

Topics in Statistical Thermodynamics

CHEM 5530 (Fall 2025)

Times: M/W 11:30 am to 12:45 pm

Location: SLSRC 2410

Course Instructor: Dr. Ulrich H.E. Hansmann

Office: SLSRC 3040

Office hours: M/W after class or by appointment

Email: uhansmann@ou.edu

Course web site: <http://hansmann-lab.com/cbpc/hansmann/5530.php>

Description

The purpose of this course is to introduce fundamental concepts of statistical mechanics and thermodynamics from the viewpoint of chemistry and biology. **Learning outcome** should be an in-depth understanding of the role of thermodynamics and statistical mechanics in describing chemical processes. The course is directed toward graduate and advanced undergraduate students in physical chemistry, biochemistry, bioengineering and chemical engineering, who will find that the presented conceptions appear in many contexts. The following concepts (among other) will be discussed:

- 1) Review of thermodynamics
- 2) The statistical basis of thermodynamics
- 3) Elements of ensemble theory
- 4) Statistical mechanics of simple gases and solids
- 5) Lattice models for liquids and solutions
- 6) Theory of phase transitions; mean field and Landau theory
- 7) Phase transitions and critical phenomena; exact models
- 8) Phase transitions in biological macromolecules
- 9) Polymers solutions: Flory-Huggins model, Flory theorem
- 10) Polymer conformations and dynamics: Rouse-Zimm model

Textbooks (suggested)

- R.K. Pathria "Statistical Mechanics", 2nd Edition, Butterworth-Heinemann, 1996
- Landau and Lifshitz, "Statistical Physics", 3rd Edition, Part 1
- M. Plischke & B. Bergersen: Equilibrium Statistical Physics, Prentice Hall 1989
- Dill and Bromberg, "Molecular Driving Forces", Garland Science, 2003

Pre-requisites

At least one undergraduate-level physical chemistry course is required, or consult with the lecturer.

Grading Scheme

Home work: 70% Final exam: 30%

Make-up exam and home work extensions

Make-up exams or assignment deadline extensions will be given only under extreme circumstances and only with prior notification and documentation. There will be no extra credit assignments given.

University codes and policies of behavior

Copyright Syllabus Statement for In-Person or Online Courses: Sessions of this course may be recorded or live-streamed. These recordings are the intellectual property of the individual faculty member and may not be shared or reproduced without the explicit, written consent of the faculty member. In addition, privacy rights of others such as students, guest lecturers, and providers of copyrighted material displayed in the recording may be of concern. *Students may not share any course recordings with individuals not enrolled in the class or upload them to any other online environment.*

Codes and Policies of Behavior Policy: Each student has to be acquainted with the University codes, policies, and procedures involving academic misconduct, grievances, sexual and ethnic harassment, and discrimination based on physical handicap.

Academic Integrity: Cheating is strictly prohibited at the University of Oklahoma, because it devalues the degree you are working hard to get. As a member of the OU community it is your responsibility to protect your educational investment by knowing and following the rules. For specific definitions on what constitutes cheating, review the Student's Guide to Academic Integrity at http://integrity.ou.edu/students_guide.html. In order to be successful in this class, all work on exams and quizzes must be yours, and yours alone. *You may not solicit or receive outside help.* On examinations and quizzes you will never be permitted to use your notes, textbooks, ect. Should you see someone else engaging in this behavior, I encourage you to report it to myself or directly to the Office of Academic Integrity Programs. That student is devaluing not only their degree, but yours, too. Students engaging in academic misconduct (including

cheating, plagiarism, and any other action that may improperly affect evaluation) will be subject to sanctions in accordance with the Norman Campus Academic Misconduct Code. *I will assign an "F" for the course* and may recommend expulsion from the University for such violations

Generative AI Usage Policy: Any usage of Generative AI in this course may be considered a violation of the academic integrity policy for this course and could result in a zero for an assignment or a failing grade on the course.

Reasonable Accommodation Policy: The Accessibility and Disability Resource Center is committed to supporting students with disabilities to ensure that they are able to enjoy equal access to all components of their education. This includes your academics, housing, and community events. If you are experiencing a disability, a mental/medical health condition that has a significant impact on one or more life functions, you can receive accommodations to provide equal access. Possible disabilities include, but are not limited to, learning disabilities, AD(H)D, mental health, and chronic health. Additionally, we support students with temporary medical conditions (broken wrist, shoulder surgery, etc.) and pregnancy. To discuss potential accommodations, please contact the ADRC at 730 College Avenue, (ph.) 405.325.3852, or adrc@ou.edu.

Religious Observance: It is the policy of the University to excuse absences of students that result from religious observances and to provide without penalty for the rescheduling of examinations and additional required classwork that may fall on religious holidays. Students who plan to observe a religious holiday should notify me as soon as possible in order to make appropriate arrangements for classwork or taking of examinations.

Title IX Resources and Reporting Requirement: Anyone who has been impacted by gender-based violence, including dating violence, domestic violence, stalking, harassment, and sexual assault, deserves access to resources so that they are supported personally and academically. The University of Oklahoma is committed to offering resources to those impacted, including: speaking with someone confidentially about your options, medical attention, counseling, reporting, academic support, and safety plans. If you would like to speak with someone confidentially, please contact OU Advocates (available 24/7 at 405-615-0013) or another confidential resource. You may also choose to report gender-based violence and discrimination through other means, including by contacting the Institutional Equity Office (ieo@ou.edu, 405-325-3546) or police (911). Because the University of Oklahoma is committed to the safety of you and other students, I, as well as other faculty, Graduate Assistants, and Teaching Assistants, are mandatory reporters. This means that we are obligated to report gender-based violence that has been disclosed to us to the Institutional Equity Office. This includes disclosures that occur in: class discussion, writing assignments, discussion boards, emails and during Student/Office Hours. For more information, please visit the Institutional Equity Office

Adjustments for Pregnancy/Childbirth Related Issues: Should you need modifications to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact me or the Accessibility and Disability Resource Center at 405/325-3852 as soon as possible.

Emergency Protocol: During an emergency, there are official university procedures that will maximize your safety:

Severe Weather: If you receive an OU Alert to seek refuge or hear a tornado siren that signals severe weather

1. *LOOK* for severe weather refuge location maps located inside most OU buildings near the entrances
2. *SEEK* refuge inside a building. Do not leave one building to seek shelter in another building that you deem safer. If outside, get into the nearest building.
3. *GO* to the building's severe weather refuge location. If you do not know where that is, go to the lowest level possible and seek refuge in an innermost room. Avoid outside doors and windows.
4. GET IN, GET DOWN, COVER UP.
5. *WAIT* for official notice to resume normal activities.

Armed Subject/Campus Intruder: If you receive an OU Alert to shelter-in-place due to an active shooter or armed intruder situation or you hear what you perceive to be gunshots:

1. *GET OUT:* If you believe you can get out of the area *WITHOUT* encountering the armed individual, move quickly towards the nearest building exit, move away from the building, and call 911.
2. *HIDE OUT:* If you cannot flee, move to an area that can be locked or barricaded, turn off lights, silence devices, spread out, and formulate a plan of attack if the shooter enters the room.
3. *TAKE OUT:* As a last resort fight to defend yourself.

Fire Alarm/General Emergency: If you receive an OU Alert that there is danger inside or near the building, or the fire alarm inside the building activates:

1. *LEAVE* the building. Do not use the elevators.

2. *KNOW* at least two building exits
3. *ASSIST* those that may need help
4. *PROCEED* to the emergency assembly area
- 5 *ONCE safely outside, NOTIFY first responders of anyone that may still be inside building due to mobility issues.*
6. *WAIT* for official notice before attempting to re-enter the building.

Mental Health Support Services: If you are experiencing any mental health issues that are impacting your academic performance, counseling is available at the University Counseling Center (UCC). The Center is located on the second floor of the Goddard Health Center, at 620 Elm Rm. 201, Norman, OK 73019. To schedule an appointment call (405) 325-2911. For more information please visit <http://www.ou.edu/ucc>.

Disclaimer: I reserve the right to change by addition and/or subtraction any and/or all materials contained in this syllabus. This includes, but is not limited to, course content, assignments, scheduled dates, and fraction(s) of the final grade assigned to individual items within the course. Although your attendance at the lecture is not required, you are responsible for any announcements made in class, including changes in the examination schedule, course content, assignments, scheduled dates, and fraction(s) of the grade assigned to individual items within the course. If changes become necessary, I will announce them as early as possible.

Last update: Aug. 20, 2025