Centro Universitario Internacional

INNOVATION FOR A HEALTHIER PLANET

CHE 211E Organic Chemistry II

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Course Information:
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"If you wish to understand the fragrance of the rose or the tenacity of the oak; if you are not satisfied until you know the secret paths by which the sunshine and the air achieve these wonders; if you wish see to the pattern which underlies one large field of human experience and human measurement, then take up Chemistry."

Charles Coulson – Professor of Chemistry, Oxford University

Course materials (required):

1) Klein, Organic Chemistry, 1st Ed., Wiley, 2011.
2) Darling, Molecular Visions Organic Model Kit.
3) Brooks-Cole, Organic Chemistry Laboratory Notebook (100 carbonless duplicate pages).
4) Mohrig et al., Techniques in Organic Chemistry, 2nd or 3rd Ed., W.H. Freeman.
5) Chemical splash-proof goggles

Recommended:

1) Harwood and Claridge, Introduction to Organic Spectroscopy, Oxford University Press, 1996.

Course Assessment:

Lab	25 points
Problem sets	16 points (5 @4 points each, drop lowest one)
Midterm exams	25 points (2 @ 12.5 points each)
Final exam	30 points (10 + 20– see below)
Reaction journal	4 points
Total	**100 points**

Lab (25 points): Instructions for laboratory component are expanded at the end of this document. Your grade will be based on the laboratory notebook, presentations, submitted lab reports and pre-lab quizzes.

Problem sets (16 points): You will complete 5 problem sets throughout the semester; the best 4 out of 5, graded out of 4 will make up your mark: this amounts to a total of 16 points. The answers for the previous problem set will be posted online immediately following submission, therefore late assignments will not be accepted. The problem sets are designed as a tool for you to practice and master the course material in preparation for the midterms and final exam and will be comprised of both routine “practice” problems

and more challenging “thought-provoking” problems. Please see the course schedule below for posting and submission dates.
Midterm exams (25 points): Two midterm exams will be held throughout the semester, on dates/rooms TBA. While we aim to have certain material covered for the midterms, the pace of the course indicated in the lecture outline might not coincide with the midterm date. We will confirm in class and through online communications what material will be included on the midterm in advance. In general, the material on the midterm exams will be up to and including the end of lecture on the Monday of the same week.

Final exam (30 points): The final exam for CHE 211 will consist of two parts: a) an open response-type test (worth 1/3 of the overall final exam grade) and b) the American Chemical Society (ACS) standardized test for Organic Chemistry (worth 2/3 of the overall final exam grade). The open response-type test will be held during the last lab lecture slot before the final exam date and will be composed by your teachers. You will write the ACS test during the normal final exam period during exam week. You must take both parts of the final exam to pass the course but you do not have to pass the final exam to pass the course. Part a) of the final exam will consist of questions similar to those on our midterm exams and problem sets and will focus only on the material covered in CHE 211. Part b) of the final exam will be cumulative and will cover both the material from CHE 210 and CHE 211.

Reactions journal (4%): Over the course of the semester, you will keep an organized account of all of the reactions that we study, including mechanisms (where applicable) and will submit the journal at the end of the course for inspection and evaluation by Prof. Zaderenko. Your reactions journal will be due on the day of the final exam during exam week (TBA) and we will try to return it to you once graded.

Class policies

Attendance Policy

Attendance in both lecture and lab are necessary and expected. Exams missed due to an excused (medical) absence must be made up within a week of returning to classes. It is each student’s responsibility to be informed of exam dates, paper due dates, required course activities, etc. before making any travel plans during the semester.

Exams: You are expected to take the midterm exams at the scheduled time. If you are suddenly ill or there is an emergency, please contact me in advance or as soon as possible after the exam, the next morning. Documentation of your emergency will be necessary. A final exam will be held during the last week of the semester and you must take the exam at the appointed time; please plan your travel accordingly.

Academic Honesty

Academic Integrity is a guiding principle for all academic activity at Pablo de Olavide University. Cheating on exams and plagiarism (which includes copying from the Internet) are clear violations of academic honesty. A student is guilty of plagiarism when he or she presents another person’s intellectual property as his or her own.
Students committing acts of academic dishonesty shall be penalized by a failing grade for the assignment and a failing grade for the course.

Extra credit: Students will not have additional “extra credit” opportunities during the course semester; only the items listed in the course assessment table above will be

used to calculate the grade. However, bonus questions may be offered on exams and assignments at the discretion of the Instructor.

Grading Scale (per UPO student handbook)

Grade Conversion Scale:

Spanish Grade:	10	9.5-9.9	9 - 9.4	8.5-8.9	8-8.4	7.5-7.9	7-7.4	6.5-6.9	6-6.4	5.5-5.9	5-5.4	0-4.9
U.S. grade:	A+	A	A-	B+	B	B	B-	C+	C	C	C-	F

Resources:

We will indicate formally our office hours to the C.U.I. (Centro Universitario Internacional), but it is more effective if you make an appointment to meet with us, we are quite flexible, although please understand that we all have many commitments and we might need to compromise to find a suitable time. I will hold extra office hours and/or tutorial sessions prior to midterm and exam dates as my schedule permits.

Your textbook is a fantastic resource that contains reading sections to broaden your perspective and practice problems. This material is meant to supplement, not replace, the lecture component, but I expect that you will read the assigned material and take it as seriously as attending class. The assigned/suggested problems will not be graded, but I expect you to do them as they are an excellent way to learn the material and practice for midterm exams and your graded assignments.

Communication

The primary mode of communication will be through Blackboard. We will post most announcements for the class on this portal; e-mail will only be used if the message is urgent or highly important (e.g., class cancellation, typo in problem set). Lecture notes, answer keys for the problem sets and exams, extra practice problems and their answers, etc. will be posted on Blackboard in the appropriate folder. If you need to contact us, please e-mail (preferred) or phone as listed above. We will reply at the earliest opportunity but please understand that it might not be right away!

Strategies for success

Organic Chemistry has a reputation as one of the most difficult classes that a student takes during their undergraduate career but it's not impossible; you can succeed and there are many ways in which to do that. The first is to recognize that the material is cumulative: what you learn in the early lectures is material that you will need to help you solve problems later in the course. You can't just compartmentalize it; instead you build on your knowledge throughout the course. For this reason**, it is very important that you have a thorough understanding of the material covered in the early lectures and that you stay on top of the class**. This takes both hard work and dedication. The second way to succeed is **to pay attention to detail**; what might seem to you like a negligible difference in chemical structure or reaction conditions can completely change the nature of the molecule or how it reacts, so it is very important on exams and assignments to make sure that you pay attention to the details of the question to arrive at the correct answer. In other words, make

sure you say what you mean and mean what you say!

Most students find that the real key to success in Organic Chemistry is **practice, practice, and more practice**. The amount of material that is covered make it practically impossible to memorize the content of the course – plus, you don't learn nearly as much when you memorize and you certainly don't retain the material. On the other hand, working through lots of examples and doing as many practice problems as possible will help you to learn and remember the material. After a certain point, you will start to recognize patterns and get a feel for how molecules react – in other words, you will develop your chemical intuition. This takes longer for some than others, but don't be discouraged; stay focused and keep at it!

Teaching Strategies

Rather than teaching/learning a plethora of reactions and molecules to memorize, the course focuses on gaining a fundamental understanding of Organic Chemistry.That way, you will retain the material long after the course is completed (and will be able to apply it to your chosen field of study!) and you will develop your critical thinking skills. Unfortunately, there will be some things that you just need to memorize – there is no way around it. But this will be kept to a minimum and we strongly discourage you from trying to memorize everything that we will cover in class – it will be both overwhelming and unproductive. Instead, we hope that by taking the assignments seriously, completing the in-chapter practice problems and using your dictionary as suggested, you will join us in thinking like an Organic Chemist and gain an appreciation for the subject.

Expectations

What we expect from you: We expect that you will have a thorough knowledge of the topics covered in Organic Chemistry I (CHE 210 if you study at UNE); if you are weak in these areas or feel you require a refresher, the onus is on you to get caught up ASAP, either by your own review or by using the office hours.

We expect you to stay on top of the material and not fall behind; you can accomplish this by regularly attending class, reviewing your lecture notes after class and making note of any trouble areas, and using your textbook to complement your lecture notes. You can also accomplish this by starting your problem sets early and not waiting until the last minute to do them.

We expect you to use the resources that we provide for you to your best advantage; this includes following up with answer keys to problem sets or your midterms corrected, lecture notes or handouts that I put online, and completing the suggested problems from the text and/or extra problem sets that I make for you. This also includes attending tutorial sessions during office hours.

What you can expect from us: You can expect us to return your work to you as soon as possible and containing as much feedback as possible. Please understand that the numerous items included in the grading are definitely time consuming, so we will seek a tradeoff between feedback and response time.

You can expect us to communicate with you as much as possible: We try very hard to answer student e-mails quickly (although it helps if you are very clear and/or specific in what you are asking us!) and if there is any additional information or clarification about

assignments or something we discussed in lecture, we will relay this information as soon as possible.

You can expect us to be committed to your success in this course; We will always make the extra effort to help you succeed in Organic Chemistry, but please remember that learning is a two-way street and that we expect you to be committed to your success, as well.

Lecture #	**Topics**	**Class Schedule**	**Lecturer**
1	Course intro, Intro to NMR spectroscopy LL: Project 2	01/25 (W)	Samuel
LAB	Project 2 (1/3 in lab)	01/26 (Th)	Samuel
2	^{1}H NMR spectroscopy	01/30 (M)	Samuel
3	^{1}H NMR spectroscopy	02/01 (W)	Samuel
LAB	Project 2 (2/3 in computer room TBA)	02/02 (Th)	Samuel
4	^{13}C NMR spectroscopy	02/06 (M)	Samuel
5	Mass spectrometry LL: Project 1	02/08 (W)	Samuel
LAB	Project 1 (1/2)	02/09 (Th)	Matilde
6	Spectroscopy wrap-up and structure elucidation reaction	02/13 (M) **PS NMR-MS due**	Samuel
7	Reactions of alkenes – cleavage reactions	02/15 (W)	Valeria
LAB	Project 1 (2/2)	02/16 (Th)	Matilde
8	Reactions of alkynes, keto-enol tautomerization	02/20 (M)	Valeria
LL	LL: Project 3	02/22 (W)	Samuel
LAB	Project 3 (1/2)	02/23 (Th)	Matilde
9	Synthesis and reactions of epoxides Nomenclature of carbonyl compounds	03/01 (W)	Valeria
LAB	Project 3 (2/2)	03/02 (Th)	Matilde
10	Redox chemistry 1: oxidation of alcohols to carbonyl compounds, reduction of carbonyl centers	03/06 (M)	Valeria
11	UV-Vis spectroscopy LL: Project 4	03/08 (W)	Samuel
LAB	Project 4	03/09 (Th)	Matilde
12	**Midterm 1**	03/13 (M)	Samuel
13	Carbonyl chemistry part 1: addition at carbonyl center LL: Project 5	03/15 **(W)**	Valeria
LAB	Project 5	03/16 (Th)	Matilde

14	Carbonyl chemistry part 2: substitution at carbonyl center	03/20 (M)	Valeria
15	Grignard reaction	03/22 (W)	Valeria
LAB	Project 4 and Project 5 (computer room TBA)	03/23 (Th)	Matilde
16	Addition of nitrogen nucleophiles to aldehydes and ketones, Formation of acetals/hemiacetals and conjugate additions	03/27 (M)	Valeria
17	Wolff-Kishner, Clemmensen, Wittig reactions. Aldol and Claisen Ester condensations	03/29 (W)	Valeria
LAB	Project 2 (3/3) Your Presentations in room TBA	03/30 (Th)	Samuel
18	Diels-Alder reaction	04/03 (M)	Samuel
19	Benzene and nomenclature of aromatic compounds, MO model	04/05 (W)	Reyes
20	Huckel's rule, aromaticity, Electrophilic Aromatic Substitution – introduction	04/17 **(M) PS UV-Diels-Alder due**	Reyes
21	Electrophilic Aromatic Substitution LL: Project 6	04/19 (W)	Reyes
LAB	Project 6	04/20 (Th)	Matilde
22	Reactions of alkenes – addition of carbenes and hydrogenation	04/24 (M)	Reyes
23	Reactions of alkenes – formation of alcohols LL: Project 7	04/26 (W)	Reyes
LAB	Project 7	04/27 (Th)	Matilde
24	Addition reactions of alkenes and alkynes–addition of HX Additions reactions of alkenes and alkynes– addition of ROH	05/08 (M)	Reyes
25	Addition reactions of alkenes and alkynes – addition of X2, halohydrins	05/09 (W)	Reyes
LAB	Presentations of Project 6	05/11 (Th)	Matilde
	Midterm 2	TBA	

** Please note that this lecture outline is tentative and subject to change depending on the pace and progress of the class.
While we will cover the fundamentals in class, there is not sufficient lecture time to discuss all the details of each topic, thus the onus is on you to complement the lecture material with that in your textbook and do the assigned in-chapter practice problems.

LABORATORY SCHEDULE FOR CHE 211

Lab #	Experiment Title	Lab	Assigned Reading Technique	Lab Quiz	Lab Due
1	Unknown Investigation using Spectroscopy	Project 2		Yes	
2	NMR Problems/Delta Workshop Spectroscopy	Handout 1		No	
3	Acid Catalyzed Dehidration of Cyclohexanol	Project 1		Yes	
4	Acid Catalyzed Dehydration of Cyclohexanol: Analysis	Project 1		No	
5	Bromination of Stilbene	Project 3A		Yes	Project 1
6	Radical Bromination	Project 3B		Yes	
7	Diels-Alder	Project 4		Yes	Project 3
8	EAS: Selectivity in Bromination of Acetanilide and 4-methyl	Project 5		Yes	Project 4
9	Diels-Alder and EAS				
10	NMR Presentations	Project 2		No	Project 5
11	**Spring Break**				
12	Identification of a Colorless Liquid	Project 6		Yes	Project 2
13	Synthesis of Nylon	Project 7		Yes	Project 6
14	***No Lab (Spring long weekend)***				
15	Presentations	Project 6		No	Project 7

All references to “techniques” are found in:
Mohrig, et. al. Techniques in Organic Chemistry: **3rd** Edition, W. H. Freeman, 2010.

Grading Breakdown for Lab

		250 pts total	25 % of total grade
Lab Quizzes	8 X 10 pts each (drop	60	6%
Lab Notebooks	6 X 10 pts	60	6%
Lab Reports	6 X 15 pts	90	9%
Handout 1	10 pts	10	1%
NMR Presentation	10 pts	10	1%
Unknown Investigation	20 pts	20	2%

Overall, your laboratory grade will be based upon:

1. preparation (pre-lab write-up & quizzes)

2. performance (lab notebook, documented results, calculations, and quizzes)

3. comprehension (lab reports: analysis & discussions of results)

4. communication (presentations, ability to impart comprehension of material)

These factors will be assessed in the following ways: a) lab quizzes, b) an overall lab notebook grade (reports and carbonless notebook), c) handouts and d) presentations.

a) Laboratory Quizzes - 10 points each

Quizzes will take place at the beginning of each lab period according to the schedule above and last for approximately 10-15 minutes at the discretion of the Instructor. During the quizzes, you will be allowed to *use your lab notebook only (**NO** loose paper, calculators or cell phones are permitted)*. Quizzes will cover the pre-lab material from the current week's lab. In the case of an unexcused absence, the missed lab quiz will be taken as a "zero". Make-up quizzes will only be allowed if there is a documented medical or personal emergency that permitted your absence from lab. Students who are more than 10 minutes late to lab will not be permitted to write the quiz.

b) Laboratory Notebooks - 10 points each

A carbonless copy laboratory notebook must be purchased and maintained as a record of your experimental work in this course. To be considered a permanent record **NOTEBOOKS MUST BE BOUND**. Actively maintain your laboratory notebook according to the guidelines below and strongly consider the feedback from your Instructor in preparing future laboratory reports. All lab data should be recorded in ink directly in the notebook (not on scrap paper & copied in later). Errors should be crossed out with a single line so that all information is still legible. Any in-lab data should be stapled or taped into your notebook. **NOTE**: 3 ring binders or the equivalent with loose-leaf paper inserted is NOT considered "bound", and is not acceptable as a lab notebook in this course. Furthermore, photocopying portions of the lab text and taping into your notebook is NOT ALLOWED. The general criteria for grading lab notebooks are given below. Also note that your lab notebook will be your only source of information for completing the laboratory experiment and quiz. No lab handouts or photocopies will be permitted during the lab section.

Lab notebooks will be graded based on the pre- and post-lab expectations for each laboratory experiment.

Do not be intimidated by how large of an undertaking maintaining a notebook seems. It does require a lot of work, but once you have gone through a couple of experiments it should be rather straightforward to keep things in order.

You will submit a carbonless copy of your notebook entry (as indicated in the lab schedule) after the completion of the lab (worth 10 points each). Please follow the guidelines outlined below to ensure that you earn full points!

Please write darkly and neatly so that your Instructor can read your

report! **Before coming to lab (pre-lab):**

Header: Name and date on every page.

Title: Must be a title that fully describes the experiment.

Purpose: Must explicitly state the purpose(s) of the experiment. "What is the point of this experiment?"

Table of materials: Must include ALL reagents, solvents and chemical materials to be used in the lab as well as any product(s) formed. Include names, structures, relevant physical constants, and safety information (hazards). Also include literature IR and/or NMR and/or UVVis spectra of reagent AND product(s), as applicable. (In other words, if you will analyze your product by IR spectroscopy, include the IR spectra of your expected product as well as that of starting materials so that you can accurately assess your experimental results.) Staple or tape these spectra to your notebook page, reducing the size of the spectra so they do not take up multiple pages in your laboratory notebook.

To find information on physical data and spectra visit the following websites: http://www.aldrich.com, www.acros.com, http://www.msdsonline.com, or riodb01.ibase.aist.go.jp/sdbs/cgi-bin/cre index.cgi?lang=eng (search SDBS). The Aldrich Library of IR Spectra is available on reserve in the library, and the CRC Handbook of Chemistry and Physics and Merck Index are available for use in the reference section. Sometimes you might need to combine print searches with on-line searches to find the information you need.

Reactions and mechanisms: Write the balanced reaction that is being carried out in the lab (if applicable). Write the full reaction mechanism including all intermediates and curly arrows if known for the experiment.

Procedure: The written procedure should be descriptive (not directly copied from your lab manual) and will be the only resource you have for carrying out the lab. Be sure to specifically cite the experiment and page number from the lab manual at the beginning of your procedure. Be sure to include all steps; if you are taking a melting point or IR spectrum or completing a technique previously described in your lab notebook, you can write "refer to page X of notebook". If you have not previously done the technique then write out the steps necessary to complete it. It is recommended to write out your procedure as a bulleted or numbered list as this will provide an efficient way to complete the experiment. It is also recommended that you divide your procedure into two sections vertically on the page so any changes made during the experiment can be noted next to the written experiment. Any changes made to the procedure need to be written in your lab notebook. PASTING THE PROCEDURE DIRECTLY INTO YOUR NOTEBOOK IS NOT ALLOWED.

During lab and post-lab:

Data: Data includes any values recorded in the lab (*e.g.,* the recovered mass of your product as well as values such as 'mass of empty watch glass', 'watch glass + product', etc.) and any measurements (melting point, TLC, etc.) or spectra (NMR, IR, UV-Vis) obtained in the lab. Any spectra that are obtained must be placed in both copies of the lab

notebook and not just stapled to your final lab report. This information needs to be included in your notebook when performing the experiment. Arrange your data in a clear, labeled and well organized fashion in the notebook. The instructor should not have to search to find your data. DO NOT WRITE INFORMATION ON SCRAPS OF PAPER TO LATER BE TRANSFERRED TO YOUR NOTEBOOK.

Conclusions: When writing the conclusion, write in the third person *e.g.,* "the percent yield obtained was 64%", not "I obtained a 64% yield". Also remember to use proper spelling, grammar and punctuation. Grades may be deduced for spelling mistakes or improper written English. The conclusions do not need to be generally more than a few sentences; work hard to be concise, in other words "say what you mean and mean what you say"

References: Make sure to always include references at the end of the notebook entry or on the same page if any information in the report was obtained through another source (not from the experimental data).

c) Laboratory Reports – 15 points each

The laboratory report is a summary of the data and calculations performed in the experiment. It is also an interpretation of these results. This interpretation of the results will be heavily weighed and is important in determining your understanding of the laboratory's material.

You will submit a typewritten and double-spaced lab report (as indicated in the lab schedule) after the completion of the lab (worth 15 points each). Please follow the guidelines outlined below to ensure that you earn full points!

Data: Data includes any values recorded in the lab (*e.g.,* the recovered mass of your product as well as values such as 'mass of empty watch glass', 'watch glass + product', etc.) and any measurements (melting point, TLC, etc.) or spectra (NMR, IR, UV-Vis) obtained in the lab. Any spectra that are obtained must be stapled to the final lab report. Also the data should be included in a well-organized fashion (*i.e*., in a table, chart or graph)

Calculations: Calculations include percent recovery or percent yield (must also have theoretical yield calculation) as applicable and any other calculations (*e.g.,* R_f value if doing TLC).

Discussion and conclusion: The discussion should be a concise account of the major findings obtained during the lab. This is not a summary of the lab (do not summarize the procedure), rather you should state your major results and what they mean/how they relate to the objectives of the lab (the purpose). The post-lab discussion should be concise and is expected to integrate all the data/observations that have been collected in the lab and use that information to then clarify the argument. Ideally all of the data should point to one conclusion and the "story" it tells is very clear. In reality, however, this rarely happens. One of the most important aspects of being a scientist is being able to explain the results and why these results differed from the expected results. Each week critically evaluate and interpret the experiment and its results. Interpreting data involves drawing the most logical connections from the data to explain why things occurred in the way they did.

For example, the discussion for a synthesis reaction should indicate what type of reaction it is (*e.g.,* a green oxidation reaction) and what the percent yield was. If there was not a 100% yield, discuss why the yield was lower than expected (or whether a 100% yield would even be expected). Then state the other major results, *e.g*., melting point, IR spectrum, and discuss them individually as they relate to the objective of the experiment; in other words, what does the data tell about the identity of the product? Is the material obtained the expected product? How does the data deviate from literature values (*e.g.,* lower melting point) and what does this mean? Is the product pure? How do you know? Finally, wrap up this section with a conclusion: state whether or not the experiment was a success (or what the final outcome is) and why it was successful or not. Be sure to include brief accounts of the data and how it helped determine the success or final outcome of the experiment. The concluding statement ("verdict") comes at the end of the section after you have presented the relevant results ("the evidence"), not at the beginning. The key to a good discussion is to answer the why questions that have surfaced during the experiment. Always be ready to explain why the experiment went as predicted or why the experiment did not.

For a lab where the identity of unknown is being determined, present the various data collected and discuss how they lead to determining the identity of the unknown. Indicate both positive and negative outcomes, e.g., "the melting point of the solid unknown was 83-86 ^{o}C, suggesting that it could be compounds W or X, but not Y and Z". Provide the data and formulate an argument that supports the upcoming conclusion. Finally, make a concluding statement about the identity of your unknown.

When writing the discussion and conclusion, it is expected to be in the third person *e.g*., "the percent yield obtained was 64%", not "I obtained a 64% yield". Also use proper spelling, grammar and punctuation. Grades may be deduced for spelling mistakes or improper written English. The discussion and conclusion do not need to be long but they need to be thorough; work hard to be concise, in other words "say what you mean and mean what you say".

Make sure to always include references at the end of the discussion if any information in the report was obtained through another source (not from the experimental data).

d) Presentations

As part of the laboratory there will be two presentations (one individual and on in teams of two). The presentations should be made and delivered using PowerPoint (or equivalent) format. The presentations will be graded based on comprehension of the material, appropriate inclusion of all relevant data, comparison to literature data and references. The visual quality of the presentations and how well it is delivered will also be evaluated. Practice the presentation in advance! The presentations should be approximately 10 minutes in length and will include a question-and-answer section at the end of each talk. **Make sure to always include references either at the end of the presentation or on the slide with data that was obtained through another source.**

e) Handout - 10 points

One "dry" laboratory session will be held to help reinforce NMR concepts from the classroom and give students a chance to learn to work with the Delta NMR software.

Students must complete the exercise during the laboratory period. They must submit a NMR handout to the Instructor at the end of the lab period.