Inorganic chemistry is a large sub-discipline of chemistry with substantial overlaps with all the other areas of chemistry. The study of inorganic chemistry can serve an important integrating function. We cannot hope to cover all topics of interest to inorganic chemists, but we will try to compromise with a good overview. This is the writing intensive course for CHMBD. Emphasis will be placed on improving writing, in both the lecture and laboratory, through the use of first (and possible second) drafts of all your writing.

**Course Outline**

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
</tr>
<tr>
<td>2</td>
<td>The Structure of the Atom</td>
</tr>
<tr>
<td>3</td>
<td>Symmetry and Group Theory</td>
</tr>
<tr>
<td><strong>Exam #1</strong></td>
<td><strong>End of September</strong></td>
</tr>
<tr>
<td>4</td>
<td>Bonding Models in Inorganic Chemistry: Ionic Compounds</td>
</tr>
<tr>
<td>5</td>
<td>Bonding Models in Inorganic Chemistry: The Covalent Bond</td>
</tr>
<tr>
<td>6</td>
<td>The Structure and Reactivity of Molecules (part)</td>
</tr>
<tr>
<td><strong>Exam #2</strong></td>
<td><strong>End of October</strong></td>
</tr>
<tr>
<td>9</td>
<td>Acid-Base Chemistry (part, as intro to coordination)</td>
</tr>
<tr>
<td><strong>Coordination Chemistry</strong></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Bonding, Spectra, and Magnetism</td>
</tr>
<tr>
<td>12</td>
<td>Structure</td>
</tr>
<tr>
<td>13</td>
<td>Reactions, Kinetics, and Mechanisms</td>
</tr>
<tr>
<td><strong>Exam #3</strong></td>
<td><strong>December 4</strong></td>
</tr>
<tr>
<td><strong>Special Topics</strong></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Organometallic Chemistry</td>
</tr>
</tbody>
</table>
**Exams**

There will be three (3) hour exams worth 100 points each. The first will be after chapter 3; the second after chapter 6. They will be given outside of class if your schedules permit.

There will be one or more problems assigned at the beginning of each lecture. The problems will be due at the beginning of the following lecture. Turned in problems will consist of the original handout, with any additional pages stapled to it. The complete, **clearly** worked out solution will always be expected for any credit. They will be turned in, in person, before class starts. These problems will not be accepted early or late under any circumstances. They are graded as follows:

<table>
<thead>
<tr>
<th>Grade Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct work and answer</td>
<td>2 pts.</td>
</tr>
<tr>
<td>Attempted, but incorrect answer</td>
<td>1 pt.</td>
</tr>
<tr>
<td>Minimal effort or not turned in</td>
<td>0 pts.</td>
</tr>
</tbody>
</table>

There will be 45 of these problems for 90 possible points. To these points will be added up to 10 discretionary points, based primarily on class participation, giving a total of 100 points.

There will be student presentations (see below) worth 100 points.

Finally, there will be a 100 point cumulative final exam. The lecture portion of the course will thus be worth 600 points.

**Presentations**

There will be 20-minute student presentations (probably outside of class time), on Groups of the periodic table. The presentations will consist of each student giving a lecture on the descriptive chemistry of one group of elements. A paper, based on your oral presentation and the oral presentation will count as 100 points. You should start your research and preparation today! Your text book is one source of information, the library another. You will discuss your presentation with me, but I will not tell you what to talk about or how to organize it. It will obviously not be comprehensive, due to the short period of time. Therefore, you must include what you feel is interesting and important. Your purpose is to give your classmates a good introduction to the chemistry of the group. You should become an expert on your group. Groups will be assigned by your choosing or a lottery. The presentations, which will be outside of class (probably on consecutive days) will be scheduled early in the semester so you will have plenty of time to prepare.

**Typed** preliminary outline with at least 4 (non web) references.  
**Due in 3 weeks.**

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typed preliminary outline</td>
<td>15 pts.</td>
</tr>
<tr>
<td>Typed first draft of paper</td>
<td>20 pts.</td>
</tr>
<tr>
<td>Review of one classmate's first draft</td>
<td>5 pts.</td>
</tr>
<tr>
<td>Typed final paper</td>
<td>30 pts.</td>
</tr>
<tr>
<td>Oral presentation; Evaluation by your peers.</td>
<td>25 pts.</td>
</tr>
<tr>
<td>Two exam questions based on your talk.</td>
<td>5 pts.</td>
</tr>
</tbody>
</table>
LABORATORY

The laboratory will consist of the qualitative analysis of two "groups" of ions, a set of two (2) core experiments dealing with the synthesis and analysis of inorganic compounds, one (1) additional experiments of your choosing and one (1) experiment dealing with synthesis and spectral analysis of several related coordination compounds. Qualitative analysis consists of an investigation of the aqueous chemistry of ions by traditional qualitative analysis methods. You will develop a qualitative analysis scheme to separate and identify the ions based on the observed solubility, acid-base, redox and coordination equilibria of the ions. The synthetic experiments will be similar to the type of laboratory you experienced in organic chemistry, but usually involving more advanced laboratory techniques.

A well organized, clearly written laboratory notebook is an important part of your laboratory grade. The notebook will be numbered consecutively from the beginning, clearly identify the experiment by name on each page, and the original turned in at the end of each laboratory period.

Preliminary drafts reports (typed) of each sub-group of elements in the qualitative analysis portion of the laboratory will be turned in one week after that sub-group is completed. A final, comprehensive laboratory report consisting of the entire group will be due one week after the last preliminary draft is turned in. A typed laboratory report consists of a title page, introduction (with background, theory, expected reactions, etc.), experimental section, results and discussion, with appropriate references. The experiments are as follows:

1. Qualitative Analysis - Handouts

   **Group 1**  
   \[ \text{Ag}^+, \text{Pb}^{2+}, \text{Hg}_2^{2+} \]

   **Group 2**  
   \[ \text{Pb}^{2+}, \text{Cu}^{2+}, \text{Hg}^{2+}, \text{Cd}^{2+} \]

   **Purpose:** Descriptive chemistry and an understanding of the interplay of solubility, acid-base, redox and coordination equilibria.

2. Core Experiments A:

   a. Preparation of Tetrabutylammonium Octachlorodirhenate(III): A Compound with a Metal-Metal Quadruple Bond. *Microscale Inorganic Chemistry - Handout* (Experiment 34)

      **Purpose:** Synthesis, IR, Inert atmosphere techniques, Magnetic susceptibility


      **Purpose:** Synthesis, Purification and Optical Rotation and Resolution
3. Additional Experiment. Choose one of the following.


Purpose: Synthesis, IR, $^1$H NMR, GC, Cylinder gas manipulation


Purpose: Synthesis, IR, $^1$H NMR, $^{13}$C NMR, Inert atmosphere techniques


Purpose: Synthesis, $^1$H NMR, Inert atmosphere techniques


Purpose: Synthesis, IR, $^1$H NMR, $^{13}$C NMR, Inert atmosphere techniques

4. Core Experiment B:


Purpose: Synthesis, UV-Vis

**Laboratory Schedule**

<table>
<thead>
<tr>
<th>Week</th>
<th>Experiment</th>
<th>Week Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check-in and Lab Policies</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Qualitative Analysis - Group 1</td>
<td>3</td>
</tr>
<tr>
<td>3 - 4</td>
<td>Qualitative Analysis - Group 2 and Combined Groups</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Qualitative Analysis - Unknown</td>
<td>7</td>
</tr>
<tr>
<td>6 - 7</td>
<td>Preparation of Tetrabutylammonium Octachlorodirhenate(III)</td>
<td>8</td>
</tr>
<tr>
<td>8 - 10</td>
<td>Synthesis and Optical Isomers of Co(en)$_3^{3+}$</td>
<td>11</td>
</tr>
<tr>
<td>11 - 12</td>
<td>Additional Experiment</td>
<td>13</td>
</tr>
<tr>
<td>13 - 14</td>
<td>An Evaluation of The Spectrochemical Series</td>
<td>Finals</td>
</tr>
<tr>
<td>14</td>
<td>Check-out</td>
<td></td>
</tr>
</tbody>
</table>
The laboratory counts 1/4 of your total grade (200 pts.) as follows:

Laboratory notebook (overall) 20 pts.
Qualitative analysis preliminary reports (typed) (2 groups) 40 pts.
Final typed overall qualitative analysis report 30 pts.
Full reports (typed, Inorganic Chemistry format) (2 core A experiments) 60 pts.
Full reports (typed, Inorganic Chemistry format) (1 selected experiment) 30 pts.
Data presentation and treatment (1 core B experiment) 20 pts.

Course Grade:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>93 - 100%</td>
</tr>
<tr>
<td>A–</td>
<td>90 - 92%</td>
</tr>
<tr>
<td>A+</td>
<td>87 - 89%</td>
</tr>
<tr>
<td>B</td>
<td>83 - 86%</td>
</tr>
<tr>
<td>B–</td>
<td>80 - 82%</td>
</tr>
<tr>
<td>B+</td>
<td>77 - 79%</td>
</tr>
<tr>
<td>C</td>
<td>70 - 76%</td>
</tr>
<tr>
<td>D</td>
<td>60 - 69%</td>
</tr>
<tr>
<td>F</td>
<td>0 - 59%</td>
</tr>
</tbody>
</table>

Note: Because the laboratory portion is a very important and integral part of this writing intensive course, you must receive a passing grade (C or higher) in the laboratory portion (sections 1 and 3) (laboratory reports) in order to receive a passing grade (C or higher) in the overall course.

Policies:

1. Do not be afraid to ask questions.
2. Class attendance is expected. The laboratory and the lecture will begin on the hour.
3. Make-up exams will only be given for legitimate absences officially recognized by Penn State University. No exceptions will be made.
4. Instructors are asked (Senate rule 49-20) to provide a statement at the beginning of a course to "clarify the application of academic integrity to that course." The Senate Rule includes the following:

   Academic dishonesty includes, but is not limited to, cheating, plagiarizing, fabrication of information or citation, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the work of other students.

Please read Senate rule 49-20 www.psu.edu/ufs/policies/47-00.html#49-20 and the Behrend guidelines on academic integrity: www.pserie.psu.edu/faculty/academics/integrity.htm. Any violation of academic integrity will receive academic and possibly disciplinary sanctions, including the possible awarding of an XF grade which is recorded on the transcript and states that failure of the course was due to an act of academic dishonesty. All acts of academic dishonesty are recorded so repeat offenders can be sanctioned according.