

Thermodynamics and Statistical Physics (PH 360) Course Syllabus

Winter 2022 ◦ Northern Michigan University

Instructor: Dr. P. W. Mengyan (“men-gin”) **Office:** Science 2513 **Phone:** 906.227.2183
Email: pmengyan@nmu.edu [preferred comm. method]. Begin subject line with “PH 360:”
Office Hours: Mon and Thurs 13:00 to 14:50 via Zoom*. Other times by appointment.
**If it is safe to meet face-to-face, office hours will be in Science 2513.*
Class Meetings PH 360 - Lecture [CRN: 11127]: {M,W,F} 10:00 to 10:50 in Science 2506
Webpage: <https://educat.nmu.edu> ; <http://physics.nmu.edu/~pmengyan>
Required Text: S.J. Blundell, Concepts in Thermal Physics. 2nd ed. (Oxford, 2010).
Lecture [ISBN: 978-0-19-956210-7] *Note the latest reprint, with corrections, is dated 2016.*

Course Description (outline and expected outcomes): This course will provide a junior to senior level introduction to equilibrium thermal and statistical physics with applications. This course will encourage developing critical thinking and general problem-solving skills. The expected outcomes are to develop a general understanding of each topic area (detailed in the schedule below) and demonstrate strong problem-solving skills. Progress towards these outcomes will be assessed through in-class exams, homework assignments, quizzes and projects. More information is available via the webpage.

Grades:

Homework, Quizzes, Attendance:	25%	A: $\geq 90\%$	A passing score for each component must be earned in order to qualify for a passing score in the course
In-semester Exams:	25%	B: $\geq 80\%$	
Final Exam:	25%	C: $\geq 70\%$	
Project:	25%	D: $\geq 60\%$	
<u>Total:</u>	<u>100%</u>	F: $< 60\%$	

'+' & '-' assigned $\pm \sim 2.0\%$ of the cutoff

Homework: Assigned periodically during lecture and may include suggested questions, readings and other activities to supplement the lecture. Due date, time and assignment description will be indicated on each assignment. Late assignments are *not* typically accepted.

The homework will take time and effort to understand and may be challenging. Start the homework as soon as it is available and allow plenty of time to work through each question. Be warned that some questions may go quickly and others may take a significant amount of time.

Quizzes: Will be administered during the regularly scheduled class time and may include content from lecture, homework, exams or any other relevant sources. They may or may not be announced during class and will *never* be announced via email. **Make up quizzes will not be administered.** These will be designed with a few goals in mind (1) provide students the opportunity to check their understanding of relevant material and receive feedback from the instructor (2) provide the instructor with feedback as to how well students are understanding the material (3) encourage students to continue to stay on top of the material, develop sound study habits, regularly attend class, etc

Exams: There will be a minimum of two (2) scheduled exams during the semester plus a cumulative final exam. Each in-class exam is equally weighted. The in-semester exams will be administered in the normal classroom, during a normal class time and may include a take-home component.

The final exam will be administered in the same room as lecture and the time pre-determined by NMU. Make up exams will not be administered. If an exam is to be missed due to extenuating circumstances, contact me via email BEFORE the scheduled exam time to see about making the appropriate arrangements. Use of notes, books or electronic gizmos of any sort will not be permitted on the exams unless otherwise specified by the instructor.

Project: Each student will complete a project that includes a formal scientific paper (PRL-style formatting with 4-page limit) and 12+3 minute presentation. These projects will be based on concepts

related to the course. The final project will be due around the last week of the course. Final papers are to be submitted no later than 17:00 the business day immediately preceding the first scheduled talk. Additional details regarding formatting, content, style and other expectations will be discussed in class.

Other Requirements and Important Notes:

- Attendance:

You are expected to be in every class and on time. Absences will be excused for officially sanctioned university events, illness (documentation *may* be required), court appearance (plaintiff, defendant, witness, juror – documentation is required), family emergencies (at the discretion of the instructor and may require appropriate documentation).

If something occurs that you feel should be grounds for being excused it is your responsibility to contact your instructor, in writing, PRIOR to the absence (if possible, or as soon as possible after the absence) to discuss the situation. Excused absences for situations beyond the purview of NMU policy are at the sole discretion of the instructor, will be evaluated confidentially, on a case-by-case basis and confirmed in writing.

An excused absence does not necessarily excuse you from completing the work. Arrangements for a planned excused absence, if possible, should be finalized (with written confirmation between student and instructor) no later than one business day before the planned absence, if possible.

Otherwise, establish contact with the instructor as soon as reasonably possible.

- Submitted work:

Unless otherwise specified by the instructor, any work submitted for credit must be on standard size clean loose-leaf paper (i.e. not torn from a notebook, not covered in mysterious substances), clearly labeled and well organized. For homework, each question should be started on a fresh sheet of paper and writing should be on only one side per page.

- MATLAB:

is to be used for any data analysis and plotting needs, including homework unless specifically stated otherwise. If you use MATLAB to assist you in solving a question submitted for credit for anything more complicated than what could be otherwise easily done on a handheld calculator, a clean version of the m-file, command output and any relevant figures must be submitted with the assignment. Exceptions to this rule can be made in the event where Maple is the more appropriate tool, but require instructor approval if it an assignment submitted for credit.

- Late Assignments:

Late work is not generally accepted. Should something arise that will prohibit you from submitting work on time, talk to your instructor as soon as you recognize there may be an issue.

- ADA Statement:

In compliance with the ADA and university policy, *“If you have a need for disability-related accommodations or services, please inform the Coordinator of Disability Services in the Dean of Students Office at 2101 C. B. Hedgcock Building (227-1737 or disserv@nmu.edu). Reasonable and effective accommodations and services will be provided to students if requests are made in a timely manner, with appropriate documentation, in accordance with federal, state, and University guidelines.”*

- Religious Holidays:

Pursuant to university policy, a student who intends to observe a religious holy day should make that intention known, in writing, to the instructor prior to an absence. A student who is absent from a class, exam or exercise for the observance of a religious holy day shall be allowed to complete an assignment or exam scheduled for that day within a reasonable time around that absence.

- Academic Integrity:

Section 2.3.1 of the NMU Student Handbook discusses scholastic dishonesty; all of which will be upheld in all aspects of this course. Academic dishonesty will not be tolerated.

- **Appropriate behavior:**
I expect students to behave in a respectful, considerate and courteous fashion in any activity related to this course (e.g. Lecture, lab, discussion, office hours etc).
Rude, disrespectful or disruptive behavior will *never* be tolerated.

Final Notes and Suggestions to Succeed:

- **Course Assistance:** A plethora of options are available to support your success in this course (e.g. Lecture [Dr. Mengyan], discussion via class, office hours, email or special appointment), your textbook, the library, other text books and your classmates. Take advantage of the available resources. **DO NOT HESITATE TO ASK QUESTIONS AS THEY ARISE!**
- Preparation is the key!
 - o Read your book material before AND after we discuss it in class
 - o Take good notes during lecture (reorganize and rewrite if necessary)
 - o Study your notes
 - o Take advantage of available resources (e.g. *actually* attend class, read the book)
 - o If something is unclear during lecture or your own studying, **ASK ABOUT IT!**
- Homework and supplemental work:
 - o Start your homework assignments as early as possible
 - o Read the homework questions when they are available before the related material is presented in class; familiarity with the questions will help you associate the relevant concepts as they are introduced in lecture, lab and while you read the material
 - o Give yourself plenty of time to complete the assignments as you will likely need to think carefully about the questions, review the relevant sections of the text or your notes and then work towards a solution
 - o Use a dedicated notebook to *fully* work out homework and supplemental questions
- Studying for any exam should be an ongoing exercise. Structured reviews of material built into your schedule promotes better long-term retention and higher understanding of the material
- I cannot stress enough: **ASK QUESTIONS WHEN YOU HAVE THEM!**

Tentative Schedule of Course Topics:

<u>Wk</u>	<u>Start Date</u>	<u>Ch.</u>	<u>Content / Additional Detail</u>
1	10 Jan 22	1,2	Syllabus, expectations; Introduction, Heat (Ch 1-2)
2	17 Jan 22	3,4,5*	Probability, Temperature, *Maxwell-Boltzmann distribution
3	24 Jan 22	6*,10*,11	*Pressure, *Thermal diffusion, 1 st Law (Energy)
4	31 Jan 22	12,13,14	Isothermal and Adiabatic processes; Heat engines and 2 nd law; Entropy
5	07 Feb 22	16,17	Thermodynamic Potentials, Applications (Rods, Bubbles, Magnets)
6	14 Feb 22	18,19	~ Exam 1 ; 3 rd law, Equipartition of energy
7	21 Feb 22	20,21	Partition Function, Statistical mechanics of ideal gas
28 Feb 22			** Mid-Semester Recess, No Class 26 Feb to 06 Mar 2022**
8	07 Mar 22	22,23	Chemical potential, Photons
9	14 Mar 22	24*,25*	*Phonons, *Relativistic gasses
10	21 Mar 22	26,27	Real gasses, cooling real gasses
11	28 Mar 22	28	Phase transitions
12	04 Apr 22		~ Exam 2 ; Special topics
13	11 Apr 22		Special topics
14	18 Apr 22		~ Projects ; Special topics; General review
FE	28 Apr 22		Final Exam: 10:00 to 11:50 in West Science 2506

Items with the "" designation may be omitted depending on interest and timing*

Notable dates

10 Jan 2022	First official day of class
17 Jan 2022	Martin Luther King Day (no class)
26 Feb to 06 Mar 2022	Mid-semester recess (no class)
13 Mar 2022	Daylight savings time starts ('spring' forward)
23 Apr 2022	Last day of class
Thurs 28 Apr 2022	Final exam (10:00 to 11:50)
Sat 30 Apr 2022	Commencement