LSC Use Only
Number: ____
Action: ____
Date: ____

UWUCC Use Only
Number: 91-37
Action: ____
Date: ____

CURRICULUM PROPOSAL COVER SHEET
University-Wide Undergraduate Curriculum Committee

I. Title/Author of Change

Course/Program Title: CH 113-Concepts in Chemistry
Suggested 20 Character Course Title: Concepts in Chem
Department: Chemistry
Contact Person: Dr. John Woolcock

II. If a course, is it being Proposed for:

____ Course Revision/Approval Only
__X__ Course Revision/Approval and Liberal Studies Approval
____ Liberal Studies Approval Only (course previously has been approved by the University Senate)

III. Approvals

John C Woolcock
Department Curriculum Committee

[signature]
Department Chairperson

[signature]
College Curriculum Committee

[signature]
College Dean *

____
Director of Liberal Studies (where applicable)

____
Provost (where applicable)

*College Dean must consult with Provost before approving curriculum changes. Approval by College Dean indicates that the proposed change is consistent with long range planning documents, that all requests for resources made as part of the proposal can be met, and that the proposal has the support of the university administration.

IV. Timetable

Date Submitted to LSC: 9/91
to UWUCC: 9/91

Semester to be implemented: Fall 1992

Date to be published in Catalog: Fall 1992

IV. DESCRIPTION OF CURRICULUM CHANGE

1. Catalog Description:

CH 113 Concepts in Chemistry

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

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.

IV. DESCRIPTION OF CURRICULUM CHANGE

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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.

2. Summary of the Proposed Revisions

We are reorganizing the distribution of topics between CH 113 and CH 114 so that the topics of solid, liquid and solution states have been moved from CH 114 to CH 113 and "descriptive chemistry of the elements" is moved solely to CH 114. To accommodate the inclusion of these topics and the expansion of the section on descriptive chemistry of the elements, the lectures devoted to other topics in the course has been reduced. The catalog description of topics for CH 113 has also been amended to include stoichiometry and an introduction to chemical reactions, both present in the previous syllabus but never formally listed in the catalog description. Finally in part IV of the syllabus, the weight given to the laboratory portion of the course has been increased slightly and the grading of daily assignments has been included while the weighing of exams has been reduced.

CH 113 is currently required if a student wishes to receive American Chemical Society (ACS) certification of the B.S. degree. This course is not required for the B.A. degree or if the student does not wish ACS certification of the B.S. degree. Notation to this effect will appear in the summary of requirements for the B.S. degree in Chemistry printed in the catalog.

3. Course Syllabus
(previous course syllabus attached as an appendix).

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 (stoichiometry).

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

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 kinetic-molecular model for gases and its relationship to observed empirical laws.

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

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 quantitatively analyze experimental data and explain its significance.

III. COURSE OUTLINE

A. Introductory Concepts (5 lectures)
   1. Scientific measurement systems and units
   2. Problem-solving techniques
   3. Atoms, molecules and ions
   4. The "mole" in chemistry
   5. The periodic table of the elements
   6. Chemical formulas and nomenclature

B. An Introduction to Inorganic Reactions (4 lectures)
   1. Writing and balancing chemical equations
   2. Types of chemical reactions: acid-base, precipitation, oxidation-reduction, combustion

C. Stoichiometry (4 lectures)
   1. Mass-mass relationships
   2. Limiting reagent concept
   3. Molar concentrations
   4. Titrations and solution stoichiometry

D. Thermochemistry (3 lectures)
   1. Enthalpy changes
   2. Hess's Law
   3. Standard enthalpies of formation
   4. Calorimetry

E. Atomic Structure (6 lectures)
   1. Historical development of atomic theory
   2. Electromagnetic radiation
   3. Development of quantum mechanics and orbitals
   4. Electron configurations
   5. Atomic properties and chemical periodicity

F. Chemical Bonding (4 lectures)
   1. Ionic versus covalent bonds
   2. Lewis structures
   3. Properties of bonds

G. Molecular Geometry (4 lectures)
   1. Molecular shape (VSEPR model)
   2. Hybrid atomic orbitals

H. 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

I. Intermolecular Forces, Liquids, and Solids (3 lectures)
   1. KMT and intermolecular forces
   2. Properties of liquids
   3. Properties of solids

J. Solutions and Their Behavior (3 lectures)
   1. Units of concentration
   2. The solution process
   3. Colligative properties

IV. Evaluation Methods

60% Exams-Three one hour exams covering the material from the preceding four to five weeks. These contain multiple choice, short answer and essay questions as well as numerical problems.

10% Quizzes-Periodic announced or unannounced quizzes covering the homework assignments and recent lecture material.

5% Problem Sets-Questions or problems selected from the exercises at the end of the chapter.

25% Laboratory-Reports and quizzes from the laboratory portion of the course.

V. Required Texts

Brown, T.L.; Lemay, H.E., Chemistry the Central Science, Prentice-Hall: Englewood Cliffs, NJ, 1991.

Abraham, M.R.; Pavelich, M.J., Inquiries Into Chemistry, Waveland Press: Prospect Heights, IL. 1979.

VI. Special Resources Requirements

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

VII. Bibliography

Kotz, J.C.; Purcell, K.F., Chemistry and Chemical Reactivity, Saunders: Philadelphia, 1987.

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

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.

Chemistry 113

Laboratory Schedule

General Topic	Experiment
Measurements	The Scientific Method (A-1; handout)
Measurements	Graphing Relationships (B-1)
Measurements	Qualitative Observations (A-2; handout)
Mole Relationships	Hydrates (C-1)
Mole Relationships	Precipitates (C-2)
Mole Relationships	Spectral Analysis for Cu^{+2}(aq) (C-4)
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, Temperature Relationships (E-1)
Gas Laws	Decomposition of Alka-Seltzer (handout)
Solution Theory	Heating and Cooling Behavior (D-3)

*The code in parenthesis represents experiments taken from the required lab test: *Inquiries Into Chemistry* by Abraham and Pavelich.

4. Rationale/Justification for the Change

For certification of the IUP B.S. degree by the American Chemical Society's Committee on Professional Training (ACS-CPT) there must be equal emphasis placed on each area of the chemistry curriculum: analytical, organic, physical and inorganic chemistry. Also required is a systematic presentation of the descriptive chemistry of the elements as part of the curriculum. We are reorganizing the sequence of topics taught in CH 113 and CH 114 so that we can meet these requirements. Currently we have only one required semester of inorganic chemistry for a B.S. degree, CH 411, which contains no descriptive chemistry. This is in contrast to other areas of the chemistry curriculum having two required semesters of lectures and laboratory work. It was therefore necessary to modify CH 113 and CH 114 so that this sequence contains the equivalent of an entire semester of inorganic chemistry that focuses primarily on the descriptive chemistry of the elements. As a consequence we also plan to change the title of CH 114 to "Basic Inorganic Chemistry" to indicate that this course will complement CH 411 and contains the bulk of the descriptive inorganic lecture and lab material. Specifically, sections III.B. and III.F. in the CH 113 syllabus contain largely inorganic topics (7 lectures) which when combined with sections III.D.-I. of the CH 114 syllabus (29 lectures) results in 36 lecture hours of inorganic chemistry with 23 lecture hours devoted to the descriptive chemistry of the elements.

V. Letters of Support:

Attached is a letter from the ACS-CPT after our most recent program review as well as a copy of the relevant portions of the ACS-CPT guidelines.

Appendix

1. Letter from American Chemical Society's Committee on Professional Training (ACS-CPT)

2. Selected pages from ACS-CPT handbook

3. Previous course syllabus for CH 113

Rationale for Reapproval of CH 113 and CH 114 as a Liberal Studies Natural Science Laboratory Course

As described in the proposals for these courses, the revisions we plan to make in CH 113 and CH 114 largely involve a reorganization of topics between the two semesters as well as an expansion of the portion of the course referred to as "descriptive inorganic chemistry". As noted above virtually all of the topics in the CH 113-114 sequence previously approved by the Liberal Studies Committee in 1989 as a laboratory science course remain. However, to accommodate the expansion of the descriptive inorganic chemistry we have reduced the number of hours devoted to all other topics by 1-2 lecture hours and deleted the most advanced concepts from these chapters which are treated more successfully in advanced courses. The deletion of topics such as "phase changes", "solubility equilibria" and "titration curves" are excellent examples.

In examining the descriptive inorganic chemistry in CH 114, we feel that this new material also fulfills the Liberal Studies primary and secondary goals listed in Part II-IV of the 1988 LS application for this course. We have attached the previous Liberal Studies proposal for reference. This type of course material has a number of characteristics that make it different from the other topics. First, it is largely factual since it describes the known structures, properties and chemical reactions of the elements and their compounds, therefore the periodic table of elements is used to organize the lectures instead. Second, each family of elements and their compounds is examined in turn and compared to neighboring groups in the periodic table. Finally, selected applications of the elements and their compounds to chemical technology is also presented. Since this material is placed at the end of the second semester the concepts, theories and principles discussed in previous chapters are reviewed and applied to specific examples. Thus, this material allows us to create links from the theories and general concepts of chemistry to specific chemical and physical properties of the elements and their compounds. To complement the lectures on descriptive inorganic chemistry we plan to substitute two or three laboratory experiments in the present syllabus with ones focusing on descriptive chemistry of the elements. Other descriptive chemistry experiments we now use in the lab portion of CH 113 will be moved to CH 114 to round out the second semester.

American Chemical Society

COMMITTEE ON PROFESSIONAL TRAINING
1155 Sixteenth Street, N.W., Washington, D.C. 20036

Barbara A. Gallagher, Secretary (202) 872-4589
Cathy A. Nelson, Staff Associate (202) 872-4599

March 20, 1989

Dr. Neil J. Asting, Chairperson
Department of Chemistry
Indiana University of Pennsylvania
Indiana, PA 15703

Dear Dr. Asting:

Thank you for sending us your department's 1987-88 annual and five-year re-evaluation reports. However, in preparing your report for review by the Committee, it was not apparent to us where descriptive inorganic chemistry is covered in your curriculum. If this material has been integrated into one or more courses, would you please send us the final exams for the courses where basic inorganic chemistry is covered. If ACS standardized exams were used for any of these courses, please provide profiles of your students rankings on each examination over the last two years.

Also, would you please send us your comments on where your students satisfy the ACS Guidelines requirement for synthesis and characterization of inorganic compounds beyond the level of general chemistry.

We would appreciate it if you could send this material by April 15.

Thank you for your cooperation.

Sincerely,

Barbara A. Gallagher

Barbara A. Gallagher
Secretary
Committee on Professional Training

BAG/dsh

MAR 23 1989

Undergraduate Professional Education in Chemistry: Guidelines and Evaluation Procedures

Fall 1983

AMERICAN CHEMICAL SOCIETY

COMMITTEE ON PROFESSIONAL TRAINING

The Core Curriculum

Programs of study in chemistry for majors and non-majors can be organized in many ways to reflect the institution's mission, the available facilities, and the interests and capabilities of the students and faculty. However organized, the core curriculum of an approved program (that part of the program taken by all certifiable graduates) must include roughly two semesters of study of each of four fundamental areas: analytical, inorganic, organic, and physical chemistry.

Initial studies should include an introduction to chemical principles, elementary quantitative analysis, and basic inorganic chemistry — the elementary quantitative analysis and the basic inorganic chemistry being equivalent to approximately a semester's work in each subject. Basic inorganic chemistry, whenever presented, should include descriptive chemistry dealing in a systematic way with the elements and the structures, properties, and reactions of their compounds. Portions of the core requirements might be completed in a course in general chemistry. For example, a general chemistry course with heavy emphasis on inorganic chemistry could satisfy as much as one-half of the one-year core requirement in that area. When parts of a general chemistry course are used to satisfy some of the core requirements, the Committee requests supporting documentation in the form of syllabi and examinations.

The remaining core material normally is covered in two semesters of organic chemistry, two of physical chemistry, one of upper level inorganic chemistry, and one of upper level instrumental analytical chemistry. Ordinarily the upper level courses in inorganic chemistry and analytical chemistry should have organic and calculus-based physical chemistry as prerequisites.

Although conventional names have been used to describe the core areas, the Committee recognizes and encourages approaches that cover the same material in different ways. All of the core courses not only must be offered but actually given on a regular schedule that enables students to take them in proper sequence.

Core courses should include examples of biochemistry, polymer chemistry, and applied chemistry, particularly if those areas of chemistry are not covered in advanced courses. Throughout the core, attention should be given to chemical safety, systematic use of the chemical literature, and computer applications.

Advanced Courses

In addition to the core, approved programs include a minimum of six semester hours of advanced work. Advanced chemistry courses are those that have a major portion of the core curriculum, usually including physical chemistry, as a prerequisite. However, a biochemistry course that uses quantitative concepts involving kinetics, thermodynamics, solution properties of macromolecules, and that has orga[nic] but not physical chemistry as a prerequisite may be appropriate for chemis[try] majors in approved programs. Also, some advanced organic courses (for examp[le] advanced organic synthesis) may not require a physical chemistry prerequisite. T[he] Committee does request for evaluation copies of course syllabi and examinatio[ns] for advanced courses that do not have a semester of physical chemistry as prer[eq]uisite.

Upper level independent study and research at the post-physical chemistry le[vel] may be counted as advanced work, as may advanced courses in chemical en[gi]neering, computer science, geochemistry, surface chemistry, mathematics, mole[cu]lar biology, physics, and other allied fields. Because of the importance of biochem[is]try and polymer chemistry, those areas should receive serious consideration [as] topics for advanced courses. However the requirement for advanced work is me[t] ... is essential that sufficient advanced courses be given each year in chemistry so th[at] if they wish to do so, students may obtain the amount of advanced course w[ork] specified in these guidelines from among courses offered by the chemistry depa[rt]ment.

Curriculum Summary

In summary, an approved program is comprised of core material equivalent [to] approximately 32 semester hours equally distributed in analytical, inorganic, [or]ganic, and physical chemistry and approximately six semester hours of additio[nal] study at the advanced level. About one-half of the core material in analytical a[nd] inorganic, as well as all of the advanced courses, should follow at least a semeste[r of] physical chemistry.

Laboratory Work

Laboratory work should give students hands-on knowledge of chemistry and self-confidence and competence to:

- plan and execute experiments through use of the literature
- anticipate, recognize, and respond properly to hazards of chemical manipu[la]tions
- keep neat, complete experimental records
- synthesize and characterize inorganic and organic compounds
- perform accurate quantitative measurements

Chem 113

[redacted]

I. CATALOG DESCRIPTION

4 credits
3 lecture hours
3 laboratory hours

CH 113 Concepts in Chemistry

[redacted]

Introductory course for chemistry majors. Topics covered include atomic theory, chemical bonding, molecular geometry, kinetic-molecular theory of gases, gas laws, thermochemistry, and descriptive chemistry of selected elements.

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.

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

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.

F. Students will be able to apply the principles presented to explain observed chemical phenomena and data collected in the laboratory.

III. COURSE OUTLINE (LECTURE)

A. Introductory Concepts (6 lectures)
   1. Measurement systems and units
   2. Problem-solving techniques
   3. Atoms, molecules, and ions
   4. Chemical nomenclature
   5. Types of chemical reactions
   6. Chemical equation writing

B. Stoichiometry (6 lectures)
   1. Mass-mass relationships
   2. Molar concentration
   3. Limiting reagent concept
   4. Titrations

C. Thermochemistry (5 lectures)
   1. Enthalpy changes
   2. Hess's Law
   3. Standard enthalpies of formation
   4. Calorimetry

D. Gases (6 lectures)
   1. Empirical laws
   2. Kinetic-molecular model

E. Atomic Structure (8 lectures)
   1. Historical development
   2. Electromagnetic radiation
   3. Quantum mechanics and orbitals
   4. Electronic configurations
   5. Chemical periodicity and the periodic table

F. Chemical Bonding (5 lectures)
   1. Ionic bonding
   2. Covalent bonding
   3. Lewis structures
   4. Properties of bonds

G. Molecular Geometry (4 lectures)
   1. VSEPRT model
   2. Hybrid atomic orbitals

IV. EVALUATION METHODS

50%	Three one-hour exams covering material from preceding 3-4 weeks. Numerical problems and short essay.
20%	Reports and quizzes from laboratory portion of the course.
20%	Comprehensive final exam.
10%	Periodic announced or unannounced quizzes covering recent material and homework assignments.

V. REQUIRED TEXTBOOKS

Kotz, J.C. and Purcell, K.F., Chemistry and Chemical Reactivity, Saunders, 1987

Abraham, M.R. and Pavelich, M.J., Inquiries Into Chemistry, Waveland Press, 1979

VI. SPECIAL RESOURCE REQUIREMENTS

Students are required to have suitable safety glasses for the laboratory.

VII. BIBLIOGRAPHY

Mortimer, C., Chemistry, Wadsworth, 1986

Brown, T.L. and LeMay, H.E., Chemistry: The Central Science, Prentice-Hall, 1988

Cotton, F.A. and Wilkinson, G., Advanced Inorganic Chemistry, Wiley and Sons, 1986

Atkins, P.W., Physical Chemistry, Freeman and Co., 1986

Skoog, D.A. and West, D.M., Fundamentals of Analytical Chemistry, Saunders, 1988

Summerlin, L.R. and Ealy, J.L., Chemical Demonstrations: A Sourcebook for Teachers, American Chemical Society, 1985

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

articles from current issues of:

Journal of Chemical Education
Chemical & Engineering News
Isis
Today's Chemist