

Spring 2020

CHEM 245-002: Organic Chemistry for Chemical Engineers (Revised for Remote Learning)

Christopher DeSantis

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**Chemistry 245 Organic Chemistry for
Chemical Engineers**
*Spring 2020 Course
Syllabus*

[NJIT Academic Integrity Code](#): All Students should be aware that the Department of Chemistry & Environmental Science (CES) takes the University Code on Academic Integrity at NJIT very seriously and enforces it strictly. This means that there must not be any forms of plagiarism, i.e., copying of homework, class projects, or lab assignments, or any form of cheating in quizzes and exams. Under the University Code on Academic Integrity, students are obligated to report any such activities to the Instructor.

COURSE INFORMATION

Course Description: This one semester course encompasses a complete treatment of all the main concepts in a traditional two semester Organic Chemistry Course. After a theoretical treatment of the structure and stereochemistry of organic molecules, the course goes deeply into an introduction of the major classes of organic molecules and their reactivity with special emphasis on the most common chemical reactions found in the chemical processing industry. A brief treatment of the major spectroscopic methods for structure elucidation completes the course.

Number of Credits: 4

Prerequisites: Undergraduate level CHEM 126 Minimum Grade of C or Undergraduate level CHEM 126 Minimum Grade of T or Undergraduate level CHEM 122 Minimum Grade of T or Undergraduate level CHEM 122 Minimum Grade of C

Course-Section and Instructors

| Course-Section | Instructor |
|----------------|---------------------------------------------------------------------------------------------------------|
| CHEM 245-002 | Dr. Christopher DeSantis |
| Webex URL | https://njit.webex.com/meet/cdesantinjit.edu |

Email: christopher.a.desantis@njit.edu

Office: Tiernan Hall B006 (basement)

Class Schedule

| | | |
|-----------|---------------------|----------|
| Wednesday | 10:00 am - 12:50 pm | KUPF 206 |
| Friday | 9:15 am - 11:20 am | KUPF 206 |

Office Hours: Tiernan 110

Tuesday: 12PM-1PM

Wednesday: 2PM-4PM

Also available by appointment

Webpage: The course website is available through Canvas, which can be accessed via the njit.edu. Please email me immediately if you cannot access the class site. All materials including lecture summaries, any PowerPoint slides, and other documents will be posted on the class site. Please check the site frequently for new materials and announcements. All grades for this course will be posted to Canvas on a regular basis. You are responsible for all updates posted to Canvas, and if you find any mistakes in content or grading, or you need help accessing these materials, please contact your instructor as soon as possible.

Required Textbook:

| | |
|------------------|-------------------------|
| Title | Organic Chemistry |
| Author | Wade and Simek |
| Edition | 9th |
| Publisher | Pearson, Glenview, IL |
| ISBN # | ISBN-13: 978-0321971371 |

University-wide Withdrawal Date: The last day to withdraw with a W is April 6, 2020. It will be strictly enforced.

Learning Outcomes: Upon completing *Chemistry 245, Organic Chemistry for Chemical Engineers*, the student will be able to do the following:

I. Basics

1. Draw chemical structures (condensed structures, structural formulas and line-angle formulas) for organic compounds including exceptions to the octet rule
2. Use VSEPR and concepts of hybridization to predict and explain the geometry of molecules
3. Discuss electronegativity and bond polarity
4. Discuss nucleophilicity and electrophilicity, and predict nucleophilic or electrophilic sites based on the structure of molecules
5. Discuss resonance and delocalization of charge in molecules
6. Identify various functional groups in organic molecules, particularly alkenes, alkynes, alcohols, acids, ethers, esters, aldehydes, ketones and amines
7. Explain Lewis acid-base theory
8. Explain rules of nomenclature to describe the various hydrocarbons
9. Describe structural and geometric isomerism
10. Describe types of intermolecular forces and explain how molecular polarity affects intermolecular forces
11. Explain the role of kinetics and thermodynamics for chemical synthesis; use potential energy diagrams

II. Structures and Reactions

12. Draw curved arrows and explain reaction mechanisms
13. Identify and describe the reactivity of various intermediates (cations, anions and radicals) produced during reactions of hydrocarbons (and other organic transformations)
14. Describe chirality and distinguish between R and S stereoisomers
15. Discuss and draw the products of substitution and elimination reactions of alkyl electrophiles
16. Describe substitution reactions and recognize SN1, SN2, E1 and E2 reactions
17. Determine the major products formed during elimination and substitution reactions (Markovnikov's rule, Zaitsev's rule)
18. Describe the properties, synthesis, and reactivity of alcohols
19. Describe the properties, synthesis and reactivity of ethers, cyclic ethers, thioethers and epoxides
20. Explain the properties and reactivity of various conjugated systems
21. Use Hückel's rule to determine if compounds are aromatic, anti-aromatic or non-aromatic, and predict chemical reactions involving aromatic compounds
22. Predict the products of reactions involving or forming ketones and aldehydes, amines, carboxylic acids and derivatives.

23. Devise syntheses of complex molecules from simpler reactants by using retrosynthetic analysis.
24. Recognize the role of organic reactions in chemical engineering, such as the synthesis of materials, polymers and/or fine chemicals

III. Structures and Analysis

25. Explain the electromagnetic spectrum and the use of spectral regions to determine molecular structure
26. Explain the use of IR spectroscopy to determine functional groups
27. Explain the role of mass spectrometry in determining the molecular formula of a compound, and identify isotopes
28. Discuss Nuclear Magnetic Resonance Spectroscopy (NMR) including ^1H and ^{13}C , and apply NMR to determine the structure of organic compounds
29. Explain UV spectroscopy and describe the use of UV absorption in structural determination of conjugated systems
30. Synthesize spectral information from the different techniques to solve for the structure of an unknown compound

POLICIES

All CES students must familiarize themselves with, and adhere to, all official university-wide student policies. CES takes these policies very seriously and enforces them strictly.

Grading Policy: The final grade in this course will be determined as follows:

| | |
|--------------------------------|------------|
| In Class Worksheets (11x) | 165 |
| Participation - 3 things (25x) | 50 |
| Homework (10x) | 55 |
| Pre-Chapter Assignment (18x) | 54 |
| Quizzes (4x) | 100 |
| Exam I | 100 |
| Exam II | 100 |
| Exam III | 100 |
| Final Exam | 125 |
| Total Points | 849 |

| | | | |
|----|-----------|---|-----------|
| A | >709 pts. | C | ≥468 pts. |
| B+ | ≥658 pts. | D | ≥426 pts. |
| B | ≥594 pts. | F | <426 pts. |
| C+ | ≥531 pts. | | |

Participation: Attendance at classes is **highly recommended**. Each class is a learning experience that cannot be replicated through simply “getting the notes.” This is also a highly compacted course and even one absence may cause a steep drop in course performance. Absences for unavoidable legitimate reasons will be permitted upon presentation of appropriate supporting documentation. At the end of each lectures, students will be required to complete a “3 things” short answer survey which will be worth 2 pts each. Lecturing will continue online as of March 23rd using Webex. The Webex URL for this class is <https://njit.webex.com/meet/cdesantinjit.edu>. This will continue in the online portion of the class but the 3 things will be administered as a quiz on Canvas that will open at the end of our sessions and be due 1 hour after our online session ends.

In Class Worksheets: There will be 11 in class works sheets worth 15 points each. Students will work in groups to develop solutions to the problems but each student must hand in a copy of their own work. The purpose of the group work is to teach each other topics in class and to discuss problems presented in the course. It is not intended for students to copy work from other students once a solution is presented. Worksheets will be graded for each individual student. **Worksheets which are not completed in class may be completed during office hours up to one week after they have been presented to the class.** Missed worksheets due to approved absences may be completed 1 week after returning to campus. **For the online session, the last hour of our 3 hour meeting will be committed to online worksheets.** Students will be broken into small, assigned groups and they will meet virtually to complete the assignments. The instructor will be online in Webex for help. Each student will upload their own work. **Every student is expected to equally contribute to the work.** Each student will earn the grade for their own work.

Pre-Chapter Assignments: A short assignment will be due before the beginning of each chapter. The purpose of the short assignment is to allow students to become familiar with basic topics to be covered in the lecture. Pre-chapter Assignments will be due at the beginning of lecture and will not be accepted late. Students can also submit completed assignments in the chemistry office by 4PM the day they are due. **For the online portion, the pre-chapter assignments will continue as online quizzes to be completed in Canvas.**

Homework Policy: Ten homework assignments worth 5 point each will be assigned. On time homework completion is critical to success in this course. The homework due dates will be clearly posted in Canvas and discussed in class. Plan timely homework completion accordingly. Late homework will not be accepted without a valid excuse and appropriate documentation. Each student is responsible for turning in a hard copy of their own work. Homework will be accepted until 4PM on the day they are due in the chemistry department office. **For the online portion of the class, homework will be assigned as scheduled according to the class calander below. The homework will be released as a PDF and students will submit a picture or scan of their work on Canvas in the assignment.**

Quizzes: Quizzes are given according to the tentative date shown on the course calendar below. There will be four quizzes given at the end of lecture worth 25 pts each. Their course content coverage will be announced in lecture. Use of notes, notebooks, or textbooks will not be permitted and mobile communication devices (iPhones, mobile phones, PDAs, computers, netbooks, smart watches etc.) should remain turned off and stored in your bag for the duration of the exam period. Students are permitted to use molecular modeling kits during quizzes. Violations of this policy will be submitted to the Office of the Provost for review. **Each student is required to bring a photo ID to a quiz and this will be used to confirm a student's identity during the quiz period. For the online portion of the class, quizzes will be administered in the Respondus Lockdown Browser. Quizzes will take place as scheduled and a sterile test taking environment is expected for each student. Quizzes will be timed and take place at the end of the 3 hour session.**

Exams: There will be 4 exams total in the semester with 3 held in class during the semester and one final exam. The following exam periods are tentative and therefore subject to change:

| | |
|-----------------------|-----------------------------------------------|
| Exam I (Ch. 1-4) | February 14, 2020 |
| Exam II (Ch. 5-8) | March 13, 2020 Moved to March 23, 2020 |
| Exam III (Ch. 9-12) | April 17, 2020 |
| Final Exam (Ch 13-20) | Final exam period (Date TBD) |

The final exam will not be cumulative. Use of notes, notebooks, or textbooks will not be permitted and mobile communication devices (iPhones, mobile phones, PDAs, computers, netbooks, smart watches etc.) should remain turned off and stored in your bag for the duration of the exam period. Students are permitted to use molecular modeling kits during exams. Violations of this policy will be submitted to the Office of the Provost for review. **Each student is required to bring a photo ID to an exam and this will be used to confirm a student's identity during the exam period.** Exams will be returned to students as soon as possible. **Exam regrades must be submitted within 1 week of returning the exam with a sheet describing the error. For the online portion of the class, exams will be administered in the Respondus Lockdown Browser. Exams will take place as scheduled and a sterile test taking environment is expected for each student. The exam will have two**

portions, both will be completed with the Respondus Lockdown Browser recording. The first portion will be made up of multiple choice, true and false, fill in the blank and other types of short answer questions and will be graded by Canvas. The second portion will be an open ended answer portion. The open ended questions will be presented with the multiple choice questions and completed with the lockdown browser recording. After closing the lockdown browser, students will have 10 minutes to upload an image in the accompanying assignment of the exam. The assignment will not have the questions but just serve as a place to submit the open ended questions. Respondus will record the video with sound of the student taking the exam and flag any suspicious behavior. Time stamps recorded by Respondus and Canvas will be used to verify the 10 minute window to upload open ended answers.

Makeup Exam/Quiz Policy: There will normally be **NO MAKE-UP QUIZZES OR EXAMS** during the semester unless a valid excuse is provided. In the event that a student has a legitimate reason for missing a quiz or exam, the student should contact the Dean of Students office and present written verifiable proof of the reason for missing the exam, e.g., a doctor's note, police report, court notice, etc. clearly stating the date AND time of the mitigating problem. The student must also notify the CES Department Office/Instructor that the exam will be missed so that appropriate steps can be taken to make up the grade.

GRADING ERROR: Assignments are returned in lecture. If you believe there is an error, you have until one week following return of the assignment to submit a piece of work for regrading. You must write a very brief description of the problem on the back of the test.

Cellular Phones/Smart Watches: All cellular phones and other electronic devices must be switched off during all class times. Such devices must be stowed in bags during exams or quizzes. Students are not permitted to keep cell phones on their person during any exams. If a cell phone is discovered in your possession during an exam the exam will be removed and immediately graded a 0.

Textbook Problems: It is important to study outside this course in order to achieve the best results. The problems within the text book, both in chapter and at the end of the chapter, provide excellent practice for the course material. Work out the problems without the study guide and check your answers after completion to ensure optimal understanding of the material. **Students are not responsible for questions related to sections not covered in the class.**

How to be successful in organic chemistry: Organic chemistry is a difficult subject and it is vital to master new material as it is presented. A successful student will 1) prepare ahead of class by reading the chapter to be discussed and formulating questions to ask in lecture 2) attend and participate in lecture by answering and asking questions and 3) work after lecture on homework and book problems. Homework is a vital part of mastering organic chemistry and nothing can replace practice. There are numerous resources for practice including online resources, the tutoring center, office hours, library resources, and other organic textbooks/workbooks. Work on problems without the solution manual open and then check answers afterwards. **Feel free to email me or come visit during office hours with any questions you may have!** After an exam/quiz/homework assignment is returned, correct any lapses in knowledge by working on topics that may have been answered incorrectly. Mastering organic chemistry takes time and practice so set aside committed time slots in your schedule to work on organic chemistry. Finally, always ask the "why" question when doing homework rather than simply memorizing answers.

Academic Integrity: *Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: <http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf>.*

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions

ADDITIONAL RESOURCES

Chemistry Tutoring Center: The Chemistry Tutoring Center is a valuable resource operating in the Central King Building at published hours. Students are HIGHLY ENCOURAGED to take advantage of this free service.

Accommodation of Disabilities: Office of Accessibility Resources and Services (*formerly known as Disability Support Services*) offers long term and temporary accommodations for undergraduate, graduate and visiting students at NJIT.

If you are in need of accommodations due to a disability please contact Chantonette Lyles, Associate Director at the Office of Accessibility Resources and Services at 973-596-5417 or via email at lyles@njit.edu. The office is located in Fenster Hall Room 260. A Letter of Accommodation Eligibility from the Office of Accessibility Resources Services office authorizing your accommodations will be required.

For further information regarding self-identification, the submission of medical documentation and additional support services provided please visit the Accessibility Resources and Services (OARS) website at:

- <http://www5.njit.edu/studentsuccess/disability-support-services/>

Important Dates

| Date | Day | Event |
|-------------------|-----|------------------------------------------|
| January 20, 2020 | M | Martin Luther King, Jr. Day |
| January 21, 2020 | T | First Day of Classes at NJIT |
| January 31, 2020 | F | Last Day for withdrawal with 100% refund |
| March 15-22, 2020 | | Spring Break |
| April 6, 2020 | M | Last Day for withdrawal |
| April 10, 2020 | F | Good Friday - No Classes |
| May 5, 2020 | T | Last Day of Classes - Friday Schedule |
| May 8-14, 2020 | | Finals Period |

Course Outline

| Week | Monday | Tuesday | Wednesday | Thursday | Friday |
|------|------------------|---------|-----------------------------------------|----------|----------------------------------------------|
| 1 | 1/20 No Class | 1/21 | 1/22 Lecture 1 – Ch 1 Worksheet 1 | 1/23 | 1/25 Lecture 2 – Ch 1 Homework 1 Due |
| 2 | 1/27 | 1/28 | 1/29 Lecture 3 – Ch 2 Worksheet 2 | 1/30 | 1/31 Lecture 4 – Ch 2/3 Homework 2 Due |

| | | | | | |
|----|------|------|---------------------------------------------------------|------|-----------------------------------------------------|
| 3 | 2/3 | 2/4 | 2/5 Lecture 5 – Ch 3/4 Worksheet 3 Quiz 1 | 2/6 | 2/7 Lecture 6 - Ch 4/5 Homework 3 Due |
| 4 | 2/10 | 2/11 | 2/12 Lecture 7 - Catch Up/Review | 2/13 | 2/14 Exam 1 |
| 5 | 2/17 | 2/18 | 2/19 Lecture 8 – Ch 6 Worksheet 4 | 2/20 | 2/21 Lecture 9 – Ch 7 Homework 4 Due |
| 6 | 2/24 | 2/25 | 2/26 Lecture 10 – Ch 7 Worksheet 5 | 2/27 | 2/28 Lecture 11 – Ch 8 Homework 5 Due |
| 7 | 3/2 | 3/3 | 3/4 Lecture 12 – Ch 8 Worksheet 6 Quiz 2 | 3/5 | 3/6 Lecture 13 – Ch 9 Homework 6 Due |
| 8 | 3/9 | 3/10 | 3/11 Lecture 14 – Catch Up/Review | 3/12 | 3/13 Exam 2 (postponed) |
| 9 | 3/16 | 3/17 | 3/18 No Class Spring Break | 3/19 | 3/20 No Class Spring Break |
| 10 | 3/23 | 3/24 | 3/25 Lecture 15 – Ch 10 Worksheet 7 | 3/26 | 3/27 Exam 2 (rescheduled here) Homework 7 Due |
| 11 | 3/30 | 3/31 | 4/1 Lecture 17 – Ch 11 Worksheet 8 | 4/2 | 4/3 Lecture 18 – Ch 11/12 Homework 8 Due |
| 12 | 4/6 | 4/7 | 4/8 Lecture 19 – Ch 12 Worksheet 9 Quiz 3 | 4/9 | 4/10 No Class Good Friday |
| 13 | 4/13 | 4/14 | 4/15 Lecture 20 – Ch 13 Catch Up/Review | 4/16 | 4/17 Exam 3 |
| 14 | 4/20 | 4/21 | 4/22 Lecture 21 – Ch 14 Worksheet 10 | 4/23 | 4/24 Lecture 22 – Ch 16/17 Homework 9 Due |
| 15 | 4/27 | 4/28 | 4/29 Lecture 23 – Ch 16/17 Worksheet 11 Quiz 4 | 4/30 | 5/1 Lecture 24 – Ch 18-20 Homework 10 |

| | | | | | |
|----|-----|--------------------------------------------------------------------------------------------|-----|-----|-------------------------|
| 16 | 5/4 | 5/5 Last Day of Classes: Friday classes Lecture 25 – Chp 18-20 | 5/6 | 5/7 | 5/8 Finals Start |
|----|-----|--------------------------------------------------------------------------------------------|-----|-----|-------------------------|

*Updated by Dr. DeSantis January 2020
Department of Chemistry & Environmental Sciences
Course Syllabus, Spring 2020*
