LSC Use Only Proposal No: LSC Action-Date:	*UWUCC Use Only* Proposal No: 12-24a. UWUCC Action-Date: AP 9/4/12 Senate Action Date: App-10/9/12

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person(s) **Wendy Elcesser**	Email Address **endyw@iup.edu**
Proposing Department/Unit **Chemistry**	Phone 72362

Check all appropriate lines and complete all information. Use a separate cover sheet for each course proposal and/or program proposal.

1. Course Proposals (check all that apply)

_____ New Course _____ Course Prefix Change _____ Course Deletion

__X__ Course Revision _____ Course Number and/or Title Change __X__ Catalog Description Change

Current course prefix, number and full title: *CHEM 214 Intermediate Inorganic Chemistry*

Proposed course prefix, number and full title, if changing: _____ *I*

2. Liberal Studies Course Designations, as appropriate

_____ This course is also proposed as a Liberal Studies Course (please mark the appropriate categories below)

_____ Learning Skills _____ Knowledge Area _____ Global and Multicultural Awareness _____ Writing Intensive (include W cover sheet)

_____ Liberal Studies Elective (please mark the designation(s) that applies – must meet at least one)

_____ Global Citizenship _____ Information Literacy _____ Oral Communication

_____ Quantitative Reasoning _____ Scientific Literacy _____ Technological Literacy

3. Other Designations, as appropriate

_____ Honors College Course _____ Other: (e.g. Women's Studies, Pan African)

4. Program Proposals

_____ Catalog Description Change _____ Program Revision _____ Program Title Change _____ New Track

_____ New Degree Program _____ New Minor Program _____ Liberal Studies Requirement Changes _____ Other

Current program name: _____

Proposed program name, if changing: _____

5. Approvals	Signature	Date
Department Curriculum Committee Chair(s)		4/11/12
Department Chairperson(s)		4/11/12
College Curriculum Committee Chair		4/20/12
College Dean		4/20/12
Director of Liberal Studies (as needed)		
Director of Honors College (as needed)		
Provost (as needed)		
Additional signature (with title) as appropriate		
UWUCC Co-Chairs	Gail S Sechrist	9/24/12

Received
SEP 24 2012
Liberal Studies

Received
APR 20 2012
Liberal Studies

Part II. Description of Curriculum Change

1. New Syllabus of Record

I. Catalog Description

CHEM 214 Intermediate Inorganic Chemistry (2c-3l-3cr)

Prerequisites: CHEM 112 or 114 (or permission of instructor)

An in-depth study of inorganic compounds beyond what is presented in general chemistry. Topics will include Lewis structures and Lewis acid-base chemistry, an introduction to inorganic solids, coordination compounds and bioinorganic chemistry. Provides a foundational understanding of inorganic chemistry to allow students to begin research and prepare for upper-level courses.

II. **Course Outcomes:** Upon successful completion of this course, the student will be able to:

1. List trends inherent in the arrangement of the elements on the periodic table
2. Draw correct Lewis structures of inorganic compounds and ions, and derive information from these structures.
3. Apply the essentials of molecular orbital theory to construct basic molecular orbital diagram
4. Describe the basic structural motifs in the solid state.
5. Calculate quantitative aspects of acid-base and redox chemistry.
6. Explain the basic aspects of coordination chemistry.
7. Discuss how the principles of inorganic chemistry can be applied to biochemical compounds.

III. **Course Outline** (allows two sessions for exams):

A. Atomic Structure and Periodic Trends (2 hours)
Spectra and orbitals, ionization energy, electron affinity, shielding and effective nuclear charge.

B. Covalent Molecular Structures (5 hours)
Valence bond theory (hybridization, σ, π, bonds) molecular orbital theory (homo- and hetero-nuclear diatomics).

C. Solid-State Materials (4 hours)
Close packing in metals and metal compounds, metallic bonding, band theory, magnetic properties, conductivity, semiconductors, insulators, and defects. Packing in ionic compounds including radius ratios for placement of ions.

D. Main Group Elements (3 hours)
Synthesis, structure, physical properties, variations in bonding motifs, acid-base character, and reactivities of the elements and their compounds.

E. Redox Chemistry (2 hours)
Oxidation numbers, terminology, periodic trends, equations, half-reactions; Latimer, Frost, and Pourbaix diagrams.

F. Transition Elements and Coordination Chemistry. (6 hours)
Ligands, coordination number, stereochemistry, bonding motifs, nomenclature, crystal field theory.
G. Bioinorganic Chemistry (4 Hours)
(Remaining 2 hours reserved for exams) (2 Hours)
H. Final Examination (during the Final Examination Period) (2 Hours)

Suggested Laboratory Outline

1. Introduction, Check-In and Safety
2. Periodic Properties.
3. MO Calculations of Small Molecules.
4. The Solid State: Packing Patterns
5. The Solid State: X-Ray Diffraction Studies.
6. Group 13 Elements and the Synthesis of Alum.
7. Group 14 Chemistry.
8. Synthesis of SbI_x.
9. Halogens.
10. Oxidation and Reduction (Redox)
11. Synthesis and Properties of Coordination Compounds and Complexes, Part I.
12. Synthesis and Properties of Coordination Compounds and Complexes, Part II.
13. Bioinorganic Chemistry.
14. Check-Out.

IV. Evaluation Methods:

2 exams @ 100 pts	200 pts. (33.3%)
Selected Assignments (quizzes, problem sets, etc)	100 pts. (16.7%)
Laboratory Reports	150 pts. (25.0%)
Final Exam	150 pts. (25.0%)
Total points	600 pts. (100.0%)

V. Example Grading Scale:

Grading Scale: A: 90-100%; B: 80-89%; C: 70-79%; D: 60-69%; F: < 60%

VI. Undergraduate Course Attendance Policy:

Attendance is expected for all classes. Individual faculty will include in their syllabus an attendance policy consistent with the Undergraduate Course Attendance Policy in the IUP Undergraduate Catalog.

VII. Required Textbook(s), Supplemental Books and Readings:

Rayner-Canham, G., Overton, T., *Descriptive Inorganic Chemistry, Fifth Edition,* W. H. Freeman , New York (2010)

VIII. Special Resource Requirements:

Safety goggles
Laboratory notebook

IX. Bibliography:

Ellis, A.B.; Geselbracht, M.J.; Johnson B.J.; Lisensky, G.C.; Robinson W.R. *Teaching General Chemistry: A Materials Science Companion*, Oxford University Press, 1998.

Emsley, J. *The Elements*, 3rd ed., Oxford University Press: New York, 1998.

Greenwood, N.N.; Earnshaw, A. *Chemistry of the Elements*, 2nd ed., Butterworth-Heinemann, 1997.

House, J.E.; House, K.A. *Descriptive Inorganic Chemistry,* 2nd ed., Academic Press: San Diego, 2010.

Rayner-Canham, G.; Overton, T. *Descriptive Inorganic Chemistry, Fifth Edition,* W. H. Freeman, New York, 2010.

Rodgers, G.E. *Descriptive Inorganic, Coordination and Solid State Chemistry*, 2nd ed., Brooks/Cole-Thomson Learning: Toronto, Canada, 2002.

Course Analysis Questionnaire

Section A: Details of the Course

A1 How does this course fit into the programs of the department? For what students is the course designed? (majors, students in other majors, liberal studies). Explain why this content cannot be incorporated into an existing course.

Intended for chemistry, biochemistry and chemistry education majors. This course revision updates CHEM 214 to bring it into compliance with new American Chemical Society certification standards (http://portal.acs.org/portal/PublicWebSite/about/governance/committees/training/acsapproved/degreeprogram/WPCP_008491). Although General Chemistry provides the background for what the ACS- Committee for Professional Training (ACS-CPT) calls "foundation courses," it itself is NOT a foundation course. The ACS-CPT requires 3-credit courses in each of the sub-disciplines (analytical, biochemistry, inorganic, organic, and physical chemistry) *beyond* General Chemistry. The current CHEM 214 course is only 2 credits. The additional credit will allow for additional topics to be included, including inorganic biochemistry. This reflects the importance of biologically-related topics in all areas of chemistry, and also our interest in including this course in the biochemistry degree program.

A2 Does this course require changes in the content of existing courses or requirements for a program? If catalog descriptions of other courses or department programs must be changed as a result of the adoption of this course, please submit as separate proposals all other changes in courses and/or program requirements.

Yes – CHEM 214 increase from 2 to 3 credits, and the combination of CHEM 410/411 (Advanced Inorganic Lab/Advanced Inorganic Chemistry) will be replaced by a revised 3-credit CHEM 411. CHEM 214 serves as a "foundation" course in Inorganic Chemistry; CHEM 411 will serve as the "in-depth" course in Inorganic Chemistry

A3 Has this course ever been offered at IUP on a trial basis (e.g. as a special topic) If so, explain the details of the offering (semester/year and number of students). No.

A4 Is this course to be a dual-level course? If so, please note that the graduate approval occurs after the undergraduate.

No.

A5 If this course may be taken for variable credit, what criteria will be used to relate the credits to the learning experience of each student? Who will make this determination and by what procedures?

No variable credit.

A6 Do other higher education institutions currently offer this course? If so, please list examples (institution, course title).

West Chester Univ., CHE 409, Descriptive Inorganic Chemistry
Clarion Univ., CHEM 271, Introductory Inorganic Chemistry
Millersville Univ., CHEM 251, Inorganic Chemistry I
Eastern Illinois Univ., 2310 CHM, Descriptive Inorganic Chemistry
Hamilton College, CHEM 265S, Inorganic Chemistry and Materials

University of Victoria, CHEM 222, Introduction to Inorganic Chemistry
Oberlin College, CHEM 213, Inorganic Chemistry
University of Tennessee at Knoxville, CHEM 230, Inorganic Chemistry

A7 Is the content, or are the skills, of the proposed course recommended or required by a professional society, accrediting authority, law or other external agency? If so, please provide documentation.

Yes. The American Chemical Society's Committee for Professional Training (ACS-CPT) describes what it calls "Foundation Course Work" in the following way: "certified majors must have instruction *equivalent* to a one-semester course of at least three semester credit hours in each of the five major areas of chemistry: analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, and physical chemistry." The ACS-CPT also recommends that "students should be exposed to the principles of macromolecules (biological molecules and materials) across foundation areas, which could then serve as the basis for deeper exploration through in-depth course work or degree tracks." The revised CHEM 214 is a foundation course that would provide students with examples of both biological molecules and materials chemistry while reinforcing and expanding the inorganic knowledge they have gained in General Chemistry. Additionally, the CPT requires a minimum of 400 hours of laboratory work beyond General Chemistry for their certified degree. The laboratory component of the revised CHEM 214 course would provide 42 (3 per week x 14 weeks) of these hours towards the Chemistry B.S. degree.

Section B: Interdisciplinary Implications

B1 Will this course be taught by instructors from more than one department? If so, explain the teaching plan, its rationale, and how the team will adhere to the syllabus of record.

No.

B2 What is the relationship between the content of this course and the content of courses offered by other departments? Summarize your discussions (with other departments) concerning the proposed changes and indicate how any conflicts have been resolved. Please attach relevant memoranda from these departments that clarify their attitudes toward the proposed change(s).

No significant overlap with courses from any other department.

B3 Will this course be cross-listed with other departments? If so, please summarize the department representatives' discussions concerning the course and indicate how consistency will be maintained across departments.

No.

Section C: Implementation

C1 Are faculty resources adequate? If you are not requesting or have not been authorized to hire additional faculty, demonstrate how this course will fit into the schedule(s) of current faculty. What will be taught less frequently or in fewer sections to make this possible? Please specify how preparation and equated workload will be assigned for this course.

Present complement of faculty in the Chemistry Department is adequate.

C2 What other resources will be needed to teach this course and how adequate are the current resources? If not adequate, what plans exist for achieving adequacy? Reply in terms of the following:

Present departmental resources are adequate to teach this course.

C3 Are any of the resources for this course funded by a grant? If so, what provisions have been made to continue support for this course once the grant has expired? (Attach letters of support from Dean, Provost, etc.)

No.

C4 How frequently do you expect this course to be offered? Is this course particularly designed for or restricted to certain seasonal semesters?

Once per year, in the spring semester.

C5 How many sections of this course do you anticipate offering in any single semester?

One lecture and two lab sections.

C6 How many students do you plan to accommodate in a section of this course? What is the justification for this planned number of students?

27– The average number of sophomore students declared as chemistry, biochemistry and chemistry education majors over the past three years is 27 per year. This would require two laboratory sections since the maximum per lab is 24 students due to safety considerations.

C7 Does any professional society recommend enrollment limits or parameters for a course of this nature? If they do, please quote from the appropriate documents.

No.

C8 If this course is a distance education course, see the Implementation of Distance Education Agreement and the Undergraduate Distance Education Review Form in Appendix D and respond to the questions listed.

Not a distance education course.

2. Summary of proposed Revisions

CHEM 214 was expanded from two credits to three credits, with additional course content about symmetry and point groups, molecular orbital theory, term symbols, oxidation-reduction, acid-base chemistry, and bioinorganic chemistry. The course will serve as a more comprehensive foundation course in Inorganic Chemistry than the current version. Course objectives and course outline have been expanded to include the additional content. The recommended text is more current.

3. Justification/Rationale for Change

The American Chemical Society's Committee for Professional Training (ACS-CPT) calls for students to take foundation course work in all five major areas of chemistry, and in-depth course in four of the five area. The ACS-CPT describes what it calls "Foundation Course Work" in the following way: "certified majors must have instruction *equivalent* to a one-semester course of at least three semester credit hours in each of the five major areas of chemistry: analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, and physical chemistry." The revised CHEM 214 provides students with the Foundation Course in Inorganic Chemistry; its content was expanded so that students would graduate with a sufficient background in Inorganic Chemistry should they choose to take their in-depth courses in other subdiscplines of chemistry. The course also prepares them for the Advanced Inorganic course. The expanded content was also guided by the ACS-CPT, which recommends that "students should be exposed to the principles of macromolecules (biological molecules and materials) across foundation areas, which could then serve as the basis for deeper exploration through in-depth course work or degree tracks." The revised CHEM 214 is a foundation course that would provide students with examples of both biological molecules and materials chemistry while reinforcing and expanding the inorganic knowledge they have gained in General Chemistry. Additionally, the CPT requires a minimum of 400 hours of laboratory work beyond General Chemistry for their certified degree. The laboratory component of the revised CHEM 214 course would provide 42 (3 per week x 14 weeks) of these hours Chemistry B.S. degree.

4. Old Syllabus of Record

I. Catalog Description

Course Title: Intermediate Inorganic Chemistry (1c-3l-2sh)
Prefix: CHEM
Number: 214
Hours: 1c-3l-2sh
Prerequisites: CHEM 112 or 114
Description: The course will present the characteristic reactions and compounds of elements from across the periodic table. For the main-group elements, both discrete molecular compounds and non-molecular materials will be discussed. For the alkali, transition and inner-transition metals, the focus will be on non-molecular species such as ionic compounds, ceramics, superconductors and other inorganic-based materials. The solid-state structure of inorganic-based materials will also be presented. Laboratory activities will be used to

reinforce concepts presented in lecture, and to stimulate interest through discovery-based exercises

II. **Objectives:** Upon successful completion of this course, the student will:
1) know trends inherent in the arrangement of the elements on the periodic table as a basis for understanding the descriptive chemistry of the elements
2) know the characteristic properties and reactions of the main-group elements.
3) know the characteristic compounds of the main-group elements.
4) be able to identify the basic structural motifs in the solid state.
5) understand the essential features of electron flow in inorganic materials.
6) understand the essential relationships between composition and properties in inorganic materials.
7) be able to apply principles learned in lecture to laboratory experiments, so that they can qualitatively and quantitatively analyze empirical data and explain its significance.

III. **Detailed Course Outline: (Midterm exam given during lab period)**
1) Periodic Trends (1 hour)
2) Compounds and reactions involving the elements of: (6 hours)
   a) Groups 1 and 2: The alkali and alkaline earth metals
   b) Group 13: Boron, aluminum, and beyond
   c) Group 14: Carbon, silicon, tin, and lead
   d) Group 15: Nitrogen, phosphorus, arsenic, and bismuth
   e) Group 16: Oxygen, sulfur, selenium, tellurium
   f) Group 17: The halogens
   g) Group 18: The noble gases
   h) The Descriptive Chemistry of the Transition Metals
3) Ionic Bonding (1 hour)
4) Solid-State Structures (2 hours)
5) Inorganic-based Materials, including: (4 hours)
   a) ceramics
   b) semi-conductors
   c) superconductors
   d) inorganic polymers
   e) metals and alloys

IV. Evaluation Methods:

Midterm Exam	100pts (20%)
Quizzes/weekly assignments	100pts (20%)
Laboratory Exercises	200 pts (40%)
Final Exam	100pts (20%)

The midterm and final exams will include a section of multiple choice and/or short-answer questions. They will also contain a number of word problem/short essay questions, these questions will account for at least 50% of the value of the exam. Each exam will be cumulative over half of the semester. The midterm exam will be administered during one of the laboratory sessions. Quizzes and weekly assignments will be based on assigned problems

and may include small group work. Laboratory exercises include laboratory reports with sections for experimental objectives, data and results, and questions and conclusions.

V. Example Grading Scale

A: ≥90% B: 80-89% C: 70-79% D: 60-69% F: <60%

VI. Attendance Policy:

The attendance policy for this course will be consistent with the university undergraduate attendance policy as described in the current catalogue.

VII. Required Textbook(s), Supplemental Books and Readings:

Descriptive Inorganic Chemistry, Third Edition, Geoff Rayner-Canham and Tina Overton, W. H. Freeman , New York (2002)

VIII. Special Resource Requirements:

1) Safety goggles
2) Laboratory notebook

IX. Bibliography:

1) *Descriptive Inorganic Chemistry, Third Edition,* Geoff Rayner-Canham and Tina Overton, W. H. Freeman: New York (2002)
2) *Descriptive Inorganic, Coordination and Solid State Chemistry*, G.E. Rodgers, 2nd ed., Brooks/Cole-Thomson Learning: Toronto, Canada (2002).
3) *Teaching General Chemistry: A Materials Science Companion*, A.B. Ellis, M.J. Geselbracht, B.J. Johnson, G.C. Lisensky, and W.R. Robinson, ACS Books (1993).
4) *Chemistry of the Elements*, N.N. Greenwood and A. Earnshaw, 2nd ed., Butterworth-Heinemann, (1997).
5) *The Elements*, John Emsley, 3rd ed., Oxford University Press: New York (1998).
6) *The Chemical Bond in Inorganic Chemistry: The Bond Valence Model*, I. David Brown, IUCr Monographs (2002).
7) *Descriptive Inorganic Chemistry,* James E. House and Kathleen A. House, Harcourt Academic Press: San Diego, (2001).

Other information:

Laboratory Schedule

1) Introduction; Safety and Check-In
2) Periodic Properties
3) Group 1 and Group 2 Ions and Water Hardness
4) The Properties of Aluminum and the Synthesis of Alum
5) Oxidation Stability of Tin and Lead

6) The Chemistry of Group 16 Elements
7) Midterm Examination
8) The Chemistry of the Halogens
9) Properties of Transition Metals
10) Solid State Structures and Properties
11) X-Ray Analysis of a Solid
12) Hydrogen Insertion into WO3
13) Inorganic Polymers: The Sol-Gel Preparation of Silica Gel Sensors
14) A Shape Memory Alloy, NiTi

5. **Liberal Studies Approval Form and Checklist** – Not applicable.

Part III. Letters of Support or Acknowledgement – Not applicable.