**Azusa Pacific University**

**College of Liberal Arts and Sciences**

**Department of Biology and Chemistry**

**Course Instruction Plan**

**CHEM 461 ⋅ Inorganic Chemistry ⋅ 3 Units**

**Fall 2022**

Monday, Wednesday, Friday 9:20 am – 10:15 am, TBD

**APU Mission Statement:**

Azusa Pacific University is as an evangelical Christian community of disciples and scholars who seek to advance the work of God in the world through academic excellence in liberal arts and professional programs of higher education that encourage students to develop a Christian perspective of truth and life.

**Department Mission Statement:**

The Department of Biology and Chemistry serves God through the integration of a Christian perspective into the disciplines of biology and chemistry, providing an environment in which students can develop a Christian worldview and learn to integrate their faith into their lives as scientists, and prepare for success in further studies and/or their chosen careers.

**Instructor:**

Dr. Jennifer Young, Associate Professor

Office: Segerstrom 302

Phone: Ext. 6517

Office Hours: TBD, and by appointment

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**Course Description:**  
This course lays a foundation in the subjects of atomic structure, bonding theory, symmetry theory, and acid-base chemistry, which is then used to explore advanced topics involving crystalline compounds, coordination compounds, and organometallic compounds. Topics include bonding, spectroscopy, and kinetics.

**Prerequisite:** C- in CHEM 252

**Credit Hour Policy:**

Following the APU Credit Hour policy, to meet the identified student learning outcomes of this course, the expectations are that this 3 unit course, delivered over a 15 week term will approximate:

2.83 hours/week classroom or direct faculty instruction. In addition, out-of-class work will approximate a minimum of 6 hours each week.

**Student Learning Outcomes:**

1. Demonstrate knowledge of the fundamental facts and concepts of inorganic chemistry.
   1. Describe the electronic configuration and periodic properties of an atom.
   2. Use VSEPR Theory to predict 3D geometries and polarity of molecules.
   3. Determine symmetry elements and point groups for molecules and appropriate applications for group theory.
   4. Draw molecular orbitals and use them to relate to structure and bonding of a molecule.
   5. Distinguish between Bronsted-Lowry and Lewis acids and bases.
   6. Use hard-soft acid-base theory to predict solubilities and bonding properties of elements.
   7. Identify structures of the crystalline solid state and calculate crystal lattice energies.
   8. Name coordination compounds using IUPAC naming rules.
   9. Draw and distinguish between coordination compound isomers.
   10. Describe metal and ligand bonding interactions.
   11. Interpret electronic spectra.
   12. Describe common techniques to characterize inorganic compounds and interpret data from these techniques.
2. Apply facts and concepts to solve inorganic chemistry problems.
3. Critically analyze peer-reviewed journal articles and summarize findings.
4. Reflect on and analyze the significance and overlap of a Christian worldview within the scientific community.

By the end of the course, students should be able to demonstrate mastery of the following learning outcomes. The IDEA objectives that are linked to the learning outcomes and the class assignments that will be used to assess mastery of the learning outcomes are organized in the following table.

|  |  |  |
| --- | --- | --- |
| **Student Learning Outcome** | **IDEA Objective** | **Assignments Used to Assess** |
| Demonstrate knowledge of the fundamental facts and concepts of inorganic chemistry. | Gaining a basic understanding of the subject (e.g. factual knowledge, methods, principles, generalizations, theories) | Exams #1-3, Homework, Group Assignments, Reading Assignments |
| Apply facts and concepts to solve inorganic chemistry problems. | Learning to apply course materials (to improve rational thinking, problem solving and decisions). | Exams #1-3, Homework, Group Assignments, Reading Assignments |
| Critically analyze peer-reviewed journal articles and summarize findings. | Learning to apply course materials (to improve rational thinking, problem solving and decisions). | Group Assignments, Final Paper |
| Reflect on and analyze the significance and overlap of a Christian worldview within a scientific community. | Learning to apply course materials (to improve rational thinking, problem solving and decisions). | Faith Integration Assignment |

**Course Materials:**

***Principles of Inorganic Chemistry*** by Brian W. Pfennig, 1st Edition, Wiley, 2015, ISBN: 978-1-118-85910-0 OR 2nd Edition, Wiley, 2021, ISBN: 978-1-119-65032-4/ 978-1-119-65033-1

Periodic table (any source or format)

Scientific calculator

Molecular model kit (recommended)

Handouts: provided in class or online for download/printing

**Course Activities, Assignments, and Assessments:**

1. *Exams.* There will be a total of three exams (120 points each) and one final exam (150 points). The exams will cover material presented in lecture, assigned reading from the textbook, and homework problems. The exams may have an in-class component and take-home component. Additional resources, such as notes, can be used on take-home exams but help from other people is not allowed. In-class exams are taken on the specified date on the course schedule. Take-home exams are due at the specified date and time on Canvas. Late exams are not accepted! If there is some extenuating circumstance preventing you from completing the exam in the allotted time, discuss this with the professor immediately.
2. *Homework.* Homework assignments will be posted on Canvas. While working with classmates on the homework assignments is encouraged, each student must turn in their own work to the assignment, written legibly. Homework assignments may be turned in as a hard copy (in class) or digital copy (uploaded to Canvas). Due dates and times are indicated on Canvas. Any assignment turned in late will lose 10% of the total points each day the assignment is late. It is essential that you start the homework assignments as soon as possible to allow you time to effectively work through the problems and avoid last minute errors. The assignments will be graded for completeness and several random or all problems will be selected and graded for correctness.
3. *Group/Pair Assignments.* Students will be expected to participate in class discussions and group/pair work as assigned. Group/Pair assignments will be graded for correctness. It is imperative that all members of a group/pair actively participate in the discussion and help provide answers to the given problems. Each group/pair member will receive the same grade on the assignment so everyone in the group/pair is accountable for the group’s/pair’s performance. All group/pair members’ names must be on the assignment for each individual to receive credit. All assignments should be written legibly and may be turned in as a hard copy (in class) or digital copy (uploaded to Canvas). Class time may be devoted to working on group/pair assignments. Due dates and times are indicated on Canvas. Any assignment turned in late will lose 10% of the total points each day the assignment is late.
4. *Textbook Reading.* Students are expected to actively read the textbook prior to the material covered in class as this will help in learning the course material and allow students to be prepared for in-class discussions. Not all content and details provided in the textbook can be covered in class, so it is imperative to read the textbook for enhanced understanding of the course content. Textbook reading assignments are provided on the course calendar.
5. *Final Paper Assignment.* This is a “mini” literature research and review paper. The point of this assignment is to allow the student to find a topic of personal interest within the inorganic field and survey some of the literature within that topic. The desired outcome of this paper assignment is to give the student practice in reading, analyzing, and summarizing peer-reviewed journal publications and to hopefully learn in more detail about current inorganic research and characterization techniques. Guidelines for the paper:

* The paper will contain the following sections: title, introduction, body, conclusion, and references; typed, single or double-spaced
* A minimum of three journal articles discussing research in the inorganic field must be analyzed and summarized. All journal articles should have been published in the past 10 years in the journal *Inorganic Chemistry* (pubs.acs.org).
* References should be provided in ACS style and in-text citations should occur by ACS style (superscripted numbers).
* Direct quotations from the journal articles are not permitted. All information from the papers should be appropriately re-worded, summarized, and cited.
* Avoid the use of first person. Write in scientific language and be sure to pay attention to grammar.
* The use of figures is encouraged; therefore, you must include at least 2 figures in your paper. You may use a figure from the journal article as long as it is properly cited. All figures should be labeled underneath the figure as: Figure #. Figure caption.
* Schedule:

Selection of three articles and instructor approval: November 4

First Draft: December 2

Peer Review: December 9

Final Draft: December 16, 5:00pm

1. *Faith Integration Assignment.* In this assignment, students will read an excerpt from the book *Science and Grace: God’s Reign in the Natural Sciences* by Don Petcher and Tim Morris. Each student will be provided several thought questions/prompts about the practical work of a scientist and how being a Christian integrates with that type of work. Each student will be graded on the completeness and genuineness of their answers to the provided prompts. Additionally, students will have an opportunity to discuss their thoughts centered around these prompts in discussion with their classmates using the Canvas Discussions tool.

**Grading:**

Grades will be based on the items listed below.

Activity Points *Grading scale for the course:*

Exams (3 x 120 pts) 360

|  |  |  |  |
| --- | --- | --- | --- |
| A | 93-100% | C | 73-76.9% |
| A- | 90-92.9% | C- | 70-72.9% |
| B+ | 87-89.9% | D+ | 67-69.9% |
| B | 83-86.9% | D | 63-66.9% |
| B- | 80-82.9% | D- | 60-62.9% |
| C+ | 77-79.9% | F | 0-59.9% |

Final Exam 150

Homework Sets 100

In-Class/Group Assignments 70

Final Paper 80

Faith Integration 40

TOTAL 800

The criteria used to calculate assignments and final grades:

|  |  |
| --- | --- |
| A | Superior knowledge regarding details, assumptions, implications, history; superior thinking with information relevant to application, critique, and relationship to other information. |
| B | More than adequate knowledge regarding technical terms, distinctions, and possesses an ability to use information. |
| C | Basic knowledge needed to function and carry on learning regarding major principles, central terms, major figures, also possesses an awareness of field or discipline. |
| D | Serious gaps in knowledge, confusion of concepts and categories, inability to recall basic information. |
| F | Absence of knowledge, incapable of carrying on a conversation about the subject, misunderstands most concepts, confuses all categories***.*** |

**Course Policies:**

1. *Attendance.* Attendance is expected by both the university and me. Class time will include material and activities that are intended to increase your understanding of the material. In the event that you miss a class, it is your responsibility to make up all assignments and obtain all information presented from a classmate before coming to the next class. If there is a foreseeable conflict, please discuss your absence with the instructor in advance.
2. *Late Assignments.* Any assignment turned in late will lose 10% of the total points each day the assignment is late.
3. *Exams.* There will be a total of three exams (in-class and take-home components) and one final exam. Cell phones, tablets, and laptops will not be permitted during in-class exams. Additional resources, such as notes, can be used on take-home exams but help from other people is not allowed. Late take-home exams are not accepted! If there is some extenuating circumstance preventing you from completing the exam in the allotted time, discuss this with the professor immediately. Make-ups for in-class exams are allowed according to the following:
   1. Make-up Exams due to an emergency. An exam may only be made up if the student has a valid excuse for missing, such as illness or injury. It is the student’s responsibility to contact the instructor within 24 hours of when the test is missed to discuss the situation and schedule a make-up time.
   2. Make-up Exams due to school activities. If a student must miss an exam due to field trips, sports events, or similar activities (with a valid university excuse), the student must discuss the situation with the instructor at least one week before the scheduled test day to make arrangements to make up the exam.
4. *Make-Up or Extra Credit Work*. No extra credit or make-up work (except in situations where there is instructor approval) will be given or granted. In particular, no extra credit work or make-up work will be given to change or improve a grade at any time during the semester or at the end of the semester.
5. *Requesting an Incomplete.* Students may request an incomplete only under special, extenuating circumstances and if the student’s work is of passing quality. An incomplete is under the discretion of the professor and the department. Students should discuss the possibility of an incomplete with the instructor, should circumstances warrant it.
6. *Electronic Devices.* Use of cell phones, tablets, laptops, etc. during class, except as a note taking device, calculator or clock is prohibited. Use of cell phones, etc. during exams for any purpose is prohibited. Cell phones and other devices must be stowed so they are not visible throughout the exam.
7. *Classroom Decorum.* A positive engaged learning environment is to be maintained during lecture. The lecture professor expects mutual respect and freedom from distraction for all involved in the learning process. This includes browsing the internet, texting, and IM/DM chatting during class which should be avoided. Questions in class pertaining to the material are encouraged and will be answered, as time permits.
8. *Outside of Class.* You are encouraged to use any resources available to help facilitate your understanding of the material and success in this class. This includes meeting with the instructor during office hours to ask questions.

**Academic Integrity:**

The mission of Azusa Pacific University includes cultivating in each student not only the academic skills that are required for a university degree, but also the characteristics of academic integrity that are integral to a sound Christian education. It is therefore part of the mission of the university to nurture in each student a sense of moral responsibility consistent with the biblical teachings of honesty and accountability. Furthermore, a breach of academic integrity is viewed not merely as a private matter between the student and an instructor but rather as an act, which is fundamentally inconsistent with the purpose and mission of the entire university. A complete copy of the Academic Integrity Policy is available in the Office of Student Life, the Office of the Vice Provost for Undergraduate Programs, and online.

Expectations for this course regarding academic integrity in this class are consistent with those outlined in the academic integrity policy with the clarifications below.

*Depending on the offense, the following consequences may result:*

* The maximum points for the activity may be subtracted from the student’s grade
* The student may receive an automatic “F” in the class
* The student will be reported to the Vice Provost for Undergraduate Programs

***Cheating, fabrication, and plagiarism*** (each a form of academic dishonesty) are serious breaches of academic integrity. It is the student’s responsibility to become familiar with the descriptions of these offenses in the Academic Integrity Policy. Academic dishonesty, or facilitating it, will lead to the penalties described above, and the incident will also be reported to the Dean and may lead to further penalties. Treating academic dishonesty seriously is appropriate for an evangelical Christian community such as Azusa Pacific University, and encourages a Christian perspective on truth.

*Policies on working with others:* Working with other students does not necessarily constitute academic dishonesty. Indeed, working with other students can help reinforce concepts and skills. Forming, and working within, a study group is itself a skill that each student should master while at college. Following are examples of activities in this class that could be done in a group, while not constituting academic dishonesty.

* Working through homework assignments,
* Working through an in-class assignment,
* Participating in a workshop exercise,
* Studying for exams.

Following are examples of activities that should not be done in a group, or with another student, and which would constitute academic dishonesty.

* Copying another student’s homework, paper, or other work,
* Looking at another student’s work while taking a quiz, exam, or test.
* Presenting someone else’s work as your own (plagiarism).

The instructor is available for clarification if you are not sure whether working with other students on a given assignment is academic dishonesty.

**Support Services Policy:**

Students in this course who have a disability that might prevent them from fully demonstrating their abilities should meet with an advisor in Accessibility and Disability Resources as soon as possible to initiate disability verification and discuss reasonable accommodations that will allow the opportunity for full participation and for successful completion of course requirements. For more information, please contact Accessibility and Disability Resources by phone at 626-815-3849, or email at disabilityservices@apu.edu.

**Diversity Statement:**

Affirming that diversity is an expression of God’s image, love, and boundless creativity, it is the University’s aim to collectively nurture an environment that respects each individual’s uniqueness while celebrating our collective commonalities. It is in this spirit that we collectively strive to create an inclusive environment in which all students, staff, faculty, and administrators thrive.

Azusa Pacific University encourages community members to resolve conflict directly, when possible. If an APU community member perceives that hostile words or behaviors were directed toward an individual or a group based on that individual’s or the group’s identity, they can submit a Bias Incident Report. Information on the reporting process is available on the website at <https://www.apu.edu/diversity/bias/>.

**Copyright Policy:**

Materials used in connection with this course may be subject to copyright protection. Students and faculty are both authors and users of copyrighted materials. As a student, you must know the rights of both authors and users with respect to copyrighted works to ensure compliance. It is equally important to be knowledgeable about legally permitted uses of copyrighted materials. Information about copyright compliance, fair use and websites for downloading information legally can be found at <https://apu.libguides.com/c.php?g=720915>

**University Policies Statement:**

All university and departmental policies affecting student work, appeals, and grievances, as outlined in the Undergraduate Catalog and/or Department Handbook will apply, unless otherwise indicated in this syllabus.

**The Library and Information Literacy:**

During this course, students may fulfill assignments by:

* Finding research help face-to-face, by phone, or email from librarians at one of the University’s Libraries [apu.edu/library/help](http://apu.edu/library/help)
* Chatting online with librarians 24/7 at [apu.edu/library/help/asknow/chat](http://apu.edu/library/help/asknow/chat)
* Making appointments with subject matter specialist librarians at [apu.edu/library/help/specialists](http://apu.edu/library/help/specialists)
* Accessing the online library at [apu.edu/library](http://apu.edu/library)
* Viewing self-paced tutorials at apu.edu/library/help/tutorials and help guides at [apu.libguides.com](http://apu.libguides.com/)

During this course, students may develop information literacy by:

* Thinking critically to find, access, and engage appropriate resources
* Identifying how information in this course’s discipline is produced and valued
* Conducting quality research activities, even to create new knowledge
* Participating ethically in this course’s community of learning

For more information, see information literacy tutorials at [apu.edu/library/help/tutorials](http://apu.edu/library/help/tutorials)

\*Framework for Information Literacy for Higher Education, Association of College and Research Libraries (2015). Available at: [ala.org/acrl/standards/ilframework](http://ala.org/acrl/standards/ilframework)

**Emergency Policy:**

It is highly recommended that you leave the class title, room and building location, and the

APU campus phone number (626) 969-3434 with family and/or other contacts if you wish to

be notified in case of an emergency.

**Faith Integration Statement:**

Academic Faith Integration is recognized as an important feature of courses at Azusa Pacific University. Students can expect to discover how relevant themes from their coursework and themes from the Christian faith meaningfully inform each other. Although faith integration is central to the mission of APU, instructors respectfully recognize that students come from a diversity of faith backgrounds and that they have a variety of perspectives.

**Bibliography:**

* Introduction to Inorganic Chemistry WikiBooks, <https://en.wikibooks.org/wiki/Introduction_to_Inorganic_Chemistry>
* *Inorganic Chemistry*, by Gary L. Miessler, Paul J. Fischer, and Donald A. Tarr, 5th Edition, Pearson
* Symmetry Resources at Otterbein University, <http://symmetry.otterbein.edu/>

**Course Schedule:**

The following schedule is subject to modification at the discretion of the instructor. Assigned reading corresponds to the textbook chapter and should be completed before the material is covered in class.

|  |  |  |  |
| --- | --- | --- | --- |
| **Date** | **Day** | **Lecture Topic** | **Text Section**  **(1st ed./*2nd ed.*)** |
| 8/29 | M | Introduction, Atomic Structure | 4.1-4.3/ *2.12-3.3* |
| 8/31 | W | Atomic Structure, Effective Nuclear Charge | 4.3-4.4, 4.6/ *3.4-3.5* |
| 9/2 | F | Periodic Properties | 5.1-5.4, 5.11/ *3.6-3.9, 3.12* |
| 9/5 | M | ***No Class (Labor Day holiday)*** |  |
| 9/7 | W | Periodic Properties | 5.1-5.4, 5.11/ *3.6-3.9, 3.12* |
| 9/9 | F | Lewis Dot Structures | 6.1-6.4/ *4.1-4.6* |
| 9/12 | M | Lewis Dot Structures | 6.1-6.4, 6.5/ *4.1-4.6, 4.7* |
| 9/14 | W | Molecular Geometry | 7.1-7.3/ *5.1-5.5* |
| 9/16 | F | Molecular Geometry | 7.1-7.3/ *5.1-5.5* |
| 9/19 | M | Catch-Up/Review |  |
| 9/21 | W | Molecular Symmetry | 8.1-8.3/ *6.1-6.3* |
| 9/23 | F | ***EXAM 1 (*Chp. 4-7/ *2-5*)** |  |
| 9/26 | M | Molecular Symmetry | 8.1-8.3/ *6.1-6.3* |
| 9/28 | W | Molecular Symmetry | 8.4-8.7/ *6.4-6.7* |
| 9/30 | F | Molecular Symmetry | 8.4-8.7/ *6.4-6.7* |
| 10/3 | M | Molecular Orbitals | 10.1-10.2/ *7.1-7.3.4* |
| 10/5 | W | Molecular Orbitals | 10.1-10.2/ *7.1-7.3.4* |
| 10/7 | F | Molecular Orbitals | 10.2-10.5/ *7.3-7.4* |
| 10/10 | M | Molecular Orbitals | 10.2-10.5/ *7.3-7.4* |
| 10/12 | W | Molecular Orbitals | 10.2-10.5/ *7.3-7.4* |
| 10/14 | F | Molecular Orbitals | 10.2-10.5/ *7.3-7.4* |
| 10/17 | M | Molecular Orbitals | 10.2-10.5/ *7.3-7.4* |
| 10/19 | W | Experimental Techniques | Handout on Canvas |
| 10/21 | F | ***EXAM 2* (Chp. 8, 10/ *6-7*)** |  |
| 10/24 | M | Crystalline Solid State | 11.1-11.3/ *8.1-8.2* |
| 10/26 | W | Ionic Solids | 12.1-12.3/ *8.3-8.4* |
| 10/28 | F | Ionic Solids, Lattice Enthalpies | 12.1-12.3/ *8.3-8.4* |
| 10/31 | M | Born-Haber Cycle, Acids and Bases | 14.1-14.3/ *9.1-9.3* |
| 11/2 | W | Acids and Bases | 14.1-14.3/ *9.1-9.3* |
| 11/4 | F | Coordination Compounds: Nomenclature | 15.1-15.3/ *10.1* |
| 11/7 | M | Coordination Compounds: Nomenclature | 15.1-15.3/ *10.1* |
| 11/9 | W | Coordination Compounds: Isomerism | 15.1-15.3/ *10.1* |
| 11/11 | F | Coordination Compounds: Isomerism | 15.1-15.3/ *10.1* |
| 11/14 | M | Coordination Compounds: Ligand Field Theory | 16.1-16.3/ *10.2* |
| 11/16 | W | Coordination Compounds: Ligand Field Theory | 16.1-16.3/ *10.2* |
| 11/18 | F | ***EXAM 3* (Chp. 11, 12, 14, 15/ *8, 9, 10.1*)** |  |
| 11/21 | M | ***No Class (Thanksgiving Holiday)*** |  |
| 11/23 | W | ***No Class (Thanksgiving Holiday***) |  |
| 11/25 | F | ***No Class (Thanksgiving Holiday***) |  |
| 11/28 | M | Coordination Compounds: Spectrochemical Series | 16.1-16.3/ *10.2* |
| 11/30 | W | Coordination Compounds: Magnetism | 15.6/ *10.3.8* |
| 12/2 | F | Term Symbols | 4.5, 16.5/ *10.3.1* |
| 12/5 | M | Term Symbols | 4.5, 16.5/ *10.3.1* |
| 12/7 | W | Tanabe-Sugano Diagrams, Electronic Spectra | 16.6-16.7/ *10.3* |
| 12/9 | F | Tanabe-Sugano Diagrams, Electronic Spectra | 16.6-16.7/ *10.3* |
| 12/12-12/16 | TBA | **Comprehensive Final Exam** |  |

**Final Paper due Friday, December 16 by 5:00pm**