Chemistry Department Graduate Policies and Procedures

"The Orange Book"

July 2022

Non-Discrimination Statement

Virginia Tech does not discriminate against employees, students, or applicants on the basis of race, color, sex, sexual orientation or identity, disability, age, veteran status, national origin, religion, or political affiliation. The university is subject to Title VI and Title VII of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, Sections 503 and 504 of the Rehabilitation Act of 1973, the Age Discrimination in Employment Act, the Vietnam Era Veteran Readjustment Assistance Act of 1974, Federal Executive Order 11246, Governor Allen's State Executive Order Number Two, and all other rules and regulations that are applicable. Anyone having questions concerning any of those regulations should contact the Equal Opportunity/Affirmative Action Office (http://www.hr.vt.edu/).

Diversity Statement – The Virginia Tech Principles of Community

- We affirm the inherent dignity and value of every person and strive to maintain a climate for work and learning based on mutual respect and understanding.
- We affirm the right of each person to express thoughts and opinions freely. We encourage open expression within a climate of civility, sensitivity, and mutual respect.
- We affirm the value of human diversity because it enriches our lives, scientific pursuits, and the University. We acknowledge and respect our differences while affirming our common humanity.
- We reject all forms of prejudice and discrimination, including those based on age, color, disability, gender, national origin, political affiliation, race, religion, sexual orientation, and veteran status. We take individual and collective responsibility for helping to eliminate bias and discrimination and for increasing our own understanding of these issues through education, training, and interaction with others.
- We pledge our collective commitment to these principles in the spirit of the Virginia Tech motto of *Ut Prosim* (That I May Serve).

Key Contacts for Graduate Study in Chemistry

- Chairperson. Dr. Amanda Morris, 540-231-5585, ajmorris@vt.edu
- Graduate Program Director. Dr. Alan Esker, 540-231-4601 aesker@vt.edu
- Graduate Admissions Director. Dr. Feng Lin, 540-231-4067, fenglin@vt.edu
- Graduate Coordinator. Ms. Joli Huynh, 540-231-8225, jolih@vt.edu

Useful Web Sites (verified June 2022)

- Chemistry Graduate Program CANVAS page: canvas.vt.edu
- GS: http://graduateschool.vt.edu/academics/graduate-catalog-policies-procedures.html
- GS Forms: https://graduateschool.vt.edu/academics/what-you-need-to-graduate/forms.html
- Graduate and Professional Student Senate (GPSS): https://gpss.vt.edu/
- Cranwell International Center: http://www.international.vt.edu

IMPORTANT NOTICE

The Policies and Procedures outlined in this Orange Book are supplemental – and entirely subordinate – to the general Virginia Tech Graduate School Policies and Procedures found at https://secure.graduateschool.vt.edu/graduate_catalog/policies.htm?nocache=1655418642294. Students are responsible to be aware of both Chemistry Department *and* Graduate School policies pertaining to their degree programs and individual situations. International students are additionally responsible for awareness of immigration policies and procedures at Virginia Tech.

1. General Policies & Procedures for Graduate Programs (MS and PhD)

A. Admission. Complete admission policies and procedures may be found at the Graduate School web site (https://graduateschool.vt.edu) and the Chemistry Department Graduate Program web site (https://chem.vt.edu/academics/graduate.html). The Chemistry Department evaluates applicants to its graduate programs on the following criteria.

- Prior academic performance as reflected in university transcripts: The courses completed, the grades earned, and the institution(s) where prior degree(s) were received
- Mastery of the English language as measured by TOEFL scores (international students) and, at the discretion of the Graduate Admissions Director (telephone interviews)
- Potential to excel in graduate study and research as reflected in letters of recommendation
- Likelihood that the student's interests and motivations are well matched to our graduate program, as measured by questions on the Graduate School application for admission
- General GRE and Chemistry Subject GRE scores are not required

B. Orientation Week. All entering students are expected to attend Orientation Week and associated activities, which take place one week before classes begin in the Fall Semester.

- The Graduate Program Director will present an introduction to Chemistry Department policies, procedures, and practices, as well as normal graduate student activities
- Students will meet with departmental financial officers to file immigration documents, confirm assistantship status, arrange payroll, and discuss insurance and liability matters
- Students who wish to be eligible for a Graduate Teaching Assistantship *at any time during their graduate program* must attend the Graduate School's GTA Workshop. The Graduate Coordinator will automatically enroll all entering students in the GTA Workshop (GRAD 5004) unless notified to do otherwise.
- Students on assistantship support must attend an initial GTA Meeting with General Chemistry or Organic Chemistry lab instructors (depending on assignment).
- Entering graduate students must take four out of five Chemistry Proficiency Exams. These are ACS exams in instrumental analysis (analytical), organic, inorganic, biochemistry, and physical chemistry. Students select four exams according to their research area and interests:

  Analytical Chemistry. Students should take the analytical and physical exams. The student has discretion in selecting the other two exams.

  Inorganic Chemistry. Students should take the analytical, inorganic, organic and physical exams.

  Organic Chemistry (small molecule and polymer). Students have the option of picking any four of the five proficiency exams.

  Physical Chemistry (theory/quantum or experimental). Students should take the analytical, inorganic, organic and physical exams.

  Physical Chemistry (theory/simulation). Students should take the inorganic, organic, physical and (at their discretion) either the biochemistry or analytical exams.

- Entering students will meet with the Graduate Program Director (or designated faculty member) to discuss the results of the exams and establish a (non-binding) initial course plan. The following guidelines are intended to assist the student, Graduate Program Director (initially), and PhD advisory committee (once established, see Sect. 1.H) in the development of a program of study.

Course suggestions for students interested in **Analytical Chemistry**					
Score Range (%)	Analytical	Physical	Inorganic	Organic	Biochemistry
< 60	4114	5114, 5124, or 5664	5414	5524 or 5154	5524 or 5154

Course suggestions for students interested in **Inorganic Chemistry**					
Score Range (%)	Analytical	Physical	Inorganic	Organic	Biochemistry
< 60	5124, 5414, 5524, or 5525	4624, 5124, 5506, or 5664	5404	5505, 5506, or 5524	4584, 4444, or B CHM 5124
> 60			5404		
Other recommendations			4444, 4624, 5414, 6434		

Course suggestions for students interested in **Organic Chemistry**					
Score Range (%)	Analytical	Physical	Inorganic	Organic	Biochemistry
< 20	5524	5506	6434	2565[1] 5505[2]	4584 or 6504
20 - 60	5524	5506		5505	4584 or 6504
> 60	5524	5506		5505	6564
General recommendations and time-frame					
Small molecule	1st term: 5524, 5505, 6564 (every other year) 2nd term: 5535, 5506				
Chemical biology	1st term: CHEM 5524, 5505, 6564 (every other year)				
Polymer	1st term: CHEM 5704, 5505 2nd term: 6564, and either 5506 or 5664 3rd term 5524, 6664 (Morphology)				

[1]Polymer organic students should take CHEM 2565

[2]Small molecule organic students should take CHEM 5505

Course suggestions for students interested in **Physical Chemistry (Theory/Quantum)**					
Score Range (%)	Analytical	Physical	Inorganic	Organic	Biochemistry
< 20	5124 or 5524	3615 and 3616	4404	2565	n/a
20 - 60		3615 or 3616			
Other recommendations			Both 6624 and 6634 are recommended before the preliminary exam		

Course suggestions for students interested in **Physical Chemistry (Theory/Simulation)**					
Score Range (%)	Analytical	Physical	Inorganic	Organic	Biochemistry

< 20	5124 or 5524	3615 and 3616	4404	2565	4615 or 4584
20 - 60		3615 or 3616			BCHM 4984
> 60					BCHM 5024
Other recommendations			Both 6624 and 6634 are recommended before the preliminary exam		SBIO/CHEM 5424G

Course suggestions for students interested in **Physical Chemistry (Experimental)**					
Score Range (%)	Analytical	Physical	Inorganic	Organic	Biochemistry
< 20	5124 or 5524	3615 and 3616	4404	2565	n/a
20 - 60		3615 or 3616			

C. Orientation to Graduate Research. Entering students are required to pass CHEM 5004 (Orientation to Graduate Research) during their first *fall* semester in residence. This course includes the following topics.
- Laboratory safety, chemical hygiene, hazardous waste handling, MSDSs, and first aid.
- Library resources, techniques for locating and organizing scientific reference materials, and educational technologies/resources such as Canvas.
- Ethics and integrity in academic life and research, including the Graduate Honor System.
- Diversity and inclusion workshops to foster an inclusive departmental community
- Conflict of Interest (COI) training provided by the Virginia Tech Office of Research.
- Resources for students with physical/mental health issues or disabilities.
- Current research activities in the Department (Poster Session).
- Introduction to the Graduate and Professional Student Senate.
- Achieving an appropriate work-life balance as a graduate student.

D. Safety. Personnel safety is a top priority. The Chemistry Department requires safety training for each student before beginning laboratory work (see Section 5.1, below).

E. Choosing a Research Director. The Research Director is the faculty member with whom the student will work most closely. Other terms for Research Director include "Major Professor," "Principle Investigator (PI)," "Faculty Advisor," and "Advisory Committee Chair." Usually each student will have one Research Director, although an arrangement with co-Directors is also possible.

During the first semester, an entering student must interview a minimum of four (4) faculty members in addition to attending the research symposia organized through CHEM 5004. A Faculty Interview Signature Form is used to document the interviews. Interviews help students to select a Research Director *and* to meet other professors who might serve on their Advisory

Committees. Therefore, *four interviews must be completed even though a student may have already identified a Research Director*.

Following the interviews, students must complete a Research Director Request Form on which they list their first choice and two alternatives. Every effort will be made to accommodate a student's first choice; however, there will be circumstances under which a student is assigned to an alternate choice. Do not rank the two alternate choices; rather, use the interviews to ensure that either alternate would be acceptable. Most importantly, bear in mind that a student's approach to graduate school, work ethic, and research productivity are much more important to their success than the particular choice of research advisor. Nevertheless, there is space on the form to provide a brief narrative explaining why your first choice will best enable you to reach your graduate career goals.

- Deadline. The completed Faculty Interview Signature Form and Research Director Request Form must be submitted to the Graduate Coordinator (Joli) on or before October 15th.
- The final assignment of the Research Director will be made by the Department Chair, and will be based on several factors including the student's nominations (and the narrative explanations thereof), the equitable distribution of students among research groups, the needs and preferences of the professors, the academic performance of the student, and the projected ability of individual professors to provide assistantship support to their students. Usually, the assignments are made before the end of the fall semester.
- Until a Research Director is assigned, the Graduate Program Director will serve as the formal advisor to each entering student.
- Students whose tentative GPA is below 3.0 for the initial semester may not be assigned to a group until the subsequent semester.

F. Non-chemistry Department Research Director selection. Students may select and be approved to work under an advisor from outside of the Department; however, the student's assistantship may be affected. Importantly, the offer of five years of guaranteed financial support for Chemistry PhD students in good academic standing is exclusively for students working with a Chemistry Department faculty member. This policy is not universal across PhD programs at Virginia Tech.

Occasionally (~1 new student per year), a student finds an exciting research opportunity with a faculty member from outside the Chemistry Department. Before a student joins the research group of a faculty member from outside the department, the Chemistry Department will request that the faculty member's home department agree to guarantee five years of financial support. Some departments agree, others do not because they do not offer the same guarantee of support for their own graduate students. If a student chooses to join another department that does not guarantee five years of financial support, a new agreement form that revokes the five-year commitment of financial support must be signed.

G. Changing Research Directors. Following assignment of a Research Director (Advisor), students are normally expected to remain in that research group for the duration of their graduate studies in order maintain satisfactory and timely progress toward degree. In rare circumstances, a student may wish to change Research Directors. Under such circumstances, the student should first meet with their Advisor to discuss, and hopefully reach a mutually

acceptable resolution. If a resolution cannot be reached, the student should consult with the GPD, who may contact the Graduate School's Ombudsperson to discuss the issue and devise a plan for addressing the concerns. Before a new group can be assigned, meetings involving the Chair of the Department, the student's current advisor, the GPD, and the Ombudsperson may take place. The reassignment to a new Advisor will be by mutual consent of the student and the new Advisor, subject to approval by the Department Chair.

H. Advisory Committee. Each student shall confer with their Research Director to develop an Advisory Committee consisting of the Research Director, as Chair, and at least two other members for an MS (total of three professors) and at least three other members (total of four professors) for a PhD committee. Additional guidelines for the composition of the Advisory Committee are provided in the Graduate Catalog and in the Advisory Committee Nomination Instructions.

- Deadline. The student's recommendation for Advisory Committee members shall be submitted to the Graduate Coordinator (Joli) on or before December 1st of the student's first year. The required form is part of the Plan of Study Setup form (see next section).

I. Plan of Study. Each student shall prepare a Plan of Study (POS) for their graduate degree, using the departmental Plan of Study Setup Form. The POS lists the courses that the student and their Advisory Committee agree will provide a background consistent with University and Departmental requirements, the student's research objectives, and the student's career plans. This Plan shall be signed by the student, the Advisory Committee, the Graduate Program Director, and the Department Chairperson (in that order). The completed form is given to the Graduate Coordinator (Joli), who will subsequently submit the POS and Advisory Committee forms to the Graduate School for approval.

All changes to the Plan of Study require a Graduate School Plan of Study Change Form to be fully executed and submitted to the Graduate Coordinator. For PhD programs, all revisions should be approved by the Advisory Committee prior to the Annual Evaluation Meeting (usually a departmental seminar, See Section 3. B) in the student's fourth academic year.

The following policies also apply to Chemistry Plans of Study (MS and PhD):

- Courses numbered *lower* than 4000 may not be applied to a Plan of Study except as Supporting Courses. They do not count toward graduate credit hour requirements. The grades earned in these courses will apply to the overall GPA.
- No more than six (6) credits of 4000-level courses may be applied to a Plan of Study. Others may be listed as Supporting Courses but do not count toward credit requirements.
- Audited courses, or courses taken as Pass-Fail for which a graded option was available, may not be used. Once a class is taken for audit, it cannot be taken at a later time for a grade. (Note: grade options may *not* be changed after a course is completed.)
- Orientation courses (GRAD 5004, CHEM 5004) may be used on a Plan of Study.
- Any course outside the Plan of Study, must be approved by the student's Advisor

J. Transfers, Waivers, and Substitutions. Students entering with prior experience in another graduate degree program (including those already holding an MS degree) are bound by the same degree requirements as all other entering students. However, a student with prior graduate course work of acceptable quality at an accredited US or Canadian university may petition the Graduate Program Director to waive specific departmental (but not University) degree requirements. Such petitions will be evaluated by the departmental Graduate Education Committee. Departmental waivers do *not* require the transfer of course credit. However, high standards are applied in the evaluation, and waivers are relatively rare.

Graduate students transferring from other universities or students with prior MS degrees often inquire about transferring course credit. In practice, credit transfers are helpful only in the most extraordinary cases, simply because Virginia Tech's credit requirements for the PhD in Chemistry are reached rather quickly just by meeting departmental requirements. The following regulations apply to transferring credits from other universities.

- The credits must have been earned as part of a *graduate* degree program (MS or PhD) at an *accredited* university within the United States or Canada.
- Research credits (thesis or dissertation) and seminar credits do not transfer.
- Courses transferred must be full-graduate courses, not BS/MS level courses.
- The student must have earned a "B" or higher in any course that is transferred.
- There must be a VT *graduate* course corresponding to each course transferred.
- Transfer credits may not exceed Virginia Tech credits on a Plan of Study.
- One credit on a quarter-system typically transfers as 2/3 of a credit at Virginia Tech.

K. Good Standing. Graduate students must maintain a minimum GPA (QCA) of 3.0 overall, and 3.0 on the courses listed on their Plan of Study to remain in "Good Standing". A student who fails to meet this standard will be placed on academic probation and will have one probationary semester in which to bring their grades above 3.0. Otherwise, the student risks dismissal from the program. There are also consequences of academic probation that may affect financial support, as explained in Section 5D. In addition, a student is expected to make "satisfactory degree progress" (encompassing research productivity, intellectual growth, and other subjective criteria) in the opinion of the Advisory Committee (or the Graduate Program Director, if a committee has not yet been appointed for the student).

L. Repeating Courses. If a student obtains a grade below C– for a course on the Plan of Study, the course **must** be retaken. After the second (passing) enrollment, the first grade is changed to a Repeat Graduate (RG) grade that does not influence the QCA; the new grade (even if lower) is used. The Graduate School may consider requests to repeat courses with grades of C or C+, but those requests are typically denied. Note that the RG option can *not* be used for Research Courses (e.g., CHEM 5994, CHEM 7994).

M. Dropping Courses. A student may drop a course without penalty or transcript mark through the 30th course day (end of the sixth week) of a semester (see the Academic Calendar for date). The Department requires students to notify the course instructor, the Graduate Program Coordinator, and their Research Director when dropping a course. (First-year students must notify the Graduate Program Director.) After the "last day to drop," a student may still withdraw from a course up through the end of the 14th week of classes (See Academic Calendar

for relevant dates). Requests are made using a Graduate School form. The transcript will be marked "WG" (withdraw-graduate) for the course. WG does not affect the GPA.

Students on assistantship support must be enrolled for 12 credit hours during the spring and fall semesters. If dropping or withdrawing from a course results in a schedule with fewer than 12 credits, the Graduate Coordinator (not the student) must add the necessary research credits (CHEM 5994 or CHEM 7994) to make up 12 credits on the student's schedule.

N. Annual Evaluations. Every academic year, each student must engage in the department's Annual Evaluation System, a formal mechanism by which Advisory Committees provide constructive feedback to student on their degree progress and academic standing. Evaluation forms and instructions will be provided as needed. The student prepares a Progress Portfolio comprising a Self-Evaluation Form, a Student Activities Report, and a Research Update, and submits their evaluation to the Chemistry Graduate Program CANVAS page. The student's Research Director then prepares a faculty evaluation in consultation with the student's Advisory Committee. The Graduate Education Committee reviews these forms to ensure a fair and equitable assignment of overall performance ratings.

O. Continual Enrollment Requirement. Graduate students to be continuously enrolled for a minimum of three credit hours in all spring and fall semesters at the University from the time of initial matriculation in the degree program until graduation. Graduate students who need to break their continuous enrollment can do so by applying for a leave of absence (http://graduateschool.vt.edu/academics/graduate-catalog-policies-procedures.html) or by participating in programs and activities approved by the Graduate School that require absence from the University. Any graduate student failing to remain continuously enrolled without approved leave will be resigned from the University. To re-enroll, a graduate student will need to apply for readmission to their academic unit and admission is not guaranteed.

From the Graduate School Policy: *Unless on approved in absentia or leave of absence status, graduate students in degree programs must be registered continuously at VT during the academic year (fall and spring semesters) and pay the prescribed tuition and fees (See Policy PPM 291). Students working on research/scholarly activity toward their thesis or dissertation should enroll in the number of credit hours that reflects the extent of a student's study or research activity. The minimum enrollment is for 3 credit hours at VT…*

Graduate students who need to break continuous enrollment can do so by applying for a leave of absence or by participating in programs and activities approved by the Graduate School that require absence from the University (in absentia status).

Graduate students in good standing who for academic reasons need to spend an entire Fall or Spring semester away from campus can apply for and be granted in absentia status (see Policy PPM 293). In absentia status is granted for work that is directly related to a student's academic course of study and that is integral to their degree. Examples include field research, clinical internship, or laboratory work with research collaborators at remote institutions. In absentia status is approved by each student's

home academic unit and then by the Graduate School. During each Fall or Spring semester in absentia, students must register for one credit hour.

To qualify for in absentia status, students must be stationed a minimum of 50 miles away from Blacksburg, and must not work on or in conjunction with any of Virginia Tech's satellite campuses and facilities. Students can remain in absentia for two consecutive semesters, but must then return to residency at the University for a minimum of one semester. Exemptions may be granted by the Graduate School when longer periods of absence are required.

In absentia status is not available to students who have not adhered to the continuous enrollment requirement, are supported by an assistantship, or are participating in an exchange program or dual degree program with an officially designated partner institution.

P. Dissertation. As the student nears completion, they prepare a dissertation describing the background to their research, the methods used, the data gathered, and the overall discoveries. The student should prepare a *preliminary draft* for formal review by the entire Advisory Committee, preferably at least *six weeks* before the anticipated defense date. The "preliminary draft" must be complete and in its final form; all tables and illustrations must be included and properly formatted. There are *many* Graduate School policies and procedures dealing with the submission of a dissertation (or thesis). Students are well advised to study these policies in great detail, and well in advance of their graduation.

The Manuscript-Based Dissertation. While a dissertation should be coherent in its subject matter, under certain conditions, manuscripts for publication and/or published papers may be used as dissertation chapters as follows. First, Electronic Thesis/Dissertation (ETD) guidelines require that the introductory pages of the thesis include an "attribution" section that describes, for each chapter, the contributions of all co-authors on the manuscript or paper, including faculty co-authors. The contributions of individuals formally acknowledged in the manuscripts should also be described. Second, a dissertation consisting of chapters comprised of manuscripts also requires an introductory (background & literature review) chapter and a concluding chapter summarizing overall findings. Third, all ETD rules apply, including rules for copyright & permissions. A complete description of these rules may be found at: http://etd.lib.vt.edu/etdformats.html.

Q. Final Oral Examination. With the exception of non-thesis MS students, all graduate students must have a Final Examination at the end of their degree program. The student must schedule their Final Exam using the Graduate School's online exam request system at https://ess.graduateschool.vt.edu/pages/login.php. The exam request, with date, time, and room, must be entered at least two (2) weeks prior to the date requested for the defense. The student's Advisory Committee members will then receive an email message asking for their approval of the requested exam. In order to approve, each faculty member must certify that they have read the dissertation and found it "ready for defense." Therefore, the student should ensure that the Advisory Committee is provided with the thesis or dissertation *four weeks* before the desired exam date so that the professors can have two weeks to review the document and provide feedback that the student may find useful in preparing for their Final Exam.

Several regulations apply to the scheduling and execution of Final Exams; the student is advised to consult the Graduate Catalog for details.

Three Easy Steps to Final Oral Exam Scheduling

(1) *Schedule and reserve:* Contact each committee member more than 5 weeks in advance of the desired defense date to tentatively schedule the exam (set the day and time). This early scheduling will reserve a spot on each committee member's schedule. Then, the student should reserve a room through the Main Office.

(2) *Distribute the dissertation to the committee.* This ***must*** be done at least four weeks prior to the defense date. The committee will have two weeks to evaluate the dissertation prior to formally scheduling the defense through the Graduate School. If the committee deems the dissertation "ready to defend", then proceed to step 3.*

(3) *Graduate School scheduling.* At least two weeks prior to the defense date, formally schedule the exam through the Graduate School's on-line system https://ess.graduateschool.vt.edu/pages/login.php.

* The *student* must verify that each committee member deems the dissertation "ready to defend" prior to completing step 3. Failure to do so jeopardizes timely completion of the degree program. An evaluation of "ready to defend" is an indication that the written work is sufficiently complete such that any recommended changes could most likely be accomplished within the two weeks following the actual defense date.

- The student is responsible for bringing the required forms to the actual defense. The Graduate Coordinator, Joli Huynh, will provide each student with hard copies of these forms.

- Enrollment Requirement for Examinations: Graduate students must be enrolled for the minimum number of credits in the semester or summer session in which they take an exam ***and*** in the semester in which they complete a degree:
  - 3 credit hours during a Fall or Spring semester or 1 credit (SSDE) during a summer session
  - 1 credit hour for students who qualify for Start of Semester Defense Exception (see below) in the semester of their final exam

R. Start of Semester Defense Exception.

SSDE is a special enrollment category for students who have fulfilled all requirements, *including advisory committee review and agreement that the thesis or dissertation is ready for defense*, and are registering only to take the final oral examination. This option is ideal for students who have completed all requirements and finalized the thesis, but were unable to defend within the previous term. This option is only appropriate for students whose thesis can be read and approved by the entire committee prior to or within the first three weeks of the semester. See: https://graduateschool.vt.edu/academics/what-you-need-to-graduate/deadlines-for-academic-progress.html for the official information.

To ***qualify*** for defending student status, a student must have:

- completed all requirements (including passing grades on all courses on the plan of study and hold a 3.0 GPA or better), except for the final exam **and**
- submitted the final copy of the thesis to the advisory committee **four weeks prior to the defense date and**

- received advisory committee approval, **who consider the document ready for defense** (to the extent that the student can make corrections and submit the ETD within a two weeks period following the defense) within the first three weeks of the semester **and**
- been enrolled in at least three credit hours the preceding semester **and**
- submitted the SSDE form to the Graduate Coordinator (Joli), who will verify that the student meets internal requirements prior to sending the form to the Graduate School on the student's behalf. A copy of the form will also be sent to the Assistant Chair of the Department, who will ensure assistantship positions and the student's status are properly administered. This must be completed **by the Friday of the third week of classes or no later than three weeks prior to the defense**, whichever date comes first. (Note: there is flexibility to this requirement during the Summer Sessions; consult the GPD for details.)

Scheduling a Final Exam within the SSDE Timeline

A student must schedule the defense within the given semester (within the first five weeks). In addition, within the **first three weeks** of the semester the student must:

1. Submit a SSDE form to the Graduate Coordinator
2. Wait for the Graduate School to enroll the student in 1 cr (students cannot enroll themselves)
3. Submit Application for Degree Conferral in HokieSPA
4. Submit Request for Final Examination (at least two weeks prior to the exam date) in the Electronic Signature System. *NOTE: The entire committee must read and approve the thesis prior to signing the on-line scheduling form*

International Students

International students who qualify for SSDE *must* defend (complete final exam) **within first five weeks of the semester** to maintain immigration status. *NOTE: Visa status may also be affected.*

Understanding Potential Implications of Start of Semester Defense Exception

A SSDE will reduce a student's enrollment status to less than full time, possibly affecting:

- financial aid or loan deferments, assistantships (SSDE students are **not eligible for assistantships, GRA or GTA, or fellowships)**, and visa status
- **Fee paid by student**: Visit www.bursar.vt.edu for current free rates.

Students should consult with the Graduate School and the Graduate Program Director to understand the consequences and requirements that result from applying for SSDE.

2. Master of Science (MS) Degree

A. Thesis Option. The following requirements apply to the MS degree with the research-based thesis option.

- Completion of 20 course credit hours (subject to normal Plan of Study policies).
- Completion of at least 10 credits of Research and Thesis (CHEM 5994). Credits earned for Research and Dissertation (CHEM 7994) may be applied to this requirement.
- Each student must present a formal seminar on their research, ordinarily in the same semester as the defense. The one credit of CHEM 5944 Graduate Seminar thus earned may be counted toward the 20 credits needed at the 5000 level or higher.
- Each student must prepare and orally defend a thesis before the candidate's Examining Committee (see Section 1N)

B. Non-Thesis Option. The non-thesis MS program is intended for students who are not interested in a research-based MS degree. A student in a thesis MS or PhD program may switch to the non-thesis MS degree option using the Change of Degree Status form.

Students in other departments (or otherwise employed) may seek the non-thesis MS degree in Chemistry while continuing in their regular positions. Such students must meet all requirements expected of chemistry students, including (a) approval of a Plan of Study, (b) assignment of a Chemistry faculty member to the Advisory Committee as chair or co-chair, and (c) passing additional programmatic requirements as defined by the MS program of interest. See the Graduate Program Coordinator for additional information. Other general requirements include:

- Completion of at least 24 course credit hours at the 5000 level or higher.
- Completion of an additional 6 course hours (either 4000 or 5000 level courses). At the Advisory Committee's discretion, 3 credits of these additional 6 credits may come from an enrollment of CHEM 5904 Project and Report–this option is normally used by students who have changed from the PhD program to the MS program and would benefit from preparing a report on the research progress they made while in the PhD program.
- Students must use the Graduate School's Exam Scheduler (https://ess.graduateschool.vt.edu/pages/login.php) to signup for a "Final Exam"; however, there is no formal exam. This is simply a step to ensure that the student has achieved the academic requirements.

C. Transferring from MS to PhD. A student on an MS plan of study may, pending approval of the Advisory Committee, transfer to the PhD program prior to the completion of their third academic year in residence, using a Change of Degree Status form. Such students are subject to the same progress deadlines as if they were in the PhD program continuously. Students who have completed and successfully defended an MS thesis are generally granted a one-year adjustment to their progress deadlines, although the 5-year assistantship support limit remains unchanged. (See section 4H for transfers from the PhD to the MS.)

3. Doctor of Philosophy (PhD) Degree – Structure and Policy Summary

A. Graduate School Course Requirements. In addition to the general policies for the Plan of Study (Section 1G), a doctoral Plan of Study must meet the following requirements.

- The student must earn a total of 90 credits. Students typically register for 12 credits per semester, and no credits during the summer. Thus the total credit requirement is easily met in 8 semesters, whereas students rarely are prepared to defend before then.
- The student must have at least 30 credits of Research and Dissertation (CHEM 7994). CHEM 5994 research credits can be counted toward a PhD, except for the 10 credits that a student may have used specifically to earn their MS degree.
- The student must earn 12 credits in lecture courses numbered 5000 or higher. Note that the Commission on Graduate Studies and Policies has granted the Chemistry Department a waiver from the 27 credit hour requirement stated in the Graduate School Policies.

B. Chemistry Department Course Requirements. Courses in the Chemistry Department are divided into four broad categories as follows. Students, in consultation with their advisor and committee, select a minimum of four graduate-level courses. Undergraduate level courses are also available where needed to address areas where a foundational level of education is necessary.

- Core Courses. The Core provides the student with an individually tailored classroom education that will support their research objectives at Virginia Tech and throughout their career.
- Foundation Courses. Based upon entrance examination scores, some students may be advised to take foundational courses to ensure that the student has an appropriate background to undertake more advanced course work and research.
- Programmatic Courses. Specific courses are introduced in progressive stages of the program to develop specific educational outcomes such as ethics and integrity, oral and written communications skills, critical reading and thinking, and proposal development. The following courses are considered Programmatic:
    - CHEM 5004 Orientation to Graduate Research
    - GRAD 5004 GTA Training Workshop
    - CHEM 5914 Literature Review and Research Plan
    - CHEM 5944 Graduate Research Seminar
    - CHEM 6904 Generating Research Ideas
    - CHEM 6914 Original Research Proposal
- Elective Courses. Courses that do not fall into any of the preceding categories are Electives. Whereas Core, Foundation, and Programmatic courses must be placed onto the student's Plan of Study, the decision to include Elective Courses on the Plan of Study is left to the student's Advisor and in consultation with their Advisory Committee.

The Chemistry Department has established course requirements (Table 1) that augment and supplement the basic requirements established by the Graduate School.

Table 1. Chemistry Department **Minimum** Course Requirements for the PhD

	Credits
Chemistry Doctoral Program Core Courses (5000 level or higher)	12
Chemistry Foundation Courses	As needed
Orientation to Graduate Research (CHEM 5004)	1
Graduate Seminar (CHEM 5944, enrollment in 2 separate semesters)	2
Literature Review and Research Plan (CHEM 5914)	3
Generating Research Ideas (CHEM 6904)	1
Original Research Proposal (CHEM 6914)	3
Research and Dissertation (CHEM 7994)	Balance
Total	**90**

- Depending on the results of student's Proficiency Exam, given during Orientation Week, additional foundational courses may be recommended. Credits for foundational courses numbered below 4000 do not count toward the total of 90 credits required for the doctorate.
- Elective courses may be placed on the Plan of Study to ensure that the student has a background consistent with research plans and career objectives.
- The orientation course (CHEM 5004) helps students meet Graduate School requirements for training in ethics and professional responsibility.
- Students must prepare a comprehensive Literature Review and Research Plan in their third semester of residence (CHEM 5914, 3 credits). See Section 4C for details.
- Students must take their Preliminary Oral Examination in the fourth semester of residence. Regulations for this exam are found in Section 4D. The "Prelim Exam" is the Graduate School's formal examination of record for doctoral candidacy.
- Students must pass a course on *Generating Research Ideas* in their fifth semester of residence (CHEM 6904 or equivalent). See Section 4E.
- Students must prepare a written *Original Research Proposal* (ORP) in their sixth semester of residence (CHEM 6914, 3 credits). The proposal is evaluated by the student's Advisory Committee, excluding student's primary Advisor. The same committee also evaluates the oral exam portion of the ORP course. See Section 4E.
- PhD candidates are required to attend all Highlands in Chemistry seminars. A student's Research Director may require attendance at additional seminars. See Section 4F.
- PhD candidates present two seminars. See Section 4F. The first (external) seminar is based upon the student's research and presented orally at a professional meeting. The second (internal) seminar is also based on the student's research and must be presented internally as part of CHEM 5944 Graduate Research Seminar. This seminar and committee meeting should take place during the student's fourth-year of study (ideally, in the 7th semester).

- Students may be subject to additional formal reviews and examinations, which usually involve a progress report and a meeting with the advisory committee. Section 4G.
- Students must prepare and successfully defend before their committee, a dissertation describing their research. See Section 1L.

C. PhD Program Timeline and Checklist. [Note: students who initially enroll in in the spring semester begin at "Year One" of the following timeline in their first fall semester.]

Year One

- Orientation Week and CHEM 5004. GTAs will also need to take GRAD 5004, and some international students may be advised to take an English Language or writing course.
- Complete HHN Chemical Hygiene Plan by 1st day of class
- Make progress on course work.
- Nomination of the Research Director (October 15).
- Appointment of the Advisory Committee (December 1).
- Submission of the Plan of Study (December 1).

Year Two

- Complete most or all recommended coursework.
- Literature Review and Research Plan (CHEM 5914, 3 credits, Fall term).
- Preliminary Oral Examination (Spring term).

Year Three

- Generating Research Ideas (CHEM 6904, 1 credit, fall term).
- Original Research Proposal (CHEM 6914, 3 credits, spring term, includes Oral Defense).
- External Seminar (CHEM 5944, 1 credit).
- Committee meeting to evaluate progress if recommended by the student's committee or requested by the student (otherwise, the annual written evaluation will suffice as a 3rd year review)

Year Four

- Required *Internal Seminar* (CHEM 5944, Fall (preferred) or spring of fourth term).
- Possible preparation and submission of dissertation.
- Possible final (Oral) examination and defense of the dissertation.

Fifth Year and Beyond

- Preparation and submission of dissertation.
- Final (Oral) examination and defense of the dissertation.
- Normal assistantship eligibility ends on August 9th of the fifth year
- Annual Committee meeting to evaluate research progress.

Every Year

- *Highlands in Chemistry* seminar attendance required.
- Complete a self-evaluation through the Annual Evaluation System.
- Committee evaluation of research progress. This requirement is met in:
  Year One by simply satisfying course requirements and meeting with the GDP if necessary,
  Year Two by the Preliminary Exam,
  Year Three by the written annual evaluation or a committee meeting, if requested by the committee or by the student,
  Year Four by the internal seminar (full committee must attend), and
  Year Five and Beyond by the Ph.D. defense or by the Committee Meeting.

4. Doctor of Philosophy (PhD) Degree – Detailed Policies and Procedures

A. Course Requirements: In addition to the programmatic courses described above, a minimum of four graduate-level (>5000) courses are required. These courses must be recommended by your advisor in consultation with your committee. Your PhD committee must approve of all course selections. These courses must be graded on an A-F scale (i.e. pass/fail courses do not apply).

See the VT Timetable of Classes (https://chem.vt.edu/graduate/current-students.html) for course scheduling. Note that not every course is taught every semester.

C. Literature Review and Research Plan. CHEM 5914 is an independent study/seminar course, with several meetings throughout the semester to provide forums for discussion. The student writes a literature review in the area of the thesis topic for evaluation by their Advisory Committee. This review (with updates) can provide the basis of the first dissertation chapter. The last several pages of the document should also outline plans for the next 3 years of research. Details and deadlines are provided in the CHEM 5914 course syllabus.

D. Preliminary Oral Examination. All doctoral students must pass a preliminary examination administered by an Examining Committee in accordance with Graduate School policies. The current Chemistry Department practice is to administer an *oral* preliminary exam based on the contents of the student's Literature Review and Research Plan, on the student's research progress to date, and on the student's general knowledge of chemistry. The exam must be held in the spring semester of the second year.

The Preliminary Exam allows the Advisory Committee to estimate whether the student is sufficiently prepared and productive that earning a PhD degree at the completion of about 5 years of study seems likely. The student will be judged on: (1) knowledge of chemistry, (2) logical/critical thinking, (3) awareness of the literature, (4) independence and originality, and (5) research productivity. The following additional policies apply:

- All students must have passed CHEM 5914 (Literature Review and Research Plan). While the Literature Review serves partly as the *basis* for the exam, it is not formally considered the written part of the Prelim Exam.
- It is strongly recommended that students complete most of their Core Courses before entering the Preliminary Exam to be sure that they have the classroom preparation that their Advisory Committees expect.
- At the beginning of the spring semester, the Graduate Coordinator will provide (via e-mail) a progress assessment of the 2nd-year students to ensure that they have met the departmental requirements for admission to the Preliminary Exam.
- Students then submit an exam request, *at least two weeks prior to the exam date*, through the Electronic Signature System: https://ess.graduateschool.vt.edu/pages/login.php.
- Students must plan in advance to ensure that all committee members can attend the examination for the date/time requested. If any committee member does not approve the examination request, the student must resubmit the request. Identifying a room in the ESS ***does not*** reserve the room; ***students*** must reserve the room through the building coordinator.

- The student is responsible for obtaining and bringing the required forms to the actual exam session. The Graduate Coordinator, Joli Huynh, will provide each student with hard copies of these forms once the Prelim Exam date has been approved.

Detailed Prelim Exam Guidelines are available through the Graduate Program Coordinator.

E. Original Research Proposal. Skills in writing research proposals are vital for meaningful research planning, communication, and for obtaining funding. This course will provide experience in the preparation of a scientific proposal. In a two-semester course sequence, students will prepare a written proposal for evaluation by committee members.

- CHEM 6904 Generating Research Ideas is a required course in the fall of the third year. This seminar course is about finding ideas, evaluating their suitability for development into proposals, and writing an abridged NSF-style proposal.
- CHEM 6914 Original Research Proposal is an independent study course. The ORP process is organized as follows:
    - The Review Panel is composed of the Student's PhD committee, excluding the student's Research Director.
    - The Review Panel first approves the Project Summary (during the previous semester, CHEM 6904) to ensure that the student's proposal area is sufficiently removed from those under investigation in their own research group and to ensure that the main idea presented by the student is adequate to develop into a full proposal.
    - The Review Panel evaluates the full proposal and provides written feedback.
    - The student schedules a one-hour oral exam with the Review Panel to discuss the proposal and answer questions based on the proposal. This oral exam is *not* formally scheduled through the Graduate School but it must be concluded before the last day of classes of the term in which CHEM 6914 is enrolled. No grade is assigned to a student in CHEM 6914 until the Review Panel has completed all of the required summary forms.
    - The student is responsible for obtaining and bringing the required forms to the actual oral exam session. The Graduate Coordinator, Joli Huynh, will provide each student with hard copies of these forms once the date has been set.
    - A course syllabus and oral exam guidelines will be provided to enrolled students.

F. Seminars. PhD students are required to attend the weekly Highlands in Chemistry Seminars for all semesters in which they are enrolled for three (3) credit hours or more. Students may miss *no more than two* Highlands Seminars in any given semester. In addition, students must attend the Graduate Seminars when enrolled in CHEM 5944 (see syllabus for details).

Students in the PhD program are required to pass CHEM 5944 in two *different* semesters (total of 2 credits). The requirement for the first external seminar may be met three ways:

- Documented oral presentation of a paper at a professional meeting. The presentation must be an *oral paper* (e.g., no poster sessions), given *outside* normal departmental functions (e.g., no group meetings), with an audience. The meeting should ideally be a national or regional ACS

Meeting or comparable organization. Meetings on the VT campus such as those organized by MII, GPSS, or ICTAS meet the requirement minimally. Documentation of the student's participation in the meeting is required. The student should also register for CHEM 5944 in the same semester that the presentation occurs, or the subsequent semester.

- Presentation of a full (e.g., 40 minute) departmental seminar at an accredited college or university within the United States or Canada. Ordinarily the institution will be the student's *alma mater* and the student will also serve to conduct graduate recruitment there.
- Presentation of a seminar on a general topic unrelated to the student's research (i.e., literature seminar), scheduled in CHEM 5944. In current practice this option is rarely used.

The second (internal) seminar requirement is met by presenting a seminar on the dissertation research and enrolling in CHEM 5944 in the first (preferred) semester of the 4th year. Additional requirements and policies for CHEM 5944 are described in the corresponding course syllabus, which will be made available to all students.

G. Additional Formal Reviews. A graduate student, or any member of their Advisory Committee, may request a meeting at any time to discuss progress in the degree program and future plans. With the Annual Evaluation System now in place, however, additional requests for progress meetings are expected to be rare.

H. Transferring from the PhD to the MS Program. Students who wish to transfer from the PhD program to the MS program (or students who are directed by their Advisory Committees to do so) should use the Graduate School Change of Degree Status form. Once a student has submitted this form, the Graduate Program Director in consultation with the student's Research Director will assign a deadline for completing and defending the MS thesis. This deadline serves partly to set an upper time limit on the guarantee of assistantship support to the student. However, assistantships for MS students are not guaranteed and will be provided on a semester-by-semester basis, depending on departmental needs and the availability of funds. For information on transferring from the MS to the PhD program, see Section 2C.

5. Additional Departmental Policies that Apply to All Graduate Students

A. Ombudsperson. The graduate student ombudsperson helps graduate students resolve issues and address concerns that arise within the university setting. Acting as an advocate for fairness, the ombudsperson provides information about institutional policies and works to help graduate students manage conflicts, understand the university system, and learn more productive ways of communicating. The office provides a safe place for graduate students to be heard and to receive impartial attention without fear of loss of privacy. Consultations are kept confidential, unless the student grants the ombudsperson permission to discuss issues with involved parties or administrators (See http://www.graduate.ombudsman.vt.edu/).

B. Safety. The Chemistry Department seeks to minimize the risks of working in its laboratories for all employees and students. All laboratory workers are expected to know the hazards of chemicals they are using, risks associated with experimental procedures they perform, and general and specific safety protocols in both teaching and research laboratories. The Chemistry Department requires safety training that each student must complete before beginning laboratory work. Individual responsibilities are in University policy 1005 (http://www.policies.vt.edu/1005.pdf). The University and laboratory-specific chemical hygiene plans (CHPs) are extensions of this policy. In addition, regular laboratory and work environment inspections are performed in an effort to ensure compliance with safety regulations. By working to maintain a safe laboratory environment, each student will be better prepared to make new discoveries in their research and seamlessly transition to other laboratories in industrial, government, and academic settings.

C. The Purpose of Assistantship Support. The Assistantship Agreement is a contract providing the student with a stipend (a form of financial aid) suitable to maintain an acceptable standard of living in exchange for the performance of specific duties. However, the main objective of the assistantship is as an educational benefit, to enable the student to focus all of their professional energies on the activities of full-time graduate study. For this reason, the Assistantship Agreement expressly prohibits students from seeking or engaging in other paid employment without the prior consent of their Research Directors (GRA) or the Graduate Program Director (GA and GTA). There is a provision for students who wish to engage in tutoring (see Section 5G below).

Teaching Assistants (GTAs) carry out instructional tasks including lab teaching, grading, exam proctoring, and assisting technical staff with the maintenance and operation of instructional instrumentation. Research Assistants (GRAs) perform research tasks that are usually (but not necessarily) applicable to the student's dissertation or thesis research. The Assistantship Agreement allows for the department to task the student with a maximum of 20 hours (*on average*) per week for the duration of the assistantship period. Research duties performed by GRAs are almost always applicable to their theses or dissertations, although GRA advisors may require other duties during the 20-hour assistantship interval. (NOTE: In addition to responsibilities associated with assistantships, students must complete course credit requirements and research credit requirements, both of which are composed of workloads defined by the instructor of record and Research Director).

Requests to change from GTA to GRA during a semester will be considered only if a suitable GTA replacement is available (this happens very rarely). While assistantship contracts are generally established for full academic years, students may be switched from GTA to GRA (and *vice versa*) between fall and spring terms to accommodate changes in research funding.

D. Tuition Remission. It is University policy that all graduate students holding an assistantship be awarded a tuition remission. Normally the tuition payment is credited directly to the student's account. It must be understood that tuition is not waived. Instead, the department uses its funds to pay the required tuition. Thus, a student not supported on assistantship is responsible for their own tuition.

E. Assistantship Eligibility. Subject to university regulations, the Department guarantees assistantship support for all graduate students on PhD Plans of Study through the end of the fifth academic year in residence (typically the Spring of the 5th year for someone who entered in the fall term). To maintain eligibility, the student must remain in "good standing". Good standing requirements include a GPA of 3.0 or better with satisfactory performance in both teaching and research, as gauged by the student's advisory committee and research director. Students with lower GPAs may receive assistantships if the Graduate Program Director requests an exception from the Graduate School. Good standing also requires that the student be making adequate degree progress in the opinion of their Advisory Committee. A student who has received two consecutive unsatisfactory evaluations through the Annual Evaluation System may be denied continued assistantship support. Students who switch from the PhD program to the MS program should discuss their eligibility for continued support with the Graduate Program Director. MS students are not guaranteed assistantship support unless they have negotiated a special agreement with the Chair of the Department.

F. Vacation and Leave Time.

1. Overview. As described in Section 5C, graduate assistantships are established by contract. Assistantships are neither faculty nor staff appointments. They are effectively studentships. Graduate assistantships do not accrue *any* leave time as a fringe benefit. There is no provision whatsoever for vacation or sick leave within an assistantship.

2. Expectations of Enrollment. Students holding assistantships must also be enrolled as full-time students (12 credits during Fall and Spring). This enrollment implies expectations for progress toward a graduate degree in accordance with the student's Plan of Study and the specific expectations established in annual evaluation documents and in meetings with the student's Research Director.

3. Planned Absences. Regardless of the student's source of assistantship support, all planned absences from the university for non-professional purposes of longer than one day must be documented in advance using the Personal Time http://www.policies.vt.edu/1005.pdf Approval Form available from the Graduate Program Coordinator. The assistantship stipend may be unpaid during the absence, for reasons including but not limited to the following:

- The planned absence prevents a GRA from contributing an average of 20 hours of effort per week toward the project sponsoring the assistantship during any single pay period.

- The planned absence interferes with the normal performance of any assigned GTA duties.

4. Unplanned Absences. Absences due to illness or other emergencies can be dismissed only if infrequent and short in duration. Students who are prevented from performing GRA or GTA duties (due, for example to illness or emergency) must inform their supervisors (both research advisors and TA advisors) of their absence and expected date of return as soon as practicable.

5. Conference Travel. Reasonable accommodations are made for graduate assistants who must be absent for legitimate professional reasons. GTAs must notify their supervisors well in advance so that assigned duties can be covered. Students hoping to be reimbursed for conference travel expenses must comply with Controller's Office policies for professional travel. There is a special form requiring an estimate of expenses and budget/account information that should be completed in consultation with the student's advisor. Ms. Beth Kast (see the Staff contact information within the Departmental website), can help you with these forms.

6. Students with Disabilities. Students with disabilities can expect accommodations to enable them to perform assigned assistantship duties, in accordance with university policy. However, assistantships cannot be provided to students whose disabilities prevent them from performing their assigned duties when given reasonable accommodations.

7. Academic Breaks. Intervals of decreased assistantship duties (such as academic breaks) serve as important opportunities to make progress in the research that will ultimately provide the substance of a student's thesis or dissertation. Effective use of these break intervals will help ensure that a student makes adequate progress toward the degree and meeting the expectations established for them in their annual evaluation documents. Assistantship Agreements require that the student check with their supervisor (Research Director for GRAs) for duties that may be assigned during academic breaks. GTAs should ask their immediate supervisors whether there are duties that must be performed outside the normal boundaries of the academic term, such as meetings and training before the semester, cleanup after the semester, or any type of prep work during the academic breaks. If no such additional duties are required, then supervisory authority for GTAs defaults to each student's individual Research Director. However the general departmental expectation is that graduate students will use the school break intervals to engage in research or otherwise make progress toward their degrees.

8. Summer Sessions. During summer sessions, graduate students are not typically enrolled. There is still a strong expectation that students holding GRA appointments will use the uncompensated 50% of their total effort to make significant progress in their thesis or dissertation research, in addition to research performed for the GRA. Contrary to prevailing opinion, GTA assignments spanning two summer sessions do not comprise one summer session of duties and one summer session of completely unregulated time. Students with teaching duties assigned during Summer Session 1 will generally have a Departmental GRA appointment in Summer Session 2, which continues until the start of the fall term. Students who have teaching duties assigned during Summer Session 2 will have a Departmental GRA appointment in Summer Session 1, which begins at the end of the Spring term. All of the above rules for leave time apply to both terms of all summer appointments.

G. Communication. Graduate students are recommended to check their mailboxes once daily for printed information from the department. However the primary means of communication in the Chemistry Department is email. Email must be checked at least every day unless the student is too sick to do so or is taking approved leave. Graduate students are required to read email messages sent to them by any member of the faculty or staff affiliated with the Department of Chemistry, College of Science, or the Graduate School.

H. Tutoring. The Department recognizes that tutoring undergraduates is a valued service and a wholesome activity because it promotes learning for both the tutor and the client. Therefore the Department allows tutoring (as a modification of the assistantship agreement) subject to the following conditions:

1. *Conflict of Interest*. A graduate teaching assistant (GTA) may not accept fees to tutor any student enrolled in any section of a course that the GTA is currently teaching or serving as a grader. In other words, you may not tutor, for a fee, any student in one of your own present lab sections. This restriction includes organic lab sections in which you serve as a floater or leader and lecture sections where you may be a grader.

2. *First-year graduate students* are not permitted to work as tutors at all during their first twelve months in residence.

3. *Time Limit*. A graduate assistant, whether funded on GTA or GRA, must notify their research advisor before working as a tutor more than four hours in any given seven-day interval. Thus, if you want to work more than four hours tutoring during the week before final exams, you should send your advisor an email to explain those plans. It is hoped that disagreements about the amount of tutoring that you are allowed to do can be worked out between you and your advisor.

4. *Subordination to University Policy*. Tutoring for hire is considered external work. All University employment and consulting policies apply fully to GTAs working as tutors.

5. *Tutor Lists*. The department provides lists of people who are interested in serving as tutors, one list for general chemistry, and one for organic chemistry. The department guarantees neither the availability nor the competence of any of their listed tutors. (Listing by the department is not to be interpreted as an endorsement.)

6. *Training and Supervision*. The department does not supervise the tutors, nor does the department provide them with training specific to tutoring.

7. *Tutoring Fees*. The tutor and the client must agree to the tutoring arrangements and fees. The Department does not monitor or enforce these agreements. It is recommended that you "get it in writing" (for example, by saving the email in which the student agrees to the tutor's fee). The tutor is responsible for collecting their own fees and paying any associated taxes. Tutors who have trouble collecting fees they are owed should contact the university police. The department does not collect any portion of tutoring fees.

8. *Scheduling Priorities*. Tutoring activities should be scheduled for times mutually acceptable to tutor and client. However these activities may not interfere with the tutor's normal classroom and research activities, including seminars and other required activities associated with graduate student work.

I. Information about Student Privacy and FERPA for the Department of Chemistry.

The following paragraph comes from the webpage of the University Registrar:

- FERPA (Family Educational Rights and Privacy Act of 1974 [U.S. Public Law 93-579]) guarantees an individual's rights to the access of their academic record. This federal law also provides guidelines as to third party access and the appropriate security of the education record. Academic Records at Virginia Tech are defined as any portion of the educational history of a student that is maintained by the University for the purpose of sharing by other academic officials and is intended to support the academic degree progress of the student. Educational Officials may view student academic records if they have a demonstrated, specific educational interest prior to the granting of access to the student record.

In the Department of Chemistry, various faculty members will have access to a graduate student's records on a "need to know" basis, and this will change as the student progresses in the program as described below:

1. Prior to admission. All research active faculty members participate in graduate recruiting and admissions. Accordingly, these faculty members will have access to application materials submitted to the Department and University in support of the application for admission. (Note: A research active faculty member is someone engaged in research and involved in the training and education of graduate students).

2. After admission, but before the selection of an advisor. The selection of a research advisor is one of the most important decisions to be made early in a student's graduate career. Because of the nature of the mentor/mentee relationship, this is a joint decision of both the student and prospective advisor. At this point in a student's career, the following faculty members will have access to a graduate student records: a) prospective advisors (as identified by the student on the Department's Research Director Request Form), and b) the Graduate Education Committee (which oversees the progress of all students in the program).

3. After selection of a research advisor. The research advisor and advisory committee are charged with overseeing and evaluating student progress. During this phase of a graduate student's career, the following individuals will have access to the student's records: a) the research advisor, b) other members of the student's advisory committee, and c) the Graduate Education Committee, Graduate Program Director, and Graduate Coordinator

J. Pregnancy and Childbirth

1. Safe Pregnancy for Chemical Laboratory Workers. The Chemistry Department seeks to minimize the risks of working in its laboratories for all employees and students, especially for pregnant individuals because of the known sensitivity of the fetus to specific chemicals, in particular teratogens. All laboratory workers, including pregnant individuals, are expected to know the hazards of chemicals they are using. Material Safety Data Sheets (MSDS) are essential but may not provide a complete set of recommendations. Additional protective equipment may be available, but alternatives to laboratory work such as spectroscopic or computational studies, library work, writing, or seminar preparation may be requested by the pregnant laboratory worker. The Department can be creative and flexible because each situation may be different. We encourage a pregnant person to consider accommodations that they might request for their wellbeing.

While there are many ways the Department can assist a person who is pregnant, we cannot activate those accommodations without their involvement. The federal Pregnancy Discrimination Act prevents the Department from compelling a person to disclose that they are pregnant, and it prevents us from assigning them to different tasks simply because of a pregnancy. The University complies with the Pregnancy Discrimination Act. If a person willingly informs us that they are pregnant and asks for reasonable accommodations, then we can help.

We encourage a pregnant graduate student who has questions to consult with their Research Director and the Graduate Program Director. Strictly confidential discussions will cover topics such as extensions to programmatic deadlines, changes in degree progress expectations, and assistantship assignments. A student on GRA or GTA may request alternative assignments. Generally, academic deadlines and eligibility for departmental assistantship support can be extended by up to one year for the new parent. To ensure fulfillment of the agreements reached, the Graduate Program Director will draft a written summary of the accommodations. Upon approval by the student, the plan will be shared with the student's Research Director, with a copy maintained in the student's records.

2. Parental Leave.

a. *Graduate Students.* An expectant graduate student desiring a paid-leave accommodation may consult with their Research Director and with the Graduate Program Director. The Assistant Chair of the Department will apply to the Graduate School for a Work-Life Grant that usually provides 6-weeks of support for a temporary replacement, either GTA or GRA, on behalf of a pregnant person *or* new parent around the time of childbirth or adoption. The graduate student must make the request for assistance in writing to the Assistant Chair for this support, ideally 6 months prior to childbirth or adoption. The individual hired as a temporary replacement for a GTA must be fully qualified and approved by the Graduate Program Director and the Assistant Chair. Normally, the leave will begin at childbirth, but it may begin earlier in special circumstances. Some of the leave time may be taken on a part-time basis, for example 4 weeks of full-time, and 4 weeks of half-time leave.

b. *Related Accommodations.* Information regarding local childcare options may be found at https://hokiewellness.vt.edu/Employees/work-life/Child_Care.html . During the leave period, the Department will make a good-faith effort to provide reasonable accommodations so that the graduate student's or laboratory staff member's health insurance does not lapse, and so that they can maintain their visa status. Access to a private, clean lactation room for parents will be available upon returning to work. Lactation rooms, both on the main campus, within the Department, and at the CRC, are listed on the Human Resources web site (https://vtnews.vt.edu/notices/adm-evergreens/hw-evglactationrooms.html). The use of these rooms requires a simple registration form to be completed. The Department of Chemistry maintains a lactation room on the 4th floor of Davidson Hall.

K. University Property. No student may remove any department / university computer or other property off-campus. All chemicals, even waste, are considered university property and must remain on campus, be disposed of following proper protocols, or be removed only with explicit permission (for conducting outside demonstrations, for example). No student may take a department computer with them on personal travel, whether in the USA or internationally. If a student's Research Director wishes to allow a student to use a university-owned computer at the student's local (e.g., Blacksburg) residence, the faculty member must complete an

inventory off-site use form. A student's Research Director may give the student *ad hoc* permission to take a laptop computer to a conference within the United States. Taking a laptop to an international conference requires, additionally, that the equipment be cleared, as part of the travel approval process, with the Office of Export and Secure Research Compliance. Please contact the Assistant Chair for guidance on that process.

The Chemistry Main Office should be notified whenever property subject to inventory (that has a bar-code sticker) is permanently relocated from one building or lab room to another.

L. Police and Legal Matters. Students must report arrests and convictions to the university. The link below has the form that students should complete as well as several FAQs on the topic. The form must be submitted in person as soon as possible after the event occurs, within 10 business days at most. Students may contact the Graduate Student Ombudsperson at the Graduate School (See sect. 5 A) for any other questions. Also see: http://www.studentconduct.vt.edu/.

Graduate Course Listing for Chemistry

(from the Graduate Catalog**)**

CHEM 5004 - Orientation to Graduate Research

A survey of topics needed to meet high standards of safety, scholarship, and productivity in research-based chemistry graduate programs. Graduate standing required.

Credit Hour(s): 1

Lecture Hour(s): 1

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5014 - Communication Skills and Methods of Presentation

Methods and style to make effective technical and nontechnic presentations including blackboard presentations, overhead presentations, slide presentations, and research posters. Video presentations with critiques.

Credit Hour(s): 1

Lecture Hour(s): 1

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5094 (BMVS 5094) (FST 5094) (TBMH 5094) - Grant Writing and Ethics

A framework for writing clear, concise grant proposals in a team-oriented, multidisciplinary approach from concept development through submission to a funding agency. Potential ethical dilemmas that may arise in academic, industrial, or federal research settings will be discussed. Pre: Undergraduate courses in one of the following: organic chemistry (CHEM 2565/2566), cell & molecular biology (BIOL 2104), Concepts of Biochemistry (BCHM 2024), or equivalent. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5114 - Advanced Electrochemistry

Discussion of theory and application of chemical equilibrium, reaction rate methods, and electroanalytical methods in analytical chemistry. One year of physical chemistry required.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5124 - Analytical Spectroscopy

Principles, instrumentation, and applications of atomic and molecular spectroscopy. Theoretical descriptions of electronic and ro-vibrational energy levels, transitions, and energy dynamics. Modern spectroscopic instrumentation and applications in quantitative analyses. Prerequisite or equivalent.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHEM 3616 (UG) OR CHEM 3616

CHEM 5134 - Introduction to Single-Crystal X-ray Diffraction

Overview of single-crystal X-ray crystallographic theory and methods for graduate students who make (or plan to make) occasional use of crystallographic data or measurements in their research. Capabilities and services of the Virginia Tech X-ray Crystallography Service Center (VTX). Preparation and submission of crystalline samples. Typical processes of crystal screening, data collection, structure solution, and data reporting. Current standards for publication of crystallographic data. Crystallography software and structural databases. Ethical standards for reporting crystallographic data. Radiation safety in crystallography. Pre: Graduate standing. Pass/Fail only.

Credit Hour(s): 1

Lecture Hour(s): 1

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5144 - Instrument Design

Design, construction, and operating principles of analytical instrumentation. Topics will include major instrument components (vacuum, optical, charged-particle), instrument construction (spectrometers, chromatographs), electronic data acquisition, and computer data analysis.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5154 - Methods in Molecular Biophysics

Modern methods of biophysical measurement, their strengths and limitations, and their application to current research problems. Mass spectrometry, differential scanning calorimetry, isothermal titration calorimetry, surface plasmon resonance, atomic force microscopy, electrophoresis, and fluorescence spectroscopy of biomacromolecules. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5174 (ESM 5174) - Polymer Viscoelasticity

Constitutive models of linear viscoelastic materials, experimental aspects, polymer response to mechanical and electrical inputs, solid state NMR and microwave interactions with polymers, free volume theories, temperature and environmental effects on polymers, physical aging of glasses. Consent required.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5404 - Advanced Inorganic Chemistry

An advanced coverage of topics in inorganic chemistry: principles of bonding in compounds of the metals and non-metals, applications of group theory to bonding, ligand field theory, inorganic and organometallic reaction mechanisms. Required core course for chemistry graduate students. One semester of undergraduate inorganic chemistry, one year undergraduate physical chemistry required.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5414 - Methods & Appl of Inorg Chem

Physical methods of measurement in modern inorganic chemistry research. Theoretical and practical aspects of spectroscopy, electrochemistry, photo-chemistry, and surface-analytical techniques as applied to inorganic compounds. Intersections of inorganic chemistry with

nanotechnology, materials science, heterogeneous catalysis, and biochemistry, as reflected in the primary research literature. Pre: Graduate Standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5424G - Adv Polysaccharide Chemistry

Structure, properties, and application of natural polysaccharides. Natural sources and methods of isolation. Synthetic chemistry and important polysaccharide derivatives Relation of structure and properties of performance in critical applications including pharmaceuticals, coatings, plastics, rheology control, and films. Conversion by chemical and biochemical methods of polysaccharide biomass to fuels and materials. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5505 - Advanced Organic Chemistry

Structure, stereochemistry, and bonding in organic compounds and their effects on organic reactivity. Ionic reactions, free radical reactions, and concerted reactions will be discussed. One year of undergraduate organic chemistry required.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5506 - Advanced Organic Chemistry

Structure, stereochemistry, and bonding in organic compounds and their effects on organic reactivity. Ionic reactions, free radical reactions, and concerted reactions will be discussed.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHEM 5505 (UG) OR CHEM 5505

CHEM 5514G - Advanced Green Chemistry

Sustainability, waste prevention, conservation of energy resources, avoidance of toxins, pollutants, and hazards in chemical processes and products. Life-cycle analysis applied to case studies involving process development and product stewardship. Applications in chemical industry, process and product design, and public policy. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5524 - Molecular Structure Determination

Structure determination of organic compounds by spectroscopic methods, with an emphasis on mass spectrometry and nuclear magnetic resonance. Course will emphasize problem-solving skills. Includes hands-on instruction in nuclear magnetic resonance spectroscopy and other analytical spectroscopic methods. Partially duplicates 4524; students cannot receive credit for both 4524 and 5524.

Credit Hour(s): 4

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lab, Lecture, Online Lecture

Prerequisite(s): CHEM 2536 (UG), (CHEM 3616 (UG) OR CHEM 4616 (UG)) OR CHEM 2536, (CHEM 3616 OR CHEM 4616)

CHEM 5525 (GEOS 5535) - X-ray Crystallography

5525: Provides a thorough grounding in the principles of the crystalline state including lattices and symmetry, leading to the formal description of structures and surfaces and interpretation of published crystallographic data. 5526: Covers methods of single-crystal and powder X-ray diffraction for the determination of the atomic arrangement of atoms within crystalline materials.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): GEOS 3504 OR CHEM 3615

CHEM 5526 (GEOS 5536) - X-Ray Crystallography

5525: Provides a thorough grounding in the principles of the crystalline state including lattices and symmetry, leading to the formal description of structures and surfaces and intrepretation of

published crystallographic data. 5526: Covers methods of single-crystal and powder X-ray diffraction for the determination of the atomic arrangement of atoms within crystalline materials.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): GEOS 5535 OR CHEM 5525

CHEM 5535 - Synthetic Organic Chemistry

Modern synthetic methods and their applications to the preparation of various classes of organic compounds.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHEM 5505 (UG) OR CHEM 5505

CHEM 5614 - Nuclear Magnetic Resonance Methods in Chemistry and Polymer Science

Theory and methods of nuclear magnetic resonance (NMR). Description and operation of NMR apparatus and experimental techniques. Optimization of NMR experiments with respect to spin relaxation, sensitivity, and resolution. Spin couplings and associated spectral features. Applications in the characterization and analysis of molecules, solids, and polymers. Theory and basic practices of solution, solid-state, and multidimensional NMR methods. Spatial imaging (MRI) and molecular diffusion (diffusometry) methods. Pre: Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5644 - Colloid and Surface Chemistry

Characterization of interfaces including liquid/gas and liquid/liquid (spread monolayers) interfaces, nature of solid surfaces, gas/solid (thermodynamics), and liquid/solid (wetting, colloidal stability) interfaces. Pre: One year of physical chemistry or consent.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5664 - Chemical Kinetics

Phenomenological kinetics with emphasis on measurement techniques and the interpretation of kinetic data. Significance of rate laws, activation parameters for mechanisms, catalysis and fast reactions in gas and condensed phase are discussed.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHEM 5614 (UG) OR CHEM 5614

CHEM 5704 - Synthesis and Reactions of Macromolecules

Advanced treatment of the kinetics, mechanisms, synthesis and reactions of macromolecules via step and chain processes. Pre: Second year grad standing in chemistry, chemical engineering, or consent.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5805 - Applied Chemistry: Review & Proposal

5805: Review of an active industrial product or process in the field of food, energy and water chemistry; drug discovery chemistry; or polymer chemistry. Assessment of trends in the academic and patent literature relevant to commercial products and processes. Scholarly management of personalized citation databases. A-F only. Pre: Graduate Standing. 5806: Written proposal and oral presentation defense of a possible development study in the field of food, energy and water chemistry; drug discovery chemistry; or polymer chemistry. Literature frameworks and precedent for development studies. Cost-benefit analysis in chemical process and product development. Oral presentation and defense of a process development proposal. A-F only.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5806 - Applied Chemistry: Review & Proposal

5805: Review of an active industrial product or process in the field of food, energy and water chemistry; drug discovery chemistry; or polymer chemistry. Assessment of trends in the academic and patent literature relevant to commercial products and processes. Scholarly management of personalized citation databases. A-F only. Pre: Graduate Standing. 5806: Written proposal and oral presentation defense of a possible development study in the field of food, energy and water chemistry; drug discovery chemistry; or polymer chemistry. Literature frameworks and precedent for development studies. Cost-benefit analysis in chemical process and product development. Oral presentation and defense of a process development proposal. A-F only.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHEM 5805

CHEM 5834 - Food, Energy, and Water Chemistry

Roles of chemistry in food production, energy utilization, and water management. Integration of sustainable food-energy-water (FEW) chemistry in progress toward environmental stewardship and resource efficiency. Principles of equilibria and speciation, reaction kinetics, wet-analytical and instrumental methods, synthesis, and physical characterization of materials emphasizing applications of FEW chemistry including water-purification materials and green agrochemical production. Analysis of current academic and patent literature describing developing chemical technologies relevant to the food, energy, and water nexus. Pre: Graduate standing

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5854 - Entrepreneurship in Medicinal Chemistry

History of entrepreneurship in medicinal chemistry. Survey of industrial medicinal chemistry sectors from small ventures to major pharmaceutical companies. Business plan development and venture capitalism. Case studies of medicinal chemistry ventures. Business and legal aspects of translating scientific discovery into intellectual property (IP), industrial processes, and competitive advantage. Academic technology-transfer procedures. Pre: Graduate standing.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5894 - Final Examination

For non-thesis candidates who are required to register for their final examination and have completed their program of study. Not to be included in minimum hours required for degree.

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5904 - Project and Report

A detailed written report on a current topic in chemistry or interdisciplinary areas involving chemistry. Non-thesis M.S. students in chemistry are required to complete 4 credit hours of CHEM 5904. Graduate standing in chemistry required.

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Level: Graduate

Instruction Type(s): Research, Online Research

CHEM 5914 - Literature Review and Research Plan

Preparation of a written review of a topical research area within chemistry or a closely allied interdisciplinary field. Graduate standing required.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5944 - Graduate Seminar

Recent advances in various fields of chemistry are covered by means of reports carefully prepared and presented by individual students, under direction of various members of chemistry faculty. Work of each student is judged not only by report he gives but also by an intelligent discussion of reports presented by other students.

Credit Hour(s): 1

Lecture Hour(s): 1

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5974 - Independent Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Level: Graduate

Instruction Type(s): Independent Study, VI

CHEM 5984 - Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 5994 - Research and Thesis

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s):

Level: Graduate

Instruction Type(s): Research, Online Research

CHEM 6434 - Organometallic Chemistry

Chemistry and applications of organometallic and related compounds.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 6464 - Current Topics in Inorganic Chemistry

Special topics in frontier areas of inorganic chemistry. Offered when appropriate.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 6504 - Chemistry of Natural Products

The structures, biosyntheses, reactions, and biomimetic syntheses of natural products, with examples from each of the major classes of polyketides, shikimates, terpenoids, alkaloids, antibiotics, and marine natural products.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHEM 5506 (UG) OR CHEM 5506

CHEM 6564 - Current Topics in Organic Chemistry

Special topics in frontier areas of organic chemistry. Offered when appropriate.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHEM 5506 (UG) OR CHEM 5506

CHEM 6624 - Chemical Thermodynamics

Rigorous application of the laws of thermodynamics to real fluids, solutions, chemical equilibria, and non-equilibrium processes.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHEM 5614 (UG) OR CHEM 5614

CHEM 6634 - Quantum Chemistry and Spectroscopy

Study of basic quantum mechanics followed by some of its applications to chemistry and spectroscopy. Topics include: the variational method; perturbation theory; Hartree-Fock theory; the electronic structures of atoms and molecules; atomic spectra; and molecular rotational, vibrational, and electronic spectra.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHEM 5614 (UG) OR CHEM 5614

CHEM 6664 - Current Topics in Physical Chemistry

Special topics in frontier areas of physical chemistry. Offered when appropriate.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHEM 5614 (UG) OR CHEM 5614

CHEM 6904 - Generating Research Ideas

Process of generating and evaluating novel research ideas in chemistry. Pre: Graduate Standing.

Credit Hour(s): 1

Lecture Hour(s): 1

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 6914 - Original Research Proposal

Preparation of a written original research proposal in chemistry or a closely related interdisciplinary field. Must have passed the Preliminary Oral Exam.

Credit Hour(s): 3

Lecture Hour(s): 3

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

Prerequisite(s): CHEM 5914

CHEM 6984 - Special Study

NONE

Credit Hour(s): 1 TO 19

Lecture Hour(s): 1 TO 19

Level: Graduate

Instruction Type(s): Lecture, Online Lecture

CHEM 7994 - Research and Dissertation

NONE

Credit Hour(s): 1 TO 20

Lecture Hour(s):

Level: Graduate

Instruction Type(s): Research, Online Research

Undergraduate Course Listing for Chemistry

(from the Undergraduate Catalog**)**

CHEM 2565-2566: PRINCIPLES OF ORGANIC CHEMISTRY

Organic chemistry for chemistry majors. Structure and reactions of organic compounds, with emphasis on fundamental principles, theories, synthesis, and reaction mechanisms. The subject matter partially duplicates that of 2535-2536; no credit will be given for the duplicated courses. Pre: 1036 or 1056 or 1036H or 1056H for 2565; 2565 for 2566. (3H,3C)

CHEM 3615-3616: PHYSICAL CHEMISTRY

Principles of thermodynamics, kinetics, and quantum mechanics applied to chemical equilibria, reactivity, and structure. Partly duplicates 4615, cannot receive credit for both 3615 and 4615. Pre: (1035 or 1055 or 1055H), (1036 or 1056 or 1056H), PHYS 2306, (MATH 2204 or MATH 2204H or MATH 2224) for 3615; MATH 2214, (CHEM 3615 or CHEM 3615H), (CHEM 3615, MATH 2214 or CHEM 3615H) for 3616. (3H,3C)

CHEM 4114: INSTRUMENTAL ANALYSIS

Principles of instrumental methods including data analysis, phase equilibrium, spectroscopy, and electrochemistry. Applications of modern instrumentation to chemical analyses using chromatography, electrophoresis, atomic and molecular spectroscopy, potentiometry, and voltammetry. Note: Graduate students will not be expected to take the corequisite lab 4124. Pre: (3615 or 3615H), 2154. Co: 4124. (3H,3C)

CHEM 4404: PHYSICAL INORGANIC CHEMISTRY

A study of spectroscopic, bonding, and structural properties of inorganic compounds. Pre: (3616 or 3616H), 2424. (3H,3C)

CHEM 4444: BIOINORGANIC CHEMISTRY

Principles underpinning the study of metal ions in biological systems. Review of basic coordination chemistry. Evolution of the distribution of metal ions in biology. Uptake of metal ions from the environment into living organisms. Regulation of metal ion concentrations in cells. Central functions of metal ions in biological systems including modulation of structure, electron transfer reactions, substrate binding and activation, and selective transfer of atoms and groups. Roles of biopolymers in the binding, regulation, and function of metal ions. Physical methods of analysis relevant to bioinorganic chemical research questions. Senior standing. Pre: (2566 or BCHM 4115), BIOL 1105, BIOL 1106. (3H,3C)

CHEM 4584: BIOORGANIC CHEMISTRY

The organic chemistry underlying the structure and properties of amino acids, peptides, and nucleic acids. Mechanisms of enzyme catalysis and coenzyme-mediated reactions. Mechanisms and thermodynamics of catabolism and anabolism of fats, carbohydrates, and proteins, and of other key biological reactions. Principles of solid-phase synthesis applied to peptides and nucleic acids. Biosynthesis of lipids, sugars, and terpenoids. Pre: 2536 or 2566. (3H,3C)

CHEM 4615, 4616: PHYSICAL CHEMISTRY FOR THE LIFE SCIENCES

Principles of thermodynamics, chemical kinetics, and chemical bonding for students in the life sciences. 4615: Laws and applications of thermodynamics. 4616: Chemical kinetics and chemical bonding including spectroscopy. Partly duplicates 3615, cannot receive credit for 3615 and 4615. Pre: (1036 or 1056 or 1056H), (MATH 1026 or MATH 1226), (PHYS 2206 or PHYS 2306). (3H,3C)

CHEM 4624: MATERIALS CHEMISTRY IN ENERGY SCIENCES

Fundamental principles of solid-state materials chemistry in energy sciences. Thermodynamics and kinetics of electron and ion transport in solid materials. Application of electrochemical and photochemical principles to batteries, fuel cells, solar cells, and other energy devices. Analytical tools and characterization methods for elucidating mechanisms within electrochemical and photoelectrochemical cells, with an emphasis on using electrochemical principles to evaluate battery chemistry. Solid-liquid interfacial mechanisms in energy devices. Critical analysis of relevant primary literature. Formulation of hypotheses and experimental design for improving device performance. Pre: Senior standing. Pre: (3615 or 4615). (3H,3C)

Graduate Course Listing for Biochemistry

(from the Graduate Catalog**)**

BCHM 5024 - Computational Biochemistry for Bioinformatics
Applications of protein structure and function, protein characterization, enzyme kinetics, and analysis of metabolic control for students with a background in computer science, mathematics, statistics, or engineering. Pre: B.S or senior standing in computer science, mathematics, statistics, or engineering. Not available to life science majors for credit.
Credit Hour(s): 3
Lecture Hour(s): 3
Level: Graduate
Instruction Type(s): Lecture, Online Lecture

BCHM 5124 - Biochemistry for the Life Sciences
Basic principles of biochemistry including protein structure, enzymology, gene expression, bioenergetics, and pathways of energy metabolism. Not available to Biochemistry majors.
Credit Hour(s): 3
Lecture Hour(s): 3
Level: Graduate
Instruction Type(s): Lecture, Online Lecture
Prerequisite(s): CHEM 2536 (UG)

Undergraduate Course Listing for Biochemistry

(from the Undergraduate Catalog**)**

BCHM 4984 – This is a special topics course.