



DEPARTMENT OF CHEMISTRY

College of Arts and Sciences

Graduate Student's Guide

to

Department Requirements and Policies

Director of Graduate
Studies

*Donald Hamelberg,
Ph.D.*

Graduate Coordinator

Kedayne King

Department Chair

*Peng George Wang
Ph.D.*

Department of
Chemistry
P.O. Box 4098
Atlanta, GA 30302

Phone

(404) 413-5497

Fax

(404) 413-5505

Web

www.chemistry.gsu.edu

(02/2016)

(Edition)

Welcome,

to the Doctoral and Master Programs in Chemistry of Georgia State University. Here you will find useful information about our programs, with degree requirements and policies, admission procedures, student support, coursework, selected courses offerings, and general exams. Suggested timelines to PhD and MS degree completion, and a section containing frequently asked questions complete this guide.

You may, or may not, know that the MS program was established in 1970 and the PhD program in 1990. Over the years, both programs have grown and expanded considerably; today, they include more than forty MS and seventy PhD students in the areas of Analytical, Biophysical, Biochemical, Organic, and Medicinal Chemistry. What you probably do not know is that we plan to expand even more in the next few years with more than forty MS and eighty PhD students! We are also looking forward to the opening of the Parker H. Petit Science Teaching Laboratory and Science Research Laboratory, which will eventually become the department's instructional and research home.

As I often tell my colleagues when they visit, we at the Chemistry Department are a "hidden secret" in the southeast, with outstanding facilities to support our research programs, and an extremely dynamic faculty conducting cutting edge research at the interface of chemistry and biology. For specific research interest I encourage you to browse our departmental web page (www.chemistry.gsu.edu). Our former graduate students go on to work in the academe and industry, both in the Atlanta-area and nation-wide. Lastly, let me enthusiastically welcome you! We are looking forward to working together with you on very exciting projects.

Best wishes,

Director of Graduate Studies

INDEX

Doctoral Program Degree Requirements and Policies	4
Master's Program Degree Requirements and Policies	13
Frequently Asked Questions	20
Useful Information	23
Appendix A: General Exam Guidelines	25
Appendix B: Course Offerings	34

DOCTORAL PROGRAM IN CHEMISTRY DEGREE REQUIREMENTS AND POLICIES

The Department of Chemistry administers a doctoral program designed to endow its graduates with the ability to approach fundamental scientific questions from both a biological and a chemical perspective. The program awards a Ph.D. in Chemistry with areas of specialization in the following core disciplines:

- Biochemistry
- Organic Chemistry/Medicinal Chemistry
- Biophysical Chemistry/Computational Chemistry
- Analytical Chemistry

A Bioinformatics Option is available in each of the core disciplines.

A Ph.D. in Chemistry with a concentration in Geochemistry is also available in collaboration with the Department of Geology. See the Department of Geology section of the Graduate Catalog for details.

Students should select a core discipline for their major area of specialization that best represents their research interests. Each discipline has a faculty member assigned as the area advisor. For entering students without M.S. degrees, a minor area of specialization should also be chosen (see Appendix A for requirements). Upon entering the program, students should meet with their Research Advisor and the Graduate Coordinator, Will Lovett, in order to design a plan of coursework specific to their discipline.

ADMISSION:

The doctoral program admits students each academic semester provided a complete application and all supporting documents are received by the appropriate deadline, approximately ten weeks before the start of the semester. Exact deadlines can be found on-line at www.gsu.edu.

Application requirements are as follows:

- I. Applicants must hold a baccalaureate or master's degree in Chemistry or Biology or a closely related field.

2. Applicants should submit transcripts of their past academic performance, scores on the general Graduate Record Examination (GRE), and three letters of reference. International applicants should also submit scores on the Test of English as a Foreign Language (TOEFL).
3. Applicants must submit a statement of their career goals and research interest.
4. Applications should be sent directly to:
Office of Graduate Studies
College of Arts and Sciences, Georgia State University
Haas Howell Building, Room 800
75 Poplar Street
Atlanta, GA 30303-3088

For an informal review of your application by the Director of Graduate Studies, please submit a copy of your application, including unofficial transcripts and test scores to:

Graduate Coordinator
Department of Chemistry, Georgia State University
Petit Science Center, Suite 380
100 Piedmont Ave
Atlanta, GA 30303
Phone: 404-413-5525
Fax: 404-413-5505

STUDENT SUPPORT:

Teaching and research assistantships are available, and individual faculty members may support students working on specific research projects with funds from research grants. Funds permitting, qualified PhD students will be awarded graduate assistantships. A limited number of fellowships including the Ambrose Pendergrast Fellowship and the David Withers Boykin Graduate Fellowship in Medicinal Chemistry are awarded by the Department to outstanding Ph.D. students. In addition, approximately 18 graduate fellowships at \$22,000 are offered in Molecular Basis of Disease (MBD) and Brains and Behavior (BB) research areas. Students entering the program with an M.S. degree are generally provided support for 3 years and for no more than 4 years. Those entering with a B.S. are generally provided support for 4 years and for no more than 5 years. Students must remain in good academic standing and make satisfactory progress toward their degree completion to continue receiving graduate assistantships.

Students also receive waived tuition and the premiums for health insurance are subsidized by the College of Arts and Sciences and the department (as part of their stipend), provided the students remain in good academic standing and upon maintaining satisfactory progress towards their degree.

Financial support is contingent upon remaining in good academic standing and on maintaining satisfactory progress towards the degree. Applicants interested in support are urged to apply as early as possible.

REQUIREMENTS FOR THE PhD DEGREE

The Doctor of Philosophy (Ph.D.) is the highest earned degree offered by the University and is conferred upon the candidate only for distinctive work and original scholarship. The completion of the specified coursework and the passing of examinations are essential, but the degree can only be given when the student has presented a dissertation judged to be a significant contribution to the advancement of science.

1. **Coursework Requirements:** A minimum of 80 semester hours of graduate credit is required for the Ph.D. degree as follows:
 - a. A minimum of 30 credit hours of graduate coursework within the core curriculum. Please note courses numbered 7000-7999 in chemistry and courses numbered 6900 and 7000-7999 in biology are not applicable towards the degree.
 - b. A minimum of 40 semester hours of research of which at least 20 semester hours must be Dissertation Research (Chem 9999).
 - c. An additional 10 hours of graduate course electives or research. Credit will be given only for those chemistry courses in which the student receives a grade of B or better.
2. **Teaching Requirement:** All graduate students must successfully complete two assignments as Graduate Laboratory Assistants (GLA's) or Graduate Teaching Assistants (GTA's), independent of funding mechanisms. Each student must also complete the Teaching Assistant training course (CHEM 8960) either before or concurrently with the first assignment. However, the summer session of CHEM 8960 does not fulfill this requirement. Furthermore, if training is determined to be required due to background or language issues those training assignments do not count towards the teaching requirement.
3. **Residence:** Six terms of residence are required, three of which must be consecutive and full-time. A Doctor of Philosophy degree will be conferred only on a student who has a distinguished record of academic achievement for a minimum of three academic years of study beyond the baccalaureate program. Upon the recommendation of the Department and with the approval of the College, up to one-half of the residence requirement may be waived on the basis of coursework completed in other programs.
4. **Research Skill/Foreign Language Requirement:** Proficiency in an approved research skill or a foreign language is required. Research skill coursework may include (but is not limited to) NMR, mass spectrometry, molecular modeling, computer language, technical writing, advanced statistics, electronics, etc. A reading proficiency in French, German, or Russian may be used to satisfy the language

requirement. Students may demonstrate a reading proficiency by passing the appropriate examination. An international student whose native language is not English may be exempted from the foreign language requirement by passing an examination.

Students entering the program with an approved M. S. degree have satisfied this requirement.

Note: credit hours used to fulfill the research/language requirement do **not** count towards degree.

5. **General Examination:** Students must pass a General Examination consisting of written and oral portions (see Appendix A for area requirements), covering the two core areas representing the student's major and minor interest. Students who enter the program with a M.S. degree (in an approved scientific discipline) have satisfied the written minor portion of the exam. The examinations are typically offered twice a year, during the Fall and Spring semesters. The student must choose a major professor (Research Advisor) before requesting to take the General Examination. The Examination Committee will consist of a minimum of three members from the laboratory faculty, one of which should be from an area different from the major. The student's Research Advisor is excluded from membership on the General Examination Committee. The members of the General Exam Committee are selected by the Area Advisor, Graduate Director and the Departmental Chair. A student may repeat (see specific guidelines for each area) the General Examination once with the original committee, or a duly constituted new committee, during the next available examination period. A student who fails the Examination the second time will be terminated from the program. Students are normally expected to take the examination at the end of their second year of study. The examination must be undertaken within four calendar years of the student's admission to the doctoral program and must be passed at least one academic year prior to the conferral of the Ph.D. degree.
6. **Admission to Candidacy:** To be admitted to candidacy, the student must have met the research skill or foreign language requirement, have passed the General Examination, and have submitted an **approved** dissertation proposal within one semester. Full-time candidates must be recommended for admission to candidacy within four calendar years of their admission to the doctoral program. Concurrent completion of the selection of the dissertation committee and subsequent meetings is required.
7. **Dissertation:** A dissertation is required of all candidates for the doctoral degree. A Dissertation Committee, of which the dissertation advisor (a member of the department's graduate faculty) will be Chair, will decide the acceptability of each dissertation. The Dissertation Committee will consist of three to five members and should be formed ASAP after completion of the General Exam. The Committee will be nominated by the student, appointed by the departmental Chair in consultation with the Graduate Director, and approved by the College. The student must submit a dissertation proposal to be **approved** by the Research Advisor and Graduate Director. Once the dissertation proposal is approved and admission to candidacy is gained each student should schedule meetings with his/her Dissertation Committee at least once a year in order to provide the Committee with a report on the progress of the dissertation research. The student must complete a defense (oral)

of the dissertation and submit an approved (signed) dissertation, which conforms to the College requirements/guidelines.

8. **Research Presentation:** The student is required to deliver a 45-50 minute oral summary of the dissertation research at an open meeting and to answer subsequent questions from the audience. This presentation can be delivered prior to the oral examination or as part of the CHEM 8550 course.

TIMELINE TO PhD COMPLETION:

For students entering the PhD program with a baccalaureate of science degree in chemistry, or with a master's degree in an unrelated field the following represents an idealized timeline to completion of the PhD.

YEAR ONE	YEAR TWO
Fall Admission into Program Transfer Credits Advisement (w/both Research & Area Advisors) Research Rotation (or Lab Assignment), Chem 8910 Complete Teaching Requirement and Chem 8960	Continue Coursework Complete Research Skill/Language Requirement Continue w/Chem 8910 Directed Research General Exam in June*

YEAR THREE	YEARS FOUR & FIVE
Submit Dissertation Proposal for Approval Admission to Candidacy Nominate Dissertation Committee Enroll in Dissertation Research (Spring Semester) CHEM 9999	Continue Dissertation Research, CHEM 9999 Hold at least One Meeting with Dissertation Committee

YEARS FIVE & SIX	GENERAL EXAM TIMELINE
Hold At least One Meeting with Dissertation Committee Submit and Defend Dissertation Graduate	Oral Committee Formed During Second Year Written Exam (3 rd Week of June) Writing Sample (See Area Requirements) Oral Exam (August/September) Dissertation Proposal (November) Nominate Dissertation Committee (Due 12/15)

For students entering the program with a master of science in chemistry or a related field, the following represents an idealized timeline to completion of the Ph.D. degree.

<p style="text-align: center;">YEAR ONE</p> <p style="text-align: center;">Fall Admission into Program Transfer Credits Advisement (w/both Research & Area Advisors) Research Rotation (or Lab Assignment), Chem 8910 Complete Teaching Requirement and Chem 8960</p>	<p style="text-align: center;">YEARS TWO</p> <p style="text-align: center;">Continue w/Chem 8910 Directed Research General Exam in December* Submit Dissertation Proposal for Approval Admission to Candidacy Nominate Dissertation Committee</p>
<p style="text-align: center;">YEAR THREE AND BEYOND</p> <p style="text-align: center;">Enroll in Dissertation Research, CHEM 9999 Hold At least One Meeting with Dissertation Committee Submit and Defend Dissertation Graduate</p>	<p style="text-align: center;">GENERAL EXAM TIMELINE</p> <p style="text-align: center;">Oral Committee Formed During FirstYear Written Exam (3rd Week of December) Writing Sample (See Area Requirements) Oral Exam (February/March) Dissertation Proposal (May) Nominate Dissertation Committee (June 15th)</p>

COURSEWORK FOR EACH CORE DISCIPLINE:

The program can be tailored to fit specific interdisciplinary needs and can be developed with prior approval. Substitutions in the curriculum can be made based on a recommendation of the research advisor and require the written approval of the Graduate Director.

The minimum number of credit hours required in each category is indicated, as well as courses that can be taken to fulfill these requirements. Credit will be given only for those Chemistry courses in which the student receives a grade of B or better. Students receiving two grades lower than B may be dropped from the program.

The Graduate Catalog is the official university guide for program requirements; however the following has been approved by the department effective spring 2008.

BIOCHEMISTRY:

Area Advisor - Dr. Kathryn Grant (404) 413-5522 or kbgrant@gsu.edu

- A. Core courses: Biochemistry (9 hours)
CHEM 6600 and 6610, 6630, 6670, 8360, 8370; or approved substitutes

- B. Area Electives: Biophysical and/or Bioorganic Chemistry (6 hours)
CHEM 8510 and other approved courses) and/or Bio-organic Chemistry
(Chem 6400, 6410) and/or Chem 6850, and/or Chem 6650, and/or approved substitutes

- C. Interdisciplinary Electives in Biology (6 hours) or approved substitutes

- D. Topics, Electives and Seminar (6-19 hours)
Chem 6050, 6450, 6900, 8550, 8800, 8900, 8910 and/or other approved courses

- E. Research (40 hours)
Chem 8900, 8910, 9999 (Minimum of 20 hours of 9999)

ORGANIC CHEMISTRY/MEDICINAL CHEMISTRY:

Area Advisors – Organic: Dr. Al Baumstark (404) 413-5516 or abaumstark@gsu.edu

Medicinal: Dr. Zhen Huang (404) 413-5535 or huang@gsu.edu

- A. Core courses: Advanced Organic and Bio-organic Chemistry (9 hours)
(Chem 6330, 6400, 6410, 6430, 6650, 8400) or approved substitutes
- B. Area Electives: Biochemistry and/or Biophysical Chemistry (6 hours)
(Chem 6600, 6610, 6370, 8510) and other approved courses
- C. Interdisciplinary Electives in Biology (6 hours) or approved substitutes
- D. Topics, Electives and Seminar (6-19 hours)
Chem 6050, 6450, 6900, 8550, 8800, 8900, 8910 and/or other approved courses
- E. Research (40 hours)
Chem 8900, 8910, 9999 (Minimum of 20 hours of 9999)

BIOPHYSICAL CHEMISTRY/COMPUTATIONAL CHEMISTRY:

Area Advisor - Dr. David Wilson (404) 413-5503 or wdw@gsu.edu

- A. Core courses: Biophysical Chemistry (9 hours)
(Chem 8510 and choice of Chem 6110, 6120, 6190, 6370, 6740, 6792, 8360, 8370, 8520) or approved substitutes. Students with a strong Physical Chemistry background can exempt Chem 6110
- B. Area Electives: Biochemistry (6 hours)
(Chem 6600, 6610, 6015) and/or Bio-organic Chemistry (Chem 6400, 6410) and/or Molecular Genetics (Biol 6890, 8500, 8750) or approved substitutes
- C. Interdisciplinary Electives in Biology (6 hours) or approved substitutes
- D. Topics, Electives and Seminar (6-19 hours)
Chem 6050, 6450, 6900, 8550, 8800, 8900, 8910 and/or other approved courses
- E. Research (40 hours)
Chem 8900, 8910, 9999 (Minimum of 20 hours of 9999)

ANALYTICAL CHEMISTRY:

Area Advisor - Dr. Gabor Patonay (404) 413-5556 or cheggp@langate.gsu.edu

- A. Core courses: Analytical Chemistry (9 hours)
Chem 6015, 6850, 6860, 6871 or approved substitutes
- B. Area Electives: Biochemistry and/or Biophysical Chem and/or Bioorganic Chem (6 hours)
(Chem 6600, 6610 and/or 8510, and/or 6400, 6410, and/or 6370) or approved substitutes
- C. Interdisciplinary Electives in Biology (6 hours) or approved substitutes
- D. Topics, Electives and Seminar (6-19 hours)
Chem 6050, 6450, 6900, 8550, 8800, 8900, 8910 and/or other approved courses
- E. Research (40 hours)
Chem 8900, 8910, 9999 (Minimum of 20 hours of 9999)

BIOINFORMATICS (OPTION)

Area Advisor - Dr. Stuart Allison (404) 413-5519 or sallison@gsu.edu

- A. Core courses: Biochemistry/Organic/Biophysical/Analytical (9 hours) or approved substitutes B.

Area Electives: Appropriate electives for core discipline selected in A or approved substitutes
- C. Interdisciplinary Electives in Biology (6 hours) or approved substitutes
- D. Computer Science courses, Electives and Seminar (6-19 hours)
 - 1. 12 hours from CSc*, Math and/or Chem/Bio Informatics courses or approved substitutes
* [CSc 6260, 6310, 6730, 6840, 8710, 8711 and Stat 8090, 8440, 8540, 8561, 8630, 8660, 8670 are possible choices]
 - 2. Chem/Bio courses to fulfill requirement or approved substitutes.
- E. Research (40 hours)
Approved research courses (Minimum of 20 hours of 9999)

MASTER OF SCIENCE IN CHEMISTRY DEGREE REQUIREMENTS AND POLICIES

The Department of Chemistry administers a masters program with a thesis and non-thesis option. The program awards a M.S. in Chemistry with areas of specialization in the following areas:

- Biochemistry
- Organic
- Inorganic
- Analytical Chemistry
- Physical

A Bioinformatics Option is available in each of the areas.

Students should select an area of specialization that best represents their research interests. Each discipline has a faculty member assigned as the area advisor. Upon entering the program, students should meet with their Research Advisor and the Graduate Coordinator in order to design a plan of coursework specific to their discipline.

ADMISSION:

The master's program admits students each academic semester provided a complete application and all supporting documents are received by the appropriate deadline, approximately ten weeks before the start of the semester. Exact deadlines can be found on-line at www.gsu.edu.

Application requirements are as follows:

1. Applicants must hold a baccalaureate degree in Chemistry or Biology or a closely related field.
2. Applicants must submit transcripts of their past academic performance, scores on the general Graduate Record Examination (GRE), and three references.
3. Applicants must submit a statement of their career goals and research interest.

(Continued on next page)

4. Applications should be sent directly to:

Office of Graduate Studies
College of Arts and Sciences, Georgia State University
Haas Howell Building, Room 800
75 Poplar Street
Atlanta, GA 30303-3088

For an informal review of your application by the Director of Graduate Studies, please submit a copy of your application, including unofficial transcripts and test scores to:

Graduate Coordinator
Department of Chemistry, Georgia State University
Petit Science Center, Suite 380
100 Piedmont Avenue
Atlanta, GA 30303
Phone: 404-413-5505
Fax: 404-413-5505

STUDENT SUPPORT:

Teaching and research assistantships are available, as well as tuition waivers to qualified individuals. Premiums for health insurance are subsidized by the College of Arts and Sciences and the department.

Support is contingent upon remaining in good academic standing and on maintaining satisfactory progress towards the degree. Applicants interested in support are urged to apply as early as possible.

TEACHING REQUIREMENT:

All supported graduated students must successfully complete two assignments as Graduate Laboratory Assistants (GLA's) or Graduate Teaching Assistants (GTA's). Each student must also complete the Teaching Assistant training course (CHEM 8960) either before or concurrently with the first assignment. However, the summer session of CHEM 8960 does not fulfill this requirement. Furthermore, if training is determined to be required due to background or language issues those training assignments do not count towards the teaching requirement.

REQUIREMENTS FOR THE MS DEGREE

Thesis Option

1. **Thesis:** A Thesis Committee, of which the thesis advisor (a member of the department's graduate faculty) will be Chair, will decide the acceptability of each thesis. The Thesis Committee will consist of three to five members and should be formed before starting the thesis research. The Committee will be nominated by the student in consultation with the thesis advisor and approved by the Graduate Director. The student must complete a defense (oral) of the thesis and submit an approved (signed) thesis, which conforms to the College requirements/guidelines.
2. **Coursework Requirements:** A minimum of 32 semester hours of graduate credit is required, of which 8 hours may be taken in a related field with approval. This includes a required 6 hours of CHEM 8999 (Thesis Research), 2 hours of CHEM 8800 (Seminar), and 3 hours of CHEM 8960 (Laboratory Supervision). CHEM 8960 does not count towards the degree as it is part of the Teaching Requirement.
3. **Research Skill/Foreign Language Requirement:** Proficiency in an approved research skill or a foreign language is required. Research skills may include (but are not limited to) NMR, mass spectrometry, molecular modeling, computer language, technical writing, advanced statistics, electronics, etc. A reading proficiency in French, German, or Russian may be used to satisfy the language requirement. Students may demonstrate a reading proficiency by passing the appropriate examination. An international student whose native language is not English may be exempted from the foreign language requirement by passing an examination. Note: credit hours used to fulfill the research skill/language requirement do **not** count towards the degree.
4. **General Examination:** The General Examination Committee for students seeking an M.S. degree with a thesis is the entire graduate faculty in chemistry. This body has stipulated that a student must demonstrate competence in three of five areas listed below, either by examination or by receiving at least a "B" in specified courses. The specified courses for each area are:

	Area	Course(s)
I	Analytical Chemistry	Chem 6850 plus one: Chem 6000, 6010, 6015, 6190, and 6871
II	Biochemistry	Chem 6600 or 6610 or approved substitutes
III	Inorganic Chemistry	Chem 6210
IV	Organic Chemistry	Chem 6400 or Chem 6410 or approved substitutes
V	Physical Chemistry	Chemistry 6110 or 8510

Students may request a written examination in one of these areas at any time by completing a form available from the Graduate Director. Students can be assigned scores of zero, 1/2 pass, and a full pass on these examinations.

Non-Thesis Option

1. **Research Paper:** A Non-Thesis Research paper must be submitted and approved by the Research Paper Advisor and the Graduate Director. A student can either report on a research project performed under the direction of the Research Paper Advisor or perform a literature search (review) and propose research that could be performed at Georgia State University.

A student must select a member of the graduate chemistry faculty to be the Research Paper Advisor and seek approval from the Graduate Director. A minimum of 3 hours of CHEM 8910 (Directed Research) should be completed before the paper is submitted. A maximum of 6 hours of CHEM 8910 can be counted towards the degree.

The Research Paper must have an introduction, a body of data and information, a discussion and conclusions section, a formal list of references and conform to ACS style. A final copy of the research paper must be submitted to the Graduate Director with a title page indicating (by signature) the research advisor's approval. The paper, with the title page, must be submitted to the Graduate Director no later than five working days before the last day of classes for the semester in which the student plans to graduate. The Research Paper will be kept on file with the permanent records for the student.

If the paper is approved by the Graduate Director and subsequently the Department, the Graduate Office will be notified that the Research Paper for the student has been submitted and approved by the Department of Chemistry.

2. **Coursework Requirements:** A minimum of 36 semester hours of graduate credit is required, of which 8 hours may be taken in a related field with approval. This includes a required 3 hours of CHEM 8910 (Directed Research), 1 hour of CHEM 8800 (Seminar), and 3 hours of CHEM 8960 (Laboratory Supervision). CHEM 8960 does not count towards the degree as it is part of the Teaching Requirement.
3. **Foreign Language/Research Skill Requirement:** Proficiency in an approved research skill or a foreign language is required. Research skill coursework may include (but is not limited to) NMR, mass spectrometry, molecular modeling, computer language, technical writing, advanced statistics, electronics, etc. A reading proficiency in French, German, or Russian may be used to satisfy the language requirement. Students may demonstrate a reading proficiency by passing the appropriate examination. An international student whose native language is not English may be exempted from the foreign language requirement by passing an examination. Note: credit hours used to fulfill the research skill/language requirement do **not** count towards the degree.

PROGRAM TIMELINE:

YEAR ONE

Fall admission into program
Advisement (Area and Research
Advisors)
Nominate Research Advisor
Core Courses
Research, CHEM 8910
Complete Teaching Requirement and
CHEM 8960
Form Thesis Committee

YEARS TWO & THREE

Continue coursework
Enroll in Thesis Research, CHEM 8999
Submit and defend Thesis or submit
Non-Thesis Research Paper
Graduate

COURSEWORK FOR EACH OPTION:

The program can be tailored to fit specific interdisciplinary needs. However, substitutions require the written approval of the Graduate Director and specialized programs designed for specific needs require approval.

The minimum number of credit hours required in each category is indicated, as well as courses that can be taken to fulfill these requirements. Credit will be given only for those Chemistry courses in which the student receives a grade of B or better. Students receiving two grades lower than B may be dropped from the program.

The Graduate Catalog is the official university guide for program requirements; however the following has been approved by the department effective spring 2008.

THESIS:

A. 26 hours of CHEM 6000 and/or CHEM 8000 level courses of which 8 hours may be taken in a related field. Please note CHEM courses numbered 7000-7999 and BIOL 6900, 7000-7999 are not applicable towards the degree.

B. 2 hours of CHEM 8800 (Seminar) are required as part of the 26 hours

C. Proficiency in a Research Skill/Foreign Language

D. General Exam:

Complete the required coursework with a "B" or better from three of the five areas-

Analytical CHEM 6850 plus one from (CHEM 6000, 6010, 6015, 6190, 6871)

Biochemistry CHEM 6600 or CHEM 6610 or approved substitutes

Inorganic CHEM 6210

Organic CHEM 6400 or CHEM 6410 or approved substitutes

Physical CHEM 6110 or CHEM 8510

E. Research:

Minimum of 6 hours of 8999 required

NON-THESIS:

- A. 36 hours of CHEM 6000 and/or CHEM 8000 level courses of which 8 hours may be taken in a related field. Please note CHEM courses numbered 7000-7999 and BIOL 6900, 7000-7999 are not applicable towards the degree. Approved curriculum and minimum hours are:

CHEM 6600/6610 or approved substitute	3 hrs
CHEM 6400/6410/6330 or approved substitute	3 hrs
CHEM 6850/6860/6871/6370/6015	3 hrs
CHEM 6110/6120/8510	3 hrs
CHEM 6000/6010/6190	6 hrs
CHEM 8800	1 hr
CHEM 8910	3 hrs
Electives	14 hrs

- B. Proficiency in a Research Skill/Foreign Language

BIOINFORMATICS:

The Department M.S. degree with emphasis in bioinformatics is available in both the Non-Thesis and Thesis options described above with the following modifications.

Math and Computer Science courses at the 7000 level that serve as prerequisites for 6000 and 8000-level interdisciplinary class may be applied towards the interdisciplinary course work requirement. At least one course in Biochemistry (CHEM 6600 or above) and CHEM 6640 or equivalent must be included in the above. In addition, 12 hours of interdisciplinary course work may be applied towards the degree selected from the following partial listing:

BIOL 6500	Human Genetics	CSC 6310	Parallel and Distributed Computing
BIOL 6564	Advanced Genetics	CSC 6730	Scientific Visualization
STAT 8050	Statistics for Bioinformatics	CHEM 6640	Bioinformatics
STAT 8540	Multivariable Methods in	MATH 6548	Methods of Variance and
BIOL 6744	Biostatistics-(research skill req)		Analysis of Regression
Chem 8630	Advanced Bioinformatics (Also crosslisted as CSc 8630 and Biol 8630)		

For the Non-thesis option the approved laboratory or literature research paper must be on a topic within the area of bioinformatics. For the Thesis Option, the research project must include bioinformatic components and one of the thesis committee members must be from outside of the Department.

FREQUENTLY ASKED QUESTIONS

1. How do I get on payroll?

In order to receive your stipend you must complete a GRA Hiring Packet which can be obtained from, and returned to, Human Resources. You can also find the payroll schedule on the Human Resources website.

2. How do I request a tuition waiver?

Each semester you will be requested to submit a Graduate Assistant Registration Form. This is used to determine your teaching assignment and to request your tuition waiver. You must submit a signed form BEFORE your tuition waiver can be requested from the College.

3. How do I enroll in the Health Insurance Plan?

You can enroll in the mandatory Pearce and Pearce Health Insurance Plan online by first visiting the GoSolar website. Select the Graduate Mandatory Plan and complete the form as directed. Please remember that although you are automatically billed for health insurance you are not automatically enrolled for coverage. If you already have coverage you can visit the same website to request a waiver.

4. How can I get evening and weekend access to Georgia State University buildings?

Simply visit Dan Adams (GCB 540 or dadams@gsu.edu) to request building access. Bring your Panther Identification Card with you.

5. How can I request permission to park in the M-Deck?

See the Graduate Coordinator for a letter stating that you are a Research Assistant working evenings and weekends and therefore requesting permission to park in the M-Deck. The letter should subsequently be submitted to Auxiliary Services.

6. How can I transfer previous graduate coursework towards the graduate program at Georgia State University?

If not already on file provide an official transcript from the domestic university/college from which the coursework is to be transferred. In addition you must provide a course description for each course to be transferred. The Transfer Request form must be signed by the student and approved by the Graduate Director and Dean of the College. Please note there are time and hour limits governing what and how much coursework can be transferred.

7. How can I get approval to register for a course?

A request should be submitted to the Graduate Coordinator. Include the course name, course CRN, and the type of approval needed, e.g. department, time conflict, etc.

8. How do I get a course substitution approved?

Substitutions are done on a case by case basis and the request should be submitted to the Graduate Coordinator and will be approved by the Graduate Director. Courses taken outside of the suggested curriculum without prior written approval will not count towards the degree.

9. What courses are approved to fulfill the Research Skill/Foreign Language requirement?

CHEM 6050 (NMR), 6450 (Molecular Modeling), and 8970 (Mass Spec.) are commonly approved Research Skills, however others are available. A proficiency exam in French, German, or Russian administered by the Department of Applied Linguistics/ESL can be used to fulfill the Language Requirement. Students whose first language is not English may demonstrate proficiency in English through the GSTEP.

10. How do I postpone graduation after officially filing?

First discuss the postponement with your Research Advisor to be sure it's necessary. If postponement is the best option notify the Graduate Coordinator and submit an official Change of Graduation Date form to the Graduation Office.

11. How do I keep track of all the requirements and deadlines for graduation?

The College provides a Graduation Calendar with requirements and deadlines on its website, as well as the Guide for Digital Thesis and Dissertation Preparation and Submission. You will also receive information from the Graduate Coordinator.

12. What are the CHEM 8900 courses for?

CHEM 8900 courses are used to close the curriculum gap between GSU cross-listed undergraduate and graduate courses. If a grade of "B" or better was earned in a cross-listed undergraduate course a student may request to register for 8900, which if approved can be used to substitute for the graduate equivalent.

13. How do I know if I am taking the right courses?

All incoming students will receive advisement regarding coursework that should be completed for their program and concentration. The Graduate Coordinator can review your progress towards the degree as you approach certain milestones. For M.S. students these are when you apply for graduation and the semester before graduation. For Ph.D. students these are before you take the General Exam, after the General Exam, when applying for graduation, and the semester before graduation.

14. When do I enroll in Dissertation Research (CHEM 9999) or Thesis Research (CHEM 8999)?

Ph.D students enroll in CHEM 9999 once admitted to candidacy, which requires having met the research skill or foreign language requirement, completion of the General Examination, and having submitted an **approved** dissertation proposal. M.S. students can enroll in CHEM 8999 once completing the course based General Exam requirements.

15. Do I have to complete the Teaching Requirement if I am supported by my Research Advisor's grant?

Yes, the Teaching Requirement is part of the PhD curriculum and all students must meet the requirement to be eligible for graduation.

16. How can I get my PhD stipend increased?

You will receive timely stipend increases if you do the following:

Complete all coursework with a B or better

Receive great evaluations in teaching and from your Research Advisor

Produce publications and make presentations

Complete your General Exam within the suggested timeframe

File for MS Non-Thesis Degree graduation after completing the General Exam

17. What are the fees and tuition?

All full time graduate students that remain in good standing and make satisfactory progress in their degree will receive support from the Department in the form of a stipend and tuition "waiver." The waiver is in quotes because tuition is not 100% waived – The student is still required to pay \$37.50 per semester. That's all. So, for Spring 2010 the fees and tuition were:

Mandatory Activities Fee:	\$615.00
Health Insurance:	\$326.50
Reagents Fee:	\$200.00
Tuition:	\$37.50
TOTAL:	\$1,179.00

Since these fees are due before the start of classes, all new students need to make sure they have the funds available when they arrive in Atlanta.

18. May I work for another State Institution or Agency while being paid as a graduate student in the Department?

As stated in the Policy Awareness & Agreement Form (6-d) Graduate Assistants, signed by all new students in the program, a student working for Georgia State University may not also be employed by another institution within the University System of Georgia or at another State of Georgia Executive- branch agency.

19. What happens if I receive the grade “U” (Unsatisfactory)?

A grade of unsatisfactory means the student is no longer in good academic standing and is no longer making satisfactory progress towards their degree. This causes the repercussions to the students’ financial support and tuition waiver discussed on page 5.

20. Can I change research groups if I receive a grade of “I” (Incomplete)?

No! A student must first complete all of the assignments and have the “I” changed to an “S” (Satisfactory). In essence no research advisor will even consider taking a student with an “I” because of the possibility that the “I” could be changed to a “U.”

21. How soon after I start the MS program can I apply to the PhD program?

Ideally, you should not apply to the PhD program until you are in your last semester of the MS program. In other words, it would be preferred for you to finish a thesis based MS prior to moving up to the PhD program. However, for students demonstrating outstanding academic achievement, having very strong faculty support, and provided that at the time of applying they have already completed one full year of the MS program and have taken 18 hours of core classes, and exception can be considered.

22. Must I take the General Exam if I entered the PhD program with an MS degree?

Yes, all PhD students must pass the General Exam. NOTE: Format will be somewhat streamlined if the student enters with an MS degree.

USEFUL INFORMATION

Department Contacts:

Director of Graduate Studies: D. Hamelberg, Ph.D. dhamelberg@gsu.edu
(404) 413-5564
519-SA

Graduate Coordinator, Kedayne King, MBA: chemgradstudent@gsu.edu
(404) 413-5497
PSC 392

Important Georgia State University web pages:

College of Arts and Sciences: www.cas.gsu.edu

GSU Chemistry: www.chemistry.gsu.edu

Graduate Studies: www2.gsu.edu/~wwwgas/

GSU Library: www.library.gsu.edu/

International Student and Scholar Services: www.gsu.edu/es/international_services.html

Health Care:

CCN Providers (Pearce and Pearce) Claims processed at 80%

Hospitals: www.ccnusa.com/medicalEd/PartialSearch.do

Urgent Care: www.ccnusa.com/medicalEd/PartialSearch.do

SouthCare Providers (Pearce and Pearce) Claims processed at 80%

Hospitals: www.southcareppo.com/framesetdef.asp?Community=Provider

GSU Health Services (Pearce and Pearce) Claims processed at 100%

147 Sparks Hall Tel: (404) 413-1930

Banking:

Wachovia Bank
2 Peachtree St NW
Atlanta, GA 30303
(404) 865-4001
wachovia.com

Sun Trust Bank
50 Hurt Plz SE
Atlanta, GA 30303
(404) 260-0083

Bank of America-Marietta Street
35 Broad St NW
Atlanta, GA 30303
(404) 893-8282
Bankofamerica.com

Transportation:

For information on bus and rail services within the Atlanta metro area visit: www.itsmarta.com

A discounted monthly rail and bus pass can be purchased from Auxiliary Services (Bookstore Building) at GSU.

MARTA Routes that service GSU

4 - McDonough/Grady Hospital www.itsmarta.com/getthere/schedules/4.htm

13 - Fair Street www.itsmarta.com/getthere/schedules/13.htm

18 - South Decatur www.itsmarta.com/getthere/schedules/18.htm

Georgia State Station www.itsmarta.com/getthere/stations/gastate.htm

For information on obtaining a drivers license visit: www.dds.ga.gov (Georgia Department of Driver Services)

Grocery and Drug Stores:

Kroger Co.
100 Peachtree St NW, Atlanta
(678) 364-0318

Publix
595 Piedmont Ave NE, Atlanta
(404) 881-1750

Walgreen Drug Store
5320 Memorial Dr, Atlanta
(404) 508-6499

General Exam Overview

All PhD students must pass the general exam early in their program. Two attempts to pass the exam are allowed. Failure to do so results in termination from the program. Specific instructions follow this section's describing the General Exam for the following areas: Biochemistry, Biophysical, Organic (Medicinal), and Analytical. All general exams consist of two portions: Written and Oral. The student's General Exam committee makes the final decisions on each exam. Three possible outcomes for the General Exam are: 1). Pass; 2). Conditional Pass (conditions must be met within the time specified); 3). Fail (student must take the exam the next time it is offered).

Procedure

Students sign up to take the General Exam in the Department Graduate Office.

1. Students take the area specific background portion of the General Exam. This may be a written exam, and ACS exam, or both. Students taking ACS-type exams must submit a ~2 page statement of career / research goals and interests as a writing sample. During the first attempt on the exam, specific standards are required to be met in order to pass. Failure to achieve standard results is a failure of the overall exam. No oral portion will be given. The student must take the exam the next time it is offered.

2. Student passes background portion on first attempt. Student will proceed to the oral portion of the exam. If the student passes then the General Exam requirement has been met. If the student receives a conditional pass on the oral portion, then the conditions must be met within the specified time to pass or the exam will be determined to be terminated (Fail). If the student fails the oral portion the exam is terminated (Fail) and the student has to wait six months before taking the final attempt.

Biochemistry Area General Exam

Students must pass a general examination consisting of written and oral portions, covering the two core areas representing the student's major and minor interest.

A. Biochemistry General Exam – Written (major)

The candidate must demonstrate sufficient scientific background for Ph.D. level research. This is accomplished by completing the following:

- I. Pass the ACS Graduate Level Biochemistry Exam or a specific written exam provided for the student by the Committee. Biochemistry Area faculty will administer and grade the ACS exam and provide a topic-by-topic analysis and recommendation to the students General Exam Committee.

The Graduate Level ACS Exam will be evaluated as follows:

- Pass: 80th percentile or higher (national level). This condition must be met on the first attempt to proceed to the oral portion. If not, the first General Exam is then terminated. The student must wait six months before taking final attempt.
 - Conditional Pass: 80-65th percentile, and pertains only to students during second attempt. An additional written "exam" is required (advisor input on questions). Student must successfully pass the additional written portions of the background exam to continue on to the oral portion.
 - Fail: below 65th percentile, and pertains only to students during the second attempt. The General Exam Committee upon discussion with advisor has the option to terminate the student. This termination cannot be contested. The committee may decide to continue and administer the oral portion (see later).
2. Submit a ~2 page statement of career/research goals and interests to the General Exam Committee for assessment of writing skills. This is required before the Oral Exam on all attempts.

B. Biochemistry General Exam – Written (minor)

The Biochemistry Group has replaced the requirement for the written minor general exam in Biochemistry by allowing students to complete the following courses with a grade of B:

- CHEM 4600/6600 Biochemistry I

Students should then complete one of the following, or a substitute approved by the Graduate Director, and complete with a B or better:

- CHEM 6610 Biochemistry II
- CHEM 6630 Enzymology
- CHEM 6670 Principles and Techniques of Practical Biochemistry

- CHEM 8360 Protein Structure and Function
- CHEM 8370 Nucleic Acid Structure and Function

Students may petition the General Exam Committee to take courses of relevance to their research from the Biology Department in lieu of the courses listed above. Students who enter the program with a M.S. degree (in an approved scientific discipline) have satisfied this portion of the exam.

C. Biochemistry General Exam – Oral (major)

The purpose of the oral portion of the Examination is to determine if a candidate has sufficient grasp of the background and material needed to complete a Ph.D. dissertation in two to three additional years. Students are expected to:

- Address areas in which they were weak on the written exam

- Answer questions appropriate to their area of interest
- Discuss their research or proposed research in detail

All students will have the opportunity to take an oral exam. The General Examination Committee will make the final decision as to whether the student has passed the entire general exam based on the written portion, the oral portion, and established excellence in scholarship and research.

Note: The student has only two opportunities to take the written essay exam. If the student does not take the oral the first time after taking the written essay exam, the student has only one chance to take the oral exam. The research advisor has right to attend oral portion.

Biophysical Area General Exam

Students must pass a general examination consisting of written and oral portions, covering the two core areas representing the student's major and minor interest.

A. Biophysical General Exam – Written (major)

The candidate must demonstrate sufficient scientific background for Ph.D. level research. This is accomplished by completing the following:

1. Pass the written Biophysical General Exam, which is administered in two portions on one day.
 - Part I: A closed book two hour exam given as a series of questions covering basic physical chemistry, thermodynamics, statistical thermodynamics, quantum mechanics, and kinetics in the style of the ACS Physical Chemistry exams
 - Part II: A four hour exam with both open and closed book portions covering advanced biophysical topics similar to those in Chem8510. Areas covered in the exam include: thermodynamics, biopolymer folding, hydrodynamics, general structure, spectroscopy, NMR, and macromolecular interactions. Students will be given some selection choices about which area questions they can answer.
2. Submit an ~2 page statement of career/research goals and interests to the General Exam Committee for assessment of writing skills

Biophysical Area faculty will administer and grade the exam and provide a topic-by-topic analysis for the General Exam Committee. In the event a student does not pass the general exam, the Exam Committee, upon discussion with advisor, has the option to terminate the student. This termination cannot be contested. If the student is not terminated an extensive written exam will be administered and will cover all major aspects of Biophysical Chemistry as developed by the Committee. The written portion may be repeated one time only and the student is expected to show specific improvement that demonstrates the ability to carry out Ph.D. level research.

B. Biophysical General Exam – Written (minor)

The Biophysical Group has replaced the requirement for the written minor general exam in biophysical chemistry by allowing students to complete the following course with a grade of B or better:

- Biophysical Chemistry (Chem 8510)

Students who enter the program with a M.S. degree (in an approved scientific discipline) have satisfied this portion of the exam.

C. Biophysical General Exam – Oral (major)

The purpose of the oral portion of the Examination is to determine if a candidate has sufficient grasp of the background and material needed to complete a Ph.D. dissertation in two to three additional years.

Format of the Oral Portion of the General Exam:

The candidate will give a brief formal presentation to the General Exam Committee on the general goals and significance of the proposed Ph. D research project as well as experimental procedures and facilities/equipment needed in the project. A more specific description of the presentation is given below. The candidate may use either computer/PowerPoint slides or overhead transparencies. The candidate must also be prepared to use a white-board/marker to address questions on topics introduced by the candidate.

Structure of the Oral Portion of the General Exam:

1. State the scientific goals of the planned research/topic.
2. Discuss relevant research that serves as background for the proposed project. Indicate those scientific areas that are well understood and those that require more investigation.
3. Discuss possible research strategies for obtaining the desired information.
4. For presentations focused on on-going projects, brief preliminary work on the project should be presented.
5. Describe specific equipment, funds, and facilities needed for the project and how they will be available.

Concepts for the Oral Portion of the General Exam:

- All students must be able to discuss Ph.D.-level “research” concepts
- Students must be able to address “weak areas” from written exam during the oral portion of the exam
- Students should be able to answer questions appropriate to area of interest

Examples:

Discuss a recent paper or method useful in biophysical research
Discuss an experimental approach in the research area of interest
Discuss the physical approach presented in an appropriate, recent paper

- All students must be able to demonstrate appropriate use of the literature

Failure to pass the oral portion of the exam means failure of the general exam. A newly reconstituted general exam committee may that the full general exam be repeated or, alternatively, just the oral portion of the general exam. The oral portion may be repeated one time only and the student is expected to show specific improvement that demonstrates the ability to carry out Ph.D. level research. The advisor has the right to observe the oral portion of the exam but must refrain from participation. At least half a year should pass before a second attempt is made.

Organic and Medicinal Area General Exam

Students must pass a general examination consisting of written and oral portions, covering the two core areas representing the student's major and minor interest. Students are allowed only two attempts to pass the General Exam.

A. Organic General Exam – Written (major)

The candidate must demonstrate sufficient scientific background for Ph.D. level research. This is accomplished by completing the following:

- I. Pass the ACS Graduate Level Organic Exam or a specific written exam provided for the student by the Committee. Organic Area faculty will administer and grade the ACS exam and provide a topic-by-topic analysis and recommendation to the students General Exam Committee.

The Graduate Level ACS Exam will be evaluated as follows:

- Pass: 90th percentile or higher (national level). (Pass: 81th percentile or higher for Chemistry Education focused students). This condition must be met on the first attempt to proceed to the oral portion. If not, the first General Exam is then terminated. The student must wait six months before taking final attempt.
- Conditional Pass: 90-74th percentile, and pertains only to students during second attempt (Conditional Pass: 81-65th percentile for Chemistry Education focused students). An additional written "exam" is required (advisor input on questions). Student must successfully pass the additional written portions of the background exam to continue on to the oral portion.
- Fail: below 74th percentile (65th percentile for Chemistry Education), and pertains only to students during the second attempt. The General Exam Committee upon discussion

with advisor has the option to terminate the student. This termination cannot be contested. The committee may decide to continue and administer the oral portion (see later).

2. Submit a ~2 page statement of career/research goals and interests to the General Exam Committee for assessment of writing skills. This is required before the Oral Exam on all attempts.

B. Organic General Exam – Written (minor)

The Organic group has provided two options for meeting the requirement for the written minor general exam in organic chemistry, for those PhD students that are not Organic oriented.

1. Complete Mechanistic Organic Chemistry (Chem 6400) or Bioorganic Chemistry (Chem 6410) or approved substitute with a grade of B or better.

O
R

2. Demonstrate sufficient background knowledge for area by passing ACS Graduate Organic Exam at appropriate level.

Graduate Level ACS Exam will be evaluated as follows:

- Pass: 70th percentile or higher (national level)
- Conditional Pass: 70-50th percentile: Weaknesses as identified by area faculty must be addressed during the oral portion for the student to pass the general exam.
- Fail: Below 50th percentile: The Exam Committee, upon discussion with advisor, has the option to terminate the exam. This termination can not be contested. If the general exam is not terminated either an extensive written exam will be administered (and passed) covering all major aspects of Organic Chemistry as developed by the Committee, or the student will be assigned a specific course to completed with a grade of B or better.

C. Organic General Exam – Oral (major)

The purpose of the oral portion of the Examination is to determine if a candidate has sufficient grasp of the background and material needed to complete a Ph.D. dissertation in two to three additional years.

Format of the Oral Portion of the General Exam:

The candidate will give a brief formal oral presentation to the General Exam Committee on a topic approved by

the chair of the general exam committee. Usually, the oral portion is focused on the general goals and significance of the proposed Ph. D research project as well as experimental procedures and facilities/equipment needed in the project. A more specific description of the presentation is given below. The candidate may use either computer/PowerPoint slides or overhead transparencies. The candidate must also be prepared to use a white-board/marker to address questions on topics introduced by the candidate.

Structure of the Oral Portion of the General Exam:

1. In consultation with the student's General Exam Committee chair, a topic is chosen. The topic could range from a presentation of a completed M.S. project (for students entering the Ph.D. program with an M.S.) to a literature topic. Current on-going research may also be presented.
2. State the scientific goals of the planned research/topic.
3. Discuss relevant research that serves as background for the proposed project. Indicate those scientific areas that are well understood and those that require more investigation.
4. Discuss possible research strategies for obtaining the desired information.
5. For presentations focused on on-going projects, preliminary work on the project should be presented.
6. Display proper style (references, etc.).

Concepts for the Oral Portion of the General Exam:

- All students must be able to discuss Ph.D.-level "research" concepts (For example: NMR and spectroscopy, molecular modeling, structure proof).
- Students must be able to address "weak areas" from written on oral portion of the exam
- Students should be able to answer questions appropriate to areas of interest
Examples:
Discuss a recent paper or reaction useful in synthesis
Discuss a mechanism in area of interest
Discuss the synthetic approach presented in an appropriate, recent synthetic paper
- All students must be able to demonstrate appropriate use of the literature

Failure to pass the oral portion of the exam (first attempt) means failure of the general exam. A newly reconstituted general exam committee may require that the full general exam be repeated but usually only the oral portion of the general exam is administered for the final attempt (since written portion was passed in the first attempt). The oral portion may be repeated one time only under these conditions and the student is expected to show specific improvement that demonstrates the ability to carry out Ph.D. level research. The advisor has the right to observe the oral portion of the exam but must refrain from participation. At least half a year should pass before a second attempt is made. The committee makes the final decision on each exam: 1) Pass; 2) Conditional Pass; or 3) Fail.

Analytical Area General Exam

Students must pass a general examination consisting of written and oral portions, covering the two core areas representing the student's major and minor interest.

A. Analytical General Exam - Written (major)

The candidate must demonstrate sufficient scientific background for Ph.D. level research. This is accomplished by passing the graduate level ACS exam, which will serve as the written portion of Analytical General Exam.

Analytical Area faculty will administer and grade the exam and provide an analysis for the General Exam Committee.

Graduate Level ACS Exam will be evaluated as follows:

- **Pass:** 85 percentile or higher (national level). In addition to the exam a written ~2-page statement of career/research goals and interests is required.
- **Conditional Pass:** 85-50 percentile (or 90-60 percentile for undergraduate level exam). An additional written "exam" is required (advisor input on questions). Student must successfully pass the second exam to continue on to the oral portion.
- **Fail:** Below 50 percentile. The Exam Committee, upon discussion with advisor, has the option to terminate the exam. This termination can not be contested. If the student is not terminated an extensive written exam will be administered and will cover all major aspects of Analytical Chemistry as developed by the Committee. The written portion may be repeated one time only and the student is expected to show specific improvement that demonstrates the ability to carry out Ph.D. level research.

B. Analytical General Exam – Written (minor)

The Analytical Group has replaced the requirement for the written minor general exam in analytical chemistry by allowing students to complete two of the following courses with a grade of B or better:

- Bioanalytical I (Chem 6850)
- Bioanalytical II (Chem 6860)
- Chromatography (Chem 6010)

Students who enter the program with a M.S. degree (in an approved scientific discipline) have satisfied this portion of the exam.

C. Analytical General Exam – Oral (major)

The purpose of the oral portion of the Examination is to determine if a candidate has sufficient grasp of the background and material needed to complete a Ph.D. dissertation in two to three additional years.

Format of the Oral Portion of the General Exam:

The candidate will give a brief formal presentation to the General Exam Committee on the general goals and significance of the proposed research project as well as experimental procedures and facilities/equipment needed in the project. A more specific description of the presentation is given below.

- All students must be able to discuss/defend research
- Students must be able to address "weak areas" as identified from the written exam
- Students should be able to answer questions appropriate to areas of interest; analytical techniques, chemistry related to analytical techniques, analytical instrumentation, etc.

Example:

- Discuss recent paper or analytical technique
 - Discuss an analytical technique in the area of interest
 - Discuss a modern analytical instrument including chemistry
- All students must be able to demonstrate use of literature

Failure to pass the oral portion of the exam means failure of the general exam. A newly reconstituted general exam committee may elect the whole general exam be repeated or, alternatively, just repeat the oral portion of the general exam. The oral portion may be repeated one time only and the student is expected to show specific improvement that demonstrates the ability to carry out Ph.D. level research. The advisor has the right to observe the oral portion of the exam but must refrain from participation. At least half a year should pass before a second attempt is made.

MS AND PhD SELECTED COURSE OFFERINGS (others available)

BIOCHEMISTRY

Chem 6600-6610. **Biochemistry I and II** (5-3 credits)

Introduction to biochemical phenomena: proteins, enzymes, vitamins, carbohydrates, lipids, nucleic acids, DNA, RNA and metabolism.

Chem 6230. **Metals in Biology and Medicine** (5 credits)

Overview of the roles of metals in biology and medicine, focusing on the metal-binding ability of proteins and nucleic acids and their relations to various disease states.

Chem 6630. **Enzymology** (3 credits)

Introduction to enzyme catalysis, with emphasis on the general concepts of enzyme kinetics and the common tools for studying enzymes.

Chem 8360. **Protein Structure and Function** (3 credits)

Protein synthesis, protein folding and motions, enzyme catalysis at the molecular level, energetics of biological processes and enzyme kinetics.

Chem 8370. **Nucleic Acid Structure and Function** (3 credits)

Structure of nucleic acids, mechanism and control of DNA and RNA synthesis, and interaction of proteins and drugs with nucleic acids.

Chem 8450. **Biomolecular Nuclear Magnetic Resonance** (1-5 credits)

Experimental design and interpretation of nuclear magnetic resonance data, particularly with respect to applications in structural biology.

Chem 8900B. **Directed Study in Biochemistry** (1-5 credits)

Investigation of biochemical research problems.

ORGANIC/MEDICINAL CHEMISTRY

Chem 6330. **Advanced Synthesis** (3 credits)

Synthesis and characterization of inorganic and organic compounds by modern methodology.

Chem 6400. **Mechanistic Organic Chemistry** (3 credits)

Applications of principles of organic chemistry to biochemical problems.

Chem 6410. **Bioorganic Chemistry** (3 credits)

Investigation into the construction of bio-organic molecular models of biochemical processes.

Chem 6430. **Advanced Organic Synthesis** (3 credits)

Focus on advanced synthetic methodologies, reaction mechanisms, and syntheses.

Chem 6440 – **Practicum in Biotechnology** (5 credits). Prerequisite: consent of instructor and the Biotechnology Committee. Laboratory training and experience related to Biotechnology. Both technique and project-based rotations will be offered. May be repeated up to three times if projects or rotations change.

Chem 6490. **Special Topics in Organic Chemistry** (3 credits)

Advanced topics in organic chemistry.

Chem 6650. **Nucleic Acid Synthesis** (3 credits)

Lectures on nucleic acid synthesis, mechanism, therapeutics and detection

Chem 8400. **Medicinal Chemistry** (3 credits)

Study of the isolation, characterization, and elucidation of structure and synthesis of medicinally important compounds. The relationship between chemical structure and biological activity of selected drugs, vitamins, hormones, and proteins is reviewed.

Chem 8900O. **Directed Study in Organic Chemistry** (1-5 credits)

Research problems in organic chemistry.

BIOPHYSICAL CHEMISTRY

Chem 6190. **Instrumental Methods III: Spectroscopy** (3 credits)

Modern spectroscopic techniques and their application to chemical problems, with the results of quantum mechanics used as a guide in the analysis of spectra.

Chem 6110, 6120. **Physical Chemistry I & II** (4, 2 credits)

Principles of thermodynamics, molecular structure, and kinetics as a basis for interpreting and interrelating the properties of matter.

Chem 6050. **Introduction to Fourier-Transform Nuclear Magnetic Resonance Spectroscopy** (2 credits)

Fundamental techniques of Fourier-Transform NMR spectroscopy.

Chem 6450. Molecular Modeling Methods (3 credits)

Use of molecular mechanics methods to solve structural problems in organic, bio-organic, and biophysical chemistry.

Chem 6580. Special Topics in Physical Chemistry (3 credits)

Advanced topics in physical chemistry.

Chem 6590. Special Topics in Biophysical Chemistry (3 credits)

Advanced topics in biophysical chemistry.

Chem 6740. Statistical Mechanics (3 credits)

Introduction to statistical mechanics and the theory of ideal and non ideal gases, liquids, and solids.

Chem 6792. Computational Chemistry (3 credits)

Application of current computational chemistry programs to research problems and projects.

Chem 8360. Protein Structure and Function (3 credits)

Protein structure, protein folding and motions, enzyme catalysis at the molecular level, energetics of biological processes and enzyme kinetics.

Chem 8370. Nucleic Acid Structure and Function (3 credits)

Topics include the structure of nucleic acids, mechanism and control of DNA and RNA synthesis, and interaction of proteins and drugs with nucleic acids.

Chem 8510. Biophysical Chemistry (3 credits)

Applications of quantitative physical techniques to biochemistry.

Chem 8450. NMR Spectroscopy (4 credits)

Theory and application of NMR Spectroscopy for the characterization and elucidation of organic and biological molecules.

Chem 8540. Biomolecular Nuclear Magnetic Resonance (3) Prerequisite: Introductory courses in spectroscopy, such as Chem 4050/6050 and Chem 4190/6190 or equivalent. Some experience in the application of quantum mechanics in spectroscopy is useful, but not essential. Experimental design and interpretation of nuclear magnet resonance data, particularly with respect to applications in structural biology.

Chem 8900P. Directed Study in Chemistry (1-5 credits)

Investigation of biophysically-related problems in chemistry.

ANALYTICAL CHEMISTRY

Chem 6015. **Separation in Biosciences** (3 credits)

Analytical chemistry applications of electrophoresis, gel chromatography precipitation, and ultracentrifugation to molecular recognition and separations in biological systems.

Chem 6850. **Bioanalytical Chemistry I** (3 credits)

Basic concepts of analytical chemistry as applied to biologically oriented problems.

Chem 6860. **Bioanalytical Chemistry II** (3 credits)

Principles underlying instrumentation, automation and laboratory computers used in solving bioanalytical problems.

Chem 6800. **Advanced Analytical Chemistry** (3 credits)

Advanced theories and methods of analytical chemistry.

Chem 6871. **Electrochemical Methods** (3 credits)

Fundamentals of electrochemistry and application to chemical problems. Special emphasis on electrode reaction mechanisms and interpretation of electrochemical results for organic, inorganic, and biological systems.

Chem 8970. **Topics in Molecular Biological Sciences** (1 or 2 credit)

May be repeated if topics vary. May be taken for one or two credit hours.

Chem 8900A. **Directed Study in Analytical Chemistry** (1-5 credits)

Research problems in analytical chemistry.

SELECTED ELECTIVES IN BIOLOGY (others available)

Bio 6430. **Microbial Diversity and Systematics** (3 credits)

Diversity and systematics of selected groups of bacteria and the yeasts.

Bio 6458. **Microbial Ecology and Metabolism** (3 credits)

Activities, populations, and interrelationships of microorganisms in their environments.

Bio 6575. **Virology** (3 credits) Biological, chemical, and physical characteristics of the viruses with emphasis on the techniques of isolation and cultivation.

Bio 6780. **Immunology** (3 credits)

Principles of immunology with emphasis on humoral and cellular immunity; immunochemical methods for detection, quantitation, and study of humoral antibodies and immune cells.

Bio 6481. **Mycology** (3 credits) Ecology, physiology and systematics of micro-fungi, with emphasis on those forms of industrial and economic importance.

Bio 6696. **Laboratory in Molecular Biological Techniques** (3 credits)
Isolation and analysis of protein and nucleic acid from prokaryotic and eukaryotic cells and viruses; molecular cloning and sequencing techniques.

Bio 8675. **Molecular Virology** (3 credits) Molecular biology of viruses, their replication and genetics, and interaction of viruses and the host cell.

Bio 6240. **Endocrinology** (3 credits) Biochemistry and physiology of the endocrine system.

Bio 6248. **Cell Physiology** (3 credits)
Mechanisms of cell and organelle function at the molecular level.

SELECTED ELECTIVES IN COMPUTER SCIENCE

CSc 6260. **Digital Image Processing** (4 credits)

This course covers the basic fundamentals of image processing which include image digitization, description, enhancement, segmentation, image transforms, filtering, restoration, coding, and retrieval. Concepts are illustrated by laboratory sessions in which these techniques are applied to practical situations, including examples from industrial and biomedical image processing.

CSc 6310. **Parallel and Distributed Computing** (4 credits)

Introduction to various parallel programming paradigms, algorithms, and architectures. Includes some hands-on parallel programming on shared-memory and message-passing parallel architectures.

CSc 6730. **Scientific Visualization** (4 credits)

Use of sophisticated computer graphics techniques and software packages to display, transform, and analyze data; mapping concepts, glyphs, and grids; rendering techniques.

CSc 6840. **Computer Graphics Imaging** (3 credits)

Modeling techniques include lofting, extrusion, surfaces or revolution, constructive solid geometry, procedural modeling, meatballs and others. Image synthesis techniques include scan-line graphics, ray tracing, and radiosity. Also covered are anti-aliasing, surface mapping, shadowing, lighting, and other relevant topics.

CSc 8710. **Deductive Databases and Logic Programming** (4credits)

An introduction to the area of deductive databases and logic programming. Topics include syntax of logic programs and deductive databases, model-theoretic, proof-theoretic and fixed-point semantics,

operational semantics such as bottom-up evaluation and SLD-resolution techniques, query optimization; negatio, constraint checking, and applications of deductive databases.

CSc 871 I. Databases and the Web (4credits)

Application of database technology to access information on the World Wide Web. Topics include: Common Gateway interface (GCI), HTML form processing, accessing databases from the Web, search engines, query languages for Web data, semi-structured data model, and XML.

SELECTED ELECTIVES IN STATISTICS

Stat 8090. Applied Multivariate Statistics (3 credits)

Matrix algebra, Multivariate normal distributions, discriminant analysis, canonical correlations, and Multivariate analysis of variance.

Stat 8440. Survival Analysis (3 credits)

Stat 8540. Multivariate Methods in Biostatistics (3 credits)

Statistical techniques involving several variables, including analysis of variance and multiple regression, applied to problems in the biological sciences, including use of a statistical computer package.

Stat 8561. Linear Statistical Analysis I (3 credits)

Topics included are statistical inference, Multivariate normal distribution, distribution of quadratic forms, linear models, regression models and experimental design models.

Stat 8630. Experimental Designs (3 credits)

Analysis of randomized and incomplete block designs; factorial and nested designs using fixed, random, and mixed effects models. Applications include use of a statistical computer package.

Stat 8660. Statistical Analysis of Directions, Shapes and Images (3 credits)

Stat 8670. Computational Methods in Statistics (3 credits)

Numerical stability of statistical package program algorithms for general linear models; influential observations; principles of Monte Carlo methods; cross-validation, jackknife, and bootstrap methods of data analysis with applications to regression and discriminant analysis; use of a statistical computer package.