

Lehman College
City University of New York
Department of Chemistry

Advanced Inorganic Chemistry CHE-443
Spring - 2019

Instructor

Professor Andrei Jitianu –PhD
Laboratory Instructor - Wong, Madeline

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Course Description

CHE-443 - **Advanced Inorganic Chemistry**,

Two lectures are offered twice per week – Monday and Wednesday 10:00-10:50 pm (11:00am)

One Laboratory of 6 hours are offered per week - Monday 11:00AM-4:50 PM

8 hours (2 lecture+6 laboratory) / 5 credits

Advanced studies in modern inorganic chemical theories on the interpretation and explanation of the properties, and relations between the elements, their compounds and structures.

Prerequisites

CHE 235, CHE 249 and 442.

Place of course in degree program

This course is a degree program requirement for BS in Chemistry, and Biochemistry program.

Academic or Learning Objectives

Student Learning Outcomes: After completing the lecture students should be able to:

- Carefully state and be able to apply the major basic concepts of inorganic chemistry. To understand the periodicity of chemical and physical properties
- Understand the chemical bonding and molecular structure using the main molecular models and to correlate these with the molecular shape.
- Be able to apply the concepts of group theory in the spectroscopy of inorganic molecules.
- Understand the structure of the inorganic solids.
- Understand structure of coordination compounds, to write the chemical formulas of these and to know the main theories which explain the bonding in complexes and electronic spectra.
- Be able to write chemical equations in a precise, effective, and understandable way.

Student Learning Outcomes: After completing the Laboratory part students should be able to:

- to prepare simple inorganic compound which have various applications; to know to write the chemical equation of the prepared compounds; to know the structure of the prepared compounds
- to understand the principle that govern the synthesis of coordinative compounds.

- to understand the principle that govern X-Ray diffraction and to be able to identify the structure and the purity of the inorganic compounds.
- to understand the principle that govern the electronic spectra and to correlate those with the UV-VIS spectra of the coordinative compounds.
- to know how to survey the literature using **scientific** search engines

To know how to put together a scientific report in a journal paper format and how to make a scientific presentation.

Required Readings

Inorganic Chemistry Seven Edition, Edited by M. Weller, T. Overton et al, at Oxford University Press, Oxford, UK 2018, ISBN- 978-0-19-876812-8

Inorganic Chemistry, Gary L. Miessler and Donald A. Tarr, Forth Edition Edited by Pearson Prentice Hall, New Jersey, ISBN: 0-1-36128661

For the laboratory section Handouts will be provide before each lab

Course Requirements and Grading

For this class there will be 1 Midterm exams and a Final exam.

The final grade will be established as follows:

Exams 1	- 20%
Final exam	- 20%
Laboratory reports	- 40%
Literature report	- 12%
Literature report presentation	- 8%

Each student's grade will be determined by counting each exam as 20% of the final grade. In the event a student misses the regular exam, the 20% for that exam will be included in the final exam. In other words, if a student were to miss **Exam 1**, the final grade and that student's final exam would count 40%. **No make-up exams will be given.**

No passing grade a student will obtain if:

- miss the Final Exam
- miss more than two experiments;
- not check out;
- not turn in the Literature report
- not present Presentation based on Literature Report

Laboratory Reports: - Laboratory reports are due one week after completion. One point (out of the maximum of one hundred) will be deducted for each day (or part thereof) that the report is late. The reports will be not accepted anymore after two weeks from the date when those were supposed to be turned in.

- The lab reports should
 - have a journal paper format
 - describe the experiments and contain all the chemical equations of the reactions done in the lab,
 - answer to the "Questions to be considered"
 - answer to all questions which will be given by the instructor before each laboratory.

- **No make-up laboratories will be given. This is in accordance with the chemistry department's policy.**

- **Literature report:**

- Literature report should be in the “Langmuir” journal format (should have Abstract, Introduction, eventually Experimental, Results and Discussion (or Results, Discussion) and Conclusion)

- should have:

- minimum 5 references from American Chemical Society Journals
- minimum 4 references from Elsevier or Springer
- and another 3 minimum references from other sources (books, journal edited by other editors).

- **Literature report presentation:**

- This will be based on the “Literature report”. Each student will have a 10 minutes presentation in PowerPoint followed by 5 minutes of questions

The plagiarism will be not accepted. Each lab report will be scanned to identify plagiarism. An identification of 30% plagiarism will consider a failure of the class.

Attendance Policy

Students **MUST** be present at every class.

A student cannot miss more than one regular exam. For the final grade the presence at the Final Exam is compulsory.

The attendance to the laboratory is compulsory. A student cannot miss more than TWO laboratories. For the case of missing more than two laboratories the student will not receive a passing grade.

No make-up laboratories will be given. This is in accordance with the chemistry department's policy.

Accommodating Disabilities

Lehman College is committed to providing access to all programs and curricula to all students. Students with disabilities who may need classroom accommodations are encouraged to register with the Office of Student Disability Services. For more information, please contact the Office of Student Disability Services, Shuster Hall, Room 238, phone number, 718-960-8441.

Classroom Policy:

Food policy: Food and drinks are not allowed in the classroom.

Cell Phone Policy. Cell phones are disruptive, even in vibrate mode. Make sure your cell phones are in silent mode before class starts. Text-messaging during class is also highly disruptive (besides absolutely rude) and is forbidden. If a cell phone rings during class, lecture will be stopped, until the student will shut down the device and the following penalties are applicable

5 pts penalty if your cell phone rings while I am in class; **10 pts penalty** if you continue the disturbance (e.g., by letting it ring again); **15 pts penalty** for 1st ring on 2nd occasion;

Electronic devices Policy No electronic devices can be used or kept accessible during examinations; this includes, but is not limited to i-Phones, cell-phones, beepers, iPods, MP3 players, tape-recorders, PDAs, **bluetooth** and other computing or music devices. Only basic calculators will be allowed.

Academic Integrity

While honest scholarship is time-consuming and often requires hard work, it is also the primary process by which students learn to think for themselves. Faculty members must teach respect for methods of inquiry within the various disciplines and make assignments that will encourage honest scholarship; students in turn must uphold a standard of honesty within the College, thereby affirming the value and integrity of their Lehman degree. The following definitions and procedures govern cases involving undergraduate student work.

The most common forms of academic dishonesty are cheating and plagiarism. Cheating is the use or attempt to use unauthorized material, information, notes, study aids, devices, or communication during an academic exercise (for example, using unauthorized books, papers, or notes during an examination; or procuring, distributing, or using unauthorized copies of examinations). Plagiarism means the failure to give credit for the source of another's words or ideas, including but not limited to books, articles, interviews, and multimedia and electronic sites, or—as in the use of borrowed or purchased papers—passing off another person's work as one's own. (Section 213-b of the New York State Education Law prohibits the sale of term papers, essays, and research reports to students enrolled in a college.) Common forms of cheating and plagiarism are highlighted in this Bulletin.

Academic dishonesty is a serious violation of the accepted values of the College. When questions of a breach of academic integrity arise, instructors will inform the students of their suspicions and provide the student with a Faculty Report Form for Incidents of Suspected Academic Dishonesty. The instructor must remember that a student's failure to respond to charges of academic dishonesty is not in and of itself an indication of guilt. The report will include an explanation of the incident, the instructor's intended academic sanction, and an indication whether or not the instructor is recommending that the College undertake disciplinary proceedings pursuant to Article 15 of the Board of Trustees Bylaws.

Academic sanctions may include but are not limited to the following:

1. **a grade of F for the course.**

Disciplinary procedures are governed by Article 15 of the Board of Trustees Bylaws. In the event the student is found guilty of academic dishonesty by a Faculty-Student Disciplinary Committee, penalties that may be imposed include but are not limited to: 1) suspension from the College or 2) expulsion from the College. Although the Office of the Vice President for Student Affairs will be guided by the recommendation of the instructor, it reserves the right to seek disciplinary sanctions under the disciplinary procedures.

Should the instructor become convinced that the suspicions are unfounded, no further action will be taken and the Faculty Report Form will be destroyed. If the suspicions are founded and if both the student and the instructor are willing, they may agree upon a resolution. Subsequently the instructor will present the completed Faculty Report Form, including the charges and resolution, to the department chair who must

forward the appropriate copies of the form to the Office of Academic Standards and Evaluation, and the Office of the Vice President for Student Affairs. If no agreement is reached, the instructor must allow a student to complete all coursework until the following appeal process has been completed.

- The first step in the appeals process is for the instructor to file the Faculty Report Form with the chair. If the term is completed, the instructor may assign a grade that reflects the intended sanction but must also provide a final grade that does not include the intended sanction if the charges are not upheld.
- If the charges are for cheating, then the chair will submit the charges to the Office of the Vice President for Student Affairs. If the charges are for plagiarism, the chair will appoint a committee of three Lehman College faculty members, which will adjudicate the matter within three weeks by majority vote. If the chair is the instructor in question, the senior member of the department Personnel and Budget Committee will act for the chair. The committee will provide written notification of its decision to the chair, who will forward this recommendation and the Faculty Report Form to the Office of the Vice President for Student Affairs.
- The Office of the Vice President for Student Affairs will review the recommendations of the instructor and the committee for possible disciplinary sanctions and provide a written notification of its decision to the department chair, the student, the instructor, and the Office of Academic Standards and Evaluation. Either the instructor or the student has the right, within three weeks of receipt of notification, to appeal the department decision in writing to the Committee on Admissions, Evaluation, and Academic Standards, which will act as adjudicator of last resort. Should any part of the three-week period fall outside the regular semester, the first three weeks of the next regular semester shall apply.

The Office of Academic Standards and Evaluation will keep all records of such proceedings on file until the student's graduation, at which time they will be destroyed.

As a result of a second upheld charge of academic dishonesty, disciplinary procedures will be pursued by the Office of the Vice President for Student Affairs as governed by the procedures under Article 15 of the Board of Trustees' Bylaws.

The following definitions and examples are adapted from the CUNY Policy on Academic Integrity.

Cheating is the unauthorized use or attempted use of material, information, notes, study aids, devices, or communication during an academic exercise. Examples of cheating include, but are not limited to the following:

- Copying from another student during an examination or allowing another student to copy your work.
- Unauthorized collaboration on a take-home assignment or examination.
- Using illegal notes during a closed-book examination.
- Taking an examination for another student, or asking or allowing another student to take an examination for you.
- Changing a graded exam and returning it for more credit.
- Submitting substantial portions of the same paper for more than one course without informing each instructor.
- Preparing answers or writing notes in a blue book (exam booklet) before an examination.
- Allowing others to research and write assigned papers or do assigned projects, including the use of commercial term paper services.
- Giving assistance to acts of academic misconduct or dishonesty.
- Fabricating data (all or in part).
- Submitting someone else's work as your own.
- Unauthorized use during an examination of any electronic devices, such as cell phones, palm pilots, computers, or other technologies to send or retrieve information.

Plagiarism is the act of presenting another person's ideas, research, or writings as your own. Examples of plagiarism include, but are not limited to the following:

- Copying another person's actual words without the use of quotation marks *and* citations.
- Presenting another person's ideas or theories in your own words without acknowledging the source.
- Using information that is not common knowledge without acknowledging the source.
- Failing to acknowledge collaborators on assignments.
- Purchasing or downloading term papers online.
- Paraphrasing or copying information from the Internet without citing the source.
- "Cutting and pasting" from various sources without proper attribution.

Lecture topics

The following topics will be covered:

Atomic structure and Periodic Trends; Molecular structure and bonding; Structure of the inorganic solids; Bonding and Molecular structure; Molecular Symmetry; Elements and their compounds; Coordinative compounds; Solid state and materials Chemistry; Nanomaterials;

Nr. Crt.	Subject
1	Chapter 8. Physical techniques in Inorganic Chemistry Diffraction methods X-ray Diffraction Neutron diffraction Absorption and emission spectroscopy
2.	Infrared and Raman Spectroscopy Ionization-based techniques Chemical analysis Thermal Analysis Microscopy
3.	Chapter 1. Atomic structure* Some principles of quantum mechanics*
4.	Heisenberg's uncertainty principle The structure of hydrogen atoms* Schrödinger equation* The particle in a Box*
5.	Atomic orbitals Shells, subshells and orbitals*
6.	Electron spin* The radial variation of atomic orbitals The angular variation of atomic orbitals
7	Many electron atoms Penetration and shielding The building-up principle
8.	Atomic parameters (radii variation; ionization Energy; Electron affinity; Electronegativity and Polarizability)
9.	Chapter 2. Molecular structure and bonding

	Molecular Orbital theory Principles of Molecular Orbital Theory
10.	The approximation of the theory <ul style="list-style-type: none"> - Homonuclear diatomic molecules - Heteronuclear diatomic molecules Structure and bond properties
11.	Chapter 6. Oxidation and Reduction Reduction potential; Standard Potentials and spontaneity Nernst Equation
12.	Redox Stability; The diagrammatic presentation of potential data Chemical extraction of the elements
13.	Chapter 4. The structures of simple solids The description of the structures of solids <ul style="list-style-type: none"> - Unit cells and the description of the crystal structure; The close packing of the spheres
14.	Holes in close-packed structures The structure of metals and alloys; Polytypism; Polymorphism in metals; Atomic radii of metals;
15.	Alloys and interstitials Intermetallic Compounds Ionic solids; The Energetic of ionic bonding
16	Defects and nonstoichiometry The electronic structure of the solids
17.	Exam 1
18.	Chapter 24. Materials chemistry and nanochemistry General principles of solid state chemistry Extended defects Defects and Ion transport Synthesis of materials Rechargeable battery materials
19.	Metal oxides <ul style="list-style-type: none"> - Oxid glasses - Framework structure Semiconductor chemistry Fullerides Nanomaterials; Inorganic-organic nanocomposites
20	Chapter 3. Molecular Symmetry* An introduction to symmetry analysis Symmetry operations*; Symmetry elements; The point groups of molecules
21.	Applications of symmetry Polar and Chiral Molecules*
22.	Symmetry of orbitals;

	The symmetry of molecular vibrations; Representations* The symmetry of molecular orbitals
23.	Chapter 7. An Introduction to coordination compounds Ligands and nomenclature
24.	Constitution and geometry; Coordination numbers Isomerism and chirality Formation constants
25.	Chapter 20. d-Metal complexes: electronic structure and spectra Electronic structure Crystalline field theory Jahn-Teller Effect*
26.	Octahedral versus tetrahedral coordination Ligand-field theory;
27.	Electronic spectra; Electronic spectra of atoms; Electronic spectra of complexes Chapter 21 Coordination Chemistry: reactions of complexes; Ligand substitution reactions; Ligand substitution in square-planar complexes
28	Ligand substitution in octahedral complexes Redox reactions Photochemical reactions
	Final exam

CHE-443 Advance Inorganic Chemistry Laboratory
2019 Spring Semester
Laboratory Instructor - **Wong, Madeline**

Please Note: This schedule is subject to minor change so that course material can be best presented. **All reading assignments are to be completed before class.**

Experiment	Date	Lab
1.	01/28/2019	Dry Laboratory; Surf the literature using the SciFinder Scholar; American Chemical Society Literature survey. Research topic for a literature report and presentation Check-in Experiment 1. Part I: Basicity of oxo Anions and Solubility of their Salt Part II: Competitive Lewis Acid-Base Reactions Part III: Hydrolysis of chlorides of various metal ions
2.	02/04/2019	Continuation of the Experiment 1 Experiment 2. Preparation of Sodium Peroxoborate
3.	02/11/2019	Experiment 3. Zeolite synthesis. Growing of a chemical garden Part I: Zeolite Synthesis

		Part II: Growing a chemical garden Experiment 4. The Synthesis and Characterization of Spinels
4.	02/25/2019	Experiment 4. The Synthesis and Characterization of Spinels – Continuation Experiment 5. Synthesis of ZnO nanoparticles
5.	03/04/2019**	Experiment 6. X-Ray Diffraction of zinc oxide nanoparticles** Training on the X-Ray diffractometer
6.	03/11/2019	Experiment 7. Copper Compounds Preparation of Potassium Trichlorocuprate (II); Preparation of Tris(thiourea)copper (I)
7.	03/18/2019	Experiment 8. Preparation of a Ferrofluid
8.	03/25/2019**	X-Ray characterization of the Ferrofluids and Spinels
9.	04/01/2019	Experiment 9. Preparation and Characterization of Sodium Tetrathionate PART I. Determination of Reaction Quantities PART II Quantitative Preparation of Sodium Tetrathionate PART III Characterization of the product
10.	04/08/2019	Continuation of Experiment 9
11.	04/15/2019	Experiment 10. Synthesis of a Heteropolytungstate and its Use in Outer-Sphere Redox Kinetics
12.	04/29/2019	Experiment 11. Ethylenediamine Complexes of Cobalt and Nickel
13.	05/06/2019	Experiment 12. Absorption spectra of Transition Metal Complexes Literature report is due
14.	05/13/2019	PowerPoint presentations for each student 10 minute for presentation and 5 minutes for questions and answers Check out

**The experiment will be run based on the availability of the X-Ray diffractometer. This experiment might be replaced with “CITING APPROPRIATELY LITERATURE ARTICLES” or other experiments