

## Information for Graduate Students in Chemistry

Department of Chemistry and Biochemistry  
Utah State University, Logan, Utah

The Department of Chemistry and Biochemistry offers advanced study and research in analytical, biological, inorganic, organic and physical chemistry. The Ph.D. degree is awarded primarily for independent research. The M.S. degree is awarded for successful completion of specific courses and of a research problem less complex than a doctoral problem. The section on Ph.D. candidacy examinations does not apply to M.S. candidates. <sup>1</sup>

**Getting Started:** In the weeks just before the start of the first academic semester, new students must participate in the graduate student's orientation program. Specifically, new students are required to attend the safety workshop and departmental orientation sessions, take departmental competency examinations, and receive academic advising. Students receiving a teaching assistantship must attend training sessions administered by the School of Graduate Studies. The scheduling of these events will be announced well in advance.

**Competency Examinations:** Graduate students are expected to demonstrate a satisfactory undergraduate level of knowledge in relevant areas in order to be eligible for the M.S. or Ph. D. degree. For students in analytical, organic and inorganic chemistry these areas are analytical, inorganic, organic, and physical chemistry. Physical chemistry students may elect to demonstrate competency in computer programming, mathematics and physics as replacements for organic, inorganic and analytical chemistry. This must be accomplished before the start of the student's second year of graduate study.

During orientation week in August, new graduate students will be required to take four placement examinations. These will be the ACS exams in Analytical, Inorganic, Organic and Physical chemistry. A student can meet the proficiency requirements by earning a score at the 40<sup>TH</sup> percentile or better. In addition, for physical chemistry students only, three competency exams, written "in-house" in computer programming, mathematics and physics will also be offered. If the student does not pass 3 out of 4 placement examinations, the requirement must be met within one year by one of the following means:

1) Earn a grade of B or better in either the following undergraduate class, in the area of deficiency:

organic: CHEM 2320, Organic Chemistry II

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<sup>1</sup>"Any grievances will be dealt with in strict conformity with the USU Student Code, available at <http://www.usu.edu/stuserv/SCode/>"

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inorganic: CHEM 5520, Advanced Inorganic Chemistry  
analytical: CHEM 5640, Instrumental Analysis  
physical: CHEM 3060 or CHEM 3070, Physical Chemistry  
or in 5000 level or higher classes, as specified by the division on a case by case basis.  
Or, division approved courses in computer science, mathematics or physics.

OR

2) Pursue independent study, and take another version of the competency examination. The exam can be taken a second time in early January, and, if necessary, a third attempt can be made in August. No more than three attempts to pass a specific examination will be allowed.

Graduate students will not be allowed to enroll in graduate courses in an area of chemistry where they haven't already demonstrated an undergraduate level of proficiency by meeting the above requirement.

If the undergraduate proficiency requirements are not met before the end of the student's first year, the student will not be permitted to continue in the graduate program.

**Selection of the Major Professor:** Newly entering graduate students should identify at least three professors within the department whose research is of potential interest to them and provide this list to the department head for approval. A form will be provided for listing the individual professors chosen by the student. The student should arrange to meet briefly (20-30 minutes) with each of the chosen professors as a first step towards choosing a major professor. Students must have the form signed by each of the professors after completion of the initial meeting. These initial meetings must be completed by the end of the third week of the semester which the student begins graduate study. From these initial meetings, the student should choose and list on the same form as above, up to three of the professors with which the student wishes to do a laboratory rotation. Each laboratory rotation will be for a period of three weeks and is designed to allow the student to gain a more in-depth understanding of a particular professor's research program. The exact nature of the rotation (for example: attendance at group meetings, additional research discussions with the professor, mutually agreeable laboratory work, etc.) will be determined by each individual professor and the student.

The completed Laboratory Rotation Form must be returned to the Department Office by the Monday of the 4<sup>th</sup> week of the entering semester. The Department Office will coordinate the scheduling of rotations for each new graduate student so as to evenly distribute students among the requested laboratories throughout the semester. The first laboratory rotations will begin the Monday of the 5<sup>th</sup> week of the entering semester, the second series of laboratory rotations will begin the Monday of the 8<sup>th</sup> week of the entering semester and the final series of laboratory rotations will begin the 11<sup>th</sup> week of the entering semester. Students must complete all laboratory rotations that have been scheduled and should have the professor sign the rotation form signifying completion at the end of each rotation. When all laboratory rotations have been completed, students will turn in the completed form to the Department Head, no later than the start of the 14<sup>th</sup> week of the semester. The graduate student should also indicate a 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup>

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preference, from the laboratory rotation list, for the assignment of a major professor. Final assignments of major professor will be by the Department Head in consultation with, and approval by, the appropriate professor and the student.

**Supervisory Committee:** After the major professor is assigned, and within the first year of residence, the student and the major professor must select faculty for the student's supervisory committee. For a Ph.D. student, a minimum of five faculty are required, with at least 3 members coming from the Department of Chemistry and Biochemistry; one member must represent a field outside Chemistry and Biochemistry but be in a field related to the student's research. For M.S. Students, a minimum of 3 faculty from the department are required, with at least one representing the student's area of specialization; at least one member must be from outside the specialization area. The student should meet with potential supervisory committee members to confirm their willingness to serve on the committee. The committee must be approved by the Department Head and the Dean of Graduate Studies. Selection of the committee should be accomplished by April 1, and the Supervisory Committee Form is to be submitted to School of Graduate Studies during the student's 2<sup>nd</sup> semester.

Beginning the second year of study, annual meetings with the supervisory committee must be held before the end of the Fall semester each year (or Spring semester for students admitted in Spring). The purpose of these meetings is to monitor and assess progress of the student in coursework and research. All students must submit a description of the planned research project, and of progress made to date, of no more than 5 pages, to their committee ten days prior to the meeting. After approval by the supervisory committee, the signed cover page is submitted to the School of Graduate Studies. In future meetings, the report should consist of a summary or research progress. An appendix at the end of this document contains guidelines for students and their committees regarding expectations of progress, and for the format of the meetings.

Note: during the year of the oral exam and proposal (typically the third year), this event counts as the required annual meeting.

Within two weeks of the meeting, the committee will forward a letter to the student, summarizing the conclusions from the meeting, which the student will sign acknowledging understanding of its contents. The signed letter will be sent to the student's file. The letter will detail the progress of the student, perceived deficiencies, steps to be taken to remedy them, and expectations for successful completion of the degree, and a recommendation will be made as to whether or not the student should be allowed to continue in the program

**Curriculum:** Students should discuss course schedules with their advisors during the first year and with their supervisory committee in subsequent years. The Graduate School requires 30 credit hours for the M.S. and 90 for the Ph.D. degrees. At least 15 of these must be

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course work credits. The remaining credits will be primarily in research (Chem 6970 or Chem 7970). Other courses may also be required as the student discusses the Program of Study with their Supervisory Committee. Students should check the graduate catalog for residence and other requirements. The maximum load for a student doing half-time teaching or research (A Teaching Assistant or a Research Assistant) is 12 credits per semester; normal student enrollment is 6-7 credits per semester. Continuous registration is required until completion of the degree program. Students receiving support during Summer Semester must also be registered for the Summer Semester.

Students in the chemistry program can choose to specialize in the areas of analytical, inorganic, organic, or physical chemistry. To qualify as a Ph.D. candidates, students must complete a minimum of 15 credits of graduate courses. Of the 15 credits, 6 must be from courses outside the student's chosen area of specialization. These may include courses outside the Department of Chemistry and Biochemistry.

Each division (analytical, inorganic, organic and physical) has established a list of core courses for students specializing in that area:

### **Analytical Chemistry:**

- Chem 7600 Analytical Spectroscopy (3 credits)
- Chem 7610 Chemical Separations (3 credits)

### **Inorganic Chemistry:**

- Chem 6500 Reactivity and Mechanisms in Inorganic Chemistry (3 credits)
- Chem 6510 Chemical Applications of Group Theory (1 Credit)

### **Organic Chemistry:**

- Chem 6300 Advanced Modern Organic Chemistry (Physical Organic) (3 credits)
- Chem 7300 Reactions and Synthesis in Modern Organic Chemistry (3 credits)
- Chem 7310 Molecular Structure/Spectroscopy of Organic Compounds (3 credits)

### **Physical Chemistry:**

- Chem 6010 Quantum Chemistry (3 credits)
- Chem 6020 Molecular Spectroscopy (3 credits)
- Chem 7020 Statistical Mechanics (3 credits)

Students entering with prior graduate course work may petition to have equivalent courses at USU waived, possibly without substitution by other courses. This decision will be made in consultation with the student's committee or with faculty within the student's division. Adequate documentation of equivalency, and possibly demonstration of competence will be required.

**Program of Study and Research Plan:** The Program of Study is to be formulated and approved by their supervisory committee and then submitted to School of Graduate Studies for approval before the end of the student's 3<sup>rd</sup> semester. Students who make satisfactory progress are considered candidates for a degree even though they may not have been formally advanced to candidacy by the Graduate School. Formal advancement to candidacy requires the completion of course work and a research proposal that has been approved by the supervisory committee. Ph.D. students also must successfully complete written and oral comprehensive examinations for formal advancement to candidacy.

**Seminars:** Seminars scheduled under the Organic/Inorganic and Physical/Analytical programs are an important aspect of graduate training. Students will register for one of these seminar programs in the Fall and Spring. Participation in the Departmental section (CHEM 7800-001) of the programs is mandatory regardless of the student's registration status, and students must also register for the appropriate section (Physical/Analytical, or Organic/Inorganic) based on area of research. The grading for seminar is on a Pass/Fail basis. Each student will present at least one seminar each year. The student will present a departmental seminar reporting the results of their research as part of the defense of the M.S. thesis or Ph.D. dissertation.

**Language:** The Department of Chemistry and Biochemistry has no foreign language requirement for advanced degrees. However, a student's supervisory committee may require a student to show proficiency in a language when deemed necessary for satisfactory progress in the student's area of research.

**Academic Status:** Students must maintain a 3.0 GPA in all courses taken at Utah State University included in their graduate Program of Study. This GPA is computed at the end of the first year and then on a semester by semester basis. It *does not* include research or seminar grades. Only one C grade in any course work listed in the Program of Study is allowed. Students receiving a second C grade will be dismissed from the program. Students must continually make satisfactory progress toward completion of a degree.

The Graduate Studies Committee will inform the Department Head of students who have failed to meet any of the requirements. A recommendation will be made for a probationary semester to make up the deficiency or for dismissal from the program. If the deficiency has not been satisfied by the end of the probationary semester, further reinstatement will be a decision of the entire faculty.

**Ph.D. Candidacy Examinations:** Ph.D. students must take both written and oral candidacy examinations. The written examination insures that students have a broad understanding of chemistry and the depth of knowledge in their chosen fields required for Ph.D. work. The written examination must be passed before the oral examination is attempted. Both exams are normally finished by the end of the second year, but must be passed by the end of the third.

Students must satisfy the written portion of the Ph.D. candidacy examination by passing a

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series of cumulative examinations. The organization of the scheduling and administration of the exams is done by the Graduate Studies Committee. Questions are solicited from the entire faculty. The examination procedure is outlined below:

1. Students normally begin taking the examinations at the beginning of the **Fall** semester of their **second** year. Students may petition to begin the examinations earlier or later in special circumstances. Such requests must be approved by the student's supervisory committee, and by the Graduate Studies Committee. Students must pass 4 out of 9 consecutive examinations offered. Missed examinations without a legitimate documented reason will be counted as failures. Nine examinations are offered each academic year on a monthly basis.
2. Cumulative examinations will be offered in analytical, inorganic, organic, and physical chemistry at the same time. Students may elect to take examinations in any area, but no more than one on the same day. Students must pass a minimum of 3 examinations in their area of emphasis as defined by their Supervisory Committee.
3. Examinations will be graded Pass/Fail, based on the percent score. A score of 60% or better always constitutes a Pass grade. Students are notified in writing about their performance on the examinations.
4. Students who do not pass 4 out of 9 examinations may complete an M.S. degree.

Upon successful or unsuccessful completion of the cumulative exam process, the Graduate Studies Committee will present the results to the faculty at the next regular faculty meeting.

*Students must take the oral portion of the qualifying examinations before the end of the second year of study or no later than three months after the last day on the semester during which they passed their last cumulative examination, whichever time comes later and excluding summer semester.*

Administration of the oral examination is the responsibility of the student's supervisory committee. To pass this examination, students must write, discuss, and defend an original research proposal.

In preparing for the oral examination, a student is permitted to solicit information from others, including faculty. However, this must be done on a strictly limited basis and good judgment must be exercised on both sides. It is expected that the originality of the research proposal and the bulk of the preparation for the defense represents the student's own work. If a student is in doubt about the propriety of requesting information in a specific case, the supervisory committee should be consulted. Any information in the written proposals obtained from others should be acknowledged. Since the faculty regards the oral examination to be a very important indication of research ability, students should not limit their preparation to the three months just before the exam. Instead, possible topics should be considered and seriously pursued from the beginning of graduate study. The procedure for this examination is outlined as follows:

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1. The student will meet with their supervisory committee to clarify the expectations of the committee regarding the oral examination. The student's Program of Study may also be discussed at this meeting. It is advised that students seek preliminary approval of their topic from the members of their supervisory committee. This meeting may be held prior to the written examination upon request of the student or a member of the committee.
2. Students must submit a typed proposal to the members of their supervisory committee at least two weeks prior to the examination date. The topic of the proposal must address an original research idea significantly outside the student's immediate research area. The proposal format is the same as required for proposals submitted to the National Science Foundation, or other national funding organization approved by the supervisory committee, and is not to exceed 15 double-spaced pages (including abstract, references, and vitae). No budget information should be included in the proposal but a brief biographical section about the author must be included. Guidelines for Proposals are available in the Chemistry and Biochemistry main office.
3. No later than one week before the scheduled examination date, the student must obtain approval to proceed with the examination from each member of the supervisory committee.
4. The oral examination begins with the student presenting a short summary of the proposal. The examination is conducted in the presence of the supervisory committee only. While the examination begins with a focus on aspects of the student's proposal, questions on topics of a more general nature will likely be asked.
5. After the examination is complete, the supervisory committee will deliberate on the student's performance in light of the expectations outlined in the preliminary meeting. A grade of Pass or Fail will be immediately announced to the student. In the case where the student fails the exam, the supervisory committee may direct the student to prepare a new proposal, revise the existing proposal, and/or address specific topics in a second attempt. Students who wish to make a second attempt for a Pass must retake the exam within two months under conditions set by the supervisory committee.
6. Students who do not pass the second examination may transfer to the Masters degree program.

Upon completion of the oral examination, the supervisory committee will present the results to the faculty at the next regular faculty meeting. The students will be informed of the recommendation of the supervisory committee prior to this faculty meeting.

**Final Requirements:** After completing research, students must report their results in a typed M.S. thesis or Ph.D. dissertation. A copy must be given to each member of the supervisory committee at least four weeks before the final examination is held. The student and the supervisory committee members must complete and sign an Appointment for Examination form for submission to the School of Graduate Studies at least ten days prior to the examination. The defense must be coordinated with the departmental seminar coordinator and announced to the faculty at least two weeks in advance.

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The final defense of the dissertation or thesis includes a formal departmental seminar followed immediately by a closed meeting of the candidate with the supervisory committee. Although a detailed summary of the research is expected, the seminar should demonstrate the ability to present material that is understandable to chemists *outside of a special research discipline*. This seminar is an important degree requirement, and it must be presented to the satisfaction of the faculty at large. Students who pass the oral examination must make any changes or revisions specified by the supervisory committee and obtain their signatures before submission to the School of Graduate Studies.

### **Guidelines for annual progress report meetings**

Annual meetings with the supervisory committee are an important part of the mentorship of graduate students. These provide a venue for feedback about the progress being made on the research project, to clarify expectations for the successful completion of the degree, and for constructive criticism to be given when necessary. Committees will particularly look for progress in the areas below, and comment on these in the letter following each annual meeting that is placed in the student's file.

#### Committee meeting progress report checklist items.

For the first meeting:

- Is satisfactory progress being made in completing coursework on the Program of Study, and are grades satisfactory?
- Is satisfactory progress being made in the research project; is progress toward research proficiency evident, and does the student show signs of taking intellectual ownership?
- Does the student meet the advisor's expectations with regard to time and effort, lab safety, notebook standards, and citizenship?
- Is there evidence that the student reads and understands the current literature in their research area?

For subsequent meetings:

- Has clear research progress been made since the previous year's meeting?
- Has the student produced work that has been presented at conferences, or in publications? If not, is there clear progress toward this goal; what are the committee's expectations in this area, and are they being met?

Particularly important for fourth year and beyond:

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- Does the level of measurable research progress, in terms of meeting abstracts or manuscripts, compare favorably with previous successful PhD students, in a comparable research area, at this point in their studies?
- Has the candidate taken intellectual ownership of their project? Can he/she make choices about the next steps in research, or just doing what they are told?
- If any these areas are not clearly satisfactorily, is there justification for continuation in the PhD program?

Any areas in need of improvement should be clearly identified in the letter, and the student given constructive criticisms during the meeting. Expectations to be met before the following year's meeting should be specified in the letter.

**Format of the meeting:** An essential part of the committee meeting is a discussion of the student's research progress. Students should come to the meeting with their notebooks, and any other materials needed to enable them to answer questions and discuss their results. The progress report must be given to committee members no later than 10 days before the meeting, and may include any publications since the previous meeting. An oral PowerPoint presentation may be a part of the annual meeting, but is not mandated. Students should consult with their committee in advance of the meeting to ascertain whether or not such a presentation will be expected, and its length.