

Georgia Tech Interdisciplinary  
Bioengineering Graduate Program  
Handbook

Fall 2023



# 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. Please direct all questions to the IBGP office (described in Program Management).

Please note: ALL ACADEMIC FORMS - Programs of Study, Thesis Committees, Topic Approvals, Candidacy and Thesis Completion MUST BE TYPEWRITTEN - NO EXCEPTIONS.

# 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 Ph.D. and M.S. students with links to the appropriate section of the handbook.

### 2.1 Ph.D. Student Timeline Summary - Major Milestones

| Time/Years | Milestone                          | Instructions  |
|------------|------------------------------------|---|
| 1.5        | Qualifying Exam                    | Scheduled by the Bioengineering Office  |
| 2.0        | Formation of Ph.D. Committee       | See Guidelines  |
| 3.0        | Proposal approval and presentation | See Guidelines  |
| 4.5 - 5.5  | Thesis approval                    | Must occur 6 months prior to defense  |
| 5-6        | Thesis Defense                     | Approval form signed by committee must be submitted to the Bioengineering Graduate Office |
| Continuous | Yearly Updates                     | Scheduled by the Student  |

### 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<br>Ph.D. Coursework Requirements |

|  |  |  |
|--|--|--|
| 3rd semester   | Submit research profile form to take qualifying exam   | Form emailed to students by Program Office.                                      |
| End of 3rd semester                                  | Oral qualifying exam   | Qualifying Exam  |
| Post-qual exam                                       | Satisfy teaching practicum   | Teaching Practicum   |
| 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 qualifying exam                  | Ph.D. Proposal- Bring Admission to Candidacy form and evaluation forms.  | Ph.D. Proposal   |
| Day of Proposal                                      | Bring Admission to Candidacy form and Evaluation forms.  | Submit all forms to Bioengineering Graduate office with all committee signatures |
| Every 12 months                                      | Meet with and update Ph.D. Committee   | Research Progress  |
| 6 months prior to defense                            | Approval to schedule defense meeting with thesis committee   | Thesis approval Meeting  |
| 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 & electronic submission of dissertation | Dissertation Submission |

### 2.1.1 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   |  |

Please note: ALL ACADEMIC FORMS - Programs of Study, Thesis Committees, Topic Approvals, Candidacy and Thesis Completion MUST BE TYPEWRITTEN - NO EXCEPTIONS.

# Chapter 3

## Administrative Issues

### 3.1 Program Management

Hang Lu, Ph.D., is the Director of the BioE Program and Mark Styczynski, Ph.D., is the Deputy Director. The office is managed by Laura Paige. Ms. Paige 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. Drs. Lu and Styczynski are responsible for overall program administration and policy directions. Program-related inquiries should be made to Ms. Paige as a start. Drs. Lu and Styczynski hold regular office hours and can also meet with students outside the office hours given appropriate notice; contact Ms. Paige to schedule an appointment. For most issues, please email as most matters can be resolved quickly this way.

#### Contact Information:

Hang Lu, Ph.D.

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Mark Styczynski, Ph.D.

Office: EBB 4013

Email: [mark.styczynski@chbe.gatech.edu](mailto:mark.styczynski@chbe.gatech.edu) Phone: 404-894-2825

Ms. Laura Paige Office: IBB 2303

Email: [laura.paige@bioengineering.gatech.edu](mailto:laura.paige@bioengineering.gatech.edu) Phone: 404-385-6655

## 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 the entire faculty who participate in the IBGP. They approve all general policies and regularly meet 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 on the IBGP website.

### 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 in which transfer credit from another institution is requested and oversight of the Ph.D. Qualifying Examinations. 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 committee 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 website.

### 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 three 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 BGA: Bioengineering Graduate Association

The BGA 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 organizes student-wide meetings and activities. The bylaws and membership of the BGA are listed in the Appendix. The BGA website is located at <http://bioengineering.gatech.edu/bioengineering-graduate-association>

### 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 <https://registrar.gatech.edu/info/petition-faculty>

## 3.3 Home School

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

The participating Home Schools in the IBGP include the Schools of Aerospace Engineering (AE), Biomedical Engineering (BME), Chemical and Biomolecular Engineering (ChBE), Civil and Environmental Engineering (CEE), Electrical and Computer Engineering (ECE), Materials Science and Engineering (MSE), Mechanical Engineering (ME) 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 satisfied 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 permissible 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.

The Home School is also responsible for the administration of tuition waivers. 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 based on 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, see <https://grad.gatech.edu/paying-for-grad-school>.
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 avail-

able 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 financial 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 tuition 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: <https://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](mailto: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 <https://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 404-894-2575, or you can learn more online at <https://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 Ms. Laura Paige without exceptions. Do not ask the chair to sign something without running it by Ms. Paige first - The Bioengineering graduate office needs to keep copies of ALL required forms. All required forms have well-publicized unchanging deadlines, and students are 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 change 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 Ph.D. 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. Lu 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/>.

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 <https://registrar.gatech.edu/info/cross-registration-application>

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. Carolyn Lerner at [carolyn.lerner@registrar.gatech.edu](mailto:carolyn.lerner@registrar.gatech.edu)

Courses for MS students must be transferrable; Ph.D. 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 Ph.D. 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. 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, will coordinate with the home schools to match students with advisors. The final/approved match is made by the home schools.

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 Ph.D.-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 classification 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 Transferring into the Bioengineering Graduate Program

Qualified graduate students from other Ph.D. programs may be eligible to transfer to the BioE program. The program requires a minimum GPA of 3.2. Students who have passed qualifying exams in their current program may petition the BioE Graduate Curriculum Committee to be transferred to the BioE Ph.D. Program without taking the BioE qualifying exam. The Grad Curriculum Committee should consider the philosophy, format, content, and outcome of the past qualifying exam in consultation with the home school. The student will then be notified if he/she will be allowed to transfer into the Bioengineering program.

### 3.13 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 school; 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 facilitate this change. Contact Ms. Paige for additional information.

### 3.14 Obtaining a M.S. During Ph.D. Study

Some IBGP students obtain a M.S. degree in the process of obtaining their Ph.D. 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 well 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. study. This is usually a non-thesis M.S. in ECE or ME. In general, 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) for a 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 include 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 numbers of hours in each category for the MS and Ph.D. degrees are described in the appropriate chapters for MS Course requirements and Ph.D. Course requirements.

Commonly used courses routinely approved by the Graduate Studies Committee for each of the categories below are listed in the Appendix on Previously Approved Courses for Program of Study. However, just because a course is on that list does not mean it will be approved - the committee considers relevance to the student's research and studies.

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.

ALWAYS submit a REVISED program of study for approval when you have changed ANY coursework on your APPROVED Program of Study.

### 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 6240, 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: ChBE 6500, MATH 6643, ECE 6601, MATH 6267, 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.

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 requirements.

### 4.2.6 Approval Process

The Graduate studies committee approves all original Programs of Study in which a student is seeking transfer credit from a previous institution. The Graduate studies committee also reviews and approves petitions from students to count courses currently not listed as approved.

All other Programs of Study are reviewed for approval by Dr. Hang Lu.

Submission does not guarantee approval, and students are cautioned against enrolling in courses that are not on approved PoS under an assumption that the course will be approved. The proposed coursework is evaluated with regard to depth, breadth, relevance to research objectives, and the 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 course without receiving approval from the program director or 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 previously approved courses and the relevant categories for the Program of Study is listed in the Appendix on Courses Previously Approved for Program of Study. Any course NOT LISTED will require the approval of the Graduate Committee - No exceptions.



### 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.policylibrary.gatech.edu/faculty-handbook/5.7-policy-responding-allegations-scientific-or-other-scholarly-misconduct> The complete text of the Georgia Tech Honor Code, student responsibilities, faculty responsibilities, and enforcement are presented at <http://www.policylibrary.gatech.edu/student-affairs/academic-honor-code> The Graduate Addendum to the Georgia Tech Honor Code is located at <http://www.policylibrary.gatech.edu/student-life/graduate-student-specific-policies> 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 submission 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 <https://grad.gatech.edu/theses-dissertations> as of the time of writing. In case of any conflict, the current institute policy supersedes 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 must 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 Program Chair 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 Bio- engineering 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

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 processes (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.

Retake students **MUST** meet with the Program Chair as soon as possible following the exam. The student's advisor is also encouraged to attend.

### 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 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 BioE 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 are 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 petitioning, with consultation with the 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 Ph.D. Thesis Committee will consist of at least 5 members constrained as follows:

- At least 3 members (including the advisor or co-advisor) must be BioE Program Faculty members.
- At least 1 member must be from the student's home school.
- At least 1 of the members must be outside of the students homeschool.

## 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](http://www.grad.gatech.edu/thesis)
10. All members of your committee are encouraged to be present at the proposal or defense. The BioE Program requires that at least 4 out of the 5 members be present- either in person, via skype or phone.



11. The minimum time between a Proposal and Defense is 6 months; however, 1 year is strongly encouraged. Please be sure to check with you Home School rules as well.

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

This section was copied verbatim from

<https://policylibrary.gatech.edu/student-affairs/policy-advisement-and-appointment-thesis-advisory-committees>

In any case of conflict, the institute policy supersedes.

## 5.7 Ph.D. Research Proposal

### 5.7.1 Overview

The goals for the thesis proposal are for the student to provide a cohesive research plan addressing a significant problem and obtain input from the thesis committee on the proposed research plan.

Approval of the thesis proposal by the committee must comprise competency on the following integrated elements.

1. critical review of the relevant literature to identify a significant problem for study
2. cohesive set of specific aims, hypothesis, and expected outcomes addressing thesis topic
3. appropriate research design and plan, including proposed experimental approaches, discussion of potential limitations and identification of alternative strategies

The thesis proposal should follow the style and content of an NIH proposal but it is not expected to attain the same level of experimental detail and supporting preliminary results. The thesis proposal represents a "blueprint" for the project but the aims and research plan specifics can evolve as the project progresses. The thesis proposal provides a formal vehicle for the thesis committee to provide input in the direction and implementation of the research strategy. The thesis proposal is not intended to serve as a binding contract .

Recommended sections (10-15 pages, single-spaced, 11/12pt, 1")

- Aims (1 page)
- Background and Significance (3 pages)
- Preliminary Results (0-3 pages)
- Research Plan (5-8 pages)

## 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 sizes which are 10 to 12 points. (No smaller than 10point 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. The Ph.D. proposal presentation consists of (1) a proposal document and (2) an oral presentation and examination evaluated by the Ph.D. Thesis committee. The proposal document must be received by the members of the thesis committee at least 2 full weeks prior to the oral presentation and examination. The student should (3) contact each committee member to arrange the delivery of the proposal in either hard-copy or electronic format.

2. Scheduling the examination: 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.*

3. Email the announcement to Laura Paige. This announcement should include the name of your Advisor as well as the names of your Thesis/Reading committee members. The program 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. Proposal Presentation.
4. Before your proposal presentation, obtain the forms necessary to be completed by the committee the day before your presentation. These include an *Admission to Candidacy* form and the Bioengineering Program's Ph.D. Proposal Evaluation forms. These can be downloaded from the Bioengineering Program web site.
5. All members of your committee are encouraged to be present at the proposal or defense. The BioE Program requires that at least 4 out of the 5 members be present- either in person, via skype or phone.

## 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

[https://grad.gatech.edu/sites/default/files/documents/thesismanual\\_2020\\_april\\_2021.pdf](https://grad.gatech.edu/sites/default/files/documents/thesismanual_2020_april_2021.pdf)

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. Then the form is submitted 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 enroll-



ment 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. A meeting with the thesis committee granting APPROVAL to schedule the defense must take place PRIOR to the actual scheduling of the defense. The Bioengineering graduate office will contact the committee for approval prior to announcing the defense.
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 Laura Paige. 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://thesis.gatech.edu/>
10. Submit the Thesis Approval Certificate to the Office of Graduate Studies and Research, Savant Building.

11. All members of your committee are encouraged to be present at the proposal or defense. The BioE Program requires that at least 4 out of the 5 members be present- either in person, via skype or phone.
12. The minimum time between a Proposal and Defense is 6 months; however, 1 year is strongly encouraged. Please be sure to check with your Home School rules as well.

# 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 MStHesis Reading Committee.
2. If a proposed member is not a Georgia Tech faculty member, a biographical sketch (NIH4- 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 Committee 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

2. and submitted by the student to Bio- engineering Program office for the signature of the Chair.
3. 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

[https://grad.gatech.edu/sites/default/files/documents/thesismanual\\_2020\\_april\\_2021.pdf](https://grad.gatech.edu/sites/default/files/documents/thesismanual_2020_april_2021.pdf) 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 the submitted 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 Laura Paige. 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://thesis.gatech.edu/>
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.

*CHAPTER 7. M.S. DEGREE REQUIREMENTS (NON-THESIS OPTION)*

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

# Chapter 8

## Annual Bioengineering Awards

The Bioengineering Graduate Program annually solicits nominations and awards monetary prizes for the following categories:

### Outstanding BioE Student Paper

- All BioE students are eligible - MUST BE CURRENTLY ENROLLED
- \$750 cash and plaque award
- Nominated by Advisor - nominations must include a letter of support from advisor discussing impact and significance of the work
- Electronic copy of paper must accompany nomination
- Paper must be published, in press or accepted in the time frame Jan 1-Dec 31, 2017

### Outstanding BioE Ph.D. Thesis

- All BioE students are eligible - DO NOT HAVE TO BE CURRENTLY ENROLLED
- \$750 cash and plaque award
- Nominated by Advisor
- Nominations must include a letter of support from advisor
- Electronic copy of Ph.D. thesis must accompany nomination
- Thesis Certificate of Completion form must be signed by ALL committee members in the time frame Jan 1-Dec 31, 2017

### Outstanding BioE Advisor

- All BioE Program Faculty are eligible
- \$500 discretionary funds and plaque
- Nominated by graduate student(s) – SUBMIT A LETTER EXPLAINING WHY YOU ARE NOMINATING FACULTY MEMBER.

### Christopher Ruffin Leadership Award

- The Student Leadership Award was established to honor the memory of Christopher Ruffin and his exceptional contributions to the BioE Program. Chris began working at GT in 1994 and joined

the bioengineering community in April 2001. As Academic Advisor in the BioE Program, Chris worked tirelessly to support the BioE students and faculty. This award recognizes a current graduate student for his or her superior contributions to the BioEngineering Program. The Leadership Award will be awarded to a student whose influence, ideals, and activities throughout his/her time in the BioEngineering Program has left a long lasting and positive impression on the institution and has raised the standard of excellence for future BioEngineering classes. Examples of strong leadership qualities include activities such as peer mentoring, teaching, and service.

Appendix A  
Faculty Membership Information

Information on Rights and Responsibilities for Faculty Membership and procedures for applying for Program Membership and Renewal are currently emailed for interested faculty upon request.

## Appendix B Faculty Committee Membership

### B.1 General Faculty

A listing of the Faculty Members of the IBGP is online: <https://bioengineering.gatech.edu/faculty>

### 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 Summer 2023 semester are:

|                     |      |
|---------------------|------|
| Hang Lu, Chair      | ChBE |
| Ed Botchwey         | BMED |
| Stanislav Emelianov | ECE  |
| Omer Inan           | ECE  |
| W. Hong Yeo         | ME   |
| Valeria Milam       | MSE  |
| Greg Sawicki        | BME  |
| Mark Styczynski     | ChBE |
| Ankur Singh         | ME   |
| Levi Wood           | ME   |

### B.3 Faculty Advisory Committee

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

|                 |      |             |
|-----------------|------|-------------|
| Todd Sulchek    | ME   | Summer 2023 |
| Julie Champion  | ChBE | Summer 2023 |
| Mark Styczynski | ChBE | Summer 2023 |

*APPENDIX B. FACULTY COMMITTEE MEMBERSHIP*

Appendix C

Bioengineering Graduate Association

BGA maintains its own web site at

<https://bioengineering.gatech.edu/bioengineering-graduate-association>

C.1 Membership

Members of BGA are listed at <https://bioengineering.gatech.edu/bga/leadership>

C.2 Bylaws

Bylaws of BGA are located: <https://bioengineering.gatech.edu/bga/constitution>



## Appendix D

### Courses Previously 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.

While this list provides guidance on courses that have been previously approved on programs of study, the appearance of a course on this list does not guarantee PoS approval. The Graduate Committee considers the relevance of the coursework to the student's research and educational interests. However, the information on this list with regard to the *category* of a particular course should be considered to be unlikely to change.

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   | 6240   | Cellular Physiology and Adaptation            | 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   | 6241   | Neuromotor Physiology                         | B        |

| Where | School | Number | Title  | Category |
|-------|--------|--------|--|----------|
| GT    | APPH   | 6231   | Human Motor Control  | BS       |
| GT    | APPH   | 6232   | Locomotion Neuromechanics                                  | B        |
| GT    | APPH   | 6400   | Human Neuroanatomy   | BS       |
| GT    | APPH   | 6600   | Muscle Struct and Plasticity                               | B        |
| GT    | APPH   | 6242   | Integrative Physiology                                     | B        |
| 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   | 6750   | Foundations of Quantitative Bioscience                     | T        |
| GT    | BIOL   | 6756   | Discovery of Signal Molecules                              | B        |
| GT    | BIOL   | 7668   | Eukaryotic Molecular Genetics                              | B        |
| GT    | BMED   | 4752   | Introductory Neuroscience                                  | B        |
| GT    | BMED   | 6032   | Biomedical Sciences II                                     | B        |
| GT    | BMED   | 6793   | Systems Pathophysiology                                    | B        |
| GT    | BMED   | 6710   | Rational Design of Biomaterials                            | T        |
| GT    | BMED   | 7201   | Advanced Topics in Cardiovascular Biology and Biomechanics | T        |
| 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   | 6760 | Acoustics I                        | E |
| GT    | AE   | 6762 | Applied Acoustics                  | E |
| GT    | AE   | 6766 | Combustion                         | E |
| GT    | AE   | 6770 | Energy: Elasticity and Plasticity  | E |
| 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 |

| Where | School | Number | Title   | Category |
|-------|--------|--------|---|----------|
| 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     | 7641   | Machine Learning  | E        |
| GT    | CS     | 7643   | Deep Learning   | T        |
| GT    | CS     | 7750   | Mathematical Foundations of Machine Learning                | 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   | Statistical Machine Learning                                | 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        |

APPENDIX D. COURSES PREVIOUSLY APPROVED FOR PROGRAMS OF STUDY

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|    |     |      |  |   |
|----|-----|------|--|---|
| 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 | CS  | 7750 | Mathematical Foundations of Machine Learning | E |

| Where | School | Number | Title  | Category |
|-------|--------|--------|--|----------|
| GT    | ECE    | 6779   | Therm Pkg-Micro/Nano Sys                               | E        |
| GT    | ECE    | 7252   | Advanced Signal Processing Theory                      | E        |
| GT    | ECE    | 7750   | Mathematical Foundations of Machine Learning           | <b>M</b> |
| GT    | ISyE   | 6215   | Models of Human Machine Systems                        | <b>E</b> |
| GT    | ISyE   | 6223   | Decision Making  | E        |
| GT    | ISyE   | 6234   | Measurement and Evaluation of Human Integrated Systems | E        |
| GT    | ISYE   | 6650   | Probabilistic Models and Their Applications            | E        |
| GT    | ISyE   | 6669   | Deterministic Optimization                             | E        |
| GT    | ISyE   | 7750   | Mathematical Foundations of Machine Learning           | 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        |
| 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     | 6449   | Transducers and Signals                                | E        |
| GT    | ME     | 6452   | Wave Propagation-Solids                                | E        |
| GT    | ME     | 6460   | MEMs Devices   | T        |
| GT    | ME     | 6601   | Fluid Mechanics  | E        |
| GT    | ME     | 6601   | Introduction to Fluid Mechanics                        | E        |
| GT    | ME     | 6602   | Viscous Flow   | E        |

APPENDIX D. COURSES PREVIOUSLY APPROVED FOR PROGRAMS OF STUDY

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|    |     |      |   |   |
|----|-----|------|---|---|
| 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  | 6769 | Linear Elasticity                             | E |
| GT | ME  | 6770 | Energy: Elasticity and Plasticity             | E |
| GT | ME  | 6779 | Therm Pkg-Micro/Nano Sys                      | E |
| GT | ME  | 6796 | Structure-property relationships in materials | E |
| GT | ME  | 7751 | Computational Fluid Mechanics                 | E |
| GT | ME  | 7771 | Mechanics of Polymer Solids                   | 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 | 6752 | Polymer Characterization                      | E |

| Where | School | Number | Title   | Category |
|-------|--------|--------|---|----------|
| 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    | MATH   | 6267   | Multivariate Statistical Analysis             | M        |
| GT    | CHBE   | 6500   | Mathematical Modeling of Chemical Processes   | M        |
| GT    | ECE    | 6601   | Random Processes                              | M        |
| GT    | MATH   | 6646   | Numerical Methods for ODEs                    | M        |
| GT    | MATH   | 6701   | Math Methods of Applied Science I             | M        |
| GT    | ME     | 6643   | Numerical Linear Algebra                      | M        |
| GT    | PHYS   | 6268   | Nonlinear Dynamics and Chaos                  | M        |
| GT    | ECE    | 6200   | Biomedical Applic MEMs                        | T        |
| GT    | AE     | 6230   | Dynamics of Mechanical Systems                | T        |
| GT    | APPH   | 6202   | Clinical Gait Analysis                        | T        |
| GT    | APPH   | 6225   | Biostatistics                                 | T        |
| GT    | BIOL   | 7015   | Cancer Biology                                | 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   | 6517   | Machine Learning for Bioscience               | T        |
| GT    | BMED   | 6700   | Biostatistics                                 | T        |
| GT    | BMED   | 6720   | Biotransprt                                   | T        |
| GT    | BMED   | 6739   | Medical Robotics                              | T        |
| GT    | BMED   | 6743   | <b>Biosolid</b> 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   | 6784   | Cardio Vascular Biomechanics                  | T        |
| GT    | BMED   | 6786   | Medical Imaging Systems                       | T        |



|    |      |      |                                     |   |
|----|------|------|-------------------------------------|---|
| GT | BMED | 6787 | Quantitative Electrophysiology      | T |
| GT | BMED | 6794 | Tissue Engineering                  | T |
| GT | BMED | 7413 | Biochemical Systems Analysis        | T |
| GT | BMED | 7610 | Quantitative Neuroscience           | T |
| GT | CEE  | 6345 | Sustainability Engineering          | T |
| GT | CHBE | 6710 | Microfluidics                       | T |
| GT | CHBE | 6752 | Polymer Characterization            | T |
| GT | CHBE | 6762 | Protein Engineering                 | T |
| GT | CHBE | 6765 | Drug Design, Development & Delivery | T |
| GT | CHBE | 6777 | Advanced Biomaterials               | T |
| GT | CHBE | 6782 | Cellular Engineering                | T |
| GT | CHBE | 6794 | Tissue Engineering                  | T |
| GT | ChBE | 8803 | BioSurfaces                         | T |
| GT | CHEM | 6750 | Prep and Reactions-Polymers         | T |
| GT | ECE  | 4781 | Bioinstrumentation                  | T |
| GT | ECE  | 4782 | Biosystems Analysis                 | T |

APPENDIX D. COURSES PREVIOUSLY APPROVED FOR PROGRAMS OF STUDY

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|    |     |      |                                |   |
|----|-----|------|--------------------------------|---|
| GT | ECE | 4783 | Intro Medical Image Processing | T |
| GT | ECE | 4784 | Engineering Electrophysiology  | T |
| GT | ECE | 6200 | Biomedical Applied MEMs        | T |
| GT | ECE | 6780 | Medical Image Processing       | T |
| GT | ECE | 6786 | Medical Imaging Systems        | T |
| GT | ECE | 6787 | Quantitative Electrophysiology | T |

| Where | School | Number | Title   | Category |
|-------|--------|--------|---|----------|
| GT    | ECE    | 6790   | Information Processing Models in Neural Systems | T        |
| GT    | ISYE   | 6413   | Dsgn and Analy-Experiments                      | T        |
| GT    | ISYE   | 6414   | Regression Analysis                             | T        |
| GT    | ISYE   | 7406   | Data Mining & Statistical Learning              | T        |
| GT    | ME     | 6607   | Interfacial Fluid Mechanics                     | T        |
| GT    | ME     | 6743   | <b>Biosolid</b> Mechanics                       | T        |
| GT    | ME     | 6746   | Rehabilitation Engineering                      | 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    | 6600   | Advanced Polymer Processing                     | T        |
| GT    | MSE    | 6752   | Polymer Characterization                        | 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     | 6230   | Dynamics of Mechanical Systems     | T        |
| GT    | AE     | 6760   | Acoustics I                        | E        |
| GT    | AE     | 6762   | Applied Acoustics                  | E        |
| GT    | AE     | 6766   | Combustion                         | E        |
| GT    | AE     | 6770   | Energy: Elasticity and Plasticity  | E        |
| GT    | AE     | 7772   | Fundamentals of Fracture Mechanics | E        |
| GT    | APPH   | 6240   | Cellular Physiology and Adaptation | BF       |
| GT    | APPH   | 6241   | Neuromotor Physiology              | B        |
| GT    | APPH   | 6225   | Biostatistics                      | T        |
| GT    | APPH   | 6232   | Locomotion Neuromechanics          | B        |
| GT    | APPH   | 6600   | Muscle Struct and Plasticity       | B        |
| GT    | APPH   | 6242   | Integrative Physiology             | B        |
| GT    | APPH   | 6225   | Biostatistics                      | T        |
| GT    | BIOL   | 6418   | Microbial Physiology               | B        |

APPENDIX D. COURSES PREVIOUSLY APPROVED FOR PROGRAMS OF STUDY

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|    |      |      |                                       |    |
|----|------|------|---------------------------------------|----|
| 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 | BF |
| GT | BIOL | 7015 | Cancer Biology                        | T  |
| GT | BIOL | 7023 | Bioinformatics                        | T  |

| Where | School | Number | Title                                       | Category |
|-------|--------|--------|---|----------|
| GT    | BIOL   | 7668   | Eukaryotic Molecular Genetics               | B        |
| GT    | BMED   | 4750   | Diagnostic Imaging Physics                  | T        |
| GT    | BMED   | 4752   | Introductory Neuroscience                   | B        |
| 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   | 6042   | Systems Physiology                          | BF       |
| GT    | BMED   | 6720   | Biotransport                                | T        |
| GT    | BMED   | 6743   | <b>Biosolid</b> 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    | BMED   | 7610   | Quantitative Neuroscience                   | T        |
| GT    | BMED   | 7013   | Integ Core Experi Design                    | 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        |
| 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   | 6710   | Microfluidics                               | T        |
| GT    | CHBE   | 6751   | Phys Chem-Poly Solutions                    | E        |
| GT    | CHBE   | 6752   | Polymer Characterization                    | T        |
| GT    | CHBE   | 6768   | Polymer Structure and Props                 | E        |

APPENDIX D. COURSES PREVIOUSLY APPROVED FOR PROGRAMS OF STUDY

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|    |      |      |                                    |    |
|----|------|------|------------------------------------|----|
| GT | CHBE | 6777 | Advanced Biomaterials              | T  |
| GT | CHBE | 6782 | Cellular Engineering               | T  |
| 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  |

| Where | School | Number | Title   | Category |
|-------|--------|--------|---|----------|
| 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    | 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   | Statistical Machine Learning                                | 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        |

APPENDIX D. COURSES PREVIOUSLY APPROVED FOR PROGRAMS OF STUDY

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|    |     |      |                            |   |
|----|-----|------|----------------------------|---|
| 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 |



| Where | School | Number | Title  | Category |
|-------|--------|--------|--|----------|
| 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    | MATH   | 6646   | Numerical Methods for ODEs                             | M        |
| GT    | MATH   | 6701   | Math Methods of Applied Sci I                          | M        |
| GT    | MATH   | 6267   | Multivariate Statistical Analysis                      | M        |
| 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        |
| 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        |

APPENDIX D. COURSES PREVIOUSLY APPROVED FOR PROGRAMS OF STUDY

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|    |    |      |  |   |
|----|----|------|--|---|
| 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 | 6643 | Numerical Linear Algebra                                   | M |
| GT | ME | 6743 | <b>Biosolid</b> Mechanics                                  | T |
| GT | ME | 6746 | Rehabilitation Engineering- Cross listed with<br>APPH 6746 | T |

| Where | School | Number | Title   | Category |
|-------|--------|--------|---|----------|
| 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     | 6779   | Therm Pkg-Micro/Nano Sys                      | E        |
| 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    | 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        |

APPENDIX D. COURSES PREVIOUSLY APPROVED FOR PROGRAMS OF STUDY

|           |     |  |    |
|-----------|-----|--|----|
| Emory IBS | 514 | Neuroanatomy and Systems<br>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  |

| Where | School | Number | Title                        | Category |
|-------|--------|--------|------------------------------|----------|
| Emory | IBS    | 542    | Concepts of Immunology       | B        |
| Emory | IBS    | 548    | Biology of the Eye           | B        |
| Emory | IBS    | 600    | Blood and Water              | B        |
| Emory | IBS    | 760    | Interfacing Eng Tech & Rehab | T        |
| 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    | BMED   | 4752   | Introductory Neuroscience          | B        |
| 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   | 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        |
| GT    | ME     | 6203   | Inelastic Deform Solids            | E        |
| GT    | ME     | 6204   | Micromechanics-Materials           | E        |
| GT    | APPH   | 6240   | Cellular Physiology and Adaptation | BF       |

APPENDIX D. COURSES PREVIOUSLY APPROVED FOR PROGRAMS OF STUDY

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|    |      |      |                                 |   |
|----|------|------|---------------------------------|---|
| GT | APPH | 6241 | Neuromotor Physiology           | B |
| GT | APPH | 6242 | Integrative Physiology          | B |
| GT | ISyE | 6215 | Models of Human Machine Systems | E |
| GT | CHBE | 6220 | Computational Fluid Dyn         | E |
| GT | ISyE | 6223 | Decision Making                 | E |

| Where | School | Number | Title   | Category |
|-------|--------|--------|---|----------|
| GT    | APPH   | 6225   | Biostatistics   | T        |
| GT    | APPH   | 6225   | Biostatistics   | T        |
| GT    | ME     | 6229   | Introduction to MEMS  | E        |
| GT    | AE     | 6230   | Dynamics of Mechanical Systems                              | T        |
| 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   | Statistical Machine Learning                                | 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        |

APPENDIX D. COURSES PREVIOUSLY APPROVED FOR PROGRAMS OF STUDY

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|    |      |      |                            |   |
|----|------|------|----------------------------|---|
| GT | ME   | 6407 | Robotics                   | E |
| 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 |



| Where | School | Number | Title  | Category |
|-------|--------|--------|--|----------|
| 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<br>Technology | E        |
| GT    | ECE    | 6451   | Intro Microelectronics                         | E        |
| GT    | ME     | 6452   | Wave Propagation-Solids                        | E        |
| GT    | ECE    | 6453   | Theory Electronic Device                       | E        |
| GT    | ECE    | 6460   | Microelectromechanical System<br>Fabrication   | E        |
| GT    | CHBE   | 6500   | Mathematical Modeling of Chemical<br>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        |

APPENDIX D. COURSES PREVIOUSLY APPROVED FOR PROGRAMS OF STUDY

|    |      |      |                               |   |
|----|------|------|-------------------------------|---|
| 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 | ME   | 6643 | Numerical Linear Algebra      | M |
| GT | MATH | 6646 | Numerical Methods for ODEs    | M |
| GT | ISyE | 6669 | Deterministic Optimization    | E |
| GT | BMED | 6700 | Biostatistics                 | T |
| GT | MATH | 6701 | Math Methods of Applied Sci I | M |

| Where | School | Number | Title                                | Category |
|-------|--------|--------|--------------------------------------|----------|
| GT    | CHBE   | 6710   | Microfluidics                        | T        |
| GT    | BMED   | 6720   | Biotransport                         | T        |
| GT    | BMED   | 6743   | <b>Biosolid</b> Mechanics            | T        |
| GT    | ME     | 6743   | <b>Biosolid</b> Mechanics            | T        |
| GT    | ME     | 6746   | Rehabilitation Engineering           | 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    | CHBE   | 6752   | Polymer Characterization             | T        |
| GT    | MSE    | 6752   | Polymer Characterization             | T        |
| GT    | BIOL   | 6756   | Discovery of Signal Molecules        | B        |
| GT    | AE     | 6760   | Acoustics I                          | E        |
| GT    | ME     | 6760   | Acoustics I                          | E        |
| GT    | AE     | 6762   | Applied Acoustics                    | E        |
| GT    | ME     | 6762   | Applied Acoustics                    | E        |
| GT    | CHBE   | 6765   | Drug Design, Development & Delivery  | T        |
| GT    | AE     | 6766   | Combustion                           | 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    | AE     | 6770   | Energy: Elasticity and Plasticity    | 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    | CHBE   | 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    | ME     | 6779   | Therm Pkg-Micro/Nano Sys             | E        |
| GT    | BMED   | 6780   | Medical Image Processing             | T        |
| GT    | ECE    | 6780   | Medical Image Processing             | T        |

APPENDIX D. COURSES PREVIOUSLY APPROVED FOR PROGRAMS OF STUDY

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|    |      |      |                                |   |
|----|------|------|--------------------------------|---|
| GT | BMED | 6782 | Cellular Engineering           | T |
| GT | CHBE | 6782 | Cellular Engineering           | T |
| GT | ME   | 6782 | Cellular Engineering           | T |
| GT | BMED | 6784 | Cardiovascular Biomechanics    | 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 |

| Where | School | Number | Title   | Category |
|-------|--------|--------|---|----------|
| GT    | BMED   | 6793   | Systems Pathophysiology                           | B        |
| GT    | ME     | 6793   | Systems Pathophysiology                           | B        |
| GT    | BMED   | 6794   | Tissue Engineering                                | T        |
| GT    | CHBE   | 6794   | Tissue Engineering                                | T        |
| 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   | 7015   | Cancer Biology                                    | T        |
| GT    | BIOL   | 7023   | Bioinformatics                                    | T        |
| GT    | ECE    | 7252   | Advanced Signal Processing Theory                 | E        |
| GT    | BMED   | 7610   | Quantitative Neuroscience                         | T        |
| 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    | Cellular, Developmental, & Molecular Neuroscience | B        |
| Emory | IBS    | 518    | Human Embryology                                  | B        |
| Emory | IBS    | 519    | Foundations in Developmental Biology              | B        |
| Emory | IBS    | 524    | Cancer Biology                                    | B        |
| Emory | IBS    | 526    | Neuroanatomy and Systems Neuroscience             | BF       |
| 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    | 555    | Basic Biomedical and Biological Sciences I        | B        |
| Emory | IBS    | 548    | Biology of the Eye                                | B        |
| Emory | IBS    | 600    | Blood and Water                                   | B        |
| Emory | IBS    | 761    | Cancer Pharmacology                               | B        |

