CHEM 320L – Experimental Organic Chemistry, Summer 2020

Course Description: Elementary organic chemistry experiments to teach basic laboratory operations. Course Attributes: None. Restrictions/Exclusions: None.
Section 001L (32452), Lab (OS), 1 unit; Meets: MW 8:00 - 10:50 am, Online Synchronous
Section 002L (32453), Lab (OS), 1 unit; Meets: MW 8:00 - 10:50 am, Online Synchronous

Instructor: Dr. Todor Gounev (gounevt@umkc.edu – preferred method of communication); Dept. of Chemistry, Flarsheim Hall 410B, 816-235-2294, Office hours, TR 10:00-11:00 AM; Office hours will be held via Zoom at https://umsystem.zoom.us/j/8623692901

Course Website: **http://d.web.umkc.edu/drewa/Chem321L/index321L.html**

Teaching assistants: will manage the operation of the laboratories.

Section	Day	Time	GTA 1	GTA 2
001	Mondays and Wednesdays	8:00 – 10:50 AM	Buwa Punchihewa btpgm7@mail.umkc.edu	Matthew Mumau mrmndm@mail.umkc.edu
002	Mondays and Wednesdays	8:00 – 10:50 AM	John Zhou jzqb9@mail.umkc.edu	Shaha Azimova sazimova@mail.umkc.edu

Office Hours: GTA office hours will be held via Zoom: [Schedule to be distributed in Week 1].

Please see teaching assistants first with a problem, then come and see the professor in charge if it cannot be resolved with the GTAs.

CATALOG DESCRIPTION: Elementary organic chemistry experiments to teach basic laboratory operations. Three hours of laboratory a week. Prerequisite: CHEM 212R and CHEM 212LR or their equivalents (each with a C-or better); Co-requisite: CHEM 320; Offered: Spring and Summer.

STUDENT LEARNING OUTCOMES

Upon completion of Chemistry 320L, students should be able to:

- Apply knowledge obtained in Chemistry 320 lecture to problem solving and critical thinking in the laboratory.
- Utilize mathematical knowledge gained from general chemistry to perform common calculations, including mass balance, limiting reagent, and percent yield.
- Engage in safe laboratory practices by handling laboratory glassware, equipment, and chemical reagents appropriately, using general guidelines and basic knowledge about the common hazards associated with them in an organic chemistry laboratory.
- Maintain an appropriate scientific notebook using notational and descriptive content containing MSDS information on relevant chemical reagents, experimental procedure followed, data collected, and observations made during the experimental process.
- Assemble glassware and perform the following techniques as a part of synthetic procedures: aqueous workup, distillation, reflux, separation, isolation, and crystallization.
- Predict the outcome of several common organic reaction types through a basic understanding of starting materials, functional groups, mechanism, and typical reaction conditions.
- Characterize prepared substances by physical and spectroscopic means.

Optional text: Mohrig, et al. Laboratory Techniques for Organic Chemistry, 4rd ed.; 2014, W.H. Freeman (ISBN- 9781464134227). 3rd edition is ok too. You can order online, or in the bookstore under CHEM 320L.

There will be other reference materials on Canvas!

Experimental handouts: Handouts will be provided on the course website (see URL above)

Required materials: A lab notebook capable of making carbon copies. (a 100-page version, should get you through Organic Lab 1 and 2…)

Technology requirements: A laptop or desktop computer capable of running Zoom. A reliable broadband internet connection capable of streaming videos. A cellphone (or another mobile device) with installed PDF scanner app such as Office Lens.

Class Attendance: Attendance is required for all of the laboratory classes. Classes will be broadcast in real time via Zoom. You will be able to see the broadcast by clicking on the appropriate link in Canvas or https://umsystem.zoom.us/j/92700229270. For security purposes, you must login to Zoom as an authenticated user of the domain umsystem.zoom.us. Use your UMKC SSO username and password to "Sign in with SSO". Classes will start at 9:00 am sharp. Use the time between 8 and 9 am to prepare for the class. Look over the procedure and the background and re-watch the lab videos if necessary. Be ready to answer questions about the experiment that will count toward your grade (see below). No makeup labs are allowed. Students must attend their assigned laboratory section.

In-class Quizzes: In the beginning of each laboratory class, you will be given a short quiz over the background and procedure of the experiment. Make sure you have read the experimental handouts and watched the pre-lab and demonstration videos. Have your pre-lab assignment ready. The quiz questions will be given through the Zoom polling tool. Again, you must login to Zoom as an authenticated user of the domain umsystem.zoom.us.

Pre-Lab Videos:
Before each lab period, you are expected to watch pre-lab videos that will give you some background and help you better understand the experiments and the techniques involved. The pre-lab videos will be available in Canvas under Media Gallery. When you enter the Zoom session at 9 am, it is expected that you have already watched the pre-lab video for that day, and you are ready to answer questions about it.

Lab Demonstration Videos:
Before each lab period, you are expected to watch videos that demonstrate the procedure of each experiment and the techniques associated with it. In these videos, a TA will perform the experiment for you showing each step in detail. Watch the videos carefully. This is the procedure that you would perform under normal circumstances in lab. Rewind and re-watch if you have to, and make sure you understand each step. The videos can be found on the course website (see URL above) or in Canvas under Media Gallery. When you enter the Zoom session at 9 am, it is expected that you have already watched the video for that day, and you are ready to answer questions about it.

Pre-Lab Assignments: You are also required to prepare a pre-lab assignment before each experiment. Writing a pre-lab ensures that you have an understanding of your tasks during an experiment before you begin. Ideally, the pre-lab should be thorough enough so that you can perform the experiment from what you have written without needing to refer to the handouts or to your book. Handwrite the pre-lab in your lab notebook. When done, use the scanner app on your cell phone to snap a picture of your pre-lab, and save it as a PDF file. Transfer the file to your computer by emailing it to yourself or otherwise. You will submit your pre-lab assignment through Canvas. Go to Assignments, and click on the pre-lab assignment you want to submit. Follow the prompts in order to upload the PDF file. Pre-lab assignments are due at 8 am on the day of the experiment (see syllabus). The pre-lab should consist of the following entries in your notebook:

- *Title:* Begin each expriment with a title, your name, the date, your GTA's name and your lab section.
- *Purpose:* A brief statement of the experimental objectives
- *Net equation and/or mechanism of reaction:* Include for all important reactions.
- *Table of quantities and physical constants:* Collect in tabular form the name, structure, molecular weight, density, melting or boiling point, solubility, mass or volume used, moles used, of any

substance whose mass or volume you must measure. Some of this information can be found in the handouts. That which is not in the handouts can be looked up in *The Aldrich Chemical Company Catalog, The Merck Index, The CRC Handbook of Chemistry and Physics,* and on-line at http://www.sigmaaldrich.com/united-states.html (after completing a search, click on the SDS icon to see the data) or webbook.nist.gov/chemistry.

- *Procedure:* Provide an outline of the experimental procedure to be carried out. Do not simply copy what is written in the handouts; use your own words and diagrams. It is often useful to construct a flow chart of the procedure.

Lab notebooks:

- Read relevant reference sections or chapter in Mohrig, et al.
- Start a "Table of Contents" page near the beginning of your notebook.
- Each experiment should begin on a new page.
- Make every entry in your notebook in ink, never in pencil. Don't erase or black out entries. Instead, ~~draw a line through the error~~ and add the new information.
- Record all laboratory observations and data directly in the lab notebook at the time they are observed. Do not use scratch paper. Do not expect to transcribe any information into the notebook at a later time.
- Organize your lab notebook using headings such as *Title, Purpose, Procedure, Apparatus* or *Glassware set-up, Balanced reaction* or *Mechanism, Observations, Purification,* etc.

Post-lab reports: You will have five days to complete the post-lab report for each experiment. For experiments completed on Monday, the report is due at 11:59 pm on Friday, while for experiments completed on Wednesday, the report is due at 11:59 pm on Sunday. Late lab reports will not be accepted.

- Post-lab report forms (Microsoft Word format) appear after each experimental lab handout on the course website. Your post-lab report must be typed using the Microsoft Word files provided on the website.
- Chemical structures and mechanisms should be carefully depicted (hand drawing in pen or software drawings), showing all the relevant atoms and bonds, particularly at the reactions sites.
- Scan any hand drawings using the scanner app on your cellphone and transfer the image file to your computer by emailing it to yourself or otherwise. Next, copy and paste the drawing into the appropriate section of the post-lab report.
- Save the report in Word format, and then convert it to PDF (or pdf print it).
- Go to Assignments in Canvas, and click on the post-lab assignment you want to submit. Follow the prompts in order to upload the PDF file.
- Please note that in post-lab reports, numbers should never begin with a decimal and units must be given (even if they are implied)! Additionally, melting points that are measured are given as a range, not as a single temperature, and are reported in ^{o}C. An example is:

Initial weight of salicylic acid	0.198 g
Volume of water used to recrystallize salicylic acid	2.50 mL
melting point of compound above (°C)	158-160 ^{o}C

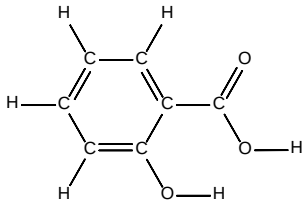
Example of how to set up your lab notebook (and see examples online)

Before the Experiment Begins

- **Experiment Title:**
- **Date:**
- **Name:**
- **Course: Chemistry 320L**

- **Section:**
- **GTA Name:**

- **Purpose:** (Purpose of the experiment; write a brief (1-3 sentences) statement of purpose for the synthesis or analysis, or state the question you are addressing)
- **Balanced Chemical Reaction:** (Write balanced chemical equations that show the overall process, not a mechanism)
- **Table of Physical Quantities:** Include all reactants, products and solvents: name of compound, molecular formula, molecular structure, molecular weight, melting point (solids) or boiling point (liquids), density, hazards.

Name (Other names)	**Molecular formula**	**Molecular structure**	**Molecular Weight (g/mol)**	**Melting or Boiling Point**	**Density**
Salicylic acid (2-hydroxybenzoic acid, o-hydroxybenzoic acid)	$C_7H_6O_3$	 (Note that stereochemistry and all atoms are shown!)	138.12	mp = 158 - 159°C	1.4
Benzoic Acid					
Phthalic Acid					
Naphthalene					
Biphenyl					
Ethanol					
Water					

Name	**Hazards (According to MSDS)**
Salicylic acid	HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. AFFECTS CENTRAL NERVOUS SYSTEM, KIDNEYS, AND PANCREAS. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT.

- **Yield Calculations:** Outline the formulas to be used in your experiment. Calculate the theoretical yield.
- **Procedure:** This is a procedural outline of what you are doing in the experiment. Remember, you will not be allowed to bring your lab report to class so it is important that you have the details of the experiment here. Leave space between lines here for any corrections that the GTA gives you to the procedures.
- **Observations**: Record all observations that take place while you are performing your experiment. This includes:
    - Actual quantities of all reagents used.
    - Amounts of crude and purified products obtained.
    - Mention measurements you took (temperature, time, melting point, and so on).
    - Odors you detect.
    - Color changes.

Grading: You will be graded on the basis of the following: Ten pre-lab assignments (10 points each), ten post-lab reports (10 points each), and ten in-class quizzes (5 points each). **Final grade:** (your points/total points) * 100 = % grade.

There are no lab make ups; if you have a valid, emergency excuse for missing, you must contact the TA and instructor ASAP for accommodation and verification. To deal with these situations note the following policy.

Grades will be assigned using the following scale: A, 100-90.0; B, 89.9-80.0; C, 79.9-70.0; D, 69.9-60.0; F, 59.9-0. The professor in charge reserves the right to make minor adjustments in the total number of points to the course and to make adjustments for inadvertent errors in the syllabus.

Grading Detail:

Assignment	Total
10 Pre-lab Assignments (10 points each)	100
10 Post-lab Reports (10 points each)	100
10 In-class quizzes (5 points each)	50
TOTAL POINTS POSSIBLE	**250**

UMKC Resources & Policy Statements

Important UMKC Resources and Policies are applicable to every course and every student at UMKC. These are located in the Canvas site for this course under the "UMKC Policies" tab. As a UMKC student, you are expected to review and abide by these policies. If you have any questions, please contact your instructor for clarification.

This course follows the "Faculty allowing recording" option of the Academic Inquiry, Course Discussion and Privacy policy.

At the end of the semester, all students will have the opportunity to evaluate this course and instructor. These evaluations, conducted online through RooEval, will remain anonymous and will not be shared with faculty until after the final grades are turned in. Link to RooEval: https://net3.umkc.edu/intapps/rooeval.

School of Biological and Chemical Sciences Course Policies & Resources

Please refer to the following web page and the linked resources for critical information regarding course policies and resources. You are expected to abide by all the rules and regulations regarding student conduct referenced in these pages: https://sbc.umkc.edu/current-students/forms-resources.html

CHEM 320L **LABORATORY SCHEDULE**		
Day	Date	Lab
Monday	June 8	Check-in: Introduction; notebook requirements; lab safety and waste disposal; read pp 2-74 in Mohrig
Wednesday	June 10	1. Crystallization: Recrystallization
Monday	June 15	2. Distillation: Steam Distillation of Toluene – Benzil Mixture
Wednesday	June 17	3. Extraction I: Separation of a Strong/Weak Acid
Monday	June 22	3. Extraction I: Continued
Wednesday	June 24	4. Extraction II: Separation and Purification of the Components of an Analgesic Tablet
Monday	June 29	5. Solid-Liquid Extraction: Trimyristin from Nutmeg
Wednesday	July 1	NO LAB
Monday	July 6	6. Grignard Reaction
Wednesday	July 8	7. Substitution Reactions S_N2: Synthesis of *trans*-1,2-dibenzoylcyclopropane
Monday	July 13	8. Substitution Reactions S_N1: triphenylmethanol
Wednesday	July 15	9. Elimination Reaction E1: Cyclohexene from cyclohexanol (fractional distillation)
Monday	July 20	10. Elimination Reaction E2: Cyclohexene from bromocyclohexane.
Wednesday	July 22	Review; Check-out
Monday	July 27	NO LAB

A copy of this statement will be provided for your signature before the first experiment

CHEM 320L Laboratory Safety Regulations: Initial the items and sign the bottom.

Semester Summer 2020 Section VO Room #_____
TA Name _____ Station # _____

1._____I will prepare for lab by studying the experiment before class and by trying to anticipate potential hazards from the chemicals or procedures to be used.

2._____I will wear approved safety goggles AT ALL TIMES in the laboratory unless the instructor gives specific approval to remove them.

3._____I will not work in the lab unless an instructor is present.

4._____I will not perform any unauthorized experiments.

5._____I will notify the instructor of any allergies or other health conditions (pregnancy, epilepsy, etc) that may affect my ability to work in a chemistry lab.

6._____I will not eat, drink, or smoke in the lab.

7._____I will not use cellular phones or radios in the lab.

8._____I will minimize my contact with chemicals by taking care to note odors, never tasting chemicals, using suction bulbs to fill pipettes, and washing any spilled chemicals off my person as soon as possible. I will wash my hands before leaving the lab.

9._____I will not wear shorts, sandals (or open-toed shoes), tank tops, or other clothing in the lab that allows unnecessary exposure to spilled chemicals. I am also aware that certain chemicals can ruin clothing and that wearing a lab coat or apron adds some degree of protection.

10._____I will secure long hair to keep it away from open flames and chemicals while I am working in the lab.

11._____I will immediately report all cuts, burns, personal injuries, fires, chemical spills, or other accidents to the instructor.

12._____I will keep my work area and the common areas of the lab clean.

13._____I will NOT return unused chemicals to their original bottles.

14._____I will consult with the instructor about the proper disposal of all waste chemicals.

15._____I know the location, operation, and appropriate uses of the eye-wash stations, safety showers, fire extinguishers, fire alarms, and fume hoods; and I know the locations of all lab exits.

16._____I agree to follow any specific or additional safety instructions that may be given for any experiments.

17._____I will conduct myself in a professional and respectful manner. I will leave the lab after I complete my work.

I understand all of these statements and agree to observe them at all times in the lab. I also understand that if I fail to observe them, I will be expelled from the laboratory.

CHEM 320L Academic Honesty Statement

I will perform the work by myself and will adhere to the UMKC Academic Conduct Standards for Students (http://www.umkc.edu/catalog/Student_Conduct.html and http://www.umkc.edu/catalog/Rules_of_Procedures_in_Student_Conduct_Matters.html). It is my responsibility to understand the facets of academic honesty and to uphold them. If I am not sure, I will consult with the instructor.

Sign: _____ **Date:** _____

ORGANIC LABORATORY Equipment List **SP2018 CHEM 320L/321L/322L**

Name: _____ TA:_____

Email _____**@mail.umkc.edu**

Section #: _____ Room #: _385_____ Hood #: _____ **L side or R side** (circle one)

Item (# Needed per Student)	**# Received by Student**	**# Returned by Student**
Beaker, 50 mL (2)	_____	_____
Beaker, 400 mL (1)	_____	_____
Beaker, 600 mL (2) plastic!	_____	_____
Erlenmeyer flask, 50 mL (3)	_____	_____
Erlenmeyer flask, 125 mL (1)	_____	_____
Erlenmeyer flask, 250 mL (1)	_____	_____
Graduated cylinder, 10 mL (1)	_____	_____
Spatula, (1)	_____	_____
Glass stir rod, large or small (2 total)	_____	_____
Powder funnel, large (1)	_____	_____
Small reaction tube, (4)	_____	_____
Large reaction tube, (1)	_____	_____

Student's Signature: _____ Date: _____

Checked IN by: _____ Date: _____

Checked OUT by: _____ Date: _____

TODAY'S TO-DO LIST!

- ✓ Sign the "post it" on your drawer so we know that drawer has been assigned.
- ✓ Put fresh paper towels to line your drawer.
- ✓ Get any glassware you are missing from your TA.
- ✓ Throw any used pipette bulbs into regular trash. Get 2 new pipette bulbs!
- ✓ Give any extra glassware to your TA.
- ✓ Wash any dirty glassware.
- ✓ Make sure there are pipettes and paper towels in the common hood space (underneath the hood).
- ✓ Put your safety goggles and Sharpie marker in your lab drawer.
- ✓ Put your lock on your drawer if you have it and give UMKC's lock to your TA.
    - o If you don't have your own lock, use UMKC's lock to lock your drawer and bring your lock next week.
- ✓ Put this sheet in your drawer and give the Laboratory Safety Regulations sheet to your TA.