

LSC Use Only Proposal No:	UWUCC Use Only Proposal No: 11-145C
LSC Action-Date:	UWUCC Action-Date: AP- 4/10/12 Senate Action Date: App- 5/01/12

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person(s) Nate McElroy	Email Address nate@iup.edu
Proposing Department/Unit Chemistry	Phone 74829

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

1. Course Proposals (check all that apply)

New Course Course Prefix Change Course Deletion

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

Current course prefix, number and full title: CHEM 325 Analytical Chemistry I

Proposed course prefix, number and full title, if changing:

2. Liberal Studies Course Designations, as appropriate

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

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

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

Global Citizenship Information Literacy Oral Communication

Quantitative Reasoning Scientific Literacy Technological Literacy

3. Other Designations, as appropriate

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

4. Program Proposals

Catalog Description Change Program Revision Program Title Change New Track

New Degree Program New Minor Program Liberal Studies Requirement Changes Other

Current program name:

Proposed program name, if changing:

5. Approvals	Signature	Date
Department Curriculum Committee Chair(s)		3/8/12
Department Chairperson(s)		3/8/12
College Curriculum Committee Chair		3/28/12
College Dean		3/28/12
Director of Liberal Studies (as needed)		
Director of Honors College (as needed)		
Provost (as needed)		
Additional signature (with title) as appropriate		
UWUCC Co-Chairs		4/10/12

Received
APR 16 2012
Liberal Studies

Received
MAR 28 2012
Liberal Studies

- II. Description of Curricular Change
1. Syllabus of Record

**SYLLABUS FOR CHEM 325
ANALYTICAL CHEMISTRY I**

I. CATALOG DESCRIPTION

COURSE TITLE:	CHEM 325, Analytical Chemistry I
NUMBER OF CREDITS:	4 cr (3c-3l-4cr)
PREREQUISITES:	CHEM 231
COURSE DESCRIPTION:	An introduction to the principles of analytical chemistry, including gravimetric, volumetric, and basic instrumental analysis. Special emphasis is placed on both perfecting the student's laboratory technique and on the application of general chemical knowledge through problem solving.

II. COURSE OUTCOMES

1. The student will be able to identify and explain how the field of analytical chemistry, the "science of chemical characterization and measurement", is an integral part of all disciplines of chemistry specifically and science in general.
2. The student will be able to calculate and explain the ways in which experimental error, determined by the accuracy and precision afforded by a particular instrument, impacts all laboratory measurements and the calculated quantities that are based on those measurements as well.
3. The student will be able to apply their knowledge of chemical concepts (equilibrium, kinetic, etc.) in solving problems.
4. For each of the analytical methods listed in Section III below, the student will be able to identify and explain their applicability, their strengths, and their limitations when applied to solving real-world problems.
5. For each of the analytical instruments introduced in Section III below, the student will be able to describe both their basic design features and the fundamental principles upon which they operate.
6. The student will develop the skills to obtain the best-possible accuracy and precision in the use of laboratory equipment and instruments
7. The student will gain experience in following analytical procedures and in collecting and interpreting their experimental laboratory data so as to reinforce the concepts presented in lecture.

III. DETAILED COURSE OUTLINE

LECTURE

The lecture portion of Analytical Chemistry I course is taught in a single lecture section. The laboratory portion is taught in small (12 students maximum) sections, all sections doing the same experiments. The topics are listed below.

Note 1 hour = 50 minutes or 1 academic hour

Three hours are designated for hour exams.

- | | | |
|-----|--|---------|
| 1. | <u>Good laboratory practice; measurement significant figures; experimental error</u> | 3 hours |
| 2. | <u>Statistics</u>
the normal distribution; mean, standard deviation; t-test, f-test; linear least squares fitting; meaning of R; simple nonlinear fitting | 4 hours |
| 3. | <u>Calibration methods</u>
calibration curves; internal standards; standard addition | 1 hours |
| 4. | <u>Aqueous Solution chemistry</u>
ionization equilibria in water; relationship between ΔG and K; solving equilibrium problems | 6 hours |
| 5. | <u>Titrimetric and other equilibrium-based methods</u>
analytical applications of acid-base, precipitation, complexometric, and redox titrations | 6 hours |
| 6. | <u>Basic Electrochemistry</u>
Cells, cell potentials | 4 hours |
| 7. | <u>Potentiometry</u>
Indicator electrodes; reference electrodes; the glass electrode – basic design; other ion-selective electrodes (introduction) | 3 hours |
| 8. | <u>Optical Spectroscopy</u>
Basic instrument design; UV-Visible absorbance; molecular emission; atomic absorption; atomic emission | 4 hours |
| 9. | <u>Chromatography</u>
Basic theory; gas chromatography (GC) – basic design; high performance liquid chromatography (HPLC) – basic design; mass selective detection in chromatography | 4 hours |
| 10. | <u>Immunological and related techniques</u>
Enzyme-linked immune assay (ELISA); affinity chromatography; DNA hybridization techniques for molecular biology/biotechnology; aptamers; molecularly imprinted polymers | 4 hours |

Terminating activity scheduled during the final exam period. 2 hours

LABORATORY

(the topics are listed below, with example exercises listed in italics)

- GRAVIMETRIC ANALYSIS: e.g., “*Gravimetric Determination of Chloride*”

2. PRECIPITATION TITRATION: e.g., “*Determination of Chloride by the Fajans Method*” (including a statistics exercise based on the class data for experiments 1 and 2)
3. ACID-BASE TITRATION: e.g., “*Analysis of Impure Soda Ash*”
4. COMPLEXOMETRIC TITRATION: e.g., “*Determination of Water Hardness*”
5. TITRATION CURVES: e.g., “*Acid-Base Titration Curves and Analysis of Milk of Magnesia, Orange Juice, and Wine*”
6. ION-SELECTIVE ELECTRODES: e.g., “*The Potentiometric Determination of Fluoride*”
7. UV-VISIBLE SPECTROPHOTOMETRY: e.g., “*Determination of Fe in Natural Waters*”
8. ATOMIC SPECTROSCOPY: e.g., “*The Determination of Iron Using Flame Atomic Absorption Spectrophotometry*”
9. GAS CHROMATOGRAPHY: e.g., “*Gas Chromatography (GC) of Alcohols*”
10. HIGH PERFORMANCE LIQUID CHROMATOGRAPHY: e.g., “*The Qualitative and Quantitative Analysis of Analgesic Tablets by High Performance Liquid Chromatography (HPLC)*”
11. KINETIC ASSAY: e.g., “*The Enzymatic Determination of Urea*”
12. OPTICAL EMISSION SPECTROSCOPY: e.g., “*The Determination of Heavy Metals in Aqueous Environmental Samples by Inductively Coupled Plasma Optical Emission Spectroscopy*”

A total of twelve experiments will be performed, one per weekly class meeting. The first week is dedicated to laboratory safety/check-in, and the last week to check-out.

IV. EVALUATION METHODS

Evaluation consists of weekly lecture quizzes, three lecture exams, four lab quizzes, twelve lab reports, and a comprehensive final exam. Typically, the lecture portion of the course counts 54%, the laboratory 30%, and the final exam 16%.

V. EXAMPLE GRADING SCALE

A: $\geq 90\%$, B: 80-89%, C: 70-79%, D: 60-69%, F: $< 60\%$

VI. ATTENDANCE POLICY

The specific attendance policy for the course will be determined by the instructor, in accordance with the general policy described in the current undergraduate catalog

VII. REQUIRED TEXTBOOK(S)

Lecture: an appropriate introductory Analytical Chemistry textbook that will provide students with an overview of the field, such as: Harris, Daniel C., “*Exploring Chemical Analysis*”, 3rd Edition, W. H. Freeman, New York, (2005); or: Skoog, D. A., D. M. West, Holler, F. J., and S. R. Crouch, “*Analytical Chemistry, an Introduction*”, 7th Edition, (1999), Thompson Brooks-Cole.

Laboratory: Handouts on procedures and background are used instead of a commercial text.

VIII. SPECIAL RESOURCE REQUIREMENTS

Safety: Some approved form of eye protection must be worn at all times in the laboratory. Students who do not comply with this regulation will be required to withdraw from the course.

Students are expected to have their own scientific calculators and laboratory notebook. Special software is available in the Chemistry Department Computer Classroom for graphing laboratory data. Students should also have access to computers for other work.

IX. BIBLIOGRAPHY

Additional textbooks and other references are available in the Chemistry Department Educational Resources Room and in the Stapleton Library.

Books:

D. C. Harris, *Quantitative Chemical Analysis*, 8th Edition, New York: W. H. Freeman and Company, 2010.

R. Kellner, J.-M. Mermet, M. Otto, M. Valcárcel, and H. M. Widmer, Editors, *Analytical Chemistry*, 2nd Edition, Germany: Wiley-VCH, 2004.

D. T. Sawyer, W. R. Heineman, J. M. Beebe, *Chemistry Experiments for Instrumental Analysis*. New York/John Wiley & Sons, 1984.

D. A. Skoog, D. M. West, F. J. Holler, and S. R. Crouch, *Fundamentals of Analytical Chemistry*, 8th Edition. United States: Thomson Brooks/Cole, 2004.

D. A. Skoog, F. J. Holler, and S. R. Crouch, *Principles of Instrumental Analysis*, 6th Edition. United States: Thomson Brooks/Cole, 2007.

Treatises:

I. M. Kolthoff and P. J. Elving, Eds., *Treatise on Analytical Chemistry*. New York/Wiley, 1961-1986.

R. A. Meyers, Ed., *Encyclopedia of Analytical Chemistry: Applications, Theory and Instrumentation*. New York: Wiley, 2000.

B. W. Rossiter and R. C. Baetzold, Eds., *Physical Methods of Chemistry*, 2nd Edition. New York: Wiley, 1986-1993.

C. L. Wilson and D. W. Wilson, Eds., *Comprehensive Analytical Chemistry*. New York: Elsevier, 1959-2003.

Official Methods of Analysis:

Annual Book of ASTM Standards. Philadelphia: American Society for Testing Materials.

Official Methods of Analysis, 18th Edition, 3rd Revision. Washington, D.C.: Association of Official Analytical Chemists, 2010.

Standard Methods for the Examination of Water and Wastewater, 21st Edition. New York: American Public Health Association, 2005.

Review Serials:

Analytical Chemistry, Application Reviews. American Chemical Society, Washington, D.C., June 15, 2009.

Analytical Chemistry, Fundamental Reviews. American Chemical Society, Washington D.C., June 15, 2010.

Critical Reviews in Analytical Chemistry. CRC Press, Boca Raton, FL.

Trends in Analytical Chemistry. Elsevier, New York.

Monographs:

Gravimetric and Titrimetric Analysis

R. deLevie, *Aqueous Acid-Base Equilibria and Titrations*. Oxford: Oxford University Press, 2001.

L. Erdley, *Gravimetric Analysis*. Oxford: Pergamon, 1965.

Spectrometric Methods

J.D. Ingle and S.R. Crouch, *Spectrochemical Analysis*, Prentice Hall, 1988.

L.H. Lajunen and P. Permaki, *Spectrochemical Analysis by Atomic Absorption and Emission*, 2nd ed., Royal Society of Chemistry, 2004.

F.M. Mirabella, *Modern Techniques in Applied Molecular Spectroscopy*, Wiley-Interscience, 1998.

Electroanalytical Methods

A. J. Bard and L. R. Faulkner, *Electrochemical Methods*, 2nd Edition. New York: Wiley, 2001.

J. Wang, *Analytical Electrochemistry*. New York: John Wiley & Sons, 2006.

Analytical Separations

C. E. Meloan, *Chemical Separations: Principles, Techniques, and Experiments*. New York: John Wiley & Sons, 1999.

Miscellaneous

E. Prichard, *Quality Assurance in Analytical Chemistry*. New York: John Wiley & Sons, 2007.

Periodicals:

American Laboratory

The Analyst

Analytical Chemistry

Analytica Chimica Acta

Analytical Letters
Applied Spectroscopy
Journal of the Association of Official Analytical Chemists
Journal of Chromatographic Science
Journal of Chromatography
Spectrochimica Acta
Talanta

Course Analysis Questionnaire

Section A: Details of the Course

- A1 How does this course fit into the programs of the department? For what students is the course designed? (majors, students in other majors, liberal studies). Explain why this content cannot be incorporated into an existing course.
This course is designed for chemistry and biochemistry majors. It will serve as an introductory course for analytical chemistry as proposed by the American Chemical Society Committee on Professional Training (ACS-CPT) guidelines. No other course offered by the department is suitable for this material.
- A2 Does this course require changes in the content of existing courses or requirements for a program? If catalog descriptions of other courses or department programs must be changed as a result of the adoption of this course, please submit as separate proposals all other changes in courses and/or program requirements.
This is considered a new course proposal that will merge content of the current CHEM-321 (Quantitative Analysis) and CHEM-323 (Analytical Methods). This course is designed to provide Chemistry majors (BS, BSEd) with an overview of analytical chemistry and to serve as the foundation course (precursor) to advanced analytical courses. Biochemistry (BS) and Clinical Lab Science (BS) majors will take this course instead of the required CHEM-323. Likewise, other majors who list CHEM-323 as an elective would now take CHEM-325. Students in other majors who plan to earn a minor in Chemistry could, in partial fulfillment of those requirements, opt to take CHEM-325 from a menu of other options.
- A3 Has this course ever been offered at IUP on a trial basis (e.g. as a special topic) If so, explain the details of the offering (semester/year and number of students).
No
- A4 Is this course to be a dual-level course? If so, please note that the graduate approval occurs after the undergraduate.
No
- A5 If this course may be taken for variable credit, what criteria will be used to relate the credits to the learning experience of each student? Who will make this determination and by what procedures?
This course is not available for variable credit.
- A6 Do other higher education institutions currently offer this course? If so, please list examples (institution, course title).
Cheyney Univ. of Pennsylvania offers Analytical Chemistry I (SCH-201); Clarion University of Pennsylvania offers Analytical Chemistry I, CHEM 353 (Lecture, 3sh) and CHEM 363 (lab, 1sh);

West Chester University of Pennsylvania, CHEM 321 (Lecture, 3sh) and Experimental Analytical Chemistry I (lab, 2sh); East Stroudsburg University of Pennsylvania, CHEM 371 (4sh); Kutztown University of Pennsylvania, CHEM 230 (4sh)

- A7 Is the content, or are the skills, of the proposed course recommended or required by a professional society, accrediting authority, law or other external agency? If so, please provide documentation. **The ACS-CPT guidelines require departments who offer an ACS-certified BS in chemistry to offer a foundation course in Analytical Chemistry. CHEM 325 is designed to meet this requirement.**

Section B: Interdisciplinary Implications

- B1 Will this course be taught by instructors from more than one department? If so, explain the teaching plan, its rationale, and how the team will adhere to the syllabus of record.
This course will be taught by Chemistry Department faculty only.
- B2 What is the relationship between the content of this course and the content of courses offered by other departments? Summarize your discussions (with other departments) concerning the proposed changes and indicate how any conflicts have been resolved. Please attach relevant memoranda from these departments that clarify their attitudes toward the proposed change(s).
The content of this course does not overlap content offered by any other department.
- B3 Will this course be cross-listed with other departments? If so, please summarize the department representatives' discussions concerning the course and indicate how consistency will be maintained across departments.
This course will not be cross-listed.

Section C: Implementation

- C1 Are faculty resources adequate? If you are not requesting or have not been authorized to hire additional faculty, demonstrate how this course will fit into the schedule(s) of current faculty. What will be taught less frequently or in fewer sections to make this possible? Please specify how preparation and equated workload will be assigned for this course.
Faculty resources are adequate. This course will replace CHEM-321 and CHEM-323.
- C2 What other resources will be needed to teach this course and how adequate are the current resources? If not adequate, what plans exist for achieving adequacy? Reply in terms of the following:
- *Space
 - *Equipment
 - *Laboratory Supplies and other Consumable Goods
 - *Library Materials
 - *Travel Funds
- This new course will not require additional resources.**
- C3 Are any of the resources for this course funded by a grant? If so, what provisions have been made to continue support for this course once the grant has expired? (Attach letters of support from Dean, Provost, etc.)
No.
- C4 How frequently do you expect this course to be offered? Is this course particularly designed for or restricted to certain seasonal semesters?
This course will be offered once per academic year.
- C5 How many sections of this course do you anticipate offering in any single semester?

Based on current numbers for CHEM-321 and CHEM-323, one lecture section and up to three lab sections (limited to 12 students b/c of space & resources). The current CHEM-321, CHEM-322, and CHEM-323 lab sections are limited to 12 students per lab sections because of space restrictions, amount of equipment/hood space, and number of instruments used in the experiments.

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

A lecture can hold as many students as needed. A lab section is limited to 12 students because of space restrictions, amount of equipment/hood space, and number of instruments used in the experiments.

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

No

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

This is not a distance education course.

Section D: Miscellaneous

Include any additional information valuable to those reviewing this new course proposal.

III. Letters of support

Letters of support were requested from affected department chairs and program coordinators. E-mail replies are attached.

Subject: New course proposal CHEM 325 (to replace CHEM 321 and CHEM 323)**From:** Nathan McElroy <nathan.mcelroy@iup.edu>**Date:** 02/17/12 02:10 PM**To:** George Long <george.long@iup.edu>, joyce.shanty@iup.edu, lpalmer@iup.edu, bharathn@iup.edu, luciano@iup.edu, Jon Southard <jonathan.southard@iup.edu>, Larry Kupchella <lawrence.kupchella@iup.edu>, Steve Hovan <hovan@iup.edu>**Cc:** Anne Kondo <anne.kondo@iup.edu>, Sharon Sowa <sharon.sowa@iup.edu>**Attached Files**

- CHEM-325 Analytical I - proposal.pdf (76 KB)

Dear Chairperson or Program Coordinator,

Please find attached the new course proposal for CHEM 325 (Analytical Chemistry I), which will replace CHEM 323 (Analytical Methods). CHEM 323 is currently required for biochemistry majors and clinical lab science majors, and it also has served in the past as an elective course for geoscience, biology, and natural science majors.

In response to recommendations of the Committee for Professional Training (CPT) of the American Chemical Society (ACS), the Chemistry Department has revised its current analytical and instrumental chemistry courses (CHEM-321 Quantitative Analysis; CHEM-322 Instrumental Analysis; and CHEM-323 Analytical Methods) by creating two new courses (CHEM-325 Analytical Chemistry I and CHEM-326 Analytical Chemistry II). These two new courses will meet the ACS-CPT guidelines that suggest a department offers a foundation course and an advanced course in analytical chemistry.

With these revisions, students who currently take CHEM-321 Quantitative Analysis and CHEM-323 Analytical Methods would in the future instead take CHEM-325 Analytical Chemistry I as the foundation course. Chemistry majors will be required to take CHEM-326 Analytical Chemistry II as their advanced course, and this course would also be available to other majors wishing to have a chemistry elective.

The new CHEM-325 course will offer an overview of analytical methods with focus on chemical, biochemical, and clinical applications. Topics include statistics, calibration methods, aqueous solution chemistry, titration methods, basic electrochemistry, optical spectroscopy, chromatography, and immunological techniques. This is designed as a 4-credit course, with three lecture hours and three lab hours per week; this would not change the current credit hours taken in CHEM-321 or CHEM-323. There will be one less hour of lab per week, however, than is currently offered CHEM-321 and CHEM-323.

We would appreciate a letter in response to these changes so that we may attach them to the curriculum proposals. If you have further questions regarding these changes, please do not hesitate to contact me.

Sincerely,
Nate McElroy

--

Nathan R. McElroy, Ph.D.
Associate Professor
Department of Chemistry
Indiana University of Pennsylvania
143 Weyandt Hall
975 Oakland Avenue
Indiana, PA 15705
+1 724 357 4829 (office)
+1 724 357 2437 (fax)

Subject: Fwd: RE: New course proposal CHEM 325 (to replace CHEM 321 and CHEM 323)

From: Nathan McElroy <nathan.mcelroy@iup.edu>

Date: 02/20/12 03:45 PM

To: Anne Kondo <anne.kondo@iup.edu>, Sharon Sowa <sharon.sowa@iup.edu>

----- Original Message -----

Subject: RE: New course proposal CHEM 325 (to replace CHEM 321 and CHEM 323)

Date: Mon, 20 Feb 2012 15:40:28 -0500

From: Evans, Deborah <EvansD@readinghospital.org>

To: 'nathan.mcelroy@iup.edu' <nathan.mcelroy@iup.edu>

This course will definitely be an acceptable course for our program at the Reading Hospital & Medical Center School of Clinical
Deborah Evans
Program Director
School of CLS, The Reading Hospital & Medical Center
Reading, PA 19612
610-988-5951
evansd@readinghospital.org

-----Original Message-----

From: Nathan McElroy [<mailto:nathan.mcelroy@iup.edu>]

Sent: Friday, February 17, 2012 2:11 PM

To: George Long; joyce.shantv@iup.edu; lpalmer@iup.edu; bharathn@iup.edu; luciano@iup.edu; Jon Southard; Larry Kupchella; Steve

Cc: Anne Kondo; Sharon Sowa

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nathan.mcelroy@iup.edu

----- Email Disclaimer -----

This email and any files transmitted with it are confidential and are intended for the named recipient(s). If you are not the

Subject: Fwd: Re: New course proposal CHEM 325 (to replace CHEM 321 and CHEM 323)

From: Nathan McElroy <nathan.mcelroy@iup.edu>

Date: 02/27/12 08:48 AM

To: Anne Kondo <anne.kondo@iup.edu>, Sharon Sowa <sharon.sowa@iup.edu>

----- Original Message -----

Subject: Re: New course proposal CHEM 325 (to replace CHEM 321 and CHEM 323)

Date: Mon, 27 Feb 2012 08:25:11 -0500

From: Joyce Ann Shanty <joyce.shanty@iup.edu>

To: <nathan.mcelroy@iup.edu>

Hi Nathan,

I have had the opportunity to share this proposed change with our clinical affiliates in the Clinical Laboratory Science Program. They, as well as I, are supportive of the changes.

Thank you for providing this information.

Joyce Shanty PhD, RN

Allied Health Coordinator

On Fri, 17 Feb 2012 14:10:51 -0500

Nathan McElroy <nathan.mcelroy@iup.edu> wrote:

> Dear Chairperson or Program Coordinator,

>

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> (Analytical Chemistry I), which will replace CHEM 323 (Analytical
> Methods). CHEM 323 is currently required for biochemistry majors and
> clinical lab science majors, and it also has served in the past as an
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> with focus on chemical, biochemical, and clinical applications.
> Topics include statistics, calibration methods, aqueous solution
> chemistry, titration methods, basic electrochemistry, optical

> spectroscopy, chromatography, and immunological techniques. This is
> designed as a 4-credit course, with three lecture hours and three lab
> hours per week; this would not change the current credit hours taken
> in CHEM-321 or CHEM-323. There will be one less hour of lab per week,
> however, than is currently offered CHEM-321 and CHEM-323.

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> Sincerely,
> Nate McElroy

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> --
> -----

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> Associate Professor
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