SYLLABUS

Chem 4235, Spring 2015 Inorganic Chemistry Lab Dr. Jack Lu

Quality Enhancement Plan (QEP)
Applied Critical Thinking for Lifelong Learning and Adaptability

Applied Critical Thinking Statement:

This course has been authorized by UHCL as an Applied Critical Thinking (ACT) Course which means that in addition to learning about the specified course content, students will be engaged with some or all of the Elements of Thought and Universal Intellectual Standards of critical thinking. The objective of an ACT course is to develop the student's ability to become skilled at analysis and evaluation by applying a set of intellectual tools that may be effectively used across all disciplines (as well as to the student's personal life). Based on the Foundation for Critical Thinking (http://www.criticalthinking.org/), critical thinking involves thinking for a *purpose*, asking *questions*, using *information*, applying *concepts*, drawing *inferences and conclusions*, identifying *assumptions*, anticipating *implications and consequences*, and recognizing *points of view*. The Universal Intellectual Standards that are applied to these Elements of Thought of critical thinking in order to develop Intellectual Traits include *clarity, accuracy, precision, relevance, depth, breadth, logic, significance,* and *fairness*.

Honesty Code: The Honesty Code is the university community's standard of honesty and is endorsed by all members of the University of Houston-Clear Lake academic community. It is an essential element of the University's academic credibility. It states: "I will be honest in all my academic activities and will not tolerate dishonesty."

Course Objective: This course concerns inorganic chemistry laboratory principles, basic manipulation skills and synthesis of different inorganic compounds. Upon completion of the course, students will be familiar with some basic skills and techniques in *depth*, understanding *concepts with clarity* In addition, high temperature techniques, vacuum line operations, inert atmosphere, FTIR and other methods will be introduced in the experiments.

Critical thinking is integrated in each lab. To be successful, before each lab class, students must *clearly* know the *purpose* of the lab and *the concepts* and methods employed in the lab, and *precisely perform* each step according to the designed procedure. They will also need to *analyze* the lab results and make *inference* to draw *relevant conclusions*. These are critical thinking elements presenting/dominating in each step through out of each lab.

Student Learning Outcomes (SLO)

After completing the course, the students are expected to be able to

1. *Clearly* and *precisely* solving problems using skills built-in with *all elements of thought in critical thinking* in inorganic synthesis.
2. Understand the *precise concepts* and issues associated with the high temperature techniques.
3. Understand some of the important *relevant questions at issues* in synthetic process.
4. *Accurately* apply various tools appropriately to construct *solutions* in inert atmosphere and vacuum line operations.
5. *Clearly* understand chemical *concepts* and issues associated with literature search project with particular compounds.
6. *Accurately* understand the manipulation skills (*inference*) and their *purposes and relevance* required for the advanced inorganic synthesis, and their *purposes and relevance*.

Note: The italicized portions of the SLO are related to critical thinking.

(SLOs 3, 4 and 5 will be used for ACT assessment.)

Prerequisite Courses: General Chemistry Laboratory; Inorganic Chemistry; Physical Chemistry and Laboratory.

Reference books:

Synthesis and Technique In Inorganic Chemistry, 1986. By Robert J. Angelici

Experimental Methods In Inorganic Chemistry, 1999. By John Tanaka, Steven Suib

Course policies:

Attendance is extremely important and regular attendance is expected. There would be no make-up labs and exams.

Grading:

Midterm exam, 20%.
Safety quiz, 5%.
Lab preparation and the understanding of the theoretical aspects and techniques of the experiments performed, 10%.

Performance (lab safety, experiment manipulation skills, housekeeping, attitude toward others in the lab, attendance and participation in all exercises, 10%.
Literature report, 10%.
Lab notebook (page 6-7 in the 2nd reference book), 20%.
Final exam, 25%.

Office Hours: Tuesday & Wednesday, 3 to 4 pm.

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Lab List:

Lab 1. Introduction, laboratory safety discussion, techniques for obtaining IR spectra and lab check in. All students must take the BB safety training and tests.

Students need to check blackboard or uhcl email account for the instructions/link. Attached are the two main components of the training. There is a bb test on the training, and an electronic signature acknowledgement "test" on the procedures.

The Advanced Lab Safety Training has more content. The test must be done by the second week of class.
https://blackboard.uhcl.edu/webapps/portal/frameset.jsp?tab_tab_group_id=_2_1&url=%2Fwebapps%2Fblackboard%2Fexecute%2Flauncher%3Ftype%3DCourse%26id%3D_25275_1%26url%3D

Lab 2. $[Co(en)_3]^{3+}$ and $[Ni(en)_3]^{2+}$

$[Co(en)_3]^{3+}$ is optically active. Optically active materials have the ability to rotate the plane of light to the right or left to a greater or lesser angle depending on the nature of the substance. This prep is also representative of the formation of coordination compounds. The compounds formed illustrate the range of colors and stability encountered in coordination compounds as well.

Lab 3. $[Cr(NH_3)_6](NO_3)_3$

In this experiment, not only will the synthesis of $[Cr(NH_3)_6](NO_3)_3$ be carried out, but techniques involved in handling liquid ammonia will be acquired.

Lab 4. Introduction to literature search and the use of Library resources in Library. Library staff will provide assistance in accessing library resources. Use STN

(easy), Chemical Abstracts on-line (after 5:00pm) and ACS on-line journals to find two abstracts which show the actual synthesis of two inorganic compounds.

Lab 5. Co(salen) and O_2 absorption

In this experiment, Co(salen) will be prepared. The oxygen up-take capacity of the compound is also investigated. The techniques including purging with an inert gas and isolation of crystalline products will be acquired.

Lab 6. $K_2S_2O_8$ (or CdI)

In this experiment, potassium peroxydisulfate ($K_2S_2O_8$) will be prepared by the electrolysis of an aqueous solution of H_2SO_4 and K_2SO_4.

(The CdI prep illustrates a basic type of inorganic reaction, that of metathesis. The structure of cadmium iodide is also of interest in that it is of a type exhibited by a number of compounds.)

Lab 7. Literature search and report.

Assignment for the literature search project.

Take the printed abstracts, including all the information needed to find the primary literature articles. The articles must be photocopied so that they can be submitted with report.

Lab 8. Literature search and report presentation.

Lab 9. $(CH_3)_3N{:}BF_3$ (or Preparation of A Zeolite, B/Al ZSM-11)

This experiment uses vacuum line system for transferring chemicals from one container to another and measuring the vapor pressure of a liquid at low temperature. The use of vacuum line is the most fundamental and important for air sensitive compounds.

(Preparation of A Zeolite, B/Al ZSM-11: Zeolites with specific catalytic properties have been one of the most important catalysts for the petroleum industry. The synthesis of zeolites with specific catalytic properties has been, and will continue to be, an important contribution of inorganic chemists to industrial chemistry.)

Applied Critical Thinking (ACT)

Vocabulary of Critical Thinking

We use the vocabulary of critical thinking described by Drs. Richard Paul and Linda Elder, including the eight elements of thought and nine universal intellectual standards:

Eight elements of Thought of Critical Thinking:

1. Purpose
2. Question at Issue
3. Information
4. Interpretation and Inference
5. Concepts
6. Assumptions
7. Implications and Consequences

8. Point of View

Nine Universal Intellectual Standards for Critical Thinking:
1. Clarity
2. Accuracy
3. Precision
4. Relevance
5. Depth
6. Breadth
7. Logic
8. Significance
9. Fairness

For more details, see:
[1] Paul, R. and Linda Elder, L., The Miniature Guide to Critical Thinking-Concepts and Tools (Thinker's Guide), 7th edition, Foundation for Critical Thinking, 2014.
[2] Paul, R. and Linda Elder, L., Critical Thinking: Tools for Taking Charge of Your Learning and Your Life, 3rd Edition, Prentice Hall, 2011.

Critical Thinking Process (CTP)

According to the ACT vocabulary we used, there are four major aspects of the Applied Critical Thinking Process, termed as the 4 C's: *curiosity, connections, creativity and communication*. In this course, the C in the student learning objectives to be assessed is *connections*:
Making *connections* to a particular issue or problem: students will use established methodology to manipulate a process, design a reaction as instructed, and carry out the synthesis successfully.

Critical Thinking Activities and Assessment

There are three assessment activities (AA) of critical thinking in the course. The evaluation of these activities is used to assess how well critical thinking is incorporated into the course. These assessments will be used as input to the UHCL Critical Thinking database for internal assessment of Critical Thinking, and will not affect your grade of the course.

AA-1. To address SLO#3, lab#2 will be carried out at specified conditions and the conditions need critical comprehension of the process. The critical thinking for this project is measureable. The manipulation skills for the preparation of the compound and its *relevance* to the *questions at issue* will be assessed. The product will be checked by FTIR test for assessment.

AA-2. To address SLO#4, Co(salen) and O_2 absorption will be carried out. In this experiment, Co(salen) will be prepared. The oxygen up-take capacity of the compound is also investigated. The techniques including purging with an inert gas using vacuum line and isolation of crystalline products will be acquired. The oxygen up-take capacity measurement is the test for the critical step of the preparation of the Co(salen). The result *solution* is measurable for the critical thinking and critical manipulation for the Critical assessment.

AA-3. To address SLO#5, two compounds literature search will be assigned (lab #7). Take the printed abstracts, including all the information needed to find the

primary literature articles. The articles must be photocopied so that they can be submitted with report. A presentation will be assessed. The accurate description and correct paper references are used to assess how clearly students *understand* the chemical *concepts* for ACT assessment.

The assessment criteria for the AA:

Assessment Activity	Assessment Outcome		
	Unacceptable	Acceptable	Excellent
AA #1	[0%,75%)	[85%,95%)	[95%,100%]
AA #2	[0%,75%)	[85%,95%)	[95%,100%]
AA #3	[0%,75%)	[85%,95%)	[95%,100%]

Overall, if 70% or above of students are evaluated to be acceptable or excellent in each activity, as well as the average of all activities, the outcomes will be deemed acceptable. Overall, the instructor will evaluate the ACT content, activities, and assessment of the course and make necessary adjustment