Introduction

Welcome to "A Guide to the Department of Chemistry"! Whether you're just starting your journey as a chemistry major or just interested in taking a couple of chemistry courses, this guide is your one-stop resource. Here, you'll find practical tips, essential links, and helpful insights to navigate your studies and lab work with ease. We've kept things straightforward, so you can easily find what you need.

For any questions or concerns, feel free to contact us at kaistchemsc@gmail.com or via this KakaoTalk open chat!

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Introduction to the Department of Chemistry

Introduction

The Department of Chemistry at KAIST provides distinguished and interdisciplinary programs in chemistry education and research. The areas of research are diverse and encompass several key fields:

- Organic Chemistry
- Inorganic Chemistry
- Physical Chemistry and Theoretical Chemistry
- Polymer Chemistry
- Biochemistry
- Nanochemistry
- Analytical Chemistry and Electrochemistry
- Computational Chemistry and AI Chemistry

The Department of Chemistry Student Council is an organization of chemistry majors, for any undergraduate students interested in chemistry! Our aim is to make the Department of Chemistry a welcoming environment to learn and explore, by organizing various events and activities such as Midterm/Finals Snack Events, Group Study Events, Individual Study/Undergraduate Research Program Exchange Events, and more!

The current president of the Department of Chemistry Student Council is Heeseong Yoon (윤희성, hsyoon01@kaist.ac.kr), and the current vice president is Hyeong Woo Shin (신형우, schrocat@kaist.ac.kr). Feel free to contact us about anything related to the Department of Chemistry or the Student Council!

Required Major Courses

Note: Consult the syllabus for each course for accurate and up-to-date information. The textbook, recommended grade level, prerequisites, and available semesters are **not official** and should only be viewed as a reference.

The following table is the courses a typical chemistry major would take for each semester (required/optional).

Note: all chemistry majors are required to take Undergraduate Colloquium and Laboratory Rotation Program (LRP).

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<tr><th colspan="2">Sophomore Year</th><th colspan="2">Junior Year</th></tr>
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Physical Chemistry I (CH211)

- This course covers foundational quantum chemistry topics such as the Schrödinger equation, hydrogen atom electronic wave functions, electronic structures of simple molecules, and rudimentary molecular spectroscopy.
- Textbook: *Physical Chemistry: A Molecular Approach* by McQuarrie and Simon, 1st ed.
- Recommended for sophomores, spring semester
- Prerequisites: None

Physical Chemistry II (CH213)

- This course covers foundational thermodynamics and statistical mechanics topics such as statistical treatment of entropy, behavior of gases and solutions, and chemical equilibrium.
- Textbook: *Physical Chemistry: A Molecular Approach* by McQuarrie and Simon, 1st ed. (same as Physical Chemistry I)
- Recommended for sophomores, fall semester
- Prerequisites: None

Organic Chemistry I (CH221)

- This course covers the basic principles of organic chemistry such as acidity and basicity of an organic compound, stereochemistry, substitution and elimination reactions, reactions involving alkenes and alkynes, and introductory spectroscopic analysis like proton NMR.
- Textbook: *Organic Chemistry* by Klein, 3rd ed.
- Recommended for sophomores, spring semester
- Prerequisites: None

Organic Chemistry II (CH223)

- This course covers the basic reactions of compounds such as alcohols, aromatic compounds, ketones and aldehydes, carboxylic acid derivatives, enols and enolates, and amines. This course also introduces principles of organic chemistry such as Hückel's rule of aromaticity and electrophilic aromatic directing groups.
- Textbook: *Organic Chemistry* by Klein, 3rd ed. (same as Organic Chemistry I)
- Recommended for sophomores, fall semester
- Prerequisites: Organic Chemistry I

Introduction to Analytical Chemistry (CH263)

- This course covers the basic principles of chemical and instrumental analysis. Topics include error analysis and basic statistical methods, systematic treatment of equilibrium, acid-base titration, EDTA titration, redox titration and fundamental electrochemistry, various spectroscopic methods, and analytical separation and chromatography methods.
- Textbook: *Quantitative Chemical Analysis* by Harris, various ed.
- For all grade levels, spring semester
- Prerequisites: None

Inorganic Chemistry I (CH344)

- This course covers the basic principles of inorganic chemistry and transition metal coordination. Topics include molecular symmetry and group theory, molecular orbitals of small molecules, crystal field theory and ligand field theory, angular overlap theory, and electronic spectra of coordination compounds.
- Textbook: *Inorganic Chemistry* by Miessler and Tarr, 5th ed.
- Recommended for sophomores or juniors, spring semester
- Prerequisites: None

Biochemistry (CH381) - Required for advanced major

- This course covers the basic principles of biochemistry. Topics include structure and function of DNA, protein structure and folding, properties and mechanisms of enzymes, and gene translation and expression.
- Textbook: *Fundamentals of Biochemistry* by Voet, Voet, and Pratt, various ed.
- For all grade levels, spring semester
- Prerequisites: None

Inorganic Chemistry II (CH345) - Required for advanced major

- This course covers the principles of inorganic chemistry and organometallic chemistry
- Textbook: *Inorganic Chemistry* by Miessler and Tarr, 5th ed.
- Recommended for juniors, fall semester
- Prerequisites: Inorganic Chemistry I

Chemistry Major Lab I (CH252)

- This course covers basic techniques of chemical experiments in physical chemistry and analytical chemistry. Experiments include electrochemistry/cyclic voltammetry and fluorescence lifetime measurement.
- Fall semester
- Prerequisites: None

Chemistry Major Lab II (CH352)

- This course covers basic techniques of chemical experiments in organic chemistry. Experiments include Fischer esterification and purification of compounds via column chromatography.
- Spring semester
- Prerequisites: Organic Chemistry I, Organic Chemistry II

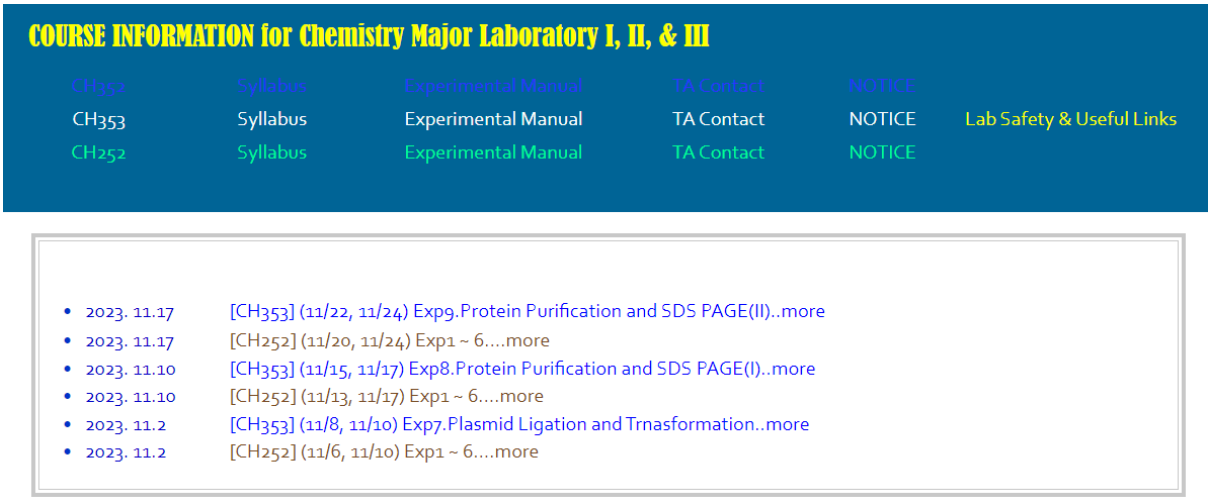
Chemistry Major Lab III (CH353)

- This course covers basic techniques of chemical experiments in inorganic chemistry and biochemistry. Experiments include ferrocene synthesis and polymerase chain reaction (PCR).
- Fall semester
- Prerequisites: Organic Chemistry I, Organic Chemistry II, Inorganic Chemistry I, Chemistry Major Lab II

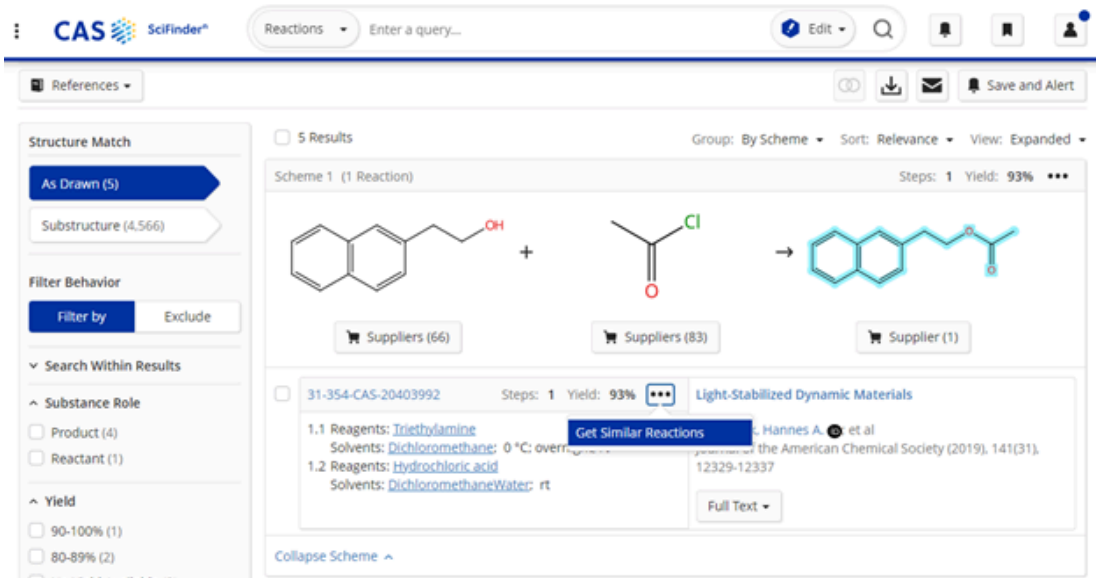
KAIST Chemistry Resources and Links

Websites

Chemistry Major Laboratory Website: Information regarding the Chemistry Major Lab I, II, III courses is uploaded here



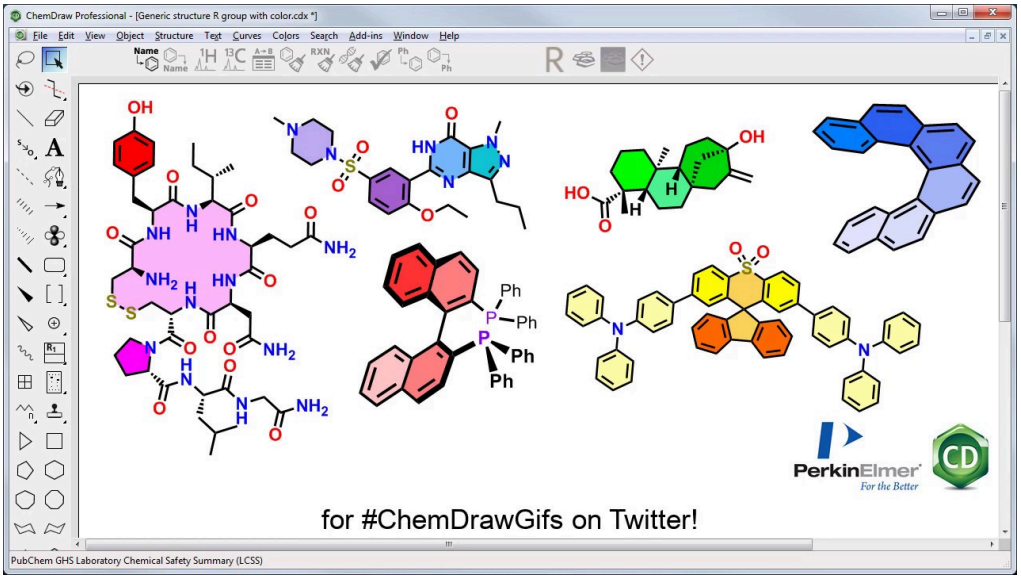
Scifinder: Allows you to explore the CAS database. Information such as physical and chemical properties, reaction, spectral data of a compound can be searched. Click here for the registration guide.



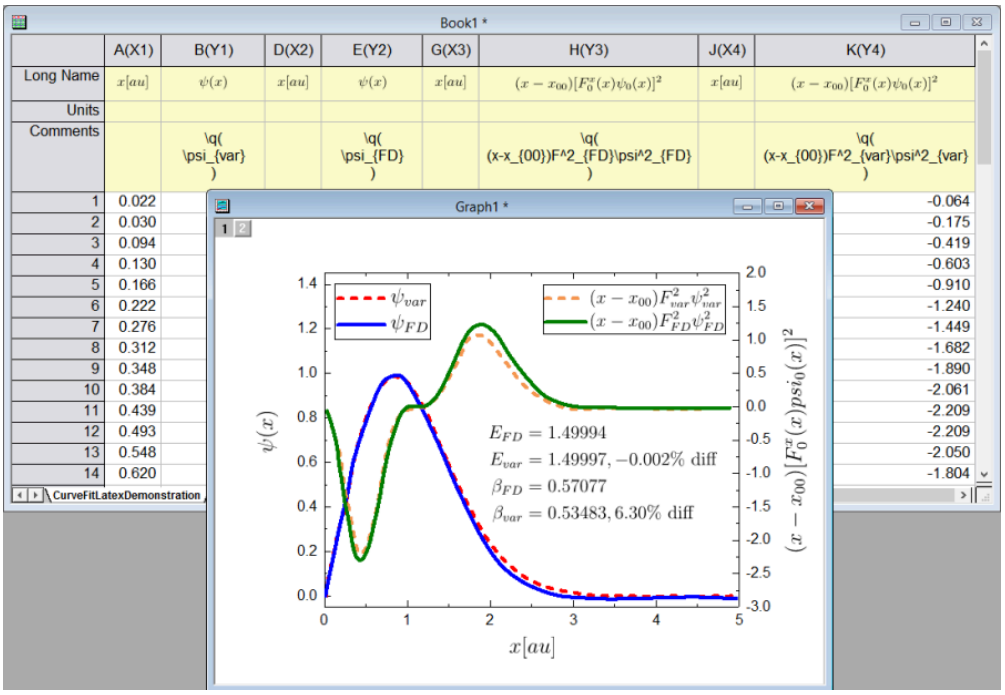
KAIST Dept. of Chem. Student Council Instagram (kaist_chem): Follow us on Instagram for the latest news and events!

Programs

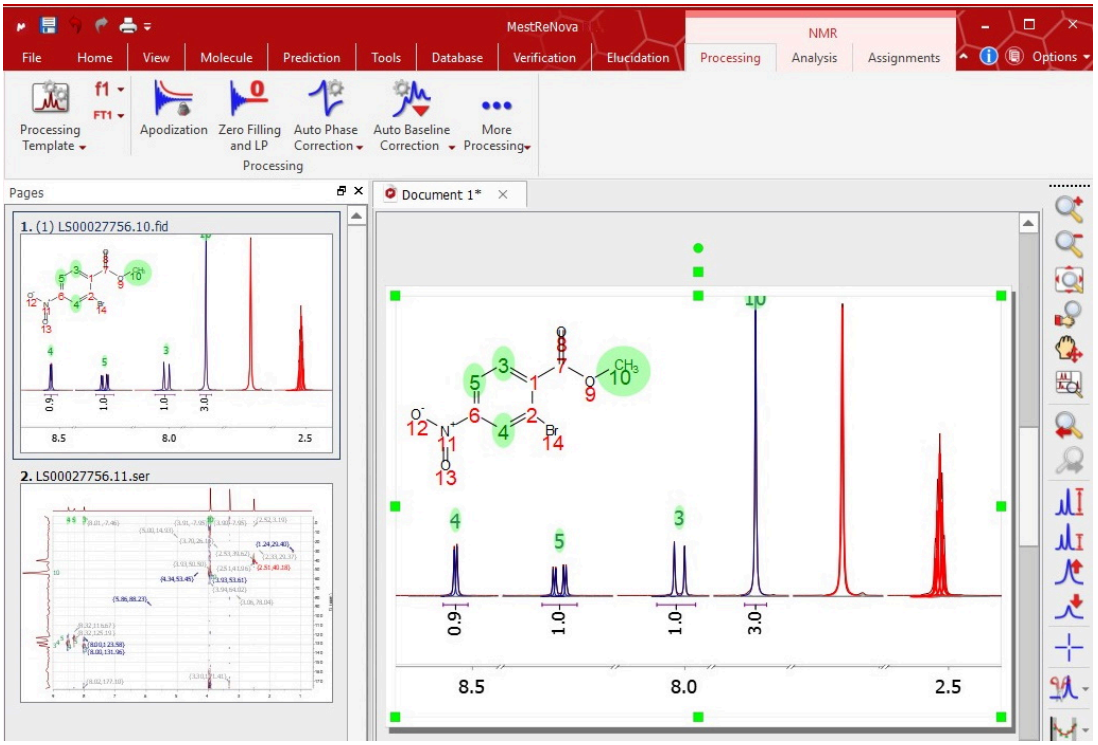
ChemDraw: A program for drawing chemical structures and reactions. It also has useful features such as proton NMR prediction. Click here for the install guide (Translation coming soon!).



Origin: A program for scientific graphing and data analysis including curve fitting. Available via KFTP.



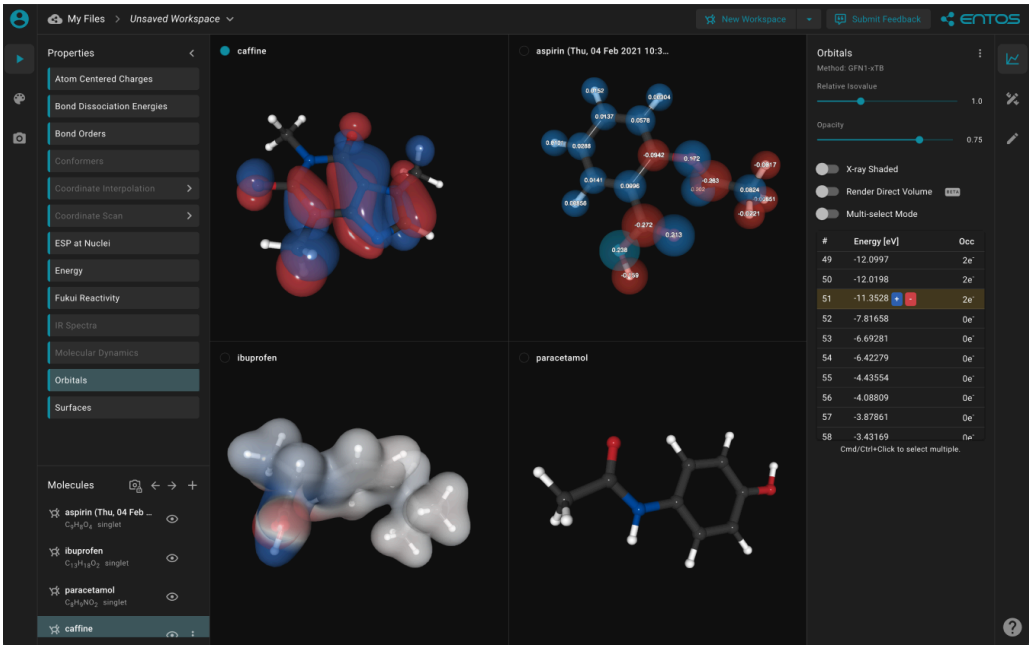
Mnova: Read and analyze various spectral data like proton NMR. For the license file and instructions for installation, contact the Department of Chemistry NMR Facility.



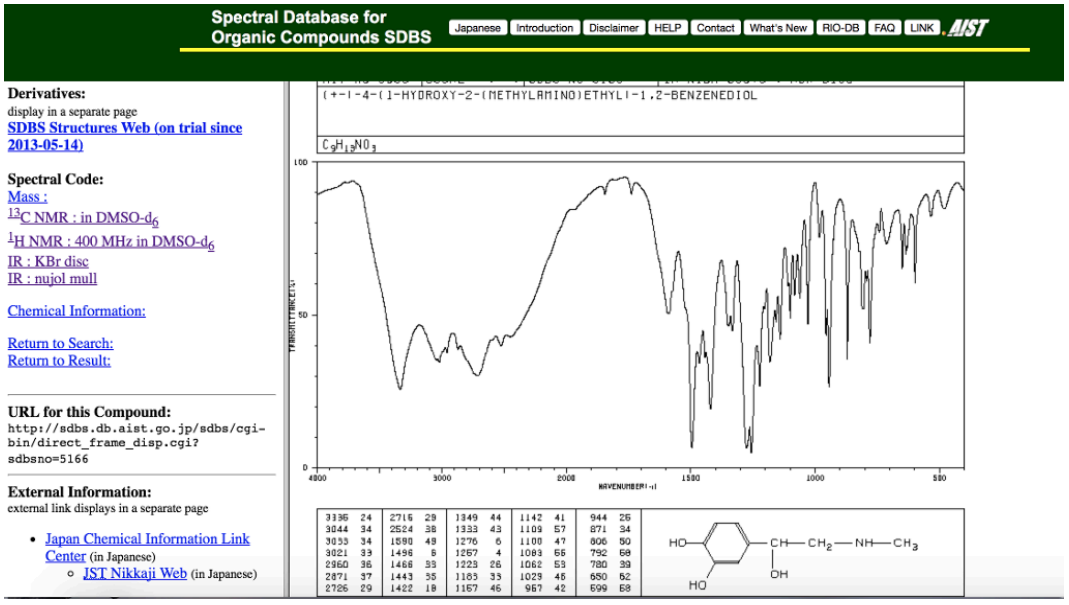
Useful Chemistry Resources and Links

Websites

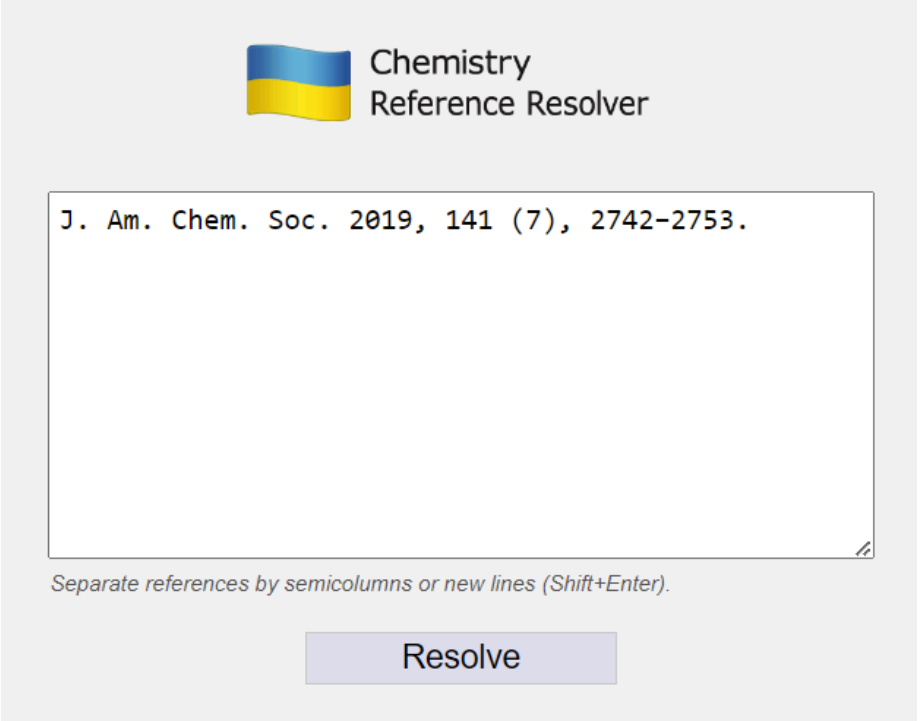
Entos Envision: Run quick quantum chemistry calculations on the web - Free for academic users



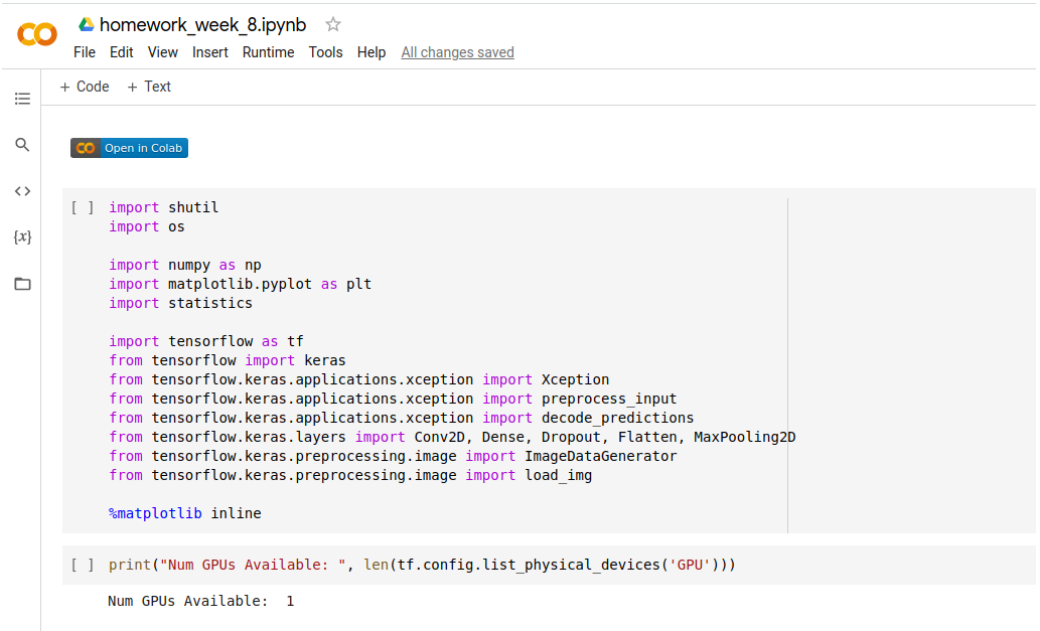
Spectral Database for Organic Compounds: A free database of spectra such as ^{1}H NMR or UV-Vis



[Chemistry Reference Resolver]: Find chemistry journal articles with the citation - Also available as a Google Chrome extension



[Google Colab]: Write and run scientific Python code without installing Python and various packages



Tips and Advices on All Things Chemistry

The following is a compilation of tips and advices from the members of the Department of Chemistry Student Council. Therefore, these may be subjective and should only be viewed as a reference.

General

- Student Council
    - For important notices, please follow this KakaoTalk open chat (Korean/English).
- Student lounge
    - The student lounge (E6-4, 1130: chemistry building first floor) is there for anyone to use!
    - Bottled water (in the fridge), printer (use it via the computer in the lounge or via WiFi), bean bags, and various amenities are there for you to use with no charge.
    - The password is 0264*.

Courses

- General advices
    - Studying chemistry alone is hard, but studying chemistry with friends might be easier and more enjoyable! Consider forming study groups with the study group program offered by the student council to study with your friends or work on lab reports together to win prizes!
    - There are plenty of external resources that could help you in learning chemistry. Free lectures such as MIT OpenCourseWare and UC Irvine OpenCourseWare are worth checking out.
    - For incoming chemistry majors: the courses we strongly recommend you take during your sophomore years are Physical Chemistry I/II and Organic Chemistry I/II; all other courses can be taken during your junior or senior years without many issues. This is because PChem I/II form the fundamentals of how you understand university/contemporary chemistry, as opposed to high school

chemistry. OChem I/II are necessary for the same reason, and also because Chem. Major Lab II/III require those courses.

- Owning a good scientific/graphing calculator and learning how to use it to its fullest extent may be very helpful in courses like Physical Chemistry I/II/III, Intro. to Analytical Chemistry, etc.
  When buying a new calculator, we recommend spending the extra money to buy calculators with a Computer Algebra System (CAS), as they offer several advantages over non-CAS calculators. Some of the calculators with CAS are HP Prime and TI-Nspire CX II CAS.
  Some of the unknown but useful functionalities for chemistry are:
  - Defining variables/functions
  - Numerical integration
  - Numerical solve (especially for Intro. to Analytical Chem.)
  - Statistics calculation (especially for Intro. to Analytical Chem.)
  - Analytic integration (CAS only)
  - Linear regression (especially for PChem III)
  - Matrix manipulation and linear algebra

- Physical Chemistry I
  - Most view PChem I as the most difficult course among all required major courses. Prepare to spend more time on this subject than your other major subjects. When studying PChem I, reading the textbook carefully and solving exercises on your own is a great starting point.
  - Understanding quantum mechanics is inherently hard - even for graduate students and professors! Try to reach out to your TA or your professor as much as possible whenever you are stuck or confused.
  - Practice solving exercises and problems quickly and accurately, making the most out of your calculator. You will see how much of a difference it makes when you learn to use your calculator effectively.
- Physical Chemistry II
  - PChem I is not considered a prerequisite for PChem II, except for a very small part about how energy levels are quantized. In fact, many take PChem II before PChem I with no problems.
  - PChem II is considered to be easier than PChem I, but it can be difficult if your knowledge and/or understanding of thermodynamics is

limited. Fully understanding the course material and being able to solve exercises similar to those covered in class is important in passing this course.

- Organic Chemistry I
    - OChem is a subject that gets better with experience! To become familiar with important concepts in organic chemistry, try to solve as many exercises and problems as possible.
    - It may be a good idea to get used to drawing chemical structures on paper by hand, as you won't be able to use your tablet on your exams.
    - Although this course requires reactions to be memorized, understanding the mechanism of each reaction will definitely help you with memorization, compared to blindly memorizing each and every reaction.
- Organic Chemistry II
    - OChem II involves a lot more reactions than OChem I, with some reactions occurring via unclear mechanisms. Making a practice sheet and regularly testing yourself to memorize all of the reactions covered in class is a good idea.
    - For each and every new lecture, you will learn several new and unfamiliar reactions. In order to not be stressed when studying for your exams, consider reviewing your OChem II materials regularly, even more so than other courses.
    - Like OChem I, solving lots of exercises and problems by hand is necessary to earn a good grade. Although it is time consuming, try solving the harder problems on your own as well, as they might come up in your exams.
- Introduction to Analytical Chemistry
    - The exams of this course (especially the midterm exam) involve solving a lot of problems in a limited amount of time. To earn a good grade in this course, optimizing your problem solving procedure is very important. Try solving exercises and problems while simultaneously timing yourself.
    - Using your calculator for statistics calculations or solving quadratic equations might be useful. As you practice solving the exercises and

problems, try to think of smart ways of incorporating the features of your calculator into your problem solving procedure.
    - The final exam may test you on concepts like spectroscopy and chromatography, unlike the midterm exam that mostly deals with numerical calculations.
- Chemistry Major Laboratory I
    - Although the experiments might involve concepts you may not have learnt before, that is fine as the TA will explain all of the necessary things you need to know to understand the experiments.
    - Write your reports just as the TA instructs you - be attentive to what the TA says during the experiment. Taking down notes on a notepad is a good idea.
    - The presentation at the end of the semester is quite important! Make sure to prepare your presentation well, even if you are busy just before the finals.
- Chemistry Major Laboratory II
    - It may be a good idea to collaborate with your labmates when writing your pre-lab and post-lab reports. This is especially true when analyzing proton NMR spectra. How about forming a study group?
    - Take as many pictures of your experiment as possible - they will help you when writing your observation, experimental details, and timestamps in your report.
- Chemistry Major Laboratory III
    - It may be a good idea to collaborate with your labmates when writing your pre-lab and post-lab reports, especially if you are less familiar with inorganic chemistry and biochemistry.
    - For the inorganic chemistry experiments, take as many pictures as possible.
    - For the biochemistry experiments, you will have a lot of downtime in the lab. This is a good time to try to understand the experimental procedure by discussing with your labmates or by asking your TAs.

Past Exam Papers (Coming Soon!)

Coming Soon!