

GUIDELINES FOR GRADUATE STUDY IN CHEMISTRY
University of Iowa
College of Liberal Arts & Sciences
Department of Chemistry

Approved by departmental faculty vote, May 7, 2019.
 This edition applies to students entering Fall 2019 and later.

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Abbreviations:

CV: Curriculum Vitae, an individual's record of academic and work history

DEO: Departmental Executive Officer, appointed by the Dean of the CLAS (College of Liberal Arts and Sciences)

DGS: Director of Graduate Studies (appointed by the DEO)

GAC: Graduate Academic Committee (appointed for each student, by student invitation)

GEC: Graduate Education Committee (departmental committee, appointed by the DEO)

GPA: Grade Point Average

GSAR: Graduate Student Annual Review

IDP: Individual Development Plan

RPR: Research Progress Report

GUIDELINES FOR GRADUATE STUDY IN CHEMISTRY

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College of Liberal Arts & Sciences

Department of Chemistry

I. Admission to Graduate Study

A. Admissions Process

Admission will be recommended by the department Graduate Recruiting and Admissions Committee after a review of the student's application and supporting evidence. In addition, the committee will recommend to the Department Chair the level of financial support that should be made to the student.

B. Advisor Selection (Standard Process)

1. A temporary advisor, assigned by the department upon entering the graduate program, will advise the entering graduate student until a research advisor is chosen.
2. Each student must choose a research advisor during the first semester in residence, subject to mutual agreement among the student, advisor, and department. Prior to selecting an advisor, the student is encouraged to meet with as many faculty members as possible. The selected area does not need to reflect the area of interest stated on the student's application for admission.
3. Each student, except those who have an approved Early Advisor Selection, will complete a series of rotations in research groups during the first semester in residence. These are assigned by the department based upon preferences indicated by the student.
4. Additional details for research advisor selection will be announced before and during the first semester of graduate study.

C. Early Advisor Selection (Optional)

1. Incoming students may communicate with potential faculty research advisors in the course of the admissions process. If a student chooses a faculty advisor prior to the deadline for accepting the departmental offer of admission (typically April 15 for fall admission), the student will send this request to that faculty member, who will forward the request along with their endorsement to the Director of Graduate Studies by the aforementioned deadline. If the request is approved, this completes the Advisor Selection process.
2. Otherwise, all incoming students will follow the standard process for choosing a research group (Section I.B) during their first semester in residence.

II. General Requirements for both Ph.D. and M.S. Degrees

The student's advisor and Graduate Academic Committee (GAC) will monitor the coursework and research progress of individual students and make periodic recommendations regarding renewal of teaching assistantships, degree completion deadlines, realistic degree objectives, and other matters.

A. Graduate Student Annual Review

1. Each student will complete a Graduate Student Annual Review (GSAR). Student components of the review are due annually. Additionally, if desired, either the student or faculty advisor have the option to initiate more frequent reviews.
2. The student submits an updated curriculum vitae (CV), research progress report (RPR), and individual development plan (IDP). For each GSAR submission, the advisor provides a response to the student documents and approves the review.
3. For more detailed guidance on preparation and submission of the GSAR, see <https://chem.uiowa.edu/graduate-menu/for-current-graduate-students/annual-reviews>

B. Proficiency Requirement

1. Students must demonstrate basic proficiency in three subdisciplines of chemistry (analytical, biochemistry, inorganic, organic, physical).
2. The proficiency requirement must be fulfilled before the beginning of the student's third semester in residence for the student to remain in the graduate program.
3. Proficiency in a subdisciplinary area is established in one of the following ways:

Scoring at the 50th percentile level (national norm) on the corresponding proficiency exam. Exams in each area will be offered before the beginning of each semester (Fall and Spring), and at the end of the Spring semester. A proficiency exam in a given area may be taken a maximum of three times.

 - i. Completing a one-semester review course with a grade of C or better.
 - ii. Completing a one-semester advanced course of at least 3 semester hours in that subdiscipline of chemistry with a grade of B or better. A list of advanced courses and the proficiencies they may satisfy is found in Appendix B.

- iii. Some advanced courses may satisfy the Proficiency Requirement in two subdiscipline areas; the student may choose to count a course toward either of two different subdisciplines, but not both.
 - iv. Courses that are used to satisfy the Proficiency Requirement cannot also be used to satisfy the Advanced Course requirement (see section III A).
4. A student who completes a proficiency course as an undergraduate at the University of Iowa will not receive proficiency credit unless they were dually enrolled in both graduate and undergraduate programs at the time the course was taken, and the proficiency course was not a requirement for completion of the undergraduate degree. Bachelors degree graduates of the University of Iowa are otherwise expected to fulfill the proficiency requirements (item A above) as would any other incoming graduate student.

C. Review Courses (to satisfy item B.3.ii above)

The designated review courses for each subdiscipline are:

Analytical:	CHEM:4171	Advanced Analytical Chemistry
Biochemistry:	BIOC:3120	Biochemistry and Molecular Biology I
Inorganic:	CHEM:4270	Advanced Inorganic Chemistry
Organic:	CHEM:4372	Advanced Organic Chemistry
Physical:	CHEM:4431	Physical Chemistry I
or	CHEM:4432	Physical Chemistry II

D. Other Information

1. Summer sessions are not counted as semesters in establishing the dates for meeting various requirements.
2. Students who are appointed to either a teaching or research assistantship may not enroll in more than twelve semester hours of credit in any semester. It is usually advantageous for students in their first semester to take a full schedule of courses.
3. All new students are required to register for Graduate Chemistry Orientation (CHEM:5091) during the first fall semester. All students must complete Ethics in Chemical Sciences (CHEM:5092) during the first or second year of their graduate program, typically in their second spring semester.

III. Additional Requirements for the Ph.D. Degree

A. Advanced Course Requirement

1. Beyond the proficiency requirements, students must complete a minimum of four additional advanced courses, totaling at least eleven semester hours of graduate credit, by the end of their fourth semester in residence.
2. Grades of "B" or higher are required to receive credit for advanced courses. A grade of "B–" does not meet this requirement.
3. Research, seminar, and pedagogy credits; courses that are listed with lower division undergraduate level numbers; and courses taken with the S/U grade option cannot be used to fulfill this requirement.
4. Students are strongly encouraged to develop a detailed course plan that is reviewed and approved by the research advisor.
5. Graduate credit from other institutions will be given consideration for fulfillment of up to six of the eleven required semester hours of advanced level coursework. Graduate courses completed at other institutions do not need to duplicate courses offered at the University of Iowa in order to receive credit. This section also applies to courses taken at the University of Iowa prior to admission to the PhD program in Chemistry.
 - i. The student must initiate the request by sending an email making the request, along with supporting documentation, to the Director of Graduate Studies.
 - ii. Supporting documentation should include a brief description of the course, a course syllabus or outline, examinations taken by the student, an indication of the textbook used, and a statement of support from the advisor. Requests should not be initiated until a permanent advisor has been assigned and the advisor has agreed that the request is appropriate.
 - iii. The Graduate College must have already accepted the course(s) as graduate transfer credit(s).
 - iv. The Graduate Education Committee (GEC) will consider the basic content of the course, the student's performance in the course, the student's performance on examinations and coursework at the University of Iowa, and the support of the research advisor.
 - v. If approved by the GEC, the research advisor and student can consider the course for inclusion in the course plan.

B. Grade Point Average

1. The Graduate College requires that all students seeking a Ph.D. maintain a 3.00 GPA for work attempted at the University of Iowa. CHEM:7999 Research in Chemistry and CHEM:6990 Research Seminar may not be

taken for a letter grade (S/U only), and are thus not included when calculating the GPA.

2. A grade of C– or higher must be obtained in order to receive graduate credit in a given course, but all grades will be included in calculating the overall grade point average. Grades of C– through B– will not count toward departmental advanced course requirements.

C. The Graduate Academic Committee (GAC)

1. GAC Composition

- i. The GAC is composed of five Faculty, at least four from Chemistry, who agree to support and advise the student during the course of the Ph.D. and beyond. GAC members meet with the student on occasion to discuss research progress and provide feedback and guidance as appropriate.
- ii. The committee will consist of the research advisor and four additional members who are invited by the student, subject to the advisor's approval.
- iii. The GAC will include one or two additional members of the same division as the student, and at least one member of each of two other divisions. Alternatively, the GAC will include one or two additional members of the same Interdisciplinary Focus Area as the student, and two other members from different Focus Areas.

2. GAC Formation

- i. The student will notify the department front office of the composition of their GAC in writing, by the beginning of the second full semester after the assignment of the research advisor. After approval by the DGS, the list will be submitted by the department front office to the Graduate College.
- ii. Students who enter the program with the Early Advisor Selection option (Section I.C.) may form their GAC within the same schedule as those in their entering class who use normal Advisor Selection (Section I.B.).
- iii. Changes of GAC composition are permitted, generally for the purpose of matching faculty expertise with student research. Requests for changes of GAC composition are submitted to the DGS, with rationale provided.

D. Comprehensive Examination

The comprehensive examination is a two-part oral examination. The first part consists of an oral defense of the student's research progress and is based upon a written Research Report submitted by the student. The

second part consists of an oral defense of an Original Proposal submitted by the student. The exam typically occurs in a student's fourth semester in residence.

1. The Comprehensive Examination Committee

The five-member committee for the comprehensive examination is the same as a student's Graduate Academic Committee (GAC), as described in Section III.D. Additional faculty members may be invited to attend the oral comprehensive examination and may be consulted in judging the presentation when it bears upon their areas of expertise. These visitors are non-voting members of the committee, and shall not be present at the time of the faculty vote on exam outcome.

2. Eligibility to Take the Comprehensive Examination

To be eligible to take the Comprehensive Examination, the student must have a cumulative GPA average of 3.00 or greater on appropriate graduate coursework at the University of Iowa. The GAC is responsible for confirming student eligibility.

- i. Appropriate graduate coursework includes review courses (Section II.C.), graded seminar presentations (Section III.E.), courses that satisfy the advanced course requirement (Section III.A.), and additional courses in chemistry or related disciplines that are judged appropriate by the student's Academic Committee (GAC).
- ii. Graduate Chemistry Orientation (CHEM:5091), Ethics in Chemical Sciences (CHEM:5092), Research in Chemistry (CHEM:7999) and Research Seminar (CHEM:6990) shall be graded on an S/U basis, and therefore are not included in the computation of the cumulative average.
- iii. A student on academic probation (see Section III.H.2) is not eligible to take the comprehensive exam.

3. Procedures and Schedules for the Comprehensive Examination

- i. The general comprehensive examination requirements set by the Graduate College must be completed by the end of the fourth semester in residence, unless an exception is approved by the DGS. Such exceptions are generally warranted if a student changes research groups. A student who fails to meet this requirement may be dismissed from the Ph.D. program. (For information about re-admittance to the Ph.D. program or change to MS program, see Section III.H.2.)
- ii. Students must submit a Research Report, Original Proposal, and current CV to the GAC six weeks prior to the last day of classes in the

academic semester of the exam. For a spring semester exam, this is defined as the Friday prior to Spring Break.

- iii. The GAC will review the Research Report and Original Proposal. If the committee approves both documents, the oral examination may be scheduled. The committee may request revisions on either or both documents. The revision request will be detailed in a letter to the student including a deadline for resubmission. The committee may also reject either or both documents which constitutes an outcome of “unsatisfactory” (see Section III.D.7).
- iv. After the GAC has agreed to schedule the Comprehensive Examination, the student should promptly contact the department administrative office to complete a Doctoral Plan of Study Summary Form and a Request for Doctoral Comprehensive Examination (see Section VIII). The plan of study will provide a listing of all graduate courses taken that apply toward the degree, courses in progress, and courses to be completed after the comprehensive examination. Approval of the Plan of Study by the advisor and the DGS is required by the Graduate College. The plan may be amended by the Committee pending the outcome of the comprehensive examination.

4. Description of the Research Report

The Research Report is intended to inform the GAC of the student's research problem and research progress. The report should describe the goals of the research project that the student is working on, their progress to date, and their future plans. The body of the research report (items I–IV below) should not exceed ten double-spaced pages including figures. Appropriate references should be cited by number in text. The expected format is as follows:

- I. *Introduction and Background.*
- II. *Goals and/or Specific Aims.*
- III. *Research Plan, Results, and Discussion.*
- IV. *Conclusions and Future Work.*
- V. *References.*
- VI. *Addenda.*

More detailed guidance on preparation of the Research Report is provided in Appendix A.

5. Description of the Original Proposal

The written Original Proposal should involve a topic that is distinct from the student's research problem. The idea must be unique and original with the

student. Although the student should consult with the advisor in identifying a topic that is of appropriate scope and distinct from the work done in the advisor's group, during preparation of the proposal, only general guidance on procedural matters by the student's advisor is permitted.

The research proposal should adhere to the following format with a maximum length of 10 double-spaced pages including figures with no appendices. Appropriate references should be cited by number in text.

- I. Introduction.*
- II. Research Question.*
- III. Significance of the Proposed Research.*
- IV. Proposed Studies*
- V. References.*

More detailed guidance on preparation of the Original Proposal is provided in Appendix A.

6. Scope of the Oral Examination

- i. The Research Report and the Research Proposal provide the basis for a wide ranging oral examination designed to assess the student's overall progress, knowledge of fundamental chemical principles and chosen area of specialization, and general competency for Ph.D. research.
- ii. The student will be asked to prepare and present a short (ca. 20 minute) summary of his/her research project. During or following this presentation, the committee will ask questions designed to probe the student's understanding of the research topic and important background material, the experimental methods and techniques which are important in the particular area, and the goals and significance of the research.
- iii. The committee next will examine the candidate's understanding of areas related to the Research Proposal. The student will be asked to give a short (ca. 20 minute) presentation of the Research Proposal. During or following this presentation, the committee will ask questions designed to probe the quality and the student's understanding of the proposal. Typically, this discussion will evolve into a wide-ranging examination of the student's general competency in the chemical sciences.

7. Outcomes of the Comprehensive Examination

The outcome of the comprehensive exam will be determined by a vote of GAC members and recorded on the Graduate College form "Report of Doctoral Comprehensive Examination".

- i. Satisfactory: If the faculty vote is 'satisfactory', the student has successfully completed the exam requirement.

- ii. Reservations: If the faculty vote is 'reservations', the student will receive guidance from the GAC with specific actions to remediate deficiencies, including a deadline for completion and followup evaluation if necessary. These tasks must be completed successfully before the deadline and before the end of the student's fifth semester in residence.
- iii. Unsatisfactory: If the faculty vote is 'unsatisfactory', the student fails the exam. The Graduate College allows two attempts at the examination. If the first ends in failure, students who wish to stay in the program must repeat the exam between four and six months from the date of the first exam.
- iv. If a GAC member is absent during the comprehensive exam, that member's vote on the outcome is counted as 'unsatisfactory'.
- v. The comprehensive examination must be passed (including satisfying any reservations) before the end of the fifth semester in residence. This time limit also applies to the second attempt. A student who has not met this deadline will be subject to dismissal from the Ph.D. program.

E. Seminar Requirements

Each student is expected to give a minimum of two acceptable seminars. One seminar must cover the student's research. The other may also deal with the student's research, or can be an extensive literature report. The student may register for the appropriate divisional seminar course and receive letter grade credit during those semesters in which the seminars are presented. The final Ph.D. defense cannot be used to meet this requirement.

F. The Research Conference ("Three Month Seminar")

1. At least three months before the anticipated final defense, the student must meet with their GAC for a research conference.
2. The composition of the GAC (see Section III.C.) for the Research Conference is generally the same as that for the Comprehensive Examination.
3. During the research conference, the student will summarize the research work to date, and will outline remaining work to be completed for the dissertation. The intent of the conference is to aid the student in organizing the material that will constitute the dissertation. The conference also enables the GAC members to become better acquainted with the objectives and outcomes of the student's research, and to make suggestions concerning work that needs to be completed before the dissertation is written.
4. If scheduling permits, the research work may be presented as a research seminar during a regularly scheduled divisional seminar

program, with a subsequent committee meeting for questions and advice.

5. If the research conference includes a public presentation, then it may be used as one of the required seminars described in section III. F.

G. Final Defense of the Ph.D. Dissertation

1. The GAC for the Research Conference will be the examining committee for the final defense.
2. Students must submit an “Application for Degree” online, and contact the department administrative office to complete the “Request for Final Examination: Advanced Degree” form. These forms must be submitted to the Graduate College in accordance with the deadlines for the session in which the degree is to be granted. The exact time and place of the examination and the title of the thesis must be stated on the request for the examination.
3. The Graduate College will make a public announcement of the final examination three weeks prior to the date of the exam. The final oral examination will be open to the public.
4. Copies of the dissertation must be made available to all members of the examining committee not later than two weeks before the date of the examination.
5. At least one reprint of a published or accepted paper based on original research with the candidate as the major or an equal contributor, in a peer-reviewed scientific journal, shall be made available to all committee members at the time the defense is being scheduled.

H. Other Graduate College Rules and Procedures

1. Registration and Residence Requirements

- i. A total of 72 semester hours of graduate credit (including transfer credit) are required. Of those 72 semester hours, at least 39 must be earned while registered in the University of Iowa Graduate College.
- ii. A student is required to register each semester after passing the comprehensive exam until the degree is awarded.

2. Academic Probation

- i. A student shall be placed on probation if, after completing nine semester hours of graded graduate work, their cumulative grade-point average (GPA) falls below 3.00. If, after completion of nine more semester hours of graded graduate work at this University, the student's cumulative

grade point average remains below 3.00, the student will be dismissed from the Ph.D. program.

- ii. A student on probation who has not already received an M.S. degree from this Department may apply for M.S. candidacy if their grade point average is above 2.75. A student may only be readmitted to the Ph.D. program if they raise their cumulative grade point average above 3.0 within one semester after dropping to the M.S. track.

IV. Additional Requirements for The M.S. Degree

- A. The proficiency requirements and general guidelines outlined in *Section II, General Requirements for both Ph.D. and M.S. Degrees* apply to the Master of Science (M.S.) program.
- B. A grade point average of at least 2.75 must be maintained in all graduate work to avoid probation and dismissal by Graduate College rules.
- C. The M.S. student's Graduate Academic Committee (GAC) shall consist of the advisor, one additional faculty member in the area of the student's research, and a third member with different expertise. The student's committee will approve courses required for the M.S. degree, and will administer any final thesis examination or non-thesis examination as the committee deems necessary.
- D. At least 30 semester hours of graduate credit (including transfer credit) are required for the M.S. degree, at least 24 of which must be completed under the auspices of The University of Iowa. Coursework that may be used to complete the M.S. degree includes advanced courses, review courses, pedagogy, seminar, and other courses deemed appropriate by the student's GAC.
- E. Of the required 30 semester hours of graduate work:
 1. at least three but no more than four semester hours of Research in Chemistry (CHEM:7999) will be included for the M.S. without thesis
 2. not more than nine hours of Research in Chemistry may be included for the M.S. with thesis.
- F. A candidate for the M.S. degree with thesis must present at least one research seminar.
- G. A candidate for the M.S. degree must submit an "Application for Degree" online, and contact the department administrative office to complete a "Non-Doctoral Plan of Study Summary Form" and the "Request for Final Examination: Advanced Degree" form. These forms must be filed in accordance with Graduate College deadlines for the session in which the degree is to be granted.
- H. If a student who wishes to obtain an M.S. is currently enrolled as a Ph.D. student, they may also need to complete an "Application for Change in Plan of Study" form.

V. Procedure for Dismissal from Degree Programs

- A. If a student is not progressing toward fulfillment of the degree requirements or has not met program requirements, the research advisor (as chair of GAC), or DGS will deliver written notice of dismissal to the student. The letter will identify specific criteria from Sections II, III, or IV of these guidelines that have been violated or not met as appropriate. The letter of dismissal will include a statement outlining the right to appeal.
- B. Any student wishing to appeal dismissal from a degree program may do so by writing to the research advisor and the DGS. The student's GAC will meet within two weeks of receiving the appeal. If the student does not have a GAC, the DGS may appoint an ad-hoc committee of faculty to review the appeal. The student may request a personal appearance before the review committee. The faculty committee will present a recommendation to the DGS who will then inform the student of the decision.

VI. Graduate Teaching Assistant Reappointments and Dismissal

A. Requirements for Reappointment

- 1. All reappointments to teaching assistantship are dependent upon
 - i. satisfactory academic standing;
 - ii. progress toward meeting thesis degree objectives;
 - iii. performance as a teaching assistant;
 - iv. availability of teaching assistantship positions.
- 2. Students who have not met the qualifications for Ph.D. candidacy by the end of the second year in residence will not be reappointed to a teaching assistantship. Departmental assistantships are usually not renewed for students beyond the fifth year.

B. Grounds for Dismissal

- 1. In accordance with the "Graduate Assistant Dismissal Policy" approved by the Iowa Board of Regents, teaching assistants may be dismissed during the term of appointment following dismissal from a degree program or loss of student status.
- 2. Other grounds for dismissal of a teaching assistant as defined by the "Graduate Assistant Dismissal Policy" include reasons sufficient to dismiss a faculty member, or failure to follow or implement instructions of the supervisor. More detailed reasons for dismissal include, but are not limited to the following:
 - i. Repeated failure to perform the assigned duties adequately. For example, failure to be present at scheduled class meetings, failure

to return graded work to students on time, or failure to adequately prepare for teaching duties. Evidence concerning the lack of preparation must include statements from students in the assistant's class.

- ii. Evidence that the assistant has assigned grades to students on the basis of personal preference or prejudice.
- iii. Evidence of sexual harassment as defined by University of Iowa policy.

C. Dismissal Procedures

The Department Executive Officer (DEO) will consider formal faculty or student complaints brought against the teaching assistant. The DEO may recommend dismissal of the teaching assistant to the Dean of the College of Liberal Arts and Sciences (CLAS).

VII. Other Sources of Information

These guidelines and requirements are intended to supplement and clarify the regulations of the Graduate College for the various degrees. Additional rules that may apply to a student's degree progress are given in the Manual of Rules and Regulations of the Graduate College (<https://www.grad.uiowa.edu/graduate-college-manual>) and the General Catalog of the University of Iowa (<http://catalog.registrar.uiowa.edu/>). Regulations regarding preparation of the Master's thesis and Ph.D. dissertation may be obtained from the Graduate College (<https://www.grad.uiowa.edu/>).

VIII. Standard Forms

Graduate students should consult with their research advisors regarding preparation of these forms, but the student is responsible for submission of forms by the deadlines that are published each semester. All Graduate College forms are found on the Graduate College website (<https://www.grad.uiowa.edu/content/publications-and-forms-for-students>), and should be completed and submitted in conjunction with administrative office staff.

A. Ph.D. Candidates

1. **Doctoral Plan of Study Summary Form.** This form requires the signature of a student's research advisor, and should be submitted to the administrative office along with the Request/Report for Doctoral Comprehensive Exam. Staff in the administrative office will forward the form to the Graduate College. The plan of study is evaluated against the student's grade report and current registration, and an approved copy will be returned for inclusion in the student's file.

2. **Request/Report for Doctoral Comprehensive Exam.** This form will be prepared after the student's GAC accepts the research proposal, and has determined a date and time for an oral comprehensive examination. This form should be completed in the administrative office with the Doctoral Plan of Study, and submitted at least two weeks prior to the comprehensive examination date. This form will be used to record the results of the oral comprehensive exam.
3. **Application for Graduate College Degree.** This form must be filed very early in the semester that the student wishes to graduate. Apply on MyUI at the following link: <https://myui.uiowa.edu>
4. **Request/Report for Final Examination: Advanced Degree.** This form must be completed and submitted to the administrative office at least three weeks prior to the examination date. This form will be used to record the results of the final oral thesis defense.

B. M. S. Candidates

1. **Change of Graduate College Status.** If a student is currently enrolled in the doctoral program and wishes to obtain a masters degree, this form will be submitted to the Graduate Admissions office. Please consult with the administrative office about this form.
2. **Application for Graduate College Degree.** This form must be filed very early in the semester that the student wishes to graduate. Apply on MyUI at the following link: <https://myui.uiowa.edu>
3. **Non-Doctoral Plan of Study Summary Form--Nondoctoral Degree** This form requires the signature of a student's research advisor, and should be submitted to the administrative office along with a copy of the Request/Report for Final Examination: Advanced Degree. Staff in the administrative office will forward the form to the Graduate College. The plan of study is evaluated against the student's grade report and current registration, and an approved copy will be returned for inclusion in the student's file.
4. **Request/Report for Final Examination: Advanced Degree.** This form must be completed and submitted to the administrative office along with the Non-Doctoral Plan of Study at least two weeks prior to the examination date. This form will be used to record the results of the M.S. final examination, if applicable.

Appendix A. Instructions for Comprehensive Exam Documents

The Research Report

The Research Report is intended to inform the GAC of the student's research problem and research progress. The report should describe the goals of the research project that the student is working on, their progress to date, and their future plans. The body of the research report (Sections I-IV) should not exceed 10 double-spaced pages including figures, 1-inch margins, and no smaller than 11-point font size. Appropriate references should be cited by number in text. The expected format is as follows:

- I. *Introduction and Background.* (≤ 2 pages) Concise discussion of research problem and critical summary of the relevant literature adequate to identify the state of knowledge in the field and to justify the working hypothesis about the research question.
- II. *Goals and/or specific Aims.* (1 paragraph) Explicit statement of the overarching goals of the student's research project. Objectives and/or working hypothesis(es) for the research question(s) should be clearly articulated and expressed. It must be clear that the research is motivated by the current state of knowledge in the field based on the background information presented in the introduction and that the hypothesis is testable.
- III. *Research Plan, Results, and Discussion.* (6-8 pages) This section should include a description of the research methodology, the anticipated results if the working hypothesis is correct and alternative outcomes that can be anticipated if the working hypothesis is invalid. This section should also present the progress to date on the research plan that is outlined including a presentation of the data that have been collected thus far, the analysis and interpretation of those data, and the initial conclusions that may be drawn from that work.
- IV. *Conclusions and Future Work.* (1 paragraph) Concise summary of the current state of the project and foreseeable future plans for progress toward completion of the research goals.
- V. *References.* A list of references should be provided, including the titles of all references. This section is not included in the page limit.
- VI. *Addenda.* Addenda should be limited to a one-page curriculum vitae, and reprints and preprints of publications resulting from the student's work to date.

The Original Proposal

The written Original Proposal should involve a topic that is distinct from the student's research problem. The idea must be unique and original with the student. Although the student should consult with the advisor in identifying a topic that is of appropriate scope and distinct from the work done in the advisor's group, during preparation of the proposal, only general guidance on procedural matters by the student's advisor is permitted.

Although the uniqueness of the proposal is important, emphasis should also be placed on such items as:

- i. Why is the problem worthy of investigation?
- ii. What is the central question to be addressed in the proposed research?
- iii. What is the working hypothesis?
- iv. How will the proposed research activities test this hypothesis?
- v. What outcomes can be expected if the hypothesis is (in)correct?
- vi. What alternate research activities might be considered to further test the hypothesis or test alternative hypotheses if the current one is invalid?

The scope of the problem should be such that a single investigator in a research university, with access to the usual research equipment, could make significant progress toward meeting the key objectives in one year of work.

The research proposal should adhere to the following format with a maximum length of 10 double-spaced pages including figures, 1-inch margins, and no smaller than 11-point font size, with no appendices. Appropriate references should be cited by number in text.

- I. *Introduction.* (≤ 2 pages) Concise presentation of the problem and its significance with a summary of the relevant literature adequate to identify the current state of knowledge and justify the research question.
- II. *Research Question.* (1 paragraph) Explicit statement of the research question and the working hypothesis about the answer to that question. It must be clear that the working hypothesis is motivated by the current state of knowledge in the field based on the background information presented in the introduction and that the hypothesis is testable.
- III. *Significance of the Proposed Research.* (≤ 1 page) Concise statement of the importance of the problem and the impact of the proposed studies. Specifically, what will become possible as a result of the proposed research that is not currently possible?
- IV. *Proposed Studies.* (6-7 pages) Description of the proposed research activities with a clear statement of how research activities and/or key experiments will test the working hypothesis. Discussion of the expected outcomes if the working hypothesis is correct and what alternative outcomes might be expected if the working hypothesis is proved invalid. Detailed procedures and techniques for the

proposed research activities should only be included to address non-routine methods or issues that are particularly significant to the success of the proposed work (e.g., determination of the stereochemistry of a key synthetic intermediate where the outcome has no definite precedence in the literature or details of an optical setup for detecting a signal that has not been implemented previously). The discussion should also identify the aspects of the proposed research that are likely to be most challenging and where the likelihood for success is most uncertain with a critical assessment of what factors influence the potential outcomes.

- V. *References.* A list of references should be provided, including the titles of all references. This section is not included in the page limit.

Appendix B. Advanced Courses in Chemistry and the Proficiencies They Satisfy

<u>Course Number</u>	<u>Course Title</u>	<u>Proficiency</u>
CHEM:4480	Introduction to Molecular Modeling	P
CHEM:4760	Radiochem: Energy, Medicine, Environment	I
CHEM:4873	Atmospheric and Environmental Chemistry	P
CHEM:4875	Introduction to Polymer Chemistry	O
CHEM:5107	Electrochemistry	A or P
CHEM:5108	Spectroscopy	A
CHEM:5109	Separations	A
CHEM:5110	Chemical Sensors	A
CHEM:5114	Chemical Systems Modeling	A or P
CHEM:5115	Biophotonics	A
CHEM:5118	Nanomaterials	P or I
	<i>(Note: Prior to March 2019 this was A or I)</i>	
CHEM:5120	Electrochemistry of Polymer Films	A or P
CHEM:5150	Chemometrics	A
CHEM:5199	Special Topics in Analytical Chemistry	A
CHEM:5202	Coordination Chemistry and Spectroscopy	I
CHEM:5203	Organometallic Chemistry	I
CHEM:5204	Physical Methods in Inorganic Chemistry	none
	<i>(Note: 2 s.h. course, does not satisfy proficiency)</i>	
CHEM:5205	Bioinorganic Chemistry	I or B
CHEM:5206	Solid-State and Materials Chemistry	I
CHEM:5212	Mass Spectrometry	A
CHEM:5299	Special Topics in Inorganic Chemistry	I
CHEM:5321	Spectroscopic Methods in Organic Chem	O
CHEM:5326	Organic Reactions	O
CHEM:5328	Mechanisms of Organic Reactions	O
CHEM:5329	Advanced Organic Synthesis	O
CHEM:5399	Organic Chemistry Special Topics	O
CHEM:5431	Statistical Thermodynamics I	P
CHEM:5433	Quantum and Computational Chemistry	P
CHEM:5434	Molecular Spectroscopy	P
CHEM:5435	Chemical Kinetics	P
CHEM:5436	Electronic Structure & Informatics Chemistry	P
CHEM:5438	Surface Chem & Heterogeneous Processes	P or A
CHEM:5499	Physical Chemistry Topics	P
CHEM:5875	Perspectives in Biocatalysis	B

Key: A = analytical, B = biochemistry, I = inorganic, O = organic, P = physical