Course Syllabus for
Organic Chemistry for Majors I
Chem 143 – Fall 2013

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Office Hours: Mon 2:30-3:30; Thurs 10:00-11:00.
Class Meetings: 11:45 am – 12:35 pm MWF, Rowell Hall 110
UVM Holidays: Classes will not be held on: September 2nd, November 25–29th.

Required Text: Solomons, T. W. G.; Fryhle, C. B. *Organic Chemistry*, 11th ed., Wiley.
Solomons, T. W. G.; Fryhle, C. B. *Student Study Guide and Solutions Manual for Organic Chemistry*, 11th ed., Wiley.

Recommended: Molecular Structure Model Kit

Course Outline:

Chapter 1. Bonding and Chemical Structure.
Sections 1.1-1.8, 1.11-1.14, 1.16-1.17

Chapter 2. Representative Carbon Compounds.
Sections 2.1-2.14

Chapter 4. Alkanes.
Sections 4.1-4.6 4.8-4.17B

Chapter 5. Stereochemistry.
Sections 5.1-5.15

Chapter 3. Intro to Organic Reactions.
Sections 3.1-3.2, 3.4-3.6, 3.9-3.11, 3.13

Chapter 6. Ionic Reactions.
All Sections

Chapter 7. Alkenes and Alkynes I. Synthesis.
All Sections

Chapter 8. Alkenes and Alkynes II. Addition Reactions.
All Sections

Chapter 10. Radical Reactions.
All Sections

Chapter 11. Alcohols and Ethers.
All Sections

Chapter 12. Alcohols from Carbonyl Compounds.
All Sections

Text boxes within the chapters entitled “The Chemistry of…” are optional. You can read them if you think this stuff is cool.

Course Grading:

Laboratory Grade	20%			
Midterm Exam 1	20%	Monday, September 23	6:00–8:00 pm	Rowell 110
Midterm Exam 2	20%	Monday, October 21	6:00–8:00 pm	Rowell 110
Midterm Exam 3	20%	Monday, December 2	6:00–8:00 pm	Rowell 110
Cumulative Final	20%	Friday, December 13	10:30–1:15	Rowell 110

Course grading will be based on three midterm exams, a cumulative final, and your laboratory grade. No exam or lab grades are dropped, so take them seriously. The only valid excuses for missing an exam are medical or other true emergency situations. If you miss an exam for such a reason, you must inform me of it promptly, present appropriate documentation of your excuse, and receive formal approval to take a make up exam. If you miss an exam for any other reason, you will receive a grade of zero for that exam. Proposals for “extra credit” will not be considered**.**

The answers to exam problems will be posted after each exam. If you have any questions concerning the grading of an exam, you must see me within one week after the day the exam is returned to the class. Exams must be taken in ink to insure that you can get points for a grading error.

Homework Problems:

The textbook and study guide have tons of homework problems to help you. For each chapter you should work as many of the suggested problems as possible. **I strongly urge you to keep up with your reading and problem solving.** The study of Organic Chemistry is a highly structured cumulative intellectual enterprise. Cramming does not work well in this subject! I will suggest some problems in each chapter each week for you but will not grade them. You should do as many as possible!

Academic Conduct: The only valid excuses for missing an exam are medical, family crisis, or other true emergency situations. Get it in writing. Any other excuse will result in a numerical score of zero for that exam. Cheating or plagiarism will be considered grounds for failing the course. All graded documents must be your own work. Cases of cheating or plagiarism will lead to further disciplinary action, which may include dismissal from the University according to the rules set forth in the University of Vermont’s *Code of Academic Integrity*.

Course Syllabus for CHEM 143 Laboratory - Fall 2013

Let's make things out of stuff! Organic lab part is awesome and was definitely a life-changing event for me. There is something very powerful about the ability to manipulate matter and transform one substance into another. There will be brilliant colors, boiling flasks, sloshing and swirling, beautiful crystals, and lots of smells - mostly good but some nasty.

Required Text: Ault, A. *Techniques and Experiments for Organic Chemistry*, 6th ed., University Science Books, 1998.

Required Materials: Bound lab notebook with carbon paper and numbered pages
Lab safety glasses, ink pen, ruler, calculator

General Considerations:

Read the assigned reading before doing the experimental work. The experiments designated within each chapter describe the procedures that you will actually carry out in the laboratory.

Schedule of Experiments:

Date	Exp #	Topic	Reading
9/3,5	–	Introduction, Safety, Check in	1-41
9/10,12	handout	Solventless aldol condensation	44-59, 150-158
9/17,19	handout	Solvent recycling	62-78, 138-149
9/24,26	handout	Fractional distillation, GLC	62-78, 70-72
10/1,3	handout	Thin layer chromatography	109-119
10/8,10	E5	Caffeine from Vivarin	317-318, 332
10/15,17	E9	Eugenol from clove oil	92-106, 346
10/22,24	handout	Liq. CO2 Extraction of Limonene	
10/29,31	E18	Dehydration of methyl-cyclohexanol	381-384
11/5,7	E25	Preparation of an *n*-alkylbromide	402-403
11/12,14	E28	Nucleophilic competition	407-409
11/19,21	handout	Synthesis of 5,10,15,20-tetraphenylporphyrin	109-116

Please carefully read and digest the assigned pages *before* you arrive for lab.

Notes:

Introduction, Safety, Check-in. Be sure to check your equipment carefully. Any broken or missing items which are cracked, chipped or otherwise in less than perfect shape should be replaced by the stockroom. You will be required to replace any missing or defective items at your expense at the end of the semester, so make sure you start with a well-stocked drawer of unbroken equipment. Make sure your glassware is clean and dry before you begin your first experiment next week.

Melting point and Solventless aldol. The purpose of this lab is to explore the technique of melting point determination and the effect of impurities on melting point. You will achieve this by determining the melting point of two solid samples that will be provided. You will also run a reaction that is an example of an "Aldol condensation reaction"; a reaction in which two molecules are combined into one product with extrusion of water. This particular reaction is unique in that no solvents are used. Solventless reactions are not always possible, but when it is possible to omit solvents it makes the reaction more environmentally friendly ("green"). You will collect the product of this reaction by filtration, dry it and determine its melting point as well. You will also determine the yield of the recovered material, bottle it, label it, and keep it in your draw for a future experiment.

Solvent Recycling: In this experiment you will be provided with dirty acetone (acetone is a common organic solvent used in many different cleaning applications) that must be purified so that we can use it throughout the rest of the semester as a cleaning agent. In this process you will learn the experimental setup for simple distillation, which is a technique commonly used for the purification of liquid chemicals. Recycling this solvent through purification by distillation is an effective means of limiting the volume of hazardous waste that must be disposed of.

Fractional distillation, GLC. Fractional distillation is more effective than simple distillation at separating compounds that have similar boiling points. In this lab you will be assigned a mixture of liquids for separation by fractional distillation. Save 1 mL of this sample for GLC analysis and fractionally distill the remainder using a stainless steel sponge-packed column. Be careful not to cut your hands on the stainless steel wire; it is sharp and very strong and should only be cut with scissors.

Thin layer chromatography. You will identify components of common analgesics by comparing the Rf of the components to Rf of standards. Silica gel plates will be available to you.

Caffeine from Vivarin. This lab introduces extraction and recrystallization as a purification technique. Experimental is noted in the text book. You will also recrystallize the product formed in the first experiment, determine the melting point of the purified material, and compare it to the melting point of the impure material.

Eugenol from clove oil. Use 10 grams of clove oil (instead of 5) and methylene chloride as solvent (instead of carbon tetrachloride). After drying the eugenol solution, rotovap the solvent before vacuum distilling the product.

Liquid CO_2 Extraction of Limonene: The use of liquid CO_2 as an extraction solvent offers many safety and environmental benefits over standard organic solvents. For example, it is nonflammable, relatively nontoxic, readily available and environmentally benign. In industrial

applications it is easy to recover the CO_2 (by controlling the pressure), thus making it possible to reuse the solvent many times with no net environmental impact. Liquid CO_2 has been used industrially for the extraction of essential oils, and in new greener methods of dry cleaning. In this laboratory we will generate liquid CO_2 and use it to extract limonene (an essential oil found in citrus fruits) from orange peel.

Dehydration of methyl-cyclohexanol. Each student will dehydrate one of the methycyclohexanols (2-, 3, or 4-). The product obtained will be analyzed by GLC.

Preparation of an *n*-alkylbromide. Adapt the procedure in the book to prepare an alkyl bromide from the primary alcohol furnished to you.

Nucleophilic competition. Carry out the experiment with the butyl alcohol assigned to you. Product analysis should be accomplished by GLC.

Synthesis of 5,10,15,20-tetraphenylporphyrin. In this experiment you will synthesize 5,10,15,20- tetraphenylporphyrin from pyrrole and benzaldehyde. This reaction occurs in the gas phase at high temperature and thus is another example of a green (solventless) reaction. These reaction conditions are also green because they avoid the use of a strong acid promoter, which is typically required to effect this transformation under standard reaction conditions. You will purify the product by column chromatography, which is a standard and very important method of purification.

Grading for the Laboratory: The laboratory grade will be based on your general ability to carry out the experiments, the accuracy with which you record and interpret your results, your performance on laboratory quizzes, and an evaluation by the TA of your overall technique and ability as an experimentalist. The total laboratory grade will be based on the following distribution of points:

Notebook:	80
Lab quizzes:	15
TA evaluation:	5
Total points:	100

Further details of lab grading are presented in a separate Laboratory Guidelines Document that you will receive at the Check-In session.

Attendance: There are no make-up lab sessions. If you miss a lab for a valid reason (a true emergency), you must provide your TA with a documented excuse for the absence. Unexcused absences will result in a numerical score of zero for that experiment. If you miss more than 2 labs *for any reason*, you will receive a grade of F for the whole course.

Breakage Card: A breakage card must be purchased from the first floor stockroom (Cook A143) prior to your first lab. The $40.00 is refunded at the end of the semester if you don't break anything. Always bring your card to lab as it is your deposit for any additional items.

Laboratory Safety: Organic laboratories are safe places to work provided that you operate with caution and forethought. Careful knowledge of the properties of what you are working with is necessary to avoid accidents and injuries. Potentially dangerous equipment and flammable, toxic, and/or corrosive materials are sometimes used. Please observe the following rules.

1. You must wear OHSA approved safety glasses in the laboratory.

2. Dress properly. Do not wear open-toed shoes or sandals. Long hair must be tied back.

3. Avoid personal contact with chemicals. It is best to wear protective gloves. If you spill any chemical on your skin, wash it off at once with soap and water and tell your TA.

4. Performance of unauthorized experiments is not allowed.

5. Horseplay or goofing around in the laboratory is strictly forbidden.

6. Drinking and eating in the laboratory are prohibited.

7 Removal of chemicals and equipment from the laboratory is forbidden.

8. Extraneous sources of sound in the laboratory are not allowed.

9. Do not work in the laboratory while under the influence of drugs or alcohol.

10. Report all accidents and injuries, however minor, to the instructor.

11. Do not pipette by mouth. Do not inhale or ingest any chemicals.

12. When leaving the laboratory be sure that all gas, air, water, steam, and electricity are off.

13. Know the location of exits, safety showers, and eye wash fountains.

14. The working space, drawers, cabinet, and shelf above your bench should be neat and clean at all times. A clear work area should be maintained. Minimize clutter.

15. The balances and balance area should be cleaned of any chemical spill.

16. Place glass in the broken glass disposal box; not in the trash.

17. Always point test tubes, flasks, and separatory funnels away from you and others.

18. Follow the instructions in your laboratory text for proper waste disposal.

19. Listen to your TA!

In case of accident:

1. Fire. Personal safety is most important. Make sure everyone gets out of the room and the building. After the safety of all is assured, you may extinguish the fire. If a person's clothing

catches fire, he or she is need of immediate help. Prevent the person from running. Put him or her under the safety shower and pull the chain. It is less effective to smother flames with a fire blanket. Never spray a person with a carbon dioxide fire extinguisher.

2. Chemicals. If corrosive chemicals are spilled on clothing, immediate showering is the best remedy. If chemicals are spilled on the skin, wash them off with large volumes of water. If a chemical is spilled in the eyes, wash your eyes immediately at the eye wash fountain.

3. Injuries. All injuries, no matter how minor, must be treated immediately by competent medical staff at the University infirmary. Report the injury to your lab instructor.

My signature below indicates that I have read, understood, and will comply with the safety rules. I understand that my lab grade will be penalized and I may be dismissed from lab if I do not comply.

Name:_____

Email:_____

Signature:_____

Date:_____