USC Dornsife

DEPARTMENT OF CHEMISTRY

Spring 2024

CHEM 423L

Instructor:

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Register for both the lecture and the lab

Thursday and Friday

Syllabus: Chem 322b or Chem 325b

17516R 001 Lecture, Thursday, 2.00-3.20 LHI 201

Lab: Thursday, 3.30 – 7.20 PM, SGM 209

Friday, 3.00 - 6.50 PM, SGM 209

Required course materials:

1. Laboratory Manual (to be provided).
2. Laboratory Notebook (National #43-649).
3. Laboratory Safety Glasses. REQUIRED to be worn at all times in the laboratory.
4. Laboratory coat to protect your clothing.

Lecture Schedule: Thursday 2:00-3:20 PM
Discussion: Thursday 3:30-4:30 PM, Friday 3:00-4:00 PM (when scheduled).
Office Hours: By appointment.
Blackboard: The class will use Blackboard for communication (http://blackboard.usc.edu).

Exam Schedule:

First Exam:	To be scheduled.
Second Exam:	To be scheduled.

Grading:

Class Performance (10 points each exp.)	140 points
Class Notebook (10 points each exp.)	140 points
Homework Assignments (5 points each exp.)	70 points
Literature Project	50 points
First Exam	100 points
Second Exam	**100 points**
TOTAL	600 points

Laboratory Performance:

Your laboratory performance will be evaluated by the TA's based on your experimental technique, your preparation and understanding of the experiment and the quality of your results (e.g. the yield, quality and purity of your prepared samples or spectra). The following guidelines will be followed:

10/10	A+	outstanding, essentially perfect results
8/10	A	very good, efficient, careful, well-prepared, good results
6/10	B	good, no major problems, average results
4/20	C	inefficient, slow, not well prepared, low quality results
2/10	D	major problems, little understanding, inadequate results
0/10	F	totally lost!, no results!

Laboratory Notebook & Lab Report:

A special laboratory notebook (National #43-649) is required for this course. This notebook has alternating white and yellow pages numbered in pairs. Your notebook should be a complete and original record of each experiment. All of your experimental observations, calculations and results should be recorded directly and accurately on the notebook (i.e. not on loose sheets of paper). After the completion of each experiment you should submit to the TA any samples you prepared properly labelled, and a copy of your lab report, which should have the following general format.

Typed reports will be preferred but are not required. Be concise and precise!

1. Your name - Date - Title
2. Introduction - Background (<1/3 of a page)
3. Reactions (Main reaction and mechanism and possible side reactions)
4. Reagents (name, structure, m.w., mmols, density, b.p or m.p., properties)
5. Experimental procedure, including separation schemes or apparatus
6. Observations, yields (g, mmols, %), physical properties, spectra
7. Conclusions, comments, explanations
8. Answers to homework

Laboratory Safety:

1. Carefully read the weeks experiment before attending class. Pay careful attention to the safety material at the beginning of each procedure!
2. You **must** **wear safety glasses** or appropriate prescription glasses **at all times** while you are in the laboratory. Also, no sandals or bare feet! Wear long sox.
3. Smoking, eating or drinking in the laboratory is strictly prohibited.
4. Do not use cracked or chipped glassware; replace it.
5. Never heat a closed system of any kind.
6. Never add boiling chips to a hot liquid.
7. Never evaporate flammable solvents (e.g. ether) on a hot plate. Use the steam bath or the rotary evaporator.
8. Before you light any flame check around carefully for any flammable materials.
9. Avoid inhalation or skin contact of organic solvents and other compounds. Many of these are toxic or irritant.
10. Keep your lab bench neat and orderly.
11. Be familiar with the location of fire extinguishers, fire blanket and fire shower and make sure you know how to use them.
12. Never taste any chemicals and always wash your hands after using them.
13. Before you use any chemical or solvent make sure you are familiar with its potential hazards, e.g. whether it is flammable, irritant, carcinogenic, etc. Such compounds can be used safely only with the proper handling and precautions (e.g. use gloves, handle them in the hood etc.).

Objectives:

The main objectives of this course are: (i) to teach advanced experimental techniques of organic and inorganic chemistry, (ii) to enhance the student's understanding of theoretical and mechanistic concepts and (iii) to demonstrate the relevance and significance of preparative chemistry to everyday life.

The course will include a lecture part and a laboratory part. The lectures will discuss the theory of the various techniques, including spectroscopy (MS, UV, IR, NMR) and chromatography (GC, TLC, LC), as well as the appropriate background for each laboratory experiment.

The topics of the experiments will cover various aspects of chemistry and its relationship to such things as: food components, pharmaceuticals, agrochemicals, materials, etc. In addition, they will provide opportunities to discuss mechanistic, theoretical and computational aspects of chemistry. In many cases the discussion will include the pertinent history of the experiments (e.g. Nobel prizes, etc.).

EXPERIMENTS

1. NATURAL PRODUCTS:

Isolation of Lycopene from tomato paste.

Isolation of d-Carvone and d-Limonene from Caraway.

Background: Lab manual and classroom discussions.

Techniques: extraction, column chromatography, steam distillation, UV, IR.

Procedure: Lab manual

2. STEROIDS:

Isolation of Cholesterol from egg yolks.

Background: Lab manual and classroom discussions.

Techniques: multiple extraction, column chromatography, IR.

Procedure: Lab manual

3. ARTIFICIAL FLAVORINGS AND SWEETENERS:

Synthesis of 3-methyl-1-butyl ethanoate (isoamyl acetate) and Dulcin.

Background: Lab manual and classroom discussions.

Techniques: distillation, IR, NMR. *Procedure: Lab manual*

4. MEDICINAL CHEMISTRY:

Synthesis of Benzocaine.

Background: Lab manual and classroom discussions.

Techniques: IR, NMR. *Procedure: Lab manual*

5. COORDINATION CHEMISTRY:

Synthesis of the copper complex of tetraphenyl porphyrin.

Background: Lab manual and classroom discussions.

Techniques: UV, NMR. *Procedure: Lab manual*

6. POLYMERS:

Synthesis of Polystyrene by free radical polymerization.

Background: Lab manual and classroom discussions.

Techniques: gpc, NMR. *Procedure: Lab manual*

7. INSECT CONTROLS:

Synthesis of cis-norbornene-5,6-endo-dicarboxylic anhydride, an insecticide analog.

Background: Lab manual and classroom discussions.

Techniques: computer calculations, NMR.

Procedure: Lab manual

8. ORGANOMETALLICS:

Synthesis of Ferrocene.

Background: Lab manual and classroom discussions.

Techniques: IR, NMR. *Procedure: Lab manual*

9. HYDROCARBON CHEMISTRY:

Synthesis of Amantadine acetate, an antiviral drug analog.

Background: Lab manual and classroom discussions.

Techniques: computer calculations, molecular mechanics, NMR.

Procedure: Lab manual

10. THE WITTIG REACTION:

Synthesis of (E)-1,2-phenyl-p-methoxy-phenylethene

Background: Lab manual and classroom discussions.

Techniques: Extraction, TLC, NMR.

Procedure: Lab manual

11. ORGANOBORON CHEMISTRY:

Synthesis of β,γ-unsaturated α-aminoacids from boronic acids

Background: Lab manual and classroom discussions.

Techniques: NMR, ion-exchange chromatography

Procedure: Lab manual

12. ORGANOPALLADIUM CHEMISTRY:

Suzuki coupling reactions to synthesize

(E)-1,2-phenyl-p-methoxyphenylethene

Background: Lab manual and classroom discussions.

Techniques: NMR, TLC, air-sensitive chemistry. *Procedure: Lab manual*

13. CATALYSIS - ASYMMETRIC SYNTHESIS:

Asymmetric Dihydroxylation and Asymmetric Aminohydroxylation

Background: Lab manual and classroom discussions.

Techniques: multistep synthesis, polarimetry, NMR.

Procedure: Lab manual

14. PHOTOCHEMISTRY:

Synthesis of Cyalume.

Background: Lab manual and classroom discussions.

Techniques: IR, chemiluminescence.

Procedure: Lab manual