

## ELEMENTARY ORGANIC CHEMISTRY LABORATORY

### Chemistry 211 Fall 2016

Coordinator: Dr. G. Govindarajoo ([ggovinda@rci.rutgers.edu](mailto:ggovinda@rci.rutgers.edu))

#### **PREREQUISITE**

Chemistry 171 (or equivalent General Chemistry Laboratory Course). Students who have not satisfied this prerequisite will not receive credit for this course even if they are enrolled.

#### **COURSE OBJECTIVES**

This course is designed to introduce the theory and practice of analytical and purification techniques commonly used in Organic Chemistry. These techniques will be used in the synthesis experiments carried out in the latter part of the course. The goal of the course is for students to be able to analyze data obtained from their observations in the experiments they perform, form reasonable conclusions and relate the reactions and reaction mechanisms from Organic Chemistry to support their analysis and conclusions.

#### **REQUIRED COURSE MATERIALS**

1. **Text Package:** Signature Lab Series: Elementary Organic Chemistry Laboratory Chemistry 211 with OWLv2 by Cengage Learning (ISBN: 9781305429697). We **will not** be using the online OWLv2 but the package is significantly cheaper than the lab manual alone and thus, it is advised that you buy the package.
2. **Laboratory Notebook:** A hard-cover or soft cover notebook with numbered gridded pages and tearout carbon-copy duplicate pages is required. (loose-leaf notebooks - like the ones you use to take notes - are not acceptable) for recording laboratory work. An example is the Student Lab Notebook by Hayden McNeil (ISBN: 9781930882232) or something similar to this (available at the bookstore or websites like Amazon.com).
3. **Safety goggles:** To protect your eyes in the laboratory (must be face-fitting and form seal around eyes; ordinary glasses or other types of safety glasses are not acceptable) – you can use the same goggles that you used for Chemistry 171 or you may purchase a new one from the bookstore. See Laboratory Safety Rules in this syllabus regarding contact lens policy.
4. **Rubber gloves:** To protect your hands and glassware while washing glassware. These are the kind of yellow or blue gloves used for cleaning around the house (available in any grocery or drug store). You will use these rubber gloves over nitrile gloves when washing glassware.
5. **“Disposable Chem Kit”:** Available at stockroom.
6. **Substantial padlock:** To secure the contents of your assigned drawer.
7. **A nongraphing simple calculator:** for use on quizzes

#### **COURSE POLICIES**

1. **Promptness:** Laboratory session will begin and end promptly as scheduled; students will not be allowed to work overtime or during off-hours. If a student arrives late to lab, he or she cannot stay longer than the latest student who came on time.

2. **Make-up:** The labs this semester are extremely full. As such, there are very few spaces open for make-ups. A missed lab period may be made up only for valid medical reason (with a doctor's note as documentation), a religious holiday (with valid documentation from the student's religious leader), valid school activities (with valid documentation) and/or with a note from the dean's office. The student is responsible for contacting Dr. Govindarajoo and speaking with the stockroom personnel (Douglass lab (848) 932-9143) to find an open spot in other lab sections. The authorization from the stockroom personnel has to be approved by Dr. Govindarajoo before a student will be allowed to make up a lab so contact Dr. Govindarajoo by e-mail immediately after obtaining a possible slot. The lab must be made up before the last date of the experiment listed under "Experiment Schedule". **Under no circumstances will a make-up lab be permitted once the last date for that experiment has past.**

You should still contact Dr. Govindarajoo immediately if you cannot find a time for a make up lab because last minute absences in some sections may clear a spot for you to make up your lab. If you manage to make up your lab, **the lab report must be marked clearly with student's name, lab instructor's name and section number and turned in to the lab instructor of the section you are making up the lab.** That lab instructor will pass your lab reports to your lab instructor. You may be also presented with alternate options to complete a lab report so make sure you contact Dr. Govindarajoo immediately if you have to miss a lab for a valid reason.

**If you fail to attend the make up lab session that was agreed upon by you and Dr. Govindarajoo,** the absence would be considered unexcused UNLESS Dr. Govindarajoo was informed of a timely manner that a valid reason (with documentation) caused you to miss your make up lab. Missing a make up lab without a valid documentable reason that Dr. Govindarajoo was not informed about beforehand may also carry additional penalties.

**Absences:** For an absence to be excused, Dr. Govindarajoo must be contacted immediately in case there is a chance for the lab to be made up. Valid documentation **MUST** be provided **within a week of the absence** to your lab instructor **and** Dr. Govindarajoo. Additionally, you must use the University absence reporting website <https://sims.rutgers.edu/ssra/> <<https://sims.rutgers.edu/ssra/>> also within a week of the absence to indicate the date and reason for your absence. If the above steps are not followed, the absence will not be excused. **NOTE: A student with 3 or more absences (valid or otherwise) will not pass the course.**

**Vacation plans are NOT valid reasons for lab make-up or absences.**

**Religious holidays and valid school activities:** Students have to contact Dr. Govindarajoo about potential absences due to religious holidays and valid school activities (sports meet etc) **by 9/14/16** so that make-ups can be arranged. Students are then responsible for e-mailing Dr. Govindarajoo with their detailed schedule for the week of the potential absence **two weeks from the potential absence** to receive instructions on a makeup or alternate arrangements. Valid documentation (letter from religious leader/faculty advisor/coach) **MUST** be provided for these potential absences by 9/14/16.

Students are responsible for all the material from a missed lab and will be tested on it in quizzes.

3. **Weather Emergencies:** Check the Rutgers website ([www.rutgers.edu](http://www.rutgers.edu)) to confirm if classes are cancelled due to weather emergencies in case of bad weather. If classes are on schedule, then labs will be held as scheduled. If there is a delay in opening, as long as there are 2 hours remaining for the lab period, students should attend lab for the remaining time. Changes in schedule and other adjustments will be announced in the Chemistry 211 website. **Students are still responsible for all the material from readings and lecture even if a particular lab is cancelled due to weather emergency.**

4. **Check out** is required of all students. Failure to check out will result in the assessment of a \$50.00 fee and the withholding of grade (for those who complete the course). **Students who drop the course after the check-in MUST check out to avoid having to pay the \$50.00 fee.**

5. **Quizzes** A short quiz (10 mins) will be given in the lab at the beginning of the lab period every week including Check-Out week. The material for the quizzes will be the previous week's lab and the lab you are about to do that particular week. A safety quiz will be given during the first week. **NOTE: No electronic equipment (including cell phones/smartphones)** is permitted to be on your person or in the vicinity while taking quizzes. Any student found in violation of this rule will be considered to have violated the academic honesty clause.

6. **Preparation** Adequate preparation before lab will reduce frustration and prevent accidents. Attempting to perform the experiment while reading the procedure for the first time is little more than a waste of time and can lead to hazardous mistakes. Part of the evaluation points assigned by your lab instructor will be determined on the basis of your preparation.

7. **Website:** We will be using sakai (URL: <http://sakai.rutgers.edu/>) as a classroom management system. You should check this site regularly. If you check it now, you will find a number of documents posted. If you are registered in the course and a Rutgers Student, you will automatically be a "member" of the online class. Under Resources on sakai, which you should go to every week to prepare for your lab, you will see modifications for experiments that you will conduct, instructions on how to write up your prelab, and preparations for this experiment. It is extremely vital that you check the website weekly for information on the experiments you are about to conduct.

8. **Laboratory Safety** All persons in the lab must observe the safety rules. Non-compliance with safety rules will result in expulsion from the lab and no make-up will be allowed.

9. **Breakage** The student is responsible for all costs of breakages. If a student has a balance that needs to be paid when grades are assigned, the student will receive a TF. The TF will be changed to student's actual grade only after the balance is paid at the cashier and receipt is shown at the Chemistry Department Main Office (WL-142).

10. **Exams that Conflict With Lab:** Your laboratory period is a scheduled class. If you have a group exam that conflicts with your lab, your lab takes priority. You will have to make arrangements with the professor of the class with the group exam to take a conflict exam. Make-ups for lab will not be approved for this situation.

11. **Students with Disabilities:** If you have a disability, you are urged to speak to the course coordinator **by 9/11/16** to make the necessary arrangements to support a successful learning experience. Also, you must arrange for the course coordinator to receive a letter from your College's Disability Concerns Coordinator verifying that you have a disability. The student must contact the Office of Disability Services to determine his/her Coordinator (848)-445-6800 or [dsoffice@rci.rutgers.edu](mailto:dsoffice@rci.rutgers.edu).

12. **Academic honesty** You are being graded on the work you perform. Use of lab reports from other students (past or present) is expressly forbidden. **Both the lender and the borrower are subject to severe penalties.** Some discussion about the labs is acceptable at the discretion of the lab instructor, but you must perform all the work (including the data analysis and answering of questions) yourself. **A lab report is NOT a collaborative effort** –it must be written in your

own words using your own data. The lab instructor is free to ask you at any point to explain what you are doing. This is to help the lab instructor instruct the confused and prevent copying of answers. If you are confused, ask for help. Don't just copy an answer. **Do not make up data.** Academic honesty also applies to all quizzes and exams in this course.

***Unauthorized posting and sharing of course material (including but not limited to: syllabi, lecture notes, past, present and future quizzes and exams, prelab and postlab questions) in paper form or online during the current semester and/or in the future is STRICTLY PROHIBITED. The unauthorized posting and sharing of course material is a violation of copyright law AND a violation of academic integrity and appropriate action will be taken against person(s) who violate this law. Report any violations promptly.***

13. **Chain of Command:** If you have a question about grading, you should first talk about it with your lab instructor. If you are not satisfied with the explanation, you may raise the question with the course coordinator. We will not intervene for questions of a small number of points. Decisions made for safety (such as ejection for violation of safety rules) can be made by any lab instructor, the stockroom personnel, or the coordinator, and these decisions are final and not subject to appeal. If you have a question about content, concepts or procedures then you may ask any lab instructors or the coordinator for help. Use our office hours.

14. **Students with Medical Conditions:** Some medical conditions such as pregnancy, asthma, allergies to certain chemicals, or other conditions may be affected by exposure to chemicals. If you believe you are pregnant or if you have a medical problem which might be affected by chemicals, please contact Dr. Govindarajoo before the lab commences or as soon as you become aware of such a condition. We will fully respect your privacy and you do not need to disclose the nature of your medical condition to us. It is, however, imperative that your physician be informed of any chemicals you may be in contact with during the semester so that he/she can determine whether it is safe for you to participate in lab assignments. We will provide you with information for your physician regarding any substances you may be exposed to. We simply require that you bring in a note from your physician indicating that they have reviewed this information and whether you may safely proceed with laboratory work. Rutgers Environmental Health and Safety (REHS) is available to assist you if your doctor recommends that you avoid or minimize contact with certain chemicals. Please feel free to contact them at (848)445-2550 to request assistance.

15. **Lost Items:** Items that are left behind in laboratories will be turned over to the stockrooms of the respective locations. Items will only be held for about a week.

### ***NOTES!!!***

1. The theoretical and practical parts for each experiment will be discussed in the lab.
3. Read the material and be prepared before lab.
4. The pre-lab questions of your report will be collected at the beginning of each experiment. **If you do not turn in your prelab questions at the beginning of the lab period, points may be deducted or you may not receive any points on the prelab part of the experiment.** The post-lab of your report will be collected at the end of the lab period. **Any delay in turning in the**

**postlabs (except for excused absences) will result in significant deductions of points or no points being awarded for that particular postlab.**

All reports must be in ink (carbon copy to remain in notebook).

### **GRADING**

1.	Laboratory Reports (32 points x 9 experiments)	288 points
2.	Safety Quiz	5 points
3.	Quizzes (16 points x 9)	144 points
4.	Super Quiz (administered during Week 7)	27 points
5.	Evaluation by lab instructor	16 points
	<b>TOTAL</b>	<b>480 points</b>

## LABORATORY SAFETY RULES

There are a few precautions that you must take to avoid accidents in the lab.

1. Face-fitting goggles must be worn at all times in the laboratory. Contact lenses, even with goggles are not permitted. Students that have a medical need to wear contact lenses while working in the teaching laboratory (proper visual acuity to complete assigned tasks) will need to inform the course coordinator and their lab instructor **and** be evaluated by Student Health. Upon review by Student Health, the student must continue to wear appropriate splash goggles at all times while in the teaching lab environment, and must also notify Student Health if they experience irritation or other problems while working in the lab environment so that REHS can do an assessment. **Students not in compliance will be dismissed from the lab.**
2. Know the location of laboratory exits. Know the location and use of fire extinguishers, eye-wash fountains, safety showers, and fire blankets in the laboratory.
3. For safety reason, you must inform your lab instructor if you leave the laboratory while an experiment is being carried out. If you feel unwell or if you see lab mate unwell while carrying out an experiment, it is crucial that you inform your lab instructor. Playtex-type rubber gloves are to be worn at all times when handling chemicals.
4. Open shoes/sandals, shorts, frilly or cumbersome clothing, bare backs or midriffs (or clothing that exposes backs and midriffs when a student reaches up or bends over), neckties, and unconfined long hair present considerable hazard in the laboratory and are **NOT PERMITTED**. Long hair should be tied back.
5. All experimental work is to be done in the hoods. Apparatus may be cleaned at regular benches.
6. If the fire alarms go off, stop all experimental work and leave all chemicals and equipment in the lab. Follow instructions of lab instructor and head for an exit and assemble outside the building to the area you were instructed to go to by the lab instructor as quickly as possible.
7. Avoid breathing the vapors of volatile solvents. Some organic solvents may be toxic or carcinogenic (cancer-producing). Organic solvents should be used in the hood.
8. Avoid contact of chemical with your skin, eyes, and clothing.
9. Handle strong acids and bases with extreme care. Strong acids and bases must remain in the allotted hoods.
10. Dispose organic waste in labeled waste containers. No waste solvents or reaction mixtures should be poured into the sinks!
11. Glass waste and broken glass **MUST** be disposed of in the broken glass containers. They **MUST NOT** be thrown in the regular trash due to potential harm to those who handle the trash.
12. No smoking, eating or drinking is allowed in the laboratory.
13. Pipetting by mouth is prohibited.

## LABORATORY SAFETY RULES (continued)

14. No unauthorized experiments or other horseplay is allowed.
15. Students must be familiar with a procedure before attempting it.
16. Clean your work area, and clean dirty glassware at the end of each period.
17. Accidents must be reported at once to lab instructor and coordinator of the course
18. All spills must be cleaned up immediately by person responsible.
19. All students are responsible for knowing the safety rules and observing them. Violation may result in expulsion from laboratory.

**REPORT EMERGENCIES TO THE RUTGERS UNIVERSITY POLICE AT  
6-911**

### **Submission of product for grading**

***NOTE! ENHANCEMENT OF PRODUCT YIELD WITH OTHER MATERIALS IS  
CHEATING.***

Use the disposable test tubes and corks supplied in your accessories kit. Make sure your sample is completely dry and free of large lumps. Label each test tube with the following information:

- Name of compound
- Structural formula of compound
- Yield; weight and percent
- Melting or boiling range
- Name of student
- Section number and name of lab instructor

Secure all test tubes with a rubber band or tape if more than one test tube is submitted.

## **BASIC LABORATORY OPERATIONS**

### **Laboratory Glassware**

Since your glassware is expensive and since you are responsible for it, you will want to give proper care and respect. Needless maltreatment of your equipment may cost you money; so if you read this section carefully and follow the procedures, you may be able to avoid some unnecessary expense. Mistreating equipment can also cause lost time in the laboratory. Cleaning problems and replacing destroyed glassware are time-consuming.

### **Cleaning Glassware**

Glassware can be cleaned more easily if it is cleaned immediately after use. With time the organic residues left in the flask will harden and stick on the surface of the flask. To remove gummy material from glassware, scrape as much as you can directly in the labeled waste container; never put organic tars, paper and other solid wastes into the sink. Next, try to remove

the remaining residue by using a small amount of acetone (1-2mL). The remaining small amounts of tars and dirt can then be removed with a large test tube brush bent in such a way that it will reach the inner surfaces of the flask. The use of a little washing powder or liquid detergent followed by a good water rinse will give a clean glassware when it dries.

***Caution!! Safety goggles must be worn when you are cleaning your glassware.***

## **FORMAT FOR LAB REPORT FOR CHEMISTRY 211**

### **Prelab Questions**

Prelab questions for each experiment can be found at the back of each experiment in the laboratory manual. These prelab questions are to be answered **before** the lab period and turned in to the lab instructor at the beginning of the lab period. The answers for the prelab questions are to be written in the space provided under the questions. Most of the answers for these questions can be found within the lab manual. Weekly announcements under "Resources" on Sakai may provide additional information. Make sure you label each page of the prelab questions with your name, section and date.

### **In-Lab Data**

In lab data is the data that you record from the experiment you conduct. You will be recording this data in the laboratory notebook. Each week, the course website ("Resources" under Sakai) will post the format of how the data is to be recorded and the modifications (if any) for the experiment you will conduct. Make sure you have a carbon copy of the data you record. You will be turning in this data along with the postlab questions to your lab instructor at the end of the lab period. Make sure each page you turn in is labeled with your name and ID number. Examples of in-lab data: appearance of each starting material, each product, weight,  $R_f$ 's for TLC, melting points, etc.

### **Postlab Questions**

Postlab questions for each experiment can be found immediately after the procedure for each experiment. These questions are to be answered in the laboratory notebook after the in-lab data is recorded. Make sure you have a carbon copy of the data you record. You will be turning in this data along with the in-lab data to your lab instructor at the end of the lab period. Make sure each page you turn in is labeled with your name and ID number.

## EXPERIMENT SCHEDULE

<b>Week</b>	<b>Dates</b>	<b>Experiment</b>	<b>Procedure/ Reading</b>
1	9/7, 9/12	Check In Safety Quiz	Tech 700: p. 1-12 Tech 702: p. 13-28
2	9/14, 9/19	Melting Point	Tech 701: p. 29-40
3	9/21, 9/26	TLC	Tech 707: p. 41-52
4	9/28, 10/3	Recrystallization	Tech 703: p. 53-64
5	10/5, 10/10	Extraction	Tech 705: p. 65-80
6	10/12, 10/17	Simple Distillation	Tech 704: p. 81-96
7	10/19, 10/24	Fractional Distillation	Tech 704: p. 81-96
(NOTE: THE EXPERIMENTS FOR WEEK 6 AND 7 AND TWO PARTS OF ONE EXPERIMENT)			
8	10/26, 10/31	Nucleophilic Substitution	Reac 714: p. 97-112
9	11/2, 11/7	Diels Alder	Synt 717: p. 113-124
10	11/9, 11/14	Oxidation	Synt 725: p. 125-140
11	11/16, 11/21	Reduction Check Out	Reac 715: p. 141-155