LSC Use Only
Number: _____
Action: _____
Date: _____

UWUCC Use Only
Number: 91-40
Action: _____
Date: _____

CURRICULUM PROPOSAL COVER SHEET
University–Wide Undergraduate Curriculum Committee

I. Title/Author of Change

Course/Program Title: CH 410-Advanced Inorganic Lab
Suggested 20 Character Course Title: Adv Inorganic Lab
Department: Chemistry
Contact Person: Dr. John Woolcock

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

X Course Revision/Approval Only
_____ 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

Department Chairperson

College Curriculum Committee

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: _____
to UWUCC: 9/91

Semester to be implemented: Fall 1992

Date to be published in Catalog: Fall 1992

I. Catalog Description

CH 410 - Advanced Inorganic Chemistry Laboratory

1 credit
0 lecture hours
3 lab hours
(0c-31-1sh)

Prerequisite: CH 322

A laboratory course in which the techniques used in the synthesis and characterization of inorganic compounds will be explored. Emphasis will be placed on the preparation of a wide variety of inorganic compounds and the methods by which they are identified and characterized.

COURSE SYLLABUS

I. Catalog Description

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1 credit
0 lecture hours
3 lab hours
(0c-31-1sh)

Prerequisite: CH 322

A laboratory course in which the techniques used in the synthesis and characterization of inorganic compounds will be explored. Emphasis will be placed on the preparation of a wide variety of inorganic compounds and the methods by which they are identified and characterized.

II. Course Objectives

A. Introduce the student to the methods used in the preparation of a wide variety of inorganic compounds.

B. Introduce the student to techniques used in the handling of microscale quantities (0.05-0.15 grams) of inorganic compounds.

C. Examine the use of spectroscopic techniques in the characterization of inorganic compounds.

III. Course Outline

A. Chemistry of the Main Groups Elements (5 weeks)
   1. Inorganic Polymers: Triethyborate and Silicone Polymers
   2. Variable Oxidation States of Tin and Lead: Preparation of Tin(II) Iodide, Tin(IV) Iodide, Ammonium Hexachloroplumbate(IV) or Ammonium Hexachloroplumbate(IV) or Ammonium Hexachlorostannante(IV)
   3. Oxyacids and their Derivatives: Synthesis and NMR Spectroscopy of Phosphorus Acid and its Esters
   4. Use of Transmetallation in Inorganic Synthesis: Preparation of Organo-tin Compounds or Trichlorodiphenyl Antimony

B. Coordination Chemistry (4 weeks)
   1. Synthesis and Infrared Analysis of the Dimethylsulfoxide Complexes of Copper, Ruthenium and Palladium
   2. Compounds with Metal-Metal Bonds: Preparation and Determination of the Magnetic Moment of Copper and Rhodium Acetates
   3. Determination of Δ_o for Cr(III) Complexes

C. Organometallic Chemistry (4 weeks)
   1. NMR Investigation of Molecular Fluxionality: Synthesis of Allyl Palladium Complexes
   2. Chromatographic Analysis of the Acylation of Ferrocene
   3. Synthesis of Metal Carbonyls

IV. Evaluation Method

The final grade for the course will be determined as follows:
80%-laboratory reports
20%-laboratory notebook

Laboratory reports will be graded using the following scheme based on the format used for publications in the inorganic literature:
10%-Abstract or Introduction
10%-Experimental Methods
35%-Summary of Results
40%-Discussion of Results
5%-References or Bibliography

The laboratory notebook will be examined several times during the semester and will be graded on the following:
10%-Acceptable table of contents
20%-Proper format including numbering all pages, the use of ink throughout, no torn out pages, correctly signing and dating each experiment, etc.
20%-Modifications to the procedure
10%-Complete listing of chemicals and equipment used; sketches of equipment are also acceptable
20%-Observations of all physical and chemical changes during the procedure.
10%-Summary of physical measurements, specifically mass of product, % yield, melting or boiling point, etc.
10%-Calculations or preliminary data analysis

V. Required Text

Szafran, Z.; Pike, P.M.; Singh, S. Microscale Inorganic Laboratory, John Wiley and Sons: New York, 1990.

VI. Special Resources Requirements

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

2. Bound "composition" book to be used as a lab notebook.

VII. Bibliography

1. Angelici, R.J. Synthesis and Technique in Inorganic Chemistry, University Science Books: Mill Valley, CA, 1985.

2. Jolly, W.M. The Synthesis and Characterization of Inorganic Compounds, Prentice-Hall: Englewood Cliffs, NJ, 1970.

3. Mayo, D.W.; Pike, R.M.; Butcher, S.S. Microscale Organic Laboratory, 2nd edition, John Wiley and Sons: New York, 1989.

4. Mills, J.L.; Hampton, M.D. Microscale Laboratory Manual for General Chemistry, Random House: New York, 1988.

5. Szafran, Z.; Pike, P.M.; Singh, S. Microscale Inorganic Laboratory, John Wiley and Sons: New York, 1990.

6. Williamson, K.L. Microscale Organic Experiments, D.C. Heath: Lexington, MA 1987.

Course Analysis Questionnaire

SECTION A: Details of the Course

A1: There is a need for better balance in the current chemistry curriculum which covers four main areas of chemistry: physical, analytical, organic and inorganic. Currently, there are full year courses in all of these except inorganic which has only one required semester, CH 411. We are trying to remedy this situation by reorganizing the entire inorganic curriculum for chemistry majors. Most importantly, there is no required inorganic chemistry lab in the current curriculum. This new course will increase the amount of lab work in synthetic inorganic chemistry in the chemistry majors curriculum. Coupled with a reorganization of CH 113/114 it will provide two semesters of formal instruction in lecture and lab in the area of inorganic chemistry. This course is not to be included in the liberal studies course list.

A2: Other courses that will be changed concurrently are CH 113, CH 114, and CH 412. These have been submitted separately to the UWUCC.

A3: The proposed syllabus of CH 410 and the syllabus of an inorganic lab course already taught in the department, CH 412, are similar. Therefore, this course does follow the format of traditional offerings in the department. It does differ in that "microscale" procedures will be used. This is a laboratory experiment where very small amounts, 0.05 to 0.150 grams, of starting material are used. All other inorganic lab texts (Angelici, 1986 and Jolly, 1970) use 5 to 15 grams to begin an experiment. The reduction in scale by a factor of 100 has the following advantages:

1. The time required to do the lab procedure is reduced by about a factor of three. This is due to the fact that operations and manipulation take less time on smaller amounts of material. The major benefit of this time savings is that a wider variety of experiments can be done in one semester widening the pedagogical impact of the course. <u>This is the most important benefit of this approach</u>.
2. The experiments are safer since smaller quantities of hazardous materials are used.
3. The cost of chemicals is reduced.
4. The cost of chemical waste disposal is sharply reduced.
5. Microscale experiments are routinely used in inorganic research.

This type of laboratory course was initially developed for organic chemistry laboratory where similar techniques are used (see books by Mayo, Pike and Butcher, 1989, and by Williamson, 1987 cited in bibliography). This approach has also begun to be adopted by authors of a freshman chemistry lab text (Mills and Hampton, 1988).

A4: This has never been offered on a trial basis at IUP. However, the experiment "Freidel-Crafts Acylation" of ferrocene (from Mayo, Pike and Butcher, 1989) has successfully been used in CH 412 for two years.

A5: This will not be a dual-level course.

A6: This course cannot be taken for variable level credit.

A7: Similar courses are taught at: Merrimack College, North Andover, MA
Northern Michigan University

A8: This course is required to retain American Chemical Society (ACS) certification of our department's B.S. degree in chemistry. The ACS Committee on Professional Training's (ACS-CPT) guidelines p. 10, states that the required core curriculum must include a course in the synthesis and characterization of inorganic compounds. This has been pointed out by the ACS-CPT (see letter from Barbara Gallagher, dated March 20, 1989) and CH 410 is the way in which we will fulfill this requirement. Although this course is similar to CH 412 we decided to create a new course for three reasons. First, since this will be the students introduction to inorganic synthesis it is necessary to begin at the most elementary level. Second, in CH 410 we can emphasize breadth by preparing a wide variety of inorganic compounds while in CH 412 we can focus in detail on more advanced techniques on a smaller number of compounds. Third, those students that wish to continue in inorganic chemistry can take CH 412 in the spring semester as an elective.

SECTION B: Interdisciplinary Implications

B1: This course will be taught by one instructor.

B2: No other courses are needed as corollaries, however, other inorganic chemistry courses including CH 114, CH 411 and CH 412 are also being revised in response to the request by the ACS-CPT (see Section A) and to eliminate overlap in the content and objective of these courses.

B3: There is no overlap of content in this course with courses in other departments.

B4: No seats in this course will be reserved.

SECTION C: Implementation

C1: Resources

a. No new faculty are needed to teach this course. There are currently four faculty in the chemistry department with the background and experience to teach this course.
b. The course will be taught in the current inorganic laboratory, room 102 of Weyandt Hall.
c. The department currently has all the equipment necessary to carry out all the required lab experiments except for a Thomas-Hoover melting point apparatus (cost~$1000) and centrifuge (~$350).
d. The greatest expense involved in this course will be the initial investment in glassware. Because microscale work requires special glassware not presently on hand, there will be an initial cost of about $2000 to equip the lab with enough kits for all students. The microscale glassware is more durable than typical labware and we envision little replacement costs due to breakage. Due to the small quantities of reagent chemicals and solvents used the cost of supplies should be no more than $500 per year including the first year the course is taught. These expenses and the equipment mentioned above will come from the operating budget of the department.
e. Current library holdings are adequate and all reference books noted in the bibliography are currently in the library or the department.
f. No travel funds will be necessary.

C2: No grants will directly fund the operation of this course. However, a senate grant ($1500) has been funded for 1990-91 that will allow us to test some of the experiments we plan to include in this course.

C3: This course will be offered every year in the fall semester. This will allow the students to take this course concurrently with CH 411, Advanced Inorganic Chemistry. The content in these courses will overlap so that CH 411 will provide the theoretical framework for the experiments in CH 410.

C4: One section of this course will be offered.

C5: Up to 24 students can be accommodated by this course. The course is limited to this number by the number of lab stations in room 102 of Weyandt Hall. We project about 10-12 students per year based on the number of B.S. students receiving ACS certification of their degree.

C6: The American Chemical Society's Committee on Professional Training does not recommend any enrollment limits.

C7: This course will be a curriculum requirement for those students who wish to have ACS certification of their degree. To accommodate this course in the curriculum the number of chemistry electives will be reduced by one (from six to five). This will not change the number of free electives, the number of credits required for the major nor increase the current 124-credit B.S. program in chemistry.

SECTION D: Miscellaneous

Included are the following appendices:

- Selected portions of the ACS-CPT handbook and 1988 extensions.
- Letters from ACS-CPT concerning the inorganic lab and inclusion of descriptive inorganic in IUP's curriculum.

Appendix

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

2. Selected pages from ACS-CPT handbook

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 or but not physical chemistry as a prerequisite may be appropriate for che majors in approved programs. Also, some advanced organic courses (for exa advanced organic synthesis) may not require a physical chemistry prerequisit Committee does request for evaluation copies of course syllabi and examin for advanced courses that do not have a semester of physical chemistry as p uisite.

Upper level independent study and research at the post-physical chemistr may be counted as advanced work, as may advanced courses in chemical neering, computer science, geochemistry, surface chemistry, mathematics, m lar biology, physics, and other allied fields. Because of the importance of bioch try and polymer chemistry, those areas should receive serious considerati topics for advanced courses. However the requirement for advanced work is is essential that sufficient advanced courses be given each year in chemistry s If they wish to do so, students may obtain the amount of advanced course specified in these guidelines from among courses offered by the chemistry d ment.

Curriculum Summary

In summary, an approved program is comprised of core material equiva approximately 32 semester hours equally distributed in analytical, inorgan ganic, and physical chemistry and approximately six semester hours of adc study at the advanced level. About one-half of the core material in analytic inorganic, as well as all of the advanced courses, should follow at least a seme physical chemistry.

Laboratory Work

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

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

American Chemical Society

COMMITTEE ON PROFESSIONAL TRAINING
1155 Sixteenth Street, N.W. Washington, D.C. 20036
FAX NUMBER: 202-872-4615

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

23 April 1991

APR 24 1991

Dr. Neil J. Asting, Chairperson
Department of Chemistry
Indiana University of Pennsylvania
Indiana, Pennsylvania 15705

Dear Dr. Asting:

The Committee reviewed the additional information that you sent to us in connection with your department's five-year reevaluation report. The Committee agreed that your plans to meet the inorganic laboratory requirement are very good and will nicely satisfy the ACS Guidelines. You indicated that the new course, Inorganic Chemistry Laboratory (CH 410), would be taught in the fall semester of 1991 pending approval by the university. The Committee would like to have an update on the status of CH 410, including a syllabus and your comments on the success of the course after it has been offered for the first time but no later than December 6, 1991.

Thank you for your cooperation during this review. If you have any questions or comments, please feel free to contact me.

Sincerely,

Cathy A. Nelson

Cathy A. Nelson
Staff Associate
Office of Professional Training