

## Chem F325L Organic Chem II Lab Syllabus

### University of Alaska Fairbanks, Spring 2022

#### Course Information

Chemistry F325, Organic Chemistry II Laboratory, 1.0 Credits  
Reichardt 245

**Co-Requisites:** Lecture component of Chem 325, Organic Chemistry II.

**Pre-requisites:** Chem 321 Organic Chemistry I (includes Laboratory)

Section	CRN	Day	Time	Teaching Assistant
F01	34386	Thursday	11:30 – 2:30	TBA
F02	34387	Thursday	2:45 – 5:45	TBA
F03	34388	Thursday	6:00 – 9:00	TBA

#### Instructor

Thomas Green, Professor of Chemistry

Reichardt 174, Phone: Home 907-452-6370 Cell 907-744-2726 [Email: tkgreen@alaska.edu](mailto:tkgreen@alaska.edu)

Office Hours: Tuesday 1-3 pm, by Zoom

**Mode of Delivery: In Person Laboratory.**

#### Teaching Assistant Office Hours

See TA Office Hours. <https://www.uaf.edu/chem/clc/>

#### Course Materials Required:

1. Laboratory Manual with all experiments and reports forms, supplied to you by instructor.
2. Lab notebook for recording experimental data, results and conclusions. The lab notebook will be supplied by the department. Student Lab Notebook, 2012 Book Factory, Lab-050-7GSS, 50 pages.
3. Textbook: Making the Connections<sup>3</sup>; A How-to-Guide for Organic Chemistry Lab Techniques, 3<sup>rd</sup> edition, Anne B. Padias, 2015, Hayden McNeil.

**Course Description:** A laboratory designed to illustrate modern techniques of isolation, purification, analysis and structure determination of covalent, principally organic, compounds. Lab portion will include an introduction to synthetic techniques and spectroscopy. Special fees apply.

**Course Goals.** Learn the following practical aspects of organic synthesis.

1. Common safety procedures.
2. Reaction methods
3. Isolation Procedures
4. Purification techniques
5. Spectroscopic and chromatographic analyses
6. Introduction to computational methods in chemistry.

### **Student Learning Outcomes**

1. Know the hazards associated with common chemicals, especially those encountered in the experiments.
2. Know how to safely assemble reaction systems using glassware commonly employed in the organic laboratory. These methods include reflux, heating and cooling of reactions, and addition of reagents.
3. Know how to isolate and purify organic products using methods such as extraction, filtration, crystallization, distillation, solvent removal, and thin layer chromatography.
4. Learn the importance of stoichiometry to a chemical reaction. Learn how to assess the efficiency of a chemical reaction (percent yield and atom economy).
5. Learn the practical aspects of spectroscopic analyses of organic compounds.
6. Learn how to build and optimize simple molecules using WebMO/Gaussian and how to measure properties of those molecules.

### **Instructional Methods**

1. The instructor or teaching assistant will provide a brief introduction on the practical aspects of organic chemistry, using a combination of Power Point slides and Chalkboard. The Lab Schedule will be available on Blackboard and at the end of this syllabus.
2. Laboratory sessions will consist of conducting reactions of organic compounds and their isolation, purification and characterization.
3. Each experiment will require a "Lab Report" which will consist of Pre-lab and Post-lab components. The Pre-lab portion must be completed prior to coming to lab. If it is not completed, you will not be allowed to work in the lab for that day's experiment. Your TA will need to verify with her/his initials that you have completed the pre-lab questions. Students are also required to keep a laboratory notebook. The lab notebook will be collected at the midterm, evaluated but not graded, and returned with suggestions for improvement. The lab notebook will be graded at the end of the semester.
4. A lab textbook *Making the Connections*<sup>3</sup> by Anne Padias which describes techniques, glassware, lab notebooks, spectroscopic techniques, etc. Readings will be assigned to the student for each experiment.

### **Lab Notebook Guidelines:**

Before each lab, you should enter the following in the notebook (with pen).

1. Title of Experiment
2. Hypothesis or Goal of Experiment
3. Overall reaction. Show structures and names of reactants, products, and reaction solvent.
4. Physical properties. Make a table of MW, boiling point (if liquid), melting point (if solid) of solvents, reactants, and products. Usually you can just copy these from your pre-lab tables.
5. Procedure. The procedure should be taken from the handout. Include amounts to be used for each reagent and solvent. If changes are made later, this can be noted later in the notebook.

During lab, you should enter the following,

6. Data and observations. Record actual amounts (volumes or mass) used for each reagent. Record physical constants such as melting point range of the product. If you ran a TLC plate, sketch plate in the notebook and indicate what developing solvent was used. If you recrystallized a product, indicate how you did it, e.g. what solvent was used. Describe the product that you obtained (color and/or appearance). If the IR and/or NMR spectra were obtained, state this here.
7. Calculations. Include the following
  - a. Identify the Limiting Reagent. To do this properly, you need to know the millimoles (mmol) of each reactant used. The limiting is the one that is not present in a stoichiometric excess.
  - b. Calculate the Theoretical Yield in grams. This calculation is based on the limiting reagent.
  - c. Calculate the Percent Yield.
8. Conclusions
  - a. Is the product pure from the mp range and the NMR/IR spectra? Compare to literature where possible.
  - b. If impure, can any impurities be identified?
  - c. Is the yield consistent with expectations for this experiment? If not, why was the yield low?

**Laboratory Safety:** Laboratory safety is a major concern of all chemical laboratories but is especially important in organic labs due to the presence of flammable solvents, potentially hazardous fumes, highly reactive reagents, etc. The first online lecture will deal explicitly with these hazards and the appropriate safety measures you must follow. Subsequent online lectures, besides covering the theory and pitfalls of the coming weeks' experiments, will also cover specific hazards that you may encounter. Please attend watch these lectures and be prepared for the lab by doing any assigned readings and completing the Pre-lab exercises before coming to lab. If you are not prepared for lab you may be asked to leave.

**Notes and Policies:**

1. Students are expected to perform experiments following commonly accepted safety protocols,
2. Safety glasses must always be worn **during lab**.
3. All labs must be completed to receive a passing grade.

**Lab Schedule** – see Canvas for specific Experimental Procedures and Report Forms.

Experiment	Date	Concepts/Techniques	Chapter Wade
No Lab	Jan 13. 20	No Lab	--
HW 1: NMR of Unknowns (30)	Jan 27	<sup>13</sup> C, <sup>1</sup> H NMR, IR Structure Determination	13
HW 2: Mass Spectrometry (30)	Feb 3	Structure Determination, Fragmentation of Functional Groups	12
Exp 1: Solvent extraction of Natural Product (50)	Feb 10	Mass Spectrometry; Solvent Extraction	12
Exp 2: Diels-Alder Reaction (50)	Feb 17	Reflux, NMR Coupling Constants, Modeling	15
Exp 3a: Iodination of Vanillin (50)	Feb 24	Electrophilic Aromatic Substitution, Modeling, Redox, Recrystallization	17
Exp 3b: Iodination of Vanillin (30)	Mar 3	Continued	17
Exp 4: Suzuki Coupling (50)	Mar 17	Catalysis, Reflux, Filtration NMR	17
Exp 5: Synthesis of Soap; Saponification (50)	Mar 24	Lipids, ester hydrolysis, micelles, NMR	20
Exp 6: Synthesis of Aspirin (50)	Mar 31	Electrophilic Addition, Reflux, Oxidation/Reduction, NMR	21
Exp 7: Extraction of Usnic Acid from Lichens (50)	Apr 7	Extraction; Column Chromatography, NMR, H-bonding	--
Make-up Labs	Apr 14	Please schedule missed labs with your TA.	

### Grading

Category	Points
Lab Reports	50 pts x 7 + 1 x 30 = 380 pts
Homework	60 pts
<b>Total Points</b>	<b>440 pts*</b>

\*The points that you earn will and be adjusted to represent 25% of your overall grade for Chem F325, which is 4 credits.

## Due Dates for Lab Reports and Homework.

All lab reports will be due exactly one week after the completion of the experiment, at 11:59 pm. All lab reports are to be submitted in lab.

Experiment	Due Date (11:59 pm)
HW 1: NMR of Unknowns (30)	Feb 7
HW 2: Mass Spectrometry and Fragmentations (30)	Feb 14
Exp 1: Solvent extraction of Natural Products (50)	Feb 21
Exp 2: Diels-Alder Reaction (50)	Feb 28
Exp 3a: Iodination of Vanillin (50)	
Exp 3b: Iodination of Vanillin WebMO (30)	Mar 14
Exp 4: Suzuki Coupling (50)	Mar 21
Exp 5: Synthesis of Soap; Saponification (50)	Apr 2
Exp 6: Synthesis of Aspirin (50)	Apr 9
Exp 7: Extraction of Usnic Acid (50)	Apr 16

**Disabilities Services:** The Office of Disability Services implements the Americans with Disabilities Act (ADA), and insures that UAF students have equal access to the campus and course materials. Students with documented disabilities who may need reasonable academic accommodations should discuss these with me during the first two weeks of class. I will work with the Office of Disabilities Services (\*208 WHIT, 474-5655) to provide reasonable accommodation to students with disabilities. You will need to provide documentation of your disability to Disability Services.

### Veteran Support Services.

Walter Crary is the Veterans Service Officer at the Veterans Resource Center, 111 Eielson Building. 474-2475. ([weccary@alaska.edu](mailto:weccary@alaska.edu)) Fairbanks Vet Center 456-4238. VA Community Based Outpatient Clinic at Ft. Wainwright is 361-6370.

**Amending this Syllabus:** Amendments and changes to the syllabus, including evaluation and grading mechanisms, are possible. The instructor must initiate any changes. Changes to the grading and evaluation scheme can be made before the add/drop date without a vote, but after that date must be voted on by the entire class and approved only with unanimous vote of all students present in class on the day the issue is decided. The lecture schedule and reading assignments (Daily Schedule) will not require a vote and may be altered at the instructor's discretion. This Daily Schedule can be found on Blackboard. Grading changes that unilaterally and equitably improve all students' grades will not require a vote. Once approved, amendments will be distributed in writing to all students via Blackboard.

**COVID-19.**

Students should keep up-to-date on the university's policies, practices, and mandates related to COVID-19 by regularly checking this website:

<https://sites.google.com/alaska.edu/coronavirus/uaf/uaf-students?authuser=0>

Further, students are expected to adhere to the university's policies, practices, and mandates and are subject to disciplinary actions if they do not comply.

**Student protections statement:** UAF embraces and grows a culture of respect, diversity, inclusion, and caring. Students at this university are protected against sexual harassment and discrimination (Title IX). Faculty members are designated as responsible employees which means they are required to report sexual misconduct. Graduate teaching assistants do not share the same reporting obligations. For more information on your rights

as a student and the resources available to you to resolve problems, please go to the following site:

<https://catalog.uaf.edu/academicsregulations/students-rights-responsibilities/>.