

## ORGANIC CHEMISTRY LABORATORY

### Chemistry 311 Fall 2016

Coordinator and Lecturer: Dr. G. Govindarajoo (ggovinda@rci.rutgers.edu)

Lecture: Tues 8:55am-9:50 am ARC 103

Wed 9:30am-10:25am LOR 020

NOTE: Students should go to the lecture that they are registered for.

#### **PREREQUISITES**

Chemistry 307 (or equivalent first semester Organic Chemistry lecture course) and Chemistry 171 (or equivalent General Chemistry Laboratory course). Students who have not satisfied these prerequisites 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. Applications of some of these techniques in biological settings will also be briefly discussed. Students will be expected to write accurate, cohesive and comprehensible laboratory reports of their experiments. 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 the Organic Chemistry lecture course to support their analysis and conclusions.

#### **REQUIRED COURSE MATERIALS**

- 1. Textbook package:** Macroscale & Microscale Organic Experiments by Williamson (6th ed. Custom Version for Rutgers University with OWL2 Access. (ISBN: 9781337496742). If you already have the custom textbook, OWL2 Access can be purchased separately from the bookstore or the cengage.com microsite specifically for this course (ISBN: 9781305652545). **Instructions on how to register for OWLv2 for the online prelab questions will be sent by e-mail at the beginning of the semester, including what to do if you run into a problem.**
- 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: 9781930882003) or something similar to this.
- 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. (Will receive on the first lab session).

6. **Substantial padlock:** To secure the contents of your assigned drawer. (FOR STUDENTS IN DOUGLASS LABS ONLY)

7. **A nongraphing simple calculator:** for use on exams and quizzes

#### **WHAT YOU NEED FOR FIRST WEEK OF LAB**

Items 1-4, 6 as shown above. You will check in this week and take a safety quiz. Make sure you have attended the first lecture during this week.

#### **WHAT YOU NEED FOR SECOND WEEK OF LAB**

Items 1-7 with **your prelab completed for first experiment** (see instructions under "Guidelines for Writing Lab Reports In Laboratory Notebook")

#### **WHAT YOU NEED FOR SUBSEQUENT WEEKS OF LAB**

Items 1-7 with **your completed postlab of the previous week's experiment AND your completed prelab for that week's experiment.** These **MUST** be completed **BEFORE** the beginning of the lab period.

#### **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. **Lectures:** Attendance in lectures is essential in order for a student to do well in this course. Significant amounts of additional material, including modifications to the lab procedure is provided in the lecture. Much of the quiz and exam material as well as what is required in the lab report will be provided during the lecture for the course in conjunction with the textbook. Lab instructors will assume that students have attended the lecture and will not provide information that has already been provided in the lecture. After the first lecture, you are required to come prepared with the outline for the next lecture which will be posted on the "Resources" link of the course website on Sakai.
3. **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 **immediately with your detailed schedule for the remainder of the lab week** to find an open spot in other lab sections. 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 passed.**  
**NOTE: You are not permitted to just show up in another lab period to make up the lab without prior authorization from Dr. Govindarajoo.**

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 and quiz (and any other materials that must be handed in) 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 hand over your lab reports to your lab instructor. Any deviation from this process may result in the material not being graded. 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 any of the above steps are not followed, the absence will not be excused. It is highly advised that you contact Dr.

Govindarajoo immediately after an absence even if you are not sure if the absence can be excused to see what your options are. **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. MCAT/DAT/OAT and similar exams 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 for any part of this course due to religious holidays and valid school activities (sports meet etc) **by 9/3/16** 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 9/13/16.

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

4. **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 311 website. **Students are still responsible for all the material from readings and lecture even if a particular lab is cancelled due to weather emergency.**

5. **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.**

6. **Laboratory Notebooks** are to be maintained according to the format described the handout "Guidelines for Writing Lab Reports in Laboratory Notebooks". Turning in late or incomplete laboratory reports and/or failure to turn in lab reports will result in deduction of lab report points which may very possibly lead to the earning of an unsatisfactory/ failing grade in the course.

7. **Online prelab questions** for first 6 experiments (excluding practical) must be completed by the deadline determined by your section time (deadline is an hour prior to your scheduled lab time) on the OWLv2 website. It is advised that you actually study the entire assignment instead of just answering the questions since some quiz/exam questions will be taken from these assignments. **Instructions on how to register for the online prelab questions will be sent by e-mail to you at the beginning of the semester.**

8. **Written Exam** will be given on the specified dates during lecture period. The material for the exams will come from your lab experiments, readings and lecture material. Since the exam is during the lecture period, students CANNOT have a conflict with the exam. Students MUST take the exam in the lab lecture session associated with their lab section. You will NOT be able to postpone/take the exam on a different date just because you have other exams that same week – you have plenty of notice and the review sheet is posted weeks ahead of time. Plan accordingly. Earning a score of less than 30% on the written exam may very possibly lead to the earning of an unsatisfactory/ failing grade in the course. **NOTE:** If you end up falling ill on the day of the exam, you have to make the decision if you take the exam or not. If you decide not to take it, get a doctor's or dean's note to excuse you for that absence. If you do decide to take the exam even though you are ill, be prepared to accept the consequences of the score you earn if you end up with a low score. We cannot disregard the score after the fact just because you took the exam while you were ill.

9. **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. Two comprehensive super quizzes will be administered during the course – more detail will be given in lecture and the website. A safety quiz will be given on the first week of lab. **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.

10. **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.

11. **Lab Practical:** The lab practical for the course will be administered during Week 7 of lab. You will be assigned a specific time slot during your regularly scheduled lab time to carry out a few techniques you would have learned during the previous weeks. You will be graded based on your skill and techniques, quality and yield of product, the ability to complete the task(s) within the given time period etc. More information will be provided closer to the time of the practical.

12. **Library Research Project:** A short assignment involving the use of library resources, citing references in proper form and researching techniques discussed in the course. More detailed instructions and information will be provided closer to the time of this assignment.

13. **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.

14. **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).

15. **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.

16. **Students with Disabilities:** If you have a disability, you are urged to speak to the course coordinator **by 9/13/16** 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@echo.rutgers.edu](mailto:dsoffice@echo.rutgers.edu)).

17. **Academic honesty** You are being graded on the work you perform. Use of lab reports/quizzes/library assignment/any other graded course material 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, exams, library assignments and other submitted materials 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, library assignments) 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 academic honesty violations promptly.*

18. **Chain of Command:** If you have a question about grading, you should first talk about it with your lab instructor - **any questions about a score of a particular quiz or lab report MUST be addressed within a week of receiving back the quiz or lab report.** 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.

19. **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.

20. **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 under “Resources”. 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 find Extra Notes for a particular experiment, prelab and postlab question assignments, as well as Hints on Preparation for a particular lab. The lecture outline for the next lecture would be posted as well.

21. **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.

## GRADING

1.	Laboratory Reports (Expt 1-6 that have online prelab questions - 6 x 23 points)	138 points
2.	Laboratory Reports with written prelab questions - (3 x 28 points)	84 points
3.	Online prelab questions (total possible points from assignments prorated to 30 points)	30 points
4.	Write up for demo experiment	8 points
5.	Lab Practical	23 points
6.	Library Research Project (due date TBA)	10 points
7.	Safety Quiz	4 points
8.	Quizzes (20 points x 7)	140 points
9.	Super Quizzes (2 x 30 points)(during Week 4 and 7 of lab schedule)	60 points
10.	Written Exam	200 points
11.	Lab instructor evaluation	13 points
	<b>TOTAL</b>	<b>710 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.
4. Playtex-type rubber gloves are to be worn at all times when handling chemicals.
5. Appropriate attire for performing experiments is a must and non-negotiable. Pants or skirts worn **MUST** cover the entire length of your legs. Shoes **MUST** be close-toed and close backed **AND** enclose your entire foot. Tops must be at least short-sleeved. 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), sleeveless tops, neckties, and unconfined long hair present considerable hazard in the laboratory and are **NOT PERMITTED**. Long hair should be tied back.
6. All experimental work is to be done in the hoods. Apparatus may be cleaned at regular benches.
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. 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.
9. Avoid contact of chemical with your skin, eyes, and clothing.
10. Handle strong acids and bases with extreme care. Strong acids and bases must remain in the allotted hoods.
11. Dispose organic waste in labeled waste containers. No waste solvents or reaction mixtures should be poured into the sinks!
12. No smoking, eating or drinking is allowed in the laboratory.
13. Pipetting by mouth is prohibited.
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.

## LABORATORY SAFETY RULES (continued)

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 8-911

#### Submission of product for grading

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

Use the vials and screwtops 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
- Melting or boiling range
- Name of student
- Section number and name of lab instructor

#### 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 on liquid detergent followed by a good water rinse will give clean glassware when it dries.



**COURSE SCHEDULE**  
**Schedule of Lectures**

<b>Week</b>	<b>Date</b>	<b>Lecture Topic</b>	<b>Reading Material</b>
1	9/6-9/7	Introduction, Safety, Melting Point	Syllabus p. 1-40 p. 41-55
2	9/13-9/14	Crystallization	p. 45-48, 57, 61-85
3	9/20-9/21	Distillation	p. 55-60, 86-99, 102-104, 116-119
4	9/27-9/28	Chromatography	p. 164-177, 185-190
5	10/4-10/5	Extraction	p.131-147
6	10/11-10/12	Esterification, IR <b>(Library Project Introduced)</b>	p. 515-521, 220-232, 55-57, 86-93
7	10/18-10/19	Aldol Condensation	p. 484-486, 61-77, 83-84
8	10/25-10/26	Nucleophilic Substitution	p. 318-325
9	11/1-11/2	Epoxidation	p. 395-399, 61-77, 83-84, 164-175, 186-190
10	11/8-11/9	Reduction	p. 668-669, 61-77, 83-84
11	11/15-11/16	Comprehensive Exam	

## EXPERIMENT SCHEDULE

Week	Dates	Experiment	Procedure
1	9/6-9/12	Check-In, Safety Quiz	
2	9/13-9/19	Melting Point	Expt. 2, 3, 4 p. 54
3	9/20-9/26	Recrystallization	Modified Expt. 5 p. 81
4	9/27-10/3	Distillation	Expt 1A, 2A p. 92-95
5	10/4-10/10	TLC (Super Quiz #1 administered)	Handout experiment p. 175-177
6	10/11-10/17	Extraction	Expt 1 p. 145-147
7	10/18-10/24	Lab Practical	
8	10/25-10/31	Esterification (Super Quiz #2 administered)	Expt. 1 p. 520-521
9	11/1-11/7	Aldol Condensation  AND Nucleophilic Substitution (Demo experiment)	Expt. 1 p. 485-486 Expt 1,2 p. 323-325
10	11/8-11/14	Oxidation (Epoxidation)	Modified Expt. 1 p. 399
11	11/15-11/21	Reduction Check-Out	Expt. 1 p. 669