College of Natural & Mathematical Sciences **Spring 2016**
CHEM 225 Organic Chemistry I (3,3) **4 Credits**

Prerequisites: CHEM 116 with a grade of C (2.0) or better

Instructor:

Prof. R. Marshall Werner
327 Crawford Hall
(906)-635-2281
mwerner@lssu.edu

Course Meeting Time:
Lecture in 336 Crawford Hall; MWF 11:00 – 11:50 am
Labs in 335 Crawford Hall; Mon 2-5 pm (A)

Office Hours:

Monday	Tuesday	Wednesday	Thursday	Friday
9:00 am – 10:30 am		9:00 am – 10:30 am		9:00 am – 10:30 am

Required Texts: *Organic Chemistry*, David Klein, 2nd Edition (ISBN: 978-1118452288)
Organic Chemistry Student Study Guide and Solutions Manual, David Klein, 2nd Edition
ISBN: 978-1118647950
Multiscale Operational Organic Chemistry, John Lehman, 2nd Edition (ISBN: 978-0132413756)
Textbooks are available at the campus bookstore. New, used, rental and digital are options depending on title.

Supplemental Items: Molecular models are available for purchase at the bookstore.

Also, an excellent Virtual Textbook of Organic Chemistry, developed by Professor William Reush at Michigan State University, is also recommended as a supplemental textbook for further clarification. The textbook can be accessed at:

http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm

Required Laboratory Items: Approved safety goggles or glasses; lab notebook with gridded duplicate pages

Moodle: Handouts and assignments that will be used in this class will be available on blackboard. If you email me using Moodle before Friday Jan. 15, you will receive **10 extra credit points**.

Course Description: Fundamental principles of organic chemistry, covering the structures, reactions and properties of aliphatic and alicyclic compounds. The course will introduce the study of organic nomenclature, functional group chemistry, stereochemistry, reactive intermediates, organic synthesis, reaction mechanisms and conjugated unsaturated systems. The laboratory introduces basic organic laboratory techniques and includes experiments in organic separations, synthesis, and analysis

Course Goals: The goal of this course is to introduce the student to organic chemistry and to provide the student with a firm foundation in organic chemistry.

Course Objectives: At the conclusion of CHEM 225, the student will be able to:

1. Convert between names and structures of organic compounds (IUPAC nomenclature).
2. Understand fundamental physical and chemical properties of numerous functional groups.
3. Predict organic products arising from specified reaction conditions.
4. Predict reasonable routes to synthesize specific organic molecules.
5. Draw mechanisms for specified chemical reactions using curved arrow formalism.

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Grading Scale and Policies:

Point Values:

3 Exams (150 pts. ea)	450 points
Final Exam	150 points
Quizzes	100 points
Laboratory	300 points
TOTAL	**1000 points**

Grading Scale:

92-100	A	78-72	C
92-90	A-	72-70	C-
90-88	B+	70-68	D+
88-82	B	68-62	D
82-80	B-	62-58	D-
80-78	C+	0-58	F

*The instructor reserves the right to curve the grading scale as deemed necessary.

Quizzes: Eleven (11) scheduled quizzes (indicated with ☺ in lab schedule) will be administered during the semester in the first 10-15 minutes at the *beginning* of laboratory periods on specified dates. The quizzes will be worth 10 points each, and you will be allowed to drop your lowest quiz score (100 points total). No make-up quizzes will be given, except for **official** excused absences. In such cases, the student is responsible for scheduling the make-up quiz **prior** to missing the scheduled quiz.

Exams: Three (3) scheduled exams will be administered during the semester and will be held during the regularly scheduled lecture period (Dates listed below). Each exam will be worth 150 points. No make-up exams will be administered, except for **official** excused absences (see above).

Final Exam: A cumulative final exam will be administered for the course which will be worth 150 points. Those missing the final exam without a valid well-documented and pre-approved excuse will not be allowed to take a make-up exam and will receive a score of zero for the final exam.

Grading Issues: Any regrading requests must be made to the instructor at that time by means of a note written on the exam and signed by the student.

Tentative Course Outline

Week	Date	Topic
1	1/11	CH 1: Review of General Chemistry
2	1/18	CH 2: Molecular Representations, Functional Groups
3	1/25	CH 15: Infrared Spectroscopy and Mass Spectrometry
4	2/1	CH 16: Nuclear Magnetic Resonance Spectrometry **(Exam 1)**
5	2/8	CH 3: Acids and Bases
6	2/15	CH 4: Alkanes and Cycloalkanes
7	2/22	CH 5: Stereoisomerism
8	2/29	**SPRING BREAK**
9	3/7	CH 6: Chemical Reactivity and Mechanisms
10	3/14	CH 7: Substitution Reactions **(Exam 2)**
11	3/21	CH 8: Alkenes and Elimination
12	3/28	CH 9: Addition Reactions of Alkenes
13	4/4	CH 10: Alkynes
14	4/11	CH 20: Aldehydes and Ketones
15	4/18	CH 21: Carboxylic Acids and Derivatives **(Exam 3)**
16	4/27	**FINAL EXAM ON WED, Apr. 27 AT 10 AM**

*The instructor reserves the right to modify this schedule with sufficient notice.

QUIZ/EXAM SCHEDULE:
Exam 1: Monday, Feb. 8th
Exam 2: Monday, March, 21st
Exam 3: Wednesday, April 20th
Final Exam: Wednesday, April 27th
Quizzes: Indicated in lab schedule with ☺

Other Important Dates:
Spring Break: Feb. 29-Mar. 4

Homework Problems / Problem Sets: I recommend that you do every single problem at the end of each chapter that we cover in this course. A list of **critically important** problems from each text chapter is listed below. In addition, problem sets with corresponding answer keys may be made available on Moodle. It is very important that you work the assigned problems immediately after material is covered. Do not wait until the day before a quiz or exam. You will find Organic Chemistry much easier if you do not fall behind. Don't just trust that you understand a given day's lecture, but work the assigned problems until you are thoroughly familiar with the material.

Ch 1: 1-16, 20-36, 38-43, 46-48, 50-59, 63
Ch 2: 5-45, 48-49, 52-58, 63, 66
Ch 15: 1-2, 9-10, 12-15, 19-20, 30-35, 37-44, 54-56
Ch 16: 7-12, 15-16, 21, 23, 25, 27, 31-32, 34-38, 55, 57
Ch 3: 1-22, 25-32, 34-53, 58, 60
Ch 4: 1-3, 5-7, 10-11, 14, 16-18, 20, 22-28, 31-35, 39, 40 (a,c), 41 (a,b), 42-43, 46-48, 50, 53-57, 59
Ch 5: 1-7, 9-11, 17-18, 21, 25-32, 35-42, 46, 48-51, 53, 57
Ch 6: 1-48
Ch 7: 1-4, 6-9, 13-21, 24-34, 38-66, 69
Ch 8: 1-2, 4-5, 7-22, 27-34, 36-39, 41-43, 45-46, 50 (a,b), 51-52, 54-64, 67-71, 73-79
Ch 9: 1-8, 10-21, 23-24, 26-31, 33-38, 40-43, 45-46, 49-54, 57-58, 60-71, 74, 83
Ch10: 1-44, 46, 51-53, 57,59-61, 64
Ch 20: Problem Set
Ch 21: Problem Set

Attendance: Attending class, completing assignments on time, and keeping up with the class material is important for success in this course and in college. Students are responsible for obtaining all notes and assignments given in class.

Electronic Devices/Disruptive Behavior: No electronic devices may be used during class including but not limited to laptops, cell phones, and portable media devices without prior permission from the instructor. Use of electronics or disruptive behavior during graded assignments (including quizzes and exams) may result in immediate dismissal from the lecture hall and a grade of zero (0) for the assignment.

Academic Dishonesty: Academic dishonesty of any kind will not be tolerated in this course, in alignment with the Lake Superior State University Student Honor Code. Students are expected to perform all assigned work themselves unless otherwise noted. You will refrain from any form of academic dishonesty or deception such as cheating, stealing, plagiarism or lying on take-home assignments, homework, computer programs, lab reports, quizzes, tests, or exams which are Honor Code violations. Any form of cheating or plagiarism will be handled in accordance with the Honor Code Procedures. Violations of the Honor Code may result in an **F** for the course grade and/or dismissal from the University.

University Policies and Statements:

The Americans with Disabilities Act & Accommodations
In compliance with Lake Superior State University policies and equal access laws, disability-related accommodations or services are available to students with documented disabilities.

If you are a student with a disability and you think you may require accommodations you must register with Disability Services (DS), which is located in the KJS Library, Room 103, (906) 635-2355 or x2355 on campus. DS will provide you with a letter of confirmation of your verified disability and authorize recommended accommodations. This authorization must be presented to your instructor before any accommodations can be made.

Students who desire such services should meet with instructors in a timely manner, preferably during the first week of class, to discuss individual disability related needs. Any student who feels that an accommodation is needed – based on the impact of a disability – should meet with instructors privately to discuss specific needs.

IPASS (Individual Plan for Academic Student Success)
If at mid-term your grades reflect that you are at risk for failing some or all of your classes, you will be contacted by a representative of IPASS. The IPASS program is designed to help you gain control over your learning through pro-active communication and goal-setting, the development of intentional learning skills and study habits, and personal accountability. You may contact 635-2887 or email ipass@lssu.edu if you would like to sign up early in the semester or if you have any questions or concerns.

CHEM 225 Laboratory Syllabus

Lab Meeting Times: Labs held in 335 Crawford Hall; Mon 2-5 pm (A),
Required Laboratory Text: *Multiscale Operational Organic Chemistry*, John Lehman, 2nd Edition
Required Laboratory Items: Approved safety goggles or glasses; lab notebook with gridded duplicate pages

Tentative Laboratory Outline

Week	Date	Reading Assignment
1	1/11	**NO LAB**
2 ☺	1/18	**Lehman**: Lab Introduction Laboratory/Safety; LAB CHECK-IN, **Moodle:** Solvents, Cleaning Glassware, Weighing **SciFinder Handout:** Following lab check-in, the second half of lab will be completed in LBR 333 **PLEASE BRING LAPTOP TO LAB IF POSSIBLE**
3 ☺	1/25	**Lehman: Experiment 1** – The effect of pH on Food Preservation *Read Appendix I through VII in Lehman*
4 ☺	2/1	**Moodle:** Spectroscopy Handout Instrumentation section on IR, GC/MS *Read Part V Operation: Instrumentation Section on NMR in Lehman* *Read Part V Operation: Instrumentation Section on Gas Chromatography and Mass Spectrometry in Lehman*
5	2/8	**Lehman: Experiment 2** – Extraction and Evaporation: Separating the Components of Panacetin. **Moodle:** Properties of Alkenes and Alkynes
6 ☺	2/15	**Lehman: Experiment 3** – Recrystalization and Melting-Point Measurement. Extraction and Evaporation: Identifying a Component of Panacetin
7 ☺	2/22	**Moodle:** Stereochemistry Handout: Molecular Models and Stereochemistry Dry Lab
8	2/29	**NO LABS - SPRING BREAK**
9 ☺	3/7	**Lehman: Experiment 4** – Heating Under Reflux: Synthesis of Salicylic Acid from Wintergreen Oil
10 ☺	3/14	**Lehman: Experiment 4** – Heating Under Reflux: Synthesis of Salicylic Acid from Wintergreen Oil (finish)
11	3/21	**Lehman: Experiment 5** – Simple Distillation Gas Chromatography Preparation of Synthetic Banana Oil
12 ☺	3/28	**Lehman: Experiment 5** (finish) **Lehman: Experiment 15** – Thin Layer Chromatographic Analysis of Drug Components *Read Part V: Operation 22*
13 ☺	4/4	**Lehman: Experiment 23** – Stereochemistry of Bromine Addition to *trans*-Cinnamic Acid **Moodle:** Properties of Aldehydes, Ketones, Carboxylic Acids
14 ☺	4/11	**Moodle:** Polarimetry, identifying Chiral Compounds
15 ☺	4/18	**CLEAN LAB AND CHECKOUT**
16	4/25	**NO LAB – FINALS WEEK**

*The instructor reserves the right to modify this schedule with sufficient notice.

☺ **Indicates a quiz will be administered during Lab Period.**

ATTENDANCE IS MANDATORY FOR ALL LABS. If you have a sanctioned university event that precludes you from attending normal lab time, please let me know by Friday, Jan. 15th. Failure to attend all labs will result in an **F** for the lab portion of the course.

The laboratory portion of the course is intended to familiarize you with common practices and techniques used by organic chemists. Most of the operational practices for each experiment are discussed in the laboratory text, and you should familiarize yourself with them before coming to lab.

Safety: We will discuss safety in first week of lab, but there are some safety practices that will be followed throughout the course of the semester:

1. **APPROVED SAFETY GLASSES OR GOGGLES MUST BE WORN AT ALL TIMES**
2. Appropriate Dress is Required (No shorts, skirts, or open-toed footwear!).
3. No food or drinks are allowed in the lab.
4. No smoking, eating, or drinking in the laboratory.
5. All chemicals, sharps, etc. must be disposed of properly. If you are not sure, ask.
6. **Come to lab prepared!**

Lab Notebook (See last 2 pages of syllabus for more information): One crucial practice in organic chemistry is keeping a detailed lab notebook. The notebook should include enough information that another scientist in the field could read your notebook and understand what was done, determine the outcome of the labs, and repeat the experiments. You are expected to keep an up-to-date detailed notebook that will be checked weekly. Write in the notebook with a ball-point pen, crossing through errors. Do not remove original pages from the notebook. Copies of the lab notebook will be due the following week. Also, always date and initial the top of lab pages as you write on them.

As the notebook is such a crucial tool for the organic chemist, you will be primarily graded in the laboratory based on your notebook (**Total lab points = 300 points with most labs being worth 25-30 points**). A handout will be posted on blackboard describing the required format that your laboratory notebook. Some of the details about required sections in the notebook include but are not limited to:

> **Prelab** – A prelab composed of an experiment title, an objective, an introduction (which includes any chemical reactions to be performed and brief synopses of new techniques), a chemical properties table (molecular weights, densities, boiling point and/or melting points should be in the table), and a calculations section will need to be completed **before** coming to lab. Prelab assignments will be collected at the **beginning** of the lab period. Coming late to lab means your prelab assignment is late and you will be assessed a late penalty. *Failure to complete the prelab means you will not be allowed to perform the experiment and will receive a grade of zero for that lab.*
>
> **Procedure and Observations** – This section will be completed *during* the lab. Do not write this section before the lab. This section will include all steps as you have performed them and all masses as you have weighed them. This section will also include observations such as boiling ranges, melting points, color changes, etc. Because you are writing the procedure and observations during the lab, it should be written in the past tense after you have performed the steps.
>
> **Results** – This section will be completed after the lab and will include percent yield, laboratory questions, etc.

The duplicate pages of the lab notebook for each experiment will be handed in for grading at the beginning of the next lab period. These will be due at the beginning of lab. **If you do not hand in assignments at the beginning of the lab, they are late and will be assessed late penalties.**

Clean-up: At the end of the lab period, all reusable labware needs to be cleaned with detergent, rinsed with dH_2O and allowed to dry (in your drawer is OK). If you have organic material on your glassware, rinse with acetone to dissolve it. Your glassware should be free of visible debris before placing it back in your drawer. All equipment should be returned to their designated location (i.e. back in the Drawer). The cleanliness of the lab should be left as it was when you came to lab. Before leaving the lab, you may be assigned a cleaning task. Dirty benches, balance areas and hoods can result in a penalty for everybody in the lab. Make sure you clean up after yourself!

Water: We will be using a lot of purified H_2O this semester. If ever in doubt, use distilled water from the special taps located near the sinks.

* The instructor retains the right to change this syllabus as he deems necessary at any time during the semester.

CHEM 225 Lab Notebook Formatting

Your laboratory notebook should begin with a table of contents (TOC). A few pages after the TOC, the first experiment will be recorded in your notebook. **Before coming to lab, read the experiment in Lehman and/or print the experiment from the class Moodle site for that week.**

Before coming to lab, you should write out the following in your lab notebook:

1. **Experiment Prelab questions and answers.** Re-write each of the prelab questions in your lab notebook, provide answers to each question in your lab notebook, and turn the carbon copy of this page in at the beginning of the lab period.

Next Page

2. **Experiment title.**

3. **Experiment objective.** (Short statement of what is to be learned/accomplished in lab)

4. **Introduction.** (Briefly outline the reaction/procedures to be use in the lab)

5. **Chemical properties table.** (molecular weights, densities, boiling point and/or melting points should be in the table),

6. **Calculations section.**

While in lab write out the following:

5. **Data/observations section.** (During lab, you will fill out this section, so leave it blank)

6. **Results and Conclusion.** (Upon completion of the lab, you will to fill out the results and conclusion section)

Unless otherwise instructed you should include the following sections in your notebook for each experiment (I've included examples in italicized text for the sections):

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Sample Note Book Entry

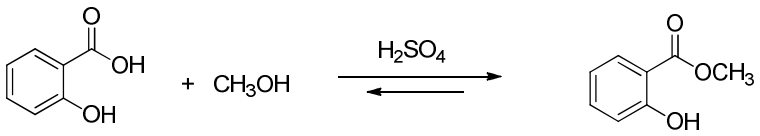
Experiment Title

The Synthesis of Methyl Salicylate from Salicylic Acid

Experiment Objective – One to two sentences describing the purpose of the lab and desired outcomes.

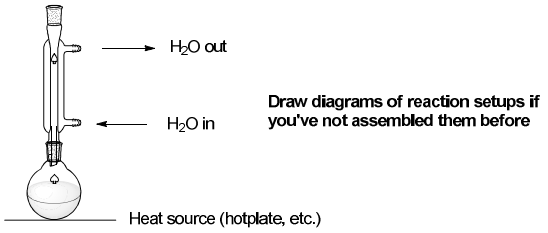
The objective of this lab is to prepare methyl salicylate from salicylic acid by means of an esterification reaction. The product will be isolated via vacuum distillation and the product purity will be determined via melting point.

Introduction – The chemical reaction of the experiment being performed in the lab and a brief synopsis of the experiment, as well as new techniques being used in the lab.



This reaction involves the esterification of salicylic acid with methanol under acidic catalyzed conditions to prepare methyl salicylate, commonly known as wintergreen oil. Salicyclic acid will be refluxed in an excess of acidic methanol to drive the reaction to completion.

One technique used in this experiment will be refluxing. Refluxing involves heating a mixture, contained within in a flask fitted with a condenser, to boil. (Additional pertinent information can be written)



Vacuum distillation will also be used in this lab in order to isolate the desired product from the crude product mixture. Vacuum distillation is a technique used to separate mixtures based on the boiling point of the individual compounds in the mixture. Vacuum distillation differs from normal distillation in that high boiling compounds can be distilled by heating them to a temperature lower than their normal boiling point due to reduced pressure created by the vacuum. This technique is useful for isolating high boiling compounds before they decompose due to excess applied heat. Write additional pertinent information about this technique and draw glassware assembly if you have not previously assembled it.

Melting Point will be used in this lab to identify the product and to determine product purity. Brief discussion of how Melting Poiont is used to determine product purity.

If provided in the lab reading or printout, copy any molecular properties of chemicals to be used into your lab notebook.

Table of molecular properties – All chemicals that will be used or prepared in this lab should be included in the table.

Name	MWt	density (g/mL)	m.p. or b.p
salicylic acid	138.12		m.p. = 159 °C
methanol	32.04	0.792	b.p. = 65 °C
sulfuric acid	98.08	1.84	b.p. = 337 °C
methyl salicylate	152.15	1.174	b.p. = 220-224 °C

Calculations – Any calculations required for the lab should go in the introduction section. For example, if the lab asks you to use 2 mmol of a chemical, you should convert it to grams so that you know approximately how much of that chemical you need to weigh out for your reaction.

Data/Observations –This section contains your procedure as you perform it and your observations (including actual, not calculated, masses and volumes). Write in this section in complete sentences:

Salicylic acid (0.2152 g) and methanol (20 mL) were added to a round bottom flask containing a stir bar. Stirring was initiated, after which concentrated sulfuric acid (0.20 mL) was carefully added dropwise to the mixture. After addition of the sulfuric acid, the mixture changed from a milky suspension to a dark tan solution. A condenser was fitted to the round bottom flask and the reaction was heated to reflux. The reaction refluxed for 1 hour. Heat was then removed and the reaction was allowed to cool to room temperature.

Results/Conclusions – This section contains a brief discussion of your lab results, including description of product and if your experiment worked as expected.

0.1523 g (64% yield) of a clear and white powder was obtained as the product. MP indicated that the product was cleanly obtained. The reaction worked as expected.