



Course Description This course is designed to introduce the student to the chemistry of alcohols, arenes, and carbonyl compounds. The approach will be both mechanistically and synthetically based. The spectroscopic tools used to discern organic structure will also be examined in some detail. The lab portion of the course will focus on synthetic organic chemistry, qualitative organic analysis, and mechanism. **We will be building on some key concepts from Chem 220, such as, Lewis structures, formal charges, the basics of polar reaction mechanisms, substitution/elimination pathways, and IR interpretation.**

Faculty Dr. Chriss McDonald, (work phone 321-4186, home 998-8647 (call anytime up until 10 pm), email [mcdonald@lycoming.edu](mailto:mcdonald@lycoming.edu)), no specific office hours but I'm usually around.

Prerequisite

Completion of Chem 220 with a grade of C- or better.

Text

Organic Chemistry 8e, John McMurry

Course Objectives

Upon completion of this course each student should be able to:

1. Use mass spectrometry, infrared spectroscopy, and NMR spectroscopy to elucidate the structure of unknown molecules.
2. Identify potential sites of chemical reactivity based on molecular structure.
3. Differentiate between aromatic and antiaromatic, and nonaromatic molecules.
4. Predict products and propose mechanisms for reactions involving alcohols, dienes, arenes, and various carbonyl compounds.
5. Propose multistep syntheses of small molecules.
6. Demonstrate proficiency with standard wet chemical and spectroscopic techniques as they apply to synthetic organic chemistry.

## Department of Chemistry Learning Goals That are Supported by Organic Chemistry II

1. Exhibit proficiency in the major sub-disciplines of chemistry;
2. Perform wet laboratory techniques that are appropriate to organic chemistry;
3. Understand and use modern chemical instrumentation
4. Exhibit integrative problem-solving skills, such as experimental design, data manipulation, and data interpretation.

This course supports the Mission of the College

(<http://www.lycoming.edu/aboutLycoming/mission.aspx>) by developing critical thinking skills and exploring scientific traditions.

### Learning Differences and Disabilities

Lycoming College provides academic support for students who have been diagnosed with learning, physical, and psychological disabilities. If you have a diagnosed disability and seek academic accommodations, please contact Dan Hartsock, Sophomore Dean and Coordinator of Services for Students with Disabilities. Mr. Hartsock will help you arrange for academic accommodations in the classroom. You may contact him as follows: 57-321-4294, Snowden Library, 3<sup>rd</sup> Floor, ARC.

### Course Format

*Lectures:* MWF, 9:00-10:05, attendance will be taken daily.

*Evening Review Session:* Problem solving sessions will be built into class time. We will also have a weekly help session in the early evening.

*Assigned homework:* There will be two assignments per topic. One from the book and a homemade one that will be handed out at the help session. These will not be graded but I expect you to do both. Homework will be discussed during the help sessions. Obviously the homework assignments will be a crucial study element for quizzes and tests. Answer keys will be posted on Moodle.

*Moodle-based supplements:* There is a Moodle site for this course which includes homework keys (primarily from the text), extra problems keys (homemade problems), and study guides.

*Other sites of value include (all of these are on the Moodle site as well):*

<http://www.cambridgesoft.com/databases/login/?serviceid=128> (accessed 1/4/12, useful for lab writeup info);

[www.nd.edu/~smithgrp/structure/workbook.html](http://www.nd.edu/~smithgrp/structure/workbook.html) (accessed 1/4/12, spectral interpretation);

[www.chem.ucla.edu/~webspectra/](http://www.chem.ucla.edu/~webspectra/) (accessed 1/4/12, spectra interpretation);

<http://accelrys.com/products/informatics/cheminformatics/draw/no-fee.php> (accessed 1/4/12, a FREE chemical drawing program!!)

*Exams:* Exams 1-3 will be hour exams on the indicated days. The final will be an American Chemical Society standardized, multiple choice exam (cumulative over the whole of organic chemistry).

*Labs:* Similar to last semester. **Prelab is in 220. T 7:45 -11:35 (221M), T 1:00 – 4:50 (221N), Th 7:45 – 11:35 (221Q).** Be on time and be prepared!!!!

*Calculators, Cell Phones, and Communication Devices:* You will need a simple calculator for lab. You will not need one for class. The use of graphing calculators, cell phones, PDA's, and any web-enabled devices are banned from class.

### Grading

Your grade will be based on the total number of points you obtain out of a possible 605. Assignment of letter grades is based on the following scale: A 625 -562 (100 - 90%), B 561 – 500 (89 - 80%), C 460 - 437 (79 - 70%), D 436 - 375 (69 - 60%), F 374 - 0 (59 - 0%). The points will be distributed as follows:

quizzes	70 points
exams 1-3	300 points
final exam	100 points (cumulative ACS exam)*
<u>laboratory</u>	<u>155 points</u>
total	625 points

\*a higher score on the final exam can be used to replace one lower score from exam 1-3.

As always you will have the opportunity to obtain bonus points through attendance at our colloquium series. Assuming you stay for the whole show and mind your manners you will receive 3 points per speaker. You may also receive up to 6 bonus points by writing a paper on a topic that we have mutually agreed upon (2 - 3 pages, typewritten, double spaced, with a minimum of three bibliographic sources). Any extra credit papers must be turned in by Friday 4/20. The ceiling on colloquium bonus points is 15.

### Academic Integrity-

Be aware that in accordance with the College's policy on academic honesty, any work you submit must be your own. Any instances of plagiarism (including copying answers from a classmate) will be penalized to the fullest extent possible and reported to the Provost and Dean of the College.

### Guidelines for Attending Colloquium

- i. Be on time.
- ii. The speaker has expended a lot of effort to prepare for the talk. Be attentive and polite.
- iii. If you can't stay for 45 minutes for an internal speaker or 60 minutes for an external speaker, don't come (please do not ask the speaker how long the talk will last).
- iv. Realize that questions for the speaker at the end is part of the talk and you will be expected to stay for that as well.

### Class Etiquette – The $\pm 5$ Policy

I'm not a cop. I won't call people out for bad behavior (unless it is disruptive). My policy is that appropriate behavior (being at class on time, paying attention, contributing to the discussion, maintaining a positive attitude...) will be rewarded with up to 5 extra points. Bad behavior (the opposite of the stuff listed above, fiddling with cell phones, not showing up, leaving class in the middle or early.....) could cost a student up to 5 points.

### A Word About Learning Chemistry

Studying chemistry is hard work for most people (this is certainly true for me). I would recommend that you work on the lecture material **at least** one hour per day (7 days/week) outside of class for starters. Once you see how things are going this amount can be adjusted as needed (I suggest a significant increase in study time prior to an exam). If you are having trouble, make sure and come and see me. I'm easy to talk to and will do whatever I can to help you. You will be responsible for all of the material listed on the following schedule for the indicated exams and quizzes. It is not sufficient to learn the material from the lecture alone. You are expected to read and think about the material prior to the lecture. The good student will read the text, read the notes, review concepts from Chem 220 that are fuzzy (see below), make lists of questions to ask me, and generally stay on top of things. We must necessarily cover a large amount of material so our pace must be geared towards those who are ready to learn. The hour exams will be cumulative in the sense that we need to know the earlier material to comprehend the latter. *Speaking of the cumulative nature of organic chemistry, here is a list of Chem 220 topics that significantly impact our studies in Chem 221. I strongly suggest these topics be reviewed prior to studying the relevant new material.*

<u>220 Topic</u>	<u>Text location</u>	<u>221 Topic</u>	<u>Text location</u>
Lewis structures	1.4, supp p 52	all mechanistic discussions	ubiquitous
functional groups	3.1	all synthetic discussions	ubiquitous
curved arrow notation	6.2,4,5	all mechanistic discussions	ubiquitous
formal, partial charges	2.1, supp p 52	all mechanistic discussions	ubiquitous
acid/base chemistry	2.7-11, supp p 50	all mechanistic discussions	ubiquitous
E <sup>+</sup> addition to alkenes	7.7-10	E <sup>+</sup> aromatic substitution	Chp. 16
S <sub>N</sub> 2/S <sub>N</sub> 1	Chp. 11	alcohols/ethers	Chps. 17,18
infrared spectroscopy	Chp. 12	NMR spectroscopy	Chp. 13

### Attendance policy

Attendance at quizzes and exams is mandatory. Makeups will be administered only if I deem the reason for the absence to be legitimate and I am made aware of the absence beforehand!!

# CHEM 22112 CHRONODYNAMICS

If there is no struggle, there is no progress

*Frederick Douglass*

Week	Date	Topic	Text	Q/E
<b>1</b>	1/9	introduction/ethers	<b>18.1,2</b> , supp 1-8	
	1/11	epoxides	<b>18.5,6</b>	
	1/13	radicals	<b>6.3,10.2</b> , supp 10	
<b>2</b>	1/16	representative radical chains	<b>8.10</b> , supp 11-13	
	1/18	mass spectrometry	<b>12.1-3</b> , supp 15-24	
	1/20	NMR theory	13.1-3, supp 27-37.5	<b>Quiz 1</b>
<b>3</b>	1/23	chemical shift and coupling	<b>13.8-11</b>	
	1/25	proton NMR problems	supp 38-40	
	1/27	carbon NMR	<b>13.4-7</b> , supp 41-49	<b>Quiz 2</b>
<b>4</b>	1/30	physical/spectroscopic properties of alcohols	<b>17.1-3</b> , supp 70-74	
	2/01	substitution/elimination rxns of alcohols	<b>17.6</b>	
	2/03	<b>Exam 1</b>	-	<b>Exam 1</b>
<b>5</b>	2/06	redox chemistry of alcohols	<b>17.7</b>	
	2/08	diene structure	<b>1.5-11, 14.1</b> , supp 77	
	2/10	electrophilic additions to dienes	<b>14.2-3</b> , supp 78	
<b>6</b>	2/13	the Diels-Alder rxn (finest in org. chem.)	<b>14.4,5</b>	
	2/15	intro to arenes	<b>15.1-2</b> , supp 80-84	
	2/17	Huckel's rule and arene spectroscopy	<b>15.3-8</b> , supp 85-91	<b>Quiz 3</b>
<b>7</b>	2/20	electrophilic aromatic substitution (EAS)	<b>16.1-3</b>	
	2/22	substituent modifications and EAS on substituted arenes	<b>16.4,5, 9-10, 24.8</b>	
	2/24	EAS on disubstituted arenes, synthesis	<b>16.6</b> , supp 93	<b>Quiz 4</b>
<b>8</b>	2/27	multistepers	<b>16.11</b>	
	2/29	aldehyde/ketone (A/K) intro, synth of A/K	<b>19.1,2,14</b> , supp 95-99	
	3/02	<b>Exam 2</b>	-	<b>Exam 2</b>
<b>9</b>	3/05	addition of H <sup>-</sup> , R <sup>-</sup> to A/K	<b>19.3-7, 17.4,5</b>	
	3/07	addition of protic nucleophiles to A/K	<b>19.8,10</b>	
	3/09	as above	as above	

**3/12, 14, and 16 SPRING BREAK WEEK, YAY!**

<b>10</b>	3/19	the Wittig rxn	<b>19.11</b>	
	3/21	A/K synthetic and mechanistic problems	<b>Chp. 19</b>	
	3/23	carboxylic acids	<b>20.1,2,5 7,8,</b> supp 101-104	<b>Quiz 5</b>
<b>11</b>	3/26	carboxylic acid derivatives	<b>21.1,10</b> supp 106-107	
	3/28	nucleophilic acyl substitution (NAS)	<b>17.4,5, 21.2-7</b>	
	3/30	addition of H <sup>-</sup> . R <sup>-</sup> to acid derivatives	as above	<b>Quiz 6</b>
<b>12</b>	4/02	synthetic problems	-	
	4.04	keto-enol isomerism	<b>22.1</b>	
	4/06	Good Friday	-	
<b>13</b>	4/09	enol-based rxns	<b>22.2-4</b>	<b>Quiz 7</b>
	4/11	generation of enolates	<b>22.5,6</b>	
	4/13	<b>Exam 3</b>	-	<b>Exam 3</b>
<b>14</b>	4/16	alkylation of enolates (S <sub>N</sub> 2)	<b>22.7</b>	
	4/18	addition of A/K to enolates	<b>23.1-7</b>	
	4/20	NAS of enolates, conjugate addition	<b>23.8-10,</b> supp 110-112	
	-			
	4/23 – 4/27	<b>final exams</b>		

# ORGANIC CHEMISTRY LAB SPRING 2012

The lab component of this course is worth 155 points. Except for the three week Qualitative Organic Analysis lab, all of the lab writeups will be worth 15 points each. The QOA lab will be worth a whopping 30 points. The week 2 quiz on IR, stoichiometry, and significant figures will be worth 15 points, and lab performance will be worth 20 points (see the Lab Performance Matrix). Many of the experiments will be inquiry-based and will impact what we do in lecture as well. **The penalty for late lab reports is 5% per school day. Lab reports cannot be turned in after any have been returned.**

## Text –

Chem 220-221 Lab Manual, McDonald and Bendorf

## Academic Integrity-

Be aware that in accordance with the College's policy on academic honesty, any work you submit must be your own. Any instances of plagiarism (including copying answers from a classmate) will be penalized to the fullest extent possible and reported to the Provost and Dean of the College.

## Lab Performance Matrix-

	<b>1 (poor)</b>	<b>2 (fair)</b>	<b>3 (good)</b>	<b>4 (outstanding)</b>
<b>Safety – Personal Attire</b>	Must be frequently reminded to wear safety glasses, appropriate clothing or footwear. Brings food, drink, cell phone or other electronic device into lab.	Need occasional reminding about safety glasses or clothing/footwear. Does not bring food, drink or personal electronic devices into lab.	<b>Consistently wears safety glasses. Wears appropriate clothing and footwear. Does not bring food, drink, or personal electronic devices into lab.</b>	Consistently wears safety glasses and appropriate attire. Does not bring food, drink or personal electronic devices into lab. Never needs to be reminded of policy. Helps others follow safety rules.
<b>Safety – Work Area and Hygiene</b>	Spills are not cleaned-up right away. Bench or hood is left in poor condition on multiple occasions.	Bench and fume hood are not always left in good condition.	<b>Keeps a clean, uncluttered work area. Bench and fume hood are cleaned at end of lab. Shared space (ie. reagent hood) is clean.</b>	During lab, work area is clean, organized, and without clutter. Bench and fume hood are thoroughly cleaned and organized at end of lab. Checks shared space to ensure it is clean.
<b>Lab Equipment and Chemicals</b>	Improper disposal of chemicals on multiple occasions. Frequently fails to store equipment properly at end of lab. Leaves lids off reagents bottles.	Improper disposal of chemicals. May occasionally fail to store equipment properly at end of lab. Lids occasionally left off reagent bottles.	<b>Personal and shared equipment stored properly at end of lab. Lids kept on reagent bottles. Chemicals are disposed of properly.</b>	Personal and shared equipment stored properly. Lids kept on reagent bottles. Chemicals are disposed of properly. Helps to ensure that others are handling chemicals, equipment and waste properly.
<b>Preparation and Efficiency</b>	Misses prelab or is significantly late on multiple occasions. Or, uses lab time poorly.	Is late to prelab on more than one occasion or does not work efficiently in lab.	<b>Arrives on time or has been slightly late on one occasion. Works efficiently in lab.</b>	Arrives on time. Works efficiently in lab. Uses “downtime” effectively (such as to prepare for later parts of the experiment).
<b>Laboratory Technique</b>	Completes experiments with little attention to technique. Careless or abusive with instruments/ equipment.	Basic proficiency at lab techniques. Or, not careful with equipment and/or instruments.	<b>Careful execution of lab techniques. Handles equipment, instruments and chemicals with care.</b>	Careful and skilled execution of lab techniques. Handles equipment, instruments and chemicals with care.

## Schedule Organic Chemistry Lab 2, Spring 2012 –

WEEK	DATES	TOPIC	ASSIGNED READINGS	WRITEUP DUE*
<b>1</b>	1/10,12	The Competition: E2 vs. S <sub>N</sub> 2 with 1-Bromodecane using Various Bases, Check-in	handout	1/24,26
<b>2</b>	1/17,19	Radical Polymerization of Methyl Methacrylate, <b>Lab Quiz</b>	Chp. 46A	none!
<b>3</b>	1/24,26	The Attack of the Killer Protons On Carvone	Chp. 32	2/07,09
<b>4</b>	1/31,2/02	as above		
<b>5</b>	2/07,09	GC Analysis of an Isomeric Mixture Generated by E.A.S.	Chp. 37	2/21,23
<b>6</b>	2/14,16	The Acylation of Anisole	Chp. 36	2/28,3/01
<b>7</b>	2/21,23	as above		
<b>8</b>	2/28,3/01	Qualitative Organic Analysis	Chp. 38	4/03,05
<b>9</b>	3/06,08	as above		
	3/13,15	S P R I N G   B R E A K		
<b>10</b>	3/20,22	as above		
<b>11</b>	3/27,29	The Synthesis of <i>N</i> -Pentyl Cinnamide <b>or</b> V for Virstatin	Chp. 47 <b>or</b> Chp. 45	part 1: 4/10,12 part 2: 4/17,19
<b>12</b>	4/03,05	as above		
<b>13</b>	4/10,12	as above		
<b>14</b>	4/17,19	as above, check-out		

**\*Writeups (STAPLED) will be due at the beginning of lab (not prelab) on the indicated day.**