The laws of Thermodynamics.
- Kinetic Theory.

**B. Effective Communicators:**

- Students will demonstrate an ability to communicate their knowledge of Physics with well written problem sets.

*Achievements of the program learning outcomes are assessed through exams and problem sets.*

**TIME COMMITMENT AND WORK FLOW:**

PHY 350 is a demanding course. Please set aside sufficient time. Below I have outlined an estimate of the time commitment involved.

**COURSE ELEMENTS:**

- **Pre-Class Reading:** You must read the assigned reading prior to class. Due to the pace of the course, we must focus our time in lectures on more challenging concepts. You are responsible for coming prepared.
- **Lecture:** Lots of questions are encouraged. This will be as informal as possible.
- **Problem Sets:** Problem sets will be posted weekly on D2L. The previous week’s problem set is due Tuesday by 11:59 pm on D2L as a single PDF file.

**GRADING:**

| <b>Component</b> | <b>Percentage</b>                   |
|------------------|-------------------------------------|
| Regular Exams    | 60% (three equally weighted exams.) |
| Final Exam       | 25%                                 |
| Problem Sets     | 15%                                 |

- **Regular Exams:** Three exams spaced throughout the semester. No exam scores will be dropped.
- **Final Exam:** The final exam is cumulative.
- **Problem Sets:** See course elements (above).

**We will be using the official WCU scale for grades, see p.48 in the undergraduate catalog.** However, I reserve the right to adjust the weights of individual components, or the scale to account for unforeseen circumstances.

**COURSE POLICIES**

*Below is a listing of established course policies. Please check this list first if you have a question. If your concern is not addressed by the list below, please see me in person.*

**ELECTRONIC DEVICE POLICY:**

The pace of the course is such that your undivided attention will be required for the entire lecture and lab period. Please set all electronics to silent or “vibrate mode” and put them away. Both you and your neighbors will be able to concentrate on the material at hand. ***If you are using a device to record lecture, please see the intellectual property statement below.***

**D2L:**

D2L will be used to post problem sets, grades, and announcements. Please make sure to check D2L periodically or enable it to push announcements via e-mail.

**ATTENDANCE POLICY:**

Attendance is taken for this course. Attending lectures, while highly correlated with success in this course is not graded. *Please note that I am required to report attendance to the University, and that this attendance can have financial aid implications.*

**INTELLECTUAL PROPERTY STATEMENT:**

I, the instructor, utilize copyrighted materials under the “Freedom and Innovation Revitalizing the United States Entrepreneurship Act of 2007” (Fair Use Act). Apart from such copyrighted materials, all other intellectual property associated with this course is owned and copyrighted by the instructor, including, but not limited to, lectures, course discussions, course notes, slides, assessment instruments such as exams, and supplementary materials posted or provided to students authored by the instructor. No recording, copying, storage in a retrieval system, or dissemination in any form by any means of the intellectual property of the instructor, in whole or in part, is permitted without prior written permission of the instructor. When such permission is granted, it must specify the utilization of the intellectual property and all such permissions and waivers shall terminate on the last day of finals of the semester in which this course is held.

**ACADEMIC & PERSONAL INTEGRITY**

It is the responsibility of each student to adhere to the university’s standards for academic integrity. Violations of academic integrity include any act that violates the rights of another student in academic work, that involves misrepresentation of your own work, or that disrupts the instruction of the course. Other violations include (but are not limited to): cheating on assignments or examinations; plagiarizing, which means copying any part of another’s work and/or using ideas of another and presenting them as one’s own without giving proper credit to the source; selling, purchasing, or exchanging of term papers; falsifying of information; and using your own work from one class to fulfill the assignment for another class without significant modification. Proof of academic misconduct can result in the automatic failure and removal from this course. For questions regarding Academic Integrity, the No-Grade Policy, Sexual Harassment, or the Student Code of Conduct, students are encouraged to refer to the Department Undergraduate Handbook, the Undergraduate Catalog, the Ram’s Eye View, and the University website at [www.wcupa.edu](http://www.wcupa.edu).

**ONLINE RESOURCES AND ACADEMIC INTEGRITY:**

Posting of any of the homework or exam questions from this course to Chegg, Course Hero, or any other site where solutions are made available for a fee is a violation of the academic integrity policy. Copying solutions to problems from these websites is a form of plagiarism since any student that does so passes off others’ work as their own. Solutions from any website which charges fees counts as buying solutions. Posting any materials which I have written, i.e., any exam questions in the course, is a violation of both academic integrity and a misuse of my intellectual property. Posting or accessing any exam course exam questions on these sites, at any time, will result in sanctions up to and including an F in the course.

**ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES**

West Chester University is committed to providing equitable access to the full WCU experience for Golden Rams of all abilities. Students should contact the Office of Educational Accessibility (OEA) to establish accommodations if they have had accommodations in the past or if they believe they may be eligible for accommodations due to a disability, whether or not it may be readily apparent. There is no deadline for disclosing to OEA or for requesting to use approved accommodations in a given course. However, accommodations can only be applied to future assignments or exams; that is, they can’t be applied retroactively. Please share your letter from OEA as soon as possible so that we can discuss accommodations. If you have concerns related to disability discrimination, please contact the university’s ADA Coordinator

in the Office of Diversity, Equity, and Inclusion: <https://www.wcupa.edu/admin/diversityEquityInclusion/> or 610-436-2433.

## EXCUSED ABSENCES POLICY

Students are advised to carefully read and comply with the excused absences policy, including absences for university-sanctioned events, contained in the WCU Undergraduate Catalog. In particular, please note that the “responsibility for meeting academic requirements rests with the student,” that this policy does not excuse students from completing required academic work, and that professors can require a “fair alternative” to attendance on those days that students must be absent from class in order to participate in a University-Sanctioned Event.

## REPORTING INCIDENTS OF SEXUAL VIOLENCE

West Chester University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to comply with the requirements of Title IX of the Education Amendments of 1972 and the University’s commitment to offering supportive measures in accordance with the new regulations issued under Title IX, the University requires faculty members to report incidents of sexual violence shared by students to the University’s Title IX Coordinator. The only exceptions to the faculty member’s reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. **Faculty members are obligated to report sexual violence or any other abuse of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred to the person designated in the University Protection of Minors Policy.** Information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is set forth at:

<https://www.wcupa.edu/admin/diversityEquityInclusion/sexualMisconduct/default.aspx>

## INCLUSIVE LEARNING ENVIRONMENT AND ANTI-RACIST STATEMENT

Diversity, equity, and inclusion are central to West Chester University’s mission as reflected in our [Mission Statement](#), [Values Statement](#), [Vision Statement](#) and [Strategic Plan: Pathways to Student Success](#). We disavow racism and all actions that silence, threaten, or degrade historically marginalized groups in the U.S. We acknowledge that all members of this learning community may experience harm stemming from forms of oppression including but not limited to classism, ableism, heterosexism, sexism, Islamophobia, anti-Semitism, and xenophobia, and recognize that these forms of oppression are compounded by racism.

Our core commitment as an institution of higher education shapes our expectation for behavior within this learning community, which represents diverse individual beliefs, backgrounds, and experiences. Courteous and respectful behavior, interactions, and responses are expected from all members of the University. We must work together to make this a safe and productive learning environment for everyone. Part of this work is recognizing how race and other aspects of who we are shape our beliefs and our experiences as individuals. It is not enough to condemn acts of racism. For real, sustainable change, we must stand together as a diverse coalition against racism and oppression of any form, anywhere, at any time.

Resources for education and action are available through WCU’s [Office for Diversity, Equity, and Inclusion](#) (ODEI), DEI committees within departments or colleges, the student [ombudsperson](#), and centers on campus committed to doing this work (e.g., [Dowdy Multicultural Center](#), [Center for Women and Gender Equity](#), and the [Center for Trans and Queer Advocacy](#)).

Guidance on how to report incidents of discrimination and harassment is available at the University’s [Office of Diversity, Equity and Inclusion](#).

## EMERGENCY PREPAREDNESS

All students are encouraged to sign up for the University's free WCU ALERT service, which delivers official WCU emergency text messages directly to your cell phone. For more information, visit [www.wcupa.edu/wcualert](http://www.wcupa.edu/wcualert). To report an emergency, call the Department of Public Safety at 610-436-3311.

## ELECTRONIC MAIL POLICY

It is expected that faculty, staff, and students activate and maintain regular access to University provided e-mail accounts. Official university communications, including those from your instructor, will be sent through your university e-mail account. You are responsible for accessing that mail to be sure to obtain official University communications. Failure to access will not exempt individuals from the responsibilities associated with this course.

## ALL OTHER ACADEMIC POLICIES

For any university wide academic policy not explicitly covered in this document, such as No Grade policies. Please consult your major advising handbook, the Undergraduate Catalog, the Ram's Eye View, or the University Website.

**TENTATIVE COURSE SCHEDULE:** (next page): A tentative schedule for the course follows. Although I will endeavor to stick closely to the schedule as posted below, I reserve the right to modify it as needed over the course of the semester. (Homework due dates can be found on D2L.)

| Date (mm/dd) | Day | #  | Topic   | Reading |
|--------------|-----|----|---|---------|
| 01/23        | T   | 1  | Intro., Thermal Equilibrium, The Ideal Gas    | 1.1-1.2 |
| 01/25        | R   | 2  | Equipartition, Heat & Work, Compression Work  | 1.3-1.4 |
| 01/30        | T   | 3  | Compression Work, Heat Capacity               | 1.5-1.6 |
| 02/01        | R   | 4  | Rate Processes and Catch-Up                   | 1.7     |
| 02/06        | T   | 5  | Two State Systems, Einstein Model of a Solid  | 2.1-2.2 |
| 02/08        | R   | 6  | Interacting Systems, Large Systems            | 2.3-2.4 |
| 02/13        | T   | 7  | The Ideal Gas, Entropy                        | 2.5-2.6 |
| 02/15        | R   | 8  | Temperature, Entropy and Heat                 | 3.1-3.2 |
| 02/20        | T   | 9  | Paramagnetism, Mech. Equilibrium and Pressure | 3.3-3.4 |
| 02/22        | R   | 10 | Chemical Potential, Catch-Up                  | 3.5-3.6 |
| 02/27        | T   |    | Heat Engines and Refrigerators                | 4.1-4.2 |
| 02/29        | R   | 11 | Real Heat Engines and Refrigerators           | 4.3-4.4 |
| 03/05        | T   | 12 | <b>Exam 1: Chapters 1-3</b>                   |         |
| 03/07        | R   | 13 | Free-Energy: Available Work, Toward Equil.    | 5.1-5.2 |
| 03/12        | T   | 14 | Phase Transformations                         | 5.3-5.4 |
| 03/14        | R   | 15 | Dilute Solutions & Chemical Equilibria        | 5.5-5.6 |
| 03/19        | M   | 16 | The Boltzmann Factor, Average Values          | 6.1-6.2 |
| 03/21        | W   | 17 | Equipartition, The Maxwell Speed Distribution | 6.3-6.4 |
| 03/26        | T   |    | <b>Exam 2: Chapters 4-5</b>                   |         |
| 03/28        | R   | 18 | Partition Functions                           | 6.5-6.6 |
| 04/02        | T   | 19 | Ideal Gas Revisited, Catch-Up                 | 6.7     |
| 04/04        | R   | 20 | The Gibbs Factor                              | 7.1     |
| 04/09        | T   | 21 | Bosons and Fermions                           | 7.2     |
| 04/11        | R   | 22 | Degenerate Fermi Gases, Blackbody Radiation   | 7.3-7.4 |

|       |   |    |                                  |         |
|-------|---|----|----------------------------------|---------|
| 04/16 | T |    | <b>THANKSGIVING BREAK</b>        |         |
| 04/18 | R |    |                                  |         |
| 04/23 | T | 22 | Debye Theory of Solids, BECs     | 7.5-7.6 |
| 04/25 | R |    | <b>Exam 3: Chapter 6-7.4</b>     |         |
| 04/30 | T | 23 | Systems of Interacting Particles | 8.1-8.2 |
| 05/02 | R |    | Catch-Up/Review                  |         |
| 05/09 | R |    | <b>FINAL EXAM 8:00-10:00 AM</b>  |         |