



Department of Chemistry  

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College of Natural Sciences  
and Mathematics

# Graduate Study in Chemistry

2022-2023 Edition

Last Revised on: 08/08/2021

## Introduction

The Department of Chemistry at the University of Houston offers programs leading to M.S. and Ph.D. degrees through research in analytical, biological, inorganic, materials, organic, physical, and theoretical chemistry. The nationally recognized 29 research-active faculty members provide a rich learning environment for approximately 130 graduate students and 30 postdoctoral fellows. A wide variety of instrument facilities and an excellent technical staff support the research and teaching efforts within the Department.

Award of the M.S. (Plan I) or Ph.D. signifies endorsement by the University that the recipient has acquired broad knowledge of the discipline and has demonstrated, by successful completion of an acceptable thesis or dissertation, research competence meeting national standards of the discipline. The University of Houston provides equal educational opportunities without regard to race, color, religion, national origin, sex, orientation, age, handicap or veteran status in compliance with Title IX regulations.

## Financial Aid

Applicants become eligible for a teaching fellowship when they file the application form for admission to the graduate program. In general, students admitted to the Ph.D. program in the Department of Chemistry will be awarded a teaching fellowship, for which the current annual stipend is approximately \$23,400. Priority for these fellowships will be given to students conducting research for an advisor in the Department of Chemistry, and students conducting research outside of the Department of Chemistry should ensure financial support from the department where they are conducting research so that funding does not lapse. Weekly teaching duties typically involve laboratory instruction and other teaching-related tasks, such as grading. Full-time students receiving a teaching or research fellowship and who are in good academic standing ( $\text{GPA} \geq 3.00$ ) are also awarded a Graduate Tuition Fellowship (GTF) and an in-state tuition waiver for up to five years of graduate study, per University policy. Additionally, mandatory university fees for all GTF-eligible students are waived. Eligible domestic students will be expected to help the university fill out a Free Application for Free Student Aid (FAFSA) form upon matriculation.

## Admissions Requirements and Applying to the Program

Graduates of colleges and universities who have completed the normal four-year program leading to a bachelor's degree in chemistry or related degree/major and who present documentary evidence of the ability to pursue graduate study are eligible for consideration for admission to the graduate program in Chemistry at the University of Houston.

A grade point average (GPA) of 3.0/4.0 or greater is required for unconditional admission. An applicant with a GPA of less than 2.8 will not be admitted without approval of the Graduate Committee and the College of Natural Sciences and Mathematics. An applicant's calculated GPA for admission is usually based on the most recent 60 semester credit hours of course work. The GPA for an applicant who has had six or more semester hours of graduate-level course work will be evaluated on the basis of those hours attempted plus sufficient post-baccalaureate and/or undergraduate work to make 60 semester hours total. The GPA for an applicant with a Master's degree or with more than 30 semester credit hours for graduate-level course work will be calculated based on that course work only. To remain in the graduate program, a conditionally admitted student who had a substandard admission GPA or other unmet requirement must earn a minimum GPA of 3.0 on the first 12 hours of work attempted at the University of Houston.

Applicants are encouraged to submit Graduate Record Exam (GRE) and Chemistry Subject Test scores with their application, though these are optional. Applications and information for the GRE may be obtained from the Educational Testing Service (ETS), <http://www.ets.org/gre>. Arrangements for taking the appropriate test should be made at least four months in advance of the application deadline.

Three (3) Letters of Recommendation should be provided: Your letters of recommendation should come from your mentor or teachers who know your background and history in academics and/or research.

Students are also asked to submit a Curriculum Vitae and Personal Statement with their application. The latter statement should include educational and career goals, prior research experience, and any preference for the type of research to be pursued (or desired faculty as a research mentor) in the Department of Chemistry at the University of Houston.

New students must be in residence a minimum of two weeks (14 days) in advance of the first day of classes of the school term. This is necessary to ensure a smooth transition to the Graduate Program and to allow time for student orientation and required laboratory and chemical safety training.

## Domestic Students

Citizens and permanent residents of the United States are considered domestic students. Completed applications from domestic applicants are due January 31 for admission in the following fall semester. It is strongly recommended, however, that they apply by December 8<sup>th</sup> to ensure full consideration of their application and to be considered for additional fellowships and scholarships.

## International Students

The University classifies a student who is not a United States citizen or permanent U.S. resident as an international student. The deadline for receipt of all application materials for international students is April 1 for admission in the fall semester. It is strongly recommended, however, that you apply by January 31<sup>st</sup> to ensure full consideration of your application and to be considered for additional fellowships and scholarships.

International applicants for whom English is not their native language or who have not received a B.S. degree from a university in an English-speaking country (for a list of qualifying countries, see <http://publications.uh.edu/content.php?catoid=22&navoid=5987>) must submit scores from the Test of English as a Foreign Language (TOEFL). Minimum scores of 550 for the paper-based test, 213 for the computer-based test, or 79 for the internet-based test are required. Additionally, upon arrival at the University of Houston, an international student who has been awarded a teaching fellowship must demonstrate an acceptable ability to communicate in the English language. A student's teaching fellowship may be revoked if he or she cannot demonstrate English language competence. The TOEFL examination is administered at least six times per year in major cities throughout the world. Further information may be obtained by visiting the ETS website at <http://www.ets.org/toefl>. The University also accepts testing results provided by International English Language Testing Service (IELTS) (<http://www.ielts.org/>), for which the minimum requirement is an overall score of 6.5, and the DuoLingo English test, for which the minimum requirement is a score of 105.

The Department follows the University's policy on English proficiency requirements with no exceptions. Further

information regarding English proficiency and exemptions can be found at <https://uh.edu/graduate-school/international-students/english-proficiency/>.

## Application Procedure

Both domestic and international students must apply to the Graduate Program in Chemistry through the online application system provided by CollegeNet, <https://www.applyweb.com/uhouston/index.ftl>. The application is free for domestic applicants. For international applicants, the cost is USD \$80, which can be paid online with a major credit card. No other payment method is accepted. Official GRE scores must be submitted to the University directly by ETS.

All required application documents must be uploaded directly into the student's account at the time of completing an application. Official individual mark sheets in certain countries, transcripts, and degree certificates must be sent directly to the Graduate school at the address below. Please note that transcripts must include an English translation.

<b>Regular Mail Address</b>	<b>Express Mail Address</b>
University of Houston Graduate Admissions P.O. Box 3947 Houston, Texas 77253-3947	University of Houston Graduate Admissions 4302 University Dr, Rm 102 Houston, TX 77204-2012

Additional official documents may also be sent to the Chemistry Graduate Advisor at the following postal or e-mail addresses when necessary.

Chemistry Graduate Advisor  
University of Houston - Department of Chemistry  
3585 Cullen Blvd. Room 112  
Houston, Texas 77204-5003  
[chemgradadvisor@uh.edu](mailto:chemgradadvisor@uh.edu)

# Requirements for Advanced Degrees in Chemistry

## *Diagnostic Examinations*

Prior to the first day of class, new graduate students take four diagnostic examinations in the areas of organic, inorganic, physical and analytical chemistry. These standardized exams are written by the American Chemical Society Examinations Institute and are used by the Department to assess the student's preparation for graduate study and to help guide the student in course and division selections.

## *Research Divisions and Programs*

Following the diagnostic examinations, a meeting is scheduled between the new student and the Graduate Chair to determine course enrollment for the first semester. The Graduate Chair serves as the student's mentor until a research mentor is selected. At that time, the student must elect a division with which to be associated. The divisions are Inorganic, Organic, and Physical Chemistry. A limited number of students may also request to participate in Chemical Biology Interdisciplinary Program. A student who requests to participate in the latter program must obtain permission from the Graduate Chair and is subject to special requirements for participating in the program and graduation. Students interested in the Chemical Biology Interdisciplinary Program should contact the Graduate Chair before the start of the first semester. Students must be a member of a division, even if conducting research outside of the Department of Chemistry.

## *Divisional Seminar Requirements*

### *Inorganic Chemistry Division:*

A: (MS (plan I) and PhD) One 20–25 min presentation of recent advances (within the last 5 years) in chemistry based on reports in the peer-reviewed chemical literature. The topic and the results presented should not be directly related to research being conducted by affiliates of the Chemistry Department at the University of Houston. The topic should not have been recently reviewed, and a substantial portion of the presentation should be based on primary reports by the active research groups rather than on review articles.

B: (PhD only) One 40–50 min presentation on the research the student has conducted that will be included in their thesis. A majority of this presentation should be the student's own efforts, with sufficient background included for understanding. Contributions from coworkers or other researchers must be acknowledged and attributed to the responsible person.

Both presentations must include a written abstract to be distributed to the division before the presentation on a timetable determined by the division. Both presentations must be easily understandable by division members for the written, verbal, and visual components. The introduction, background, hypotheses, approach, experiments, data, conclusions, and references must be included and scientifically sound. The student must be able to answer questions satisfactorily and show a basic understanding of the principles supporting the presented work.

The presentation will be evaluated by faculty members present, ideally with the PI present as an advocate for the student presenter. If the presentation is deemed unsatisfactory, the student will need to repeat the presentation on the same or different topic in a satisfactory manner. Both seminar requirements need to have been completed satisfactorily before the student obtains a Ph.D. degree.

A student pursuing a thesis-based Master's degree will have had to complete part A of the requirements above satisfactorily before receiving their degree.

*Organic Chemistry Division:*

A: (MS (plan I) and PhD) One 30–40 min presentation of recent advances (within the last 5 years) in chemistry based on reports in the peer-reviewed chemical literature. The topic and the results presented should not be directly related to research being conducted by affiliates of the Chemistry Department at the University of Houston. The topic should not have been recently reviewed, and a substantial portion of the presentation should be based on primary reports by the active research groups rather than on review articles.

B: (PhD only) One 40–50 min presentation on the research the student has conducted that will be included in their thesis. A majority of this presentation should be the student's own efforts, with sufficient background included for understanding. Contributions from coworkers or other researchers must be acknowledged and attributed to the responsible person.

Both presentations must include a written abstract to be distributed to the division before the presentation on a timetable determined by the division. Both presentations must be easily understandable by division members for the written, verbal, and visual components. The introduction, background, hypotheses, approach, experiments, data, conclusions, and references must be included and scientifically sound. The student must be able to answer questions satisfactorily and show a basic understanding of the principles supporting the presented work.

The presentation will be evaluated by faculty members present, ideally with the PI present as an advocate for the student presenter. If the presentation is deemed unsatisfactory, the student will need to repeat the presentation on the same or different topic in a satisfactory manner. Both seminar requirements need to have been completed satisfactorily before the student obtains a Ph.D. degree.

A student pursuing a thesis-based Master's degree will have had to complete part A of the requirements above satisfactorily before receiving their degree.

*Physical Chemistry Division:*

A: (MS (plan I) and PhD) One 30 min presentation of recent advances in relevant chemistry based on reports in the peer-reviewed chemical literature, to be given during the second year of the graduate study. The topic presented should not have direct overlap with the student's own research project and with the methods used in the student's research group. The topic should not be from a review article, and a substantial portion of the presentation should be based on primary reports by the active research groups rather than on review articles.

B: (PhD only) One 40–50 min presentation on the research the student has conducted that will be included in their thesis, as a pre-defense talk within the final year of the graduate study. A majority of this presentation should be the student's own efforts, with sufficient background included for understanding. Contributions from coworkers or other researchers must be acknowledged and attributed to the responsible person.

Both presentations must include a written abstract to be distributed to the division before the presentation on a timetable determined by the division. Both presentations must be easily understandable by division members for the written, verbal, and visual components. The introduction, background, hypotheses, approach, experiments, data, conclusions, and references must be included and scientifically sound. The student must be able to answer questions

satisfactorily and show a basic understanding of the principles supporting the presented work.

The presentation will be evaluated by faculty members present, ideally with the PI present as an advocate for the student presenter. If the presentation is deemed unsatisfactory, the student will need to repeat the presentation on the same or different topic in a satisfactory manner. Both seminar requirements need to have been completed satisfactorily before the student obtains a Ph.D. degree.

## Course of Study

### *Advisor Selection*

The selection of a research advisor to guide a student through his or her thesis or dissertation research is a critically important step. New graduate students must meet with several (at least four) members of the Chemistry faculty to discuss potential research projects and mutual interests. After meeting with faculty members and deciding which faculty member's research provides the best fit (performed by October 16<sup>th</sup>), students should ask the faculty member for permission to join the faculty member's research group in the Department of Chemistry. Students who enter in the fall semester must choose and be accepted by a research advisor no later than November 1<sup>st</sup>. Students are expected to begin research as soon as they have chosen an advisor. Students who cannot choose an advisor in the required time may request from the Graduate Committee an additional semester to decide. Extensions are granted, however, only under extraordinary circumstances. Failure to observe the time limit for choosing a research advisor will jeopardize a student's standing in the Graduate Program and may result in termination from the PhD program. The Graduate Chair will serve as advisor until the research advisor is selected. Students may have co-advisors and do research with multiple groups with one or both in the Department of Chemistry. Students wishing to do research only with a group outside the Department of Chemistry should secure a formal Advisor of Record from the Department of Chemistry to serve as chair of their dissertation committee and should ensure that the research advisor(s) outside the Department of Chemistry are able to provide support via a Research Assistantship when Chemistry Teaching Assistantships are not available.

### *Thesis/Dissertation Committee*

The student's thesis or dissertation committee is designated by the end of their fourth long semester (counting only fall and spring semesters as "long semesters"); the student must submit their ORP Committee preferences online by April 1<sup>st</sup> of their second year. The committee consists of five members: the student's research advisor (who does not sit in the ORP exam), two faculty members in the student's division, one chemistry faculty member outside the student's division, and one member from outside the Department of Chemistry (this can be a faculty member from another department or university, or a person from industry who has earned a Ph.D.). The research advisor and student choose one committee member from the Department and one from outside the Department. These selections, along with requests or recommendations for other committee members, are communicated to the Chair of the Graduate Committee via an online form by April 1<sup>st</sup> unless they joined the graduate program during the spring semester. Students who join the program in the spring must submit their preferences by Nov. 1<sup>st</sup> of their second year. The Graduate Chair selects the other two members of the dissertation or thesis committee to complete the prescribed distribution and also later approves the final dissertation or thesis committee. A Committee Composition Form ([http://www.uh.edu/nsm/\\_docs/nsm/students/graduate/Committee-Composition.pdf](http://www.uh.edu/nsm/_docs/nsm/students/graduate/Committee-Composition.pdf)) must be submitted by the student the semester *prior* to the intended semester for graduation.

## ***Degree Credit Hours***

A minimum of 54 total credit hours for the Ph.D. program and 30 total credit hours for the M.S. thesis program of graduate-level work, which may include lecture courses, lab courses, seminars, research, etc., are required for the completion of a graduate program of study. The expected total number of credit hours for a PhD is 90. Graduate students who are awarded research or teaching fellowships must enroll for nine semester hours during fall and spring semesters and the semester hours for the summer required by College or University policy (summer enrollment hours may vary). All M.S. and Ph.D. candidates must be continuously enrolled full time until the degree requirements are completed. Students will be considered as continuously enrolled with an approved leave of absence on file. This program follows the leave of absence policy and rules defined in the University Graduate Catalog. Graduate students are expected to be in residence all year to conduct their thesis or dissertation research beginning in the first year of their graduate studies.

## **Divisional Course Requirements**

Completion of a minimum of six (6) graduate-level lecture-based courses is required. The courses listed below are those that the Divisions accept as fulfilling the six-course requirement. Students may take additional graduate-level courses with the written approval of their research advisor(s) and Graduate Chair. Please visit the Graduate Catalog on the University website for the complete listing of courses (<http://www.uh.edu/graduate-catalog/>) and use the online Course Listing via the University website (<http://www.uh.edu/academics/courses-enrollment/class-schedule>) to determine the courses being offered in a particular semester. Any courses that are not listed in the relevant section below or do not conform to the stated requirements must be approved by the student's advisor(s), the division, and the Graduate Committee to qualify as one of the six required courses for that student.

### **Inorganic Division**

1. Required (1):

- CHEM 6374 – Physical Inorganic Chemistry I (Fall)

2. Five (5) of the following courses:

- CHEM 6311 – Mechanisms (Fall)
- CHEM 6312 – Bonding (Fall)
- CHEM 6313 – Thermodynamics / Kinetics (Fall)
- CHEM 6314 – Spectroscopy (Spring)
- CHEM 6321 – Quantum Chemistry (Fall)
- CHEM 6330 – Advanced Polymer Chemistry (Spring)
- CHEM 6332 – Inorganic Material Analysis (prerequisite: CHEM 6374, Spring)
- CHEM 6375 – Physical Inorganic Chemistry II (prerequisite: CHEM 6374, Spring)
- CHEM 6376 – Organometallic Chemistry (Spring)
- CHEM 6377 – Solid State Chemistry (Fall)

## Organic Division

### 1. Required (3):

- CHEM 6311 – Mechanisms (Fall)
- CHEM 6351 – Organic Structure Determination (Fall)
- CHEM 6352 – Organic Reactions and Synthesis (Fall)

### 2. Three of the following elective courses:

- CHEM 6312 – Bonding (Fall)
- CHEM 6313 – Thermodynamics / Kinetics (Fall)
- CHEM 6314 – Spectroscopy (Spring)
- CHEM 6330 – Advanced Polymer Chemistry (Spring)
- CHEM 6332 – Inorganic Material Analysis (prerequisite: CHEM 6374, Spring)
- CHEM 6353 – Physical Organic Chemistry (prerequisite: CHEM 6311, Spring)
- CHEM 6374 – Physical Inorganic Chemistry I (Fall)
- CHEM 6375 – Physical Inorganic Chemistry II (prerequisite: 6374, Spring)
- CHEM 6376 – Organometallic Chemistry (Spring)
- CHEM 6377 – Solid State Chemistry (prerequisite: CHEM 6374, Spring)
- PCOL 6397 – Drug Design and Discovery (Spring)
- CHEM 6399 – Bio-Inorganic Chemistry (not currently offered)
- CHEM 6394 – Selected Topics in Organic Chemistry (Stereochemistry, Spring)

## Physical Division

### 1. Required (2):

- CHEM 6313 – Thermodynamics & Kinetics (Fall)
- CHEM 6321 – Quantum Chemistry (Fall)

2. In addition to the two required courses, four (4) additional 6000 or 7000-level graduate courses to be decided by the student and his/her advisor. The following two courses are strongly recommended:

- CHEM 6314 – Spectroscopy (Spring)
- CHEM 6322 – Statistical Thermodynamics (Spring)

## **The following specific requirements apply to M.S. (Plan I) and Ph.D. candidates**

1. All graduate-level courses must be in Chemistry or pre-approved courses in related fields at the 6000 level or above. A cumulative GPA of at least 3.0 must be maintained. This program follows the GPA definition published by the University.

2. Graduate students must take CHEM 6111 (Graduate Colloquium, one hour credit) in each long semester during which a full 9 credit hours of lecture-based courses are not taken during their first two years of study. At a minimum, students must be enrolled in CHEM 6111 once in their graduate career. Although participation in the Graduate

Colloquium is required each semester the student is enrolled at the University, enrollment after the first two years of study is not required.

3. Graduate students must take CHEM 6112 (Graduate Seminar, one hour credit) in each long semester during which a full 9 credit hours of lecture-based courses are not taken during their first two years of study. At a minimum, students must be enrolled in CHEM 6112 once in their graduate career. Although participation in the Graduate Colloquium is required each semester the student is enrolled at the University, enrollment beyond the second year of study is not required.

4. Students holding a teaching fellowship must register for CHEM 6115 (TA training, one hour credit) in each long semester during which they are teaching a course they have not previously taught and during which a full 9 credit hours of combined lecture-based courses and seminar courses are not taken. Students holding a teaching assistantship who are already enrolled in 9 credit hours must register for 6015 (TA training, zero-hour credit) during any semester in which they are a TA for a course not previously taught.

5. Chemistry degree requirements for the M.S. program must be met within five calendar years after admission to the Chemistry graduate program. For Ph.D. program students, it is ten calendar years.

6. Chemistry coursework requirements must be met within the first four long semesters for MS (plan I) and PhD program students. Graduate students cannot take coursework after the first four long semesters in residence without approval from the Graduate Committee. Exceptions are granted only under extraordinary circumstances.

7. Two grades of C<sup>+</sup> or lower will result in the student being placed at the bottom of the priority list for receipt of a teaching fellowship.

8. Students receiving a teaching fellowship must be certified in English proficiency. The certification is automatic for students who have graduated with a B.S. degree from an institution in the United States, Canada, the United Kingdom, Australia, or New Zealand.

9. A student receiving grades of U, C<sup>+</sup>, or lower for twelve (12) credit hours will be terminated from the Graduate Program. A GPA of 3.00 or greater must be attained prior to application for graduation.

### **The following specific requirements apply to Ph.D. candidates:**

1. Ph.D. candidates must complete six lecture-based graduate-level courses (no less than 18 credit hours) according to the course requirements in their elected division or special program. A complete course requirement list is available in a previous section of this document.

2. At the end of the fourth long semester, the Graduate Chair reviews the course work students in the Program. Two grades of C<sup>+</sup> or lower will result in the student being terminated from the Ph.D. program and enrolled in the M.S. (Plan I) program. In an effort to receive a higher grade, a student may retake a course in which a grade of C<sup>+</sup> or lower was received provided this is done before the end of the fourth long semester. Both grades are used, however, in computing a student's overall GPA.

3. After the second but prior to the end of the fifth long semester, students must complete an Oral Research Progress Exam (see below for details). Satisfactory completion of this exam along with the course requirements listed above results in promotion to Ph.D. candidacy.

4. For all semesters prior to Ph.D. candidacy, students must enroll in CHEM 6198, 6298, ...6998 Special Problems (the second digit indicates the number of credit hours), so that the required number of credit hours (usually 9) each semester is attained. Following promotion to Ph.D. candidacy, the student must enroll in CHEM 8198, 8298, ... 8998 Doctoral Research to fulfill the credit hour requirement.
5. Candidates for a Ph.D. in chemistry must take a minimum of three credit hours of Doctoral Dissertation (CHEM 8399, 8699 and 8999) prior to graduation. Once enrolled in Doctoral Dissertation, registration must be continuous and no grade is awarded until semester in which the degree is conferred.
6. Per NSM rules, each calendar year after the ORP exam PhD candidates must communicate with their dissertation committee and have them certify that the student is making adequate progress toward their degree using the [Dissertation Progress Committee Approval Form](#).
7. A final oral defense of the Ph.D. dissertation before the thesis committee is required. This is a closed exam (i.e., no outside observers).

### **The following specific requirements apply to the M.S. (Plan I) program:**

1. M.S. students must complete six graduate-level courses (no less than 18 credit hours) based on the course requirements in their elected division and special program. A complete course requirement list is available in a previous section of this document.
2. An Oral Research Progress examination is not required for M.S. students.
3. For all semesters, students should enroll in CHEM 6198, 6298, ... 6998 Special Problems (the second digit indicates the number of credit hours), so that the required number of credit hours each semester is attained.
4. M.S. students must take at least six credit hours of Master's Thesis (CHEM 6399 and 7399). Once enrolled in Master's Thesis, registration must be continuous and no grade is given until the semester in which the degree is conferred.
5. A final oral M.S. thesis defense before the thesis committee is required. This is a closed exam (i.e., no outside observers).

### **The following specific requirements apply to the M.S. (Plan II) program:**

In addition to the above degree programs, the Department of Chemistry offers a non-thesis (Plan II) M.S. degree program. This program does not require a research-based thesis; instead, the program emphasizes course work. It is designed to meet the needs of students who are employed in a chemistry-related field. No financial assistance from the Department of Chemistry is available to M.S. (Plan II) degree students. Completion of the M.S. (Plan II) program represents a terminal degree in the Department of Chemistry. Transfer from the regular Graduate Program to the Plan II Program and vice versa is normally prohibited and is at the discretion of the Graduate Committee. The M.S. (Plan II) degree requirements are as follows:

1. Four diagnostic examinations must be taken no later than the beginning of the second semester of study.
2. A minimum of 30 total semester credit hours must be completed.

3. The following three courses must be taken (9 hours):
  - a. CHEM 6311: Mechanisms
  - b. CHEM 6313: Thermodynamics and Kinetics
  - c. CHEM 6374: Physical Inorganic Chemistry
4. The remaining 21 credit hours may be selected from graduate level courses in the Department of Chemistry and require approval of the Graduate Chair.
5. With the written approval of the Graduate Chair, graduate-level courses outside the Department of Chemistry may be substituted for the remaining 21 credit hours in requirement 4 above.
6. Requirements for the M.S. (Plan II) degree must be met within five calendar years after admission to the program.
7. A maximum of two graduate lecture courses may be transferred to the University of Houston from other institutions to satisfy the degree requirements with permission of the Graduate Committee.

## Credit for Previous Work

Course credit earned earlier than four years before the candidacy examination will not count toward the degree. With permission from the Graduate Committee, graduate lecture courses may be transferred from other institutions. A Ph.D. student may transfer a maximum of three graduate lecture courses and an M.S. student may transfer a maximum of two graduate lecture courses. For a course to be considered for transfer credit, the student must score 75<sup>th</sup> percentile or higher in the area of the corresponding diagnostic examination and received a B+ or higher grade in the transferred course, and the course must have not been used to satisfy the requirements of another degree.

**Special Note:** Students in an accelerated UH M.S./B.S. program, such as the so-called 3+1 Program, may transfer additional course credits with permission of the Graduate Committee.

## Oral Research Progress Examination

After the second but prior to the end of the fifth long semester (fall and spring are the long semesters), a student wishing to obtain a Ph.D. must undergo an Oral Research Progress (ORP) examination administered by the student's ORP committee. The six courses required by the student's division must be completed before the ORP is taken. The ORP exam must be completed before the end (defined as the official closing of the session) of the student's 5th semester in residence. Failure to observe this time limitation will result in the student being placed in the M.S. (Plan I) program. The committee consists of four (4) faculty members; the student's research advisor(s) may not serve on the ORP committee. The committee has two (2) faculty members from within the student's division – one of whom will be designated as the "chair" of the committee, one (1) member from outside the division but within the Department, and one from outside the Department (researchers from industry with a Ph.D. degree are eligible). The student's research advisor and the student choose two committee members, one of whom is the member from outside the department. The Graduate Chair appoints the two other committee members. The student's research advisor and the student may make recommendations for the other two members of the committee to the Graduate Chair and may request that a particular faculty member (only one) be excluded from the committee. All four members of the ORP committee must be physically present during the entire ORP examination for it to be

considered a valid exam, though if necessary the member from outside the department may fulfill this requirement with an electronic presence (teleconference or web-based conferencing). The ORP committee form can be found at the department web site, <http://www.chem.uh.edu/graduate/forms/index.php>, for download and completion.

The exam consists of an oral presentation by the student on the research progress to date and an outline of proposed future research. At least 7 days prior to the ORP exam, the student gives the ORP committee members a written report that summarizes the student's research progress and proposed future research. This report may be no longer than 10 double-spaced pages (figures included) with a minimum font size of 11 and margins on all sides of 1 inch. An 11th page may be used for single-spaced references (ACS journal format with titles).

The student's research advisor should give a short verbal statement addressed to the committee (without the student present) or a short written statement to the Committee Chair before the examination begins that details the student's abilities, progress, and other relevant matters, but the student's research advisor may not be present during the examination. The committee will weigh the advisor's comments carefully in their deliberations, and it will holistically determine a decision regarding the outcome of the exam without the student or advisor present.

The student's oral presentation lasts no longer than 30 minutes and is followed by questions from the committee, typically lasting no longer than one hour, on the student's general area of research and general knowledge of chemistry. Questions may also be asked during the student's presentation. If only a phone connection is available to the absent member, the student presentation must have been sent to the absent member ahead of time, so all committee members are able to view the presentation. Based on the results of the examination, the ORP committee decides whether the student is admitted to Ph.D. candidacy. The student's research advisor and student are not permitted to be present during the committee's deliberations. The deliberations focus on the following aspects of the student's exam:

1. General knowledge in the area of specialization.
2. Knowledge of previous work and techniques in the research field.
3. Research progress, potential for future research and originality of the project.
4. Quality of oral presentation, organization, and research summary.
5. Ability to formulate analytical solutions to the questions posed.

The results of the ORP examination are communicated in writing to the Graduate Chair by means of a summary evaluation form. The dissertation committee's recommendation is one of the three options listed below:

1. Student passed at the Ph.D. level.
2. Student failed, but may retake the ORP exam by a specified date, which must be no later than the end of the sixth long semester.
3. Student failed. The committee recommends the student to be placed into the MS (Plan I) program OR terminated from the program at the end of the semester.

The decision of the committee is final. The ORP committee's evaluation worksheet and summary are considered confidential. The student may request the final average score for his/her ORP exam from the Graduate Chair, but there is no requirement that it be released.

Once a student passes their ORP exam, they are required by NSM rules to meet with their committee each calendar year. The form to certify that the student has met with their committee and is making suitable progress may be

found in the forms section of the Graduate Student section of the Department of Chemistry website.

## Dissertation or Thesis

A candidate for a Ph.D. or M.S. (Plan I) graduate degree conducts research under the direction of his or her research advisor and dissertation/thesis committee. The results of the research form a large and necessary component of the dissertation/thesis committee's evaluation that the student is capable of conducting original chemistry research and of systematically planning and executing a research project.

After the dissertation or thesis has been written, the candidate must pass a final oral dissertation/thesis examination administered by the dissertation/thesis committee. This examination deals extensively with that portion of the candidate's field of specialization under which the dissertation/thesis falls. Per College of Natural Sciences and Mathematics (NSM) guidelines, the absence of only one member of the committee due to an emergency the day of the defense is permitted; otherwise the defense must be rescheduled. At least half of the committee must be physically present at the defense of an M.S. thesis or a Ph.D. dissertation. Arrangements must be made for the members who are not in Houston to attend the defense remotely via video conferencing. If only a phone connection is available to the absent member, the student presentation must have been sent to the absent member ahead of time, so all committee members are able to view the presentation. The dissertation/thesis must be successfully defended no later than two weeks before the deadline for submission of the final approved copy to NSM. Copies of the dissertation/thesis must be given to the committee members no less than two weeks prior to the oral final dissertation/thesis examination. Students and committee members must adhere to all NSM guidelines (<http://publications.uh.edu/content.php?catoid=40&navoid=14120>).

## Dissertation or Thesis Committee

Upon promotion of a student to Ph.D. candidacy, the student's research advisor becomes the chair of the student's dissertation committee and the members of the ORP committee automatically become members of the student's dissertation committee. In the case of a student having two research co-advisors, the second research advisor will replace one member of the ORP committee with the retiring member selected by the Graduate Chair.

The thesis committee of a student in the MS Plan I program is composed of five members: the research advisor, two (2) faculty members from within the student's division, one faculty member from outside the division but from within the Department, and one member from outside the Department, which may be a faculty member from the University, from another university or college, or a person from industry with a Ph.D. related to chemistry.

A thesis/dissertation Committee Composition Form required by the College of Natural Sciences and Mathematics (NSM) must be completed and submitted to the College one semester *prior* to graduation. Should changes in the committee composition be necessary, a Change in Committee Composition Form must be submitted for re-approval prior to the thesis/dissertation defense exam.

The committee composition and change in committee composition forms can be found at the following link: <http://www.uh.edu/nsm/students/graduate/forms/>. When updating committee members, complete all member names on form but only obtain signatures from the new member.

## Additional Requirements for Graduate Students

The GPA in course work (exclusive of dissertation or thesis and special problems courses) must not fall below 3.00. The overall GPA must also be maintained at or above 3.00.

A student who earns two or more grades of C<sup>+</sup> or lower in chemistry course work while in the graduate program at UH may not receive financial support from the Department. The College will terminate a student who accumulates four or more grades (or 12 credit hours) of C<sup>+</sup>, U, or below in courses.

A minimum of 12 months continuous full-time residence at the University of Houston is required for all Ph.D. candidates. Any off-campus research that will become part of a dissertation or thesis must have prior written approval of both the external company or institution involved and the Graduate Committee.

## Grievance Policy

For matters of academic honesty, students should refer to the University Academic Honesty policy.\* For all other matters, a multi-level procedure for redress of a grievance is available to any graduate student of the department. Prior to initiating the grievance process at the departmental level, the grieving student has the opportunity to seek advice from the College, by requesting an appointment with the Associate Dean for Graduate Studies. The Associate Dean may recommend that the student meet with one or two members of the College Graduate Committee, who are not in the same department as the student, to discuss the issues at hand.

To initiate the grievance process within the Department of Chemistry, the student must communicate with the Graduate Committee Chair (or, if the Graduate Committee Chair is involved in the grievance, the Department Chair) in writing. In this notice, the grievant must state:

1. The issue being grieved and evidence to support the grievance.
2. The desired resolution.

The grievance will be heard and adjudicated by the Graduate Committee, which is empowered, if deemed appropriate, to take statements from individuals involved in the case. Such individuals will be contacted to set a time, place, and date for their testimony to be given. No formal record of the proceedings need be kept. Normally, the committee shall complete its work within thirty calendar days of the request for a hearing unless extenuating circumstances make this deadline impossible to meet. A brief, written summary of the decision of the committee with their findings and recommendations will be provided to the student and the Department Chair within ten days of completion of the committee's work.

Every effort shall be made by the student, faculty member, and chair to resolve the grievance within the departmental structure. If the departmental grievance procedures do not resolve the grievance, the graduate student may petition the college for redress of the grievance. The student must file written notice of a formal grievance with the Associate Dean for Graduate Studies within ten calendar days from the receipt of the departmental decision regarding the grievance.

*\*Because assigning a grade or evaluating a student's academic performance involves the faculty's professional judgment and is an integral part of the faculty's teaching responsibilities, disagreement with an instructor concerning a grade or evaluation is not a justifiable grievance under this policy. In cases where such is in question, the faculty member shall be responsible for the assignment of grades.*

## Counseling

Counseling and Psychological Services (CAPS) can help students who are having difficulties managing stress, adjusting to the demands of a professional program, or feeling sad and hopeless. You can reach CAPS ([www.uh.edu/caps](http://www.uh.edu/caps)) by calling 713-743-5454 during and after business hours for routine appointments or if you or someone you know is in crisis. No appointment is necessary for the “Let's Talk” program, a drop-in consultation service at convenient locations and hours around campus. <https://uh.edu/caps/outreach/lets-talk/index>

## List of Active Chemistry Research Advisors Accepting Graduate Students

**Baldelli, Steven**, Professor (Physical Chemistry)

Nonlinear optics, vibrational spectroscopy, surface chemistry, electrochemistry, microscopy, batteries/fuel cells electrodes, and polymer surfaces.

**Bittner, Eric R.**, Moores Professor (Physical Chemistry)

Quantum dynamics and ultrafast processes. Spontaneous coherence and collective quantum effects. Quantum phase transitions in low dimensional systems. Note: prospective Chemistry students must either take Mathematical Physics or demonstrate strong proficiency in advanced physics and mathematics.

**Brgoch, Jakoah**, Associate Professor (Inorganic Chemistry)

Inorganic materials chemistry. Experimental and computational studies of complex chemical and physical phenomena in materials chemistry. Synthetic solid-state chemistry, crystallography, physical property measurements, and density functional theory.

**Brookhart, Maurice**, Professor (Organic Chemistry)

Synthetic and mechanistic organometallic chemistry; applications of organometallic complexes in organic synthesis; reactions of coordinated ligands; carbon-hydrogen bond activation; and homogeneous catalysis by transition metals, especially olefin polymerizations.

**Cai, Chengzhi**, Professor (Organic Chemistry)

Synthesis and properties of polymers. Multi-disciplinary research in nanotechnology and advanced materials for high-tech applications.

**Carrow, Bradley**, Associate Professor (Organic Chemistry)

Mechanism-driven design of transition-metal catalysis that can enable sustainable organic transformations and materials chemistry. Research bridges the fields of organometallic, physical organic, synthetic organic, and polymer chemistry through mechanism-informed ligand design, new elementary catalytic steps, and control between active states.

**Chen, Tai-Yen**, Assistant Professor (Physical Chemistry)

Study of metal homeostasis in healthy and diseased neurons using single-molecule techniques and dynamics and

mechanisms of protein machineries involved in metal trafficking within/between neurons to understand how metals affect neuronal signaling and cause neurodegenerative diseases.

**Chiang, Naihao**, Assistant Professor (Physical Chemistry)

Single-molecule chemistry, plasmonics, near-field enhanced optical spectroscopy, scanning probe microscopy, quantum coherent control in condensed phase, and plasmonic-induced intracellular delivery.

**Comito, Robert**, Assistant Professor (Organic Chemistry)

New catalytic methods for organic and polymer synthesis using main group catalysis, including living olefin polymerization and ambiphilic copolymerization to synthesize advanced polyolefins with improved properties. Olefin difunctionalization and C-H activation relevant to medicinal chemistry and complex molecule synthesis.

**Daugulis, Olafs**, Robert A. Welch Chair in Chemistry (Organic Chemistry)

Synthetic organic and organometallic methodology including group 11 metal (Cu, Ag, Au) chemistry to organic synthesis and polymer chemistry, and the development of new enantio- and diastereoselective transformations.

**Do, Loi H.**, Associate Professor (Organic Chemistry)

Synthetic organometallic catalysis and bioinorganic chemistry. Development and studies of transition metal complexes for applications in medicine and fuel/biofuel synthesis.

**Gilbertson, Scott R.**, M.D. Anderson Professor (Organic Chemistry)

Synthetic organic and medicinal chemistry. Development of new synthetic methods and the utilization of synthetic chemistry for the study of important biological and medical problems.

**Guloy, Arnold M.**, Moores Professor and Associate Chair (Inorganic Chemistry)

Solid state chemistry; synthesis and characterization of crystalline solids with novel structures and unusual properties; highly correlated materials, including high temperature superconductivity.

**Halasyamani, P. Shiv**, Professor (Inorganic Chemistry)

Solid state chemistry; Synthesis, characterization, and development of structure-property relationships in new functional inorganic materials; second-order non-linear optical behavior (second-harmonic generation, piezoelectricity, ferroelectricity, pyroelectricity), and multi-ferroic behavior. Single crystal growth.

**Harth, Eva M.**, Professor and Director of Welch Center for Excellence in Polymer Chemistry (Organic Chemistry)

Novel biomedical materials and technologies to create polymeric networks in nanoscale to increase the therapeutic function of synthetic and biological substances.

**Jacobson, Allan J.**, Robert A. Welch Chair of Science (Inorganic Chemistry)

Synthesis and structural characterization of mixed metal oxides; ionic and electrical conductivity in solids; synthesis of composite structures.

**Lee, T. Randall**, Cullen Distinguished University Chair and Associate Dean for Research (Organic Chemistry)

Chemical synthesis and self-assembly to prepare nanoscale materials (e.g., organic thin films, polymers, and nanoparticles) for use in various technological and medicinal applications.

**Lubchenko, Vassiliy**, Professor (Physical Chemistry)

Study of strongly non-equilibrium and disordered systems with applications to materials science, molecular electronics and biophysics.

**May, Jeremy**, Professor (Organic Chemistry)

Natural product total synthesis, development of transition metal-based synthetic methods using carbenoid and ylide-like intermediates, mechanistic elucidation, medicinal chemistry, biomolecular recognition, and drug target identification.

**Miljanic, Ognjen**, Professor (Organic Chemistry)

Supramolecular chemistry, self-sorting processes, metal-organic and covalent-organic frameworks, fluorescent sensors.

**Teets, Thomas**, Associate Professor (Inorganic Chemistry)

Molecular inorganic chemistry; Homogenous catalysis, targeting applications in renewable energy, fuels; Synthetic methodology. Applications in organometallic catalysis, electrocatalysis, and photochemistry.

**Wu, Judy**, Associate Professor (Organic Chemistry)

Physical organic chemistry and applied computational quantum chemistry. Studies on noncovalent interactions for the design of functional organic and bioorganic systems. Understanding structure-property relationships in hydrogen (H-) bond mediated catalyses, self-assembly, and molecular recognition processes.

**Xu, Shoujun**, Professor (Physical Chemistry)

Developing laser-detected magnetic resonance imaging. Applications of novel and conventional magnetic molecular imaging for biomedicine and materials science.

**Yang, Ding-Shyue Jerry**, Associate Professor (Physical Chemistry)

Ultrafast electron diffraction and surface imaging, non-equilibrium electronic and structural dynamics, photoinduced phase transitions of condensed-matter and nanostructured materials and at interfaces.

**Zastrow, Melissa**, Assistant Professor (Inorganic Chemistry)

Biological and chemical approaches to examine the roles of essential metals in the gut microbiota and modulating bacterial cell-to-cell communication. Techniques include protein biochemistry and protein design, molecular biology, synthesis, cell imaging, and absorption and fluorescence spectroscopy.

Additional information may be found at <http://www.chem.uh.edu>

## Chemistry Courses

The first two digits of a course number have a particular significance. The first indicates the scholastic level: 4000 series for senior undergraduate; 6000, 7000 and 8000 series for graduate. The second digit indicates the number of credit hours.

### 6111: *Graduate Colloquium*

Seminars presented by invited speakers of national and international reputation.

### 6112: *Graduate Seminar*

Seminars presented by students, faculty and invited speakers on advanced topics in chemistry.

### 6115: *Seminar in Chemistry Laboratory Instruction*

General laboratory instructional techniques; interrelation of teaching assistants, faculty and department staff.

### 6198, 6298, 6398, 6498, 6598, 6698, 6798, 6898, 6998: *Special Problems*

### 6311: *Mechanisms*

A discussion of basic physical relationships (bonding, stereochemistry, conformational analysis, isotope effects), as well as a mechanistic description of a select series of reactions.

### 6312: *Bonding*

Symmetry, bonding and structure of molecules and solid state materials.

### 6313: *Thermodynamics and Kinetics*

Thermodynamics of gaseous and condensed phase chemical systems. Rates and mechanisms of chemical reactions.

### 6314: *Spectroscopy*

Interpretation and applications of spectroscopy to chemical systems.

### 6320: *Molecular Mechanics and Modeling*

Use of energy functions and interactive graphics to evaluate molecular properties.

### 6321: *Quantum Chemistry*

Introduction to quantum mechanics and the fundamental theory of atomic and molecular structure and dynamics.

6322: *Statistical Thermodynamics*

Introduction to statistical thermodynamics and the theory of macroscopic properties of gaseous and condensed phases.

6324: *Molecular Spectroscopy*

Theoretical description of the interaction between radiation and matter. Application to major types of spectroscopy.

6330: *Advanced Polymer Chemistry*

Basic principles and latest advances in polymer chemistry and their applications. Synthetic approaches and history of development and uses.

6332: *Inorganic Material Analysis*

Crystal structure, x-ray, electron, and neutron diffraction techniques, electron microbeam imaging and analytical techniques, and other instrumental methods of chemical analysis. Theory, routine use of equipment and applications of each technique.

6333: *Fundamentals of Chemical Analysis*

Basic principles and latest advances of experimental methods in physical and analytical chemistry.

6334: *Electroanalytical Chemistry*

Advanced topics in classical polarography, coulometry, single and multiple-sweep voltammetry, pulse polarography, chronopotentiometry, and chronoamperometry.

6351: *Organic Structural Determination*

A survey of current techniques used in organic structural determinations.

6352: *Organic Reactions and Synthesis*

A description of current synthetic methodology useful for the preparation of a wide variety of organic molecules.

6353: *Physical Organic Chemistry*

A mechanistic description of key organic reactions and reaction intermediates.

6374: *Physical Inorganic Chemistry I*

Bonding theories applied to diatomic and polyatomic inorganic molecules, ionic solids, extended array solids, d-block metal complexes, spectroscopy.

6375: *Physical Inorganic Chemistry II*

Crystal symmetry and space groups, electronic structures, diffraction methods, and magnetism.

6376: *Organometallic Chemistry*

Synthesis and reactivity of organometallic compounds. Reaction mechanisms and applications to catalysis, organic synthesis and materials research.

6377: *Solid State Chemistry*

Synthesis and categorization of solid materials. Chemical bonding and structure-property relationships.

6394: *Selected Topics in Organic Chemistry*

6395: *Selected Topics in Analytical Chemistry*

6396: *Selected Topics in Inorganic Chemistry*

6397: *Selected Topics in Physical Chemistry*

6399; 7399: *Master's Thesis*

7190; 7290; 7390: *Advanced Topics in Chemistry*

May be repeated for credit when topics vary. Bioinorganics; organometallics; surface science, homogeneous/heterogeneous catalysis; theoretical bio-organic modeling; spectroscopy and electro-bioanalytical chemistry.

7321: *Quantum Mechanics in Chemistry*

Advanced theory of molecular structure and dynamics. Quantum many-body methods. Modern literature of quantum mechanics.

7322: *Scattering Theory*

Quantum mechanics of atomic and molecular collisions. Inelastic and rearrangement collision phenomena. Exact and approximation methods.

7323: *Statistical Mechanics in Chemistry*

Advanced theory of the structure and dynamics of gaseous and condensed phase systems. Classical many-body theory.

*7325: Surface Science*

Fundamental structures of surfaces. Properties of absorbed and adsorbed species. Spectroscopy of surfaces.

*7333: Design and Analysis of Chemical Experiments*

The principles and application of experimental design and the analysis of data, with emphasis on systems theory, response surface methodology and pattern recognition techniques.

8198; 8298; 8398; 8498; 8598; 8698: *Doctoral Research*

8399; 8699; 8999: *Doctoral Dissertation*