Status: PENDING

PROGRAM REQUEST
Chemistry Ph.D.

Last Updated: Myers,Dena Elizabeth
05/26/2011

Fiscal Unit/Academic Org	Chemistry - D0628
Administering College/Academic Group	Mathematical And Physical Sci
Co-adminstering College/Academic Group	
Semester Conversion Designation	Re-envisioned with significant changes to program goals and/or curricular requirements (e.g., degree/major name changes, changes in program goals, changes in core requirements, structural changes to tracks/options/courses)
Current Program/Plan Name	Chemistry
Proposed Program/Plan Name	Chemistry Ph.D.
Program/Plan Code Abbreviation	CHEM-PH
Current Degree Title	Doctor of Philosophy

Credit Hour Explanation

Program credit hour requirements		A) Number of credit hours in current program (Quarter credit hours)	B) Calculated result for 2/3rds of current (Semester credit hours)	C) Number of credit hours required for proposed program (Semester credit hours)	D) Change in credit hours
Total minimum credit hours required for completion of program		120	80.0	80	0.0
Required credit hours offered by the unit	Minimum	120	80.0	80	0.0
	Maximum	120	80.0	80	0.0
Required credit hours offered outside of the unit	Minimum	0	0.0	0	0.0
	Maximum	0	0.0	0	0.0
Required prerequisite credit hours not included above	Minimum	0	0.0	0	0.0
	Maximum	0	0.0	0	0.0

Program Learning Goals

Note: these are required for all undergraduate degree programs and majors now, and will be required for all graduate and professional degree programs in 2012. Nonetheless, all programs are encouraged to complete these now.

Program Learning Goals

Assessment

Assessment plan includes student learning goals, how those goals are evaluated, and how the information collected is used to improve student learning. An assessment plan is required for undergraduate majors and degrees. Graduate and professional degree programs are encouraged to complete this now, but will not be required to do so until 2012.

Is this a degree program (undergraduate, graduate, or professional) or major proposal? Yes

Does the degree program or major have an assessment plan on file with the university Office of Academic Affairs? No

A full assessment plan has been submitting using the survey form

Program Specializations/Sub-Plans

If you do not specify a program specialization/sub-plan it will be assumed you are submitting this program for all program specializations/sub-plans.

Pre-Major

Does this Program have a Pre-Major? No

Attachments

- Curriculum Letter.pdf: Letter

  (Letter from Program-offering Unit. Owner: Coleman,Robert S)

- statement_PhD.pdf: Ph.D. Program Proposal

  (Program Proposal. Owner: Coleman,Robert S)

- Chemistry PhD cover letter.doc: NMS Division of Arts and Sciences cover letter

  (Letter from the College to OAA. Owner: Andereck,Claude David)

Comments

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Coleman,Robert S	04/27/2011 04:58 PM	Submitted for Approval
Approved	Coleman,Robert S	04/27/2011 04:59 PM	Unit Approval
Revision Requested	Andereck,Claude David	05/03/2011 01:17 PM	College Approval
Submitted	Coleman,Robert S	05/09/2011 12:31 PM	Submitted for Approval
Approved	Coleman,Robert S	05/09/2011 12:32 PM	Unit Approval
Revision Requested	Andereck,Claude David	05/11/2011 07:03 PM	College Approval
Submitted	Coleman,Robert S	05/12/2011 08:11 AM	Submitted for Approval
Approved	Coleman,Robert S	05/12/2011 08:11 AM	Unit Approval
Approved	Andereck,Claude David	05/17/2011 12:50 PM	College Approval
Approved	Myers,Dena Elizabeth	05/26/2011 08:54 AM	GradSchool Approval
Pending Approval	Soave,Melissa A Cameron,Erin Marie	05/26/2011 08:54 AM	CAA Approval

Division of Natural and Mathematical Sciences

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May 17, 2011

Dena Myers
Graduate School
250 University Hall
230 North Oval Mall
Campus

Dear Dena:

It is a pleasure to forward to you the proposal for the doctoral program in Chemistry under semesters. The Department undertook an extensive review of their graduate program. The resulting doctoral program involved a significant re-envisioning and modernization of the structure of the program, with an emphasis on half-semester topical courses and the establishment of core courses in fundamental areas of chemistry. The curriculum provides increased flexibility for students.

Beyond my own review of the documents, the proposal has been discussed by colleagues from other NMS units at a meeting on May 3, 2011. Feedback from these discussions has been incorporated in the proposal.

If you have any questions, I would be happy to address them.

Sincerely,

David Andereck
Professor of Physics
Associate Dean of Natural and Mathematical Sciences, College of Arts and Sciences

To: University Semester Conversion Committees

Re: Conversion of Chemistry Graduate Degree Programs (M.S. and Ph.D.)

Date: May 5, 2011

The Department of Chemistry offers graduate programs leading to the Masters of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees. Graduate courses and research programs are offered in analytical, biological, inorganic, organic, physical and theoretical chemistry, and affiliated multidisciplinary areas of study. The Department does not formally recruit students into the M.S. program; rather, all students are admitted into the Ph.D. program, whereupon a certain proportion of matriculated students choose to terminate their studies with the M.S. degree. All admitted students, other than those with fellowships, are supported by the department as teaching assistants.

The first year of graduate study is devoted largely to advanced coursework with the opportunity to begin research mid-year. During the second and subsequent years, the major emphasis is given to research for both M.S. and Ph.D. students. Doctoral students begin their examinations for admission to Ph.D. candidacy in their second year. These examinations include both written and oral portions; they are designed to verify the student's competence as an independent scientist.

All graduate research is carried out under the direct supervision of a faculty adviser(s) who serves as the student's preceptor. Many research groups are enriched by the presence of postdoctoral researchers and visiting professors. Graduates of the program are employed by industrial and government laboratories and as research and teaching staff members at colleges and universities across the United States.

The curriculum for graduate programs in Chemistry has remained relatively unchanged for many years, with courses being organized by area of study (divisionally). While new courses have infrequently been added, existing course structure has not evolved to fully meet the needs of the modern graduate student of chemistry. Consequently, the conversion to semesters represented an opportunity for the Department of Chemistry to re-envision the presentation of its curriculum, in order to maximize flexibility for students studying across different sub-areas of chemistry, to provide greater inter-divisional course offerings, to reorganize courses into topical offerings of greater relevance to student interests, and to codify various courses that have not been formally added to the curriculum.

The process for conversion of the graduate curriculum by the Graduate Studies Committee of the Department began in the summer of 2009. (NB. The progress of conversion was significantly delayed until the decision to merge the Departments of Chemistry and Biochemistry was formalized.) An initial strategy was formulated, wherein courses were to be offered in defined topical areas rather than as

sequences of intermediate and advanced courses. These topical areas included new core course offerings in the disciplines of analytical, biological, inorganic, organic, and physical chemistry that would be of general interest to beginning graduate students outside of a specific division. These core courses were viewed as foundational and would provide students with a common knowledge base with which to begin more advanced coursework. The core course structure was also envisioned to foster multidisciplinary interactions between students in different divisions, as these students would take a partially common set of courses during the first autumn session. The majority of topical courses were re-designed as seven-week session courses to further increase flexibility in student curricula by allowing a greater degree of diversity in course offerings.

It should be stressed that within this re-envisioned curriculum, the actual informational content would remain constant in the quarter-to-semester conversion, whereas the sequence and organization of informational transfer to students would change. The greater flexibility of course offerings will also reduce any difficulties for the small fraction of students faced with transitioning from quarters to semesters after their first year of study.

The curriculum was discussed extensively by the Graduate Studies Committee in formal meetings and electronically. The divisional representatives to this committee worked with divisional faculty to re-design course structure, to develop syllabi, and to sequence the course offerings. Consequently, all faculty members have had ample opportunity to provide input into the process. In cases where courses crossed divisional boundaries, interdivisional collaboration effectively merged divisional interests and needs. This process is ongoing, and it may be possible to further consolidate course offerings.

The M.S. and Ph.D. program requests and graduate course structure was unanimously approved by the Graduate Studies Committee (6-0), Chaired by the Vice Chair for Graduate Studies, and were approved by the Department of Chemistry tenure-track faculty (28-0) via an on-line, authenticated vote.

Details of the re-designed curriculum are provided in the accompanying documentation.

Sincerely,

Malcolm H. Chisholm
Chair and Distinguished University Professor
Department of Chemistry

Robert S. Coleman
Vice Chair for Graduate Studies
Department of Chemistry

DOCTORAL PROGRAM PROPOSAL – DEPARTMENT OF CHEMISTRY

Table of Contents

PROGRAM RATIONALE

The Department of Chemistry has traditionally offered thesis-based M.S. and Ph.D. degrees. In conversion to semesters, the fundamental basis for graduate degrees in Chemistry remains unchanged, although the coursework providing foundational knowledge has been re-designed and the content presentation has been re-envisioned.

Courses will continue to be offered in defined areas of specialization, except traditional sequences of intermediate and advanced courses have been re-designed to meet the needs of a modern program in chemical research. Courses are now offered from a topical perspective. These topical areas include foundational core course offerings in the disciplines of analytical, biological, inorganic, organic, and physical chemistry of general interest to beginning graduate students outside of a specific division. The majority of Introductory and Intermediate courses (6000-7000 level) were re-designed as seven-week session courses to further increase flexibility in student curricula by allowing a greater degree of diversity in course offerings and for flexibility in designing multidisciplinary tracks of study. Thus, the student under the new semester system will have a greater ability to take coursework that best suits their research interests, rather than a strictly proscribed curriculum based on divisions. It should be stressed that the overall content of the re-designed coursework is unchanged or modestly enhanced, and more modern topics that have been introduced as Individual Studies courses (693) or have been repeated offerings of advanced topics courses under quarters have been codified as new courses under semesters.

DOCTORAL PROGRAM IN CHEMISTRY

The Graduate School requirements for the Ph.D. degree are stated in the Graduate School Handbook. The Chemistry Department has several additional requirements and procedures as outlined below. The student may follow either of two paths. The first involves proceeding directly to the Ph.D. degree. The second involves completion of an M.S. degree followed by continuation toward a Ph.D. degree. In either program, the candidate must satisfy the course requirements of one of the divisions of the chemistry department, or a designed multidisciplinary course of study, in addition to all departmental requirements.

The purpose of coursework in the Ph.D. program is to prepare the student to take the Candidacy Examination for the Ph.D. degree and to undertake work on a significant original investigation in chemistry that culminates in the doctoral dissertation. With the approval of the advisor, a student may elect to meet specific degree requirements in any of the areas of chemistry in the department, normally the one in which the student's major research effort is planned.

The Ph.D. degree is a research degree, and thus most coursework is taken during the first year; usually only selected advanced subjects are taken in the second and subsequent year. Those courses indicated as electives may include those offered in other areas by the Division (both inside and outside the Chemistry Department) and, in some cases, additional courses in the major field. Advanced subjects are usually in the major field. Students may enroll in research as early as spring semester of their first year, and they must do so by the summer term of their first year in graduate school.

Students in good standing in the graduate school will enroll for Research in Chemistry (CHEM 8999) when they begin their degree research, and during each subsequent term. Each student should enroll every semester (except summer term) for one hour of a divisional Seminar course (889X, where X = 1-6), unless doing so violates the credit hour limits. This course requires regular attendance at departmental and/or divisional seminars.

GRADUATE COURSEWORK UNDER SEMESTERS

Course Structure and Total Contact Hours Chemistry graduate courses under the semester system are either 7- or 14-weeks in length, for 1.5 or 3.0 credits, respectively. The autumn and spring semesters have been divided into two sessions each, designated as AU-1/AU-2 and SP-1/SP-2. The May term will be used primarily for specialized or laboratory courses, and the Department does not teach graduate courses during the summer term. The recommended first-year graduate coursework in terms of contact hours is slightly increased in semesters over contact hours in the current quarter system. Some of the expansion is due to increased course content and some is due to imperfect conversions of courses with 48- vs. 55-minute lectures and 10-week quarters versus 7- or 14-week sessions. For example, under quarters, 8-9 quarter-length courses correspond to 192-216 hours of lecture, whereas under semesters, 11-12 seven-week session (half-semester) courses correspond to 201-220 hours of lecture.

Recommended Curriculum The following tables indicate the proposed recommended first-year curriculum for incoming graduate students in the Department of Chemistry. The terminology "introductory" and "intermediate" are used in this context. Thus, first-year graduate students will begin introductory-level coursework (6000-level) in the first semester, moving to intermediate-level coursework (7000-level) in the second semester (Table 1). Please note that not all courses are 7-week sessions; some courses are 14-week semester courses, and will take the place of two 7-week session courses (dotted vertical line, Course 1, Table 1).

All instructional content from quarter-based courses will be represented in the semester courses listed at the end of this document (Page 15).

Table 1. Recommended Coursework for First-Year Graduate Students (Credit Hours)					
Year 1	AU-1	AU-2	SP-1	SP-2	SU
Course 1	Introductory Divisional Course (1.5) 6000-level	Introductory Divisional Course (1.5) 6000-level	Intermediate Divisional Course (1.5) 7000-level	Intermediate Divisional Course (1.5) 7000-level	Thesis Research (4) 8999
Course 2	Core Elective (1.5) 6N10*	Introductory Divisional Course (1.5) 6000-level	Intermediate Divisional Course (1.5) 7000-level	Intermediate Course (1.5) 7000-level	
Course 3	Core Elective (1.5) 6N10*	Introductory or Intermediate Divisional Course (1.5) 6000-7000 level	Intermediate Course (1.5) 7000-level	[Intermediate or Advanced Course] (1.5) 7000-8000 level	
Course 4	Faculty Research (1) 6780	Lab Safety (1) 6781	Ethics (1) 6782		
Course 5	Seminar (1) 889N*		Seminar (1) 889N*		
Course 6	Non-thesis Research (4) 8998		Thesis Research (5-8) 8999		
Total Credit Hours	16		16		4
*N = 1 (analytical), X = 2 (biological), X = 3 (inorganic), X = 4 (organic), X = 5 (physical), X = 6 (theoretical).					

Specialized topics in the sub-disciplines of Chemistry will be offered as "Advanced Topics" 8000-level courses. Advanced Topics courses will be completed during the second and third years of study (Table 2). Typically 2-3 such courses per division are required.

Table 2. Recommended Coursework for Second- and Third-Year Students (Credit Hours)

Year 2-3	AU-1	AU-2	SP-1	SP-2	SU
Course 1	Advanced Topics (0-3) 8N99*		Advanced Topics (0-3) 8N99*		Thesis Research (4) 8999
Course 2	Seminar (1) 889N*		Seminar (1) 889*		
Course 3	Thesis Research (4-7) 8999		Thesis Research (4-7) 8999		
Total Credit Hours	8		8		4

*N = 1 (analytical), X = 2 (biological), X = 3 (inorganic), X = 4 (organic), X = 5 (physical), X = 6 (theoretical).

Credit Hour Accumulation Departmental rules require students to pass their Candidacy Examination by the end of the third year of study. At this point, according to the above plan, students will have completed 76 credit hours if they pass Candidacy in summer term of their third year. If Candidacy is passed earlier, students will have 75 credit hours (if Candidacy is passed in spring semester of the third year) or 70 credit hours (if Candidacy is passed in autumn semester), by the end of their third year. Under the proposed plan, and considering various scenarios for the timing of the Candidacy Exam, students will obtain the 80 credit hours required for the doctoral degree in less than four years.

It is exceedingly rare for a student to pass Candidacy before their third year of study, and Departmental records indicate that such students have always been supported on fellowships. In these infrequent cases, since fellowship-supported students must register for 12 credit hours per term, such a student would have 70 credit hours by the end of their second year of study.

Students in years 4-5 (and beyond if necessary) will register each semester for the divisional Seminar course and Thesis Research (Table 3).

Table 3. Recommended Coursework for Advanced Students (Credit Hours)

Year 4-5	AU-1	AU-2	SP-1	SP-2	SU
Course 1	Thesis Research (2) 8999		Thesis Research (2) 8999		Thesis Research (3) 8999
Course 2	Seminar (1) 889N*		Seminar (1) 889N*		
Total Credit Hours	3		3		3

*N = 1 (analytical), X = 2 (biological), X = 3 (inorganic), X = 4 (organic), X = 5 (physical), X = 6 (theoretical).

Curricular Requirements While each division (sub-discipline) in the Department of Chemistry has specific courses that are recommended, some of which proceed in a specific sequence, the Department does not consider that courses are formally "required" in the sense that a student cannot receive a graduate degree without successfully completing a given course. Students follow divisional guidelines and requirements for coursework, but exceptions are usually allowed and substitutions for introductory and intermediate courses are common. In the case of elective courses, some divisions have lists of approved electives, whereas other divisions allow the student considerable flexibility in choosing such courses. The Department also offers a multi-disciplinary track of study that is custom designed by the student and the student's advisor and which must be approved by the Graduate Studies Committee. The only true requirement for coursework is the advanced, special topics course offered by the Department. Even so, students are allowed to substitute outside-division offerings on a case-by-case basis, subject to divisional approval. Ultimately, it is the student's advisor and the Graduate Studies Committee who have final approval for a proposed curriculum.

REQUIREMENTS OF THE CHEMISTRY DOCTORAL PROGRAM

The following information is taken from the document "Summary of Procedures and Requirements for Graduate Degrees (2010-2011)." No significant changes to this document are envisioned upon semester conversion.

Admission to the Doctoral Program in Chemistry Admission requires demonstration of an acceptable B.S. or B.A. degree, and a reasonable expectation of success in the Ph.D. program. The student should have a minimum overall undergraduate point-hour ratio of at least 3.2 (on a 4.0 basis), suitable performance on the graduate record examination (GRE), or satisfactory completion of such specific additional requirements as may be stipulated in special cases. The Graduate Admissions Committee reviews and makes recommendations on each application for admission to the program. The Vice Chair for Graduate Studies has final approval on all offers of admission.

Duration of Graduate Programs in Chemistry The student who proceeds toward the Ph.D. without the M.S. degree will probably spend between 4-6 years, depending on the student's own initiative and research success. The student who has previously received a M.S. degree probably will spend four years in the Ph.D. program. The shorter time-periods apply to those students who enter with a strong undergraduate preparation, take a full course load, and are efficient and productive researchers.

Placement Exams At the time students enroll in the Graduate School the department will administer a series of written examinations that are used to gauge competence at the undergraduate level in analytical, biological, inorganic, organic, and physical chemistry. The purpose of these examinations is to aid the student and faculty advisors in planning a suitable progression of course work leading to the advanced degree. Students who are considered "not proficient" in an area will be provided with advice on how to strengthen competency in that area. Such advice may include suggested course work and/or a course of independent study.

Safety Seminar Program (CHEM 6781 – Laboratory Safety) Every graduate student is required to attend a complete series of Safety Seminars during their first year of study. The purpose of the series is to maintain high safety standards in the departmental teaching and research laboratories. The series of lectures, given weekly by the departmental safety coordinator, covers topics ranging from the handling of corrosive and toxic chemicals to fire fighting. Failure to attend any of these lectures will constitute an unsatisfactory performance as a Graduate Associate and may result in loss of departmental support during the summer of the first year. In addition to the Safety Seminars, each student must become familiar with the department's Chemical Hygiene Plan and the Standard Operating Procedures associated with their work.

Financial Support for Graduate Students Most graduate students receive financial support as Graduate Associates, either Teaching Associates (GTA) or Research Associates (GRA), or as Fellows during their tenure in the department. Graduate students supported by any of these appointments may not hold additional employment of any kind without express permission of the Vice Chair for Graduate Studies. The Graduate School sets mini-

mum requirements of eligibility for GA appointments to students who are in a degree program. Until passing the Candidacy Exam, students must register for at least eight (8) credit hours during autumn and spring semesters and at least four (4) credit hours during the summer term. After entering Ph.D. candidacy, the minimum number of credit hours per term is three (3) for all three terms. Students who hold fellowships or traineeships must register for twelve (12) credit hours during each term the appointment is held prior to entering Ph.D. candidacy, when they must register for a minimum of three (3) credit hours. Each of these registration requirements qualifies the student to be considered "full-time" for purposes such as visas, health insurance, etc.

There are further requirements imposed by the Graduate School. A student must be enrolled for at least three (3) credit hours during the term in which they graduate. A Master's degree requires at least 30 graduate credit hours, and the Ph.D. requires at least 80 graduate credit hours. Audited courses do not count toward these minima.

Departmental policies coincide with these guidelines for the most part:

(1) Students with a GPA below 3.00 lose their right to a summer term Graduate Research Associate appointment from the department (dGRA), and may lose future support as a GA.

(2) Students must advance to candidacy by the end of their third year in order to maintain support either in the form of a GRA, GTA, or fellowship appointment. Students failing to advance to candidacy by the end of the third year must petition the Vice Chair for Graduate Studies for continuation of support.

(3) Students required to obtain an M.S. degree prior to moving onto the Ph.D. track are still expected to advance to candidacy by the end of their third year to maintain support either in the form of a GRA or GTA appointment. Students failing to advance to candidacy by the end of their third year must petition the Vice Chair for Graduate Studies for continuation of support.

(4) Students who are entering their sixth year of graduate training must petition the Vice Chair for Graduate Studies to receive support during their sixth year, and must have the approval of their advisor. Approval of such petitions will require the demonstration of a reasonable prospect that the degree program can be completed within one year.

(5) Department policies specify that, except in unusual cases, students who have been enrolled for more than six years may not receive support as a GTA, GRA, or Fellow, from Research Foundation, departmental, or other funding sources. In exceptional instances, the Vice Chair for Graduate Studies will consider a petition for support beyond six years.

(6) Every faculty member is required to evaluate their Graduate Teaching Assistants each term with ratings of Excellent (E), Satisfactory (S+, S, or S–), or Unsatisfactory

(U). Evaluations are based on overall performance as a teaching associate, but also include punctuality, attendance of staff meetings, and attitude toward students. Students receiving an unsatisfactory (U) teaching evaluation will be suspended from their teaching appointment for one term and must petition the Vice Chair for Graduate Studies for subsequent reinstatement. No TA support will be available during such a suspension. Two S– ratings are regarded as equivalent to one U rating. Any subsequent U will lead to dismissal from the teaching program. No further TA support will be available. A further S– rating will result either in complete dismissal from the teaching program or a one-term suspension, as appropriate.

Faculty Research Presentations Students are required to attend a series of weekly Faculty Research Presentations during first session of the autumn semester (AU-1) of their first year in the program (CHEM 6780). The purpose of these presentations is to provide students with an overview of the types of research being conducted in various research groups, and to help students identify the faculty members that he/she wishes to interview. The point of attending presentations in the areas of interest to the student is obvious. The Department also hopes that attending presentations from other disciplines will provide students with points of reference, should they need help during the course of their graduate studies, for topics in which their advisor is not an expert.

Advisor Selection and Initiation of Research Dissertation research is initiated when a student has selected a research adviser, and has been admitted into a research group. The selection of an advisor is a major step in a student's program. The process involves a formal system of interviews. To initiate the procedure, the student will obtain a "Selection of Research Advisor Form" from the Graduate Office and designate a minimum of four (4) faculty members that he/she wishes to interview. Students are encouraged to interview as many faculty as they feel may provide research programs of interest. The Vice Chair will assign additional faculty members for Graduate Studies in accordance with departmental and divisional guidelines, and provide the student with an "Interview Record Sheet." All faculty members on the "Interview Record Sheet" must sign the sheet after they have been interviewed. Students then submit a rank-ordered list of their top three choices for advisor ("Choice of Preceptor" form) to the Graduate Office by the last day of final exams in autumn semester. The Graduate Studies Office provides the list of student advisor preferences to the division secretaries and faculty. Following any formal discussion between faculty that may be required by a division, the faculty member listed as the first choice must decide whether or not to serve as advisor to the student. The faculty member notifies the division secretary and Graduate Studies Office of his/her decision. If a faculty decides not to serve as advisor, the faculty member who is the second choice makes a similar decision. This process is repeated until the student has an advisor. In the event a student is not accepted by one of their top three choices, the Vice Chair for Graduate Studies becomes active in helping the student find an advisor, in a manner left to the discretion of the Vice Chair. Once the list of advisor preferences has been distributed, it is a goal of the department to place students in research groups within a two-week period. The process of selecting an advisor must be completed by the end of the second semester in order to qualify for a summer term dGRA appointment.

A student may complete their Ph.D. research under the supervision of an advisor from outside the Department of Chemistry with a co-advisor on the Chemistry faculty. All such arrangements must be collaborative in nature with the Chemistry faculty member serving as the Principal Investigator on the research project, and are subject to approval by the Vice Chair for Graduate Studies, who will request a description of the proposed research and consider whether it is suitable for a Ph.D. thesis in Chemistry.

After selection of an advisor and in consultation with the student and their advisor, the Vice Chair for Graduate Studies will appoint an advisory committee for each student. The purpose of the advisory committee is to provide each student with support and guidance during their graduate career. Students should meet with their advisory committee during the autumn semester of each year to discuss their progress in course work, examinations and research. In addition, students are free to meet with any committee member at any time during the year. The department hopes that this process will provide a mechanism for forging closer ties between students and faculty, both before and after graduation.

If a student leaves a group, or the faculty advisor resigns his/her position as preceptor, the student will have up to one semester to find a new advisor. After this time, support will be withdrawn.

First-Year Oral Examination All students pursuing either a Ph.D. degree must take an oral examination in the summer of their first year of study. The focal point of this examination is a paper that is related to the student's research topic, and which is selected jointly by the student and their advisor. The purpose of this exam is to evaluate the student's progress within the context of an activity that is relevant to their research interests, and to determine whether the student is ready to proceed with further requirements of the Ph.D. program.

Repeat exams or extra chances at cumulative exams will only be given in exceptional cases. The student must clearly state the grievance and proposed redress in a petition to the Graduate Studies Committee, who will act on the petition in consultation, and based on the recommendation, of the division(s) administering the exam.

Candidacy Exam The advisor and student should collectively determine the precise timing of the Candidacy Examination. Students who have passed the First-Year Oral Examination should initiate the Candidacy Examination no earlier than the spring of their second year and no later than the summer of their third year. Students requiring further evaluation via cumulative exams should initiate their Candidacy Examination within six (6) months of completing cumulative exams. Students requiring further evaluation via completion of an M.S. degree should initiate their Candidacy Examination within six (6) months of completing their M.S. degree. In all instances, students must complete their Candidacy Examination by the end of their third year in the program.

The Candidacy Examination offered by the different divisions in the Department of Chemistry vary slightly in format, but in each case this examination includes both written and oral portions in accordance with procedures from the Graduate Handbook. The examination is a comprehensive test administered by a committee of faculty, and is based on the fundamen-

tals of the broad area of chemistry in which the student is specializing. Satisfactory performance in the written and oral examinations admits the student to Candidacy for the doctoral degree at the end of the term in which the exam is passed.

The written portion of the Candidacy Examination for the Ph.D. takes the form of an original research proposal written by the candidate. The purpose of this written exam is to examine the creative potential of the candidate and their knowledge of relevant literature surrounding the proposed research. The Candidacy Examination committee must indicate approval of the proposal by signing a form (available from the Graduate Studies Office) and a copy of the approved proposal must be filed with the Graduate Studies Office).

The oral portion of the Candidacy Examination consists of general questions that may be initiated by the defense of the original written proposal that constitutes the written portion of the Candidacy Examination. The examination committee must approve the written portion of the Candidacy Exam three weeks prior to the oral exam. A final draft of the student's written examination must be available to all members of the oral examination committee, including a possible university representative appointed by the Graduate School, at least two weeks prior to the examination. The candidate shall be judged on the oral examination by his/her performance on the general questions and the defense of his/her research proposal.

The Vice Chair for Graduate Studies, with advice from the student's advisor, will assign faculty to the student's candidacy exam committee.

Dissertation The dissertation resulting from the student's graduate research must represent a significant contribution to knowledge in chemistry. Its importance should be sufficient to warrant the acceptance for publication of a paper based upon it by one of the respected journals of chemistry or a related scientific area. A reading committee composed of the adviser and at least two graduate faculty members (often members of the student's Advisory Committee) will consider the merit of the dissertation in detail. The student's advisor selects this committee.

Final Oral Exam On approval of the dissertation by the advisor and the reading committee, a final oral examination, based largely on the dissertation work, will be held in accord with the Graduate School guidelines. The examination committee will consist of the members of the dissertation reading committee, and a graduate faculty member nominated by the Dean of the Graduate School from a department other than Chemistry. A unanimous vote of all committee members is required for a satisfactory decision.

DOCTORAL PROGRAM UNDER QUARTERS

The following table outlines the suggested Ph.D. curriculum for entering graduate students under the current quarter system (Tables 4, 5, and 6). All courses are three (3) credit hours. The specific recommendations or requirements vary slightly by area of specialization, but in general, entering graduate students take 8-9 lecture courses during their first year, with variation existing largely in the balance of major subject/elective courses. Students are expected to take between 1-3 advanced subject courses (900-level) over the remaining years of study, depending on divisional guidelines.

Table 4. Recommended Coursework for First-Year Students (Credit Hours)

Year 1	AU	WI	SP	SU
Course 1	Major Subject (3)	Major Subject (3)	Major Subject (3)	Thesis Research (7) 999
Course 2	Major Subject (3)	Major Subject (3)	Elective (3)	
Course 3	Elective (3)	Elective (3)		
Course 4	Colloquium (1) 885	Colloquium (1) 885	Colloquium (1) 885	
Course 5	Faculty Research (1) 693	Lab Safety (2) 685		
Course 6	Research (9) 999	Research (8) 999	Research (13) 999	
Total Credit Hours	20	20	20	7

Table 5. Recommended Coursework for Second- and Third-Year Students (Credit Hours)				
Year 2-3	AU	WI	SP	SU
Course 1	Advanced Subject (0-3)	Advanced Subject (0-3)	Advanced Subject (0-3)	Thesis Research (7) 999
Course 2	Colloquium (1) 885	Colloquium (1) 885	Colloquium (1) 885	
Course 3	Research (5-8) 999	Research (5-8) 999	Research (5-8) 999	
Total Credit Hours	9	9	9	7

Table 6. Recommended Coursework for Advanced Graduate Students (Credit Hours)				
Year 4-5	AU	WI	SP	SU
Course 1	Colloquium (1) 885	Colloquium (1) 885	Colloquium (1) 885	Thesis Research (3) 999
Course 2	Research (2) 999	Research (2) 999	Research (2) 999	
Total Credit Hours	3	3	3	3

All instructional content from quarter-based courses will be represented in the semester courses listed at the end of this document (Page 15). The non-coursework requirements under the quarter system will remain unchanged under the semester system, and are detailed above.

TRANSITION PLAN

As indicated above, the vast majority of graduate students in the Department of Chemistry finish their basic coursework during their first year of study. Exceptions to this are largely due to some courses being offered in alternate years, and these alternate year courses will still be offered in the same order so as not to delay students. Thus, for the cohort of 55-60 students entering the doctoral program in AU11 quarter, there will be a few (< 10%) who have not taken all their required coursework by the time semester conversion is implemented in the AU12 semester. The Vice Chair for Graduate Studies will manage individual advising of this remnant group of students, in concert with their research advisors. The greater flexibility of course offerings will also reduce any difficulties for the small fraction of students faced with transitioning from quarters to semesters after their first year of study.

Because there is no required number of credit hours of coursework that students must complete for the Ph.D. degree, there are no issues of credit hour conversion between quarters and semesters for graduate courses.

SEMESTER COURSE LIST

Semester Course Number	Course Title	Semester Credit Hours	Quarter Course Basis	Quarter Credit Hours
5193	Individual Studies	1.0-10	693	0-15
5194	Group Studies	1.0-10	694	1.0-5.0
5420	Spectroscopy of Organic Compounds	1.5	632	3.0
5430	Carbohydrate Chemistry	1.5-3.0	635	3.0
5440	Introduction to Computational Chemistry	1.5-3.0	644	3.0
5520	Nanochemistry	3.0	611	3.0
6110	Survey of Instrumental Methods	1.5	new	
6120	Analytical Data Treatment	1.5	720	3.0
6210	Chemistry at the Interface of Biology	1.5	new	
6310	Fundamentals of Coordination Chemistry	1.5	new	
6320	Synthetic Principles in Inorganic Chemistry	1.5	753	3.0
6330	Group Theory and Bonding	1.5	851	3.0
6340	Physical Methods in Inorganic Chemistry	1.5	752	3.0
6410	Basic Organic Reaction Mechanisms	1.5	new	
6420	Stereochemistry and Conformational Analysis	1.5	730	3.0
6430	Introduction to Organic Synthesis	1.5	832/833	3.0/3.0
6440	Introduction to Physical Organic Chemistry	1.5	731/831	3.0/3.0
6510	Quantum Mechanics and Spectroscopy	1.5	new	
6520	Thermodynamics	1.5	775	3.0
6530	Kinetics	1.5	775	3.0
6540	Introduction to Electronic Structure	1.5	866	3.0
6550	Atmospheric Chemistry	1.5	641	3.0
6780	Faculty Research Presentations	1.0	new	
6781	Laboratory Safety	1.0	685	2.0
6782	Ethics in Scientific Research	1.0	new	
7120	Electrochemistry	3.0	821	3.0
7130	Fundamentals & Techniques of Separation Science	3.0	822	3.0
7140	Analytical Spectroscopy	3.0	823	3.0
7150	Mass Spectrometry	3.0	825	3.0
7160	Nuclear Magnetic Resonance	3.0	824	3.0
7170	Analytical Surface Science	1.5-3.0	new	
7320	Organometallic Chemistry	1.5	751	3.0
7330	Solid State Chemistry	1.5	754	3.0
7340	Diffraction Methods	1.5	new	

7350	Inorganic Photochemistry	1.5	995	3.0
7360	Bioinorganic Chemistry	1.5	752	3.0
7370	Nanochemistry	1.5	995	3.0
7380	Inorganic Materials	1.5	995	3.0
7390	Advanced Inorganic Laboratory	1.5	755	3.0
7430	Advanced Organic Synthesis	1.5	832/833	3.0/3.0
7440	Kinetics, Catalysis, and Transition State Theory	1.5	731/831	3.0/3.0
7450	Metals in Organic Synthesis	1.5	833	3.0
7460	Advanced Organic Reaction Mechanisms	1.5	731/831	3.0/3.0
7470	Computational Chemistry	1.5	944	3.0
7480	Advanced Organic Synthesis Laboratory	3.0	835/836	3.0-5.0
7520	Advanced Molecular Quantum Mechanics	3.0	862/863	3.0/3.0
7530	Spectra and Structure of Molecules	3.0	863/866	3.0/3.0
7540	Chemical Dynamics	3.0	876	3.0
7550	Statistical Thermodynamics	3.0	880	3.0
7560	Introduction to Astrochemistry	3.0	740	3.0
7570	Aerosol Science	1.5	new	
7580	Lasers, Optics, and Optical Instrumentation	1.5-3.0	997	3.0
7590	Molecular Simulation of Materials	3.0	996	3.0
8199	Advanced Topics in Analytical Chemistry	1.5-3.0	991	3.0
8299	Advanced Topics in Biochemistry	1.5-3.0	990	3.0
8399	Advanced Topics in Inorganic Chemistry	1.5-3.0	995	3.0
8499	Advanced Topics in Organic Chemistry	1.5-3.0	941/942/943	3.0
8599	Advanced Topics in Physical Chemistry	1.5-3.0	997	3.0
8699	Advanced Topics in Theoretical Chemistry	1.5-3.0	996	3.0
8891	Analytical Seminar	1.0	885	1.0
8892	Biochemistry Seminar	1.0	885	1.0
8893	Inorganic Seminar	1.0	885	1.0
8894	Organic Seminar	1.0	885	1.0
8895	Physical Seminar	1.0	885	1.0
8896	Theoretical Seminar	1.0	885	1.0
8899	Doctoral Seminar	1.0	new	
8998	Non-thesis Research	1.0-15	new	
8999	Thesis/Dissertation Research	1.0-15	999	1.0-15