

CHEM 210: Chemical Application of Calculus and Physics, Spring 2024

Time and location: Friday 1:00-1:50 PM, GMCS-306

Instructor: Yuezhi Mao (he/him/his)

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Office: GMCS 213D

Office hour: Tuesday 3-4:30pm (overlaps with the office hour for 410A)

Course Overview:

CHEM 210 is a 1-unit course designed to enhance students' understanding of the essential mathematical and physical concepts involved in CHEM 410A lectures. It is intended to be taken *concurrently with CHEM 410A* so that the relevant materials in the latter will be reviewed in a timely manner. Concurrent enrollment in this course is *required* for 410A students who have received a grade below "C" (< 1.7) in any of the math and physics prerequisite and is also *strongly recommended for all other students*. Since the instructor is the same as 410A this semester, this course can also be viewed as a guided study session focusing on problem-solving skills, during which the instructor will provide help constantly. These problem-solving skills, which are usually not covered during the 410A lectures due to limitation on time, turned out to be crucial for students' success in 410A exams based on previous teaching experience.

IMPORTANT NOTE: CHEM 210 is specifically designed to enhance student learning in CHEM 410A. *If you are not enrolled in 410A this semester, this course will not be suitable for you.* It is strongly recommended that you *register for this course when you are concurrently taking 410A.*

Student learning objectives:

At the end of this course, the students will be able to:

- Enhance their understanding of the mathematical concepts used to formulate the fundamental principles of quantum mechanics
- Efficiently solve calculus and other mathematical problems involved in physical chemistry
- Identify the mathematical formulas/equations needed to solve a given physical chemistry problem
- Describe the physical picture and the quantitative relationships that are underneath each model/example system discussed in the 410A class
- Connect the mathematical formulas and physical models introduced to examples in chemistry

Tentative course calendar:

Date	Content
01/19	Complex numbers; basic rules of differentiation/integration
01/26	Calculus of sine and cosine functions
02/02	Operators; eigenvalues and eigenfunctions; orthogonality
02/09	Probability and expectation values; particle-in-a-box states

02/16	Gaussian functions; quantum harmonic oscillator
02/23	Quantum models for 2-D and 3-D rotations; angular momentum
03/01	3-D rotation (continued); hydrogenic atoms
03/08	Hydrogenic atoms (continued); electronic configuration of many-electron atoms
03/15	Spin states of two electrons; spin-orbit coupling; atomic term symbols
03/22	Atomic term symbols (continued); B-O approximation; VB and MO wavefunctions
03/29	LCAO-MO method; secular equations; Hückel theory
04/05	Spring break (no class)
04/12	Hückel theory (continued); Bohr frequency condition and conversion between commonly used units; spectral broadening
04/19	Calculations based on rotational and vibrational terms
04/26	Franck-Condon principle; vibrational fine structure of electronic spectra

Grading scheme:

There is no homework or exams in CHEM 210. The grading for this course will be *entirely based on attendance and participation*. There are a total of 14 meeting times and the grades will be given as follows:

Days attending/participating	Grade	Days attending/participating	Grade
12-14	A	6	C
11	A-	5	C-
10	B+	4	D+
9	B	3	D
8	B-	2	D-
7	C+	<2	F

Add/Drop Procedure: The add/drop deadline is *January 26, 2024*. Please refer to <https://registrar.sdsu.edu/students/registration> for full details. Starting from the 3rd class on Feb. 2, you must be an enrolled student to attend this class.

Essential student information:

For essential information about student academic success, please see the [SDSU Student Academic Success Handbook](#).

- SDSU provides disability-related accommodations via the Student Ability Success Center (sascinfo@sdsu.edu | sdsu.edu/sasc). Please allow 10–14 business days for this process. Please note that accommodations are not retroactive, and that the instructor cannot provide accommodations based on disability until an accommodation letter is received.
- Class rosters are provided to the instructor with each student's legal name. Please let the instructor know if you would prefer an alternate name and/or gender pronoun.