**Comprehensive Course Syllabus**

# Organic Chemistry II

## Course Description:

The purpose of this course is to provide students with basic understanding of the underlying principles associated with several of the organic functional groups and the skills needed to be successful in university level organic chemistry. The curriculum includes a study of stereochemistry, nomenclature, basic reactions, mechanisms, and laboratory analysis. This course presents organic chemistry as a progressive and systematic building of molecules from alcohols to carboxylic acids and its derivatives. The course is hands-on, inquiry-based, and places heavy emphasis on laboratory work. Most of the organic chemistry laboratory activities involve reinforcing concepts being learned in the classroom that also enhance the student's organic chemistry lab skills. Applications of the lab and homework problems will culminate with the identification of organic compound unknowns.

## Teaching and Learning Methodology and Philosophy:

The Organic Chemistry curriculum at IMSA provides a learning environment that is competency-driven, based on previous experiences, laboratory-based, and integrative. Students are expected to construct their own knowledge under the facilitation of a teacher who is committed to creating these learning opportunities. Consistent with the expectation that students construct their own knowledge, the majority of the student's time is spent on laboratory activities that reinforce classroom learning. Students are expected to ask questions, make observations, collect data, look for evidence and draw conclusions. Students share their findings by writing laboratory summaries or reports and/or by applying their findings to new situations. The classroom environment is collaborative and student-centered, where students have the opportunity to ask questions discuss concepts and teach each other.

## Instructors:

| Instructor: | Dr. Laura Kopff | Dr. John Thurmond | Dr. Anita White |
|---|---|---|---|
| Office: | B147 | B120B inside B120A | E100A inside E100 |
| Phone: | 907-5901 | 907-5072 | 907-5949 |
| Email: | lkopff@imsa.edu | jthurmond@imsa.edu | awhite@imsa.edu |
| Office Hours*: | A days- 2:20-3:15 pm<br>I days- 1:00-3:00 pm | A/C days 11:40 am-12:40 pm | B/C days 12:00 pm - 1:00 pm |

* or by appointment

## Meeting Days, Time and Room:

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|---|---|---|---|
| Organic Chemistry II-1 | B/D days Mods 1-2 | B148 | White |
| Organic Chemistry II-2 | A/C days Mods 3-4 | B148 | Thurmond |
| Organic Chemistry II-3 | B/D days Mods 5-6 | B148 | Kopff |

## Text/Materials:

The textbook is Organic Chemistry – A Short Course, 12th edition, by Hart, Craine, Hart, and Hadad. Other required materials include a laptop, tablet, or notebook for note taking, a calculator, and pens/pencils. Additional materials will be provided.

## Student Learning Objectives:

Characterize stereoisomers (conformers, enantiomers, diastereomers, meso compounds) and name them using the correct notation

Name alkyl halides, alcohols, phenols, aldehydes, ketones, carboxylic acids and carboxylic acid derivatives using IUPAC rules and/or common names given the structure

Draw structures of alkyl halides, alcohols, phenols, aldehydes, ketones, carboxylic acids and carboxylic acid derivatives given IUPAC or common names

Identify and differentiate conditions for nucleophilic substitution versus elimination reactions

Explain the acidic and basic properties associated with alcohols

Predict and explain basic reactions of alcohols, aldehydes, ketones, carboxylic acids and carboxylic acid derivatives

Predict chemical reactions of a compound based upon the functional group(s) present

Explain differences between electrophilic addition and electrophilic substitution reactions

Use reactions to generate simple (2 to 3- step) routes of organic compound synthesis

Explain what IR spectroscopy is measuring and how it can aid in the identification of organic compounds

Explain what NMR is measuring and how it can be used to help identify organic compounds

Predict structures based on IR and/or NMR spectral information

Laboratory Objectives

Use molecular models to visualize chirality and stereocenters, to assign R and S configurations, and to explore differences in enantiomers, diastereomers and meso compounds

Use the relationship between the structure of an alkyl halide and its reactivity toward $S_N1$ and $S_N2$ reactions to determine the structural type of an unknown compound

Perform reactions typical of alcohols and distinguish between aliphatic (primary, secondary, and tertiary) alcohols and aromatic (aryl) alcohols (phenols)

Use thin-layer chromatography (TLC) to identify constituents of an unknown substance

Use basic diagnostic tests and prepare synthetic derivatives for the purpose of identifying an unknown aldehyde or ketone.

Distinguish various carbohydrates using diagnostic tests.

Prepare a carboxylic acid and carboxylic acid derivative

Determine and compare the solubility of known carboxylic acids

Identify likely functional group(s) in an organic molecule from an Infra-Red (IR) spectrum

Given a molecular formula and the $^{1}H$ NMR spectrum, be able to identify a compound.
Use the knowledge gained in the organic laboratory to identify organic unknowns

**More detailed objectives are provided at the beginning of each unit**

**SSLs and Outcomes:**
IA= Informally Assessed; FA=Formally Assessed; NA=Not Assessed; ABNA=Addressed But Not Assessed

**I. Developing the Tools of Thought**
A. Develop automaticity in skills, concepts, and processes that support and enable complex thought. This is done through lab observations, data collection, analysis, and using lab equipment properly. **FA**
B. Construct questions which further understanding, forge connections, and deepen meaning. This is done by analyzing data to draw conclusion and relate it to the concept. **FA**
C. Precisely observe phenomena and accurately record findings. This is done through laboratory observations, data collection and analysis. **FA**
D. Evaluate the soundness and relevance of information and reasoning. This is done by drawing conclusions from laboratory data. **FA**

**II. Thinking About Thinking**
A. Identify unexamined cultural, historical, and personal assumptions and misconceptions that impede and skew inquiry. This is done by using Lewis dot structures and looking at Bohr models. **FA**
B. Find and analyze ambiguities inherent within any set of textual, social, physical, or theoretical circumstances. **ABNA**

**III. Extending and Integrating Thought**
A. Use appropriate technologies as extensions of the mind. This is done by the use of calculators and computers. **IA**
B. Recognize, pursue, and explain substantive connections within and among areas of knowledge. This is done by making historical connections to the scientists as well as relationships to everyday phenomena. **FA**
C. Recreate the beautiful conceptions that give coherence to structures of thought. This is done through analyzing and learning about molecular structures and chemical reactions. **IA**

**IV. Expressing and Evaluating Constructs**
A. Construct and support judgments based on evidence. This is done by laboratory exploration, constructing laboratory reports as well as identifying unknown compounds based on previous learnings. **FA**

B. Write and speak with power, economy, and elegance. This is done through lab reports, demonstrating understanding through discussions and oral presentations. **FA**
C. Identify and characterize the composing elements of dynamic and organic wholes, structures, and systems. This is done by applying basic naming and reaction properties to more complex molecules. **FA**
D. Develop an aesthetic awareness and capability. This is done by drawing attention to links between current content and the world around them. **IA**

**V. Thinking and Acting With Others**
A. Make reasoned decisions which reflect ethical standards, and act in accordance with those decisions. This is done by not manipulating data to fit conclusions and preventing plagiarism in lab reports. **FA**
B. Establish and commit to a personal wellness lifestyle in the development of the whole self. This is done by adhering to safety rules of the laboratory. **IA**

## Instructional Design and Approach:

The Organic Chemistry curriculum at IMSA provides a learning environment that is competency-driven, based on previous experiences, laboratory-based, and integrative. Students are expected to construct their own knowledge under the facilitation of a teacher who is committed to creating these learning opportunities. Consistent with the expectation that students construct their own knowledge, the majority of the student's time is spent on group or laboratory activities that reinforce classroom learning. Students are expected to ask questions, make observations, collect data, look for evidence and draw conclusions. Students share their findings by writing laboratory reports and/or by applying their findings to new situations. The classroom environment is collaborative and student-centered, where students have the opportunity to ask questions, discuss concepts and teach each other.

## Student Expectations:

The experience you have in this course will be directly related to your level of participation!! One cannot choose to be a non-participant and expect to reap all of the possible benefits. Therefore, some guidelines for a successful experience are listed below.

1. PLEASE be on time and ready for class - both mentally and physically. It is the responsibility of each student to inform the instructor and arrange for make-up work due to excused absences (preferably in advance!).
   Students who are more than 5 minutes but less than 50 minutes late will be given an unexcused absence for the day. Any assignment due that day will also be considered late. Any activity that is submitted for credit on that day can be made up by the student but will also be marked late.
   Students more than 50 minutes late will also be given an unexcused absence and any assignment submitted will be marked late. NO credit will be awarded for make-up work Refer to the Student Handbook for specific effects of excessive tardies and absences.
2. Besides being on time, please have all the materials you will need for the class WITH YOU! Our work on many days will require your notebook, lab notebook or laptop/tablet, calculator and pen/pencil. Lab notebooks and lab data forms will be the only items allowed in the lab in which to record data. Therefore if you forget it, you cannot participate in lab work until you retrieve it!

3. Turning work in late is discouraged. When an assignment has been collected, it may be submitted for late credit at a 10% penalty per day. Once the teacher has returned material that has been assessed, it cannot be submitted for late credit.
4. No cell phones may be used, sunglasses worn, or food/drinks ingested in the lab.
5. Collaboration is encouraged throughout all facets of this course. Academic dishonesty, however, is not. It is expected that students will discuss laboratory results, and partners will share common data. It is also expected that all reports/work reflect individual thought and other sources will be referenced appropriately.
6. Goggles and closed-in shoes must be worn at all times in lab. Keep your work/lab area neat and clean. Penalties may be incurred for lab areas not cleaned up.
7. **All** IMSA materials and equipment will remain in the classroom (or laboratory) unless given permission by the instructor. Perform only those experiments authorized by the instructor.
8. If, at any point, you are experiencing some confusion - get help ***immediately.*** Concepts cannot build upon each other if one is not understood. Do not wait until office hours occur. Schedule an appointment for a mutually convenient time.

**Assessment Practices, Procedures and Processes:**

Your grade in this course will be a reflection of all aspects of the course. Points will be earned for lab experiments and reports, problem solving, written assignments, quizzes, and tests. 40% of your classroom average will be from lab work. This component of your grade will include lab reports, summaries, and/or quizzes (either pre-lab or post-lab). In lieu of a written final exam, the "Unknown Analysis" lab at the end of the semester will be considered the final assessment. This grade will be incorporated into the 40% lab grade.

Another 50% will come from your quiz and test average. There will be four quizzes and four unit tests.

The remaining 10% will come from everything else other than the above mentioned grades. We will call this the "miscellaneous" category. The miscellaneous category includes such items as homework, homework quizzes, presentations, and projects.

Your grade for the semester will be determined by the following scale:

A = 90% B = 80% C = 70%

**Sequence of Topics and Activities:** see detailed calendar

# Organic Chemistry II – Spring 2020

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| **Jan 13 A**<br>Course Introduction, pre-test, Introduction to stereoisomerism<br>**Activity: Chirality and Stereoisomers**<br>***Assignment 1*** | **14 B** | **15 I** | **16 C**<br>Stereoisomerism: R and S isomers<br>**Activity: Chirality and Stereoisomers**<br>***Assignment 2*** | **17 D** |
| **20**<br>**Martin Luther King Day**<br>**Academy Closed** | **21 A Assembly**<br>Enantiomers, Diastereomers and Meso compounds<br>**Activity: "Alice in MIL"**<br>***Assignment 3*** | **22 B** | **23 C SHORT**<br>**Quiz: Stereoisomerism**<br>Alkyl halide naming<br>**Lab: Haloalkane reactivity**<br>***Assignment 4*** | **24 D** |
| **27 A**<br>**Lab: Haloalkane reactivity** | **28 B** | **29 I** | **30 C**<br>$S_N1$ and $S_N2$ Reactions<br>**Lab: Nucleophilic substitution kinetics**<br>***Assignment 5*** | **31 D** |
| **3 A**<br>Substitution vs. Elimination Rxns<br>**Activity: Nucleophilic substitution vs. elimination reactions**<br>***Assignment 6*** | **4 B** | **5 I**<br>Interims begin | **6 C**<br>**Unit 1 Review** | **7 D** |
| **10 A**<br>**Unit 1 Test**<br>***Assignment 7*** | **11 B** | **12 I** | **13 C- SHORT**<br>Alcohol and phenol nomenclature<br>**Lab: Reactions of Alcohols**<br>***Assignment 8*** | **14**<br>**Staff Community learning day** |
| **17**<br>**President's Day**<br>**Academy Closed** | **18 D**<br>**See Feb. 13** | **19 I** | **20 A**<br>Acidity/basicity of alcohols<br>**Lab: Reactions of alcohols**<br>***Assignment 9*** | **21 D** |
| **24 A**<br>**Quiz: Alcohol naming**<br>Synthesis of Alcohols<br>**Lab: Reactions of Alcohols**<br>***Assignment 10*** | **25 B** | **26 C**<br>Reactions of Alcohols<br>**Activity: Reactions of Alcohols** | **27 D** | **28 I**<br>**Professional Development Day** |
| **Mar 2 A**<br>**Assembly**<br>**Unit 2 Review**<br>**Lab: TLC of Analgesics** | **3 B** | **4 I** | **5 C**<br>**Unit 2 Test**<br>***Assignment 11*** | **6 D** |
| **9 A**<br>Aldehydes/ ketone nomenclature<br>**Lab: Aldehydes and ketones**<br>***Assignment 12*** | **10 B** | **11 I** | **12 C**<br>Synthesis of Aldehydes and Ketones<br>**Lab: Aldehydes and ketones** | **13 D SHORT**<br>**3rd Qtr Ends** |

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|---|---|---|---|---|
| **16**<br>**It's** | **17**<br>**Spring** | **18**<br>**Break** | **19**<br>**Week** | **20**<br>**!!!** |
| **23 A**<br>Aldehyde and ketone reactions<br>Presentation preparation<br>**Lab: Aldehydes and ketones**<br>***Assignment 13*** | **24 B** | **25 I**<br>**Grading Day** | **26 C**<br>**Quiz: Aldehyde and ketone naming**<br>**Presentations:** Aldehyde and ketone reactions<br>***Assignment 14*** | **27 D** |
| **30 A**<br>**Unit 3 Review**<br>**Lab: Reactions of Carbohvdrates** | **31 B** | **April 1 I** | **2 C**<br>**Unit 3 Test**<br>***Assignment 15*** | **3 D** |
| **6 A**<br>Carboxylic acid nomenclature and properties<br>***Assignment 16*** | **7 B** | **8 I** | **9 C SHORT**<br>Carboxylic acid derivatives nomenclature<br>***Assignment 17*** | **10**<br>**Extended break** |
| **13**<br>**Extended break** | **14 D**<br>**Lab: Prepara-tion of a carboxylic acid**<br>***Assignment 17*** | **15 I** | **16 C**<br>**Lab: Carboxylic acids and derivatives** | **17 D** |
| **20 A**<br>**Lab: Carboxylic acids and derivatives** | **21 B** | **22 I**<br>**IMSAloquium** | **23 C**<br>Carboxylic acids and derivatives reactions<br>***Assignment 18*** | **24 D** |
| **27 A**<br>**Naming CA and derivatives quiz**<br>IR Spectroscopy<br>**Lab: IR spectroscopy**<br>***Assignment 19*** | **28 B** | **29 I** | **30 C**<br>NMR Spectroscopy<br>**Lab: NMR Spectroscopy**<br>***Assignment 20*** | **May 1 D** |
| **4 A AP Exams**<br>**Unit 4 Review** | **5 B AP Exams** | **6 I AP Exams** | **7 C AP Exams**<br>**Unit 4 Test** | **8 D AP Exams** |
| **11 A AP Exams**<br>**Lab: Unknown analysis** | **12 B AP Exams** | **13 C AP Exams**<br>**Lab: Unknown analysis** | **14 D AP Exams** | **15 I AP Exams**<br>**Placement Testing PROM** |
| **18 A**<br>**Lab: Unknown analysis** | **19 B** | **20 I** | **21 C SHORT**<br>Semester wrap-up, Post-test<br>Unknown analysis lab due | **22 D-SHORT** |
| **25**<br>**Memorial Day holiday** | **26**<br>**Final Exams** → | **27** | **28** → | **29**<br>**Final Exam makeups** |