

CHEMISTRY 434-INORGANIC CHEMISTRY

Southern Connecticut State University

Dr. M. J. G. Lesley

Jennings 308 (203) 392-6262

E-mail: Lesleym1@Southernct.edu

Lectures: TBA

Office Hours: TBA

While Friday afternoon is usually reserved for student research, I will make appointments to meet with students. A detailed schedule is posted on my office door. Under no circumstances should a student expect to be able to interrupt a lecture or laboratory for additional help. Please consult the schedule!

Text: 1. Housecroft, C. E. and Sharpe, A. G. *Inorganic Chemistry, 3rd Edition*; Prentice Hall: New York, 2008. (ISBN: 978-0-13-175553-6)
2. Vincent, A. "Molecular Symmetry and Group Theory, 2nd Ed.", John Wiley and Sons, New York, 2001. (ISBN 0-471-48939-5)

Laboratory Text: Lesley, M. J. G. *Chemistry 434-Inorganic Chemistry Laboratory Manual*
(distributed in lab)

Other required materials:

Molecular Model Set

Laboratory Notebook, hard cover, bound notebook only.

Course Overview: Chemistry 434, Inorganic Chemistry, examines aspects of main group, transition metal, and organometallic chemistry. The use of symmetry relationships and point group determination will be discussed in terms of the development of molecular orbital theory and the infrared characterization of transition metal compounds. The study of ligand bonding with transition metals will be examined with attention drawn to coordination compounds, electron counting rules, isomerism, metal-metal bonding, and reactivity. The scope and limitations of theories involved in describing the bonding on a molecular level will be examined in detail. These will be applied to methods of characterization such as magnetic susceptibility, photoelectron spectroscopy, NMR, UV/visible and IR spectroscopy, etc..

The laboratory portion of this course will focus on synthetic methodology and the acquisition / interpretation of data. This portion of the course will be used to lecture additional aspects of inorganic chemistry on a more practical basis while re-iterating concepts from the classroom. The experiments that have been selected demonstrate fundamental main group, transition metal, and organometallic chemistry. The independent projects that have been selected allow students the opportunity to investigate additional topics pertaining to inorganic chemistry as well as interdisciplinary topics such as materials science, transition metal catalyzed organic transformations and bio-inorganic chemistry.

It is strongly suggested that the student obtain a molecular model set since a substantial portion of this course will encompass analysis of 3-dimensional symmetry properties and isomerism in transition metal compounds. A model set will be extremely helpful to visualize the 3-dimensional structure of the compounds that will be examined.

Final Course Evaluation:

2 One-hour examinations	30 pt
Assignments	15 pt
Laboratory Grade	30 pt
Final Examination	25 pt

	100 pt

The actual letter grade will be based on the grading scale given below. Please remember that it is the policy of the Chemistry Department at Southern Connecticut State University that, to receive a passing grade in CHE 434, you **MUST pass the laboratory portion** of the course. A passing grade for the laboratory portion of the course is 60% (or 18/30 pt).

Letter Grade Scale:

The actual grade will be based on the grading scale given below with possible adjustment for class average at the end of the semester (at the instructor's discretion).

A+	(100-96)	B+	(85-82)	C+	(73-70)	D+	(61-58)	F	<50
A	(95-91)	B	(81-78)	C	(69-66)	D	(57-54)		
A-	(90-86)	B-	(77-74)	C-	(65-62)	D-	(53-50)		

Assignments: Assignments will be distributed in class and will also be available outside my office. Complete written answers are required to receive full credit. Individual effort is required. Due dates will be indicated on the individual assignments. Assignments are due at the beginning of the scheduled lecture session.

Late/Missed Work: There will be no make-up examinations except in the case of substantiated illness (a doctor's note is required). The student must contact the professor or another member of the departmental office prior to an absence for an examination or else a grade of zero will be assigned for the examination. The same policy applies to assignments and laboratory reports. The latter are due at the beginning of the scheduled meeting time. A doctor's note will be required upon returning to class to receive any consideration due to illness.

Attendance: Regular and prompt attendance of scheduled classes and laboratory sessions is necessary for the student to derive the intended benefit of the learning experience the college strives to provide, and for the optimization of student academic progress. Attendance in lectures is not mandatory but is strongly advised. Prompt attendance for laboratory sessions is **mandatory!** Students arriving more than 20 minutes late for the laboratory session will not be

allowed to complete the experiment and will receive a grade of zero for the entire exercise (even if it is a two week experiment). Failure to complete more than one laboratory exercise for reasons other than a substantiated illness will result in a grade of F for the course. This rule will be strictly enforced.

Accommodating Students With Disabilities: As a student with a disability, before you receive course accommodations, you will need to make an appointment with the Disability Resource Office located in EN 15 to arrange for approved accommodations. However, if you have other information you would like to speak with me about, if you have emergency medical information to share with me, or if you need special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible. My office is located in Jennings Hall (JE 308) and my office hours are listed on the first page. Every effort will be made to accommodate students in this course.

Inclement Weather: When inclement weather threatens, call the university's WeatherChek voice mail message line (203-392-SNOW) to hear the latest official information on possible delayed openings, class cancellations, or the closing of the university. In the event that an examination is postponed due to weather, the examination will be held at the next scheduled class meeting. Assignments will be due the following scheduled class meeting.

Academic Dishonesty: Unfortunately, the question of academic dishonesty occasionally becomes an issue between an instructor and a student. The best way to avoid this is to be sure that no suspicion arises. **Cheating on exams, laboratory reports, assignments or any other portion of this course will not be tolerated. The student handbook outlines the various prerogatives of the instructor in cases of academic dishonesty.**

Plagiarism is considered to be an example of academic dishonesty. This includes the copying of pictures or ChemDraw structures that have been obtained from the world wide web and pasted into a document you are submitting. You are expected to know how to use ChemDraw software and to draw any structures, equations, reaction schemes, etc. for your reports. The Dean of Arts and Sciences has established a database of students who have plagiarized work for the purpose of disciplinary action.

Course Outline:

<u>Date</u>	<u>Topic</u>	<u>Reading</u>
Week 1,2	Periodicity, Shielding effects, Lewis Structures; VSEPR, Multiple bonds, hybridization, Polar / Nonpolar Bonds and Molecules,	Ch 1 and Sec.4.1-4.3
Week 3,4	Simple Molecular Orbital Theory, Homonuclear Diatomic Molecules Heteronuclear Diatomics, Triatomics, Hybridization and MO's. Crystal Field Theory (introduction)	Ch 4
Week 5, 6	Symmetry Elements and Operations, Point Groups, Character Tables.	Ch 3, Handouts, Vincent Text
TBA	Exam #1	
Week 7, 8	Applications of Group Theory (Using Character Tables): Interpretation of IR and Raman Spectroscopy; Deriving MO Diagrams for d-orbitals, Polyatomic MO's	Ch 3,4, Handouts, Vincent Text
Week 9,10	Main Group Chemistry: Hydrogen, Group IA,IIA,IIIA Elements Group IIIA,IVA Elements and Boron Clusters, Group VA, VIA, VIIA, VIIIA Elements, Multinuclear NMR (main group compounds and Transition Metal complexes)	Selected material from Ch 10-17 NMR will be selected from the above chapters, Sec 2.11 and handouts
Week 11, 12	Introduction to Transition Metal Chemistry Coordination Number and Survey of Structures Organometallic Chemistry; Bonding with Organic Ligands, 18 Electron Rule	Ch 19, 20,23
TBA	Exam#2	
Week 12,13	Nomenclature, Isomerism, Crystal Field Theory and d-orbital Splitting in Octahedral and Tetrahedral Geometries, Jahn-Teller Effect; CFSE, High Spin vs Low Spin Compounds, Magnetic Susceptibility, Spectrochemical Series, Ligands and Pi Bonding to Metals	Ch 19, 20,23
Week 13, 14	Electronic Spectra (UV/vis spectra); Microstates and Term Symbols, Selection Rules and Assignment of UV/vis Spectra, Orgel Diagrams, Tanabe-Sugano Diagrams	20.6 and handouts
Week 14	Substitution in Octahedral and Square Planar Molecules, The trans-effect series, Redox processes involving transition metal compounds, Reactions of organometallic compounds; catalytic cycles	Ch 23, 25 and 26
TBA	Final Examination (Tentative)	

CHE434 Inorganic Chemistry Laboratory

The first laboratory session (check-in) will be held on **TBA**. The chemistry department requires that everyone wear Safety Glasses while in the laboratory, beginning with the first laboratory. The proper safety glasses must meet OSHA regulations and can be purchased at the Southern Connecticut State University Bookstore or a Chemistry Club representative. If you show up for any laboratory period without the proper safety glasses you will **NOT** be allowed to perform the experiment and will receive a zero grade for that experiment. Failure to complete more than one experiment will result in an automatic grade of 'F' for the course.

The student must provide evidence of preparation in the laboratory **notebook** in order to perform the experiment. This includes, but is not limited to, a complete table of reagents (including FW, amount used (g, mL) and #mol) and a summary of health issues associated with the reagents to be used including which waste bottles will you use for waste/washes etc. that you will generate. The laboratory notebook should adhere to the following guidelines. Initial pages should contain a table of contents (including dates). Notebooks should contain consecutively numbered pages, and have clearly labeled calculations and notes from pre-lab discussions on the left-hand side pages. This includes balanced equations, formula or molecular weights, and molar calculations. The right-hand side pages should contain clearly labeled measurements, other data and results, and observations. Be sure to include solvents and filenames used for spectral acquisition.

The final laboratory grade (100 pt) will be based on the following grading scheme:

CHE434

Lab Examination	10 pt
Notebook	10 pt
4 Lab Reports	40 pt
Independent Project	40 pt

A more detailed description of the grading scheme for the individual laboratory reports and the independent project is provided in the laboratory text for the course.

Remember: Late reports will not be accepted and a grade of zero will be given!

Laboratory Reports

Complete laboratory reports must be type written with proper formatting. All chemical structures should be prepared using ChemDraw® or an equivalent drawing program. Photocopies are not acceptable and a full letter grade will be deducted. The report should be divided into the following sections for each formal report including the independent project report:

Title page: Title, date experiment was performed, and names of experimenter(s).

Purpose: Give a brief description of the goals of the experiment. (2-3 sentences)

Introduction: Give a brief description (5 page maximum) of **pertinent** theory such as historical background, definitions, industrial applications, potential side reactions, and related chemical processes. The student is expected to reference additional materials including textbooks and inorganic chemistry journals. Proper reference citation format consistent with ACS guidelines is required (see the laboratory manual for more details).

Procedure: Give a description of the experiment performed including individual experimental measurements (masses, volumes, etc. that were used) and any potential hazards. Written in the third person and past tense. Be as brief as possible without sacrificing important details! Remember that a non-expert should be able to repeat the synthesis.

Data and Results: Tabulated experimental results, all spectra collected for the experiment (labeled neatly with no writing on the spectral output), sample calculations using proper significant figures. Tabulated data should be assigned to the appropriate structural feature where possible. All spectra (including impurities, solvent resonances, etc) should be assigned in the tables and discussed in the following section as described below.

Discussion: This is one of the most important sections of the laboratory report. Discuss the experiment and include observations, difficulties encountered, sources of experimental error as they apply to your results, and data and spectral analysis. Discuss spectra and how they can be used to rationalize the structure and connectivity of the products. Discuss any residual resonances and their origin. Use the spectra of the starting materials for comparison and emphasize which if any resonances are new and how they relate to the chemical transformation being studied. Explain how your results compare with the literature results (including published sources of related IR, NMR, UV/Vis etc. spectra and explain any differences) with appropriate references.

Conclusion: State the final results of the experiment (e.g. final % yield, whether or not the experiment was a success and if the purpose was achieved). This section should be no more than 5 sentences.

References: List each reference in the numerical order in which it appears in the introduction and discussion sections according to acceptable ACS style. Reference numbers should appear sequentially in the final report.

Questions: For some experiments there will be questions that will require searching the chemical literature in order to answer. These questions pertain to related theoretical and synthetic chemistry. The complete answers should be included at the end of the report.

Independent Projects

General note to students: A brief synopsis of each project will be provided by the instructor. In the initial stage of the project students are expected to obtain the appropriate references and submit a "synthetic strategy". This document must be submitted at least **one week** prior to the start of the project. Pertinent material should also be present in the laboratory notebook. This document must contain a complete introduction (including references) and a proposed experimental procedure. The procedure should contain all appropriate calculations for each reaction including theoretical yields and the solvents to be used for reactions, recrystallizations, etc.. Any hazards especially in regards to reagents that are air sensitive, and how you will use theories from the "Techniques for Manipulating Air-Sensitive Compounds" session to accomplish the necessary tasks, must be addressed. Students are expected to characterize starting materials, isolated intermediates, and final products by all means possible for the final report. The instructor can be consulted prior to submission of the synthetic strategy to assure this section is complete. Submit samples of each product that has been characterized in a labeled vial. The vial label should indicate the name of the substance (or chemical formula), name of the experimenter, quantity of chemical and the date it was prepared. The final report should also address comments made by the instructor for the "synthetic strategy" where appropriate.

Failure to submit an appropriate "synthetic strategy" according to the guidelines described above will result in a grade of zero for that portion of the independent project. No late submissions of the project will be accepted for grading. (Late submissions of the "synthetic strategy" will be reviewed for comments however a grade of zero will be given for that portion of the grade.) The final report is due at the beginning of the check-out session.