

COURSE INFORMATION (SECTION 01)

Lectures: Monday & Wednesday 4:00 - 5:20 pm; Conklin Hall 100; [Maps&Directions](#)

Office Hours: Wednesday 2:00 -3:00 pm or by appointment galoppin@newark.rutgers.edu; Life science center 1, 3rd floor office suite 301F.

Description: Fundamental principles in organic chemistry. Synthesis and reactivity of major classes of functional groups, fundamental reaction classes, spectroscopic methods, polymer chemistry. Special attention is given to reaction mechanisms, stereoelectronic effects and the application of organic chemistry in modern research.

Modality: This course is delivered in person, all material is available via Canvas

Prerequisites: 21:160:335 ORGANIC CHEMISTRY I or 01:160:307 ORGANIC CHEMISTRY

Recitations for Section 01: Professor Fina Liotta, fliotta@rutgers.edu Thursday 8:30-9:50 am Conklin Hall 100, Recitations will be used to discuss homework problems and review lecture material.

Disclaimer: These lecture materials are protected by copyright laws. The copyright ownership of the lecture materials vests in either the Professor teaching the course, or to Rutgers University to the extent applicable. The copyright owner of the lecture materials grants you a non-exclusive and limited license only to use them for your own personal use during the course. Sharing them with others (including other students), reproducing, distributing, or posting any copyright protected part of the lecture materials elsewhere-including but not limited to any internet site-will be treated as a copyright violation and an offense against the honesty provisions of the Code of Student Conduct.

Learning Objectives: After completion of this course students should

- be familiar with spectroscopic methods used in organic chemistry
- be familiar with major classes of functional groups in organic chemistry
- be familiar with fundamental reaction classes in organic chemistry
- be familiar with introduction to polymer chemistry
- be able to determine structure using spectroscopic methods
- be able to predict reactivity of functional groups
- be able to rationalize reactivity trends of functional groups
- be able to plan synthetic routes to simple organic molecules
- be able to draw roadmaps for fundamental reaction classes
- be familiar with general synthetic approaches used in organic chemistry
- be familiar with the major current state-of-the-art methods in organic chemistry

INSTRUCTOR SECTION 01 INFORMATION

Instructor:	Professor Elena Galoppini
Office:	Life Science Center I, LSC 301d in the 3 rd floor office suite
Email:	galoppin@newark.rutgers.edu
Office Hours:	Wednesday 2:00 -3:00 pm or by appointment Life Science Center I, 3 rd floor office suite reading room
Recitations:	Dr. Fina Liotta: fliotta@rutgers.edu

IMPORTANT DATES SPRING 2022

Academic Calendar (NCAS is school 21): <https://registrar.newark.rutgers.edu/registrar-spring-academic-calendar-0>

Classes begin: Tuesday, 18 January

Classes end: Monday 2 May

Spring Break: 12 – 20 March

Spring Exams: 5 – 11 May

Add/Drop/Withdraw: Add/Drop period: January 18 - January 25; Last day to drop with a "W": March 21

TEXTBOOK & OTHER RESOURCES**Required Textbook:**

- “Brown, Iverson, Anslyn, & Foote *Organic Chemistry*, 8th ed., and the accompanying *Student Study Guide and Solutions Manual*, (Brooks/Cole-Cengage Learning).
- Note that the Rutgers-Newark Bookstore and NJ Books sell a loose-leaf binder-ready version of the complete text and solution manual.
- The bookstore version of the text also includes access to an optional online homework system.

Other Resources:

- Powerpoints used in class will be made available ahead of each lecture on [Canvas](#)
- A studyguide will be provided prior to each exam.

Recommended Test Banks:

Make sure that you cover all sample multiple-choice questions that are included in the lecture slides. Additional resources for multiple-choice questions in organic chemistry 2 are below:

<https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/Questions/problems/indexam.htm>

<https://www.sanfoundry.com/1000-organic-chemistry-questions-answers/>

<https://global.oup.com/uk/orc/chemistry/okuyama/student/mcqs/>

https://www.varsitytutors.com/organic_chemistry-practice-tests#practice-tests-section

<https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/questions/problems.htm>

<https://www.albert.io/organic-chemistry-2>

Useful Websites (see also in Canvas):

- <https://www.name-reaction.com/list>
- <https://www.organic-chemistry.org/namedreactions/>
- <https://www.masterorganicchemistry.com/>
- <https://organicchemistrydata.org/>

SUGGESTED END OF CHAPTER HOMEWORK PROBLEMS FROM TEXTBOOK

Homework **will not be graded** but selected problems will be in exams.

Chapter 15	1-6,7,8,10,12,20,21,22,23
Chapter 16	1-13,14-20,24,29,30,31,32,38,42,43,46,59
Chapter 17	1-6,8,10,15,17,18-22,26,28,33,35,40,48,50
Chapter 18	1,3-10,12,16,18,19,20,22-25,27,32,35,37,41,64,66
Chapter 19	1-17,18,19,20,22,29,31,33,43,46,50,51,57,78
Chapter 13	2,3,5-8,9,12,15,17,19,24
Chapter 14	2,4,8,14,15,16,17,23,25,29,31,36
Chapter 20	1,2-4,5-13,14-17,19,23,28,30,32,36,50,52
Chapter 21	1-7,9(skip b,g),12,15-17,20,22,23,26,32,36,45,46,52abc
Chapter 22	1-6,8,15,16,19,20,21,22,26,28,32-35,37,40
Chapter 23	1-15,16,18,24,25,33,34,45,47,48
Chapter 24	1,2,4,7,10,32,33
Chapter 29	1-4,5abc,6,7,11,16,24,25,32,33,38

HELP !

- *Help!* If you need assistance, study tips, or have questions about the course material or homework problems, see Dr. Galoppini and Dr. Liotta during office hours, make an appointment to see them at times other than office hours, or contact the Learning Center for other options.
- *The Learning Resource Center* in Conklin Hall can provide various types of assistance:
- *Free Tutoring.* If there are enough requests at the Learning Resource Center for tutors, free tutoring will be provided.
- *Learning Assistants.* If you would like advice on how to develop better study habits and skills, make an appointment with a learning assistant at the Learning Resource Center.

COURSE SCHEDULE				M = MONDAY ; W = WEDNESDAY
JANUARY				
Lecture 1*	W	19	Chapter 15: Introduction to Organometallic Compounds	
Lecture 2*	M	24	Chapter 15	
Lecture 3*	W	26	Chapter 16: Aldehydes and Ketones	
Lecture 4	M	31	Chapter 16	start in person Conklin 100 ↓↓↓
FEBRUARY				
Lecture 5	W	2	Chapter 16	
Lecture 6	M	7	Chapter 16	
Lecture 7	W	9	Chapter 17: Carboxylic Acids Chapter 18	
Lecture 8	M	14	Chapter 18: Functional Derivatives of Carboxylic Acids	
Lecture 9	W	16	Chapter 18	
Lecture 10	M	21	Chapter 19: Enolate Anions and Enamines	
Lecture 11	W	23	Chapter 19	
Lecture 12	M	28	Exam 1: Chapters 15,16,17,18	
MARCH				
Lecture 13	W	2	Chapter 19	
Lecture 14	M	7	Chapter 13: Nuclear Magnetic Resonance Spectroscopy	
Lecture 15	W	9	Chapter 13	
<i>Lectures 16 and 17 No class • 12 -20 March Spring Break</i>				
Lecture 18	M	21	Chapter 14: Mass Spectrometry	
Lecture 19	W	23	Chapter 20: Dienes, Conjugated Systems, and Pericyclic Reactions	
Lecture 20	M	28	Chapter 20	
Lecture 21	W	30	Chapter 21: Benzene and the Concept of Aromaticity	
APRIL				
Lecture 22	M	4	Chapter 21:	
Lecture 23	W	6	Chapter 22: Reactions of Benzene and its Derivatives	
Lecture 24	M	11	Chapter 22	
Lecture 25	W	13	Exam 2: Chapters 13,14,19,20,21,22	
Lecture 26	M	18	Chapter 23: Amines	
Lecture 27	W	20	Chapter 23	
Lecture 28	M	25	Chapter 23	
Lecture 29	W	27	Chapter 24: Catalytic Carbon-Carbon Bond Formation	
MAY				
Lecture 30	Mon	2	Chapter 24	
May 11 starts at 11:45 am - FINAL EXAM				

* First 3 lectures and office hour on 26 will be via Zoom (see Canvas)

GRADING POLICY MORE DETAILS AFTER THE COURSE STARTS

Midterm 1: 50%*
Midterm 2: 50%*
Quizzes (6-7 in total): bonus 5%
Final: 50%

*Two 80-minute midterms exams will count for 50% of the course grade, and a comprehensive final exam will count for the other 50% of the course grade.

Make up policy: The lowest score of the 80-minute midterm exams or an 80-minute midterm exam missed for any reason will be dropped.

Exams and quizzes will cover lecture material, text, assigned problems and problems discussed in the class.

Letter grades will be assigned according to the following scale (scores are percentages of the maximum possible points):

A (100-85), B+ (84-80), B (70-79), C+ (69-65), C (64-55), D (54-45), F (44-0)

ABOUT MIDTERMS 1 & 2

- The 2 eighty-minute midterms on selected chapters (Midterm 1 and 2) will be administered in person and during class period unless University policy changes due to COVID. All in-person exams will be closed book, closed note.
- The midterm with the worse score OR missed for any reason, will be dropped. The remaining midterm will count for **50% of the course grade.**
- Each midterm will consist of **40 multiple-choice questions** (1 point per question, only 1 answer choice for each question is correct, no open ended questions, 4 choices each question) + **up to 5 bonus questions.** In each exam **the score will be normalized to 40 questions, and the additional bonus questions will be on the top of it.** This also means that you can simply skip the additional bonus questions that you do not wish to answer and still get 100%. (Example; if 5 bonus points are given and someone scores all 45, this counts as $45/40 = 112.5\%$, if someone scores 30 of the 45 then it is $30/40 = 75\%$)

ABOUT THE FINAL

- The comprehensive (= all material, all chapters) final examination will count for **50% of your grade** The exam will be administered at the time and day indicated in the syllabus. It will be in person unless University policy changes due to COVID. All in-person exams will be closed book, closed note.
- The final will consist of **40 multiple-choice questions** (1 point per question, only 1 answer choice for each question is correct, no open ended questions, 4 choices each question) + **up to 5 bonus questions.** The score will be normalized to 40 questions, and the 5 additional questions will be on the top of it (just like described above for the midterms).

ABOUT THE QUIZZES

Everyone will receive up to 5% bonus of the final score from quizzes. All quizzes are administered in person at the start of recitations by Prof. Fina Liotta unless University policy changes due to COVID. All quizzes will consist of multiple-choice questions only and Dr. Liotta will communicate the format and the schedule.

SOME COURSE RULES

- Please be punctual: classes start at 4:00 pm exactly.
- Please feel free to email (galoppin@newark.rutgers.edu) if you need to make an appointment with me.
- Emails that do not have proper salutation and signature will be ignored.

ACADEMIC POLICIES AND PROCEDURES**Attendance Policy.**

- Please, review Rutgers University attendance policy, which can be found at <http://policies.rutgers.edu/view-policies/academic-%E2%80%93-section-10#2>
- You are responsible for material covered in any class that you do not attend. If you miss a class, you must contact a classmate or me for the missed information. If you have a situation that might cause you to miss an entire week of class, discuss it with me as soon as possible.

This course adheres to Rutgers University policies on academic integrity.

Please see: <http://academicintegrity.rutgers.edu/academic-integrity-policy> and <http://academicintegrity.rutgers.edu/resources-for-students/>

STUDENT CODE OF CONDUCT

Students are required to adhere to the [University Student Code of Conduct](#) delineated in the Rutgers Student Affairs website [Student Conduct](#) page: <http://studentconduct.rutgers.edu/student-conduct-processes/university-code-of-student-conduct/#1495568095620-2f5ce77d-17dd>

ACCOMMODATIONS AND SUPPORT STATEMENT

Rutgers University Newark (RU-N) is committed to the creation of an inclusive and safe learning environment for all students and the University as a whole. RU-N has identified the following resources to further the mission of access and support:

For Individuals with Disabilities: The Office of Disability Services (ODS) is responsible for the determination of appropriate accommodations for students who encounter barriers due to disability. Once a student has completed the ODS process (registration, initial appointment, and submitted documentation) and reasonable accommodations are determined to be necessary and appropriate, a Letter of Accommodation (LOA) will be provided. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at ods.rutgers.edu. Contact ODS at (973)353-5375 or via email at ods@newark.rutgers.edu.

For Individuals who are Pregnant: The Office of Title IX and ADA Compliance is available to assist with any concerns or potential accommodations related to pregnancy. Students may contact the

Office of Title IX and ADA Compliance at (973) 353-1906 or via email at TitleIX@newark.rutgers.edu.

For Absence Verification: The Office of the Dean of Students can provide assistance for absences related to religious observance, emergency or unavoidable conflict (e.g., illness, personal or family emergency, etc.). Students should refer to [University Policy 10.2.7](#) for information about expectations and responsibilities. The Office of the Dean of Students can be contacted by calling (973) 353-5063 or emailing deanofstudents@newark.rutgers.edu.

For Individuals with temporary conditions/injuries: The Office of the Dean of Students can assist students who are experiencing a temporary condition or injury (e.g., broken or sprained limbs, concussions, or recovery from surgery). Students experiencing a temporary condition or injury should submit a request using the following link: <https://temporaryconditions.rutgers.edu>.

For English as a Second Language (ESL): The Program in American Language Studies (PALS) can support students experiencing difficulty in courses due to English as a Second Language (ESL) and can be reached by emailing PALS@newark.rutgers.edu to discuss potential supports.

For Gender or Sex-Based Discrimination or Harassment: The Office of Title IX and ADA Compliance can assist students who are experiencing any form of gender or sex-based discrimination or harassment, including sexual assault, sexual harassment, relationship violence, or stalking. Students can report an incident to the Office of Title IX and ADA Compliance by calling (973) 353-1906 or emailing TitleIX@newark.rutgers.edu. Incidents may also be reported by using the following link: tinyurl.com/RUNReportingForm. For more information, students should refer to the University's Student Policy Prohibiting Sexual Harassment, Sexual Violence, Relationship Violence, Stalking and Related Misconduct located at <http://compliance.rutgers.edu/title-ix/about-title-ix/title-ix-policies/>.

For support related to interpersonal violence: The Office for Violence Prevention and Victim Assistance can provide any student with confidential support. The office is a **confidential resource** and does *not* have an obligation to report information to the University's Title IX Coordinator. Students can contact the office by calling (973) 353-1918 or emailing run.vpva@rutgers.edu. There is also a confidential text-based line available to students; students can text (973) 339-0734 for support.

For Crisis and Concerns: The Campus Awareness Response and Education (CARE) Team works with students in crisis to develop a support plan to address personal situations that might impact their academic performance. Students, faculty and staff may contact the CARE Team by using the following link: tinyurl.com/RUNCARE or emailing careteam@rutgers.edu.

For Stress, Worry, or Concerns about Well-being: The Counseling Center has confidential therapists available to support students. Students should reach out to the Counseling Center to schedule an appointment: counseling@newark.rutgers.edu or (973) 353-5805. If you are not

quite ready to make an appointment with a therapist but are interested in self-help, check out *TAO at Rutgers-Newark* for an easy, web-based approach to self-care and support: <https://tinyurl.com/RUN-TAO>.

For emergencies, call 911 or contact Rutgers University Police Department (RUPD) by calling (973) 353-5111.

ADDITIONAL INFORMATION ON STUDENT SUPPORT SERVICES

Academic Services:

- For academic support visit Rutgers Academics Student Support at <https://www.rutgers.edu/academics/student-support>
- Any student can obtain tutoring and other help at the [Learning Centers](#) on each campus. Check the website at <https://rlc.rutgers.edu/>
- For coaching help with writing skills and assignments visit the [Writing Coaching](#) webpage at <https://rlc.rutgers.edu/student-services/writing-coaching>
- Many library resources are available online. Assistance is available through phone, email, and chat. For information, check the [Rutgers Libraries](#) website at <https://www.libraries.rutgers.edu/>

Rutgers Student Health Services:

For more information visit: <http://health.rutgers.edu/>

Veteran Services:

Please visit the [Office of Veteran and Military Programs and Services](#) website for more information: <https://veterans.rutgers.edu/>

LECTURES OUTLINE:**Chapter 15. Organometallic Compounds**

- I. Carbon-Metal Bonds
- II. Classical Organometallic Reagents
 - A. Grignard Reagents
 - B. Organo Lithium Reagents
 - C. Gilman Reagents
- III. Reactions Involving Carbenes

Chapter 16. Aldehydes and Ketones

- I. Nomenclature
- II. Structure and Bonding
- III. Preparation of Aldehydes and Ketones
- IV. Reactions
 - A. Addition Reactions
 - B. The Wittig Reaction
 - C. Reactions alpha to the Carbonyl Carbon
 - D. Oxidations
 - E. Reductions

Chapter 17. Carboxylic Acids

- I. Structure and Bonding
- II. Nomenclature
- III. Properties
- IV. Preparations of Carboxylic Acids
 - A. Oxidation of Alcohols
 - B. Grignard Reactions
- V. Reactions
 - A. Reductions
 - B. Esterification
 - C. Acid Chloride Formation
 - D. Decarboxylation

Chapter 18. Carboxylic Acid Derivatives

- I. Nomenclature and Examples
- II. Nucleophilic Acyl Substitution Reactions
- III. Preparations and Reactions
 - A. Acid Chlorides
 - B. Acid Anhydrides
 - C. Esters
 - D. Amides
 - E. Nitriles

Chapter 13. Nuclear Magnetic Resonance (NMR) Spectroscopy

- I. Physical Basis
 - A. Nuclear Magnetic Resonance
 - B. Chemical Shift
 - C. Spin-Spin Splitting
 - D. Signal Integration
- II. Interpreting Proton NMR Spectra
 - A. Index of Hydrogen Deficiency
 - B. Example
- III. Instrumentation
- IV. Topicity of Atoms or Groups
- V. Fast Chemical Exchange
- VI. Instrumentation
- VII. ¹³C NMR

Chapter 14. Mass Spectrometry

- I. Principles and Instrumentation
- II. Analysis of Mass Spectra
 - A. Molecular Ion
 - B. Fragmentation Patterns
 - C. Isotope Patterns
- III. High Resolution Mass Spectrometry

Chapter 19. Enolate Anions and Enamines (Carbonyl Condensation Reactions and Reactions of alpha-beta-Unsaturated Carbonyl Compounds)

- I. Enolates and Enamines
- II. Aldol Reaction
 - A. Mechanism
 - B. Use in Synthesis
 - C. Intramolecular Aldol Reactions
- III. Condensations with Esters
 - A. Claisen Condensation
 - B. Dieckmann Condensation
 - C. Crossed Claisen Condensations
 - D. Hydrolysis and Decarboxylation
- IV. Reactions with Enamines
- V. Acetoacetic Ester Synthesis and Malonic Ester Synthesis
- VI. Conjugate Additions to α - β -Unsaturated Carbonyl Compounds

Chapter 20. Dienes, Conjugated Systems, and Pericyclic Reactions

- I. Special Stability of Conjugated Dienes
 - A. Evidence from Heats of Reactions
 - B. Resonance View
 - C. Molecular Orbital View
- II. Electrophilic Additions to Conjugated Dienes
 - A. Reaction and Mechanism
 - B. Thermodynamic vs. Kinetic Control
- III. Pericyclic Reactions
 - A. Diels-Alder Reaction
 - B. Cope and Claisen Rearrangements
- IV. UV-Visible Spectroscopy
 - A. Physical Basis / Alkene Example
 - B. Other Examples
 - C. Typical Use

Chapter 21. Benzene and the Concept of Aromaticity

- I. Examples of Aromatic Compounds
- II. Benzene
 - A. Structure and Bonding Issues
 - B. Bonding Models
- III. Hückel's Criteria for Aromaticity
 - A. The Rules
 - B. Why $[4n+2]$?
 - C. Heterocyclic Examples
 - D. Polycyclic Aromatics
- IV. Nomenclature
 - A. Monosubstituted Benzenes
 - B. Disubstituted Benzenes
- V. Selected Reactions of Phenols and Reactions at Benzylic Positions
 - A. Reactions of Phenols
 - B. Reactions at Benzylic Positions
- VI. NMR Spectroscopy of Benzene Derivatives

Chapter 22. Reactions of Benzene and its Derivatives

- I. Electrophilic Aromatic Substitution Reactions
 - A. Reactions of Benzene
 - B. Mechanisms
 - C. Directing Effects
 - D. Activating and Deactivating Groups
- II. Useful Reactions of Benzene Substituents
- III. Nucleophilic Aromatic Substitution Reactions
 - A. Addition-Elimination Mechanism
 - B. Benzyne Intermediate Mechanism

Chapter 23. Amines

- I. Nomenclature and Examples
 - A. Aliphatic Amines
 - B. Aromatic Amines
 - C. Heterocyclic Amines
 - D. Biological Amines
- II. Structure, Bonding, and Properties
- III. Preparations of Amines
 - A. Alkylation of Ammonia and Amines
 - B. Reductions of Amides and Nitriles
 - C. From Epoxides
 - D. Reductive Amination of Aldehydes and Ketones
 - E. Reduction of Nitrobenzenes
- IV. Reactions of Amines
 - A. Alkylation and Acylation
 - B. Imine and Enamine Formation
 - C. Two Special Elimination Reactions
 - D. Reactions with Nitrous Acid
 - E. Reactions of Aryl Diazonium Salts

Chapter 24. Catalytic C-C Bond Formation

- I. Review of C-C Bond Forming Reactions
- II. Palladium-Catalyzed Coupling Reactions
 - A. Heck Reaction
 - B. Allylic Alkylation
 - C. Suzuki and Stille Coupling
 - D. Sonogashira Coupling
 - E. Acyl Coupling (handout only)
- III. Alkene Metathesis