

**Georgia Institute of Technology**  
**Institute Graduate Curriculum Committee**  
**Revised Minutes**  
**November 6, 2014**

**Present:** Breedveld (ChBE), Cozzens (Vice Provost), Jagoda (AE), Pikowsky (Registrar), Koh (Student Representative), Flowers (ARCH), Ayhan (ISyE), Smith (AE), Dickson (CHEM)

**Visitors:** Laros (Registrar), Merkousko (Registrar), Bamburowski (Grad. Studies), Mark (PE), Clark (MUSI), Williams (ECE), Erera (ISyE), Sankar (AE), Pritchett (AE), Turner (GTRI), Irizarry (BC), Di Lorenzo (EAS), Weitz (BIOL)

**Note:** All action items in these minutes require approval by the Academic Faculty Senate. In some instances, items may require further approval by the Board of Regents or the University System of Georgia. If the Regents' approval is required, the change is not official until notification is received from the Board to that effect. Academic units should take no action on these items until USG and/or BOR approval is secured. In addition, units should take no action on any of the items below until these minutes have been approved by the Academic Faculty Senate or the Faculty Executive Board.

19 Voting members/10 required for a quorum.

**There was no quorum for the face-to-face meeting. An email ballot subsequently approved the actions of those Committee members who were present at the meeting and approved the Minutes themselves. A quorum of the members participated in the email ballot.**

**Academic Matters**

1. A motion was made to *approve* a request from the School of Music for a new course. The motion was seconded and approved.

***New Course - Approved***

MUSI 6005: Music Ensemble

0-3-1

Note: This course is letter grade only and is repeatable for credit.

2. A motion was made to *approve* a request from the School of Aerospace Engineering for a new course. The motion was seconded and approved.

***New Course - Approved***

AE 6552: Advanced Topics in Humans and Autonomy

3-0-3

3. A motion was made to *approve* a request from the School of Industrial and Systems Engineering for a degree modification. The motion was seconded and approved.

### **Degree Modification - Approved**

#### Master of Science in Supply Chain Engineering

The request to modify the Master of Science in Supply Chain Engineering (SCE) degree program is to remove two courses listed as required prerequisites.

In the original proposal for the Supply Chain Engineering degree program, two courses were listed as prerequisites to provide background knowledge in statistics (ISYE 6331) and finance (ISYE 6332). Most students admitted into the program have sufficient prior preparation in these areas.

For those who do not, existing courses offered by the Stewart School of Industrial and Systems Engineering (ISyE) or by the College of Business are available as electives, and students are advised to take these electives as necessary by the Faculty Director. These existing electives include:

- ISYE 6414 Regression Analysis
- ISYE 6413 Design of Experiments
- ISYE 6739 Statistical Methods
- MGT 6753 Introduction to Management for Engineers

Additionally, some statistics and finance content is provided by the ten (10) courses (30 credit hours) in the required curriculum for the program. No course content from ISYE 6331 or ISYE 6332 is specifically required in order to successfully complete any of the required courses in the program.

The removal of the two prerequisite courses will not affect the total required hours for the SCE degree nor will it impact the offering of any other courses. The ten required courses will remain and no new courses will be required.

4. A motion was made to *approve* a request from the School of Electrical and Computer Engineering and the Department of Biomedical Engineering for a new cross-listed course. The motion was seconded and approved.

### **New Courses – Approved**

ECE 6790: Information Processing Models in Neural Systems 3-0-3

BMED 6790: Information Processing Models in Neural Systems 3-0-3

5. A motion was made to *approve* a request from the Schools of Civil and Environmental Engineering, Biology, and Earth and Atmospheric Sciences for a new Program Prospectus. The motion was seconded and approved.

### **New Program Prospectus - Approved**

Doctor of Philosophy with a major in Ocean Science & Technology

Georgia Tech (GT) has a strong and diverse expertise in ocean sciences and technology with internationally established and highly visible scientific leaders that focus on solving outstanding ocean challenges at the frontier of science, technology and society. Although this expertise spans a wide range of research foci, it lives in pockets of excellence that are distributed across different schools on campus. These include the schools of Earth & Atmospheric Sciences (EAS), Civil and Environmental Engineering (CEE), and Biology (BIO).

The program will leverage the programmatic model of the highly successful Bioengineering Ph.D. at GT. Students will be admitted with a home school in CoS or CoE. Participating faculty can mentor students irrespective of their home school. Program faculty will include members from all Schools in CoS and CoE, which will strengthen the quantitative core of the program. Research will be driven by student and faculty interest in thematic areas of the program, culminating in a Ph.D. in Ocean Science and Technology. New themes will be considered and added as the research frontiers of the participating faculty expands.

There was some question from Committee members as to what employment opportunities there might be for graduates of this program. Although post-docs might be in demand, Committee members felt that availability of such temporary positions would **not** be sufficient to make the case for good employment opportunities.

It was suggested that the proposal be strengthened by better addressing the program's likely impact on economic development in the state and by outlining the other types of employment opportunities for graduates of the program.

6. A motion was made to *approve* a request from the School of Building Construction, GTRI, and GTPE for a new Program Prospectus. The motion was seconded and approved.

### **New Program Prospectus - *Approved***

#### **Professional Masters in Occupational Safety and Health Management**

The objective of the Professional Masters in Occupational Safety and Health Management is to provide individuals ascending to leadership positions with the knowledge and skills to define and effectively manage safety and health programs in a wide range of organizations where they can have a positive impact in the wellbeing of the labor force.

The Professional Masters in Occupational Safety and Health Management (PMOSH) program is a terminal degree for industry professionals with 3-5 years of work experience. It is designed to help students develop the skills and knowledge necessary to successfully define and manage complex safety and health programs for companies in construction and/or general industry. Students will

gain real-world experience by collaborating in a team environment through a hybrid of online and in-person learning. They will learn how to think strategically to determine strengths in their company's safety and health management systems while also identifying areas of risks.

The degree will include six required core courses, three elective courses and a capstone experience course. Students will choose one of two cohorts of learning: Construction or General Industry. The PMOSH program will provide applied, practical education through projects, teamwork, and industry-relevant case studies. Courses will be taught primarily by CoA faculty and GTRI faculty affiliated with CoA. The program proposal will include courses from other academic units that have taught relevant courses in the past, and whose faculty have expressed interest in participating in the program. The curriculum will be designed to accommodate such existing courses, as well as incorporate new ones over time as emerging trends in occupational health and safety would allow for the development of new materials and courses.

The two-year program will be delivered in a modular, online, cohort format, with up to four one-week visits to campus. The curriculum will combine six core courses common to all industries, with topics including safety management, safety standards, ergonomics, leadership, communication in industry environments, economics, etc.; and three courses comprising an elective technical concentration focused on general industry safety or construction industry safety. A capstone course designed to integrate core curriculum topics to analyze the safety situation in a company and develop a business case and propose improvements, will make up the final course.

Committee members noted that the proposal is very heavily focused on the building construction industry although concerns about occupational health and safety are very pervasive throughout the economy and society. It was also noted that there might be other academic units on campus that would be interested in partnering with the start-up group at some time in the future due to the multidisciplinary nature of this subject matter. There are other industries, such as chemical engineering, that could certainly be involved in this kind of program.

The prospectus was approved with the suggestion of addressing the other industries that might be related or involved and to note that this is a program that might well become multidisciplinary at Tech with several other programs that would have a specific interest in the content.

7. A motion was made to *table* a request from the School of Biology for a new course. The motion was seconded and approved.

### **New Course – Tabled**

BIOL 6755: Foundations in Quantitative BioSciences

Note: This course was tabled until it has been taught as a Special Topics course and a decision has been made if it will be a cross-listed course.

8. A motion was made to *approve* a request from the Schools of Applied Physiology, Biology, Chemistry and Biochemistry, Earth and Atmospheric Sciences, Mathematics, Physics, and Psychology for a new degree. The motion was seconded and approved.

### **New Degree - Approved**

#### Doctor of Philosophy with a major in Quantitative BioSciences

Georgia Tech proposes to create an elite, interdisciplinary PhD degree program in the Quantitative BioSciences. Quantitative BioSciences is, operatively, the “study of foundational and applied problems in the biosciences, with a focus on quantitative reasoning given uncertainty”. The PhD in Quantitative BioSciences will leverage increasing recognition for the interdisciplinary study of bio-focused problems taking place in the seven Home Schools of CoS at GT. Moreover, the long-term success of Georgia Tech’s elite programs in engineering and computing requires a dynamic core of scientists (and students) with expertise in multiple specializations within the biosciences. Hence, despite the fact that the home schools for the QBioS PhD will reside within CoS, program faculty will include members of CoS, CoE and CoC. The QBioS program is designed to provide PhD graduates with the skills and expert knowledge necessary to move directly into academia, industry and/or government, where they can apply the specific domain expertise and the broad modeling tools to problems of foundational and practical import. Such a program would help provide for the growing needs of companies (particularly in biotech, energy and environmental sectors), universities and governmental organizations (e.g., the CDC, FDA, DOE and others) in Georgia, throughout the Southeast, and nationally.

**Curriculum:** List the entire course of study required and recommended to complete the degree program. Provide a sample program of study that would be followed by a representative student. Include Area F requirements (if applicable).

#### *Program of Study*

The PhD in Quantitative BioSciences is designed to give graduates training in the quantitative analysis of problems in the biosciences – spanning foundational advances and application to challenges in human health, energy and the environment. Such training includes:

- Learning how to identify cutting-edge questions in the biosciences
- Developing broadly relevant mathematical and computational skill-sets
- Applying mathematical and computational methods to understand and predict the structure and dynamics of complex biosystems.
- Advancing the knowledge base of the quantitative biosciences, culminating in published research satisfying the requirements, in part, of a Doctorate in Quantitative BioSciences.

The PhD in QBioS is designed to be completed over 4.5 – 6 years (fall, spring and summer), with an expected duration of 5.5 years, with a total of 40-credit hours required for each student.

The program includes the 7 Schools within the College of Sciences: Applied Physiology (AP), Biology (BIOL), Chemistry and Biochemistry (CHEM), Earth and Atmospheric Sciences (EAS), Mathematics (MATH), Physics (PHYS) and Psychology (PSYC). Faculty from these schools provide distinct and complementary expertise leveraged by the QBioS PhD, both in terms of coursework and research specialization. Additional program faculty include members of CoE and CoC. Interdisciplinary cooperation and input is ensured by the diversity of faculty in the program. Key to this cooperation is the establishment of a founding program graduate committee comprised of 10 faculty members, representing 6 Schools within CoS and one member from CoE.

Students will take introductory courses in which the study of mathematical and computational methods is presented, studied, and applied in the context of biologically relevant domains. Then, additional electives will be provided the necessary combination of breadth and depth to ensure that students have the necessary mathematical and computational skill sets to propose and accomplish their thesis research. These electives will include courses outside of the home school of the student, hence the student (with input from their advisory committee) will need to choose such electives carefully to tailor a program of study matched to their interests, abilities and

#### *Core courses*

The QBioS PhD will include the following core courses: (i) Foundations of Quantitative BioSciences; (ii) Seminar in Biology - Quantitative BioSciences Focus. The purpose of these courses is to train students to reason quantitatively given uncertainty, with a focus on problems in the biosciences. The Foundations course will train students to understand and re-implement (in an *in silico* sense) the key combination of mathematical and biological insights that helped resolve seminal debates in the biosciences, e.g., whether mutation was random or acquired, how neurons transmitted information from one to another, and how organisms evolved in response to complex stimuli and selection pressures. The Quantitative BioSciences seminar will serve the dual role of introducing QBioS students to research advances in the laboratories and groups of participating program faculty as well as providing a first-point of contact for matching students and faculty. Finally, students are expected to have a foundation in programming methods and the use of relevant tools for the development of reproducible research in the biosciences. The Foundations of Quantitative BioSciences course will include an introduction to MATLAB as well as extensive development of models using the MATLAB language. In addition, students are expected to participate in an annual “Computing Bootcamp” workshop, jointly organized with the PhD Program in Bioinformatics (see Letter of Support from King Jordan). All

matriculated students will take these three courses in their first semester, cohort style. In the second semester, all students will take a second semester of the seminar course.

### *Required courses*

Beyond the core introductory courses, each student is required to take the equivalent of 9 credit hours of advanced coursework in quantitative modeling. Such requirements are intended to ensure that students will have the necessary skill-sets to meaningfully engage with their bioscience thesis research. The appropriate course-set will be decided upon mutual agreement between the student and thesis advisor, with suggested courses included in the list of course descriptions below. Additional courses may be added with permission of the adviser.

### *Electives/Track requirements*

Students will be required to take two advanced graduate courses in a specific domain in order to learn the principles, problems and techniques associated with a specific disciplines within the biosciences. Specialization courses are sorted into the following themes:

- Chemical Biology
- Molecular and Cellular Systems
- Behavior and Physiology
- Ecology
- Evolution
- Earth Systems

A list of suggested courses are included in the list of course descriptions. At least three hours must be in a class in which mathematical and computational methods constitute a core part of the instruction and course objectives. Additional courses will be included based on the development of new courses by program faculty.

### *Rotations*

Rotations denote the immersion of a PhD student in the lab/group of a potential faculty advisor for a period of approximately 6.5 weeks (1/2 of a term). The QBioS PhD requires that PhD students perform at least 2 rotations. Rotations ensure that PhD students experience a range of potential research environments before selecting a thesis advisor. There is precedence for the use of rotations in areas relevant to QBioS at Georgia Tech. For example, at Georgia Tech, Physics has a form of rotations, which are termed “Special Problems”. In Biology, the molecular and cellular biology group requires them, whereas the ecology and evolutionary biology group does not. Hence, we also recognize that there is not a uniform standard with respect to rotations in the Home Schools represented in the QBioS PhD program. Yet, in an interdisciplinary field, part of our goals is to ensure that students have an appreciation for the broad application of quantitative methods in the biosciences, even if their eventual research includes specialization in a particular discipline. Moreover, rotations are required at the majority of peer

QBioS-like programs, e.g., at Colorado, Rice, Princeton, UCSF, and Brandeis. Students who do not identify a laboratory match at the end of the Spring semester

can rotate in up to 2 additional groups in the Summer semester of their first year. The culmination of the rotation system is the placement of students with an adviser.

### *Thesis Research*

In addition to the university guidelines, the QBioS PhD requires that some portion of the PhD candidate's research must have been accepted as a “first-author” publication in a refereed scientific journal before the thesis defense. Given differences in fields and author order conventions, here we use the term “first-author” to denote the person primarily (or equally) responsible for conducting the research that led to publication. PhD students must make a public presentation and defense of their thesis. The thesis defense consists of a public seminar followed by an oral examination by the student's thesis advisory committee. The final defense must be administered by a committee of five faculty members, composed of the student's advisor, three members of the academic faculty of QBioS program and one additional member (who must be external to the QBioS program).

### ***General Requirements for a PhD in Quantitative BioSciences***

The following set of requirements is the complete set of requirements for all QBioS PhD students:

- Foundations in Quantitative BioSciences course (1 course, 4 hours)
- Seminars in Quantitative BioSciences (2 courses, 2 hours)
- Quantitative Modeling core, including a computational-focused class (3 courses, 9 hours)
- Bioscience disciplinary electives (3 courses, 9 hours; including 2 courses from one of the six bioscience disciplines and 1 course involving the application of quantitative methods to the biosciences)
- Scientific interface minor (9 hours, equivalent to Institute approved minor)
- Thesis research (15 hours)
- Responsible Conduct in Research (RCR) Training
- Computing bootcamp (1 hr)
- Each student's course choices must satisfy the requirements of at least one of the defined tracks (initially Chemical Biology, Molecular and Cellular Systems, Behavior and Physiology, Ecology, Evolution, and Earth Systems)

TOTAL: 40 hours



	<b>Fall semester</b>	<b>Spring semester</b>	<b>Summer semester</b>
<b>Recommended 1<sup>st</sup> year general program</b>  <b>Including:</b> <b>A – Courses</b> <b>B – Rotation + research</b> <b>C – Teaching</b>	<b>A1. Foundations in QBioS (4 hrs)</b> <b>A2. Quantitative Modeling (3 hrs)</b> <b>A3 Elective in BioSciences (3 hrs)</b> <b>A4. QBioS Seminar (1 hr)</b> <b>B. Computing Bootcamp</b> <b>C. Teaching assistantship (12 hrs, home school)</b>	<b>A1. Quantitative Modeling (3 hrs)</b> <b>A2. Elective in BioSciences (3 hrs)</b> <b>A3. QBioS Seminar (1 hr)</b> <b>A4. RCR training</b> <b>B. Rotation (6 hrs)</b> <b>C. Teaching assistantship (12 hrs, home school)</b>	<b>A. Optional writing course (2 hrs)</b> <b>B. Thesis research (12 hrs)</b>  <b>(support expected from GRAs)</b>

9. The Office of Graduate Studies presented information and opened the discussion of a Cooperative Agreement between Tongji University and Georgia Tech. The new practice in relation to these agreements is that the Office of Graduate Studies will present them to the Committee for information as well as input.

This Cooperative Education Program Agreement (“Agreement”) is between the Board of Regents of the University System of Georgia, U.S.A., by and on behalf of the Georgia Institute of Technology, School of Civil and Environmental Engineering (hereafter referred to as “GT-CEE or Georgia Tech”), and Tongji University, in the People's Republic of China, College of Environmental Science and Engineering (hereafter referred to as “TONGJI-CESE”). The purpose of this Agreement is to establish a 3+2 cooperative bachelor/master degree program (hereafter referred to as “Program”) between the two institutions, and stipulate the terms and conditions for the administration of this Program.

The institutions agree to establish a cooperative education program whereby qualified students may earn a specified bachelor's degree from TONGJI-CESE and a specified master's degree from GT-CEE by completing three years of coursework at TONGJI-CESE and two years of coursework at GT-CEE.

TONGJI-CESE, the participants in the Program will be limited to enrollment in existing Bachelor of Science degree programs in Environmental Engineering, Municipal Engineering or Environmental Science.

At GT-CEE, the participants in the Program will be limited to enrollment in existing master's degree programs in Environmental Engineering or other master's degree programs offered by the School of Civil and Environmental Engineering only.

Students who have been accepted by and enrolled at TONGJI-CESE as undergraduate students will complete six semesters of the eight-semester Bachelor of Science program at TONGJI-CESE. If accepted into the Program, students will be permitted by TONGJI-CESE to complete their final two semesters of study towards the TONGJI-CESE Bachelor of Science degree at GT-CEE. Upon being accepted into the Master's degree program by GT-CEE, their second year would be for the purpose of obtaining a Master of Science degree from GT-CEE. Credits earned for courses successfully completed at GT-CEE may be applied toward students' TONGJI-CESE Bachelor of Science degree at the discretion of, and according to the policies and standards established by TONGJI-CESE. Credits earned for courses successfully completed at GT-CEE and not applied to the TONGJI-CESE Bachelor of Science degree may be applied toward students' Master of Science degree from GT-CEE according to standard policies and practices at GT-CEE. Credit for any course taken at either institution may be applied only to one degree.

Each institution has established its own degree completion requirements. Students participating in the Program must satisfy all degree requirements of the institution granting the degree in order to successfully complete the Program.

Each institution has established its own minimum qualifications, application review criteria, and prerequisite requirements for all applicants. Each institution will apply its existing requirements and criteria in determining the acceptability of applicants to the Program.

10. The committee discussed a proposal from the RCR Committee, which is currently a free-standing committee, to become a sub-committee of the IGCC. The Chair requested and received approval from the committee to put together a proposal of this nature to the Faculty Executive Board after discussing the issue with the current RCR Committee leadership. The Faculty Executive Board can approve the formation and membership of this new sub-committee, as it can with subcommittees in general.
11. There was not sufficient time to vote on the actions of the Petitions Subcommittee. This will be handled via an email vote and reported in the next set of Minutes.

Adjourned,  
Reta Pikowsky  
Registrar