THE SCHOOL OF CHEMISTRY AND BIOCHEMISTRY
GEORGIA INSTITUTE OF TECHNOLOGY

GRADUATE STUDENT HANDBOOK

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PREFACE

An Overview of the Graduate Program in Chemistry and Biochemistry at Georgia Tech

The graduate curriculum in the School of Chemistry and Biochemistry builds on a student's undergraduate experience to provide the scientific, technical, and professional foundational training needed for a fruitful and challenging career. Two graduate programs are offered: students in the M.S. program complete coursework and have the option of conducting research. The Ph.D. program further develops the key skills required to complete high-quality, world recognized research.

The major milestones and requirements of the Ph.D. program are summarized in a timeline at the end of this section. In the first two years, you will complete courses that bridge between introductory (undergraduate) material and contemporary research. Considerable flexibility in the choice of classes allow you to tailor the curriculum to your developing research interests.

In the fall semester of the first year, you will participate in the *Faculty Seminar (CHEM 8001)* where members of the faculty discuss their research interests. This is an opportunity to learn more about the expertise in the School, and it is an aid to research advisor selection. In the spring semester of the first year, you will participate in Information Resources for Chemists and Biochemists (CHEM 8002). This includes seminars on Responsible Conduct of Research and Ethics, which is sponsor-required training for all students who will be funded on federal grants/contracts, laboratory safety philosophy and approach, and other professional skills.

Students pursuing their Ph.D. take a series of *literature examinations* administered in Jan-Aug of the first year. These exams aid in the transition from the lecture-based delivery of material to the self-guided critical evaluation of recent research literature. The examinations require that you apply knowledge from courses and self-study to understand important research topics. As in many other aspects of graduate study, collaboration among students, as you prepare for these exams, is strongly encouraged (please refer to Georgia Tech's Academic Honesty policy regarding collaborative work). In the second year, you will present your own seminar in the *Student Seminar* series (CHEM 8003), as well as a poster and written description of research in *Introduction to Research* (CHEM 7001).

Students must select a primary research advisor by February 1 in their first year of study, although extensions may be granted. To aid in selecting a research advisor, students are encouraged, but not required, to pursue rotations in two or three research laboratories during the preceding fall semester. In collaboration with the primary advisor, students must assemble a Ph.D. *thesis advisory committee* shortly after joining a research group and send the list of the committee members to the Director of Graduate Studies no later than July 15. This committee is a source of independent scientific, technical, and career advice for the student, and it is expected to act in the student's interests. (See section 5.7 for committee makeup guidelines.)

Upon successful completion of the literature examinations, students should complete the *Ph.D. Candidacy Examination*, composed of: (i) a review of their progress in research along with a thesis proposal, and (ii) an original research proposal. The original proposal requires that you propose an

innovative solution to a current problem of your own choosing. The proposal must demonstrate sound reasoning and be based on good precedence from the literature. This is also a time for you to meet with your thesis committee to further define the scope of your research plans.

Students should begin research as soon as possible, but no later than sometime during their second semester in residence. Although each Ph.D. student has a set of individual goals, progress in research often relies on teamwork. While the traditional areas of analytical, biochemistry, inorganic, physical, and organic chemistry serve as foundations for classroom and instruction and some research programs, many research projects are highly interdisciplinary and involve collaborations with other scientists and engineers in the School, across campus, at other universities, or in industry. Such partnerships may include research off-campus or industrial co-op experiences. In addition to publishing research in internationally recognized journals, students are encouraged to present their work at regional, national and international conferences. Funds are available for this purpose. Enquiries regarding travel funding should be directed to the Director of Graduate Studies

After successful completion of the Ph.D. Candidacy Examination, which should be done before the end of the second year in residence, students are required to provide a progress update to their thesis advisory committees at least once each year. This update requires the submission of a written progress report to all committee members, and in-person meetings with at least three committee members, not to include their advisor. Presentation of research at the annual student-faculty retreat can fulfill the in-person reporting requirement for one of these years. A special pre-thesis review meeting with the committee is required within six months of the student's desired Ph.D. defense date, to make sure that the proposed content of the thesis meets departmental expectations. At least one paper, with the student as an author, should be submitted for publication in a peer reviewed journal prior to the PhD defense. The final Ph.D. thesis defense should present a summary of the student's goals, methods and results, and provide justified conclusions which are of value to the scientific community and society. While serving as a final examination, the thesis defense should also be an academic achievement of which the student can be proud.

The Ph.D. program in the School of Chemistry and Biochemistry at Georgia Tech is both nurturing and challenging. It fosters teamwork, problem solving, innovation, and the critical evaluation and presentation of data. Through this curriculum, students are prepared to meet the challenges and opportunities of a diverse array of careers in industrial, academic, and government positions.

Please note that this handbook a living document, which will be frequently updated. The requirements for our graduate degrees are summarized in the Institute Catalog (www.catalog.gatech.edu) and this document supplements, but does not supersede, the catalog requirements. Students and faculty are encouraged to make the Graduate Program office aware of mistakes or confusing passages in this document, and to contribute ideas for the improvement of our program in any way.

Graduate Program Timeline

Year	Month(s)	Requirement, Milestone, or Event
1	August	Initial orientation, teaching assistant training
	Fall semester	Register for 6-9 credits of coursework (two or three classes) Register for CHEM 9000 (Doctoral Thesis), CHEM 8001 (Faculty Seminar), CHEM 8000 (Departmental Seminar), CETL 8000 (Graduate Teaching Assistantship Preparation) and CHEM 8997 (Teaching Assistantship, if you will be a Teaching Assistant that semester) Start work on research advisor identification by talking with faculty and their students.
	Aug. – Feb.	Research rotations with one or more research groups (optional but encouraged)
	Aug. – Oct.	CHEM 8001 (Faculty Seminar)
	October	Graduate student-faculty retreat (optional, but strongly encouraged)
	Nov. 15	Earliest date to submit paperwork to join a research group
	Spring semester	Register for 6 credits of coursework (two classes) CHEM 8002 (Resources Seminar) Register for CHEM 9000 (Doctoral Thesis), CHEM 8000 (Departmental Seminar), and CHEM 8997 (Teaching Assistantship, if you will be a Teaching Assistant that semester)
	Jan. – August	Literature exams
	Feb. 1	Deadline for selection of research group
	July 15	Deadline for assembly of a thesis advisory committee
	Summer	Register for CHEM 9000 (Doctoral Thesis) You should be fully integrated into your research group and initial project
2	Fall semester	Complete required coursework (if necessary) CHEM 7001 (Introduction to Research) CHEM 8003 (Student Seminar)
	October	Graduate student-faculty retreat (optional, but strongly encouraged)
	December 1	Report summarizing research to date due for CHEM 7001
	Jan. – May 15	Ph.D. candidacy exams
3	October	Graduate student-faculty retreat (optional, but strongly encouraged)
	Aug. – April	Annual meeting with thesis committee members
	May 15	Annual progress report due to thesis committee and grad program office
4	October	Graduate student-faculty retreat (optional, but strongly encouraged)
	Aug. – April	Annual meeting with thesis committee members
	May 15	Annual progress report due to thesis committee and grad program office
5	October	Graduate student-faculty retreat (optional, but strongly encouraged)
	May 15	If data review meeting has not yet occurred, annual progress report due to thesis committee and grad program office
	6-months prior to defense	"Data review" meeting with thesis committee approximately six months before expected Ph.D. thesis defense date, for the purpose of planning and approving the expected content of the thesis.
5.5		**Ph.D. thesis seminar and defense (Average duration of Program is 5.5 years)**

CHANGES FROM PREVIOUS EDITION

Course list updated
The list of graduate courses offered has been updated (section 3) to reflect recent additions.

Some CHEM 4XXX courses can be used towards an MS degree
Up to 6 hours of CHEM 4XXX courses, from a list specified in the catalog and section 4 of this document, can be used to towards the requirements of both the thesis and non-thesis MS.

Seminar courses renumbered
CHEM 8001 and 8003 are now used in place of special topics course numbers for two of the required seminar courses.

1. INTRODUCTION

This handbook has been prepared to acquaint graduate students in the School of Chemistry and Biochemistry at the Georgia Institute of Technology (Georgia Tech) with the regulations and procedures related to graduate study. It is intended to be a supplement, not a substitute, for other published material, such as the *Georgia Tech General Catalog*. Each graduate student should consult the catalog and this document for information. Questions about academic issues should be addressed to the Director of Graduate Studies, Dr. Kenyetta Johnson (Molecular Science and Engineering building, room 2222L; telephone 404-894-8227) or to the Associate Chair for Academic Programs, Prof. Angus Wilkinson (Molecular Science and Engineering building, room 1100J, telephone 678 595 6713).

1.1. Graduate Standing

Students who satisfy the entrance requirements (see *General Catalog*) as judged by the Graduate Admissions Committee, the School Chair, the Registrar, and the Vice Provost of Graduate Education and Faculty Affairs are admitted to full graduate standing.

A student whose academic background is deemed to be insufficient for admission with graduate standing, may be admitted as a non-degree seeking special student. These students will take courses to make up for the background deficiency and to demonstrate the ability to do effective work (GPA of at least 3.0 in approved lecture courses) before they may reapply for admission with full graduate standing. Graduate courses passed as a non-degree seeking student may be counted toward the degree requirements upon acceptance into a degree program. Students who wish to enroll for course work but not to pursue a program of study toward a graduate degree may be admitted as a special student upon approval of the Graduate Committee, the School Chair, the Registrar, and the Vice Provost of Graduate Education and Faculty Affairs. If subsequently accepted into a degree program, these students may petition for courses taken while they were a special student to be counted toward a graduate degree.

1.2. The Graduate Committee, Director of Graduate Studies, and the Graduate Programs Office

Academic issues related to graduate studies in the School of Chemistry and Biochemistry are handled by the Graduate Program Committee. The current composition of the committee can be found on the School's web site: www.chemistry.gatech.edu

Proposed programs of study to satisfy the PhD minor requirement, programs of study for M.S. degrees, petitions, and other requests for Graduate Committee action should be submitted, by email, to Dr. Kenyetta Johnson in the Graduate Programs Office. Please note the Institute deadlines for submission of degree petitions, which are posted on the Institute's graduate studies website: www.grad.gatech.edu.

Procedural issues related to graduate studies are handled by the Academic Programs Office located in Molecular Science and Engineering Office 2222L of the School of Chemistry and Biochemistry. Questions may be addressed to Dr. Kenyetta Johnson (Director of Graduate Studies).

2. ACADEMIC PROGRAM REQUIREMENTS

2.1. Registration

All full-time students are required to register for at least two approved lecture courses, which count towards the program of study for the Master's program or Ph.D. program, in their first semester and two in their second semester. Students are required to maintain a minimum grade point average of 2.70 for the M.S. and 3.00 for the Ph.D. program. Any student with a lower average will be advised to improve their GPA to the minimum required for their program in order to continue to receive financial aid. Students with an overall GPA below 2.70 in graduate chemistry lecture courses will not be allowed to continue graduate study beyond their first two academic semesters. The requirements for M.S. and Ph.D. degrees are outlined in Sections 4 and 5, respectively. Financial assistance in the form of a teaching or research assistantship requires maintenance of good standing (see Section 6).

All full-time graduate teaching and research assistants are required to register during Phase I for 21 credits (of which 12 must be on a letter-grade or pass/fail basis) in the fall and spring semesters and 16 credits (of which 12 must be on a letter-grade or pass/fail basis) during the summer semester. Schedules will consist of lecture, seminar, assistantship, and thesis hours.

- The number of lecture course hours will vary each semester.
- Students are required to register for CHEM 8000-Departmental Seminar (1 credit, Thursdays from 3:30 – 4:30 pm unless noted otherwise) during Fall and Spring Semesters until admitted to Ph.D. candidacy
- Teaching Assistants will register for 3 credits of CHEM 8997-Teaching Assistantship (if applicable).
- In Fall of the first year, all students will register for CETL 8000, Graduate Teaching Assistantship Preparation (1 credit)
- The remaining hours will be designated as thesis work (CHEM 7000-Masters Thesis or CHEM 9000-Doctoral Thesis).

2.2. Transfer and Advanced Standing Credit

Students requesting the use of credit for graduate courses taken at other institutions must petition the graduate committee within the first month of residence at Georgia Tech. The amount of credit that can be transferred, and the way in which it is transferred depends on the program of study (MS see Section 4.5; Ph.D., see Section 5.4) and performance on courses at Georgia Tech in the first semester of residence.

Students who have taken an advanced undergraduate course, that covers material at the same level as a regular graduate course offered in the School of Chemistry and Biochemistry, may apply to take an examination for advanced standing.

2.3. Research Rotations

Although not a required component of the graduate program, students are encouraged to pursue rotations in up to three research groups during the fall semester of their first year of study. Research rotations are a great way to get to know specific research areas, faculty members, and their research groups prior to selecting a primary research advisor. Students interested in research rotations should directly contact the respective faculty members and inquire about available space.

2.4. Choosing a Research Advisor (to be completed by Feb. 1 of the first year)

Students entering in the summer or fall semesters must enroll in CHEM 8001 (fall semester). This course, which is graded based on attendance, offers an overview of research programs, presented by faculty members in the form of short lectures, and will aid you in identifying a research advisor. Students should also arrange meetings with several individual faculty members to discuss specific research projects and their expectations. The student must select a research advisor by February 1st. A student should submit an *application* to join a research group between November 15th and February 1st. *Acceptance into a research group is contingent on space and resource availability. Final approval for joining your preferred research group is given by the School Chair.*

Descriptions of faculty research interests and activities are available on departmental web pages. These may not be completely up to date, so you are encouraged to have conversations with faculty and current group members, and to examine recent publications. Students may join research groups headed by Georgia Tech faculty members who do not have a funded appointment in the School of Chemistry and Biochemistry. For faculty members with adjunct status in the School of Chemistry and Biochemistry (SoCB) (these individuals are listed on the SoCB web page as faculty members), a co-advisor is not required. However, students must have a co-advisor with a paid appointment in the School of Chemistry and Biochemistry if the primary advisor has no appointment in the School of Chemistry and Biochemistry. Note also that prior approval by the Director of the Graduate Programs and the School Chair is required.

2.5. Honor Code and Proper Ethical Conduct

Students are expected to comply with the Georgia Tech Honor Code and display professional ethical conduct in all of their interactions with other people, and during the design, execution and publication of research. A copy of the Honor Code is available via the *Georgia Tech General Catalog* In addition, general guidelines for professional behavior can be found at "Ethical & Professional Guidelines - American Chemical Society (acs.org)" and those specifically pertaining to publication can be found at http://pubs.acs.org/page/policy/ethics/index.html. Plagiarism is the act of using another person's work or ideas and misrepresenting this information as your own. It is a serious offense that violates the Honor Code at Georgia Tech. In order to familiarize yourself with plagiarism and academic misconduct, you may visit the following website for examples: https://policylibrary.gatech.edu/student-life/student-code-conduct, https://wts.indiana.edu/writing-guides/plagiarism.html Proper ethical conduct also includes making the environment conducive to excellence for all. Accordingly, all students are expected to treat everyone on campus with respect.

3. GRADUATE COURSES

All courses are 3 credits L/G, P/F or audit unless noted otherwise.
A complete listing of graduate courses in chemistry can be found in the institute catalog.
https://catalog.gatech.edu/coursesaz/chem/
A summary of the frequently offered graduate chemistry course can be found on the School's graduate course web page https://chemistry.gatech.edu/graduate-courses

The following list shows courses that have been offered in recent years.

CHEM 6170	Inorganic Chemistry I
CHEM 6171	Inorganic Chemistry II (Energy Conversion)
CHEM 6172	Physical Methods in Inorganic Chemistry
CHEM 6181	Chemical Crystallography
CHEM 6182	Chemistry of the Solid State
CHEM 6183	Organometallic Chemistry
CHEM 6271	Analytical Chemistry I
CHEM 6273	Analytical Techniques for Chemistry and Biology
CHEM 6281	Mass Spectrometry
CHEM 6288	Analytical Separations
CHEM 6370	Organic Reaction Mechanisms
CHEM 6371	Identification of Organic Compounds
CHEM 6372	Physical Organic Chemistry
CHEM 6373	Organic Synthesis
CHEM 6381	Advanced Organic Synthesis
CHEM 6472	Quantum Chemistry and Molecular Spectroscopy
CHEM 6481	Statistical Mechanics
CHEM 6485	Computational Chemistry
CHEM 6491	Quantum Mechanics
CHEM 6492	Molecular Spectroscopy
CHEM 6501	Biochemistry I
CHEM 6502	Biochemistry II
CHEM 6571	Enzymology and Metabolism
CHEM 6572	Macromolecular Structure
CHEM 6573	Molecular Biochemistry
CHEM 6581	Protein Crystallography
CHEM 6582	Biophysical Chemistry

Note that CHEM 67XX courses are cross listed with courses from other schools

CHEM 6750	Polymer Synthesis (cross-listed with Materials Science and Engineering)
CHEM 6751	Physical Chemistry of Polymer Solutions (cross-listed with Materials Science and Engineering)
CHEM 6752	Polymer Characterization (cross-listed with Materials Science and Engineering, 4 credits)
CHEM 6755	Theoretical Chemistry of Polymers (cross-listed with Materials Science and Engineering)
CHEM 6757	Advanced Polymer Chemistry
CHEM 6760	Biocatalysis and Metabolic Engineering
CHEM 6762	Protein Engineering
CHEM 6765	Drug Development
CHEM 6785	Nanoscale Science and Technology
CHEM 7000	Masters Thesis (1-21 credits, P/F)
CHEM 7001	Introduction to Research (3 credits, L/G)
CHEM 8000	Seminar (1 credit, P/F)
CHEM 8001	Faculty Seminar (2 credits, P/F)
CHEM 8002	Information Resources for Chemists and Biochemists (2 credits, P/F)
CHEM 8003	Student seminar (2 credit, L/G)
CHEM 8801	Special Topics (1 credit)
CHEM 8802	Special Topics (2 credits)
CHEM 8803	Special Topics (3 credits)
CHEM 8813	Special Topics in Inorganic Chemistry (3 credits)
CHEM 8823	Special Topics in Analytical Chemistry (3 credits)
CHEM 8833	Special Topics in Organic Chemistry (3 credits)
CHEM 8843	Special Topics in Physical Chemistry (3 credits)
CHEM 8853	Special Topics in Biochemistry (3 credits)
CHEM 8873	Special Topics in Polymer Chemistry (3 credits)
CHEM 8901	Special Problems (variable credit)
CHEM 8902	Special Problems (variable credit)
CHEM 8903	Special Problems (variable credit)
CHEM 8997	Teaching Assistantship (1-9 credits, P/F)
CHEM 8998	Research Assistantship (1-9 credits, Audit)
CHEM 9000	Doctoral Thesis (1-21 credits, P/F)

4. REQUIREMENTS FOR THE M.S. DEGREE

4.1. Introduction

This section is a summary of the requirements for the M.S. More details are given in later sections of the *Graduate Handbook.*

There are two paths within our M.S. degree program: Thesis Option and Non-Thesis Option.

4.2. Requirements for the M.S. (Thesis Option)

- 12 credits (four 3-credit courses, L/G) in an area of specialization (see Major areas for Ph.D. program, Section 5.1).
- 6 credits (two 3-credit courses, L/G) in a second area of specialization (see Major areas for Ph.D. program, Section 5.1).
- 6 credits approved electives, including any course from the listed areas of specialization (see Major areas for Ph.D. program, Section 5.1) and seminar courses. A maximum of 3 credits can be on pass-fail basis.
- 6 credits of Masters Thesis (CHEM 7000)
- Completion of a thesis describing original research

Note: All coursework and seminars required for the program of study must be completed within the first two years of study. Also, see Section 2 for Information about minimum academic requirements for graduate standing.

Up to 6 hours of 4000 level credit, at a grade of B or above, can be used toward this degree from the following list of courses: CHEM 4113, CHEM 4311, CHEM 4341, CHEM 4401, CHEM 4452, CHEM 4485, CHEM 4521, CHEM 4740, CHEM 4759, CHEM 4760, CHEM 4762, CHEM 4765, CHEM 4775, CHEM 4776, and CHEM 4785. CHEM 4XXX special topics courses will be considered on a case by case basis. CHEM 4XXX and CHEM 6XXX courses that are largely equivalent can't both be counted.

For the M.S. degree (thesis option), the student must demonstrate the ability to conduct independent research as shown by the completion of high-caliber research, which should result in publication. This research will form the basis for the M.S. thesis.

Upon selection of a research topic, the student must file a "Request for Approval of Master's Thesis Topic" (see www.grad.gatech.edu). The form consists of a dissertation title and brief formal statement describing the thesis research.

The research thesis must be written while enrolled at Georgia Tech. The candidate must present a document presenting, in good English, the results of an investigation directed by a member of the faculty of the School of Chemistry and Biochemistry. The form of the thesis is described in the Thesis and Dissertation Manual, available from the Graduate Education Office (see www.grad.gatech.edu). A draft of the thesis should be submitted to the Thesis Reading Committee **at least 14 days** before graduation. The thesis reading committee must have at least three members, the majority of whom must be faculty in the School of Chemistry and Biochemistry.

4.3. Requirements for the M.S. (NON-Thesis OPTION)

- 12 credits (four 3-credit courses, L/G) in an area of specialization (see Major areas for Ph.D. program, Section 6.1).
- 6 credits (two 3-credit courses, L/G) in a second area of specialization (see Major areas for Ph.D. program, Section 6.1).
- 3 credits (one 3-credit courses, L/G) in any area of specialization (see Major areas for Ph.D. program, Section 6.1).
- 9 credits of approved free electives, which may include any course from the listed areas of specialization (see Major areas for Ph.D. program, Section 6.1), CHEM 7001, 8000, 8001, 8002, 8003, 8901, 8902, or 8903. A maximum of 3 credits on pass-fail basis may be used.

Note: All coursework and seminars required for the program of study must be completed within the first two years of study. Also, see Section 2 for Information about minimum academic requirements for graduate standing.

Up to 6 hours of 4000 level credit, at a grade of B or above, can be used toward this degree from the following list of courses: CHEM 4113, CHEM 4311, CHEM 4341, CHEM 4401, CHEM 4452, CHEM 4485, CHEM 4521, CHEM 4740, CHEM 4759, CHEM 4760, CHEM 4762, CHEM 4765, CHEM 4775, CHEM 4776, and CHEM 4785. CHEM 4XXX special topics courses will be considered on a case by case basis. CHEM 4XXX and CHEM 6XXX courses which are largely equivalent can't both be counted.

4.4. Transfer of Credit for the M.S. Program

Students may request transfer of credit for graduate courses taken at other US or Canadian institutions that were not used to satisfy degree requirements at that institution. Requests must be made within the first month of residency at Georgia Tech. A maximum of 6 credits may be transferred. Students may petition the graduate committee to take other courses for which they are adequately prepared by "Advanced Standing".

4.5. Required Forms

Candidates for the M.S. degree must file a "Petition for Degree" (available from the Registrar's Office) with the Registrar by the required Institute deadlines (see www.registrar.gatech.edu). Students who do not complete their requirements and graduate when anticipated must file an extension to postpone their graduation to the following semester.

Upon completion of the M.S. degree program, or upon termination of the program for any reason, the student is expected to meet with the Director of Assessment of the School of Chemistry and Biochemistry for an exit interview. For more information, see:

https://chemistry.gatech.edu/graduate-academic-forms

All students are required to complete a clearance form prior to departure:
http://www.chemistry.gatech.edu/academics/graduate-academic-forms

5. REQUIREMENTS FOR THE Ph.D.

5.1. Introduction

This section is a summary of the requirements for the Ph.D. program. More details are given in later sections of the *Graduate Handbook.*

The Ph.D. program in Chemistry and Biochemistry requires successful completion of five courses with a satisfactory grade point average, a series of seminar courses, the Ph.D. candidacy examination, and defense of a thesis describing original research.

- Students must complete a total of five 3-credit hour classes chosen from at least two different specializations, and at least two of the classes must be designated core courses (see section 5.2). These are the courses designated as "Coursework from areas of specialization" (6 credits) and "Doctoral Minor" (9 credits) in the Institute Catalog.
- A series of seminars must be completed (CHEM 8000, 8001, 8002, 8003)
- CHEM 7001 "Introduction to Research" must be completed
- In addition to above courses and seminars, Ph.D. candidates must complete:
    - a series of literature exams (administered throughout spring and summer of the first year)
    - a Ph.D. candidacy exam following completion of the literature exam requirement, and no later than the beginning of the third year.
    - annual written progress reports describing the original research
    - annual meetings with the thesis advisory committee
    - a data review 6 months prior to thesis defense
    - a defense of the thesis describing original research

5.2. Coursework

Doctoral students must complete a series of five courses. The course selection must cover at least two different specializations, and at least two of the courses must be designated core courses as defined below for each specialization. All five courses must be completed with an A or B letter grade to satisfy the requirements for PhD candidacy (see also section 5.3).

The courses are organized within six specializations, each of which includes designated core courses as well as a series of electives. In addition to the courses offered by the School of Chemistry and Biochemistry, students may also propose graduate courses from other departments as electives; however, such proposals must be approved by the graduate program committee in advance of the respective course registration deadline. A list of example course combinations is provided in Section 5.15.

Specialization:

1. Inorganic Chemistry

Core Courses	Electives
CHEM 6170 Inorganic Chemistry I CHEM 6172 Physical Methods in Inorg. Chemistry	CHEM 6171 Inorganic Chemistry II [#] CHEM 6181 Chemical Crystallography CHEM 6182 Chemistry of the Solid State CHEM 6183 Organometallic Chemistry CHEM 8813 Special Topics in Inorganic Chemistry

[#] CHEM 6170 prerequisite

2. Analytical Chemistry

Core Courses	Electives
CHEM 6271 Analytical Chemistry I CHEM 6281 Mass Spectrometry	CHEM 6273 Analytical techniques for chemistry and biology CHEM 6288 Analytical Separations CHEM 8823 Special Topics (Proteomics by Prof. Torres, Metabolomics by Prof. Fernandez)

3. Organic Chemistry

Core Courses	Electives
CHEM 6370 Organic Reaction Mechanisms CHEM 6372 Physical Organic Chemistry # CHEM 6371 Identification of Organic Compounds	CHEM 6373 Organic Synthesis [#] CHEM 6381 Advanced Organic Synthesis CHEM 6382 Comp. Methods in Org. Chem. CHEM 8333 Special Topics in Organic Chemistry

[#] CHEM 6370 prerequisite

4. Physical Chemistry

Core Courses	Electives
CHEM 6481 Statistical Mechanics or CHEM 6755 Theoretical Chemistry of Polymers CHEM 6491 Quantum Mechanics or CHEM 6472 Quantum Chemistry and Molecular Spectroscopy	CHEM 6471 Chem. Thermodynamics and Kinetics CHEM 6482 Chem. Kinetics and Reaction Dynamics CHEM 6483 Chemistry of Electronic Materials CHEM 6484 Optical Organic Materials CHEM 6485 Computational Chemistry CHEM 6492 Molecular Spectroscopy CHEM 8843 Special Topics in Physical Chemistry

5. Biochemistry

Core Courses	Electives
CHEM 6571 Enzymology and Metabolism CHEM 6572 Macromolecular Structure CHEM 6573 Molecular Biochemistry	CHEM 6501 Biochemistry I CHEM 6502 Biochemistry II CHEM 6581 Protein Crystallography CHEM 6582 Biophysical Chemistry CHEM 6583 Drug Design and Discovery CHEM 6584 Contemporary Biochemistry CHEM 6756 Signaling Molecules CHEM 6760 Biocatalysis and Metabolic Engineering CHEM 8853 Special Topics (Bioinorganic Chem.)

6. Polymer Chemistry

Core Courses	Electives
CHEM 6750 Preparation and Reaction of Polymers	CHEM 6751 Phys. Chemistry of Polymer Solutions *
CHEM 6752 Polymer Characterization *	CHEM 6757 Advanced Polymer Chemistry
	CHEM 8873 Special Topics in Polymer Chemistry

* CHEM 6750 (or equivalent) prerequisite

5.3. GPA Requirements

- Students must have a GPA greater than 2.50, based on two or more classes, after the first semester in order to take literature exams. Students with a GPA of less than 2.50 after the first semester may not continue in the Ph.D. program without approval of the graduate committee.
- Grades of "C" do not count toward the five-course requirement for the Ph.D. program. Students earning a "C" will therefore have to take additional coursework according to the rules outlined in Section 5.2.
- Students must have a GPA of greater than 2.70, based on four or more classes, at the end of the second semester in order to continue in the Ph.D. program. Students with a GPA of less than 2.70 may not continue in the Ph.D. program without approval of a written petition to the graduate committee.
- **Georgia Tech has a minimum cumulative GPA requirement of 3.00 for a PhD degree.**

5.4. Transfer of Credit for the Ph.D. Program

Students may request transfer of credit for graduate courses taken at other US or Canadian institutions within the first month of residency at Georgia Tech. Credit will only be transferred if a student completes three courses during the first semester of residence. All three courses must fulfill the selection requirements as outlined in Section 5.2, and must be passed with an A or B letter grade. A maximum of 6 credits may be transferred. Students may petition the graduate committee to take other courses for which they are adequately prepared by "Advanced Standing" (see:http://www.catalog.gatech.edu/academics/undergraduate/credit-tests-scores/advanced-standing/).

5.5. Required Seminar Courses

Students in the Ph.D. program must complete a series of seminar courses (CHEM 8001-2-3) and CHEM 7001 during the first three semesters in residence (excluding summer), and register for the departmental seminar (CHEM 8000) *every* semester, except summer.

CHEM 7001: Introduction to Research (3 cr., second Fall, L/G)

CHEM 8000: Seminar (1 cr, repeatable, P/F)
This course counts as 1 credit and is administered on a pass/fail basis. The grade for this course will be based on attendance at Departmental Seminars. All graduate students without candidacy are required to attend these seminars on Thursday afternoons. For a detailed schedule, please visit the departmental webpage.

CHEM 8001: Faculty Research Seminar (2 cr, first Fall, P/F)
Students will enroll in CHEM 8001 (Faculty research seminar) during the fall semester of their first year. The purpose of this course is to aid students with advisor selection by offering an overview of research projects in the School of Chemistry and Biochemistry.

CHEM 8002: Information Resources for Chemists and Biochemists (2 cr, first Spring, P/F)
Students will enroll in CHEM 8002 during the spring semester of their first year. The purpose of this course is to introduce students to topics such as responsible conduct of research (RCR training), scientific ethics, chemical safety, intellectual property, career opportunities, diversity issues, and research proposal development.

CHEM 8003: Student Seminar (3 cr, second Fall, L/G)
All graduate students will enroll for CHEM 8003 (Student seminar) during the fall semester of their second year. This course consists of a series of seminars, which are presented by students on topics from the recent literature and their own research. The course must be passed with an A or B grade. Students obtaining a lower grade will be required to retake the seminar in the following year.

5.6. Ph.D. Literature Examinations (to be completed by the end of the second year)

Students begin literature exams in January of the first year, but only if they have successfully completed at least two graduate classes during their first semester with a GPA of greater than 2.50 (unless approved otherwise by the Graduate Committee). A total of eight literature exams will be given from January through August. Each two-hour exam will be based on reading assignments from the recent research literature, which will be posted two weeks before the scheduled exam date. A different faculty member writes the exam for each topical area. *Exam questions will evaluate the student's ability to critically assess data and information in the reading assignments and, also, test a student's understanding of fundamental concepts relevant to the topics at hand.* To avoid conflicts with classes and teaching assignments, all exams will be scheduled during evening hours.

Reading assignments and examinations will be offered for each traditional subdiscipline (analytical, biochemistry, inorganic, organic, physical). Each exam will be graded on a 0 - 4 scale. A student must accumulate 16 points from 8 or fewer consecutive exams to successfully complete the requirement. Only those students who successfully complete the literature examination requirement can proceed to the Student Seminar and Ph.D. candidacy examination requirements.

Students are allowed to take only one test during each exam period. To ensure fairness in grading, the exams will be coded so that the identity of the person submitting the exam is unknown to the grader. Unexcused absences from an examination will result in a grade of zero. If absent for an excusable reason, a student may petition, in writing, the Graduate Committee for special consideration.

If a re-grade is desired, students have one week after the return of the graded exam to file a formal request with the Academic Programs Office. This written request should clearly and concisely address each question that is being considered for a re-grade. Because the grading (and re-grading) of these exams is done in a "blinded" fashion (student names are not known to the examiner), students must not communicate directly with the professor of record for the exam during the re-grade period. All literature grades are final after the re-grade period.

Any student who is mathematically eliminated from successfully completing the literature examination requirement will be notified and will not be allowed to take the remaining examinations. The student will have the opportunity to take additional courses and a second attempt to pass the literature exam requirement in the following academic year. Note that in such cases, the student will also be expected to complete the other requirements, including the Ph.D. candidacy examination, during the semester after successful completion of the literature exam requirement.

5.7. Appointment and Composition of the Ph.D. Advisory Committee

A Ph.D. advisory committee must be appointed for each student by July 15th in the first year of graduate study. The committee will consist of:

(i) Three members of the academic faculty in the School of Chemistry and Biochemistry (i.e., tenured or tenure-track; NOT adjunct). This includes the student's principal research advisor

(ii) One member of the academic faculty from a Ph.D. or MD granting department, at any accredited university, with no appointment (other than adjunct) in the School of Chemistry and Biochemistry.

(iii) One of the following: a member of the academic faculty from the School of Chemistry & Biochemistry, a Principal Research Scientist from the School of Chemistry & Biochemistry, a member of the academic faculty or a Principal Research Scientist from another school at the Georgia Institute of Technology, or a Ph.D.-level staff member from another research organization (GTRI, IPST, industry, national laboratory, or Ph.D. or MD granting academic department, etc.) who has been involved in collaborative research described in the student's thesis.

Other, non-voting, members of the committee may be appointed IN ADDITION to the five voting members identified above. Students are required to submit names of their thesis committee members for approval by July 15 via email to the Academic Programs Office (email: kenyetta.johnson@chemistry.gatech.edu). As required by Institute regulations, the School's Graduate Committee will review and approve the composition of the thesis committees.

Students should consult with their research advisors regarding the selection of people for their thesis committee, and the final composition of the committee must be agreed to by both the student and the advisor. The committee's responsibilities are to the School and Institute (to provide oversight so as to help maintain standards of performance and ethics appropriate to the granting of

the Ph.D. degree) and to the student (to provide guidance, independent scientific perspective, and advocacy in the student's best interests in the event of a dispute with the research advisor).

5.8. Transfer to the M.S. Program

A student may be transferred to the M.S. program at the end of their first year if their GPA is less than 3.00 or if fewer than four lecture courses were successfully completed towards fulfilling the Ph.D. program requirements. A student who fails the literature exam requirement a second time will be also transferred to the M.S. program. These conditions also affect eligibility for support as a graduate assistant (see Section 6.2).

5.9. Ph.D. Candidacy Examination

To be completed within two semesters of completing literature exams (i.e., normally by the end of the fifth semester). The examination should be scheduled with the committee at least three months in advance.

The Ph.D. Candidacy Examination consists of a document and oral presentation presenting: (I) a review of research progress to date (Review of Initial Research) and a Thesis Proposal (Sections A-E below), and (II) an Original Proposal (Sections F-H below). The proposals must describe the investigation of phenomena and the acquisition of new knowledge, or the solution of a significant problem. The proposals must be based on the scientific method.

The Ph.D. candidacy documents and presentations should reflect the student's mastery of the current literature, strengthened by scientific judgment arising from research experience and interactions with colleagues. The committee's evaluation will be based on a rating of research work completed to date; mastery of the background, design, and potential pitfalls of the project; and demonstrated understanding and application of fundamental principles of chemistry.

The required materials (hard copy and electronic files) along with a copy of the student's GT transcript and resume should be submitted to the examination committee at least one week before the oral presentation. The documents should use the following headings. The length of each section is *suggested.* The entire proposal should be no longer than 15 pages, excluding references.

I. REVIEW OF INITIAL RESEARCH AND THESIS PROPOSAL

A. Background and introduction to the thesis project (2-3 pages)
   What are the key questions arising from recent literature in the field of the thesis topic? What other approaches are currently being explored by other researchers?
B. Hypothesis/Aims (0.5 page)
   Given the background in section A, delineate 2-3 Specific Aims for your thesis project. For each aim, state a hypothesis and briefly outline your approach to test the hypothesis.
C. Significance of the thesis project (0.5 page)
   If your thesis project works, why would it be significant?
D. Preliminary results (3-4 pages)
   This section should offer an overview of your progress towards achieving the stated goals, including a brief discussion of your results.

E. Research Plan (2-3 pages)
For each of your aims, outline a research plan that describes how the stated goals will be achieved. What is your experimental approach to addressing each specific aim? What results might you expect and in what way would they support the hypothesis? What other possible outcomes are there and how would these modify your hypothesis (i.e., what do we learn if this approach fails?)
F. Literature References

II. ORIGINAL RESEARCH PROPOSAL

The original research proposal may be in the same general field as the thesis topic, thus building on the same background. In this case, *the goals of the proposal should be significantly different from the aims of the thesis project (and other research being conducted at Georgia Tech)*. Alternatively, the student may choose to develop a proposal in a different research area. In the former case, the committee will expect a higher level of mastery of the background concepts and literature.

The proposal document should be structured as outlined above for the research review and thesis proposal, but without section D (preliminary results):

A. Background and introduction (2-3 pages)
B. Hypothesis/Aims (0.5 page)
C. Significance (0.5 pages)
D. Research Plan (2-3 pages)
E. Literature References

III. ORAL EXAMINATION PROCEDURE

The examining committee chair will be chosen by the committee in consultation with the student, either before the candidacy examination or at the beginning of the meeting; the research advisor cannot be chair. The advisor is not required to attend the candidacy examination meeting. If absent, the advisor will provide a confidential written memo to the committee with an evaluation of the student's progress, strengths, and weaknesses. If the advisor does attend, those remarks can be delivered in person. The student may use any standard visual aid, including slides, for the presentations to the committee.

The examination will proceed as follows:

1) The student will be asked to leave the room so that the committee can briefly prepare for the meeting and review or receive the advisor's pre-exam remarks. Other than these remarks, and the committee's discussion of the student's performance at the conclusion of the exam, the advisor is to be an observer of the proceedings and not a participant.
2) The student will be invited back into the room and, if present, the advisor will be asked to leave so that the committee can ask the student for their thoughts on how their research experience to date has been.
3) The advisor, if participating, will be invited back into the room.

4) The student will present a review of the research project, including background, justification, and progress. This presentation should be designed to take no longer than 30 minutes if delivered without interruption; however, students should anticipate being interrupted with questions throughout. One hour will typically be allocated to this part of the exam.
5) The student will then present the original research proposal, again in a manner designed to review the background, importance, previous results in the literature, and proposed studies. Again, the presentation should take no more than 30 minutes, with an hour overall allocated to this presentation and discussion.
6) The student will then leave the room and the committee will come to a decision. The possible outcomes are:
   (i) Pass
   (ii) Provisional Pass - with *minor* clarifications to be submitted within a period specified by the committee, usually within two weeks
   (iii) Provisional Fail - The committee may request to have the student prepare a new presentation, which must be completed by the end of the following semester.
   (iv) Fail - Transfer to the M.S. program.

7) In consultation with the committee, the committee chair will submit a confidential written evaluation of the student's performance on the exam, along with the recommendations of the committee, to the Graduate Program Office within two weeks of the exam date.
8) Members of the committee will complete a rubric-driven evaluation of the student's performance on the different components of the candidacy exam, for the student's benefit, and for program assessment purposes.

Any student who fails to fulfill this requirement by the end of the spring semester after the completion of literature exams (and has not petitioned the graduate committee for a deferment) will receive a "fail" on their first attempt and may be required to take classes to complete the non-thesis M.S. degree.

5.10. Annual Progress Reports

Upon successful completion of the Ph.D. candidacy examination, students are required to submit a progress report and present their results to their thesis committee by December 1 of each year, starting with year 3 in residence. The responsibility for completing this requirement on time each year rests with the student; note that scheduling should not be left to the last minute.

The written report (3-5 pages) should summarize the achievements and progress made towards completion of the research goals and offer a brief overview of future work. Copies of peer-reviewed publications that resulted from the thesis work should be provided as an appendix.

The oral presentation to the thesis committee should include a brief introduction to the thesis topic, a statement of the specific aims and hypotheses, an overview of the current achievements, and a brief outlook on future work. A minimum of three committee members must be present for this meeting. The student will not be required to leave the room after the presentation for committee

discussion. The chair of the committee will also give the student an opportunity to talk with committee members in the absence of the research advisor.

Students who will be giving an oral presentation of their work at the annual graduate research retreat are not expected to meet with their thesis committee during the same year, but are still required to submit a written progress report.

5.11. Data Review (~6 months prior to graduation)

To be completed or scheduled prior to completion of the Online Application to Graduate-OAG (approximately 6 months before graduation, deadline set by the Registrar's office. See www.registrar.gatech.edu). The review should be scheduled with the committee at least three months in advance. It is highly recommended that the complete committee is assembled for the purpose of this review.

The purpose of this written and oral review is for the committee and student to determine what further work should be performed to complete the thesis. It generally takes place 6 months before the Thesis Defense, prior to petitioning for the Ph.D. degree. The student should provide the Thesis Committee with the following one week ahead of the review: (i) an outline of the thesis (a proposed table of contents), (ii) a brief written summary of results (often in the form of published, submitted or in-progress manuscripts, and/or a short summary of unpublished results), and (iii) an outline of experiments proposed to complete the thesis. It is recommended that the remaining proposed work be grouped into three categories: (a) what must be completed for the thesis to be viable, (b) what would be good to complete, but is not absolutely essential, and (c) additional results that would add to the work, but are not expected to be achievable before completion of the thesis.

5.12. Petition to Graduate (see Institute deadlines)

Candidates for the Ph.D. degree must file an "Online Application for Graduation-OAG" available at www.registrar.gatech.edu by the Institute deadlines. Additional forms and deadlines can be found at the GT graduate office website: www.grad.gatech.edu

5.13. Thesis Defense

For the Ph.D. degree, students must demonstrate the ability to conduct independent research, as shown by the accomplishment of a considerable amount of high-caliber work *that results in publications in the peer-reviewed scientific literature*. The student is expected to contribute to the conceptual as well as the experimental aspects of the investigation.

The research thesis or dissertation must be written while enrolled at Georgia Tech. The thesis defense takes the form of an open seminar followed by a closed session with the thesis committee; at least 4 of the 5 thesis committee members must be present, in person or on-line, during the defense. The student must be enrolled during the semester in which the final doctoral examination is performed.

Guidelines for the final doctoral examination are described in the Manual for Graduate Theses, available from the Division of Graduate Studies and Research (see www.grad.gatech.edu). A copy

of the Ph.D. thesis should be provided to the committee **two weeks prior** to the final doctoral examination date.

Students must notify Dr. Kenyetta Johnson in the Academic Programs Office of their thesis defense presentation by submission of a "Thesis Defense Announcement" via email *two weeks prior to the defense*. The announcement will be released via the Academic Programs Office to the department and a copy will be sent to the Georgia Tech Graduate Office. Please format the announcement as follows (example below):

Mr./Ms. First and Last Name

Thesis Title: "XYZ"

Thursday, May 18th, 2017 at 1:00 PM
Location

Committee Members:
Prof. XYZ (Advisor) - School of Chemistry and Biochemistry
Prof. XYZ- School of Chemistry and Biochemistry
Prof. XYZ- School of Chemistry and Biochemistry
Prof. XYZ- School of Chemistry and Biochemistry
Prof. XYZ- School of …….

5.14. Exit Interview/Clearance Form

Upon completion of the Ph.D. degree program, the student is expected to meet with the Director of Assessment of the School of Chemistry and Biochemistry for an exit interview. In addition, all students are required to complete a clearance form prior to departure – see https://chemistry.gatech.edu/graduate-academic-forms.

5.15. Suggested Course Selections for Different Areas of Research Emphasis

The course work requirements of the PhD program in the School of Chemistry and Biochemistry allow for a high degree of flexibility to best match individual interests of students and align with their research projects. Organized along specific research themes, the following course combinations may serve as examples to guide students with their course selections. This section will be updated frequently: students are encouraged to contribute suggestions.

Example Research Themes:

Inorganic and Organometallic Chemistry

Core Courses	Electives
CHEM 6170 Inorganic Chemistry I	CHEM 6183 Organometallic Chemistry
CHEM 6172 Physical Methods in Inorganic Chemistry	CHEM 6171 Inorganic Chemistry II
CHEM 8833 Organic Reaction Mechanisms	

Inorganic Materials

Core Courses	Electives
CHEM 6170 Inorganic Chemistry I	CHEM 6182 Solid State Chemistry
CHEM 6172 Physical Methods in Inorganic Chemistry	CHEM 6181 Crystallography
	MSE 6110 Transmission Electron Microscopy

Bioinorganic Chemistry

Core Courses	Electives
CHEM 6170 Inorganic Chemistry I	CHEM 6582 Biophysical Chemistry
CHEM 6572 Macromolecular Structure	CHEM 8853 Bioinorganic Chemistry
CHEM 6573 Molecular Biochemistry	

Chemical Ecology

Core Courses	Electives
CHEM 6370 Organic Reaction Mechanisms	CHEM 6756 Signaling Molecules
CHEM 6371 Identification of Organic Compounds	BIOL 6620 Aquatic Chemical Ecology
	BIOL 6417 Marine Ecology

Biomedical Informatics

Core Courses	Electives
CHEM 6281 Mass Spectrometry	MATH 6267 Multivariate Statistical Analysis
CHEM 6573 Molecular Biochemistry	BMED 6517 Machine Learning in Biosciences
CHEM 6273 Analytical techniques for chemistry and biology	CS 7540 Spectral Algorithms and Representations

Synthetic Organic Chemistry

Core Courses	Electives
CHEM 6370 Organic Reaction Mechanisms	CHEM 6373 Organic Synthesis
CHEM 6372 Physical Organic Chemistry	CHEM 6183 Organometallic Chemistry
CHEM 6371 Identification of Organic Compounds	

Molecular Immunology

Core Courses	Electives
CHEM 6572 Macromolecular Structure	BIOL 6570 Immunology
CHEM 6573 Molecular Biochemistry	CHEM 6571 Enzymology and Mechanism

6. FINANCIAL ASSISTANCE AND EMPLOYMENT OPPORTUNITIES

6.1. Teaching and Research Assistantships

Graduate students in the School of Chemistry and Biochemistry are financially supported either as Graduate Teaching Assistants (GTAs) or Graduate Research Assistants (GRAs), or through external fellowships that they have been awarded (NSF GRFP, Gates Foundation, etc.). Entering graduate students are usually supported as GTAs. Their duties can consist of laboratory supervision and instruction, proctoring of exams, presentation of recitation sessions, grading, office hours, and laboratory preparation. Teaching assignments are made by a school level committee charged with serving the best interests of our undergraduate program. Please see Appendix B: Guidelines for Graduate Teaching Assistants.

Students may be appointed to research assistantships, which permit them to conduct full-time research for their thesis while pursuing advanced studies. GRA stipends are the same as those for GTAs. Please see Appendix B: Guidelines for Graduate Research Assistants.

Students supported as Graduate Assistants (GTA or GRA), who are properly registered and making satisfactory progress towards their degree, receive a tuition exemption. These students are still required to pay Institute fees each semester. Teaching and research assistants are expected to perform their duties in a responsible and professional manner. Graduate teaching and research assistants are expected to review and comply with Georgia Tech's policy on harassment (https://policylibrary.gatech.edu/employment/equal-opportunity-nondiscrimination-and-anti-harassment-policy) and student sexual misconduct (https://policylibrary.gatech.edu/student-life/sexual-misconduct), and to generally treat everyone with whom they come in contact as part of their research, teaching, and training activities with respect.

6.2. Assistantship Requirements

Graduate students receiving financial assistance from the School of Chemistry and Biochemistry are required to register as full-time students, maintain good standing according to the Institute's academic standards (see www.registrar.gatech.edu), and make satisfactory progress towards their degree as outlined below:

1. Students must maintain good standing with the Institute. A student must maintain a GPA of 3.00 or greater in order to guarantee continuation of financial support.
2. Students must complete a minimum of four approved graduate classes by the end of the spring semester of their first year with a grade of B or higher, and complete any remaining classes required for the Ph.D. with a grade of B or higher by the end of their second year.
3. Students are required to attempt literature exams in January-August of their first year and successfully complete the literature examination requirement by the end of the second year.
4. Ph.D. students are required to take their candidacy examination by the end of the spring semester in their second year. Failing to pass this examination will result in transfer to the Master's program and possible loss of departmental support.
5. Students must maintain satisfactory grades and performance evaluations in research and teaching (see "Guidelines for Graduate Teaching Assistants"). Any student who receives

an unsatisfactory evaluation will receive a letter from the Chemistry and Biochemistry Academic Office placing them on review, outlining the deficiencies and indicating corrective actions that must be taken to remove the deficiencies. A second unsatisfactory evaluation will result in loss of departmental support and being dropped from the program.

6. By February 1 of the second semester, students must have identified a research advisor in the School of Chemistry and Biochemistry in order to register for classes each term and to receive financial support.
7. Students must complete Lab Safety 101 and right-to-know training requirements
8. Students must complete all the sponsor and Institute requirements for "Responsible Conduct of Research".
9. Support as a GTA may be limited to the first five years for Ph.D. candidates. Students who are beyond their fifth year of graduate study can only be appointed as a GTA upon approval by the School Chair, and such appointments may not be granted.
10. Support for students who elect to change from the Ph.D. program to the M.S. program, and remain in good standing, will be limited to the amount of time in which they can reasonably complete all of the requirements for the degree.
11. Exceptions to the above conditions may be requested based on demonstration of extraordinary circumstances by written petition to the Chemistry and Biochemistry Graduate Program Committee. The petition must include a letter of support from the student's thesis advisor and a demonstration of satisfactory progress toward degree objectives.

6.3. Fellowships

Students are strongly encouraged to apply for fellowships supported by the National Science Foundation, the National Institutes of Health, the John and Fannie Hertz Foundation, and other agencies. A list of science and engineering fellowships at Georgia Tech and elsewhere can be obtained at https://grad.gatech.edu/fellowship-opportunities. A student who has continuing fellowship support from external sources should be aware of any obligations to the external sponsoring agency. If the student is unable to fulfill the requirements of the fellowship during the period of accommodation they may be appointed as a Graduate Assistant at the regular assistantship level for that period. *https://finaid.gatech.edu/award-process/ gives Fellowship disbursement dates, tax information, and contact information for Financial Aid consultation.* ***If you receive a fellowship please contact the Director of Graduate Studies, Dr. Kenyetta Johnson.***

6.4. Loans

The Financial Aid Office, located in the Administration Building, can assist students in securing both short-term (emergency) and long-term loans.

6.5. External Employment

Teaching and Research Assistantships are awarded specifically to allow students to pursue full-time study towards the M.S. or Ph.D. degrees. Thus, students receiving financial assistance from the School of Chemistry and Biochemistry may not be employed elsewhere. In cases of financial hardship, a petition may be submitted to the Graduate Committee for waiver of this requirement. Written approval by the thesis advisor, showing that additional work will not interfere with the performance and duties or normal progress in the degree program, should accompany the petition. Failure to comply with this employment requirement will result in termination of departmental financial support.

6.6. Conference Travel Awards

Graduate students who have been accepted to present their work at an upcoming scientific conference or meeting can apply for funding assistance from several sources, including the Institute's Graduate Student Government (SGA) and from the College of Science (please see https://www.sga.gatech.edu/conferencefunds/) as well as from the department. (Students are eligible to receive one departmental travel award per fiscal year.) All of these funding sources are intended as a secondary source, to complement funds from the research advisor, or other sponsored funds, that do not cover all costs incurred for a trip. To apply for travel funding from the department, please contact Dr. Johnson.

APPENDIX A: Required forms

DOCUMENTATION OF ACCEPTANCE INTO A RESEARCH GROUP

School of Chemistry and Biochemistry, Georgia Institute of Technology

To the student: Selection of a research advisor requires attendance at the Faculty Seminar Series (CHEM 8001) in the Fall semester followed by discussion with individual faculty members. Complete this form with a faculty member and submit it to the Academic Programs Office by February 1.

Research Advisor Selection

I wish to accept _____(student's name)_ into my research program.

He/she will begin a research project in the area of : _____
(provide 3-5 word description)
This project is currently supported by: _____ *(provide funding agency)*
I expect to support him/her by the following means:
Upcoming Summer GTA / GRA worktag # _____
Upcoming Fall GTA / GRA worktag #_____

I have _____ students supported as GTAs in spring (excluding current first year students).
I expect to have __ students supported as GTAs for the upcoming summer semester.
I expect to have __students supported as GTAs for the upcoming fall semester.

Safety Training Requirements for Anticipated Research

In addition to the core first-year Graduate Safety Training Program (Information Security and Protection, Introduction to Chemical Safety, and Introduction to Lab Safety), this student will also complete the following Specialized Laboratory Safety Courses prior to the start of his/her research (selections will be reviewed for appropriateness by the School's Safety Committee).

CHECK ALL THAT APPLY

- ❒ Radioactive Materials
- ❒ Radiation producing equipment
- ❒ Laser safety
- ❒ General BioSafety
- ❒ Hazardous waste
- ❒ Shipment of Dangerous Goods

Leave blank	
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

*Signature and date*_____(*Student*)

*Signature and date*_____(*Research advisor*)

Approved / Declined

*Signature and date*_____*(School Chair)*

Core first-year Graduate Safety Training Program has been completed.

*Signature and date*_____(*School safety committee)*

Specialized Graduate Safety Training requirements have been completed.

*Signature and date*_____(*School safety committee)*

School of Chemistry and Biochemistry
Georgia Institute of Technology

COMPLETION OF DATA REVIEW

The thesis committee of _____ (student's name) has reviewed research to be included in the thesis, discussed remaining research goals, and approves the student's petition to graduate.

Signatures required:

_____, Thesis Advisor

_____, Chemistry

_____, Chemistry

_____, _____

_____, _____

To Student: Submit this form with your Petition to Graduate to the Academic Programs Office, MoSE 2222L by mid-semester of the semester prior to the semester in which you intend to graduate.

APPENDIX B. Guidelines for Teaching and Research Assistants

GUIDELINES FOR GRADUATE TEACHING ASSISTANTS

GTAs must communicate frequently and effectively with the supervising faculty member for their assigned course.

- You must provide a detailed schedule to your supervisor so that they can arrange meetings.
- Set a detailed schedule of your assigned lab, proctoring, and grading responsibilities.
- You must check your mailbox in the main office and your Georgia Tech email frequently for messages from your supervisor. You should also seek out your supervisor on a regular basis.
- You must attend all meetings arranged by your supervisor. Be punctual. Contribute to these meetings.
- Meet with your supervisor frequently, at least once per week.
- Be proactive: Ask your supervisor if there are any duties which need attention.

In all duties as a GTA, you must understand the material covered in the course. You must take measures to understand the material by reading the textbook, attending lectures and by discussion with your supervisor.

If you have an unavoidable time-conflict with an assignment, you must inform your supervisor (the lab coordinator for lab assistants, or lecturer for conflicts with homework and exam grading). You must arrange with your supervisor to either reschedule an assignment or find a mutually agreeable replacement to fulfill your duties. GTAs should not "swap" duties without consulting the supervisor. Although senior GTAs might be given extra responsibilities, and might be asked to mentor junior colleagues, they do not have supervisory roles over other GTAs.

You must perform all duties associated with your assignment in a timely and professional manner. This includes all responsibilities for preparation of laboratory activities, staffing of laboratory sections, proctoring, grading, recitation and office hours.

- Proctoring requires careful attention to the needs of students. In addition, you must be alert to observe any action which constitutes academic dishonesty. These should be reported to the supervising professor.
- Grading requires careful evaluation of each piece of work submitted. Your grading must be fair to all students. Grading must be at an appropriate standard; you must know the expectations of your supervisor and when it is appropriate to award partial credit.
- If you are teaching recitation sections or providing office hours, find out from your supervisor what should be covered. In general, it is not appropriate to simply provide

answers to assigned questions. Engage the students in a dialog to develop concepts, problem solving approaches, etc. Use recitation time and office hours efficiently.

- Teaching in the laboratory requires careful attention to issues related to safety. You are responsible for the safety of students in the laboratory. You must adequately alert students to potential hazards. It is a policy of the School of Chemistry and Biochemistry to require eye protection in *all* laboratories at *all* times. It is your responsibility to enforce this policy. If students are not wearing eye protection they are required to leave the laboratory. Failure to enforce safety guidelines constitutes unsatisfactory performance of your teaching duties.

- If you are responsible for preparation or supervision of a laboratory activity, you must develop experience with the technique. GTAs supervising students in a laboratory activity are responsible for solving problems encountered with equipment and samples. Whenever appropriate, the laboratory supervisor should he consulted. Organization of each individual laboratory activity is the responsibility of the GTA under the direction of the supervisor.

- GTAs are responsible for preparation and clean-up of the laboratory at the beginning and end of each laboratory period, and at the start and end of each semester. Generally, you should have students tidy up their work areas at the end of each laboratory period. However, at the end of the laboratory session there is usually a need for additional tidying.

GTAs, laboratory coordinators and supervising professors constitute a unit which works together to provide a safe, nurturing and stimulating environment for students. This team will maintain an atmosphere of mutual respect in all aspects of their interactions with each other and with students.

- All students should be treated with respect and courtesy. However, you must also maintain your authority over the class, and command the respect of your students.

- Other GTAs should be treated with respect and courtesy. They have the same responsibilities as you. They should be consulted whenever appropriate.

- Laboratory coordinators should be treated with respect and courtesy. They have supervisory responsibility for all aspects of the laboratory. They should be consulted whenever appropriate. You should be responsive to the laboratory coordinator's directions.

- The supervising professor should be treated with respect and courtesy. They have supervisory responsibility for all aspects of the course. They should be consulted whenever appropriate. You should be responsive to your supervisor's directions.

GUIDELINES FOR GRADUATE RESEARCH

A Ph.D. is *earned*, not awarded, on the basis of an independent body of work. The earning of a Ph.D. is a complex process, in which you bear the primary responsibility. You are given a high degree of independence in a project. It is your job (1) to become familiar with the literature in the project area; (2) to determine from the literature if the planned work is really new; (3) to turn an initial idea into a project in which you bring your own ideas and your own critical thought; (4) to execute experiments which test hypotheses; (5) to generate new experiments *on your own,* which allow you to bring to fruition a completed research project.

1. **Thesis**. The thesis should have a beginning (background), a thesis (description of rationale for experiments based upon background), a description of the experimental data, and a discussion of the conclusions based upon that data. It should have *complete* references and background which document that this is a new piece of work. It should have a detailed description of experiments which confirm *beyond doubt* the claims made, allow an independent investigator to reproduce the experiments described and confirm the identity of the materials or data produced.

2. **Publications**. A good thesis should lead to 3 or more publications. Ideally, at least 2 of those should be accepted before you leave. The main difference between writing a manuscript for publication and writing a thesis is that the level of detail in the thesis is typically greater than in the body of the publication. However, it is common to find theses where each chapter presenting results is based on, or largely identical to, a published paper.

3. **Notebook.** The primary source for the experimental part of the thesis is a well-written and complete notebook. Neatness counts less than completeness. Data should never be written on scraps of paper for later transcription. The notebook should be dated regularly. Electronic lab notebooks, such as the Labarchives (https://www.labarchives.com/) product licensed by Georgia Tech, are acceptable. A notebook must provide sufficient detail that all the requirements for publication can be met, and the reported work could be reliably reproduced by someone who is from outside of your research group.

4. **Experimental data**. Data from all measurements should be clearly tied to the sample used for the measurements using a *reference to the notebook describing the synthesis or source of the sample*. Data should be stored in electronic form. An electronic lab notebook, ELN, allows the data to be stored along with the experiment and sample description in archival form. If an ELN is not used, the data must be carefully organized and archived so that after you leave Georgia Tech other researchers can readily find and use the data.

5. **Spectra.** In synthetic experiments, spectra (IR, NMR, MS) are obviously taken of all new compounds. However, it is almost always a good idea to take spectra of crude reaction mixtures after solvent removal. This avoids problems later on when chromatography or other subsequent separation attempts lead either to disappearance of materials or to rearrangement on columns. Also, this helps to solve problems of poor mass balance.

6. **Reports**. Semester-reports may be required by some advisors and annual progress reports are required by the School. The purpose of these is to serve as intermediate stages to the publication and/or thesis. Good reports save you a tremendous amount of work at thesis time, because they remind you of missing data and experiments that are difficult to perform later. They also force you to examine the literature to make sure you are not reinventing the wheel! The quality of your reports should be that you can simply "cut and paste" them into your thesis.

7. **Hours.** Graduate school is probably the last opportunity you will have for flexible hours. However, you need to work in way that provides for good progress towards graduation. We encourage you to take some time for yourself and find a good work-life balance. Discuss work expectations with your potential advisor before joining a specific research group and ensure they are in line with your own expectations. The School does not set the amount of vacation time that graduate students are allowed to take, but a reasonable amount is 2-3 weeks per calendar year in addition to Institute Holidays (13 days each year). This is decided on a per research group basis. All planned absences should be discussed with your advisor as soon in advance as possible. Additionally, if you are a TA, you should discuss potential absences with your supervisor well in advance (preferably before the semester begins). There is no guarantee that a suitable replacement can be found for you. Any disagreements should be brought forward to the School leadership for consultation. A schedule of holidays is published each year by the Institute and can be found at https://hr.gatech.edu/payroll.

Items 1-7 above involve personal responsibility. However, earning a Ph. D. is an apprenticeship, which means you learn from others. Creativity and individuality are crucial in becoming a good researcher. However, there are policies and good practices which must be followed in order for other researchers to be able to conduct their work efficiently. Therefore, for a common good, your individuality must take a back seat here and you should strive to work as part of a team. Do not be afraid to ask questions if you are unsure! Everyone is there to help you. Since this requires a high degree of collegiality, there are some obligations on your part to the rest of your research group:

8. **Fix it!** Especially if *you* break it, get it fixed. If an item of equipment is broken, even if you are not responsible, take steps to get it fixed. If there is a person assigned to the equipment, notify him or her. If you are the person assigned to a piece of equipment, keep it in good running order at all times.

9. **Clean it!** Even on your bench, accumulating dirty glassware is a safety and health hazard. A messy work area is unacceptable. If you have a spill and do not clean it promptly, ***you*** *are knowingly exposing others to danger*. ONLY YOU know what you left on/around the balance, rotavap, other equipment and how to **properly** and **safely** dispose of it (solvents left on a rotavap, vacuum line traps - for example). Areas around equipment (and computers) are for everyone to use. Your experiment must be contained to those work areas. They need to be thoroughly emptied and cleaned upon completion of your experiments, so that the next user does not have to guess about safety of the stuff you left behind. Areas around computers need to be uncluttered, so whoever needs to use them,

can do his/her work efficiently. Make sure you have removed all of your materials: notes, spectra, etc. when you are finished.

All group members have a responsibility to contribute to laboratory safety. It is important, that everyone works to keep labs organized, clean and safe.

10.. **Label it!** Never put an unlabeled flask in the refrigerator. Make sure labels are securely fastened, generally with tape. Use only dark ink on the labels.

11. **Order it!** If you use the last of the group solvent, order more. If you use the last TLC plate, order more. If you break something that can't be fixed, replace it.

12. **Return it!** When you need to borrow something, ASK FIRST! If the person is not available, take a few moments to write a note. If nothing else, common courtesy calls for returning what you have borrowed as soon as possible. Returning an empty chemical bottle or a piece of glassware that is less than impeccably clean- is not good enough! Tools, cuvettes, and other common equipment should be returned to their storage place immediately after use.

13. **Enforce good security.** Challenge people walking the halls after hours. Ask for identification. Don't be afraid to demand their reasons for being in the building. Call the police if someone refused to provide that identification. Lock the lab door if you are leaving and no one is left, and check the other doors.

14. **Safety habits.** YOU, and OTHER PEOPLE as well, have a RIGHT to work in a SAFE environment. YOU MUST NOT, BY YOUR CARELESS ACTIONS/ NEGLIGENCE ENDANGER OTHER WORKERS. YOU have the RIGHT to DEMAND - other people in their work observe proper safety procedures. If you observe unsafe behavior that is concerning, please report to your advisor and to the School leadership.

    You should know the properties of the chemicals you work with. Especially important is that you are aware of health hazards they may pose. If you don't know, always assume that the chemical is a health hazard. Therefore, make sure you package all the chemicals that you store in the lab properly, in closed bottles/flasks/jars, clearly labeled (see **Label it!)**. Other potential dangers include compressed gas cylinders, lasers, high voltages and biohazards. Please ensure you take all necessary training based on current and future research projects. Remember, MAKE SAFETY A PRIORITY!

GUIDELINES FOR PRESENTATIONS IN CHEM 8003 STUDENT SEMINAR

The Graduate Seminar serves at least three purposes that are very important for the doctoral student's scientific career development:

- To give graduate students an opportunity to demonstrate their breadth of knowledge, and
- To give graduate students practice in developing strong oral communication/presentation skills, and
- To help with preparations for their candidacy examinations

Each student will present twice. Once on a literature topic and once on their own research. The following criteria should be met when selecting a literature topic and journal article(s):

Literature Seminar

Seminar topics are subject to approval by the course instructor. Topic changes are strongly discouraged once approved. If you wish to change the topic of your seminar, this should be done in consultation with the instructor.

Since the Graduate Seminar is intended to give students an opportunity to demonstrate breadth of knowledge, and practice in developing strong oral communications and presentation skills, the literature presentation should cover important, high-quality, recent progress in an area of chemistry/biochemistry.

Requirements for the literature seminar topic:
• Cutting-edge and contemporary research (within the last 5 years)
• NOT related to the graduate student's research, unless approved by the course instructor.
• NOT work done at Georgia Tech
• NOT work done at the presenter's undergraduate, or previous graduate, institution.
• NOT research presented in a seminar over the last two academic years.

There are numerous types of journal articles published today. Some are very short (i.e. 2-4 pages) while other are very long (i.e. review articles that are the length of book chapters). The expectation for the Graduate Seminar is that students select full research articles (generally 5-12 pages in length) as opposed to communications, letters, etc. If necessary, students may select one short paper as a primary reference for his/her talk.

Each literature based Graduate Seminar should be based on work described in primary research articles. However, additional references may be reviewed for development of general information and for citation in the presentation itself. All data being presented should come from the primary research articles.

Presentation of the student's own research

This presentation should present the project background, the questions or hypotheses to be addressed, the likely significance of the work, results to date, and plans for the future.

Presentation Guidelines

Each Graduate Seminar should be a PowerPoint-based multimedia presentation. Each presentation will be timed and penalties for exceeding the 20-minute limit, or for falling short of the time limit

will be imposed at the discretion of the instructor. A general rule-of thumb is that there is one slide covered per 1-2 minutes when speaking at a moderate pace.

Audience members are permitted to ask questions during the Graduate Seminar. This is important for clarity and for development of skills in interacting with the audience. Presenters should be prepared for interruptions, but should still exercise control over the presentation with respect for the audience members. The audience will provide feedback via an online survey tool. The instructor will provide feedback to the speaker via a form. All feedback must be constructive.

Attendance and Grading

Attendance and grading policies will be determined by the course instructor as stated in the course syllabus.

Assistantship Accommodations arising from Medical Needs

The following guidelines allow a graduate student to maintain full-time status and assistantship support when they are unable to perform their regular balance of academic, teaching, and research activities for more than three weeks due to medical needs or childbirth (including routine prenatal care and care of a newborn). Accommodations for periods of less than three weeks are to be made within the existing framework of Research and Teaching Assistantships in conjunction with the supervisor. Accommodation for longer periods may be made by redefining the activities associated with the student's assistantship, which may include modification of the balance between instructional and research activities. Certification from an appropriate medical professional is required in all cases other than pregnancy/childbirth/newborn care. Students who make use of these policies may request a one-semester delay for any remaining academic requirements (e.g., candidacy exam, seminar).

In all cases, the student should initiate discussions with his/her advisor and the Associate Chair for Academic Programs as soon as possible. For accommodations related to pregnancy, childbirth and care of a newborn, this discussion should take place at least five months before the expected delivery. Discussion related to other medical conditions should take place: (i) as soon as possible following a diagnosis (or development of a planned course of treatment), or (ii) as soon as is reasonable after hospital admission in the case of a medical emergency.

The discussion between the student, advisor and Associate Chairs will focus on defining duties to be conducted during the time of accommodation while: (i) maintaining full-time student standing, and (ii) maintaining full assistantship support. Assistantship support will be provided as a combination of funds from the research advisor and School, reflecting the balance of duties to be performed.

Related policies and procedures

"Incomplete" course grades. Students registered for classes should consider the Institute's policies regarding the assignment of a grade of "Incomplete" and how course requirements will be completed upon returning to a regular academic schedule.

Unpaid leave of absence. A student who wishes to take an unpaid leave of absence either after or in lieu of these accommodations may do so. Readmission after more than one semester requires a petition to the faculty (by Institute regulations), which will be approved by the School provided the student left in good standing.

External Fellowships. A student who has continuing fellowship support from external sources should be aware of any obligations to the external sponsoring agency. If the student is unable to fulfill the requirements of the fellowship during the period of accommodation s/he may be appointed as a Graduate Assistant at the regular assistantship level for that period.