LSC Use Only No:	LSC Action-Date:	UWUCC USE Only No.	UWUCC Action-Date:
248		02-60e	Senate Action Date: App 4/29/03

App 4/3/03

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person: **Ronald F. See**	Email Address: **rfsee@iup.edu**
Proposing Department/Unit: **Chemistry**	Phone: **7-4489**

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

1. Course Proposals (check all that apply)

_____New Course _____Course Prefix Change _____Course Deletion

__X__Course Revision __X__Course Number and/or Title Change __X__Catalog Description Change

CHEM 113 – Concepts in Chemistry	CHEM 113 – Concepts in Chemistry I
***Current* Course prefix, number and full title**	***Proposed* course prefix, number and full title, if changing**

2. Additional Course Designations: check if appropriate

__X__ This course is also proposed as a Liberal Studies Course.

_____ This course is also proposed as an Honors College Course.

_____ Other: (e.g., Women's Studies, Pan-African)

3. Program Proposals

_____Catalog Description Change _____Program Revision

_____New Degree Program _____Program Title Change _____Other

_____New Minor Program _____New Track

***Current* program name**	***Proposed* program name, if changing**

4. Approvals		**Date**
Dept Curriculum Committee Chair	Ronald F. See	2/3/03
Department Chair	Lucien VanTassel Ramsey	2/5/03
Coll. Curriculum Committee Chair		2/10/03
College Dean		2/11/03
Director of Liberal Studies *		
Director of Honors College *		
Provost *		
Additional signatures as appropriate: (include title)		
UWUCC Co-Chairs	Gail S. Sechrist	4/3/03

* where applicable

FEB 11 2003

Part II. 1. New Syllabus of Record

I. Catalog Description

Course Title: Concepts in Chemistry I
Prefix: CHEM
Number: 113
Hours: 3c-3l-4sh
Prerequisites: none
Co-requisites: none
Description: Introductory course for chemistry majors. This course is the first half of a two-semester sequence designed to give students the foundation of knowledge and laboratory techniques required to successfully complete a chemistry degree program. Topics include atomic theory, an introduction to chemical reactions, stoichiometry, thermochemistry, chemical bonding and molecular geometry, transition metal complexes, polymers and biomolecules.

II. **Objectives:** Upon the successful completion of the course, the student will:

1) be familiar with the basic language of chemistry, including molecular formulas, nomenclature, and the writing of chemical equations.
2) be able to carry out stoichiometric calculations related to chemical reaction systems.
3) understand the principles of chemical thermodynamics, specifically enthalpy.
4) understand the current atomic model for matter and its historical development.
5) be able to draw correct Lewis structures of any simple main-group molecule or polyatomic ion.
6) understand the currently accepted models for chemical bonding and molecular structure, and their applications in main-group, transition metal, and polymeric complexes.
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.
8) be able to use computer applications for data collection, data analysis, and simple molecular orbital calculations.

III. **Detailed Course Outline** (allows three hours for exams):

1) Measurement (2 hours)
   a) metric system, significant figures
   b) dimensional analysis, accuracy and precision
2) Compounds and Nomenclature (3 hours)
   a) atoms, isotopes, introduction to periodic table
   b) compounds, nomenclature of ionic and molecular compounds
   c) writing and balancing chemical reactions
3) Stoichiometry (5 hours)
   a) atomic mass, Avogadro's number, moles, percent composition
   b) basic stoichiometry calculations
   c) limiting reagents, percent yield
4) Chemical Reactions (5 hours)
   a) precipitation, net ionic reactions
   b) neutralizations reactions, titrations
   c) oxidation-reduction reactions
   d) molarity, solution stoichiometry

5) Thermochemistry (5 hours)
   a) enthalpy, first law of thermodynamics
   b) phase changes, enthalpies of reaction
   c) standard enthalpy of formation, Hess's Law
6) The Atom and Atomic Orbitals (2 hours)
   a) historical background of the atomic model
   b) quantum theory, modern atomic model
   c) atomic orbitals, quantum numbers, Aufbau principle
7) Periodic Trends (2 hours)
   a) electron configurations, the periodic table
   b) periodic trends in physical and chemical properties
8) Lewis Structures (5 hours)
   a) basics of Lewis structures
   b) Lewis structures of molecules and polyatomic ions
   c) advanced structures, formal charge
   d) bond order and resonance
9) Molecular Geometry and Theory (4 hours)
   a) shapes of molecules, VSEPR model
   b) bond energy and length, valence bond theory
   c) basics of molecular orbital theory
   d) applications of molecular orbital theory
10) Transition Metal Complexes (3 hours)
   a) ligands and coordination bonds
   b) structure and geometric isomers
   c) ligand field theory
11) Polymers and Biomolecules (3 hours)
   a) properties of polymers
   b) proteins
   c) nucleic acids

IV. Evaluation Methods:

Exams	3-60 minute exams x 100pts	= 300pts (37.5%)
Quizzes	10-10 minute quizzes x 10pts	= 100pts (12.5%)
Laboratory	Reports (12 x 10 pts) + quizzes (4 x 20 pts)	= 200pts (25%)
Final Exam	120 minute exam x 200pts	= 200pts (25%)

The 60 minute exams will include a section of multiple choice and/or short-answer questions, and a section of word problems; these problems will account for at least 50% of the value of the exam. The quizzes will be used to reward completion of the homework assignments. Each quiz will consist of a few questions from the homework, with the numbers or compounds changed from the homework question. The laboratory reports are generated by the student, with sections for introduction, observations, data and calculations, data analysis, summary of results, and questions and discussion. Periodic laboratory quizzes will assess understanding of concepts. The final exam will be similar in form to, but twice as long as, the 60-minute exams. The final exam will be cumulative over the entire semester of material.

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:

1. *General Chemistry: The Essential Concepts*, Raymond Chang, 3rd ed., McGraw Hill, New York (2002).
2. *Inquiries into Chemistry*, M.R. Abraham and M.J. Pavelich, 3rd ed., Waveland, Prospect Heights, IL (1997).

VIII. Special Resource Requirements:

1. Safety goggles
2. Laboratory notebook

IX. Bibliography:

1. *General Chemistry: The Essential Concepts*, Raymond Chang, 3rd ed., McGraw Hill, New York (2002).
2. *Inquiries into Chemistry*, M.R. Abraham and M.J. Pavelich, 3rd ed., Waveland, Prospect Heights, IL (1997).
3. *Inorganic Chemistry*, J.E. Huheey, E.A. Keiter, R.L. Keiter, 4th ed., Harper Collins, New York (1993).
4. *Chemical Principles*, Steven S. Zumdahl, 3rd ed., Houghton Mifflin, Boston (1998).
5. *Physical Chemistry*, Joseph H. Noggle, 3rd ed., Harper Collins, New York (1996).
6. *Chemical Bonding and Molecular Geometry: from Lewis to Electron Densities*, R.J. Gillespie and P.L.A. Popelier, Oxford U. Press, New York (2001).
7. http://www.princeton.edu/~mcbrown/display/faces.html (contains biographies of African Americans in the Sciences)
8. *Journal of Chemical Education*
9. *Chemical and Engineering News*
10. *Today's Chemist at Work*
11. *Women Changing Science: Voices from a Field in Transition*, Mary Morse, Perseus Publishing: Cambridge, MA, 2001
12. *Nobel Prize Women in Science: Their Lives, Struggles and Momentous Discoveries*, **2nd Ed.** Sharon Bertsch McGrayne. Joseph Henry Press: Washington, DC, 2001
13. *Notable Women in the Physical Sciences: A Biographical Dictionary*, Benjamin F. Shearer and Barbara S. Shearer, Eds., Greenwood Press (1997).
14. *Women in Chemistry and Physics: A Biographical Sourcebook*, Louise S. Grimstein, Rose K. Rose and Miriam H. Rafailovich, Eds., Greenwood Press (1993).
15. *Blacks in Science and Education,* Vivian O. Sammons, Hemisphere Publishers, Washington, D.C. (1989).

Other information:

Laboratory Schedule

1) Introduction; Safety, and Check-In
2) Scientific Method
3) Measurements

4) Hydrates
5) Acid-Base Titration
6) Precipitates
7) Qualitative Analysis
8) Zinc and Hydrochloric Acid
9) Dissolution Reactions
10) KOH & HCl
11) Chromatography
12) VSEPR Model
13) Molecular Models on a Computer
14) Check-Out and Final Quiz

Part II. 2. Summary of the proposed revisions.

Old Catalog Description: CHEM 113 Concepts in Chemistry (3c-3l-4sh)
An introductory course for chemistry majors. Topics covered include atomic theory, an introduction to chemical reactions, stoichiometry, thermochemistry, chemical bonding, molecular geometry, kinetic-molecular theory of gases, the liquid and solid states, and solution theory.
New Catalog Description: CHEM 113 Concepts in Chemistry I (3c-3l-4sh)
Introductory course for chemistry majors. This course is the first half of a two-semester sequence designed to give students the foundation of knowledge and laboratory techniques required to successfully complete a chemistry degree program. Topics include atomic theory, an introduction to chemical reactions, stoichiometry, thermochemistry, chemical bonding and molecular geometry, transition metal complexes, polymers and biomolecules.

Three topics taught in the former CHEM 113 (Gases, Spontaneous Reactions and Gibbs Free Energy, Solids and Intermolecular Forces) have been moved to CHEM 114. One topic (Compounds of the Transition Metals) formerly in CHEM 114 has been moved to CHEM 113, and one new topic (Polymers and Biomolecules) has been added. The revised laboratory activities reflect the new lecture topics.

Part II. 3. Justification/rationale for the revision.

The revision of this course is primarily a result of the program revisions proposed by the Department of Chemistry. These revisions were undertaken to modernize the chemistry curriculum, and to meet the new certification guidelines of the American Chemical Society (ACS); the pertinent pages from these guidelines are included as an appendix in the Chemistry B.S. proposal package (complete guidelines are available at www.chemistry.org/portal/Chemistry). As a part of this program revision, we took the descriptive chemistry topics out of CHEM 114 and put them into a new course, CHEM 214. The result is that the other topics in the former CHEM 113 and 114 have been expanded. The three topics moved to CHEM 114 will mesh well with other material in that course, and allow more time for those topics that remain in the first-semester course. Two topics have been moved into CHEM 113, as both these topics flow naturally from the covalent bonding and molecular structure chapters that will immediately precede them. The chemistry department faculty feel that by expanding the topics that will remain in CHEM 113 and 114, chemistry and biochemistry majors will be better prepared for subsequent courses in analytical and physical chemistry.

Part II. 4. Old syllabus of record.

COURSE SYLLABUS

I. Catalog Description

CH 113 - Concepts in Chemistry

4 credits
3 lecture hours
3 lab hours
(4c-3l-4sh)

Introductory course for chemistry majors. Topics covered include atomic theory, an introduction to chemical reactions, stoichiometry, thermochemistry, chemical bonding, molecular geometry, gas laws, the liquid and solid state and solution theory.

II. COURSE OBJECTIVES

A. Students will be familiar with the basic language of chemistry including molecular formulas, nomenclature and the writing of chemical equations.

B. Students will be able to carry out quantitative calculations related to chemical reaction systems and their applications (stoichimetry).

C. Students will understand the principles of chemical thermodynamics, specifically enthapy.

D. Students will understand the current atomic model for matter and its historical development.

E. Students will understand the currently accepted models for chemical bonding and structure.

F. Students will understand the states of matter and their characteristic properties.

G. Students will understand the kinetic-molecular model for gases and its relationship to observed empirical laws.

H. Students will understand the principles of solution theory and the properties of solutions.

I. In the laboratory students will be able to apply the principles learned in lecture so that they can qualitatively and quantitaively analyze experimental data and explain its significance.

III. COURSE OUTLINE

A. Some Useful Ideas and Tools of Chemistry (1 lecture)
1. Scientific measurement systems and units
2. Problem-solving techniques

B. Atoms, Molecules and Ions (4 lectures)
1. Simple models of the atom
2. The "mole" in chemistry
3. The periodic table of the elements
4. Chemical formulas and nomenclature
5. Quantitative determination of chemical formulas

C. An Introduction to Inorganic Reactions (4 lectures)
1. Writing and balancing chemical equations
2. Reactions of ionic compounds in water
3. Types of chemical reactions
4. Oxidation-reduction reactions

D. Stoichiometry: Quantitative Information (4 lectures)
1. Mass-mass relationships
2. Limiting reagent concept
3. Molar concentrations
4. Titrtations and solution stoichiometry

E. Thermochemistry (3 lectures)
1. Enthalpy changes
2. Hess's Law
3. Standard Enthalpies of Formation

F. The Spontaneity of Chemical Reactions: Entropy and Free Energy (3 lectures)
1. Spontaneous and non-spontaneous reactions
2. Entropy
3. Free energy

G. The Structure of the Atom (3 lectures)
1. Electromagnetic radiation
2. Development of quantum mechanics and orbitals

H. Atomic Electron Configurations and Chemical Periodicity (3 lectures)
1. Electron Configurations
2. Atomic properties and periodicity

I. Basic Concepts of Bonding and Molecular Structure (5 lectures)
1. Ionic versus covalent bonds
2. Lewis structures

3. Properties of bonds
4. Molecular shape (VSEPR model)

J. Further Concepts of Chemical Bonding (3 lectures)
1. Valence bond theory
2. Hybrid atomic orbitals

K. Gases and Their Behavior (4 lectures)
1. Units of Pressure and the Simple Gas Laws
2. The Ideal Gas Law
3. Kinetic Molecular Theory (KMT)
4. Applications of KMT

L. Intermolecular Forces, Liquids, and Solids (3 lectures)
1. KMT and Intermolecular Forces
2. Properties of Liquids
3. Properties of Solids

M. Solutions and Their Behavior (3 lectures)
1. Units of Concentration
2. The Solution Process
3. Colligative Properties

IV. Evaluation Methods

40%	Exams - Two one hour exams covering the material from the preceeding four to five weeks. These contain mulitple choice, short answer and essay questions as well as numerical problems.
20%	Final Exam - Comprehensive but also covers material form the preceeding four weeks; identical to the exams in format.
10%	Quizzes - Periodic announced or unannounced quizzes covering the homework assignments and recent lecture material.
5%	Problem Sets - Questions or problems selected from the excersizes at the end of the chapter.
25%	Laboratory - Reports and quizzes from the laboratory portion of the course.

V. Required Texts
Lecture:
1. Kotz J.C.; Purcell, K.F. *Chemistry & Chemical Reactivity,* Saunders: Philadelphia, 1991.
or
2. Brown T.L.; Lemay, H.E., *Chemistry the Central Science,* Prentice-Hall: Englewood Cliffs, NJ, 1991.

Lab:
Abraham, M.R.; Pavelich, M.J.*Inquiries into Chemistry,* Waveland Press: Prospect Heights, IL, 1991.

VI. Special Resources Requirements

Each student is expected to purchase a pair of safety goggles for use in the laboratory.

VII. Bibliography

Mortimer, C. *Chemistry,* Wadsworth: New York, 1986.

Brown T.L.; Lemay, H.E., *Chemistry the Central Science,* Prentice-Hall: Englewood Cliffs, NJ, 1988.

Cotton, F. A.; Wilkinson, G. *Advanced Inorganic Chemistry,* John Wiley and Sons: New York, 1986.

Atkins, P.W. *Physical Chemistry,* Freeman and Co.: New York, 1986.

Skoog, D.A.; West, D.M. *Fundamentals of Analytical Chemistry,* Saunders: Philadelphia, 1988.

Summerlin, L.R.; Ealy, J.L. *Chemical Demonstrations: A Sourcebook for Teachers,* American Chemical Society: Washington D.C., 1985.

Summerlin, L.R.; Borgford C.L.; Ealy, J.L. *Chemical Demonstrations: A Sourcebook for Teachers, Vol. 2,* American Chemical Society: Washington D.C., 1987.

Articles from current issues of:
Journal of Chemical Education
Chemical and Engineering News
Chemtech
Isis
Today's Chemist

Chemistry 113

Laboratory Schedule

General Topic	Experiment
Measurements	Introduction to the Scientific Method (handout)
Measurements	Qualitative Observations (handout)
Measurements	Graphing Relationships (B-1)
Mole Relationships	Hydrates (C-1)
Mole Realtionships	Zinc and Hydrochloric Acid (C-3)
Mole Relationships	Spectral Analysis for $Cu^{+2}(aq)$ (C-4)
Acid/Base Chemistry	Acid and Base Classifications (G-1)
Thermochemistry	Dissolution Reactions (D-1)
Thermochemistry	Potassium Hydroxide and Hydrochloric Acid (D-2)
Atomic Theory	Atomic Spectrum of Hydrogen (handout)
Molecular Structure	Lewis Structure and VSEPR (H)
Gas Laws	Pressure, Volume, Temperture Relationships (E-1)
Physical States	Heating and Cooling Behavior (D-3)

*The code in parethesis represents experiments taken from the required lab text: *Inquiries into Chemistry* by Abraham and Pavelich.

Part II. 5. LIBERAL STUDIES COURSE APPROVAL, PARTS I-III: GENERAL INFORMATION CHECK-LIST

I. Please indicate the LS category(ies) for which you are applying:

LEARNING SKILLS:

_____ First Composition Course	_____ Second Composition Course
_____ Mathematics	

KNOWLEDGE AREAS:

_____ Humanities: History	_____ Fine Arts
_____ Humanities: Philos/Rel Studies	_____ Social Sciences
_____ Humanities: Literature	_____ Non-Western Cultures
__X__ Natural Sci: Laboratory	_____ Health & Wellness
_____ Natural Sci: Non-laboratory	_____ Liberal Studies Elective

II. Please use check marks to indicate which LS goals are primary, secondary, incidental, or not applicable. When you meet with the LSC to discuss the course, you may be asked to explain how these will be achieved.

Prim	Sec	Incid	N/A	
				A. Intellectual Skills and Modes of Thinking:
X				1. Inquiry, abstract logical thinking, critical analysis, synthesis, decision making, and other aspects of the critical process.
	X			2. Literacy--writing, reading, speaking, listening.
X				3. Understanding numerical data.
		X		4. Historical consciousness.
X				5. Scientific Inquiry.
		X		6. Values (Ethical mode of thinking or application of ethical perception).
		X		7. Aesthetic mode of thinking.
X				**B. Acquiring a Body of Knowledge or Understanding Essential to an Educated Person**
	X			**C. Understanding the Physical Nature of Human Beings**
				D. Collateral Skills:
			X	1. Use of the library.
X				2. Use of computing technology.

III. The LS criteria indicate six ways that courses should contribute to students' abilities. Please check all that apply. When you meet with the LSC, you may be asked to explain your check marks.

_____ 1. Confront the major ethical issues that pertain to the subject matter; realize that although "suspended judgment" is a necessity of intellectual inquiry, one cannot live forever in suspension; and make ethical choices and take responsibility for them.

__X__ 2. Define and analyze problems, frame questions, evaluate available solutions and make choices.

__X__ 3. Communicate knowledge and exchange ideas by various forms of expression, in most cases writing and speaking.

_____ 4. Recognize creativity and engage in creative thinking.

_____ 5. Continue learning even after the completion of their formal education.

__X__ 6. Recognize relationships between what is being studied and current issues, thoughts, institutions, and/or events

IV. A. This is not a multiple-section or multiple-instructor course.

B. The contributions of minorities and women to the development and advancement of chemistry will be included wherever possible. This would include the historically significant contributions of such notable women and minorities as Marie Curie and Irene-Joliet Curie in the study of radioactivity; Marie-Anne Pierrette Lavoisier as the personal laboratory assistant for her husband; Rosalind Franklin, in the elucidation of the structure of the DNA helix; Mary Caldwell in the purification of enzymes; Dorothy Crowfoot Hodgkin in molecular structure determination; K.C. Nicolaou for his work; in natural product synthesis; C.V Raman for his groundbreaking work in spectroscopy; and G. N. Ramachandran for work in the structure of proteins by X-ray crystallography.

C. Articles from current issues of publications such as the *Journal of Chemical Education*, *Chemical and Engineering News*, *Today's Chemist at Work* will provide outside readings on current topics in Chemistry. *Chemical and Engineering News* is the weekly publication of the American Chemical Society that provides news of the chemical world including "worldwide coverage in the scientific, technological, educational, business, and governmental aspects of chemistry." *Today's Chemist at Work* is a monthly publication of the American Chemical Society that serves industrial chemists.

D. This is not an introductory course for a general student audience.

CHECK LIST -- NATURAL SCIENCES (Laboratory)

Knowledge Area Criteria which the course must meet:

__X__ Treat concepts, themes and events in sufficient depth to enable students to appreciate the complexity, history and current implications of what is being studied; and not be merely cursory coverage of lists of topics.

__X__ Suggest the major intellectual questions/problems which interest practitioners of a discipline and explore critically the important theories and principles presented by the discipline.

__X__ Allow students to understand and apply the methods of inquiry and vocabulary commonly used in the discipline.

__X__ Encourage students to use and enhance, wherever possible, the composition and mathematics skills built in the Skill Areas of Liberal Studies.

Natural Science Criteria which the course must meet:

__X__ Examine a body of knowledge of natural science that will contribute to an understanding of the natural world.

__X__ Provide an understanding of the development of natural science theories and their modification.

__X__ Teach students to formulate and test hypotheses.

__X__ Provide an understanding of some of the "great moments" in the history of natural science and the individuals, including women and minorities, responsible for them.

Natural Science Laboratory Criteria which the course must meet:

__X__ Provide students with opportunities to learn and apply data-gathering techniques.

__X__ Provide students with opportunities to develop skills in making accurate observations, in formulating concise and appropriate descriptions of natural phenomena, and in producing meaningful systems of classification for natural objects.

__X__ Provide students with opportunities to apply theories to practice in the working world of science.

Additional Natural Science Criteria which the course should meet:

__X__ Encourage an appreciation of the complex interrelationship of natural science with the life of the individual.

__X__ Develop in students the abilities necessary to cope with the consequences of natural science in the modern world.

__X__ Develop an inquiring attitude consistent with the tenets of natural sciences, an attitude that is willing to expose fallacy on the basis of reason, that demands evidence for scientific assertions, and yet is tolerant of hypotheses in the absence of contradictory evidence.