University of North Texas
CHEM 3520 – Physical Chemistry II – Spring 2024

Syllabus

Instructor Team

• Instructor
  o Dr. Omar Valsson
    ▪ Office: Chemistry Building, Room 205C (enter from 205/CASCaM Suite on 2nd floor)
    ▪ Email: omar.valsson@unt.edu
    ▪ Twitter: @OmarValsson
    ▪ Webpage: www.valsson.info

• Teaching Assistant (TA) / Grader
  o Kriti Alam
    ▪ Office: Chemistry Building, Room 262
    ▪ Email: KritiAlam@my.unt.edu
    ▪ Webpage: www.valsson.info/members/kriti-alam

Schedule

• Lectures: 10:00 – 10:50 am, Mon/Wed/Fri
  o In the Life Science Building A, Room 106
  o Given by the instructor, Dr. Omar Valsson
  o First Lecture will be Wednesday, January 17

• Recitations (optional): 2:00 – 2:50 pm, Wed
  o In Business Leadership Building, Room 090
  o Given by the TA, Kriti Alam, or the instructor, Dr. Omar Valsson
  o First Recitation will be Wednesday, January 24

All information given below is subject to change at the discretion of the instructor. All changes will be communicated to students via Canvas or email.

Office Hours – Dr. Omar Valsson

• Mondays, 12:15 – 2:00 pm, or by appointment
• In-person at my office (Chem 205C)
• Can be online via Zoom if requested in advance
• A heads-up message if you are planning to come by would be appreciated
Course description and goals

Physical Chemistry II is the second part of a two-course sequence designed to provide students with the fundamental understanding of the principles underlying the behavior of chemical systems. In this course, we will explore the basics of quantum mechanics and spectroscopy. Quantum mechanics provides a mathematical description of the behavior and interactions of very small particles that are not correctly described by classical mechanics.

We will have a detailed discussion of the theoretical fundamentals and chemical applications of quantum mechanics. We will discuss how quantum mechanics determines atomic and molecular structure and spectroscopic transitions in microwave, infrared, electronic, photoelectron, electron spin and NMR.

Familiarity with Calculus I, II and Multivariable Calculus, as well as Mechanics and Electromagnetism will be necessary.

At the conclusion of the course, you will be able to:

- Understand the development and necessity of quantum mechanics
- Define and describe the postulates of quantum mechanics
- Explain atomic/molecular structure and spectroscopy in terms of quantum mechanics.
- Deduce molecular structure from spectroscopic data.

Prerequisite

CHEM 3510 (one of whose prerequisites is two semesters of calculus).

Readings and Material

- Recommend text: Atkins’ Physical Chemistry, by Atkins, de Paula, (and Keeler). Any edition should work, but Chapter references will be based on 11th/12th edition and 10th edition. Lectures will be based on the 11th/12th editions (which are very similar). Note that the accompanying Student Solutions Manual is not needed.
- Various online references cover the same material and are useful:
  - Sections 1 to 15 in Physical Chemistry LibreText
  - MIT OCW Physical Chemistry
- Videos at the TMPchem Channel on YouTube covering the material are very useful and highly recommended – https://www.youtube.com/user/TMPchem
- Mathematical background: Mathematical Methods for Molecular Science, by John Straub is a good reference for the mathematical background needed, will be available in Canvas.
- Other reading material and handouts, including journal articles, will be made available on Canvas.
- All lecture slides and notes from my lectures will be made available on Canvas.
Course Outline
The schedule of topics listed below is an estimate. Inevitably the pace of the lectures will adjust to the realities of the classroom and we might not cover some of the material.

To make the best usage of the lectures, you should read the relevant readings before each lecture. Throughout the semester, I will inform via Canvas what material will be covered in each lecture beforehand. The readings in Atkins’ Physical Chemistry are given below, and I will point to the relevant sections in the online material in the announcements.

Readings in Atkins’ Physical Chemistry
Chapters/Topics in parentheses for 12th and 11th / 10th edition
(The chapter division is the same in for 12th and 11th editions)
- Introduction, Motivation for Quantum Mechanics (7A / 7A)
- Mathematical background (complex numbers, differential equations, ...)
- Introduction to QM (7B-7C / 7B-7C)
- Mathematics for QM and Fundamental Concepts (7B-7C / 7B-7C)
- QM Theory of Motion – Translation (7D / 8A)
- QM Theory of Motion – Vibration (7E / 8B)
- QM Theory of Motion – Rotation (7F / 8C)
- Atomic Structure and Spectra – The Hydrogen Atom (8A / 9A)
- Atomic Structure and Spectra – Many-Electron Atoms (8B / 9B)
- Atomic Structure and Spectra – Atomic Spectra (8C / 9C)
- Molecular Structure – Valence-Bond Theory (9A / 10A)
- Molecular Structure – Molecular Orbital Theory (9B / 10B)
- Molecular Structure – Diatomic Molecules (9C-9D / 10C-10D)
- Molecular Structure – Polyatomic Molecules (9E / 10E)
- Molecular Structure – Computational Chemistry (9F / Not in 10th and 11th editions)
- Molecular Spectroscopy – General (11A / 12A)
- Molecular Spectroscopy – Rotational (11B / 12B-12C)
- Molecular Spectroscopy – Vibrational (11C-11E / 12D-12E)
- Molecular Spectroscopy – Electronic Spectra (11F-11G / 13A-13C)
- Magnetic Resonance – General (12A / 14A)
- Magnetic Resonance – NMR Spectra (12B / 14B)
- Magnetic Resonance – Pulse Techniques in NMR (12C / 14C)
- Magnetic Resonance – Electron Paramagnetic Resonance (12D / 14D)
Course Grading

The course grades will be calculated as follows:

- Attendance – 10% (based on lecture attendance only)
- Homework – 40%
- Take Home Exam 1 – 20% (provisionally planned the week of March 4–8)
- Take Home Exam 2 – 20% (provisionally planned the week of April 22–26)
- Literature Project – 10% (provisionally planned the week of April 1-5)

In addition:

- Optional mathematical homework exercise that can give up to extra 10% points

Note that there will be no final exam in the course.

Letter grades will be assigned based on the numerical scores: A = 90-100; B = 80-89; C = 70-79; D = 60-69.

Attendance

- Attendance will be taken during lectures and will account for 10% of the grade.
- If you know that you cannot attend a lecture due to some reason, please let me know beforehand.
- Acceptable exceptions to attending lecture will be approved on a case-by-case basis.
- Requests for excused absence must be communicated to the instructor, Dr. Omar Valsson, in written form via email at omar.valsson@unt.edu beforehand.
- Acceptable university excused absence include active military service, a religious holy day, or an official university function as stated in the Student Attendance and Authorized Absences Policy.
- If you cannot attend a class due to an emergency, please let me know. Your safety and well-being are important to me.
- Up to three unexcused absences are allowed during the semester. In other words, only unexcused absences above 3 will affect the attendance grade.

Homework

- There will around 7-9 homework assignments throughout the semester, depending on the pace at which the material is covered.
- All homework assignments will be posted and collected via the internet.
- You must access your assignment online on the course website on Canvas, work the problems, and submit your solutions by the due date indicated online.
- In general, no late assignments will be accepted. Deadline extensions may be given on a case-by-case basis for exceptional cases or for religious observance. Excused extensions should be arranged prior to the due date.
- Homework will be graded, and the grades returned around one week after the due date. All questions concerning the grading of homework assignments must be directed to the instructor in writing within two weeks after the grades are returned to the class.
- Homework solutions will be posted after the due date.
• The one worst homework assignments will be excluded from the final grade calculation of the homework. All other homework assignments will carry equal weight towards the grade.

Take Home Exams
• There will be two take home exams during the semester.
• The exams are provisionally planned for the weeks of March 4–8 and April 22–26.
• The take home exams questions will be based on lecture material, material contained in the texts and in the homework assignments.
• The take home exams will be open book exams. You can freely use Atkins’ and other books, notes from lectures and recitations, and other resources to solve the exams.
• However, you are not allowed to discuss any exam questions with your classmates or ask questions online.
• Any student caught cheating will be given a grade of zero for the final exam.
• All questions concerning the grading of the in-class exams must be directed to the instructor in writing within two weeks after the grades are returned to the class.

Literature Project
• There will be a project where you will study a research paper from the literature applying quantum mechanics to a practical chemistry problem.
• We will discuss this research paper in class.
• There will be a brief assignment where you will answer questions based on the paper and the in-class discussions.
• Further information will be given later.

Optional Mathematical Homework Exercise
• There will be an optional mathematical homework exercise given at the end of the course.
• This homework exercise can add up to extra 10% points to the grade.
• This optional homework exercise is to acknowledge the effort you may have put into learning additional mathematics needed to tackle the course.

Class Policy
• Connect with me through email and/or by attending office hours. During busy times, my inbox becomes rather full, so if you contact me and do not receive a response within two business days, please send a follow up email. A gentle nudge is always appreciated.
• Research has shown that students who attend class are more likely to be successful. Therefore, attendance to the lectures is, in principle, mandatory and you should attend every class. You will get a part of your grade for attendance of lectures. Acceptable exceptions will be approved on a case-by-case basis. Acceptable university excused absence include active military service, a religious holy day, or an official university function as stated in the Student Attendance and Authorized Absences Policy. If you
cannot attend a class due to an emergency, please let me know. Your safety and well-being are important to me.

- It is important for all of us to be mindful of the health and safety of everyone in our community. Please contact the instructor if you are unable to attend class because you are ill, or unable to attend class due to a health related issue. Acceptable exceptions will be approved on a case-by-case basis.

- I value the many perspectives students bring to our campus. Please work with me to create a classroom culture of open communication, mutual respect, and inclusion. All discussions should be respectful and civil. Although disagreements and debates are encouraged, personal attacks are unacceptable. Together, we can ensure a safe and welcoming classroom for all. If you ever feel like this is not the case, please stop by my office and let me know. We are all learning together.

- Being punctual indicates our respect for others. Please arrive before class begins to find a seat, prepare your materials, and connect with your peers. The beginning of class is especially critical—just like the beginning of a movie or book. Being late to class is sometimes inevitable. If you are late, know that you are welcome to join the class, but please do so without distracting others. More than two instances of tardiness will result in an absence from class.

- Students are to be prepared for class (read/review assigned chapters prior to lecture) and are expected to participate by answering in-class questions and taking weekly quizzes.

- Silence mobile phones prior to attending class. Put mobile phones away.

- Learning is a two-way street, therefore, I will ask you for feedback throughout the course. I will take your feedback seriously, and work hard to incorporate your ideas on how to improve the course.

- My policy in this class is to **not** communicate any details regarding your grade through email. I will only discuss these details in private in-person meetings or through private online meetings.

**Ancillary Information**

**Succeed at UNT**

UNT endeavors to offer you a high-quality education and to provide a supportive environment to help you learn and grown. And, as a faculty member, I am committed to helping you be successful as a student. Here’s how to succeed at UNT: **Show up. Find Support. Get advised. Be prepared. Get involved. Stay focused.** To learn more about campus resources and information on how you can achieve success, go to [http://success.unt.edu/](http://success.unt.edu/).

**Legal Notice Regarding Lecture Notes**

My lectures and notes are protected by state common law and federal copyright law. You are authorized to take notes in class thereby creating a derivative work from my lecture, but the authorization extends only to making one set of notes for your own personal use and no other use. You are not authorized to record my lectures, to provide your notes to anyone else (hard
copy or electronic), or to make any other use of those notes without express prior written permission from me.

**Academic Dishonesty**
Students caught cheating or plagiarizing will receive a “0” for that particular assignment or exam. Additionally, the incident will be reported to the Dean of Students, who may impose further penalty. According to the UNT catalog, the term “cheating” includes, but is not limited to: (a) use of any unauthorized assistance in taking quizzes, tests, or examinations; (b) dependence upon the aid of sources beyond those authorized by the instructor in writing papers, preparing reports, solving problems, or carrying out other assignments; (c) the acquisition, without permission, of tests or other academic material belonging to a faculty or staff member of the university; (d) dual submission of a paper or project, or resubmission of a paper or project to a different class without express permission from the instructor(s); or (e) any other act designed to give a student an unfair advantage. The term “plagiarism” includes, but is not limited to: (a) the knowing or negligent use by paraphrase or direct quotation of the published or unpublished work of another person without full and clear acknowledgment; and (b) the knowing or negligent unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials. Further information on UNT’s policy on **Academic Dishonesty** can be found at: [http://www.vpaa.unt.edu/academic-integrity](http://www.vpaa.unt.edu/academic-integrity)

**Acceptable Student Behavior**
Student behavior that interferes with an instructor’s ability to conduct a class or other students’ opportunity to learn is unacceptable and disruptive and will not be tolerated in any instructional forum at UNT. Students engaging in unacceptable behavior will be directed to leave the classroom and the instructor may refer the student to the Dean of Students to consider whether the student’s conduct violated the Code of Student Conduct. The university’s expectations for student conduct apply to all instructional forums, including university and electronic classroom, labs, discussion groups, field trips, etc. The Code of Student Conduct can be found at [https://deanofstudents.unt.edu/conduct](https://deanofstudents.unt.edu/conduct).

**Withdrawal from Class**
The administration of this institution has set deadlines for withdrawal of any college-level courses. These dates and times are published in that semester’s course catalog. Administration procedures must be followed. It is the student’s responsibility to handle withdrawal requirements from any class. In other words, I cannot drop or withdraw any student. You must do the proper paperwork to ensure that you will not receive a final grade of “F” in a course if you choose not to attend the class once you are enrolled.

**ADA Policy**
UNT makes reasonable academic accommodation for students with disabilities. Students seeking accommodation must first register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide a student with an
accommodation letter to be delivered to faculty to begin a private discussion regarding one’s specific course needs. Students may request accommodations at any time, however, ODA notices of accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of accommodation for every semester and must meet with each faculty member prior to implementation in each class. For additional information see the ODA website (https://disability.unt.edu/).

Canvas

Canvas will be used to post course materials and your grades. To get to this resource, go to https://unt.instructure.com/login/canvas and follow the UNT link to log on. (You will log on using your UNT EUID and password.) Once logged on, select this course.

Course Evaluation - Student Perceptions On Teaching (SPOT)

Student feedback is important and an essential part of participation in this course. The Student Perceptions On Teaching (SPOT) is a requirement for all organized classes at UNT. This short survey will be made available at the end of the semester to provide you with an opportunity to evaluate how this course is taught.

Retention of Student Records

Student records pertaining to this course are maintained in a secure location by the instructor of record. All records such as exams, answer sheets (with keys), and written papers submitted during the duration of the course are kept for at least one calendar year after course completion. Course work completed via the Canvas online system, including grading information and comments, is also stored in a safe electronic environment for one year. You have a right to view your individual record; however, information about your records will not be divulged to other individuals without the proper written consent. You are encouraged to review the Public Information Policy and the Family Educational Rights and Privacy Act (FERPA) laws and the university’s policy in accordance with those mandates at the following link: https://ferpa.unt.edu/

Emergency Notification and Procedures

UNT uses a system called Eagle Alert to quickly notify you with critical information in the event of an emergency (i.e., severe weather, campus closing, and health and public safety emergencies like chemical spills, fires, or violence). The system sends voice messages (and text messages upon permission) to the phones of all active faculty staff, and students. Please make certain to update your phone numbers at http://www.my.unt.edu. Some helpful emergency preparedness actions include: 1) know the evacuation routes and severe weather shelter areas in the buildings where your classes are held, 2) determine how you will contact family and friends if phones are temporarily unavailable, and 3) identify where you will go if you need to evacuate the Denton area suddenly. In the event of a university closure, please refer to Canvas for contingency plans for covering course materials.
Sexual Assault Prevention
UNT is committed to providing a safe learning environment free of all forms of sexual misconduct, including sexual harassment sexual assault, domestic violence, dating violence, and stalking. Federal laws (Title IX and the Violence Against Women Act) and UNT policies prohibit discrimination on the basis of sex, and therefore prohibit sexual misconduct. If you or someone you know is experiencing sexual harassment, relationship violence, stalking, and/or sexual assault, there are campus resources available to provide support and assistance. UNT’s Survivor Advocates can assist a student who has been impacted by violence by filing protective orders, completing crime victim’s compensation applications, contacting professors for absences related to an assault, working with housing to facilitate a room change where appropriate, and connecting students to other resources available both on and off campus. The Survivor Advocates can be reached at SurvivorAdvocate@unt.edu or by calling the Dean of Students Office at 940-565-2648. Additionally, alleged sexual misconduct can be non-confidentially reported to the Title IX Coordinator at oeo@unt.edu or at (940) 565 2759.