

Brooklyn College
Advanced Inorganic Chemistry CHEM 4761/CHEM 7761G – Spring 2016

Lecture Tuesdays/Thursdays 6:30-7:45PM Room 1127N

Professor Maria Contel

Contact information:

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Office hours: Tuesdays: 5:00-6:00 PM; Wednesdays 12:00-1:00 PM

(if you need to see me at other times, please call or email for appointment at least 24 hours in advance).
Appointments requests received during the weekend will be processed on Mondays. I will not check emails on Saturdays and on Sundays.

Course Description:

This course will introduce students to the contents of advanced inorganic chemistry. This course will focus on the study of symmetry and group theory, molecular orbitals, coordination and organometallic chemistry, crystalline solid state, environmental, bioinorganic and green chemistry. The laboratory course is designed to get basic training in inorganic chemistry synthesis (coordination and organometallic complexes, solid state), characterization techniques (including multinuclear NMR), bioinorganic chemistry and homogeneous catalysis. The concepts learnt in this course will be helpful for students planning to continue studying inorganic chemistry and taking other advanced courses in this discipline as well as for students planning to study other areas of chemistry.

Learning Goals:

Upon completion of the course, students should be able to:

- Predict electronic configurations, periodic trends and structures and approximate angles of molecules.
- Recognize most common point groups for a molecule and identify symmetry of orbitals and vibrations. Build qualitative molecular orbitals (MO) for small and large molecules, identify hard/soft acids and bases and predict reactivity.
- Know the fundamentals of coordination and organometallic chemistry (nomenclature, isomerism, principles of ligand field theory, MO, ligands, fundamental reactions and study of reactions mechanisms, principles of homogeneous catalysis).
- Know the principles of solid-state chemistry (ionic solids, thermodynamics of ionic crystal formation, metallic bonding, conductance of metals, silicates).
- Know the fundamentals of bioinorganic, environmental and green chemistry (representative examples of bioinorganic compounds and their actions, examples of the environmental effects of both metals and non-metals, principles of green chemistry).

Textbook:

Required:

Inorganic Chemistry, Gary L Miessler, Paul J. Fischer and Donald Tarr, 5th Ed, Pearson – Prentice Hall (2013). 4th Ed ok as well

Solutions Manual for Inorganic Chemistry (Miessler & Tarr)

Highly recommended:

- Inorganic/organic molecular models

Other Recommended books

- Inorganic Chemistry, Shriver & Atkins, 5th Edition, Freeman (2010)

- Molecular Symmetry and Group Theory, Alan Vincent, 2nd Ed, Wiley (2001)

Grading: The final grade will be determined as follows:

Grade based on 3 individual tests and 10 individual/team RAT assessments

First Peer Evaluation (non-graded): Each individual will evaluate the contributions of all the other team members by completing the quantitative and qualitative portions of the midterm peer evaluation form located at the end of the syllabus. This form will be collected on the day of test 1. The results will be disseminated anonymously to all team members by Prof. Contel.

Final Peer Evaluation (graded): At the end of the term, it is necessary for all members of this class to assess the contributions that each member of the team made to the work of the team. This contribution should presumably reflect your judgment of such things as:

Preparation - Were they prepared when they came to class?

Contribution - Did they contribute productively to group discussion and work?

Respect of others' ideas - did they encourage others to contribute their ideas?

Flexibility - Were they flexible when disagreements occurred?

It is important that you raise the evaluation of people who truly worked hard for the good of the group and lower the evaluation of those you perceived not to be working as hard on group tasks. See Final Peer Evaluation Form.

Course Evaluation

Individual Performance: 80%		Team Performance: 20%	
Individual RATs (11)	14%	Team RATs (10)	15%
Test 1	22%	Peer Evaluation	5%
Test 2	22%		
Test 3	22%		

Final course grade (based on a total of 100): 100-90 A⁺, 89-85 A, 84-80 A⁻, 79-75 B⁺, 74-70 B, 69-65 B⁻, 64-60 C⁺, 59-55 C, 54-50 C⁻, 49 or less F.

Tentative schedule and dates for the tests:

	TEST 1	TEST 2	TEST 3
Date	March 15th	April 12th	May 24th
Material covered	Units 1-3	Units 4-5	Units 6-8

Graphing calculators and cell phones are not allowed on exams! Pencils cannot be used to write exams. Exams written with pencil will not be graded.

Tests will be different for undergraduate and graduate students (harder for the later). RATs will be the same as all students will be distributed in teams.

Issues of Courtesy: Lecture will start as scheduled, at 6:30 PM. Please arrive on time (especially on RAT days when the RATs will be distributed immediately after class starts!), with your cell phone, pager, and/or other electronic devices turned off.

Teaching Method

This course will be using the Team-Based Learning (TBL) strategy (www.teambasedlearning.org).

TBL will increase students' understanding of course concepts by using them to solve authentic, real-world problems and help them develop their workplace learning skills. The primary course objective shifts from content transmission (lectures) to helping students learn how to use course content to solve significant problems; in fact, an important fraction of class time will be spent solving problems and making decisions. It will be done in a way that will hold teams accountable for using course content to make decisions (solve problems) that will be reported publically and subject to cross-team discussion/critique.

Overview of TBL Sequence

Phase 1 – Preparation: Students will complete specified preparatory materials (readings and assignments) for each unit.

Phase 2 – Readiness Assurance Test: On selected days, students will be given a Readiness Assurance Test (RAT). The RAT measures their comprehension and mastery of the assigned readings and helps them deepen their understanding of the course material needed to begin problem solving in Phase 3. Once the test period is over, the instructor may present a short mini-lecture to clarify concepts that are not well understood as evidenced by test scores. The purpose of Phase 2 is to ensure that students and their teammates have sufficient foundational knowledge to begin learning how to apply and use the course concepts in Phase 3. **RATS are closed book and based on the assigned preparatory material** (readings and assignments).

- **Individual RAT (iRAT):** Students individually complete a 4-7-question multiple-choice test based on the readings.
- **Team RAT (tRAT):** Following the iRAT, the same multiple-choice test is re-taken with their team. These tests use a “scratch and win” type answer card known as an IF-AT. The students develop a consensus with their teammates, and then scratch off the opaque coating hoping to reveal a star that indicates a correct answer. The team is awarded 4 points if they uncover the correct answer on the first scratch, 2 points for the second scratch, and 1 point for the third scratch. If they are incorrect with any scratch, the team needs to reconsider, discuss, and make another decision.
- **Appeals Process:** Once the team has completed the team test, they have the opportunity to fill out an appeals form. The purpose of the appeals process is to allow the team to identify questions where they disagree with the question wording or ambiguous information in the readings. The instructor will review the appeals outside of class time and report the outcome of the team appeal at the next class meeting. Only teams are allowed to appeal questions (no individual appeals).

Impact of appeals on test scores:

When an appeal is accepted on a question that a team has missed (no individual appeals will be accepted):

1. It counts. In other words, the points missed will be added to:
 - a. their team score
 - b. the score of any individual in the team who answered the same as the team
 - c. only those teams that appeal.
 2. Team member(s) who had the original correct answer will continue to receive credit on the question.
- **Feedback and Lecture:** Following the RATs and Appeal Process, the instructor provides a short, clarifying lecture on any difficult or troublesome concepts or asks for further questions to help clarify the material. On Thursdays the instructor will provide a lecture and/or go to phase 3.

Phase 3 – In-Class Activities: Students and their teams use the foundational knowledge, acquired in the first two phases, to work on specific problems that will be reported publically and subject to cross-team discussion/critique. These will be similar to problems that will appear on tests.

Promoting Individual Accountability

The Readiness Assurance Process is designed to promote individual accountability. The Readiness Assurance Process requires individuals to complete a multiple-choice test covering a set of pre-assigned readings and turn in their answers. Students are individually accountable because the individual scores count as part of the course grade. Next, during the team test (exact same test as individual), each member is invariably asked to voice and defend his or her choice on every question as the teams come to a consensus on their answers. The resulting discussions produce immediate peer dialogue/feedback that provides clear evidence of the quality of individual preparation and the importance of obtaining input from everyone on all important decisions. Third, members who are chronically unprepared almost invariably receive a low peer evaluation score.

Promoting Team Accountability

Fostering team accountability is very important. Without team accountability, neither instructor nor students know: 1) if their learning goals have been achieved, or 2) if students are taking teamwork seriously. Teams can be held accountable by carefully managing intra-team and whole-class discussions. The key is the nature of the application activity. First, team assignments must require production of a tangible output. Second, the “product” that teams are asked to create should enable both immediate feedback on the quality of teamwork and the opportunity for direct comparisons from other teams.

Accountability matters: If students fail to prepare for teamwork, then better prepared students are likely forced to “carry” their less willing and/or less able peers. Additionally, improperly managed team discussions are likely to degenerate into social events in which little if any learning occurs. Both problems can be avoided almost entirely by establishing accountability practices. The key is using assignments and practices that hold individuals and teams accountable for their contributions and behaviors. Accountability to the team occurs via immediate peer feedback and direct anonymous assessment in the peer evaluation process.

(Information about TBL adapted from *Three Keys to Using Learning Groups Effectively* by Larry Michaelsen; *Student Orientation Materials* by Dean Parmelee; and *The Essential Elements of Team-Based Learning* by Michaelsen& Sweet.)

Course Requirements

Class attendance and participation: Students are required to keep up-to-date on class readings and assignments, and to be active team members. If students miss a class, they miss whatever their team did. The team process is critical to learning, and the content of each session will be reflected on the midterm and final exams. Most teams, in real life and here, will forgive a single absence for which students have a really good reason, and be less forgiving of multiple or casual absences. More than one absence and/or tardiness will affect the course grade (two points per absence and one point for lateness). Attendance is taken at the beginning of class and it is expected that all students will be present at the start of class. Brooklyn College abides to the state law regarding non-attendance because of religious beliefs, as expressed in page 79 of the student bulletin (available at:

http://www.brooklyn.cuny.edu/web/off_registrar/141024_2014-15_Undergraduate_Bulletin.pdf).

As cited in the bulletin (p. 79): “The New York State Education Law provides that no student shall be expelled or refused admission to an institution of higher education because he or she is unable to attend classes or participate in examinations or study or work requirements on any particular day or days because of religious beliefs. Students who are unable to attend classes on a particular day or days because of religious beliefs will be excused from any examination or study or work requirements. Faculty must make good efforts to provide students absent from class because of religious beliefs equivalent opportunities to make up for the work missed”. If you are unable to attend class in any occasion for religious reasons, please notify me during the first week of class to make the necessary arrangements.

Assigned Readings: Students are expected to have completed all the readings for each class and be prepared to engage in classroom discussion and team activities regarding the assigned readings. [Assigned readings will be posted on black board by Friday afternoon every week.](#)

Content and Tentative Schedule Lecture Course

Slides, reading assignments, selected problems and any other extra materials will be posted on Black Board. Make sure that you have access to black board and that you know how to use it.

Introduction to the course. Explanation teaching method. Formation of Teams. February 2th

Unit 1

Chapters 1-3. Introduction to inorganic chemistry. Atomic theory. Chapters 2-2-4 to 3. Periodic trends. Simple bonding theories. Feb 4th, 11th, Feb 16th **Tuesday Feb 9th no class!**

Learning objectives: Predict electronic configurations, periodic trends and structures and approximate angles of molecules

i/tRATs: Feb 4th, Feb 16th [RATs 1 & 2](#)

Unit 2

Chapter 4. Symmetry and group theory. Applications to vibrational spectroscopy.

February 18th, 23rd, 25th

Learning objectives: Recognize most common point groups for a molecule and identify symmetry of orbitals and vibrations.

i/tRATs: Feb 23rd [RAT 3](#)

Unit 3.

Chapter 5. Molecular orbitals: general principles. Homonuclear diatomic molecules. Heteronuclear diatomic molecules. Larger molecules.

March 1st, 3rd, 8th, 10th

Learning objectives: Build qualitative molecular orbitals (MO) for small and large molecules

i/tRATs: March 1st [RAT 4](#)

Test 1: Units 1-3, March 15th

Unit 4.

Chapter 6. Acid-base and donor-acceptor properties.

March 17th, 22nd

Learning objectives: Identify hard/soft acids and bases and predict reactivity

i/tRATs: March 17th [RAT 5](#)

Unit 5.

Chapter 9-11. Coordination chemistry. Nomenclature, isomerism, coordination numbers and geometries. Electronic structure. Ligand field theory. Electronic spectra. Reactions and mechanisms.

March 24th, 29th, 31st, April 5th, 7th

Learning objectives: Know the fundamentals of coordination chemistry (nomenclature, isomerism, principles of ligand field theory, MO, ligands, fundamental reactions

i/tRATs: March 24th, April 7th [RATs 6 & 7](#)

Test 2: Units 4-5, April 12th

Unit 6.

Chapter 13-14. Organometallic chemistry and catalysis.

April 14th, 19th, 21st, May 3rd

Learning objectives: Know the fundamentals of organometallic chemistry (counting electrons, ligands, fundamental reactions and principles of homogeneous catalysis).

i/tRATs: April 19th, May 3rd [RATs 8 & 9](#)

Unit 7

Chapter 7. The crystalline solid state.

May 5th, 10th

Learning objectives: Know the principles of solid-state chemistry (ionic solids, thermodynamics of ionic crystal formation, metallic bonding, conductance of metals, silicates)

i/tRATs: May 5th [RATs 10](#)

Unit 8.

Chapter 16. Elements of bioinorganic and environmental chemistry.

Green Chemistry (materials provided by Prof. Contel)

May 12th, 17th

Learning objectives: Know the fundamentals of bioinorganic, environmental and green chemistry (representative examples of bioinorganic compounds and their actions, examples of the environmental effects of both metals and non-metals, principles of green chemistry)

Tests 3: Units 6-8, Tentative May 24th

University's policy on Academic Integrity:

The faculty and administration of Brooklyn College support an environment free from cheating and plagiarism. Each student is responsible for being aware of what constitutes cheating and plagiarism and for avoiding both. The complete text of the CUNY Academic Integrity Policy and the Brooklyn College procedure for implementing that policy can be found at this site: <http://www.brooklyn.cuny.edu/bc/policies>. If a faculty member suspects a violation of academic integrity and, upon investigation, confirms that violation, or if the student admits the violation, the faculty member MUST report the violation.

Information about the Center for Student Disability Services:

In order to receive disability-related academic accommodations students must first be registered with the Center for Student Disability Services. Students who have a documented disability or suspect they may have a disability are invited to set up an appointment with the Director of the Center for Student Disability Services, Ms. Valerie Stewart-Lovell at 718-951-5538. If you have already registered with the Center for Student Disability Services please provide your professor with the course accommodation form and discuss your specific accommodation with him/her.

Important dates (deadlines) in Spring 2016 (undergraduate students)

February 4	Thursday	Last day to add a course/ Last day to file for elective course Pass/Fail
February 9	Tuesday	Conversion Day; Classes follow a Friday Schedule
February 12	Friday	Lincolns Birthday - College is closed
February 15	Monday	Last day to apply for Spring 2016 Graduation (June 1) President's Day - College is closed
February 18	Friday	Last day to drop a course without a grade
March 23rd	Wednesday	Classes follow Monday schedule
April 11	Monday	Last day to withdraw from a course with a W (non-penalty) grade
April 15	Tuesday	Last day to resolve Fall 2015 and Winter 2016 incomplete grade (INC)
April 22-30	Friday-Saturday	Spring Recess
May 15	Sunday	Last day to file for Summer (September 1) graduation.
May 19	Thursday	Reading Day or Final Examinations
May 20-29	Saturday-Friday	Final Examinations - Day/Evening
May 28	Saturday	End of Spring Term

Important dates (deadlines) in Spring 2016 (graduate students)

February 4	Thursday	Last day to add a course
February 9	Tuesday	Conversion Day; Classes follow a Friday Schedule
February 12	Friday	Lincolns Birthday - College is closed
February 15	Monday	Last day to apply for Spring 2016 Graduation President's Day - College is closed
February 18	Friday	Last day to drop a course without a grade
February 26	Friday	Last day to apply for the Language and Comprehensive Exams
March 23rd	Wednesday	Classes follow Monday schedule
April 6	Wednesday	Language Exams
April 11	Monday	Last day to withdraw from a course with a W (non-penalty) grade
May 2	Monday	Last day to resolve Fall 2015 and Winter 2016 incomplete grade (INC)
May 5	Thursday	Comprehensive Exams for Sabbath Observers
April 22-30	Friday-Saturday	Spring Recess
May 6	Friday	Last day to file approved thesis
May 7	Saturday	Comprehensive Exams
May 15	Sunday	Last day to file for Summer (September 1) graduation.
May 19	Thursday	Reading Day or Final Examinations

May 20-29	Saturday-Friday	Final Examinations - Day/Evening
May 28	Saturday	End of Spring Term/ Last day to file for Maintenance of Matriculation

YOUR NAME: _____

**TEAM-BASED LEARNING
MIDTERM PEER FEEDBACK
NOT GRADED**

Team: _____

Colleague you are evaluating: _____

PART ONE: QUANTITATIVE ASSESSMENT (CHECK *ONLY ONE BOX* FOR EACH OF THESE 12 ITEMS)

COOPERATIVE LEARNING SKILLS:	NEVER	SOMETIMES	OFTEN	ALWAYS
Arrives on time and remains with team during activities				
Demonstrates a good balance of active listening & participation				
Asks useful or probing questions				
Shares information and personal understanding				

SELF-DIRECTED LEARNING:	NEVER	SOMETIMES	OFTEN	ALWAYS
Is well prepared for team activities				
Shows appropriate depth of knowledge				
Identifies limits of personal knowledge				
Is clear when explaining things to others				

INTERPERSONAL SKILLS:	NEVER	SOMETIMES	OFTEN	ALWAYS
Gives useful feedback to others				
Accepts useful feedback from others				
Is able to listen and understand what others are saying				
Shows respect for the opinions and feelings of others				

PART TWO: QUALITATIVE ASSESSMENT (FOR EACH ITEM, WRITE *AT LEAST ONE* SENTENCE, BUT *NOT MORE THAN THREE* SENTENCES)

1) What is the single most valuable contribution this person makes to your team?

2) What is the single most important way this person could alter his/her behavior to more effectively help your team?

TEAM-BASED LEARNING FINAL PEER EVALUATION GRADED

At the end of the term, it is necessary for all members of this class to assess the contributions that each member of the team made to the work of the team. This contribution should presumably reflect your judgment of such things as:

Preparation - Were they prepared when they came to class?

Contribution - Did they contribute productively to group discussion and work?

Respect of others' ideas - did they encourage others to contribute their ideas?

Flexibility - Were they flexible when disagreements occurred?

It is important that you raise the evaluation of people who truly worked hard for the good of the team and lower the evaluation of those you perceived not to be working as hard on team tasks.

Evaluate the contributions of each person in your team except yourself, by distributing 100 points among them. *Include comments for each person.*

Team #:	Points Awarded:
1. Teammate's Name: a. In what ways was your teammate MOST helpful to the team? b. In what ways could your teammate improve to be more effective?	
2. Teammate's Name: a. In what ways was your teammate MOST helpful to the team? b. In what ways could your teammate improve to be more effective?	
3. Teammate's Name: a. In what ways was your teammate MOST helpful to the team? b. In what ways could your teammate improve to be more effective?	
4. Teammate's Name: a. In what ways was your teammate MOST helpful to the team? b. In what ways could your teammate improve to be more effective?	

Your Name:	Total Points =	100
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Readiness Assessment Test Appeals Instructions

Purposes of the appeals process:

1. Clarify uncertainty about your understanding of the concepts.
2. Give additional recognition and credit when “missing” a question was caused by:
 - a. Ambiguity in the reading material
 - b. Disagreement between the reading material and our choice of the correct” answer
 - c. Ambiguity in the wording of the question

Guidelines for preparing successful appeals:

Appeals are granted when they demonstrate that you understood the concept(s) but missed the question anyway or that your confusion was due to ambiguity in the reading. As a result:

1. If the appeal is based on ambiguity in the question, you should:
 - a. Identify the source of the ambiguity in the question and,
 - b. Offer an alternative wording that would have helped you to avoid the problem.
2. If the appeal is based on either inadequacies in the reading material or disagreement with our answer, you should:
 - a. State the reason(s) for disagreeing with our answer and,
 - b. Provide specific references from the reading material to support your point of view.

Impact of appeals on test scores:

When an appeal is accepted on a question that a team has missed (no individual appeals will be accepted):

1. It counts. In other words, the points missed will be added to:
 - a. their team score;
 - b. the score of any individual in the team who answered the same as the team;
 - c. only those teams that appeal.
2. Team member(s) who had the original correct answer will continue to receive credit on the question.

Readiness Assessment Test Appeal

APPEAL– RE-WRITE OF BAD QUESTION (TEAMS ONLY) – TEAM # _____

QUESTION # _____

Guidelines for preparing successful appeals:

Appeals are granted when they demonstrate that you understood the concept(s) but missed the question anyway or that your confusion was due to inadequacies in either the question or the reading material.

For appeals based on AMBIGUITY OF THE QUESTION, you should:

1. Identify the source of ambiguity in the question and,
2. Offer an alternative wording that would have helped you to avoid the problem.

In the space below, re-write the question so that it is a better one:

APPEAL– BASED ON CONTENT ISSUES (TEAMS ONLY) – TEAM # _____

QUESTION # _____

PROPOSED CORRECT ANSWER _____

Guidelines for preparing successful appeals:

Appeals are granted when they demonstrate that you understood the concept(s) but missed the question anyway or that your confusion was due to inadequacies in either the question or the reading material.

For appeals based on CONTENT, you should:

1. State the reason(s) for disagreeing with our answer and,
2. Provide specific references from the reading material to support your point of view.

In the space below, explain, with references from the readings if possible, why you feel your selected response was the BEST one.