Georgia Tech Interdisciplinary Bioengineering Graduate Program Handbook

August 2007

Contents

Chapter 1

Introduction

Welcome! This handbook is intended to outline the policies, procedures, and degree requirements for students enrolled in Georgia Tech's Interdisciplinary Bioengineering Graduate Program (IBGP).

While this handbook is intended to answer most questions about program policies and degree requirements, there are always circumstances that may not be clearly covered within this handbook. Information about the program is also available on the IBGP website, located at http://www.bioengineering.gatech.edu. When conflicting information may appear to exist, this handbook is assumed to take precedence over the website.

Ultimately, if something is not clear, ask! Please direct all questions to the IBGP office (described in Program Management).

Chapter 2

Deadlines and Timelines

Most students reading this handbook are usually trying to determine “how to do something” at some point in their academic journey towards a graduate degree. This section describes deadlines and a typical timeline for a Ph.D. and M.S. student with links to the appropriate section of the handbook.

2.1 Ph.D. Student

2.1.1 Deadlines

When	What	Section Link
First week	Register for courses and pay fees	Course Registration
First 6 weeks	Find a Research Advisor	Thesis Advisor Selection
First semester	Submit Program of Study	Program of Study Categories Ph.D. Coursework Requirements
3rd semester	Submit biosketch form to take qualifying exam	Form emailed to students when needed by Program Office.
End of 3rd semester	Oral qualifying exam	Qualifying Exam
Post-qual exam	Satisfy teaching practicum	Teaching Practicum
Post-qual exam	Graduate office submits *Admission to Candidacy form* and *Minor Approval form*	You will be contacted if info is needed.
Within 6 months of qualifying exam	Form Ph.D. Committee	Ph.D. Committee formation
Two weeks prior to Ph.D. Proposal	Announce Ph.D. Proposal	Ph.D. Proposal Announcement
Within 12 months of qulifying exam	Ph.D. Proposal	Ph.D. Proposal
Every 6 months	Meet with and update Ph.D. Committee	Research Progress
Semester prior to semester intending to defend Ph.D.	Petition to Graduate	Ph.D. Petition to Graduate
First week of graduating semester	Be enrolled or complete *enrollment waiver* to defend by waiver deadline and graduate but not pay fees for that semester	Enrollment Waiver Info
At least six weeks prior to defense	Schedule Ph.D. Defense and provide *Preliminary Draft* to Ph.D. Committee	Schedule Defense
At least two weeks prior to defense	*Final Draft* to Ph.D. Committee and confirm defense date/time	Final draft to committee
At least two weeks prior to defense	Public announcement of defense	Public Announcement
Day of defense	Bring *Thesis Approval Certificate* and Evaluation Forms	Defense Forms
Post-defense	Submit signed approval form and electronic submission of dissertation	Dissertation Submission

2.1.2 Every Semester

When	What	How
1st week	Ensure you are registered for 21 hours of full-time course work and research hours	21 Hour Requirement
1st week	Pay fees	Student Fees
mid-semester	deadline for cross-enrollment at other Atlanta universities	Cross Enrollment at Other Atlanta Universities
mid-semester	DROP DAY	
all semester	1st and 2nd year US students: apply for domestic fellowships (NSF, NDSEG, DOE, etc)	External Fellowships
all semester	3rd and 4th year US students: apply for NIH-NRSA, AHA, and other 'senior graduate student' fellowships	

2.2 M.S. Student

2.2.1 Deadlines

When	What	Section Link
First week	Register for courses and pay fees	Course Registration
First 6 weeks	Find a Research Advisor	Thesis Advisor Selection
First semester	Submit Program of Study	Program of Study Categories M.S. Coursework Requirements
Before graduating semester	Graduate office submits *Minor Approval form*	You will be contacted if info is needed.
Semester prior to semester intending to defend M.S. and prior to submitting petition to graduate	Form M.S. Committee and submit *Request for Approval of Thesis Topic* form	M.S. committee formation
Semester prior to semester intending to defend M.S.	Petition to Graduate	M.S. Petition to Graduate
First week of graduating semester	Be enrolled or complete *enrollment waiver* to defend by waiver deadline and graduate but not pay fees for that semester	Enrollment Waiver Info
At least six weeks prior to defense	Schedule M.S. defense and provide *Preliminary Draft* to M.S. Committee	Schedule Defense
At least two weeks prior to defense	*Final Draft* to M.S. Committee and confirm defense date/time	Final draft to committee
At least two weeks prior to defense	Public announcement of defense	Public Announcement
Day of defense	Bring *Thesis Approval Certificate* and Evaluation Forms	Defense Forms
Post-defense	Submit signed approval form and electronic submission of dissertation	Thesis Submission

2.2.2 Every Semester

When	What	How
1st week	Ensure you are registered for 21 hours of full-time course work and research hours	21 Hour Requirement
1st week	Pay fees	Student Fees
mid-semester	deadline for cross-enrollment at other Atlanta universities	Cross Enrollment at Other Atlanta Universities
mid-semester	DROP DAY	

Chapter 3

Administrative Issues

3.1 Program Management

The IBGP is directed by Dr. Robert Butera, and the office is managed by Mr. Chris Ruffin. Mr. Ruffin handles most routine administrative aspects of the program (such as anything involving submitting a form or requesting approval) and coordinates admissions with the Home Schools. Dr. Butera is responsible for overall program administration and policy directions.

Any program-related inquiries should be made to Mr. Ruffin.

Dr. Butera holds regular office hours and is free to meet with any student given appropriate notice; contact Mr. Ruffin to schedule an appointment. Please email first – many issues can be resolved quickly this way.

Contact Information:

Dr. Robert Butera
Office: Whitaker 3104
Email: rbutera@gatech.edu
Phone: 404-385-6655

Mr. Chris Ruffin
Office: Petit Biotechnology Building Administrative Suite
Email: cruffin@bme.gatech.edu
Phone: 404-385-6655
FAX: 404-894-4200

3.2 Committees

The following committees govern the operation of the Bioengineering Program. Their memberships are listed in Faculty Committee Membership appendix.

3.2.1 General Faculty

This is all the faculty who participate in the IBGP. They approve all general policies and meet regularly each semester. Faculty meetings have a quorum requirement for voting: a quorum is defined as 33% of the number of faculty actively advising one or more Ph.D. students in the IBGP.

A full listing with terms of membership is listed in the Appendix.

3.2.2 Graduate Studies Committee

The Graduate Studies Committee oversees the operation of the IBGP. The committee has responsibility for all graduate-level degree requirements, approval of M.S. and Ph.D. Programs of Study forms, oversight of the Ph.D. Qualifying Examinations, and, approval of M.S. and Ph.D. Thesis Reading Committees. A student may petition the Graduate Studies Committee regarding academic issues by submitting a petition detailing his/her request to the Bioengineering Program Chair. The comittee meets monthly during the academic year. Members of this committee are appointed by the IBGP Program Chair, who chairs the committee. The committee roster is listed in the Appendix. Submission deadlines for petitions are listed on the IBGP web site.

3.2.3 Faculty Advisory Committee

The Faculty Advisory Committee (FAC) acts as an advisory body to the Program Director on all matters concerning the welfare of the Program. Additional responsibilities of the Faculty Advisory Committee include review of program delivery and requirements. The FAC meets regularly during the academic year. The FAC has six members who serve three year terms, with staggered terms such that two members are elected each year. Membership in the FAC is voted upon by the Program Faculty. The FAC elects a chair for the year from among its members.The committee roster is listed in the Appendix.

3.2.4 BGSAC: Bioengineering Graduate Student Advisory Committee

The BGSAC is a committee of IBGP graduate students and represents the interests of the students to the Program Chair, as well as working with the Program Chair on issues that have

the potential to improve interactions among graduate students, faculty, and administration. Membership is by election from a pool of eligible students nominated from the IBGP student population. The committee meets with the Program Chair at least once a semester and organize student-wide meetings. The bylaws and membership of the BGSAC are listed in the Appendix. The BGSAC website is located at http://www.bioengineering.gatech.edu/students/advisory.html.

3.2.5 Institute Graduate Committee

This is a committee of the Georgia Tech Academic Faculty. The Institute Graduate Committee has responsibility for all Institute-wide academic policies and degree requirements at the graduate-level. In addition, the Institute Graduate Committee makes decisions regarding all Institute-level graduate student petitions. These petitions include, but are not limited to, late withdrawals, changes in graduate standing, grade disputes, and re-admissions. Student Petition forms are available in Records Office, located on the main floor of the Administration Building (Tech Tower). Students filing such petitions must discuss the petition with the Bioengineering Program Chair. Additional information about filing petitions to the Institute Graduate Committee can be found at http://www.grad.gatech.edu/admin/gradcommittee/Petition_hints.html.

3.3 Home School

The Interdisciplinary Bioengineering Graduate Program (IBGP) is one of Georgia Tech's few *interdisciplinary* graduate programs. It is independent of of any particular school of department and is supported by the College of Engineering. Participating academic units are called *Home Schools*.

As of January 1, 2006, the participating Home Schools in the IBGP include the Schools of Aerospace Engineering (AE), Biomedical Engineering (BME), Civil and Environmental Engineering (CEE), Electrical and Computer Engineering (ECE), Materials Science and Engineering (MSE), Mechanical Engineering (ME), Polymer Textile and Fiber Engineering (PTFE), and the College of Computing (CoC).

Home Schools admit students to the IBGP and set administrative policies for students in that Home School (such as stipend policies). **Home Schools may impose service requirements upon students (such as teaching assistantship practicum policies).** For example, the IBGP has a *Teaching Practicum* requirement for its students; this requirement is satisifed by the internal requirements that some home schools impose on all students, regardless of major (these schools include but are not limited to ME and BME).

Home Schools do not administer degree requirements, such as qualifying exams, approval of programs of study, and procedures related to dissertation committee selection and defense.

In some cases the Home School may *constrain* a student's options within what is permissibile under the IBGP requirements – examples include make-up of Ph.D. committee membership and requiring certain courses on a program of study. However, Home Schools cannot *alter* any programmatic requirements.

The Home School of the student, as well as the student's research advisor (if a different Home School), also set policies regarding laboratory and research infrastructure: examples include office space, mail boxes, FAXes, photocopying, travel rules, vacation policies, etc.

Program faculty membership in the IBGP is independent of Home School participation - any faculty member at Georgia Tech may apply for IBGP membership. Program faculty may advise IBGP students in any home school.

3.4 Financial Support

All issues of financial support are a matter between the home school and the student. Please follow your Home School's policies regarding forms and deadlines to avoid any discontinuation of support. This is especially important if your Home School is not that of your advisor.

Three types of financial aid are available to qualified graduate students:

1. **GRA/GTAs** (Graduate Research Assistantships/Graduate Teaching Assistantships). These are awarded on the basis of academic potential and performance and not on the basis of need. They are awarded either at the time of your offer of admission or by a faculty member wishing to support you in their laboratory as a GRA. **Please note:** If you were *not* admitted with financial support, the *last day* a student can be placed on a GRA for the semester is the last day of the first week of classes. After this date, *even if a professor wishes to financially support a student, the student cannot be supported as a GRA until the following semester.* In this interim period, the student may be supported as an hourly employee, but will not be eligible for a tuition waiver and will have to pay all relevant fees and tuition.

2. **External Fellowships**. Students are highly encouraged to apply for external fellowships such as NSF, NDSEG, Department of Energy, Department of Homeland Security, and NIH NRSAs. Most of these are only available to US citizens and permanent residents. For more information, contact Dr. Amanda Gable at amanda.gable@grad.gatech.edu. A web page describing many of these opportunities for graduate students is located at `http://www.undergradstudies.gatech.edu/fellowship`.

3. **Out-of-state Tuition Waivers**. Waivers are only awarded to Ph.D. students based on a nomination by the student's Home School. Out-of-state Tuition Waivers are not guaranteed and require re-nomination each semester. In recent years, this option is rarely available to students, and are typically reserved for students supported by internally funded

fellowships and training grants. *GRAs and GTAs do not need to obtain an out of state tuition waiver; tuition is covered by virtue of being a GRA/GTA.*

Most students in the IBGP are supported as GRAs. Some Home Schools admit students as GRAs (GTAs) or without any guarantee of finanacial support.

3.5 Student Fees

Tuition and Fees are listed on the web site of the Georgia Tech Bursar's Office: http://www.bursar.gatech.edu. Students are required to pay all mandatory fees. Students on GTAs/GRAs have their tution almost entirely paid for; those with out-of-state waivers must pay partial tuition.

3.6 Computer Accounts and Email Policy

All students are provided a "GT Account" upon enrollment; information about student accounts is available online at http://www.oit.gatech.edu. New students can activate their account at the following web page: http://passport.gatech.edu.

The Bioengineering Program will use your GT Account for all official email communication. *It is assumed that this account is read daily* – Georgia Tech also uses this account for all official communication with a student. This account has an email address that typically looks like gtg123@mail.gatech.edu.

Georgia Tech provides an alias service that allows any student to obtain a *your-name@gatech.edu* email address. You can set this alias by logging in at http://passport.gatech.edu.

Individual Home Schools and laboratories may provide additional computer and email accounts.

3.7 Counseling Center

Graduate school is a life changing event, and the path is not always easy. The Counseling Center at Georgia Tech provides individual and group counseling, workshops on such topics as stress management and study skills, career counseling and psychological testing. The Center is staffed by licensed psychologists, counselors, and marriage and family therapists, as well as counselors-in-training.

The Counseling Center can be reached at 404-894-2935, or you can learn more online at http://www.counseling.gatech.edu.

3.8 Correspondence and Forms

All paper correspondence, including required forms, between students and the Bioengineering Program, Chair, or Committees should be provided to Mr. Chris Ruffin **without exceptions**. **Do not ask the chair to sign something without running it by Mr. Ruffin first** - often the office needs to keep copies of required forms. All required forms have well-publicized unchanging deadlines, and students are well aware of these deadlines in advance. A summary of form and procedural deadlines is listed in this handbook for Ph.D. students and M.S. students.

3.9 Course Registration

3.9.1 General Guidelines

All previously enrolled Bioengineering Program graduate students are required to register for Georgia Tech coursework during Phase I registration (pre-registration) for the following semester. Phase I registration occurs midway through the current semester.

New graduate students will register during Phase II/III for their first semester. Phase III registration, the last chance to register or chance courses, concludes at the end of the first week of classes. After the first semester, new graduate students will be able to register during Phase I. Information regarding registration can be found online at https://oscar.gatech.edu.

Students should register for 21 hours in the Fall/Spring semester, and 16 hours in the Summer semester. After registering for coursework, remaining hours should be registered as XXX7000YY or XXX9000YY (for MS and PhD students, respectively, with XXX being your Home School and YY being the section for your research advisor). First semester Bioengineering students should register for a specific section under Dr. Butera for their first semester. Some schools may have other required hours to register for GRAs, GTAs, or requirements such as seminar series and teaching practicums.

In rare cases, a student may be enrolled part-time; however, **do not enroll part-time unless you have consulted with the IBGP office, your Home School, and your research advisor.** It could jeopardize your funding and/or cause you to pay additional tuition and fees out of your own pocket.

Please be aware of registration deadlines for the upcoming semester, especially when students are only doing research and still must register for research hours. Registration dates are available online at http://www.registrar.gatech.edu/registration/calendar.php.

There is no reprieve for forgetting to register – you will not be eligible to be paid as a GRA and will be responsible for paying all tuition and fees for the following semester. The registrar is strict with respect to fee payment and registration deadlines.

3.9.2 Cross Enrollment at Other Atlanta Universities

Graduate students may cross-register for courses at other Atlanta-area universities, such as Emory University and Georgia State University, via the Atlanta Regional Consortium for Higher Education (ARCHE). You must be a full-time student in good academic standing at the time of application in order to cross-enroll. The deadline for cross-enrollment is part-way through the *preceding* semester of the intended enrollment semester, so plan ahead. More information is available online at http://www.registrar.gatech.edu/registration/cross.php. A link to the required form is online at http://www.atlantahighered.org/memberservices/crossregistration.asp. You should receive a notification by email if your cross-enrollment request is approved. As of the time of this writing, the contact person in the Registrar's Office for cross-enrollment is Ms. Tammy Dennis at tammy.dennis@registrar.gatech.edu.

Courses for MS students must be transferrable; PhD students can simply apply such courses to their Program of Study subject to approval of the Graduate Committee. How such courses factor into GPA calculations is described in the GPA Requirements section.

3.10 Thesis Advisor Selection

3.10.1 Selection Process

During the first six week of the Fall Semester, first-year Bioengineering PhD students are matched up with their research advisors. Students are required to interview up to six faculty in whose labs they are interested in working; students are provided a list of such labs at the start of the semester. At the end of this period, students and advisors submit an ordered list of their preferred labs. The director of the program, with assistance of the IBGP Graduate Committee, attempts to make as many high priority matches as possible. **All newly admitted students must participate in the advisor selection process, unless your official offer of admission letter specifically named a faculty member as your advisor. This includes students with external support, such as NSF Fellowships. Exceptions to this policy (typically associated with training grants) require permission of the program chair.** The matching process utilizes the following criteria in order of importance: student preference, faculty preference, priority for externally funded projects, and current distribution of students among advisors.

There are typically many more opportunities for PhD-level research than exist for MS-level research. MS students are recommended to seek out an advisor as early as possible - while they can participate in the matching process, their opportunities will be limited.

Note that if you were admitted without a GRA, placement with an advisor does not mean you can be funded as a GRA during that semester, unless an agreement was reached between the student and advisor prior to the end of the first week of classes. See the Financial Support section for more information.

3.10.2 Change of Advisor

A student seeking a change of advisor must first discuss the matter with his/her current advisor and satisfactorily complete all GRA and research obligations. The Program Chair must be involved in these discussions to ensure that all parties' needs and obligations are met. Upon satisfactory completion of these obligations the current advisor will then "release" the student by signing a "Change-of Advisor" form. This form is then taken to Bioengineering Program for approval.

3.11 Change of major from M.S. to Ph.D.

Once a Master's degree has been completed, a student may petition the Bioengineering Graduate Committee to request approval to enter the Ph.D. degree program. This petition must be accompanied by a letter from the M.S. Thesis reading committee assessing the student's ability to succeed in the Ph.D. program. This letter must be signed by all Committee members. If the petition is approved, the student will take the Bioengineering Qualifying Exam provided he/she fulfills the exam requirements within six months of entering the Ph.D. program.

3.12 Change of Home School

The IBGP allows students in any Home School to pair with advisors in any Home School. Students are bound by the policies of the home school of the student. In some cases, a student may wish to home shool; the most common scenario is to change to the Home School of the advisor. Changing Home School requires the consent of the student's thesis advisor as well as the graduate office of the Home School being changed to. A Change of Major form is used to faciliate this change. Contact Mr. Ruffin for additional information.

3.13 Obtaining a M.S. During Ph.D. Study

Some IBGP students obtain a M.S. degree in the process of obtaining their degree. These situations typically fall into two categories:

1. *Obtaining a M.S. (Thesis) in the process of pursuing Ph.D. studies*. A student categorized as a Ph.D. student may still obtain a M.S. (Thesis) in Bioengineering. This requires the consent of the Ph.D. advisor. Contact the IBGP office for more information. Briefly, the student needs to satisfy the M.S. as wsell as Ph.D. timelines.

2. *Obtaining a M.S. (Non-Thesis) while pursuing Ph.D. studies.* Some students opt to obtain a coursework-based M.S. during Ph.D. studies. This is usually a non-thesis M.S. in ECE

or ME. In generall, the IBGP program office *will not approve* a request for a M.S. (Non-Thesis) in Bioengineering from a Ph.D. student in the IBGP.

Chapter 4

Requirements for all Degrees

4.1 GPA and General Course Requirements

There are several GPA requirements for remaining in the IBGP and course requirements for graduating from all IBGP degree programs.

- **Graduate courses taken at Emory University and Georgia State University** are factored into the GPA calculation for the purposes of qualifying exam eligibility and all other GPA requirements.
- **A student must have a 3.20 GPA (rounded to 2 decimal places) to be eligible to take qualifying exams. For the purposes of eligibility to take qualifying exams, this GPA will be calculated only from courses on an approved Program of Study.** Only courses taken at Georgia Tech, Emory University, and Georgia State University will factor into this calculation. If a student is not eligible to take qualifying exams, the student will be removed from the Ph.D. program.
- **A student must maintain a 3.00 GPA (rounded to 2 decimal places) to earn a M.S. in Bioengineering and 3.20 (rounded to 2 decimal places) or Ph.D. in Bioengineering.** This is a Bioengineering program requirement, although some Home Schools have similar requirements that are consistent with this. If a student's GPA drops below the minimum GPA, he/she will be given two semesters in residence to raise his/her GPA to regain good academic standing. Failure to do so will result in the student being dropped from the program.
- **Courses applicable towards a degree must be taken for a letter grade**, and the student must have received a grade of A, B, or C. **Such courses includes all courses on a student's Program of Study.** Courses with grades of D or F do not count towards satisfying a student's degree requirements.

- **Courses taken pass/fail will not count towards a degree**, other than research/thesis hours and pass/fail courses explicitly required by either the Bioengineering Program or a home school. For example, several Home Schools have a seminar requirement whose satisfaction is indicated by a pass/fail course.
- **Special Problem courses** (directed study with a professor) may not count towards the degree. (Special Topics courses offered to the general graduate student population are acceptable).

4.2 Program of Study

A primary feature of the IBGP is the flexibility in required coursework, which allows a student considerable latitude in pursuing a wide range of areas of research within the IBGP. The *Program of Study* (PoS) is a document that describes the coursework that a student intends to take to satisfy their degree requirements. The intent of the PoS is to promote sufficient depth and breadth in the academic coursework of IBGP students. The categories of the Program of Study are described below, along with guidelines or requirements of each. Students must also satisfy a coherent minor requirement, also described below.

GPA and grade requirements are described in the GPA and General Course Requirements section. Required number of hours in each category for the MS and PhD degrees are described in the appropriate chapters for MS Course requirements and PhD Course requirements.

Commonly used courses routinely approved by the Graduate Studies Committee for each of the categories below are listed in the Appendix on Pre-approved courses for Program of Study.

Only courses on an APPROVED Program of Study will apply towards degree requirements. A Program of Study must be submitted by the end of the first semester of enrollment, and any time that the intended Program of Study changes.

4.2.1 Engineering Fundamentals

Engineering Fundamentals are courses that apply a relatively small set of quantitative principles to a wide class of problems for the purposes of design or analysis. The focus should be applying these basic principles to complex problems. These courses should not have a biological or biomedical focus.

4.2.2 Biological Sciences

Biological Sciences are courses that enhance a student's knowledge and skills in the biological/biomedical *sciences*. **Engineering courses involving biomedical applications almost always do not count towards this requirement**. The few exceptions are science-focused

courses, primarily courses in physiology and pathophysiology offered by the School of Biomedical Engineering. Students typically satisfy this requirement with courses offered by the Schools of Biology, Chemistry and Biochemistry, and Applied Physiology. Many students cross-enroll in courses offered by graduate programs at Emory University and Georgia State University.

A Ph.D. student must take at least one *Biological Foundations* course prior to taking the Ph.D. qualifying exam. This list of courses is: APPH 6211, BIOL 7001, BMED 6031, BMED 6042, CHEM 6501, IBS 555, and IBS 514.

4.2.3 Engineering Mathematics

The Engineering Mathematics requirement is satisfied by a single course taken from the following list: BMED 6041, ChBE 6500, ME 6758, ECE 6601, or PHYS 6268. Additional courses may be approved by petitioning the Bioengineering Graduate Committee, who will evaluate such requests in terms of course rigor and applicability to engineering problems. Courses at the 4000-level, as well as courses on the topic of statistical analysis, are explicitly not allowed.

The Mathematics requirement for Ph.D. students who matriculated prior to 2006, as well as M.S. students, requires 6 semester hours of coursework (not constrained to the above list), of which at least 3 semester hours must be at the graduate level. Courses are subject to approval by the Graduate Studies Committee. It is recommended to consult with the Program Chair regarding acceptable courses in this category prior to submitting a revised PoS.

4.2.4 Bioengineering/Electives

These are courses focused in the student's chosen area of research and should be justified in the narrative submitted with a student's Program of Study.

4.2.5 Coherent Minor

The Coherent Minor is a requirement demonstrating sufficient depth in another concentration area. This consists of several courses in a coherent research area. *The course applicable towards the minor may also count towards the other PoS categories*; students often utilize their Engineering Fundamentals or Biological Sciences courses to also satisfy their minor.

4.2.6 Approval Process

The Graduate Studies Committee approves all Programs of Study. **Submission does not guarantee approval**, and students are cautioned against enrolling in courses that are not on an approved PoS under an assumption that the course will be approved. *The Graduate Studies*

Committee evaluates the proposed coursework with regard to depth, breadth, relevance to research objectives, and academic rigor of the proposed courses.

Students should submit a completed PoS form *along with a document justifying the selection of courses and their relevance to the student's research and academic goals*. This material must be submitted before the end of the first semester and anytime thereafter when a student's intended coursework changes. Revised PoS submissions should be accompanied by a memo describing and explaining the nature of the revision. The PoS must be signed by the student's research advisor.

Failure to submit a PoS before required deadlines will result in a HOLD placed on a student's registration for the following semester.

Avoid common crises, such as:

1. Taking a non-pre-approved course without receiving approval from the Graduate Committee (do not assume that taking the course is grounds for approval)
2. Requesting a Program of Study change at the last minute (your desire to graduate is not sufficient grounds to approve a course)
3. Requesting course approval because you are up against a registration deadline and there is not another Graduate Committee meeting before the start of classes (the submission and meeting schedule for the semester is posted on the program web site).

The Graduate Committee does understand that some schools may change course offerings with short notice and is sympathetic to such requests when such situations occur.

A list of pre-approved courses and the relevant categories for the Program of Study is listed in the Appendix on Courses Pre-approved for Program of Study.

4.3 Graduate Coursework From Other Universities

Graduate level course work taken for a Master's degree (even at another university) may be included in the Ph.D. Program of Study provided that a grade of B or better was earned for these courses. The submitted PoS and course justification should also include a copy of the student's transcript and a detailed course description and syllabus for each course for which the student wished to receive credit.

Courses taken towards a MS in Bioengineering at Georgia Tech may not necessarily be approved as applicable towards the Ph.D. in Bioengineering.

Courses taken at another university towards a Master's degree may not be applied towards a M.S. Program of Study.

4.4 Honor Code

All participants in the IBGP are expected to uphold the Academic Honor Code at all times. The Honor Code is intended to continuously remind students and faculty of the importance of honesty and responsible conduct in their professional lives. It also serves to increase awareness on the part of both students and faculty of the rules regarding academic honesty and the process to be followed if these rules are broken. Since graduate students are involved in research and scholarly activities which occur outside the classroom, The Georgia Tech Academic Honor Code contains a Graduate Addendum to address additional aspects of academic integrity associated with such activities. Graduate students are also encouraged to become familiar with the Institute Policy on Scholarly Misconduct, located at http://www.academic.gatech.edu/handbook/Research/35.1_Policy_on_Scholarly_Misconduct.htm.

The complete text of the Georgia Tech Honor Code, student responsibilities, faculty responsibilities, and enforcement are presented at http://www.deanofstudents.gatech.edu/Honor. The Graduate Addendum to the Georgia Tech Honor Code is located at http://www.deanofstudents.gatech.edu/Honor/gradadd.html. All students are expected to be familiar with the Honor Code.

4.5 Policy on Open Publication

Georgia Institute of Technology policy states that Doctoral and Master's Theses should be openly published. Upon the request of the student and with the consent of the student's advisor, the electronic submisssion of the thesis can routinely be withheld from circulation for one year. Research arrangements that would preclude publication for an extended time or permanently for reasons of national security or a sponsor's proprietary interest, however, are not appropriate for dissertations or theses. It is anticipated that all doctoral work and a significant amount of master's research will be published in the open, refereed literature.

This policy is cited verbatim from www.grad.gatech.edu/thesis as of the time of writing. In case of any conflict, the current institute policy supercedes this one.

Chapter 5

Ph.D. Degree Requirements

5.1 Overview

The degree of Doctor of Philosophy recognizes proficiency and high achievement in research. After adequate preparation, the candidate must complete a searching and authoritative investigation of a special area in the chosen field culminating in a written thesis covering that investigation. The thesis must be either an addition to the fundamental knowledge of the field or a new and better interpretation of facts already known. It must demonstrate that the candidate possesses powers of original thought, talent for research, and ability to organize and present findings.

Students in the Bioengineering Ph.D. Program are expected to develop multidisciplinary research expertise while working on an interdisciplinary bioengineering research topic. The requirements for each student in the Ph.D. program in Bioengineering include the satisfactory completion of a set of core courses in bioscience, engineering fundamentals, advanced mathematics, and bioengineering, passing a comprehensive qualifying examination, a Ph.D. thesis proposal examination, and a Ph.D. thesis defense. Each student must also complete a minor program.

5.2 Coursework

The Program of Study categories are described elsewhere. In terms of those categories, the coursework requirements for a Ph.D. are:

- **Engineering Fundamentals**: 9 semester hours, with at least 6 semester hours at the graduate level.
- **Biological Sciences**: 9 semester hours, with at least 6 semester hours at the graduate

level. One course musrt be an approved Biological Foundations course.

- **Engineering Mathematics**: 3 semester hours at the graduate level, with specific course restrictions (see Engineering Mathematics description).
- **Bioengineering/Electives**: 12 semester hours, with at least 9 semester hours at the graduate level.
- **Coherent Minor**: 9 semester hours, which may include courses from other categories.
- **4000-level Courses**: No more than 6 hours of 4000-level courses may apply towards the Ph.D. course requirements.

5.3 Qualifying Exam

5.3.1 Eligibility

Each Bioengineering Ph.D. student entering with a B.S. degree is required to take the qualifying exam at the end of the student's third academic semester of study as long as the student maintains the GPA requirements described in the GPA section.

Students entering with a M.S. degree must take the exam after two academic semesters of residency, but may petition the Graduate Committee to defer a semester if the need for additional coursework is justified. To take the exam, each student must have passed at least two bioscience and two engineering fundamentals courses listed on the student's approved Program of Study, including a Biological Foundations course. Summer terms do not count as academic semesters of residency. A student may not defer taking the qualifying exam due to a failure to maintain academic requirements.

5.3.2 Exam Philosophy

The exam is structured to assess: the student's ability for independent thinking and decision making; knowledge and integration of engineering and biological concepts; and the application of this knowledge to interdisciplinary bioengineering problems. Although the exam will not be coursework specific, it will be tailored to the student's background, graduate coursework and general research area. The exam emphasizes the student's ability to integrate bioscience and engineering concepts to solve bioengineering problems. The committee will evaluate the correctness of the students' responses as well as judge the overall level of breadth, depth and integration of the students' responses. Clarity and conciseness of the presentation of responses is very important.

5.3.3 Exam Committee

The exam will be an oral examination administered by a faculty committee consisting of three bioengineering Program faculty members with broad expertise in areas of traditional engineering, biological sciences and bioengineering. The Bioengineering Graduate Committee will appoint the Qualifying Exam Committee based on the student's background, graduate coursework and research area. The committee members should have a distribution in rank, and should not consist solely of untenured faculty. Up to one non-program faculty member may be used.

The thesis advisor is encouraged to attend the exam as an observer. He/she may not make comments during the exam, unless requested to do so by a committee member. The thesis advisor will not be present while the committee is making its final decision on the student's Qualifying Exam performance.

5.3.4 Exam Chair Selection

A small subset of the Program faculty will chair the exam committees each year. All exam Chairs will meet prior to and after the exams are administered to address issues of exam uniformity and parity.

5.3.5 Procedures Prior to the Exam

1. The Bioengineering Graduate Program Chair will ask the student to provide a one-page write-up of his/her academic background and research work to-date, no less than 6 weeks prior to the exam. This includes a list of courses enrolled in to date. This material and a transcript will be provided to the committee.

2. The student will meet with the exam committee Chair to discuss the philosophy of the exam, the mechanics of the exam and any other points the student or committee Chair deem appropriate. The student may also meet individually with his/her other committee members prior to the exam.

3. Neither the chair nor the committee members will discuss specific exam questions with the student.

4. The Chair of the committee will request, via email, initial exam questions from the committee members. It will be the responsibility of the Chair to ensure that questions are fair and cover the intent of the exam described in the Exam Philosophy subsection. The chair should ensure that the questions are appropriate given the student's research to date and coursework to date. These should be distributed to the committee members before the exam.

5. The scheduling of a first-time qualifying exam date and time will be handled by the Bioengineering Program office. If an exam must be rescheduled, the Exam Committee Chair

is responsible for finding a time within the exam period suitable to all other committee members, the student, and the advisor. The Bioengineering Program office must be notified immediately of the new exam time and location.

5.3.6 Procedures the Day of the Exam

1. It is the student's responsibility to bring extenuating circumstances (such that the exam should not be held) to the chair's attention before the exam begins.
2. The committee will meet alone for 5 minutes to discuss the order and scope of the exam. The chair will remind the committee of the student's coursework and research to date, as well as how long the student has currently been enrolled.
3. An exam will typically last 90 minutes, and sufficient time should be provided to each committee member to ask questions.
4. During the exam, the chair has the responsibility of ensuring that the exam proceeds on time and within scope.
5. The advisor's presence is solely to ensure that the student received a fair examination. The advisor should not volunteer any information nor ask any questions unless it relates directly to the conduct of the exam.
6. The vote to pass or fail the student will be based on the student's exam performance only.
7. There will be only one vote taken. This vote is binding and conducted by the Chair. Each committee member must make a final decision prior to the voting, as there will not be a second vote. The voting must take place prior to the exam committee's adjournment. No voting will take place after the adjournment, by e-mail or otherwise.
8. The Chair of the exam committee has the discretion to limit the length of the committee's discussions.
9. Each committee member must complete an evaluation form with appropriate comments at the end of the exam. The exam chair is expected to deliver the evaluations to the program office. The Program Chair uses these evaluations to assess whether the student is meeting the program objectives and to provide additional feedback to the student and advisor regarding the exam performance.

5.3.7 Oral Exam Vote

If the vote is 3/0 or 2/1 (where X/Y indicates X vote to pass and Y vote to fail), the student passes the exam.

If the vote is 1/2 or 0/3 and the exam is being conducted for the first time for that student, the student must retake the exam. The committee will summarize its decision and detailed

recommendations in a memo to the Bioengineering Graduate Program Chair within two days of the exam. The committee's vote will not be recorded, unless the committee unanimously wishes to make its voting an open record.

If the vote is 1/2 or 0/3 and the exam is a retake exam, the student fails. The appeal process (described below) is to be followed.

5.3.8 Retake Exams

A student may retake the exam only once. At the time of the exam retake, the student must meet the GPA requirement and otherwise be in good academic standing. A retake may only be scheduled either 1) during a regularly scheduled exam period (typically June and January) or 2) within two weeks prior to a scheduled Bioengineering Program faculty meeting.

Retake exams are encouraged to occur as soon as possible (within 1-2 months) unless course-work requirements merit a semester delay.

5.3.9 Exam Conditions

An exam committee's decision (pass or fail) may be accompanied by recommended or required conditions. These conditions are based on the committee's interpretation of the student's exam performance relative to the Exam Philosophy. The conditions imposed by the committee should be directly relevant to the student's exam performance. The Bioengineering Graduate Program Chair will monitor the completion or non-completion of these conditions. If the student does not satisfactorily complete all of the Exam Committee conditions, the student cannot continue in the Bioengineering Ph.D. Program.

5.3.10 Appeals of Second Exam Failures

The Qualifying Exam Committee determines whether the student passes or fails the exam. *In the case of a second exam failure, the student's case is automatically considered by the Bioengineering Program faculty at its next scheduled meeting following the student's qualifying exam.* At this meeting each student will be discussed, and this discussion will be moderated by the Program Chair. The Chair will solicit comments from the student's research advisor, qualifying exam committee, and the faculty as a whole. Any program faculty member may offer comments or ask questions. A vote is taken by secret ballot and tallied by the Program Chair or his designate. A positive vote of greater than or equal to 2/3 of faculty in attendance is required for a student to remain in the program as a Ph.D. student. This vote is subject to Bioengineering Program quorum requirements.

A faculty meeting shall be scheduled as immediately as possible following a regularly scheduled qualifying exam period. There is only one opportunity for appeal.

5.3.11 Notification of Outcome

Students are notified of a final outcome only after the next faculty meeting, where any appeals, if any, are discussed. Students are not to be told of the results of an exam vote, but only the outcome of the entire process of exam and appeal (i.e. the student remains a Ph.D. student or becomes a M.S. student and must exit the program after satisfying M.S. degree requirements). This also requires that a faculty meeting is scheduled shortly after second exams are taken.

The Bioengineering Program Office will notify the student and the student's advisor in writing of the exam outcome and any additional requirements. Faculty should not report the outcome of oral exam decisions directly to students. This allows for fair and timely notification for all students.

5.4 Teaching Practicum

Ph.D. students entering the Bioengineering Program in Fall 2003 and subsequent semesters are required to take part in an approved Teaching Practicum for one semester. This requirement does not apply to students who matriculated the Bioengineering Program prior to Fall 2003.

The purpose of the practicum is to provide the student with an all-encompassing experience in teaching a course. It is not merely being a Teaching Assistant (in fact, just grading papers will not count), nor is it merely giving a few lectures, nor is it dumping the entire burden of teaching the course upon you. It is a partnership between you and a course instructor who will serve as your mentor to help you learn all of the aspects of teaching a course. The teaching practicum requirements include:

- the requirement will not occur until after the student passes the qualifying exam;
- the thesis advisor must approve the practicum assignment;
- the student will work with a Bioengineering Program faculty member on all aspects of teaching a course, including:
  - delivering lectures or managing discussion sessions
  - holding office hours
  - helping to prepare and grade assignments
  - the instructing faculty member must attend the student's lectures and provide feedback (i.e. this should *not* be just an excuse for you covering the instructor's lectures when the instructor is out of town. Covering lectures is OK, but they will not count towards those requiring instructor feedback.)
  - Teaching Practicum students are also required to meet as a group (4-5 times a semester) with selected faculty members to discuss aspects of teaching, learning theories, teaching methods and tips.

The Program Chair and Graduate Studies Committee is responsible for approving all practicum experiences. A form is available from the IBGP office to obtain initial approval for a practicum experience and certification of completion of the proposed practicum.

You are also responsible for any teaching requirements imposed by your specific Home School. Those requirements may satisfy your BioE teaching practicum requirements if they conform to the requirements listed above. The Home School requirements may be above and beyond or independent of the IBGP requirements. At the time of this writing the Schools of ME and BME have practicum requirements that are consistent with the above expectations (though they may require additional semesters of service). Consult your Home School for more information.

5.5 Ph.D. Committee Formation

All Ph.D. students must submit a list of proposed Thesis Committee members to the Bioengineering Program Office for approval by the Bioengineering Program Chair. Submission must take place within 6 months of passing the Bioengineering Ph.D. Qualifying Examination. The student's Thesis advisor should provide a short justification for the selection of each member of the Ph.D. Thesis Reading Committee. The student and the advisor will be notified when the committee list has been approved or if any changes to the list are necessary. If a proposed member is neither a Georgia Tech faculty member nor a Bioengineering Program faculty member, a biographical sketch (NIH-style or similar Curriculum Vitae, 4 page) of that proposed member must also accompany the request (this requirement may be waived for faculty that have regular interaction with the program).

The student's Thesis Committee will consist of 5 members. Constrained as follows:

1. At least three members of the committee (including the advisor or co-advisor) must be Program Faculty members;
2. At least two members must be from outside the home school;
3. At least one of the members from outside the home school must be a member of the Georgia Tech Academic Faculty.

For the purposes of these requirements, a student's Ph.D. advisor is considered "inside" the home school. Faculty with primary appointments outside the home school but with a joint or adjunct appointment inside the home school are considered "outside" the home school. A co-advisor may be listed that does not count towards the five required members but has the same responsibilities as the committee members.

At least two Thesis Committee members must be from outside of the student's Home School. Faculty with joint appointments in the Home School (primary appointment outside of Home School) are considered to be outside members unless they serve as the advisor. **One of the**

two "outside" committee members must have no affiliation with the Home School and preferable from the biological sciences (from GIT or a collaborating institution).

5.6 General Guidelines for Ph.D.-Level Research

1. The research should provide a useful educational experience for the student emphasizing creativity, independent action and learning, research methodology, and scholarly approach.

2. The research must be relevant to the field in which the student is pursuing a degree.

3. The contributions to knowledge must be original and as such, should represent a substantial addition to the fundamental knowledge of the field or a new and better interpretation of facts already known. The research must demonstrate creativity. Thesis is based on well known principles, techniques, and models applied to situations only somewhat different from previous applications are not acceptable.

4. The dissertation should contain clear statements about (a) the relevance and importance of the problem and (b) the significance, originality, and generality of the research results. The relationship of the research to the literature of the field should be described.

5. The research should possess the major characteristics of the scientific method, namely, objectivity and reproducibility. Assumptions should be clearly stated in both experimental and theoretical research.

6. The dissertation should reflect a level of competence indicative of significant achievement beyond the master's level. Thus, the research is expected to draw directly upon advanced learning in the student's major field and demonstrate mastery of that knowledge.

7. The dissertation must demonstrate understanding of the theory and methodology related to its main thrust. Further the Thesis should reflect knowledge of the application area.

8. The research should result in at least one paper publishable in a suitable refereed journal of bioengineering or biomedical science as appropriate.

9. The dissertation should demonstrate a high degree of proficiency in written communication of research results. It should conform to the Institute's requirements as outlined in the Office of Graduate Studies and Research www.grad.gatech.edu/thesis

10. The scope of the research should be such that it requires at least the time and effort equivalent of one year of full time graduate study.

This section was copied verbatim from http://www.grad.gatech.edu/admin/advise_policy.html. In any case of conflict, the institute policy supercedes.

5.7 Ph.D. Research Proposal

5.7.1 Overview

The well-conceived Proposal will help the student:

- develop the critical questions;
- lay the foundation for the research;
- isolate pending problems and suggest actions before wasting inordinate amounts of time;
- serve as a "map" for the research; and
- think through the whole process, indicating the need for an integrated approach.

The objective of the Ph.D. Proposal is the early assessment of the student's chosen topic of research for satisfactory completion of the doctoral degree. The Proposal should be written to delineate the specific area of research by stating the purpose, scope, methodology, overall organization, and limitations of the proposed study. It should include a review of relevant literature and an indication of the expected contribution of the research.

Students are required to submit a list of Ph.D. committee members within 6 months after successful completion of the Ph.D. Qualifying Exam. Students are required to submit an approved Ph.D. Proposal to the Bioengineering Program Office within 12 months after successful completion of the Ph.D. Qualifying Examination. The submission of the approved Proposal should include a typed "Request for Admission to Ph.D. Candidacy Form" signed by members of the student's Thesis Committee. This form requires the signature of the Bioengineering Program Chair before the form is submitted to the Graduate Studies and Research Office.

5.7.2 Format

Cover Sheet

The cover sheet for the Ph.D. Proposal, *Request for Admission to Ph.D. Candidacy Form*, is a formal statement naming the student's Thesis advisor and setting forth the Thesis topic selected for the investigation, and a 200-word summary of the proposed Thesis.

Title

The title of the proposed Thesis topic should be brief, scientifically and technically valid, understandable to a scientifically or technically literate reader, and suitable for use in the public press.

Summary

The 200-word summary of the proposed activity should be a self-contained description of the activity. The summary should be written in the third person and include a statement of objectives, methods to be employed, and the significance of the proposed activity to the advancement of knowledge. It should be informative to other persons working in the same or related fields and, insofar as possible, understandable to a scientifically literate reader.

Table of Contents

A table of contents is required and should show the location of each section of the Proposal as well as major subdivisions of the project description, such as the summary of previous work, and methods and procedures to be used.

Project Description

The proposal should be written in the format of a NIH R01 grant application (PHS 398 form).

The main body of the Proposal should be a clear statement of the work to be undertaken and should include:

- objectives for the proposed research and expected significance;
- relation to longer-term goals of the investigator's project; and relation to the present state of knowledge in the field, to work in progress by the investigator under other support, and to work in progress elsewhere; and a
- general plan of work including the broad design of activities to be undertaken, an adequate description of methods and procedures, and, if appropriate, plans for preservation, documentation, and sharing of data, samples, physical collections, and other related research products.

Specific formatting requirements include:

- The project description must not exceed 25 pages.
- Visual materials, including charts, graphs, maps, photographs, and other pictorial presentations ARE INCLUDED in the 25-page limit.
- Pages should be of standard size (8.5" x 11"; 21.6cm x 27.9cm) and with 2.5cm margins at the top, bottom, and on each side.
- The type size must be clear and readily legible, in standard size which are 10 to 12 points. (No smaller than 10 point font size should be used.)

- The document should be single spaced, but not so tight as to be difficult to read.
- Pursuant to the Metric Conversion Act of 1975, as amended by the Omnibus Trade and Competitiveness Act of 1988, the Proposal is required to use the metric system of weights and measures, unless impractical or inefficient.

Bibliography

Citations must be complete (including full name of the authors, title and location in the literature). There is no page limitation for this section of the Proposal.

5.7.3 Procedure for Ph.D. Proposal Presentation

1. Poll the committee and establish a date and time for the presentation, reserve a room and prepare an announcement of the presentation. The student is responsible for reserving the room and obtaining the necessary audio visual equipment prior to the oral presentation. *Some faculty have extremely busy schedules, and this step should be done at least 6 weeks in advance to ensure faculty availability.*
2. Email the announcement via e-mail to Mr. Chris Ruffin. This announcement should include the name of your Advisor as well as the names of your Thesis/Reading committee members. **The Institute requires that this step be completed at least two weeks before the presentation so that it can be posted.** The subject line on the announcement should read **Ph.D. Defense Presentation**.
3. Before your defense, obtain the forms necessary to be completed by your committee at your defense. These include an *Admission to Ph.D. Candidacy* form and Bioengineering Program Ph.D. Proposal Evaluation Forms. These can be downloaded from the Bioengineering Program web site.

5.8 Research Progress

The student should meet with his/her Thesis/reading committee on at least a yearly basis to review research progress. In addition, effective Fall 2005, students are required to complete an annual progress update that is due at the start of each subsequent Fall semester or upon graduating. This form is available on the Bioengineering Program web site.

5.9 Ph.D. Defense

After adequate preparation, the candidate must complete a searching and authoritative investigation of his/her chosen field, culminating in a written Thesis covering that investigation. An

oral defense will be scheduled on the subject matter for the Thesis and the field in which it lies.

Georgia Tech maintains a Thesis manual which contains two important sections: "What you have to do to graduate" and "Documents and Forms." The website for the Thesis Manual is located at http://www.grad.gatech.edu/thesis/thesis_man.html. Much of it is reflected in the Bioengineering Program procedures described below, which must be followed.

5.9.1 Procedure for Ph.D. Defense Presentation

1. To complete its records for each Ph.D. student the Registrar's Office requires *A Petition for Degree*. **The degree petition must be submitted to the Registrar's Office prior to the end of the semester preceding the student's final semester.** The exact date is listed in the OSCAR by semester. The student must complete the form and it must be signed by the student and the advisor. The form is taken to the cashier's office and the required fee is paid. Once paid, return the petition to the Bioengineering Program Office for the chair's signature.

2. The student must be registered during the semester in which the final presentation occurs. A student must also be registered the semester he/she plans to graduate unless an enrollment waiver is requested and approved. **An enrollment waiver will not be approved if the Thesis has not been accepted by the Graduate Studies Office by the published deadline.**

3. **Six weeks prior to the intended defense date**, poll the committee to establish a date and time for the presentation. Reserve a room and prepare an announcement of the presentation. The student is responsible for reserving the room and obtaining the necessary audio visual equipment prior to the oral presentation. *At this time, a preliminary thesis draft must be provided to the committee.*

4. The final presentation may be scheduled only after the members of the Thesis Reading Committee have reviewed the draft written document and consider the Thesis to be satisfactory.

5. **Two weeks prior to the intended defense date**, a final draft must be provided to the committee and the defense date confirmed.

6. **At least two weeks prior to the defense**, Email the announcement to Mr. Chris Ruffin and the Graduate Coordinator of your Home School. This announcement should include the name of your Advisor as well as the names of your Thesis/Reading committee members. The subject line on the announcement should read **Ph.D. Defense Presentation**. *Georgia Tech requires at least two weeks publicity of your defense, **without exception**.*

7. Before your defense, obtain the forms necessary to be completed by your committee at your defense. These include a *Thesis Approval Certificate* and Bioengineering Program

Ph.D. Defense Evaluation Forms. These can be downloaded from the Bioengineering Program web site.

8. The signed *Thesis Approval Certificate* form is then given to Bioengineering Program Chair to sign.

9. After successful public defense of the Thesis, the candidate prepares a final manuscript incorporating the modifications required by the Thesis Reading Committee. After obtaining approval signatures from the Thesis Reading Committee and the Bioengineering Program Chair, the candidate should follow the electronic submission, printing and distribution as specified at: `http://www.grad.gatech.edu/thesis/electronic_submission.html`

10. Submit the Thesis Approval Certificate to the Office of Graduate Studies and Research, Savant Building.

Chapter 6

M.S. Degree Requirements (Thesis Option)

The purpose of the Master's Thesis is to further the educational development by requiring the student to plan, conduct, and report an organized and systematic study of importance.

In keeping with the Bioengineering policy of educating both practicing and research engineers, a Thesis can range from a design project to a fundamental research investigation. Although the student may propose a Thesis topic and seek an advisor, the usual procedure is for a student to work on a problem suggested by a faculty member. If the student is employed on a sponsored research project, the Thesis will usually be derived from this work.

6.1 Coursework

The Program of Study categories are described elsewhere. In terms of those categories, the coursework requirements for the M.S. (Thesis) are:

- **Engineering Fundamentals**: 3-6 semester hours, with at least 3 semester hours at the graduate level.
- **Biological Sciences**: 3-6 semester hours, with at least 3 semester hours at the graduate level.
- **Engineering Mathematics**: 3 semester hours at the graduate level, with specific course restrictions (see Engineering Mathematics description).
- **Bioengineering/Electives**: 9 semester hours, with at least 6 semester hours at the graduate level.

- **TOTAL Engineering Fundamentals+Biological Sciences** must be at least 9 semester hours. Students must justify their selection of courses and how they complement their academic background with the justification text that is submitted with the Program of Study. In general, *a student with a B.S. in Engineering will be required to take 6 hours of biological sciences, and a student with a B.S. in Biological Sciences will be required to take 6 hours of engineering fundamentals. Students with a B.S. in Biomedical Engineering will be evaluated depending on the emphasis of their undergraduate curriculum.* **The decision regarding the number of hours in each category is made by the Graduate Chair in consultation with the Graduate Committee, and are solely based on the undergraduate transcript. If in doubt, please check before submitting a Program of Study.**

Total degree hours are 21 semester hours, with at least 15 at the graduate level.

6.2 M.S. Committee Formation

The student must submit a list of Thesis Committee members to the Bioengineering Program Office for approval by the Bioengineering Program Chair. The committee must have at least three members, subject to the constraints below.

1. The student's Thesis advisor should provide a short justification for the selection of each member of the MS Thesis Reading Committee.
2. If a proposed member is not a Georgia Tech faculty member, a biographical sketch (NIH 4 page CV or similar) of that proposed member must also accompany the request.
3. The advisor or one of the co-advisors must be a program faculty member.
4. There must be at least two regular members who are not advisors, one from the student's home school and a second who is from outside the home school.

6.3 Procedure for Committtee Formation and Topic Selection

1. Once a Thesis topic is chosen, a *Request for Approval of Thesis Topic* needs to be signed by the Thesis advisor, Thesis committee members and submitted by the student to the Chair of the Bioengineering Program.
2. The *Request for Approval of Thesis Topic* should be submitted as early as possible, but not later than the petition for degree.

6.4 Procedure for M.S. Defense

MS Thesis students must give an oral presentation of the Thesis. This presentation is not a formal defense; rather, the approval of the Thesis is based upon the written document.

Georgia Tech maintains a Thesis manual which contains two important sections: "What you have to do to graduate" and "Documents and Forms." The website for the Thesis Manual is located at http://www.grad.gatech.edu/thesis/thesis_man.html. Much of it is reflected in the Bioengineering Program procedures described below, which must be followed.

1. To complete its records for each M.S. student the Registrar's Office requires *A Petition for Degree*. **The degree petition must be submitted to the Registrar's Office prior to the end of the semester preceding the student's final semester.** The exact date is listed in the OSCAR by semester. The student must complete the form and it must be signed by the student and the advisor. The form is taken to the cashier's office and the required fee is paid. Once paid, return the petition to the Bioengineering Program Office for the chair's signature.

2. The student must be registered during the semester in which the final presentation occurs. A student must also be registered the semester he/she plans to graduate unless an enrollment waiver is requested and approved. **An enrollment waiver will not be approved if the Thesis has not been accepted by the Graduate Studies Office by the published deadline.**

3. The candidate must provide copies of the completed final draft of the Thesis to each member of the Thesis/Reading Committee. This must be done at least **two weeks** before the final Thesis Presentation.

4. **Six weeks prior to the intended defense date**, poll the committee to establish a date and time for the presentation. Reserve a room and prepare an announcement of the presentation. The student is responsible for reserving the room and obtaining the necessary audio visual equipment prior to the oral presentation. *At this time, a preliminary thesis draft must be provided to the committee.*

5. The final presentation may be scheduled only after the members of the Thesis Reading Committee have reviewed the draft written document and consider the Thesis to be satisfactory.

6. **Two weeks prior to the intended defense date**, a final draft must be provided to the committee and the defense date confirmed.

7. **At least two weeks prior to the defense**, Email the announcement to Mr. Chris Ruffin and the Graduate Coordinator of your Home School. This announcement should include

the name of your Advisor as well as the names of your Thesis/Reading committee members. The subject line on the announcement should read **M.S. Defense Presentation**. *Georgia Tech requires at least two weeks publicity of your defense,* ***without exception***.

8. Before your defense, obtain the forms necessary to be completed by your committee at your defense. These include a *Thesis Approval Certificate* and Bioengineering Program M.S. Defense Evaluation Forms. These can be downloaded from the Bioengineering Program web site.

9. The signed *Thesis Approval Certificate* form is then given to Bioengineering Program Chair to sign.

10. After successful public defense of the Thesis, the candidate prepares a final manuscript incorporating the modifications required by the Thesis Reading Committee. After obtaining approval signatures from the Thesis Reading Committee and the Bioengineering Program Chair, the candidate should follow the electronic submission, printing and distribution as specified at: `http://www.grad.gatech.edu/thesis/electronic_submission.html`.

11. Submit the Thesis Approval Certificate to the Office of Graduate Studies and Research, Savant Building.

Chapter 7

M.S. Degree Requirements (Non-thesis Option)

The purpose of the M.S. Degree (Non-Thesis) is primarily to allow a Bioengineering focus for BS/MS students who have been enrolled at Georgia Tech as undergraduates and accepted by a participating school into the BS/MS program.

At the time of this writing, *only the Schools of ECE and ME offer the non-thesis option.*

7.1 Coursework

The Program of Study categories are described elsewhere. In terms of those categories, the coursework requirements for the M.S. (Non-Thesis) are:

- **Engineering Fundamentals**: 6-9 semester hours, with no more than 3 hours at the 4000 level.
- **Biological Sciences**: 6-9 semester hours, with no more than 3 semester hours at the 4000 level.
- **Engineering Mathematics**: 3 semester hours at the graduate level, with specific course restrictions (see Engineering Mathematics description).
- **Bioengineering/Electives**: 12 semester hours, with at least 9 semester hours at the graduate level.
- **TOTAL Engineering Fundamentals+Biological Sciences** must be at least 15 semester hours. Students must justify their selection of courses and how they complement their academic background with the justification text that is submitted with the Program of Study.

Total degree hours are 30 semester hours, with at least 24 at the graduate level.

Appendix A

Faculty Membership Information

Information on Rights and Responsibilities for Faculty Membership and procedures for applying for Program Membership and Renewal are online at http://www.bioengineering.gatech.edu/faculty/rightsandrespons.htm

Appendix B

Faculty Committee Membership

B.1 General Faculty

A listing of the Faculty Members of the IBGP is online at http://www.bioengineering.gatech.edu/faculty/faculty.html

B.2 Graduate Studies Committee

The Graduate Studies Committee is chaired by the IBGP Program Chair. Members are appointed by the Chair. Current committee membership as of the Fall 2006 semester are:

Robert Butera	ECE
Tom Burkholder	APPH
Steve DeWeerth	BMED/ECE
Rudy Gleason	ME/BMED
Julie Jacko	BMED
Frank Loeffler	CEE
Valeria Milam	MSE
Oskar Skrinjar	BMED
Stephen Spriggle	ARCH/APPH
Johnna Temenoff	BMED
Ajit Yoganathan	BMED

B.3 Faculty Advisory Committee

The Faculty Advisory Committee members, their Home School, and their expiration term are listed below. New members are elected for terms starting in the Fall semester.

Robert Lee	BMED	Fall 2008
Xiaoping Hu	BMED	Fall 2008
Joseph LeDoux	BMED	Fall 2009
Hang Lu	ChBE	Fall 2009
David Ku*	ME	Fall 2010
Julie Jacko*	BMED	Fall 2010

* denotes nominated to replace those with terms expiring in Fall 2007, pending IBGP program faculty approval in August 2007.

By-laws of the Faculty Advisory Committee are available online at http://www.bioengineering.gatech.edu/documents/BIOE%20FAC%20-%20by-laws%20approved%209-28-2004%20(2).pdf

Appendix C

Bioengineering Graduate Student Advisory Committee

BGSAC maintains its own web site at http://www.bioengineering.gatech.edu/students/advisory.html.

C.1 Membership

Members of BGSAC are listed at http://www.bioengineering.gatech.edu/students/advisory.html.

C.2 Bylaws

Bylaws of BGSAC are listed at http://www.bioengineering.gatech.edu/students/bgsacbylaws.htm.

Appendix D

Courses Pre-approved for Programs of Study

Please see the Program of Study sections for more information. In the tables below, approved categories are indicated by M: Engineering Mathematics, E: Engineering Fundamentals, B: Biological Sciences, BF: Biological Foundations course, T: Technical/Bioengineering Electives and X: Not Allowed. Any course approved for M, B, or E will also be approved in the T category.

Courses not listed are subject to approval by the Graduate Committee. Appeals for *listed* courses to be considered for another category not listed will usually be denied, as this list is compiled based on years of past history considering such requests.

D.1 Course Listings by Category

Where	School	Number	Title	Category
GT	APPH	6211	Systems Physiology I: Cellular Mechanisms	BF
GT	BIOL	7001	Foundations of Molecular and Cellular Biology	BF
GT	BMED	6031	Biomedical Sciences I	BF
GT	BMED	6042	Systems Physiology	BF
GT	CHEM	6501	Biochemistry I	BF
Emory	IBS	514	Neuroanatomy and Systems Neuroscience	BF
GT	APPH	6212	Systems Physiology II: Physiology of Neuromotor Tissues	B
GT	APPH	6232	Locomotion Neuromechanics	B
GT	APPH	6600	Muscle Struct and Plasticity	B
GT	APPH	6213	Systems Physiology III: Integrated Systems and Adaptation	B
GT	BIOL	6418	Microbial Physiology	B
GT	BIOL	6570	Immunology	B

Where	School	Number	Title	Category
GT	BIOL	6600	Evolution	B
GT	BIOL	6611	Advanced Microbial Physiology	B
GT	BIOL	6626	Physiological Ecology	B
GT	BIOL	6756	Discovery of Signal Molecules	B
GT	BIOL	7668	Eukaryotic Molecular Genetics	B
GT	BMED	6032	Biomedical Sciences II	B
GT	BMED	6793	Systems Pathophysiology	B
GT	CHEM	6183	Organometallic Chemistry	B
GT	CHEM	6373	Organic Synthesis	B
GT	CHEM	6502	Biochemistry II	B
GT	CHEM	6571	Enzymology	B
GT	CHEM	6572	Macromolecular Structures	B
GT	CHEM	6573	Molecular Biochemistry	B
GT	CHEM	6582	Biophysical Chemistry	B
GT	ME	6793	Systems Pathophysiology	B
Emory	IBS	506	Basics of Neurological Diseases	B
Emory	IBS	518	Human Embryology	B
Emory	IBS	519	Foundations in Developmental Biology	B
Emory	IBS	524	Cancer Biology	B
Emory	IBS	526	Cellular and Developmental Neuroscience	B
Emory	IBS	527	Cell Biology and Histology	B
Emory	IBS	531	Principles of Pharmacology	B
Emory	IBS	536	Drug Metabolism and Toxicology	B
Emory	IBS	542	Concepts of Immunology	B
Emory	IBS	548	Biology of the Eye	B
Emory	IBS	600	Blood and Water	B
Emory	IBS	761	Cancer Pharmacology	B
GT	AE	7772	Fundamentals of Fracture Mechanics	E
GT	CEE	6251	Fluid Mechanics	E
GT	CEE	6504	Finite Element Methods	E
GT	CEE	7772	Fundamentals of Fracture Mechanics	E
GT	CHBE	6100	Thermodynamics	E
GT	CHBE	6200	Transport Phenomena	E
GT	CHBE	6220	Computational Fluid Dyn	E
GT	CHBE	6250	Mass Transport Through Solids	E
GT	CHBE	6260	Mass Transfer	E
GT	CHBE	6300	Kinetic and Reactor Design	E
GT	CHBE	6400	Adv Process Control	E
GT	CHBE	6768	Polymer Structure and Props	E
GT	CHBE	7772	Fundamentals of Fracture Mechanics	E
GT	CHEM	6751	Phys Chem-Poly Solutions	E
GT	CS	6230	High Performance Parallel Computing: Tools and Applications	E
GT	CS	6452	Protoyping Interactive Systems	E

Where	School	Number	Title	Category
GT	CS	6456	Principles of UI Software	E
GT	ECE	4270	Fundamentals of DSP	E
GT	ECE	4580	Computational Computer Vision	E
GT	ECE	6130	Adv VLSI Systems	E
GT	ECE	6250	Advanced Dig Sig Proc	E
GT	ECE	6254	Stat Digit Sig Proc and Mod	E
GT	ECE	6255	Digit Proc-Speech Signal	E
GT	ECE	6258	Image Processing	E
GT	ECE	6273	Pattern Recognition	E
GT	ECE	6350	Electromagnetics	E
GT	ECE	6360	Microwave Design	E
GT	ECE	6370	Electromagnetic Radiation and Antennas	E
GT	ECE	6380	Intro Computational EM	E
GT	ECE	6412	Analog Integ Circuit Dgn	E
GT	ECE	6414	Analog Integrate Sys Dgn	E
GT	ECE	6435	Neuro Analog VLSI Circuits	E
GT	ECE	6442	Electronic Oscillators	E
GT	ECE	6450	Introduction to Microelectronics Technology	E
GT	ECE	6451	Intro Microelectronics	E
GT	ECE	6453	Theory Electronic Device	E
GT	ECE	6460	Microelectromechanical System Fabrication	E
GT	ECE	6500	Fourier Tech and Signal Analy	E
GT	ECE	6501	Fourier Optic and Holography	E
GT	ECE	6520	Integrated Optics	E
GT	ECE	6522	Nonlinear Optics	E
GT	ECE	6542	Optoelectronic Systems	E
GT	ECE	6550	Linear Systems	E
GT	ECE	6552	Nonlinear Systems	E
GT	ECE	6553	Optimal Control	E
GT	ECE	6554	Adaptive Control	E
GT	ECE	6556	Intelligent Control	E
GT	ECE	6560	PDEs Image Proc and Vision	E
GT	ECE	6605	Information Theory	E
GT	ECE	6606	Coding Theory and Appl	E
GT	ECE	6771	Optoelectronics	E
GT	ECE	6779	Therm Pkg-Micro/Nano Sys	E
GT	ECE	7252	Advanced Signal Processing Theory	E
GT	ISyE	6215	Models of Human Machine Systems	E
GT	ISyE	6223	Decision Making	E
GT	ISyE	6234	Measurement and Evaluation of Human Integrated Systems	E
GT	ISyE	6669	Deterministic Optimization	E
GT	ME	6124	Finite-Element Method	E
GT	ME	6201	Principle-Continuum Mech	E

Where	School	Number	Title	Category
GT	ME	6203	Inelastic Deform Solids	E
GT	ME	6204	Micromechanics-Materials	E
GT	ME	6229	Introduction to MEMS	E
GT	ME	6242	Mechanics of Contact	E
GT	ME	6301	Conduction Heat Transfer	E
GT	ME	6302	Convection Heat Transfer	E
GT	ME	6303	Thermal Radiation Heat Transfer	E
GT	ME	6304	Principles of Thermodynamics	E
GT	ME	6305	Apps of Thermodynamics	E
GT	ME	6401	Linear Control Systems	E
GT	ME	6402	Nonlinear Control System	E
GT	ME	6403	Digital Control Systems	E
GT	ME	6405	Intro to Mechatronics	E
GT	ME	6407	Robotics	E
GT	ME	6441	Dynamics	E
GT	ME	6442	Vibration-Mechanical Sys	E
GT	ME	6443	Variational Methods in Engineering	E
GT	ME	6452	Wave Propagation-Solids	E
GT	ME	6601	Fluid Mechanics	E
GT	ME	6601	Introduction to Fluid Mechanics	E
GT	ME	6602	Viscous Flow	E
GT	ME	6622	Experimental Methods	E
GT	ME	6760	Acoustics I	E
GT	ME	6762	Applied Acoustics	E
GT	ME	6766	Combustion	E
GT	ME	6768	Polymer Structure and Props	E
GT	ME	6770	Energy: Elasticity and Plasticity	E
GT	ME	6796	Structure-property relationships in materials	E
GT	ME	7751	Computational Fluid Mechanics	E
GT	ME	7772	Fundamentals of Fracture Mechanics	E
GT	ME	7774	Fatigue of Materials and Structure	E
GT	MSE	6130	Surface Analysis	E
GT	MSE	6310	Thermodynamics and Kinetics of Transport	E
GT	MSE	6751	Phys Chem-Poly Solutions	E
GT	MSE	6768	Polymer Structure and Props	E
GT	MSE	6796	Structure-property relationships in materials	E
GT	MSE	7772	Fundamentals of Fracture Mechanics	E
GT	PTFE	6100	Mechanics of Fibrous Materials	E
GT	PTFE	6751	Phys Chem-Poly Solutions	E
GT	PTFE	6768	Polymer Structure and Props	E
GT	PTFE	6796	Structure-property relationships in materials	E
GT	BMED	6041	Analytical Methods for BME	M
GT	CHBE	6500	Mathematical Modeling of Chemical Processes	M

Where	School	Number	Title	Category
GT	ECE	6601	Random Processes	M
GT	ME	6758	Numerical Methods in ME	M
GT	PHYS	6268	Nonlinear Dynamics and Chaos	M
GT	APPH	6225	Biostatistics	T
GT	APPH	6225	Biostatistics	T
GT	BIOL	7023	Bioinformatics	T
GT	BMED	4750	Diagnostic Imaging Physics	T
GT	BMED	4783	Intro Medical Image Processing	T
GT	BMED	4784	Engineering Electrophysiology	T
GT	BMED	6743	Tissue Mechanics	T
GT	BMED	6774	Biomaterials: Structure and Function	T
GT	BMED	6777	Advanced Biomaterials	T
GT	BMED	6780	Medical Image Processing	T
GT	BMED	6782	Cellular Engineering	T
GT	BMED	6786	Medical Imaging Systems	T
GT	BMED	6787	Quantitative Electrophysiology	T
GT	BMED	6794	Tissue Engineering	T
GT	CHBE	6794	Tissue Engineering	T
GT	CHEM	6750	Prep and Reactions-Polymers	T
GT	ECE	4781	Bioinstrumentation	T
GT	ECE	4782	Biosystems Analysis	T
GT	ECE	4783	Intro Medical Image Processing	T
GT	ECE	4784	Engineering Electrophysiology	T
GT	ECE	6780	Medical Image Processing	T
GT	ECE	6786	Medical Imaging Systems	T
GT	ECE	6787	Quantitative Electrophysiology	T
GT	ISYE	6413	Dsgn and Analy-Experiments	T
GT	ISYE	6414	Regression Analysis	T
GT	ME	6743	Tissue Mechanics	T
GT	ME	6777	Advanced Biomaterials	T
GT	ME	6782	Cellular Engineering	T
GT	ME	6794	Tissue Engineering	T
GT	MP	4750	Diagnostic Imaging Physics	T
GT	MSE	6752	Polymer Characterization	T
GT	MSE	6774	Biomaterials: Structure and Function	T
GT	MSE	6777	Advanced Biomaterials	T
GT	NRE	4750	Diagnostic Imaging Physics	T
GT	PHYS	6268	Nonlinear Dynamics	T
GT	PTFE	6750	Prep and Reactions-Polymers	T
Emory	IBS	534	Computational Neuroscience	T
GT	BMED	6022	BME Problem Solving II	X

D.2 Course Listings by School/Dept

Where	School	Number	Title	Category
GT	AE	7772	Fundamentals of Fracture Mechanics	E
GT	APPH	6211	Systems Physiology I: Cellular Mechanisms	BF
GT	APPH	6212	Systems Physiology II: Physiology of Neuromotor Tissues	B
GT	APPH	6225	Biostatistics	T
GT	APPH	6232	Locomotion Neuromechanics	B
GT	APPH	6600	Muscle Struct and Plasticity	B
GT	APPH	6213	Systems Physiology III: Integrated Systems and Adaptation	B
GT	APPH	6225	Biostatistics	T
GT	BIOL	6418	Microbial Physiology	B
GT	BIOL	6570	Immunology	B
GT	BIOL	6600	Evolution	B
GT	BIOL	6611	Advanced Microbial Physiology	B
GT	BIOL	6626	Physiological Ecology	B
GT	BIOL	6756	Discovery of Signal Molecules	B
GT	BIOL	7001	Foundations of Molecular and Cellular Biology	BF
GT	BIOL	7023	Bioinformatics	T
GT	BIOL	7668	Eukaryotic Molecular Genetics	B
GT	BMED	4750	Diagnostic Imaging Physics	T
GT	BMED	4783	Intro Medical Image Processing	T
GT	BMED	4784	Engineering Electrophysiology	T
GT	BMED	6022	BME Problem Solving II	X
GT	BMED	6031	Biomedical Sciences I	BF
GT	BMED	6032	Biomedical Sciences II	B
GT	BMED	6041	Analytical Methods for BME	M
GT	BMED	6042	Systems Physiology	BF
GT	BMED	6743	Tissue Mechanics	T
GT	BMED	6774	Biomaterials: Structure and Function	T
GT	BMED	6777	Advanced Biomaterials	T
GT	BMED	6780	Medical Image Processing	T
GT	BMED	6782	Cellular Engineering	T
GT	BMED	6786	Medical Imaging Systems	T
GT	BMED	6787	Quantitative Electrophysiology	T
GT	BMED	6793	Systems Pathophysiology	B
GT	BMED	6794	Tissue Engineering	T
GT	CEE	6251	Fluid Mechanics	E
GT	CEE	6504	Finite Element Methods	E
GT	CEE	7772	Fundamentals of Fracture Mechanics	E
GT	CHBE	6100	Thermodynamics	E
GT	CHBE	6200	Transport Phenomena	E
GT	CHBE	6220	Computational Fluid Dyn	E

Where	School	Number	Title	Category
GT	CHBE	6250	Mass Transport Through Solids	E
GT	CHBE	6260	Mass Transfer	E
GT	CHBE	6300	Kinetic and Reactor Design	E
GT	CHBE	6400	Adv Process Control	E
GT	CHBE	6500	Mathematical Modeling of Chemical Processes	M
GT	CHBE	6768	Polymer Structure and Props	E
GT	CHBE	6794	Tissue Engineering	T
GT	CHBE	7772	Fundamentals of Fracture Mechanics	E
GT	CHEM	6183	Organometallic Chemistry	B
GT	CHEM	6373	Organic Synthesis	B
GT	CHEM	6501	Biochemistry I	BF
GT	CHEM	6502	Biochemistry II	B
GT	CHEM	6571	Enzymology	B
GT	CHEM	6572	Macromolecular Structures	B
GT	CHEM	6573	Molecular Biochemistry	B
GT	CHEM	6582	Biophysical Chemistry	B
GT	CHEM	6750	Prep and Reactions-Polymers	T
GT	CHEM	6751	Phys Chem-Poly Solutions	E
GT	CS	6230	High Performance Parallel Computing: Tools and Applications	E
GT	CS	6452	Protoyping Interactive Systems	E
GT	CS	6456	Principles of UI Software	E
GT	ECE	4270	Fundamentals of DSP	E
GT	ECE	4580	Computational Computer Vision	E
GT	ECE	4781	Bioinstrumentation	T
GT	ECE	4782	Biosystems Analysis	T
GT	ECE	4783	Intro Medical Image Processing	T
GT	ECE	4784	Engineering Electrophysiology	T
GT	ECE	6130	Adv VLSI Systems	E
GT	ECE	6250	Advanced Dig Sig Proc	E
GT	ECE	6254	Stat Digit Sig Proc and Mod	E
GT	ECE	6255	Digit Proc-Speech Signal	E
GT	ECE	6258	Image Processing	E
GT	ECE	6273	Pattern Recognition	E
GT	ECE	6350	Electromagnetics	E
GT	ECE	6360	Microwave Design	E
GT	ECE	6370	Electromagnetic Radiation and Antennas	E
GT	ECE	6380	Intro Computational EM	E
GT	ECE	6412	Analog Integ Circuit Dgn	E
GT	ECE	6414	Analog Integrate Sys Dgn	E
GT	ECE	6435	Neuro Analog VLSI Circuits	E
GT	ECE	6442	Electronic Oscillators	E
GT	ECE	6450	Introduction to Microelectronics Technology	E
GT	ECE	6451	Intro Microelectronics	E

Where	School	Number	Title	Category
GT	ECE	6453	Theory Electronic Device	E
GT	ECE	6460	Microelectromechanical System Fabrication	E
GT	ECE	6500	Fourier Tech and Signal Analy	E
GT	ECE	6501	Fourier Optic and Holography	E
GT	ECE	6520	Integrated Optics	E
GT	ECE	6522	Nonlinear Optics	E
GT	ECE	6542	Optoelectronic Systems	E
GT	ECE	6550	Linear Systems	E
GT	ECE	6552	Nonlinear Systems	E
GT	ECE	6553	Optimal Control	E
GT	ECE	6554	Adaptive Control	E
GT	ECE	6556	Intelligent Control	E
GT	ECE	6560	PDEs Image Proc and Vision	E
GT	ECE	6601	Random Processes	M
GT	ECE	6605	Information Theory	E
GT	ECE	6606	Coding Theory and Appl	E
GT	ECE	6771	Optoelectronics	E
GT	ECE	6779	Therm Pkg-Micro/Nano Sys	E
GT	ECE	6780	Medical Image Processing	T
GT	ECE	6786	Medical Imaging Systems	T
GT	ECE	6787	Quantitative Electrophysiology	T
GT	ECE	7252	Advanced Signal Processing Theory	E
GT	ISyE	6215	Models of Human Machine Systems	E
GT	ISyE	6223	Decision Making	E
GT	ISyE	6234	Measurement and Evaluation of Human Integrated Systems	E
GT	ISYE	6413	Dsgn and Analy-Experiments	T
GT	ISYE	6414	Regression Analysis	T
GT	ISyE	6669	Deterministic Optimization	E
GT	ME	6124	Finite-Element Method	E
GT	ME	6201	Principle-Continuum Mech	E
GT	ME	6203	Inelastic Deform Solids	E
GT	ME	6204	Micromechanics-Materials	E
GT	ME	6229	Introduction to MEMS	E
GT	ME	6242	Mechanics of Contact	E
GT	ME	6301	Conduction Heat Transfer	E
GT	ME	6302	Convection Heat Transfer	E
GT	ME	6303	Thermal Radiation Heat Transfer	E
GT	ME	6304	Principles of Thermodynamics	E
GT	ME	6305	Apps of Thermodynamics	E
GT	ME	6401	Linear Control Systems	E
GT	ME	6402	Nonlinear Control System	E
GT	ME	6403	Digital Control Systems	E
GT	ME	6405	Intro to Mechatronics	E

Where	School	Number	Title	Category
GT	ME	6407	Robotics	E
GT	ME	6441	Dynamics	E
GT	ME	6442	Vibration-Mechanical Sys	E
GT	ME	6443	Variational Methods in Engineering	E
GT	ME	6452	Wave Propagation-Solids	E
GT	ME	6601	Fluid Mechanics	E
GT	ME	6601	Introduction to Fluid Mechanics	E
GT	ME	6602	Viscous Flow	E
GT	ME	6622	Experimental Methods	E
GT	ME	6743	Tissue Mechanics	T
GT	ME	6758	Numerical Methods in ME	M
GT	ME	6760	Acoustics I	E
GT	ME	6762	Applied Acoustics	E
GT	ME	6766	Combustion	E
GT	ME	6768	Polymer Structure and Props	E
GT	ME	6770	Energy: Elasticity and Plasticity	E
GT	ME	6777	Advanced Biomaterials	T
GT	ME	6782	Cellular Engineering	T
GT	ME	6793	Systems Pathophysiology	B
GT	ME	6794	Tissue Engineering	T
GT	ME	6796	Structure-property relationships in materials	E
GT	ME	7751	Computational Fluid Mechanics	E
GT	ME	7772	Fundamentals of Fracture Mechanics	E
GT	ME	7774	Fatigue of Materials and Structure	E
GT	MP	4750	Diagnostic Imaging Physics	T
GT	MSE	6130	Surface Analysis	E
GT	MSE	6310	Thermodynamics and Kinetics of Transport	E
GT	MSE	6751	Phys Chem-Poly Solutions	E
GT	MSE	6752	Polymer Characterization	T
GT	MSE	6768	Polymer Structure and Props	E
GT	MSE	6774	Biomaterials: Structure and Function	T
GT	MSE	6777	Advanced Biomaterials	T
GT	MSE	6796	Structure-property relationships in materials	E
GT	MSE	7772	Fundamentals of Fracture Mechanics	E
GT	NRE	4750	Diagnostic Imaging Physics	T
GT	PHYS	6268	Nonlinear Dynamics	T
GT	PHYS	6268	Nonlinear Dynamics and Chaos	M
GT	PTFE	6100	Mechanics of Fibrous Materials	E
GT	PTFE	6750	Prep and Reactions-Polymers	T
GT	PTFE	6751	Phys Chem-Poly Solutions	E
GT	PTFE	6768	Polymer Structure and Props	E
GT	PTFE	6796	Structure-property relationships in materials	E
Emory	IBS	506	Basics of Neurological Diseases	B

Where	School	Number	Title	Category
Emory	IBS	514	Neuroanatomy and Systems Neuroscience	BF
Emory	IBS	518	Human Embryology	B
Emory	IBS	519	Foundations in Developmental Biology	B
Emory	IBS	524	Cancer Biology	B
Emory	IBS	526	Cellular and Developmental Neuroscience	B
Emory	IBS	527	Cell Biology and Histology	B
Emory	IBS	531	Principles of Pharmacology	B
Emory	IBS	534	Computational Neuroscience	T
Emory	IBS	536	Drug Metabolism and Toxicology	B
Emory	IBS	542	Concepts of Immunology	B
Emory	IBS	548	Biology of the Eye	B
Emory	IBS	600	Blood and Water	B
Emory	IBS	761	Cancer Pharmacology	B

D.3 Course Listings by Number

Where	School	Number	Title	Category
GT	ECE	4270	Fundamentals of DSP	E
GT	ECE	4580	Computational Computer Vision	E
GT	BMED	4750	Diagnostic Imaging Physics	T
GT	MP	4750	Diagnostic Imaging Physics	T
GT	NRE	4750	Diagnostic Imaging Physics	T
GT	ECE	4781	Bioinstrumentation	T
GT	ECE	4782	Biosystems Analysis	T
GT	BMED	4783	Intro Medical Image Processing	T
GT	ECE	4783	Intro Medical Image Processing	T
GT	BMED	4784	Engineering Electrophysiology	T
GT	ECE	4784	Engineering Electrophysiology	T
GT	BMED	6022	BME Problem Solving II	X
GT	BMED	6031	Biomedical Sciences I	BF
GT	BMED	6032	Biomedical Sciences II	B
GT	BMED	6041	Analytical Methods for BME	M
GT	BMED	6042	Systems Physiology	BF
GT	CHBE	6100	Thermodynamics	E
GT	PTFE	6100	Mechanics of Fibrous Materials	E
GT	ME	6124	Finite-Element Method	E
GT	ECE	6130	Adv VLSI Systems	E
GT	MSE	6130	Surface Analysis	E
GT	CHEM	6183	Organometallic Chemistry	B
GT	CHBE	6200	Transport Phenomena	E
GT	ME	6201	Principle-Continuum Mech	E

Where	School	Number	Title	Category
GT	ME	6203	Inelastic Deform Solids	E
GT	ME	6204	Micromechanics-Materials	E
GT	APPH	6211	Systems Physiology I: Cellular Mechanisms	BF
GT	APPH	6212	Systems Physiology II: Physiology of Neuromotor Tissues	B
GT	APPH	6213	Systems Physiology III: Integrated Systems and Adaptation	B
GT	ISyE	6215	Models of Human Machine Systems	E
GT	CHBE	6220	Computational Fluid Dyn	E
GT	ISyE	6223	Decision Making	E
GT	APPH	6225	Biostatistics	T
GT	APPH	6225	Biostatistics	T
GT	ME	6229	Introduction to MEMS	E
GT	CS	6230	High Performance Parallel Computing: Tools and Applications	E
GT	APPH	6232	Locomotion Neuromechanics	B
GT	ISyE	6234	Measurement and Evaluation of Human Integrated Systems	E
GT	ME	6242	Mechanics of Contact	E
GT	CHBE	6250	Mass Transport Through Solids	E
GT	ECE	6250	Advanced Dig Sig Proc	E
GT	CEE	6251	Fluid Mechanics	E
GT	ECE	6254	Stat Digit Sig Proc and Mod	E
GT	ECE	6255	Digit Proc-Speech Signal	E
GT	ECE	6258	Image Processing	E
GT	CHBE	6260	Mass Transfer	E
GT	PHYS	6268	Nonlinear Dynamics	T
GT	PHYS	6268	Nonlinear Dynamics and Chaos	M
GT	ECE	6273	Pattern Recognition	E
GT	CHBE	6300	Kinetic and Reactor Design	E
GT	ME	6301	Conduction Heat Transfer	E
GT	ME	6302	Convection Heat Transfer	E
GT	ME	6303	Thermal Radiation Heat Transfer	E
GT	ME	6304	Principles of Thermodynamics	E
GT	ME	6305	Apps of Thermodynamics	E
GT	MSE	6310	Thermodynamics and Kinetics of Transport	E
GT	ECE	6350	Electromagnetics	E
GT	ECE	6360	Microwave Design	E
GT	ECE	6370	Electromagnetic Radiation and Antennas	E
GT	CHEM	6373	Organic Synthesis	B
GT	ECE	6380	Intro Computational EM	E
GT	CHBE	6400	Adv Process Control	E
GT	ME	6401	Linear Control Systems	E
GT	ME	6402	Nonlinear Control System	E
GT	ME	6403	Digital Control Systems	E
GT	ME	6405	Intro to Mechatronics	E
GT	ME	6407	Robotics	E

Where	School	Number	Title	Category
GT	ECE	6412	Analog Integ Circuit Dgn	E
GT	ISYE	6413	Dsgn and Analy-Experiments	T
GT	ECE	6414	Analog Integrate Sys Dgn	E
GT	ISYE	6414	Regression Analysis	T
GT	BIOL	6418	Microbial Physiology	B
GT	ECE	6435	Neuro Analog VLSI Circuits	E
GT	ME	6441	Dynamics	E
GT	ECE	6442	Electronic Oscillators	E
GT	ME	6442	Vibration-Mechanical Sys	E
GT	ME	6443	Variational Methods in Engineering	E
GT	ECE	6450	Introduction to Microelectronics Technology	E
GT	ECE	6451	Intro Microelectronics	E
GT	CS	6452	Protoyping Interactive Systems	E
GT	ME	6452	Wave Propagation-Solids	E
GT	ECE	6453	Theory Electronic Device	E
GT	CS	6456	Principles of UI Software	E
GT	ECE	6460	Microelectromechanical System Fabrication	E
GT	CHBE	6500	Mathematical Modeling of Chemical Processes	M
GT	ECE	6500	Fourier Tech and Signal Analy	E
GT	CHEM	6501	Biochemistry I	BF
GT	ECE	6501	Fourier Optic and Holography	E
GT	CHEM	6502	Biochemistry II	B
GT	CEE	6504	Finite Element Methods	E
GT	ECE	6520	Integrated Optics	E
GT	ECE	6522	Nonlinear Optics	E
GT	ECE	6542	Optoelectronic Systems	E
GT	ECE	6550	Linear Systems	E
GT	ECE	6552	Nonlinear Systems	E
GT	ECE	6553	Optimal Control	E
GT	ECE	6554	Adaptive Control	E
GT	ECE	6556	Intelligent Control	E
GT	ECE	6560	PDEs Image Proc and Vision	E
GT	BIOL	6570	Immunology	B
GT	CHEM	6571	Enzymology	B
GT	CHEM	6572	Macromolecular Structures	B
GT	CHEM	6573	Molecular Biochemistry	B
GT	CHEM	6582	Biophysical Chemistry	B
GT	APPH	6600	Muscle Struct and Plasticity	B
GT	BIOL	6600	Evolution	B
GT	ECE	6601	Random Processes	M
GT	ME	6601	Fluid Mechanics	E
GT	ME	6601	Introduction to Fluid Mechanics	E
GT	ME	6602	Viscous Flow	E

Where	School	Number	Title	Category
GT	ECE	6605	Information Theory	E
GT	ECE	6606	Coding Theory and Appl	E
GT	BIOL	6611	Advanced Microbial Physiology	B
GT	ME	6622	Experimental Methods	E
GT	BIOL	6626	Physiological Ecology	B
GT	ISyE	6669	Deterministic Optimization	E
GT	BMED	6743	Tissue Mechanics	T
GT	ME	6743	Tissue Mechanics	T
GT	CHEM	6750	Prep and Reactions-Polymers	T
GT	PTFE	6750	Prep and Reactions-Polymers	T
GT	CHEM	6751	Phys Chem-Poly Solutions	E
GT	MSE	6751	Phys Chem-Poly Solutions	E
GT	PTFE	6751	Phys Chem-Poly Solutions	E
GT	MSE	6752	Polymer Characterization	T
GT	BIOL	6756	Discovery of Signal Molecules	B
GT	ME	6758	Numerical Methods in ME	M
GT	ME	6760	Acoustics I	E
GT	ME	6762	Applied Acoustics	E
GT	ME	6766	Combustion	E
GT	CHBE	6768	Polymer Structure and Props	E
GT	ME	6768	Polymer Structure and Props	E
GT	MSE	6768	Polymer Structure and Props	E
GT	PTFE	6768	Polymer Structure and Props	E
GT	ME	6770	Energy: Elasticity and Plasticity	E
GT	ECE	6771	Optoelectronics	E
GT	BMED	6774	Biomaterials: Structure and Function	T
GT	MSE	6774	Biomaterials: Structure and Function	T
GT	BMED	6777	Advanced Biomaterials	T
GT	ME	6777	Advanced Biomaterials	T
GT	MSE	6777	Advanced Biomaterials	T
GT	ECE	6779	Therm Pkg-Micro/Nano Sys	E
GT	BMED	6780	Medical Image Processing	T
GT	ECE	6780	Medical Image Processing	T
GT	BMED	6782	Cellular Engineering	T
GT	ME	6782	Cellular Engineering	T
GT	BMED	6786	Medical Imaging Systems	T
GT	ECE	6786	Medical Imaging Systems	T
GT	BMED	6787	Quantitative Electrophysiology	T
GT	ECE	6787	Quantitative Electrophysiology	T
GT	BMED	6793	Systems Pathophysiology	B
GT	ME	6793	Systems Pathophysiology	B
GT	BMED	6794	Tissue Engineering	T
GT	CHBE	6794	Tissue Engineering	T

Where	School	Number	Title	Category
GT	ME	6794	Tissue Engineering	T
GT	ME	6796	Structure-property relationships in materials	E
GT	MSE	6796	Structure-property relationships in materials	E
GT	PTFE	6796	Structure-property relationships in materials	E
GT	BIOL	7001	Foundations of Molecular and Cellular Biology	BF
GT	BIOL	7023	Bioinformatics	T
GT	ECE	7252	Advanced Signal Processing Theory	E
GT	BIOL	7668	Eukaryotic Molecular Genetics	B
GT	ME	7751	Computational Fluid Mechanics	E
GT	AE	7772	Fundamentals of Fracture Mechanics	E
GT	CEE	7772	Fundamentals of Fracture Mechanics	E
GT	CHBE	7772	Fundamentals of Fracture Mechanics	E
GT	ME	7772	Fundamentals of Fracture Mechanics	E
GT	MSE	7772	Fundamentals of Fracture Mechanics	E
GT	ME	7774	Fatigue of Materials and Structure	E
Emory	IBS	506	Basics of Neurological Diseases	B
Emory	IBS	514	Neuroanatomy and Systems Neuroscience	BF
Emory	IBS	518	Human Embryology	B
Emory	IBS	519	Foundations in Developmental Biology	B
Emory	IBS	524	Cancer Biology	B
Emory	IBS	526	Cellular and Developmental Neuroscience	B
Emory	IBS	527	Cell Biology and Histology	B
Emory	IBS	531	Principles of Pharmacology	B
Emory	IBS	534	Computational Neuroscience	T
Emory	IBS	536	Drug Metabolism and Toxicology	B
Emory	IBS	542	Concepts of Immunology	B
Emory	IBS	548	Biology of the Eye	B
Emory	IBS	600	Blood and Water	B
Emory	IBS	761	Cancer Pharmacology	B