



**SUMMARY OF
PROCEDURES AND
REQUIREMENTS
FOR GRADUATE DEGREES**

DEPARTMENT OF CHEMISTRY
THE OHIO STATE UNIVERSITY

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SUMMARY OF PROCEDURES AND REQUIREMENTS FOR GRADUATE DEGREES IN THE CHEMISTRY DEPARTMENT

INTRODUCTION

The requirements for advanced degrees at The Ohio State University are summarized in the Graduate School Handbook (GSH), which is available in the Graduate School office. Each student should obtain a copy of this Handbook upon entering OSU and keep it for reference during the tenure of his or her degree program.

The present document summarizes specific requirements for graduate degrees in Chemistry, as well as additional comments and instructions for students in our program. Remember that the graduate student in Chemistry who seeks the M.S. or the Ph.D. degree is expected to expend a major effort on the research problem that culminates in a thesis or dissertation. To reach this goal the candidate will conduct independent research under the guidance of an advisor, prepare and present a thesis on the study, and demonstrate that it adds significant new knowledge to some area of chemistry. The course requirements are designed to prepare the student for this major challenge of graduate education. Do not become preoccupied with these rules, but be guided by them to an increasingly productive and rewarding experience.

ADMISSION TO GRADUATE PROGRAMS 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 3.0 (on a 4.0 basis), suitable performance on the graduate record examinations, or satisfaction of such specific additional requirements as may be stipulated in special cases. The Graduate Admissions Committee reviews each application for admission to this program.

TRANSFER STUDENTS

At the time of admission, the Admissions Committee may make a recommendation that certain transfer students be exempted from the first-year exams (see section II.A below). This decision will be based on the student's academic record, and level of research experience. If no recommendation is made, transfer students will be required to take the first-year exam.

Transfer students may petition to allow courses they took at a previously attended institution to stand in place of courses required here. The student will submit previous course materials – syllabi, notes, homework and exams – which will be evaluated by appropriate faculty in our department.

ACADEMIC STANDARDS FOR GRADUATE PROGRAMS

A graduate student doing acceptable work toward a graduate degree is expected to maintain a point-hour ratio of B (3.0) or better in all graduate-credit courses. If at any time, after 15 hours of graduate credit, a student's cumulative point hour ratio (CPHR) falls below the 3.0 requirement, the student is placed on probation automatically by the Graduate School. Although the student is expected to raise the CPHR above 3.0 the next quarter, continued enrollment is permitted on a quarter-by-quarter basis, as determined by the Graduate Studies Chair of the Department of Chemistry and the Graduate School.

THE DURATION OF GRADUATE PROGRAMS IN CHEMISTRY

Normally, an M.S. student will spend two years in residence. 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 previously has 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 EXAMINATIONS

At the time students enroll in the Graduate School, the department will administer a series of written examinations that are used to gauge their 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 a given 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 685)

Every graduate student is required to attend a complete series of Safety Seminars during the winter quarter of the first year. 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 as a graduate student. Graduate students supported by any of these appointments may not hold additional employment of any kind without express permission of the Graduate Studies Committee. The Graduate School sets minimum requirements of eligibility for GA appointments to students who are in a degree program. Until passing the candidacy exam (section II.B) students must register for a minimum of 9 credit hours during autumn, winter and spring quarters and 7 credit hours during the summer.¹ After entering Ph.D. candidacy, the minimum number of credit hours per quarter is 12 and a minimum of 20 credit hours over at least two quarters is must be completed after admission to candidacy. Students who hold fellowships must register for 15 credit hours during each quarter the appointment is held. International students who are not holding a GA appointment (an exceedingly rare occurrence) must register for 10 credit hours per quarter.

There are further requirements imposed by the Graduate School. A student must be enrolled for at least 3 credit hours during the quarter in which they graduate. A Master's degree requires a total of at least 45

¹ It is a quirk of the OSU system that the Registrar considers graduate students enrolled for less than 10 credit hours to be part-time students. However, the Graduate School has advised us that there are no negative consequences for enrollment of less than 10 credit hours. Since enrollment for less than 10 credit hours entails some financial benefits to the Department or your advisor without any adverse consequences, you may be advised to enroll for 9 hours during the regular academic year or 7 hours during the summer.

graduate credit hours, and the Ph.D. requires at least 135 graduate credit hours. Audited courses do not count toward these minima.

Departmental policies coincide with these guidelines for the most part:

- (1) Students with GPA's below 3.0 lose their right to a 4th quarter Graduate Research Associate appointment from the department, and may lose future support as a TA.
- (2) Students must advance to candidacy by the end of their third year to maintain support either in the form of an RA, TA or fellowship appointment. Students failing to advance to candidacy by the end of the third year must petition the Graduate Studies Committee 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 an RA or TA appointment. Students failing to advance to candidacy by the end of their third year must petition the Graduate Studies Committee for continuation of support.
- (4) Students required to take a terminal M.S. degree are expected to defend their thesis by the end of their third year. Students failing to defend their M.S. thesis by the end of their third year must petition the Graduate Studies Committee for continuation of support.
- (5) Students who are entering their sixth year (completing their 20th quarter excluding Early Start) of graduate training must petition the Graduate Studies Committee to receive support during their sixth year (quarters 21- 24), 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.
- (6) Department policies specify that, except in unusual cases, students who have been enrolled for more than 24 quarters (excluding Early Start) may not receive support as a GTA, GRA, or Fellow from research Foundation, departmental, or other sources. In exceptional instances, the Graduate Studies Committee will consider a petition for support beyond 24 quarters.
- (7) Each faculty member is required to evaluate their Graduate Teaching Assistants each quarter with ratings of Excellent, Satisfactory, or Unsatisfactory. Evaluations are based primarily 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 quarter and must petition the Vice Chair for Graduate Studies for 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-quarter suspension, as appropriate.

GRIEVANCE PROCEDURES

Discussion with the Vice Chair for Graduate Studies usually leads to resolution of a grievance. If discussion with the Vice Chair proves unsatisfactory, the Council on Research and Graduate Studies has established grievance procedures, copies of which are available in the Graduate School.

ENGLISH REQUIREMENTS - International Students

A student whose native language is not English must demonstrate a satisfactory proficiency in English at the beginning of the graduate program. Courses in written and oral English may be required for students who show a deficiency that might prove to be a handicap to graduate work. Students who hold a TA will be required to demonstrate proficiency in Spoken English, either by passing the SPEAK TEST or a Mock Teaching Test, both of which are administered by the English as a Second Language Program. Students must be certified to teach by the end of the summer quarter of their first year. International students may also be required to take written English courses (106, 107, 108.2) after taking English entrance examinations. Chemistry students are required to complete all written English courses by the end of their 4th quarter at OSU.

INITIATION OF RESEARCH AND ADVISOR SELECTION

Dissertation research is initiated after 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 Department Graduate Office and designate a minimum of 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, to the Graduate Studies Office, a list of the top three choices in rank order ("Choice of Preceptor" form) on a date that is announced at the start of autumn quarter, typically during the ~~third~~ first week in January. 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 third quarter in order to qualify for a fourth quarter RA appointment.

A student may complete their Ph.D. research under the supervision of an advisor from outside the Department of Chemistry and a co-advisor on the Chemistry faculty. All such arrangements are subject to approval by the Graduate Studies Committee, who will request a description of the proposed research and consider whether it is suitable for a Ph.D. thesis in Chemistry.

After advisor selection 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 quarter 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 should leave a group, or the faculty advisor resign his/her position as preceptor, the student will have up to one quarter to find a new advisor. After this time, support will be withdrawn.

FACULTY RESEARCH PRESENTATIONS

Students are required to attend a series of weekly Faculty Research Presentations during the autumn quarter of their first year in the program. 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 4 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.

GRADUATE PROGRAMS

I. DEGREES GRANTED, RESIDENCE AND CREDIT HOUR REQUIREMENTS

A. MASTERS PROGRAM

The student must have a minimum residence of three quarters at The Ohio State University with completion of at least 45 quarter hours of graduate work. The student's course program should be decided in conjunction with the Advisor. Course work must be at the 600-900 level, and the courses in related fields must be acceptable to the Chairman of the Graduate Studies Committee of the Department of Chemistry, the student's advisor, and the student's division. Divisional course requirements for the M.S. degree can be found under the section titled "Course and Examination Requirements for the Subdisciplines in Chemistry" (pages 14-31) of this document.

Students will carry out a research program that will culminate with the writing of a thesis. The research program should be initiated after the beginning of the second quarter in residence. See Initiation of Research under Ph.D. requirements, and Graduate Examinations for various subdisciplines, for more specific procedures.

A student must submit an "Application to Graduate" form to the Graduate School no later than the second Friday of the quarter in which graduation is expected. At least two weeks prior to the date proposed for conferring the M.S. degree, the candidate must pass an oral examination before a committee composed of at least two Chemistry Department faculty members including their research advisor. Should the graduate record of the candidate be wholly satisfactory to the examining committee, the scope of the examination will be confined to the candidate's field of specialization.

Students working toward an M.S. degree will not receive financial support from the department (GRA, GTA, GAA) after completion of 12 quarters (excluding Early Start) in the program. The Department of Chemistry does not award an M.S. Degree without a thesis.

B. DOCTORAL PROGRAM

The Graduate School requirements for the Ph.D. degree are stated in Part V of 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 in addition to all departmental requirements.

The purpose of course work in the Ph.D. program is to prepare the student to take the General Examinations for the Ph.D. (written and oral) 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, that area will be the one in which the student's major research effort is planned.

Students initiating graduate studies at The Ohio State University after having received M.S. degrees at other institutions can petition to have course requirements waived as follows. The student submits evidence (for example syllabus, course notes and examinations) of having taken a course equivalent to one required by this program to the appropriate Division Secretary. The evidence is evaluated by

appropriate faculty who recommend whether or not the course satisfies requirements in the division of the student's specialization. The recommendation is submitted by the evaluator for approval to the Secretary of the Division and the Chair of the Graduate Studies Committee.

The Ph.D. degree is a research degree and thus most course work is taken during the first year; usually only selected advanced subjects are taken in the second year. Those courses indicated as electives may include those required 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 winter quarter of their first year, and they must do so by the summer quarter following their first year in graduate school.

Students in good standing in the graduate school will enroll for Research in Chemistry (Chem 999) when they begin their degree research. Each student must enroll every quarter for one hour of Chem 885 (Colloquium in Chemistry). This course requires regular attendance at departmental and/or divisional seminars.

The broadly defined contents of the Ph.D. curriculum in Chemistry are illustrated in the "Suggested Ph.D. Curriculum" which follows. More specific sample curricula are presented on a divisional basis on following pages.

C. Suggested Ph.D. Curriculum

<u>First Year, Autumn</u>	<u>Hours</u>		<u>Second Year, Autumn</u>
Major Subject	6		Advanced Subject 3
Electives	3		Research (999) 8
Colloquium (885)	1		Colloquium (885) 1
<u>First Year, Winter</u>			<u>Second Year, Winter</u>
Major Subject	6		Advanced Subject 3
Electives	3		Research (999) 8
Colloquium (885)	1		Colloquium (885) 1
Safety Seminar (685)	2		
<u>First Year, Spring</u>			<u>Second Year, Spring</u>
Major Subject	3		Advanced Subject 3
Elective	3		Research (999) 8
Research (999)	5		Colloquium (885) 1
Colloquium (885)	1		
<u>First Year, Summer</u>			<u>Second Year, Summer</u>
Research (999)	12		Research (999) 12
<u>All Subsequent Quarters</u>			
Research (999)	11		
Colloquium (885)	1		

Students holding a TA/RA appointment must register for at least 10 credits each quarter.
Fellowship students must register for at least 15 credits each quarter.

II. DEPARTMENTAL REQUIREMENTS FOR THE Ph.D. DEGREE

A. First-Year Oral Examination

All students pursuing either an M.S. degree or Ph.D. degree must take an oral examination near the end of their first year of study. The focal point of this examination is a paper selected by the student and advisor that is related to the student's research topic. 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. The administration of the first-year oral examination is outlined below.

1. By the end of the first week of spring quarter, the secretary of each division announces to students:
 - a two-week time period for administration of the first-year oral examination.
 - possible outcomes after the exam (e.g. proceed to the Ph.D. candidacy examination, take a series of written examinations prior to proceeding to the candidacy examination ...).
 - a three-member committee, or set of three-member committees to give the oral exams.

A single three-member committee of faculty members is typical because all students in a division will be judged by a common standard. However, it may not be practical for a single committee to examine all students in each division.

2. The examination committees attend a brief orientation with the Vice Chair for Graduate Studies to make sure that examinations are conducted consistently within the department.
3. The student and advisor are jointly responsible for selection of a journal article, related to the student's research topic, which will form the basis of the exam. The article may or may not be one published with the advisor as a co-author. In some cases, prior approval of the article by the committee may be required (as defined in Section III of this document). It is a good strategy to choose an article that covers substantial scientific issues without being overly difficult. An article that is, for example, a brief communication of measurements will give the examination committee little inspiration for exam questions. In that case the line of questioning will be less predictable and put the student at a disadvantage. The student and advisor are jointly responsible for delivering a copy of the article to the each examination committee member two weeks in advance of the exam period.
4. The Graduate Studies Office, in consultation with committee members and students, will be responsible for scheduling the individual exams. All exams must take place within the specified two-week period unless the student has a valid excuse. Significant life events (e.g. wedding), documented medical excuses, or important scientific activities (e.g. conference) constitute valid excuses.
5. The format of the exam will include a short presentation by the student of no more that 5-10 minutes, followed by approximately one hour of questioning. The student may use the chalkboard, overheads or computers as part of this presentation (refer to divisional requirements in Section III of this document). The presentation and paper will serve as the starting point for questioning. Students will be expected discuss the content of the paper and respond to questions about larger concepts underlying research described in the paper. The advisor, if not a member of the committee, can sit in on the exam. The advisor may formulate questions with the permission of the committee, but may not assist the student with answers.

6. After the exam, the student is excused. The exam committee and the advisor will have a brief (5-10 minute) meeting to exchange impressions on the exam. This is very useful for getting a more accurate view of the student's performance and preventing later misunderstandings.
7. Within two working days of the last exam,* all examination committees of each division will meet and, based on the student's overall performance on the oral exam and first-year course work, determine whether each student should proceed directly with the Ph.D. program, undergo further evaluation (as defined by each division in Section III of this document), or proceed to a terminal M.S. degree. Forms for communication of the results will be furnished by the Graduate Studies Office.
8. Within three working days of the last exam,* the results of the exams must be communicated to the division secretaries and the Graduate Studies Office.
9. Within four working days of the last exam,* the results of the exams will be reported to the students by the Graduate Studies Office.

* excluding exams delayed for weddings, etc.

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.

B. General Examination or Candidacy Examination.

The precise timing of the candidacy examination should be determined collectively by the advisor and the student using the following guidelines. Students who have passed the First-Year Oral Examination should complete the candidacy examination no earlier than the spring of their second year and no later than the autumn of their third year. Students requiring further evaluation via cumulative exams should initiate their candidacy examination within 6 months of completing cumulative exams. Students requiring further evaluation via completion of an M.S. degree should initiate their candidacy examination within 6 months of completing their M.S. degree. All 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 somewhat in format as described in sections that follow, but in each case this examination includes both written and oral portions. The examination is a comprehensive test administered by a committee of the faculty and is based on the fundamentals of the entire area of chemistry in which the student is specializing. The student's progress in research will also be evaluated by the exam committee. Satisfactory performance in this examination or series of examinations admits the student to candidacy for the degree at the end of the quarter in which the exam is passed, or the series concluded.

The **written portion of the Candidacy Examination** for the Ph.D. takes the form of an original written research proposal prepared 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 details of this examination are delineated in Section III of this document.

The oral portion of the Candidacy Examination for the Ph.D. 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 written portion of the candidacy exam must be approved by the examination committee 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 (see next section), 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.

Procedures for Selection of Candidacy Examination Committee

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

1. The student's adviser will recommend three faculty members, in addition to him/herself, to the Vice Chair to serve on the oral committee. Faculty members will normally be from the student's division.
2. The Vice Chair may select two of the three nominees, or may suggest another faculty member if inequities exist in the distribution of assignments.
3. When required by division rules, the Vice Chair will also assign a committee member from outside the division. The university representative will sometimes be assigned by the Dean of the Graduate School.
4. The Vice Chair will notify the adviser of those individuals to serve on the committee, and the adviser will arrange a time and location for the exam in consultation with his/her colleagues, and the Vice Chair's office. The appropriate form (Doctoral Notification of Candidacy Examination form) will be prepared by the Vice Chair's office and the advisor/student must file this form with the Graduate School at least two weeks prior to the examination date.

C. Dissertation. The dissertation resulting from the student's graduate research must represent 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.

D. Final Oral Examination. 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.

III. COURSE AND EXAMINATION REQUIREMENTS FOR THE SUBDISCIPLINES IN CHEMISTRY

With the approval of his/her adviser, a student may elect to satisfy the specific graduate degree requirements in any one of the areas of chemistry (i.e. division) in the department. Alternatively, the student and advisor may jointly propose a multidisciplinary program of student by submitting an application for the Multidisciplinary Track for evaluation and approval by the Graduate Studies committee.

The examination procedures employed by the different divisions are defined in the following sections. Each of the procedures allows an early delineation of the final study plan and the nature of the degree to which the student's effort will lead. Divisional requirements, such as satisfactory performance on a qualifying examination or presentation of seminars, are supplemental to the departmental requirements.

A. Analytical Chemistry. A Ph.D. candidate is required to take, in addition to those graduate analytical courses recommended by his/her adviser, Chemistry 721, three of the five 820 series courses (821, 822, 823, 824 and 825) and at least three courses numbered 700 or above in areas other than analytical chemistry. The choice among alternatives will be made in consultation with the student's adviser and in view of the major interest areas of the candidate. When appropriate, courses with numbers below 700 may be substituted by petition to the analytical division faculty. Acceptable courses in areas outside analytical include, but are not limited to, the following: Biochemistry 733, 734; Inorganic Chemistry 751, 752, 753, 851; Organic Chemistry 731, 832, 833; Physical Chemistry 861, 862, 863, 775, 880, 876.

Sample Analytical Chemistry Ph.D. Curriculum

<u>First Year, Autumn</u>	<u>Hours</u>	<u>Second Year, Autumn</u>	<u>Hours</u>
721, 82x Analytical Chem	3	82x Analytical Chem	3
775 or 861 Physical	3	999 Research	8
Elective a	3	885 Colloquium	1
885 Colloquium	1		
 <u>First Year, Winter</u>		 <u>Second Year, Winter</u>	
82x Analytical Chem	3	999 Research	11
862 Physical	3	885 Colloquium	1
Elective b	3		
885 Colloquium	1		
685 Safety Seminar	2		
 <u>First Year, Spring</u>		 <u>Second Year, Spring</u>	
82x Analytical Chem	3	999 Research	8
Elective c	3	885 Colloquium	1
999 Research	5	991 Special Topics	3
885 Colloquium	1		
 <u>First Year, Summer</u>		 <u>Second Year, Summer</u>	
999 Research	7	999 Research	12
720 Analytical Chem	3		
 <u>All Subsequent Quarters</u>			
999 Research	11		
885 Colloquium	1		

- a. Usual electives are 751, 731 or 733
- b. Usual electives are 752, 832
- c. Usual electives are 753, 833

82x Series Courses: Students are required to take three of the following courses. The courses will be rotated as follows:

School year ending with an even number

Autumn	821	Electrochemistry
Winter	822	Separation Science
Spring	833	Spectroscopy

School year ending with an odd number

Autumn	824	Nuclear Magnetic Resonance
Winter	825	Mass Spectrometry
Spring		Special Topics Course

The degree programs available to students interested in Analytical Chemistry are:

- The M.S. Degree
- The Ph.D. Degree

1. The M.S. Degree. Students who intend to terminate graduate studies after the M.S. degree follow this degree program. It is also followed by students whose early graduate performance indicates that completion of a thesis problem and writing of a M.S. thesis would be of considerable help in advancing their academic program and students who cannot complete a given requirement of the Ph.D. program. For example, students who do not pass the Candidacy Examination portion of the Ph.D. program often complete the thesis M.S. degree program. The minimum course requirements for the M.S. Degree are completion of Chem 720 and Chem 721. Other courses may be required by the advisor as required for the student to gain expertise aligned with the thesis project. The student must also write an M.S. thesis and defend this thesis (oral examination) as delineated on page 8 of this document.

2. The Ph.D. Degree. To proceed toward a Ph.D. degree without obtaining the M.S. degree students must make satisfactory progress as follows:

- The student must be enrolled in the Graduate School and maintain a 3.0 GPA at the end of the third quarter of the first academic year and all quarters thereafter.
- The student must have selected a research advisor by the end of the third quarter of the first academic year and must remain in a research group thereafter.
- During the summer following the first academic year, the student must present a poster on his/her research carried out during the first academic year.
- The student must complete 21 hours of lecture courses (graded A thru E) during the Autumn, Winter and Spring quarters of the first academic year. A minimum of 15 of these credits must be at the 700 level or above (Chem 661.01, 661.02, and 694 will be treated as 700 level courses for this purpose).
- The student must pass the First-Year Oral Examination (see below).

First Year Research Project

Each student seeking to earn the Ph.D. degree is expected to begin a research project in the first year at Ohio State. The choice of such a project will be made in consultation with the student's advisor. A poster

session will be held at the end of the summer quarter in which the first year students will have the opportunity to report on their progress and to discuss their research with other students and faculty. All first year students must present a poster. A brief written description of the poster presentation shall be provided, in advance, to the analytical division secretary.

Student Seminars

Students seeking to earn a Ph.D. degree are expected to present seminars to the analytical division during their second and final years in the program, as part of the requirement for Chemistry 885. The second year seminar will generally be 30 minutes long on a topic determined by the student and his advisor, and will be evaluated by both faculty and students in attendance.

First-Year Oral Examination

The first-year oral examination will typically occur one week after finals week for spring quarter. This will be an oral examination that will last approximately one hour. The structure of this examination will involve the student choosing (in consultation with their advisor) a published paper to present orally and evaluate critically. The chosen paper must receive prior approval by the examination committee. The examination committee will consist of three analytical faculty members with one alternate (the research advisor is not to be among the 3 person committee). The student may make a five minute presentation and may use chalk and the chalkboard for the remainder of the exam.

Based on the exam performance, course grades and early research progress, three exam outcomes are possible: 1) Proceed directly to the Ph.D., 2) completion of a Master's degree before proceeding to the Ph.D., or 3) stop graduate studies after completion of a terminal Master's degree. The exam outcomes will not be decided until all students have taken the examination. All students who take the oral exam will be provided feedback on the results of their examination.

Candidacy Examination

The student will write and defend an original research proposal that will be followed by a general question period by the examination committee.

The ongoing and contemplated research problems in the advisor's group cannot be used for proposed topics. However, this does not necessarily exclude proposals in the broad area of the advisor's research program. At least one month before the oral exam, the student will submit an abstract to the committee members in the Chemistry Department for approval of the research topic. At least three weeks prior to the examination the student is to submit to the committee a detailed description of the proposed research. This should include Objective (~ 1/2 page), Background (~ 1 1/2 pages), Project Description and Data Analysis (~ 14 pages) and References (1 page). This document must be approved by the committee prior to scheduling the oral defense of the proposal. The document describing the proposed research will constitute the **written portion of the candidacy exam** for analytical students. The defense of this proposal will constitute the **oral portion of the candidacy exam**.

B. Biochemistry. The minimum course requirements consist of: (1) 16 credit hours of Biochemistry from courses listed in the Chemistry Department's offerings, with a minimum of 9 credit hours in Chemistry 990 (Chemistry 733 and 752, and Biochemistry 770, can be counted as part of the 990 requirement). Other 700 level or higher courses offered by other divisions or departments may be substituted with the approval of the division faculty. (2) 3 hours of credit in Organic Chemistry at the 700-900 level, preferably Chemistry 731. (3) 3 credit hours of Physical Chemistry at the 700-900 level, preferably Chemistry 775. The individual course program will be selected from the courses listed below, as well as other pertinent courses.

Sample Biological Chemistry Ph.D. Curriculum for Graduate Associates*

<u>First Year, Autumn</u>	<u>Hours</u>	<u>Second Year, Autumn</u>	<u>Hours</u>
731 Advanced Organic	3	775 Intro. Thermo/Kinetics	3
761 Proteins	3	885 Colloquium	1
Elective (MCB 762 or MG 701)	3	999 Research/Elective [‡]	5
885 Colloquium	1		
 <u>First Year, Winter</u>		 <u>Second Year, Winter</u>	
685 Safety Seminar	2	885 Colloquium	1
733 Bio-Organic Catalysis	3	999 Research/Elective [‡]	8
885 Colloquium	1		
999 Research [†] or Elective [‡]	3		
 <u>First Year, Spring</u>		 <u>Second Year, Spring</u>	
763 Biochemistry	2	885 Colloquium	1
885 Colloquium	1	999 Research	8
999 Research/Elective [‡]	6		
 <u>First Year, Summer</u>		 <u>Second Year, Summer</u>	
999 Research	7	999 Research	7

Also in 2nd year: Journal Club Literature Presentations; Complete Written Cumulative Exams if assigned; Complete General Exam; Thesis Research.

Year 3 and 4: Complete General Exam; Thesis Research and Journal Club Presentation (Research-In-Progress).

[†]If you have joined a lab. Students should aim to select an adviser by the end of the autumn quarter.

[‡]You may wish to complete your electives in your second year. Consult with your adviser.

***Note: This is a sample program only!** The particular program to be followed must be decided on in consultation with the faculty adviser and must conform to the Divisional guidelines given above. Students who have not had an undergraduate biochemistry course are advised to enroll in Biochemistry 511 during their first year, unless they pass the Biological Chemistry placement test. All other students should take 761 (Proteins) and one elective, preferably MCB 762 (Enzymes) or Mol Gen 701 (DNA Transactions).

The graduate degree program in Biochemistry has two categories:

- The M.S. Degree
- The Ph.D. Degree

1. The M.S. Degree. This program is followed by students who intend to terminate graduate studies after the M.S. degree, by students whose early graduate performance indicates that completion of a thesis problem and writing of a M.S. thesis would be of considerable help in advancing their academic program and students who cannot complete a given requirement of the Ph.D. program. For example, students who do not pass the Candidacy Examination portion of the Ph.D. program often complete the thesis M.S. degree program. The course requirements for the M.S. degree are 23 hours of course work in Chemistry (600-level and above) including the following biochemistry courses: 761, 762, 733, and 763. At least 22 additional credits at the graduate level are required. These courses may consist of research courses or other graduate level courses required by the student's research advisor. The student must also write an M.S. thesis describing original research and defend this thesis in front of a committee consisting of their advisor and one other faculty member from the biological chemistry division.

2. The Ph.D. Degree. Students who qualify to proceed to the Ph.D. degree must fulfill the following requirements:

Course Requirements as stated at the top of page 18. Students working toward the Ph.D. degree must address placement exam performance as outlined on page 4 of this document and must maintain an overall grade point average of 3.0 and a grade point average of 3.0 or better in biochemistry courses taken as a graduate student at Ohio State.

Seminar Presentation: The student is required to present, before all the members of the division, two one-hour seminars, reviewing a specific topic of current interest. The topic of the first presentation will be assigned and the student will choose the topic of the second presentation. Generally, both of these presentations will be scheduled in the second year. In addition, students in the fourth year and beyond will be asked to present a brief Research-In-Progress talk to the division.

First-Year Oral Examination: This exam will take place during the first two weeks of summer quarter. The exam will last for approximately 1 hour. The student, in consultation with the adviser, will choose a published paper related to his/her research. The chosen paper must be approved by the committee two weeks before the exam. The student will present the paper in 5-10 minutes using only chalk and the chalkboard; no overheads or computerized slides may be used. The student will be asked questions on the paper and background pertaining to the subject area of the paper. The committee members will evaluate the performance. The examination committee will consist of three faculty designated by the Biological Division. The advisor may attend the examination, and help the committee formulate the questions for the student, but cannot assist the student in any manner. After the examination, the committee and the student's advisor will have a brief meeting to exchange impressions on the examination. The committee will assign 1 to 5 points based on a combination of the student's overall performance on the oral exam, course work during the first year and other factors. A score of 5 points will be required for the student to go directly to candidacy exam.

Based on this performance, a recommendation will be made by the committee on whether the student can proceed directly to candidacy exam, complete a terminal Master's degree, or be further evaluated by taking cumulative examinations. Feedback will be provided to the students as delineated on page 11 of this document.

To make up deficient points, the students needing further evaluation will take a series of cumulative examinations. These "cumes" will be offered during October, November, January, February, April, and May. Students will be awarded 0, 0.5, or 1 point on each exam. The student will have 6 chances to achieve a total of 5 points (including points awarded by the first-year oral examination committee). Students who fail to obtain the 5 points by the end of the Spring quarter of the second year will be asked

to complete a terminal M.S. degree, except in rare cases when the division faculty determine that further graduate work would be fruitful and in the student's best interest.

Candidacy Examination: In the general examination, the student presents and defends an original research proposal in an area other than that of the student's thesis work before the members of an examining committee set up for each student. The Vice Chair selects the members of the committee based on the recommendation of the adviser, according to the procedures specified in section II.B. Students are encouraged to take this part of the general examination taken within one quarter of passing their final cumulative examination. Before preparing the written proposal, the student is required to (1) submit to each member of the examination committee a proposal outline (maximum of 300 words) and (2) obtain approval from each committee member for the proposed study. The actual written proposal should follow the NIH postdoctoral grant format, which can be obtained from the NIH website. The document describing the proposed research will constitute the **written portion of the candidacy exam**. Members of the exam committee will provide a critique of the proposal to the student within two weeks of receiving the proposal. The candidacy committee must approve this document prior to scheduling the oral portion of the candidacy examination, and a final draft of the document must be available to all members of the committee (including the university representative appointed by the Graduate School, if applicable) two weeks prior to the oral examination. The adviser and student are responsible for arranging a time and location for the oral exam. In the **oral portion of the candidacy exam**, the committee will ask general questions to evaluate the research proposal and the student's knowledge of the entire area of biochemistry (and related areas in which the student is specializing). Students may bring up to five slides in any format, but preferably as printed handouts, to aid in the discussion of the proposal; however, the entire exam will consist of questions from the committee.

C. Inorganic Chemistry. In addition to all the requirements of the Graduate School and the Department of Chemistry, the Ph.D. aspirant in Inorganic Chemistry must fulfill the following: Credit must be obtained for the major courses 751, 752, 753, 754, 755, 851 and 995. Three courses must be taken in chemical areas other than Inorganic, at least two of which should be in the same field (e.g. biological, physical, etc.). The courses should be chosen from approved 600 level, or any 700, 800, or 900 level courses in Chemistry, Chemical Engineering 671, 761, or Material Science and Engineering 705. Other courses outside of the Department will be considered upon petition.

Sample Inorganic Chemistry Ph.D. Curriculum

<u>First Year, Autumn</u>	<u>Hours</u>	<u>Second Year, Autumn</u>	<u>Hours</u>
751 Organometallic Chem	3		
752 Inorganic BioChem	3	999 Research	9
Elective	3	885 Colloquium in Chem	1
885 Colloquium in Chem	1		
 <u>First Year, Winter</u>		 <u>Second Year, Winter</u>	
753 Inorg/Cluster Chem	3	999 Research	9
851 Theoretical Inorg Chem	3	885 Colloquium in Chem	1
Elective	3		
885 Colloquium in Chem	1		
685 Safety Seminar	2		
 <u>First Year, Spring</u>		 <u>Second Year, Spring</u>	
754 Solid State Chem	3	999 Research	6
755 Inorganic Chem Lab	3	885 Colloquium in Chem	1
885 Colloquium in Chem	1	*995 Seminar	3
Elective	3		
999 Research	1-2		
 <u>First Year, Summer</u>		 <u>Second Year, Summer</u>	
999 Research	9	999 Research	10
885 Colloquium in Chem	1		
		 <u>All Subsequent Quarters</u>	
		999 Research	9
		885 Colloquium in Chem	1

* Not offered on a regular basis.

To ensure a timely start to their research endeavors, students are encouraged to select a research adviser by the end of winter quarter of the first year.

The graduate degree program in Inorganic Chemistry consists of:

- The M.S. Degree
- The Ph.D. Degree

1. M.S. Degree

In the M.S. program, the candidate must conduct independent research under the guidance of an advisor, prepare and present his/her thesis and demonstrate that it adds new knowledge to some area of chemistry. The candidate would select 27 hours of course work in chemistry (600-level and above) including the following Inorganic courses: Chemistry 751, 752, 753, 754, 755, and 851. Part of the 27 hours of course work may be in related fields if they are acceptable to the Graduate Committee of the Department of Chemistry. Thesis work will require a minimum of 15 additional credit hours in Chemistry 999. The total credit hours must be a minimum of 45 hours. Students not continuing on to the Ph.D. degree are expected to pursue this M.S. program.

2. Ph.D. Degree

(a) First Year Oral Examination.

The examination of all inorganic first-year students will occur early in the Summer Quarter. This will be an oral examination and will last approximately 1 hour. The structure of this examination requires a student to select a published paper that has been approved by the student's advisor. The student will give an oral presentation and critical evaluation of the content of the paper. The student will be asked questions by the committee on the contents of the paper as well as general background material pertaining to the subject matter of the paper. The examination committee will consist of three inorganic faculty members. Based on the performance on the oral exam and course grades during the student's first year in graduate school, a recommendation will be made by the committee on whether the student proceed directly to candidacy, or complete an M.S. degree first, or complete a terminal M.S. degree. All students who take the oral exam will be provided feedback on the results of their examination. Students who are required to complete an M.S. degree first must defend their thesis by the end of Summer Quarter of their second year.

(b) Candidacy Examination.

The decision on who may proceed to the Ph.D. will be predicated on the successful completion of the Ph.D. candidacy examination. The rules on candidacy will be the same for students who complete an M.S. thesis and for those who proceed directly to candidacy. The candidacy exam must be successfully completed by the end of the student's third year.

Written Portion of the Ph.D. Candidacy Examination. Following a satisfactory evaluation in the first-year oral examination, or completion of an M.S. thesis (if required), a student will prepare an original written research proposal and will defend this proposal as the oral portion of the Ph.D. candidacy examination. The document may propose research whose completion is anticipated to be part of the student's Ph.D. thesis, but not research already completed or in progress. Alternatively, an original research proposal unrelated to the Ph.D. project may be submitted. In both cases the written proposal, which should be from 5-10 pages in length, should be sufficiently complete, proceeding from background material through the proposed research, to the bibliography, so that the reader can evaluate both the basic research idea and the methodology proposed for its solution. An NSF- or NIH-style format is recommended. Satisfactory progress in research is a factor in deciding whether the student would pass the exam.

All candidates in inorganic chemistry who expect to take oral exams during a given quarter must submit their written proposals to the members of their committee (relevant inorganic faculty and the out-of-division representative) by Friday of the **second week** of that same quarter. Appropriate responses from faculty members on the committee will be made to the candidate within one week. The response may consist of evaluation, criticism, and/or suggestions. In order to have enough time to react to the faculty response, it is suggested that the oral examinations be scheduled during the last 2 or 3 weeks of the

quarter. The candidate must obtain the approval of the committee, by signature of an approval form, at least three weeks prior to the exam and this will constitute passing the written part of the exam. The student is reminded that Graduate School rules require these exams to be scheduled at least two weeks in advance. If applicable, the written research proposal must be presented to the graduate school representative as soon as that individual is known.

Oral Portion of the Ph.D. Candidacy Examination. The examination committee includes four members of the chemistry department faculty, including the research advisor, and three of these should be from the inorganic chemistry division. The examination session will run for no more than two hours and is mainly concerned with testing the fundamental knowledge and preparation of the student in his/her chosen discipline. The first forty to sixty minutes of the oral examination may involve questions relating to and discussion of the research proposal submitted by the candidate in order to gain admission to the oral examination. Thereafter questions will be of a more general nature, ranging over fundamental chemical subjects and detailed aspects of inorganic chemistry. Satisfactory performance on the oral examination will constitute admission to candidacy for the Ph.D. degree. One then concentrates on research and writing the dissertation.

(c) Dissertation Defense and Inorganic Seminar.

By the time you reach this stage, you will be *the* expert in some area of modern inorganic chemistry. After writing your dissertation in conjunction with your major professor, you will defend the dissertation and discuss your research with three members of the inorganic faculty. In addition, you are required to present a seminar before the inorganic students, postdoctoral fellows, and faculty so that we can learn about your contributions to our knowledge of chemistry.

D. Organic Chemistry. The mission of the organic chemistry program is to develop independent creative scientists and teachers. Its culmination is the Ph.D. dissertation, an original and significant contribution to chemical science. Although the main activity in graduate school is research, the student also fulfills the more formal requirements listed below.

Degree Programs:

- The M.S. Degree
- The Ph.D. Degree

A student is directed along one of these degree programs as determined by the wishes of the student, the judgment of the preceptor, and the performance of the student on written and oral examinations. In addition to course work and degree research, a student working toward a Ph.D. in the organic division must pass the Candidacy Examination. This Examination consists of both a written and an oral part as described in the Rules of the Graduate School, the details of which are summarized below. After passing the Ph.D. Candidacy Examination, each student must present at least one seminar to the organic division faculty and students, following the guidelines set forth by the division.

1. The M.S. Degree

In the M.S. program, the candidate must conduct independent research under the guidance of an advisor, prepare and present his/her thesis and demonstrate that it adds new knowledge to some area of chemistry. The candidate must complete a minimum of 45 hours of course work in chemistry (600-level and above) including the following organic courses: Chemistry 632, 730, 731, 831 and 832. Thesis work requires a minimum of 20 credit hours in Chemistry 999. Students completing this program must write and defend a thesis according to the guidelines presented on page 8 of this document.

2. The Ph.D. Degree

Placement Examination and Course Requirements

Placement exams are administered to each student upon entry into the Chemistry Graduate Program. Students who pass the organic placement by September of their first year, will enroll in Chem 730 and 731 (Autumn), Chem 632, 831 and 832 (Winter), and Chem 833 (Spring). Each student also will take two of the courses in the Chem 94x-series from among those offered before graduation. Chem 94x courses are variable special topics courses such as Computational Chemistry (Chem 944), which is offered every spring, and alternate-year presentation of Carbohydrate Chemistry. Students who enter with a Master's degree, and who pass the organic placement examination, may petition the Division for a waiver of part of the first-year course requirements (see page 3). Ph.D. students must also take one chemistry course at the 600-level or above outside the area of organic chemistry. Students are advised to fulfill the elective requirements during their first year of enrollment.

Students who do not pass the organic placement examination, in consultation with their advisor and the Vice Chair for Graduate Studies, may consider delaying enrollment in either Chem 730 or 731 until they have become proficient in organic chemistry. Students who enroll in the Early Start Program (June) are advised to enroll in the organic survey course (Chem 693E) during the Summer Quarter and take the organic placement exam in September. Students who are still not proficient after the Autumn Orientation Program in September may consider enrolling in the H251/H252/H253 course sequence during their first year. This decision should be made in consultation with the student's advisor and the Vice Chair for Graduate Studies. These students will then complete an M.S. degree, following their Summer oral during the second year (see below).

First-Year Oral Examination

Students will take an oral examination during the first or second week of the Summer quarter of their first year. The examination will last 60 minutes and the focal point of the examination will be a paper selected jointly by the student and his/her advisor. It is expected that the paper will be from organic chemistry literature that is related to the planned thesis research. The student will submit a copy of the paper to the committee (defined below) at least 2 weeks prior to the examination. The oral examination will start with a short presentation (5-10 minutes) by the student, highlighting the salient features of the paper. The rest of the examination will be devoted to the student answering questions from the committee members and discussing the broader issues underlying the research described in the paper. The questions will be directed principally toward the topic of the paper, but some general questions may also be asked if the answer to these questions help the student address specific issues related to the paper. The advisor may attend the examination, and help the committee formulate the questions for the student, but cannot assist the student in any manner. After the examination, the committee and the student's advisor will have a brief meeting to exchange impressions on the examination.

Within two working days of the last examination in the division, the committee will meet and assign a point value (1-5) to each student based on his/her overall performance on the oral exam and first-year (graduate) course work. A total of 5 points will be required to proceed to the Ph.D. Candidacy Examination. The score assigned by the examination committee will determine whether each student should:

- (a) proceed directly to the Ph.D. program
- (b) take cumulative examinations to make up the deficient points. These examinations will be offered during October, November, January, February, April, and May. Students will be awarded 0, 0.5, or 1 point on each exam. The student will have 6 chances to collect a total of 5 points including those awarded by the first-year oral examination committee. Students who fail to obtain the 5 points by the end of the spring quarter of the second year will be asked to complete a terminal M.S. degree, except in rare cases when the division Faculty, in consultation with the student's advisor determines that further graduate work is warranted. In that case, the student may petition the division to proceed to Ph. D., but only after obtaining the M. S. degree.
- (c) proceed to a terminal M.S. degree

Within three working days of the last of the first-year oral examinations, the results will be communicated to the organic division secretary and the graduate office.

Committee for the first-year oral examination. A single committee of current Faculty will administer the examination during a specific academic year. An alternate member will be appointed by the division secretary if the student's advisor is a member of the examination committee.

Students who are not proficient in organic chemistry upon entering the degree program (i.e., those who choose not take the first year graduate courses) are required to complete an M.S. degree prior to proceeding with the Ph.D. program. Such students should take the summer oral examination during their second summer, and follow the same path as described in the previous sections in a timely fashion.

Ph.D. Candidacy Examination

The candidacy examination is initiated according to the guidelines on page 12 in Section I of this document. The student will write and defend an original research proposal, not related to her/his own research. The written research proposal prepared according to guidelines available from the division secretary must be submitted to members of his/her committee at least four weeks prior to the oral candidacy examination. The proposal should be returned to the student with comments within 7 days of the submission to the committee members. The written proposal constitutes the **written portion of the candidacy examination**, and must be approved in writing (form available in graduate office) by the chemistry department committee members two weeks prior to the **oral portion of the candidacy examination**. Approval by the committee members means that the quality of the proposed research and the written presentation are satisfactory, and the student may schedule the oral examination. The oral portion of the candidacy examination takes place over a two-hour period that is divided into two parts of approximately one hour each. During the first hour the student must defend and respond to questions about the research proposal. During the second hour, the examination is opened to general questions on fundamental subjects in chemistry and detailed aspects of organic chemistry not necessarily related to the proposal.

Seminar Presentation

After passing the candidacy exam, each student will present a one-hour seminar to the organic division, following the guidelines established by the division. The student must consult with faculty member responsible for the seminar program at that time. This faculty member, in addition to helping the student with the technical aspects of the presentation, should make sure that the guidelines are followed. The responsible faculty member in consultation with other members of the division will assign a grade (S or U) for the seminar. If the performance is judged unsatisfactory, the student will be asked to repeat the presentation to available organic faculty members.

- *Organic Division Seminar Guidelines.* Upon completion of the written and oral portions of the Ph.D. candidacy examination, a student will present a seminar following the guidelines below. The focus of the seminar will be the student's Ph.D. thesis research project. The talk should last 45-50 minutes and the student may choose any of the standard formats for presentation, including presentation software such as PowerPoint, blackboards, or overheads. The first part of the talk (20-30 minutes) should include a thorough review of the literature with the goal of providing a meaningful context and global perspective for current and future work. The material gathered for this review should be appropriate for and may eventually be used as introductory sections of the student's thesis. For the remaining portion of the talk, a progress report on the student's research accomplishments should be presented. In planning the seminar and prior to the presentation, the student should consult with the organic division faculty member in charge of student seminars during the quarter in which the seminar will be presented to obtain approval. The student should also distribute a concise and carefully worded abstract (1-2 pages) before the beginning of the seminar. If the performance is judged unsatisfactory, the student will be asked to repeat the presentation to available organic faculty members.

Sample Ph.D. curriculum for Organic students passing the Organic placement exam in September.

<u>First Year, Autumn</u>	<u>Hours</u>	<u>First Year, Winter</u>	<u>Hours</u>
730 Organic Synthesis	3	831 Physical Organic	3
731 Physical Organic	3	832 Organic Synthesis	3
ELECTIVE	3	632 Spectroscopy	3
885 Colloquium	2	685 Safety	2
<u>First Year, Spring</u>		<u>First Year, Summer</u>	
833 Organic Synthesis	3	999 Research	12
885 Colloquium	1		
999 Research	8		

YEAR 2:

Selected Special Topics: 941, 942, 943, 944 or other advanced courses approved by the Division;
Take cumulative exams if needed; complete candidacy examination; thesis research; Chem 885 each quarter

YEAR 3 & 4:

Thesis Research, Chem 885 each quarter; complete candidacy exam; present divisional seminar.

Sample Ph.D. curriculum for Organic students deficient in the Organic placement exam

<u>First Year, Autumn</u>	Hours	<u>Second Year, Autumn</u>	Hours
251H Organic	3	730 Organic	3
ELECTIVES	6	731 Organic	3
885 Colloquium	1	885 Colloquium	1
		999 Research	5

First Year, Winter

252H Organic	3
685 Safety	2
632 Spectroscopy	3
ELECTIVES	3
885 Colloquium	1

Second Year, Winter

831 Organic	3
832 Organic	3
885 Colloquium	1
999 Research	5

First Year, Spring

253H Organic	3
ELECTIVES	3
885 Colloquium	1
RESEARCH	5

Second Year, Spring

833 Organic	3
885 Colloquium	1
999 Research	8

First Year, Summer

999 Research	12
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Second Year, Summer

999 Research	12
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Year 3:

Selected Special Topics: 941, 942, 943, 944
Complete cumulative exams if needed
Thesis research, Chem 885 each quarter
Complete Candidacy Examination

Year 4:

Thesis Research, Chem 885 each quarter
Present divisional seminar

E. **Physical Chemistry.** The Ph.D. student in physical chemistry will normally take at least 18 hours of physical chemistry courses (775, 861-2-3, 876, and 880) plus at least 12 hours of electives as indicated in the sample curriculum.

Sample Physical Chemistry Ph.D. Curriculum

<u>First Year, Autumn</u>	<u>Hours</u>	<u>Second Year, Autumn</u>	<u>Hours</u>
775 Thermo/Chem Kinetics	3	Elective ^a	3-5
861 Quantum Chem I	3	999 Individual Studies	6-8
Elective ^a	3	885 Colloquium in Chem	1
885 Colloquium in Chem	1		
Language (as needed)	3-5		

<u>First Year, Winter</u>	<u>Hours</u>	<u>Second Year, Winter</u>	<u>Hours</u>
862 Quantum Chem II	3	Elective ^a	0-5
876 Chemical Dynamics	3	999 Individual Studies	6-11
Elective ^a	3-5	885 Colloquium in Chem	1
885 Colloquium in Chem	1		
Language (as needed)	3-5		
685 Safety Seminar	2		

<u>First Year, Spring</u>	<u>Hours</u>	<u>Second Year, Spring</u>	<u>Hours</u>
863 Quantum Chem III	3	Elective ^a	0-5
880 Statistical Thermodynamics	3		
Elective ^a	3	999 Individual Studies	6-11
885 Colloquium in Chem	1	885 Colloquium in Chem	1
999 Research	2		

<u>First Year, Summer</u>	<u>Hours</u>	<u>Second Year, Summer</u>	<u>Hours</u>
999 Individual Studies	12	999 Research in Chem	12
First-year oral exam			

Third Year, Autumn
Selection of topic for written portion of candidacy examination

Third Year, Winter
Oral portion of Ph.D. candidacy exam

Students holding a TA/RA appointment must register for at least 10 credits each quarter. Fellowship students must register for at least 15 credits each quarter.

<u>Subsequent Quarters</u>	
999 Research in Chem	11
885 Colloquium	1

^aUsual alternatives are: Mathematics 512 (3 hr), 513 (3 hr), 514 (3 hr), 568 (3 hr), 601 (5 hr), 602 (5 hr); Chemistry 721, 730, 731, 751, 754, 866; Physics 555 (4 hr), 656 (4 hr), 657 (5 hr), 664 (4 hr); Special topics courses in physical chemistry or fields related to physical chemistry, sometimes listed as Chemistry 694, may be taken as elective courses.

Degree Programs:

- The M.S. degree
- The Ph.D. Degree

While it is normally anticipated that the entering student will pursue the Ph.D. degree, in cases where the student performance has fallen below that necessary for continuing to the Ph.D. or so elects for personal reasons, the student may end his/her studies with the M.S. degree. The Graduate School of The Ohio State University automatically admits the student as a candidate in the M.S. degree program of the department to which the student applied. A student may be requested to obtain an M.S. before the Ph.D. degree, or may proceed directly to the Ph.D., depending on the best educational interests of the student.

1. The M.S. Degree. In the M.S. program with thesis, the candidate must conduct independent research under the guidance of an advisor, prepare and present his/her thesis and demonstrate that it adds new knowledge to some area of chemistry. The candidate would complete 45 hours of course work in chemistry (600-level and above) including the following physical chemistry courses: Chemistry 861, 862, 863, 775, and 880. Thesis work requires a minimum of 15 credit hours in Chemistry 999. Students completing this program must write and defend a thesis according to the guidelines presented on page 8 of this document.

2. The Ph.D. Degree

Qualification for PhD. A student can qualify for admission to the Ph.D. Candidacy examination administered by the Physical Chemistry Division by satisfactory performance in their course work and on an oral exam offered during the summer quarter after the first academic year of graduate study.

First-Year Oral Exam. An oral exam will be offered to Physical Chemistry students, normally during weeks 3-6 of the summer quarter. Details concerning administration of the oral exam can be found on pages 11-12 of this document. The topic of the exam is developed jointly by the student and his/her advisor and will be reflected by the choice of a research paper from the Physical Chemistry literature. It is expected that the paper will be related to the thesis research planned for the student. The student should submit a copy of the paper to the Physical division secretary at least two weeks in advance of the exam. The exam will be directed principally toward the topic, but some general physical chemistry questions may also be asked of the student if exploration of the topic touches upon broader issues. The student will receive feedback on his/her performance on the oral exam.

The oral examination committee will recommend one of the following options based on the student's performance in course work, the oral exam, and possible research activity to that point.

- Terminate graduate studies with an M.S. degree,
- Continue graduate studies by first completing an M.S. degree, followed by the Ph.D.,
- Proceed directly to the Ph.D. degree.

The terminal M.S. is invoked when the committee judges that further graduate work is not in the student's best interest. If progress toward the Ph.D. is recommended, the decision on whether to require an M.S. before the Ph.D. is based on all aspects of the student's activity to that point. The decision is made by considering that, for some students, it is helpful to have the smaller goal of an M.S. degree before the Ph.D. It is not exclusively linked to performance on the oral exam.

General Examination. The examination for admission to Ph.D. candidacy, consisting of written and oral portions, is given on an individual basis. The examination committee of 3 faculty members, at least 2 of which are from the Physical Chemistry Division, will be selected according to the procedures specified on page 12. The written portion is an original research proposition. The student chooses the topic, alone or with the advice of a faculty member. It may not be a research problem currently being pursued by the student or even a variation or modification of the student's current research. The topic may anticipate planned research directions. The topic must receive preliminary approval by the student's advisor and must concern a significant problem in physical chemistry. Subsequent to the advisor's approval, the topic in abstract form must be submitted for approval to the other 3 members of the exam committee, at least two of which are from the Physical Chemistry Division.

- **Written portion.** The written proposal must clearly define an original research problem and explain why its solution will be significant to the field of physical chemistry. It should be limited to 12 pages. It is suggested that it contain an abstract stating the research problem, 3-5 pages of background and motivation, and 5-6 pages of proposed research and analysis. The proposal must represent independent work of the student, although others, including faculty, may be consulted for technical or bibliographic advice. Following the exam committee's approval of the topic, the student will have 4 weeks to prepare and submit his/her proposal. Each member of the exam committee will submit a written critique of the proposal to the student and other members of the committee within 2 weeks of receiving the proposal. If the committee members judge that revisions of the proposal are necessary, the student must submit a revised version to each committee member within 3 weeks of receiving their critiques. Presentation of a final proposal, which is judged satisfactory by each member of the committee, will constitute successful completion of the written portion of the Candidacy Exam. If a second revision of the proposal is not acceptable to all the committee members, then the committee can declare that the student has failed the written portion of the General Exam, and recommend that the oral portion not be scheduled.
- **Oral portion.** The oral portion of the Candidacy Exam is scheduled by the student and his/her advisor through the Graduate School. The committee will normally consist of the faculty who evaluated the written proposal, but substitutions may be made if necessary. The content of the oral examination will be directed toward the proposal, and to some general issues in the field of physical chemistry. Satisfactory performance will result in admission to candidacy for the Ph.D. degree. Failure may result in a second attempt on recommendation of the Candidacy Examination Committee, possibly requiring a new written proposal, no later than the second quarter following the first oral exam.