

**Program Revision - B.S. degree in Chemistry**

LSC Use Only No:	LSC Action-Date:	UWUCC USE Only No. Senate Action Date:	UWUCC Action-Date: <i>App 4/18/01</i> <i>Minor App - 4/22/03</i>
		<i>02-60a Senate App</i>	<i>4/29/03</i>

**Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee**

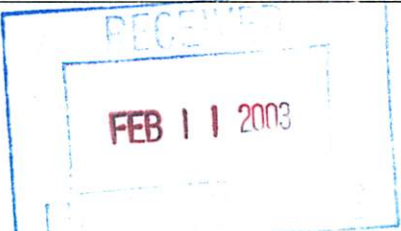
Contact Person: <b>Ronald F. See</b>	Email Address: <b>rfsee@iup.edu</b>
Proposing Department/Unit: <b>Chemistry</b>	Phone: <b>7-4489</b>

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

<b>1. Course Proposals (check all that apply)</b>		
<input type="checkbox"/> New Course	<input type="checkbox"/> Course Prefix Change	<input type="checkbox"/> Course Deletion
<input type="checkbox"/> Course Revision	<input type="checkbox"/> Course Number and/or Title Change	<input type="checkbox"/> Catalog Description Change
<u>Current Course prefix, number and full title</u>		<u>Proposed course prefix, number and full title, if changing</u>
<b>2. Additional Course Designations: check if appropriate</b>		
<input type="checkbox"/> This course is also proposed as a Liberal Studies Course.	<input type="checkbox"/> Other: (e.g., Women's Studies, Pan-African)	
<input type="checkbox"/> This course is also proposed as an Honors College Course.		
<b>3. Program Proposals</b>		
<input type="checkbox"/> New Degree Program	<input checked="" type="checkbox"/> Catalog Description Change	<input checked="" type="checkbox"/> Program Revision
<input type="checkbox"/> New Minor Program	<input type="checkbox"/> Program Title Change	<input checked="" type="checkbox"/> Other <i>Minor</i>
<input type="checkbox"/> New Track		
<u>Current program name</u>		<u>Proposed program name, if changing</u>
<b>4. Approvals</b>		
Dept Curriculum Committee Chair	<i>Ronald F. See</i>	<i>2/11/03</i>
Department Chair	<i>Bruce Lanfassen Ramsey</i>	<i>2/11/03</i>
Coll. Curriculum Committee Chair	<i>[Signature]</i>	<i>2/11/03</i>
College Dean	<i>John D. [Signature]</i>	<i>2/11/03</i>
Director of Liberal Studies *		
Director of Honors College *		
Provost *		
Additional signatures as appropriate:		
(include title)		
UWUCC Co-Chairs:	<i>Gail S. Schust</i>	<i>4/8/01</i> <i>4/22/03</i>

**FEB 20 2003** \* where applicable

11-February 2003



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### Part II. Description of Curriculum Change

#### 1. Catalog Description For The Revised Bachelor of Science in Chemistry

<b>Liberal Studies:</b> As outlined in the Liberal Studies section with the following specifications: <b>Mathematics:</b> MATH 123 (4sh mathematics) <b>Natural Sciences:</b> PHYS 131-141 and 132-142 <b>Liberal Studies Elective:</b> 3sh		<b>49</b>
<b>Major:</b> <b>Required Courses:</b>		<b>45</b>
CHEM 113	Concepts in Chemistry I (1)	4sh
CHEM 114	Concepts in Chemistry II (1)	4sh
CHEM 214	Intermediate Inorganic Chemistry	2sh
CHEM 231	Organic Chemistry I	4sh
CHEM 232	Organic Chemistry II	4sh
CHEM 301	Introduction to Chemical Research	1sh
CHEM 321	Quantitative Analysis	4sh
CHEM 322	Instrumental Analysis	4sh
CHEM 341	Physical Chemistry I	4sh
CHEM 342	Physical Chemistry II	3sh
CHEM 343	Physical Chemistry Laboratory I	1sh
CHEM 344	Physical Chemistry Laboratory II	1sh
CHEM 410	Advanced Inorganic Chemistry Laboratory	1sh
CHEM 411	Advanced Inorganic Chemistry	3sh
CHEM 498	Problems in Chemistry	2sh
<b>Controlled Electives: (2)</b>		
Additional Chemistry electives from the list: CHEM 331, 421, 435, 441, 481		3sh
<b>Other Requirements (3)</b>		<b>14-18</b>
BIOL 111	Principles of Biology I	4sh
BIOC 301	Biochemistry I (4)	3sh
MATH 124	Calculus II for Physics, Chemistry and Math	4sh
One additional Mathematics elective from the list: MATH 171, 241, 342		3-4sh
Foreign Language Intermediate Level (5)		0-3sh
<b>Free Electives</b>		<b>8-12</b>
<b>Total Degree Requirements</b>		<b>120</b>

1. CHEM 111 and 112 can be substituted for CHEM 113 and 114, respectively, for the chemistry B.S. degree.
2. Qualifying students can also use 500 or 600 level CHEM courses to meet this requirement.
3. Students electing a concentration in Pre-Medicine must take BIOL 151, 263, 331 and CHEM 351.
4. Students electing a concentration in Pre-Medicine may substitute CHEM 351 for BIOC 301
5. Intermediate-level foreign language may be included as Liberal Studies elective.

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### 2. Summary of Changes

- a) Side-by-side comparison of Present and Proposed programs (courses that represent change from the present curriculum in italics).

Present			Proposed		
Liberal Studies: As outlined in Liberal Studies section with the following specifications: Mathematics: MATH 123 Natural Sciences: PHYS 131-141 and 132-142 Liberal Studies Electives: MATH 124, no courses with CHEM prefix		56-57	Liberal Studies: As outlined in Liberal Studies section with the following specifications: Mathematics: MATH 123 (4sh mathematics) Natural Science: PHYS 131-141 and 132-142 <i>Liberal Studies Electives: 3sh</i>		49
Required Courses:		43-44	Required Courses:		45
CHEM 113	Concepts in Chemistry (1)	4sh	CHEM 113	Concepts in Chemistry I (1)	4sh
CHEM 114	Basic Inorganic Chemistry (1)	4sh	<i>CHEM 114</i>	<i>Concepts in Chemistry II (1)</i>	<i>4sh</i>
CHEM 231	Organic Chemistry I	4sh	<i>CHEM 214</i>	<i>Intermediate Inorganic Chemistry</i>	<i>2sh</i>
CHEM 232	Organic Chemistry II	4sh	CHEM 231	Organic Chemistry I	4sh
CHEM 301	Chemistry Seminar	1sh	CHEM 232	Organic Chemistry II	4sh
CHEM 321	Quantitative Analysis	4sh	<i>CHEM 301</i>	<i>Introduction to Chemical Research</i>	<i>1sh</i>
CHEM 322	Instrumental Analysis	4sh	CHEM 321	Quantitative Analysis	4sh
CHEM 341	Physical Chemistry I	4sh	CHEM 322	Instrumental Analysis	4sh
CHEM 342	Physical Chemistry II	3sh	CHEM 341	Physical Chemistry I	4sh
CHEM 343	Physical Chemistry Laboratory I	1sh	CHEM 342	Physical Chemistry II	3sh
CHEM 344	Physical Chemistry Laboratory II	1sh	CHEM 343	Physical Chemistry Laboratory I	1sh
CHEM 410	Advanced Inorganic Chemistry Laboratory	1sh	CHEM 344	Physical Chemistry Laboratory II	1sh
CHEM 411	Advanced Inorganic Chemistry	3sh	CHEM 410	Advanced Inorganic Chemistry Laboratory	1sh
			CHEM 411	Advanced Inorganic Chemistry	3sh
			<i>CHEM 498</i>	<i>Problems in Chemistry</i>	<i>2sh</i>
Controlled Electives: Additional Chemistry electives from the following: CHEM 331, 335, 351, 376, 412, 421, 441, 498		5-6sh (2)	<i>Controlled Electives: Additional Chemistry electives from the list: CHEM 331, 421, 435, 441, 481 (2)</i>		3sh
Other Requirements: Additional math: COSC 110 and one additional course from the following: MATH 171, 227, 241, 342 Pre-Med Program (3) Foreign Language Intermediate Level (4)		7-14 7-8sh 0-6sh	Other Requirements: (3,4) <i>BIOL 111</i> <i>BIOC 301</i> <i>MATH 124</i> and one of the following: <i>MATH 171, MATH 241, or MATH 342</i> <i>Foreign Language Intermediate Level (5)</i>		14-18 4sh 3sh 7-8sh 0-3sh
Free Electives: (5)		9-17	Free Electives:		8-12
Total Degree Requirements		124	Total Degree Requirements:		120

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- (1) Those who took CHEM 111 and 112 should take CHEM 116 for American Chemical Society (ACS) certified B.S.
  - (2) CHEM 498 (2sh) required for ACS certification.
  - (3) Chemistry/Pre-Med program requires BIOL 111, 112, 263, 331, 352, and CHEM 351.
  - (4) Intermediate-level Foreign Language may be included in Liberal Studies electives.
  - (5) Pre-Med sequence requires Biology sequence 18 sh.
- (1) *CHEM 111 and 112 can be substituted for CHEM 113 and 114, respectively, for the chemistry B.S. degree.*
  - (2) *Qualifying students can also use 500 or 600 level CHEM courses to meet this requirement.*
  - (3) *Students electing a concentration in Pre-Medicine must take BIOL 151, 263, 331 and CHEM 351 instead.*
  - (4) *Students electing a concentration in Pre-Medicine may substitute CHEM 351 for BIOC 301.*
  - (5) *Intermediate-level foreign language may be included as Liberal Studies elective.*

### b) List of All Associated Course Changes (new or revised courses, number, title, or description changes, and deletions)

#### Revised Courses with New Titles and New Descriptions:

- CHEM 113 Concepts in Chemistry I
- CHEM 114 Concepts in Chemistry II
- CHEM 301 Introduction to Chemical Research
- CHEM 411 Advanced Inorganic Chemistry
- CHEM 498 Problems in Chemistry

#### New Courses:

- CHEM 214 Intermediate Inorganic Chemistry

#### Existing Course Addition:

- BIOL 111 Principles of Biology I
- BIOL 151 Human Physiology (Pre-Medical concentration)
- BIOC 301 Biochemistry I

#### Course Deletions from Program:

- COSC 110 Problem Solving and Structured Programming
- BIOL 112 Principles of Biology II (Pre-Medical concentration)
- BIOL 352 Comparative Animal Physiology (Pre-Medical concentration)
- Reduction of the foreign language requirement to three semester hours of intermediate foreign language.

### 3. Rationale for Changes.

#### Introduction

This revision to the B.S. degree program in chemistry was prompted by a change in the certification requirements (Appendix A) of the American Chemical Society (ACS). The

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Millersville, and West Chester) and the other ten are outside of Pennsylvania. This analysis, and the discussions between our faculty members, yielded the following recommendations:

1. Use the existing BIOC 301 to satisfy the ACS biochemistry requirement.
2. An increase in the number of sh required for the B.S. degree in chemistry.
3. A change in structure for the undergraduate research component of the B.S. degree program.
4. The use of 400/500- and 600-level courses for the chemistry elective.
5. A redistribution of chemistry sh in the suggested sequence, resulting in more hours during the sophomore year.

Each one of these topics is presented in detail below.

### Recommendations

*Use of BIOC 301 to satisfy the ACS Biochemistry requirement.* The fields of chemistry and biology are becoming more closely related, and the probability that chemistry majors will require a background in biochemistry is ever increasing. Therefore, the ACS is requiring that approved programs include at least three sh in biochemistry. After discussions with the biochemists in our department, we have determined that the existing BIOC 301 is the most appropriate course to satisfy the ACS requirement. To prepare the chemistry majors for BIOC 301, we will also require BIOL 111, which is already a requirement for Chemistry Education and for the Pre-Medicine concentration. We feel that these two courses will ensure that IUP chemistry majors have an adequate background in biochemistry.

To help make room for BIOL 111, the B.S. major no longer includes the requirement of COSC 110. Computers are certainly an important component of modern chemistry, but the chemistry-specific computer applications that our students will need in their professional careers are already being integrated into almost all the departmental courses, including the freshman chemistry courses. While COSC 110 is certainly of value to our majors, we feel BIOL 111 will be of greater utility to a larger number of students, and provide instruction in areas not covered by other CHEM courses.

*Increase in sh for the B.S. degree in chemistry.* The present B.S. chemistry degree program in chemistry requires 43-44 sh of CHEM courses. The analysis of comparable programs (Appendix B) shows this to be far below the mean of 50.4, and less than all but three of the comparison programs. Additionally, all four SSHE institutions with ACS-certified chemistry degrees require far more (49-61) sh of chemistry or biochemistry courses for their degrees. In order to upgrade the B.S. chemistry major at IUP, we plan to make the following changes:

Add BIOC 301 (Biochemistry I, 3 sh) as a requirement for the B.S. chemistry degree. Not only will this change increase the sh in the degree program, but it will also satisfy the ACS biochemistry requirement. It is the opinion of the biochemists on the chemistry department faculty that BIOC 301 is the most appropriate biochemistry course for the B.S. chemistry majors.

- Add the new course CHEM 214 (Intermediate Inorganic Chemistry, 2 sh). This course is intended to replace and extend the material presented in the current CHEM 114/116. It is not

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possible to incorporate all the material in a typical first-year chemistry sequence and the descriptive chemistry of the elements without severely compromising other topics in the course that provide important background for subsequent courses in the major. This change in CHEM 114 will also make it easier for students who take CHEM 111 & 112 to switch to a major in chemistry. (CHEM 113/114 is the freshman chemistry sequence intended for chemistry and biochemistry majors. The topic lists for the proposed 113/114 are similar to CHEM 111/112, but the focus, pedagogical approach, and the laboratory experiments differ considerably to meet the needs and develop skills appropriate for chemistry and biochemistry majors.) The inorganic faculty considers it vital that, given the nature of the material in CHEM 214, this course has a lab component. The American Chemical Society's Committee for Professional Training (ACS-CPT) describes in its guidelines for accreditation that "optimum learning occurs where problem solving and laboratory experience reinforce the study of essential content." The ACS-CPT also recommends that "wherever possible, core courses should include examples of materials chemistry." CHEM 214 is a core course in the revised curriculum that provides students with examples of materials chemistry and inorganic polymers while presenting a systematic descriptive chemistry of the elements. The recommendations in Inorganic Chemistry for a second-level core course in Inorganic Chemistry build upon "the introductory courses that cover elementary principles of chemical bonding and structure, thermodynamics, kinetics, and descriptive chemistry of the elements." The descriptive chemistry of the elements requires practical hands-on experiences to appreciate the "practical aesthetic, and humanistic aspects of chemistry."

The net result of these changes will be to require 45 sh of CHEM courses and the 3 sh BIOC 301, a total of 48 sh. While this total is still below the mean for the 14 comparison institutions, the proposed changes do strengthen the B.S. chemistry degree at IUP. This increase in CHEM/BIOC sh will result in a decrease of the free elective hours. However, the proposed 11-12 free elective sh would still be in the normal range for the laboratory science B.S. programs.

*Change in the Undergraduate Research Requirement.* Probably the most significant experience for a chemistry major at IUP is to take part in undergraduate research. The coursework completed by chemistry majors teach concepts and the techniques of mastering new technical information, and teaching laboratories give experience with physical techniques and data analysis. However, only in undergraduate research does the student actually do chemistry as it is done by professional chemists. Research requires students to learn an area in depth and solve problems for which there is no established procedure or known answer. For many students, research will lead to presentations at scientific conferences such as the Intercollegiate Student Chemists' Convention and American Chemical Society national and regional meetings. Also, the mentor-student relationships built during research go well beyond what is usual between a student and their classroom instructors; undergraduate research in chemistry is not ordinary independent study; there is a high degree of interaction between professor and undergraduate research student.

The present Chemistry B.S. requires 2 semesters of undergraduate research, which are typically done during the senior year. We believe that it is preferable to start the undergraduate research experience earlier in the student's academic career. A semester of research in the junior year will make our majors more prepared, and more competitive, for summer research fellowships at national laboratories, research-intensive universities and in industry. This will also allow the

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student to have two semesters of research by December of their senior year, instead of rushing to get research done in their last semester before graduation. We will also include more formal requirements for the two semesters of undergraduate research: a) an undergraduate research proposal; b) an oral presentation to the department; c) a report on research results in ACS-approved format.

The final change to the undergraduate research component of the B.S. degree in chemistry will be the revision of CHEM 301. This course will be moved to the fall semester so that undergraduate research can start in the spring of the junior year. Also, a portion of this course will be reserved for a discussion of ethics in chemical research.

*The Use of Graduate-level Courses as Undergraduate Electives.* The present Chemistry B.S. curriculum requires at least one CHEM elective course. Since the Chemistry department offers a M.S. degree, undergraduate students are now able to satisfy the elective with graduate-level (400/500- or 600-level) courses. However, the most common choice of recent B.S. chemistry majors to satisfy the CHEM elective has been CHEM 351 (Biochemistry). Since BIOL 111 and BIOC 301 are new requirements in the proposed B.S. Chemistry degree, CHEM 351 will no longer satisfy the CHEM elective. This means that each B.S. chemistry major may take at least one graduate-level CHEM course as their controlled elective. The student may choose an in-depth course in one area of chemistry.

*Increase in Suggested Semester Hours During the Sophomore Year.* In the present Chemistry B.S. curriculum, the student takes only four CHEM courses in their first two academic years. Based on our analysis of comparison institutions (Appendix B), we are proposing that two additional courses be suggested for the sophomore year. One course, CHEM 321 (Quantitative Analysis), is an existing course now suggested for the junior year. Some IUP students have taken CHEM 321 as sophomores, and have reported that this may be a more natural sequence to take the course, since it expands on many of the concepts presented in the freshman year chemistry courses (CHEM 113 & 114). Of the 14 comparison programs, 10 suggest their analogous course (called Analytical I in Appendix B) for the sophomore year. The other course, CHEM 214 (Intermediate Inorganic Chemistry), is a new course to be suggested for spring of the sophomore year. Of the five comparison programs that offer an analogous course, four suggest it for the sophomore year.

An additional reason to suggest these courses in the sophomore year concerns the choice of undergraduate research area. Students will be choosing research advisors in the later part of the first semester of their junior year. If the student has followed the suggested schedule, they will have taken, or be taking, at least one course from each of the four divisions (analytical, inorganic, organic and physical) of chemistry. This will help the student make a choice of research advisor that fits their personality and interests. The suggested sequence of courses in the B.S. chemistry degree program is found in Appendix C.

### **Response to the Reduction of Total sh to 120**

The change in the total credits required for graduation, and in Liberal Studies elective requirements, have necessitated some changes in the non-CHEM courses we will be requiring for our degree programs. Our present majors typically satisfied the Liberal Studies electives with two intermediate-level foreign language courses and MATH 124. After considering several options,

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the department has decided to change our foreign language requirement to a minimum of 3 semester hours at the intermediate level. This foreign language requirement can also be used by students to satisfy 3sh of Liberal Studies elective. We have also decided to move MATH 124 to "Other Requirements." These changes, along with the increase in CHEM/BIOC sh, retain 11-12 sh of free electives in the B.S. Chemistry degree program.

### **Productivity Concerns**

The IUP and SSHE administration has recently expressed a desire to increase the "productivity" (defined as the ratio of student credit hours to faculty contact hours) of all programs. The chemistry faculty recognizes that the new course, CHEM 214, includes a lab and therefore will not improve productivity. However, it should be pointed out that there are several other facets of this proposal that will clearly increase the number of students in existing courses. Most dramatically, BIOC 301 should experience an increase of 6-12 students each fall – this represents an approximately 100% increase in the enrollment of this course, but will **not** require an additional section. Similarly, the use of cross-listed graduate-level CHEM courses as electives will increase enrollment by 3-4 students, on average, for each course. Finally, the move of CHEM 321 to the 3<sup>rd</sup> semester should result in a small increase in the number of students in this course.

### **Summary**

Although this revision in the B.S. curriculum was prompted by the addition of Biochemistry to the certification requirements of the ACS, the Chemistry Department has taken this opportunity to improve our B.S. chemistry curriculum. We are proposing an increase in the total semester hours of CHEM/BIOC courses in the major, as well as a restructuring of the undergraduate research component. We feel that these changes will not only meet the ACS requirements, but also improve the preparation of IUP chemistry majors for graduate school or employment. Because only one new course is being proposed, these changes can also be carried out at a minimal cost to both the department and the university.

## **Part III. Implementation**

### **1. How the Revisions will Affect Students Already in the Existing Chemistry Program.**

Changes will not affect students in existing program, except that CHEM 321 will probably have students in their junior year (old program) and students in their sophomore year (new program) taking the same course in Fall 2004.

### **2. How the Proposed Revisions will Affect Faculty Teaching Loads.**

The faculty teaching load will increase by one contact hour in the fall and three contact hours in the spring. CHEM 301 (1 sh) is moved from spring to fall, and the four-contact-hour CHEM 214 is added in the spring. This small change can be accommodated by the present complement of 20 faculty members of the department.

In Fall 2004, CHEM 321 will have increased enrollment, as mentioned above. This may require one additional lab section for that semester only. Other courses, such as BIOC 301, will



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experience an increase in enrollment but not so much that any additional sections will be required.

### **3. Adequacy of Other Resources.**

Other resources (space, equipment, supplies, travel funds) are expected to be adequate.

### **4. Expectation of an Increase or Decrease in the Number of Students as a Result of These Revisions.**

By updating the chemistry major programs, we are making them more attractive, so that they might attract/retain more majors. However, we do not foresee any change in numbers large enough to put any additional strain on the resources of the department as a result of this program revision.

## **Part IV. Periodic Assessment**

There are two components proposed for the periodic assessment of this degree program. One is a survey of the senior students completing the degree program, and the other is a five-year re-evaluation of the program by the departmental curriculum committee.

*Senior Survey* – A requirement in the revised CHEM 498 will be the completion of a survey (Appendix D) by the seniors in the B.S. degree program. The chemistry department secretary will transcribe the results of these surveys, and then the anonymous results will be distributed to the chemistry department faculty.

*Five-year Review* – The American Chemical Society evaluates the B.S. degree programs for certification every five years. It is proposed that the chemistry department curriculum committee will conduct a formal review of the curriculum two years before this scheduled review. Among the items that the committee should review are: a) the responses from the senior surveys; b) changes in ACS certification requirements; c) comments from colleagues about any potential changes in the degree programs. The ACS is scheduled to review our program in 2003-2004 and in 2008-2009, so this process would start in Fall 2006, two years before the 2008 ACS review.

## **Part V. Course Proposals**

The following course proposals are part of this package:

- CHEM 113 Concepts in Chemistry I
- CHEM 114 Concepts in Chemistry II
- CHEM 214 Intermediate Inorganic Chemistry
- CHEM 301 Introduction to Chemical Research
- CHEM 411 Advanced Inorganic Chemistry
- CHEM 498 Problems in Chemistry

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### **Part VI. Appendices**

- A. Pertinent information from the ACS Committee on Professional Training guidelines for certified degrees in chemistry.
- B. B.S. chemistry programs of comparison institutions
- C. Suggested sequence of courses in B.S. chemistry degree program
- D. Senior survey

### **Letters of Support**

Letters of support from the following are attached.

- N. Bharathan & J. Southard, Biochemistry Co-coordinators
- Carl Luciano, Biology Department Chairperson
- Jim Wolfe, Chairperson, Department of Computer Science
- Charles R. McCreary, French and German Department Curriculum Committee Chair
- David A. Foltz, Spanish Department Curriculum Committee Chair

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### **Appendix A - Pertinent information from the ACS Committee on Professional Training guidelines for certified degrees in chemistry.**

(from the Biochemistry topical supplement to the guidelines)

In the belief that all future professional chemists need to know some biochemistry, the ACS guidelines require that all approved programs offer, and all certified majors graduate with, the equivalent of three semester hours of biochemistry. Molecular aspects of biological structures, equilibria, energetics, and reactions should be covered in the required biochemistry experience for chemistry majors. Enough of an introduction to these topics should be presented so that students can obtain the flavor of modern biochemistry.

Approved programs may implement the requirement in one of three ways: 1) distributed, with biochemistry integrated into other courses of the required chemistry core; 2) a separate, three-semester-credit-hour core course in biochemistry; or 3) a biochemistry course that fills part of the advanced course requirement. A laboratory program in biochemistry is optional.

#### **Separate core course** (This is the option chosen by the IUP chemistry faculty)

If a separate, three-semester-credit-hour biochemistry course in the core is used to satisfy the biochemistry requirement; a prerequisite of more than one semester of organic chemistry will be needed in most cases. In addition, the remaining part of the core must still maintain a comparable emphasis on analytical, inorganic, organic and physical chemistry. Creativity will be necessary in modifying the core so that it can include the biochemistry course while maintaining this comparable emphasis.

(from *Undergraduate Professional Education in Chemistry: Guidelines and Evaluation Procedures*)

#### **Ic. Curriculum Requirements**

**Introduction.** The principal purpose of the ACS approval process for undergraduate programs is to help departments provide chemistry majors with a sound education in the fundamental areas of modern chemistry. The CPT believes that it can help departments best by setting general curricular goals rather than by specifying exact curricular structure, realizing that a department's curriculum should build on the strengths of the institution and its faculty. Programs as different in character as those with a major emphasis on fundamental principles and those that are strongly based on industrial applications have produced students who have gone on to have distinguished careers in chemistry. As stated in the preface, the Committee encourages departments to explore the many ways by which a curriculum can meet the guidelines described below.

**Core Curriculum Requirements.** Programs of study in chemistry curricula for majors and nonmajors 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. Regardless of which organization of the curriculum is adopted, that part of the program specified as the core curriculum taken by all certifiable chemistry graduates includes a minimum of 28 semester credit

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hours (or the equivalent thereof for institutions on the quarter system) of basic instruction with comparable emphasis on the areas of **analytical chemistry, inorganic chemistry, organic chemistry, and calculus-based physical chemistry**. **Biochemistry** must also be part of the undergraduate curriculum for chemistry degree students. Two modes are possible for biochemistry. One consists of integrating the equivalent of three semester credit hours of biochemistry into the core. The other consists of having a three-semester-credit-hour course in biochemistry serve as one of the advanced courses. Although a laboratory component is not required for biochemistry, such experience is welcome. (See Commentary on Curriculum Requirements, pp. 8–9.) For options other than chemistry itself, some of the core may be modified as indicated after the description of the various options. The 28 semester credit hours of study shall include the equivalent of 7 semester credit hours (300–350 contact hours) of laboratory instruction distributed, not necessarily in equal proportions, among synthesis and characterization of inorganic and organic compounds, chemical and instrumental methods of analysis, and experimental physical chemistry.

**Advanced Course Requirements.** In addition to the core curriculum, the faculty of an approved program should teach a minimum of two advanced courses on a regular cycle (see the Advanced Courses and Research sections, pp. 11–12). The amount and nature of advanced work for students to be *certified* depend on the chemistry degree option that is chosen by the student. In addition to the core, minimum requirements for approval of the chemistry degree program and for certifying students as having completed this degree are as follows:

**CHEMISTRY:** Six semester hours of advanced courses that include sufficient laboratory work to bring the total number of laboratory hours to 500. For individual students the advanced courses may include or even consist entirely of research that culminates in a comprehensive written report. If the equivalent of three semester credit hours of biochemistry is not incorporated into the core, one of the advanced courses must be a course in biochemistry.

**Research.** Undergraduate research can integrate the components of the core curriculum into a unified picture and help undergraduates acquire a spirit of inquiry, independence, sound judgment, and persistence. By doing research, undergraduates develop the ability to use the chemical literature and report effectively in spoken and written presentations. Also, supervision of research helps the faculty maintain enthusiasm, professional competence, and scholarly productivity. The Committee strongly endorses undergraduate research as one of the potentially most rewarding aspects of the undergraduate experience. A successful project requires proper and careful attention by the faculty advisor. It places heavy demands on the faculty, the students, and the institution. The ideal research project is well defined, stands a reasonable chance of completion in the time available, avoids excessively repetitive work, requires the student to use advanced concepts as well as a variety of experimental techniques and instruments, and develops chemical information that might be publishable. It brings the student into active contact with the research literature. Though reality frequently falls short of the ideal set of goals, the experience can nevertheless be extremely valuable. A well-written, comprehensive, and well-documented *research report* must be prepared, regardless of the degree of success of a student's project. The report should be constructively criticized at an early stage by the faculty supervisor. A supplement available from the Office of Professional Training (OPT) provides concrete advice on good report writing. As much as two semester equivalents (six semester hours) of research

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consistent with this description may take the place of advanced courses for certification for individual students. A good research project would involve at least 90 hours of work per semester (or equivalent in quarter hours) and could provide the additional hours to bring the laboratory total to 500 hours. If research is used as one or both advanced courses for certification of students, the Committee expects to see examples of student research reports as part of each five-year review.

**Related Studies.** Well-prepared students should emerge from a program in chemistry with

- a firm foundation in the fundamentals and applications of calculus, including proficiency with partial derivatives and some knowledge of differential equations;
- an understanding of the basic principles of linear algebra;
- practical knowledge of statistics with applications to validation of data and design of experiments;
- experience with computers, including an ability to use spreadsheets, numerical and non-numerical algorithms, simulations, data acquisition, and use of databases for information handling and retrieval; and
- a good foundation in physics.

Chemistry pervades our modern social and economic life. All chemists, including those whose interests focus strongly on research, can benefit from an understanding of economics, marketing, business, and the environment. Courses in these subjects are recommended to the extent permitted by other academic requirements. Within chemistry courses themselves, advantage should be taken at all levels of course sophistication to point out the connections between science and society.

**Foreign Language.** If American students are to participate fully in chemistry today, which is worldwide in scope, they should know at least one other language and culture, even though English is the international language of science. The study of a foreign language, although not required, is highly recommended, particularly for students who plan to pursue graduate studies in chemistry.

**Communication Skills.** Effective written and oral communication skills are no less essential to the well-trained scientist than to the humanist. Speech and English composition courses alone are rarely enough to attain sufficient skill. Frequent exercises in writing and speaking should be a part of the chemistry curriculum and should be critically evaluated by the chemistry faculty. Ideally, every course should be an exercise in expressing ideas clearly. Seminars, progress reports, term papers, laboratory reports, problem sets, and examinations all should be evaluated for clarity as well as accuracy. Tutoring and laboratory assisting also are highly effective ways for students to consolidate their chemical knowledge and improve their communication skills.

**Alternative Pedagogies.** Much experimentation occurs in the teaching of chemistry as well as in the organization of the content and the formulation of laboratory experiments. This experimentation involves, for example, laboratory-driven instruction, problem-solving formats, and group learning. The Committee considers the guidelines to be consistent with using a wide range of pedagogies.

## **Program Revision - B.S. degree in Chemistry**

***Chemical Literature and Information Retrieval.*** Students preparing for professional work in chemistry must learn how to retrieve specific information from the enormous and rapidly expanding chemical literature. The complexity of this task is such that one can no longer easily acquire the necessary skills without some formal instruction. An excellent means for doing so is with a specific course, which usually would not qualify for the advanced course requirement. Other means for imparting these skills involve coordinated instruction integrated into individual courses. Library and computer exercises should be included in such instruction. In departments requiring undergraduate research, instruction in information retrieval may be a part of the introduction to research, but it should be recognized that adequate presentation of the subject, including an understanding of the use of *Chemical Abstracts*, *Science Citation Index*, and other compilations, will generally require formal classes. It is essential that students gain experience with online, interactive computer files, which can include the compendia just mentioned. Students must have a prior understanding of the organization and use of printed information sources in order to employ computer-readable files to best advantage. The CPT recognizes that this edition of the guidelines is being prepared at a time when personal computers and Internet access are having profound effects on access to and use of the scientific literature. The Committee has tried to look ahead in preparing this edition and expects to review issues related to chemical literature access frequently.

***Professional Ethics.*** Chemistry is a discipline in which high standards of conduct must be exemplified by teachers and researchers in ways that students cannot fail to observe and adopt. Openness about discoveries and independent verifiability of experiments reinforces good ethical practice in the field. Disclosures of unethical practices by some scientists have caused many chemists to conclude that presenting ethical principles should be an intentional part of teaching chemistry. The Committee recommends that such instruction be part of the chemistry curriculum. A supplement on ethics will be available in 2000 from the OPT and at the CPT Web site.

## Program Revision - B.S. degree in Chemistry

Appendix B. Comparison Programs by Year

	Bloomsburg	Clarion	Millersville	W. Chester	C. Michigan Ball St.	E. Illinois	Fredonia St.	G. Mason	Illinois St.	Indiana St.	UMass-Dart.	UNC-Wilm.	Youngs. St.	IUP average	IUP proposed
<b>Freshman</b>															
Gen Chem I	4	4	4	5	4	4	4	4	4	4	4	5	4	4	4
Gen Chem II	4	4	4	5	4	4	4	4	4	4	4	5	4	4	4
NDS* hours			1									1			
<b>Total</b>	<b>8</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>11</b>	<b>8</b>	<b>8</b>	<b>8.4</b>
<b>Sophomore</b>															
Organic I	4	4	4	6	5	4	4	4	5	4	4	5	4	5	4
Organic II	4	4	4	5	5	4	5	4	5	5	4	5	4	5	4
Analytical I			4	5	3	4	3		4	2	4		4	5	4
Discriptive Inorg.		2	3				2					4			2
Org. Spectroscopy	2	2									1				
NDS* hours	1	1					1	1	3			3	3		
<b>Total</b>	<b>11</b>	<b>13</b>	<b>15</b>	<b>16</b>	<b>13</b>	<b>12</b>	<b>15</b>	<b>9</b>	<b>17</b>	<b>11</b>	<b>13</b>	<b>17</b>	<b>15</b>	<b>15</b>	<b>13.7</b>
<b>Junior</b>															
Physical I	3	4	3	4	3	3	4	3	3	3	4	4	4	3	4
Physical II	3	4	3	3	3	3	3	3	3	3	4	4	3	3	3
Physical Lab	2	2	2	4	2			2	4	2	4		2	2	2
Analytical I	3	4						4				5			
Analytical II	4	4		5			3	5							4
Discriptive Inorg.				3											
Advanced Inorg.				3										3	
Inorg. Lab			1	2							2				
Biochemistry	4		4			3	3							3	
Org. Spectroscopy													2		
Adv. Organic Lab			1	3									2		
NDS* hours			3	4	1		4	1		3	3		1		2
<b>Total</b>	<b>19</b>	<b>18</b>	<b>17</b>	<b>21</b>	<b>9</b>	<b>9</b>	<b>17</b>	<b>18</b>	<b>10</b>	<b>11</b>	<b>17</b>	<b>13</b>	<b>14</b>	<b>14</b>	<b>15.5</b>
<b>Senior</b>															
Analytical II			4		3		3		5	3	3	3	4		
Advanced Inorg.	3	3	3		4	3	2	3	3	3	3	3	3		3
Inorg. Lab	1							1	2	1		1	1		1
Biochemistry		3		3	4			3	4	3	3	3	3		3
Physical Lab												2			
Molec. Struct. Det.							3								
NDS* hours	7	4	8	7	2	6	1	4	3	3	4		3	15	4
<b>Total</b>	<b>11</b>	<b>10</b>	<b>15</b>	<b>10</b>	<b>13</b>	<b>9</b>	<b>9</b>	<b>11</b>	<b>17</b>	<b>13</b>	<b>13</b>	<b>12</b>	<b>14</b>	<b>15</b>	<b>12.3</b>
<b>total hours</b>	<b>49</b>	<b>49</b>	<b>56</b>	<b>67</b>	<b>43</b>	<b>38</b>	<b>49</b>	<b>46</b>	<b>52</b>	<b>43</b>	<b>51</b>	<b>53</b>	<b>51</b>	<b>52</b>	<b>49.9</b>
* Non-Division Specific (Intro to Research, Research, Chemistry Electives, etc.)															

## Program Revision - B.S. degree in Chemistry

### Appendix C – Suggested sequence for the B.S. in Chemistry (120 Total Credits)

1 <sup>st</sup> Semester		S. H.	2 <sup>nd</sup> Semester		S. H.
CHEM 113	Concepts in Chemistry I	4	CHEM 114	Concepts in Chemistry II	4
MATH 123	Calculus I for Chem, etc.	4	MATH 124	Calculus II for Chem, etc.	4
ENGL 101	College Writing	4	FDNT 143	Nutrition & Wellness (or)	3
HIST 195	History & Mod. Era (or)	3	HPED 143	Health & Wellness	
ARHI 101	Intro to Art (or)		HIST 195	History & Mod. Era (or)	3
MUHI 101	Intro to Music (or)		ARHI 101	Intro to Art (or)	
THTR 101	Intro to Theater		MUHI 101	Intro to Music (or)	
			THTR 101	Intro to Theater	
		15			14
3 <sup>rd</sup> Semester			4 <sup>th</sup> Semester		
CHEM 231	Organic Chemistry I	4	CHEM 232	Organic Chemistry II	4
CHEM 321	Quantitative Analysis	4	CHEM 214	Intermediate Inorganic	2
PHYS 131	Physics I Lecture	3	PHYS 132	Physics II Lecture	3
PHYS 141	Physics I Lab	1	PHYS 142	Physics II Lab	1
ENGL 121	Humanities Literature	3		Social Science	3
			ENGL 202	Research Writing	3
		15			16
5 <sup>th</sup> Semester			6 <sup>th</sup> Semester		
CHEM 301	Intro to Chemical Research	1	CHEM 342	Physical Chemistry II	3
CHEM 341	Physical Chemistry I	4	CHEM 344	Physical Chem II Lab	1
CHEM 343	Physical Chem I Lab	1	CHEM 322	Instrumental Analysis	4
BIOL 111	Principles of Biology I	4	CHEM 498	Problems in Chemistry	1
	Foreign Language	3		Philos./Relig. Studies	3
	Non-Western Culture	3		Free Elective	3
		16			15
7 <sup>th</sup> Semester			8 <sup>th</sup> Semester		
CHEM 410	Adv. Inorganic Chem Lab	1	CHEM xxx	Chemistry Elective	3
CHEM 411	Adv. Inorganic Chem	3	LBST 499	Synthesis	3
CHEM 498	Problems in Chemistry	1		Social Science	3
MATH xxx	Math Elective	3		Free Electives	6
BIOC 301	Biochemistry I	3			
	Free Electives	3			
		14			15



## Program Revision - B.S. degree in Chemistry

### Appendix D

#### Chemistry Department Senior Survey

The faculty of the Chemistry Department would like to hear your opinions on the courses you took as a major in chemistry. Please fill out the survey below, and return it to the departmental secretary in the envelope provided. The secretary will transcribe your responses before any faculty member sees them, to ensure that your input remains as anonymous as possible. The faculty of the department will use the results of these surveys to make changes that will improve the experience for future chemistry majors.

1. Which degree will you be earning?  
(circle one)

B.S. – Chemistry	B.S. – Chemistry Education
B.A. – Chemistry	B.S. – Chemistry Pre-Med
	B.A. – Chemistry Pre-Med
2. What are your plans after graduation?  
(circle one)

employment
graduate school in chemistry
other professional school (medical, law, MBA, etc.)
not sure
3. How well prepared do you feel to take the next step after graduation in your career plans?  
Please explain any advantages or deficiencies that you feel your IUP education has given you.
4. What specific CHEM or BIOC courses were you positively, or negatively, impressed by in your degree program. Please focus your comments on the content and delivery of the course material, rather than the personality of the professor.



**Program Revision - B.S. degree in Chemistry**

To: Curriculum Committee  
The University Senate  
IUP

From: Dr. N. Bharathan, Dr. Jonathan N. Southard,  
Co-Coordinator  
Biochemistry Program  
IUP

Date: December 9, 2002

Subject: Program Revisions, B.S., B. S. Pre-Med, B. A., and B. A. Pre-Med  
Degrees in Chemistry

We are writing to support the program revisions submitted by Dr. Ronald See of the Chemistry Department. The changes in requirements for Biochemistry courses have been discussed and approved by the Biochemistry faculty. These revisions will not require any additional faculty complement in the Biochemistry Program. We fully support the program revisions described in this proposal.

**Program Revision - B.S. degree in Chemistry**

From: "Carl Luciano" <luciano@iup.edu>  
To: "Dr. Ronald F. See" <rfsee@iup.edu>  
Cc: <luciano@iup.edu>,  
"Art Hulse" <NTCC@iup.edu>,  
"Barkley Butler" <bbutler@iup.edu>,  
"Thomas Simmons" <tsimmons@iup.edu>

Subject: Re: chem revisions

Date: Thu, 12 Dec 2002

Ron

Sorry to take so long getting back to you. This should not be a problem for us.

I am working on the Fall, 2003 schedule right now. Should I go ahead and add CHEM majors to the list of those allowed to register for BIOL 111?

Thanks, CL.

**Program Revision - B.S. degree in Chemistry**

Date: Mon, 09 Dec 2002

From: Jim Wolfe <jlwolfe@iup.edu>

Subject: Re: letter for chem revisions

Ron,

We acknowledge your plan to drop COSC 110 as a requirement for students in the Chemistry BS program. Although we are disappointed that you are making this choice, we understand the motivations for your decision.

Good luck with your reduction to 120 credits.

Jim Wolfe

## Program Revision - B.S. degree in Chemistry

From: "Charles R. McCreary" <chasmc@iup.edu>  
To: "Dr. Ronald F. See" <rfsee@iup.edu>  
CC: Anita Henry <ahenry@grove.iup.edu>,  
Foster Jones <fjones@grove.iup.edu>,  
LaurieHurt <lhurt@iup.edu>,  
Irene Wallaert <wallaert@iup.edu>,  
Peter Sullivan <psulliv@iup.edu>,  
Ken Brode <kwbrode@iup.edu>,  
Ludo op de Beeck <pzcc@iup.edu>,  
Ludo op de Beeck <drlobd@hotmail.com>

Date: Tue, 10 Dec 2002

Subject: Re: letter for chem revisions

Dear Dr. See,

Thank you for your recent email concerning your response to the 120 credit hour mandate. On behalf of my colleagues in French and German, I would like to express our thanks to your department for its support of the foreign language requirement in your major. We are gratified that you recognize the importance of foreign languages in a well-rounded university degree.

We regret that you feel compelled to reduce your department's language requirement to a total of three credits; the 120 hour mandate is causing hardships throughout the university. In looking over your proposal, my colleagues and I noted three courses in your package; on which you might want some further background:

FRNC253 - Intermediate Composition and Conversation: This is a course which is currently only offered as a part of our Summer in Nancy, France program. Only students who enroll in our study abroad program receive credit for this

GRMN201 - Intermediate German: This course had historically been offered on the "intensive accelerated" model, meaning that it granted six credit hours (i.e. this course substituted for GRMN251 AND GRMN252 together.) With the retirement of the colleague who taught this course, it is unclear whether we will be in a position to offer it in the future.

GRMN221 - Conversation III: Due to budgetary and staffing constraints, this course has not been offered in the past two years.

If you require any further clarification, please do not hesitate to contact me

Thank you

**Program Revision - B.S. degree in Chemistry**

From: "David's mail at iup;" <dafoltz@iup.edu>  
To: <RFSee@iup.edu>  
Cc: "roger smith" <rsmith@iup.edu>  
Subject: Proposal for change in foreign language requirement  
Date: Tue, 10 Dec 2002

Dear Dr. See.

Dr. Smith, the chair of the Spanish Department, has asked me to review the proposal from the Chemistry Department to change the Liberal Studies requirement in foreign languages, and then give you a response today. I am the chair of the Spanish Department Curriculum Committee, which met yesterday to review the proposal. We thank you for sharing it with us and for seeking our response or input. We have no objection to the proposed change in that we feel it will not substantially change the current requirement in Spanish. We appreciate that you have the wisdom to insist that an educated person in today's world should have an understanding and appreciation of a second language and its culture.

Sincerely,

David A. Foltz, chair  
Spanish Department Curriculum Committee

**Current Catalog Description:**

Degrees offered by the Department of Chemistry are the Bachelor of Science in Chemistry, the Bachelor of Arts in Chemistry, and the Bachelor of Science in Education with a Chemistry major. The first two degrees are under the College of Natural Science and Mathematics, and the third is under the College of Education and Educational Technology. The department also offers a Chemistry minor.

The B.S. in Chemistry is a professional degree and is certified by the American Chemical Society. The student completing this major should be qualified to assume a position in industry or government as a chemist, or to apply for admission to graduate school to pursue advanced studies leading to the M.S. or Ph.D. degree. The student considering going to a professional school who also wishes to complete this degree should elect appropriate courses as required by the professional school in addition to the courses required here. Those students who are particularly interested in biochemistry should elect a few selected biology courses.

The curriculum leading to the B.A. in Chemistry is designed to allow for the workable union of nonscience areas with chemistry in such a way as to retain the fundamental science and mathematics requirements needed for a career in chemistry. A careful selection of electives will qualify the student for entrance into many fields in which there is an acute need for educated people and, at the same time, satisfy the entrance requirements of various professional and graduate schools.

Some possible and useful combinations between chemistry and other disciplines would include chemistry-biology, chemistry-business administration, chemistry-computer science, chemistry-criminology, chemistry-government, chemistry-pre-dental, chemistry-pre-law, chemistry-safety science, chemistry-pre-medicine, and chemistry-English (technical writing). The student must arrange a practical sequence of non-chemistry courses in consort with his/her advisor and the department chairperson concerned. A student seeking a career in forensic science should major in chemistry. The department also offers pre-medical programs in both the B.S. and B.A. curricula. These programs prepare the student to satisfy the entrance requirements of medical schools.

The curriculum leading to the B.S. in Education with a Chemistry major is designed to prepare the student to teach chemistry at the secondary school level. Upon completion of the specified coursework and the requirements for teacher certification processes, the student is eligible for Pennsylvania certification by the Pennsylvania Department of Education.

**Proposed Catalog Description:**

Degrees offered by the Department of Chemistry are the Bachelor of Science in Chemistry, the Bachelor of Arts in Chemistry, and the Bachelor of Science in Education with a Chemistry major. The first two degrees are under the College of Natural Science and Mathematics, and the third is under the College of Education and Educational Technology. The department offers a formal pre-medical concentration in the B.A. curriculum, and a Chemistry minor.

The B.S. in Chemistry is a professional degree and is certified by the American Chemical Society. The



student completing this major should be qualified to assume a position in industry or government as a chemist, or to pursue graduate studies leading to the M.S. or Ph.D. degree in chemistry, biochemistry, materials science, forensic science, or an associated field.

The curriculum leading to the B.A. in Chemistry is designed to allow for the workable union of other disciplines with chemistry in such a way as to retain the fundamental science and mathematics requirements needed for a career in chemistry. A careful selection of electives will qualify the student for entrance into many fields in which there is an acute need for persons with scientific training, and, at the same time, satisfy the entrance requirements of various professional and graduate schools. This degree may also be of interest to students who have completed a significant number of semester hours in another degree program, and decide they want to earn a degree in chemistry.

The B.A. in Chemistry can incorporate a complementary program in almost any other field in the university; some disciplines which make useful combinations include biology, business administration, computer science, criminology (forensic science), English (technical writing), geoscience, government, physics and safety science. In particular, a student seeking a career in forensic science should major in chemistry.

The B.A. degree program offers a concentration in Pre-Medicine. This concentration includes all courses required for entrance into medical school, and is sequenced to prepare students to take the MCAT in the spring of their junior year. A degree in chemistry, with Pre-Medical concentration, gives students the flexibility of choosing medical school, graduate school or employment in the chemical industry after graduation.

Both degrees in chemistry also provide excellent preparation for entrance into a variety of other professional schools, including dental, veterinary, pharmacy, chiropractic, and law. The student considering going to one of these professional schools after completion of a chemistry degree should work closely with their advisor and select additional courses as required by the professional school.

The curriculum leading to the B.S. in Education with a Chemistry major is designed to prepare the student to teach chemistry at the secondary school level. Upon completion of the specified coursework and the requirements of the teacher certification process, the student is eligible for Pennsylvania certification by the Pennsylvania Department of Education. Additionally, the curriculum in this degree program is designed so that students have the opportunity to obtain a B.S. in Education - Chemistry degree certified by the American Chemical Society.

#### **Proposed Catalog Description:**

Degrees offered by the Department of Chemistry are the Bachelor of Science in Chemistry, the Bachelor of Arts in Chemistry, and the Bachelor of Science in Education with a Chemistry major. The first two degrees are under the College of Natural Science and Mathematics, and the third is under the College of Education and Educational Technology. The department offers a formal pre-medical concentration in the B.A. curriculum, and a Chemistry minor.

The B.S. in Chemistry is a professional degree and is certified by the American Chemical Society. The student completing this major should be qualified to assume a position in industry or government as a chemist, or to pursue graduate studies leading to the M.S. or Ph.D. degree in chemistry, biochemistry,

materials science, forensic science, or an associated field.

The curriculum leading to the B.A. in Chemistry is designed to allow for the workable union of other disciplines with chemistry in such a way as to retain the fundamental science and mathematics requirements needed for a career in chemistry. A careful selection of electives will qualify the student for entrance into many fields in which there is an acute need for persons with scientific training, and, at the same time, satisfy the entrance requirements of various professional and graduate schools. This degree may also be of interest to students who have completed a significant number of semester hours in another degree program, and decide they want to earn a degree in chemistry.

The B.A. in Chemistry can incorporate a complementary program in almost any other field in the university; some disciplines which make useful combinations include biology, business administration, computer science, criminology (forensic science), English (technical writing), geoscience, government, physics and safety science. In particular, a student seeking a career in forensic science should major in chemistry.

The B.A. degree program offers a concentration in Pre-Medicine. This concentration includes all courses required for entrance into medical school, and is sequenced to prepare students to take the MCAT in the spring of their junior year. A degree in chemistry, with Pre-Medical concentration, gives students the flexibility of choosing medical school, graduate school or employment in the chemical industry after graduation.

Both degrees in chemistry also provide excellent preparation for entrance into a variety of other professional schools, including dental, veterinary, pharmacy, chiropractic, and law. The student considering going to one of these professional schools after completion of a chemistry degree should work closely with their advisor and select additional courses as required by the professional school.

The curriculum leading to the B.S. in Education with a Chemistry major is designed to prepare the student to teach chemistry at the secondary school level. Upon completion of the specified coursework and the requirements of the teacher certification process, the student is eligible for Pennsylvania certification by the Pennsylvania Department of Education. Additionally, the curriculum in this degree program is designed so that students have the opportunity to obtain a B.S. in Education - Chemistry degree certified by the American Chemical Society.

### Minor Revision:

#### Current Program:

##### Minor—Chemistry

20

#### Required Courses:

CHEM 111	General Chemistry I	4sh
CHEM 112	General Chemistry II	4sh
CHEM 231	Organic Chemistry I	4sh
CHEM 232	Organic Chemistry II	4sh
One chemistry elective from the following:		
CHEM 321, 323, 351		4sh

#### Proposed Program:

##### Minor— Chemistry

20

#### Required Courses:

CHEM 111 or 113	General Chemistry I or Concepts in Chemistry I	4cr
CHEM 112 or CHEM 114	General Chemistry II or Concepts in Chemistry II	4cr
CHEM 231	Organic Chemistry I	4cr
CHEM 232	Organic Chemistry II	4cr
At least 4 additional semester hours from the list:		
CHEM 321, 323, 341, 351		