



**RENSSELAER POLYTECHNIC INSTITUTE**

**School of Engineering**

# **Biomedical Engineering**

**Graduate Student Handbook**

**FALL 2018**

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## Introduction

Welcome to BME at Rensselaer - home to one of the oldest and most reputable biomedical engineering departments in the United States. We combine a strong engineering tradition of problem solving with a high level of scholarship and research. For over 40 years, we have produced outstanding academics, industry leaders and research scientists. As part of the bio-revolution at Rensselaer we are undergoing a large expansion and creating a new face of BME.

We are delighted that you have chosen to pursue a graduate degree in this department. Both the University and the Department have requirements that you must satisfy to complete your degree. The requirements imposed by Rensselaer Polytechnic Institute appear in the Rensselaer Catalog. The purpose of this handbook is to provide information about specific additional requirements imposed by the Department of Biomedical Engineering and about other procedures and policies of the department.

## Contact List for Biomedical Engineering

Department Head:	Dr. Juergen Hahn ( <a href="mailto:hahnj@rpi.edu">hahnj@rpi.edu</a> )	JEC7052
Administrative Staff:	Ms. Mary Foti ( <a href="mailto:fotim@rpi.edu">fotim@rpi.edu</a> )	JEC7049
Payroll Staff:	Ms. Debora Jackson ( <a href="mailto:jacksd2@rpi.edu">jacksd2@rpi.edu</a> )	JEC5022
Graduate Program Director:	Dr. Leo Wan ( <a href="mailto:wang@rpi.edu">wang@rpi.edu</a> )	
Graduate Committee	Dr. Ryan Gilbert (Discussions in Graduate Research) Dr. Xavier Intes (Recruiting & Admissions) Dr. Monica Agarwal (Graduate Symposium)	

### General Links:

Advising and Learning Assistance Center: <http://alac.rpi.edu/setup.do>

Career and Professional Development Center: <http://www.rpi.edu/dept/cdc/>

Co-Op / Internships: <http://www.rpi.edu/dept/cdc/students/experience/coop/index.html>

Course Catalog: <http://www.rpi.edu/academics/catalog/>

Registrar Forms: <http://sfs.rpi.edu/update.do?catcenterkey=29>

Student Handbook: <http://www.rpi.edu/dept/doso/2010-2012RPIStudentHandbook.pdf>

Student Information System: <http://sis.rpi.edu/>

Office of Graduate Education: <http://gradoffice.rpi.edu/setup.do>

Graduate Forms: <http://gradoffice.rpi.edu/update.do?catcenterkey=20>

BME forms: <http://bme.rpi.edu/graduate>

## GENERAL DEPARTMENTAL REQUIREMENTS

### **Registration Requirements**

Rensselaer Polytechnic Institute requires that fellowship holders and graduate assistants register for a minimum number of hours for credit. Taking between 12 and 15 credits in the fall and spring is considered a full-time student throughout that calendar year. Students must register for at least 12 credits per semester to maintain full-time status. The only exception to this requirement is for those students serving as teaching assistants. These students may register for a minimum of 9 credits to maintain their full-time status. Students enrolling for more than 15 credits during the fall or spring terms will be charged the academic year tuition rate plus a per-credit-hour rate for each credit hour exceeding 15 credits.

It is suggested that students register for 15 credits, as this ensures full time status even if a 3-credit course were dropped. That being said, dropping a course after the 2<sup>nd</sup> week of class should only be done in consultation with the advisor and the graduate program director.

Summer Administrative Registration (SAR) is a no charge registration requirement for graduate students who will be receiving a stipend over the summer or graduating in the summer semester. Students taking credit-bearing course or research credits should not register for SAR. Eligibility for SAR requires that the student has been registered in both the previous fall and spring semesters.

In summary the registration requirements for the Department of Biomedical Engineering are:

- Students should be registering for 15 credit hours for the fall and spring semester (but no more than 15 credit hours). The institute minimums are 12 credit hours for students not serving as teaching assistant and 9 credit hours for students serving as teaching assistants.
- Students who receive support during the summer should register for SAR, but cannot take credit-bearing courses or research credits.
- If you want to take credit-bearing courses or research credits during the summer then normal tuition charges apply. Make sure to discuss this with your advisor before registering.
- You must be registered in the term you are completing your degree.

### **Add/Drop Requirements**

It is important that the Registration Requirements described above are met to be considered for full-time study. This is important for international students who have to meet certain visa requirements but more generally for all students to meet the university' residency requirements. The most common problem related to the Registration Requirements results from dropping courses after the deadline for adding a course has passed as the deadline for dropping courses

is later than the one for adding courses. Please note that Late Drops/Adds are rarely approved except under extreme circumstances. The following rules for dropping/adding courses:

- You have 2 weeks to add courses and 8 weeks to drop courses. Any add/drop request after these deadlines is considered a late add/drop and requires written approval (which is not guaranteed → fill out and submit the late add/drop form on the OGE web site).
- You should consult your advisor if you plan to drop/add a course before the add deadline.
- You should consult both your advisor and GPD prior to dropping a course if after the add deadline has passed.
- Adds/Drops may require that a new Plan of Study is submitted.
- Late Adds/Drops may require that the instructor (for courses) should send a note to the Office of Graduate Education to verify the student's attendance and that he/she is making satisfactory academic progress.
- Both the Late Add/Drop form and the Graduate Independent Study form are required for Late Independent Study submissions.
- Both the Late Add/Drop form and the Thesis/Project Dissertation Registration Form are required for Late Thesis/Project/Dissertation submissions. Additionally, the Advisor and Graduate Program Director should include a note outlining the reasons for submitting at this late date and a brief description of the research and academic progress to date.
- Students who receive approval to drop a course after the eighth week of classes will receive a grade of "W" in the course.

### **Annual Review**

Reviews are performed annually for all doctoral students; twice a year for first year students in the doctoral program.

At the end of your first term in the program, doctoral students will meet with their advisor to review progress in research and coursework, typically in December. A short internal review form will be submitted to the department requiring both the students and advisors signature.

The graduate school will send the forms to the BMED department for distribution to all doctoral students with instructions at the end of the Spring term and the forms are due prior to graduation. These forms ask for information regarding the student's progress towards the degree, the student is meeting expectations and career goals. Students should complete the forms, schedule a meeting with their research advisor to discuss progress/expectations/goals, their thesis advisor will complete the form, both will sign and submit the completed forms to the BMED office for submission to the graduate school. This is an opportunity to set goals for the up-coming year and discuss progress toward academic goals.

### **Chain of Command**

Most students will be assigned to a research advisor upon the start of their first semester in the program. Any concerns which a student might have should be discussed with the advisor first.

*In case there is no resolution then this concern can be brought up with the Graduate Program Director. The GPD might decide to consult the Graduate Committee for procedural matters which are outside of the scope of this handbook.*

If a student is not assigned a Research Advisor upon starting in the BME graduate program, then an Academic Advisor will have been assigned. This Academic Advisor serves as advisor to the students until a research advisor has been chosen. In some cases, the GPD assigns an academic advisor to a student until they have found a Research Advisor. The academic advisor will then serve as the first point of contact for the student.

### **Departmental Seminars**

All graduate students are required to attend departmental seminars as a part of their education. Seminars typically fall on Thursdays from 3-4 pm and seminar dates are advertised at the beginning of the semester. Students are excused from seminars if they (1) have a regularly scheduled class that meets during the seminar timeslot or if (2) their TA assignment conflicts with the seminar timeslot.

### **Discussions in Graduate Research**

The department offers a seminar/colloquia series about Discussions in Graduate Research. These seminars are intended to provide the students with some soft skills which are important, but usually not taught within a lab setting. Examples of topics covered are how to prepare for fellowship applications, how to write research papers, how to create CVs which grab the attention of an employer, etc. The seminars are a zero credit hour class that graduate students pursuing a PhD are required to register for and attend, MS students are welcome to attend, but are not required to do so.

### **Graduate Committee Meetings**

The Graduate committee meets monthly from August to June. Students should submit documents for consideration by the committee at least 2 week prior to a scheduled meeting date to Ms. Mary Foti. This document will be reviewed in a preliminary fashion by Ms. Foti for any issues and Ms. Foti will notify the student if problems exist. Once the preliminary review is passed, the documents are submitted to the committee 1 week prior for consideration. After the committee meets, you will receive feedback regarding the status of your submission. If rejected, the committee will provide feedback and you should meet and discuss in detail, the submission with your advisor prior to re-submitting the documentation.

### **Paperwork**

All paperwork that is submitted by a student requires that the student signs the form. Next, the student's advisor needs to sign. All paperwork is to be directly submitted to Ms. Mary Foti who will then disseminate it further (for consideration by the graduate committee or to collect signatures from the GPD or Department Head where appropriate) prior to submission to the graduate school.

### **Petitions for Extensions or Courses**

All petitions require a cover letter explaining the reason for the petition. In addition, some petitions mentioned in this handbook require a memo by the student's Research Advisor. Petitions should be filed with Ms. Mary Foti who will forward them to the Graduate Program Director for review. The Graduate Program Director decides if a petition should be approved, rejected, or brought up for discussion with the Graduate Committee before a decision is made.

Please note that all petitions should be submitted prior to the deadlines and before a student engages in activities covered by the petition.

### **Responsible Conduct of Research (RCR) Training**

All students who are supported by their advisor on National Science Foundation funds need to complete the Responsible Conduct of Research Training prior to receiving support. This training is offered by CITI for RPI. Additional information on the training can be found at: <http://rpi.edu/research/office/rcr.html>

Furthermore, all PhD students are required to complete the training prior to their Candidacy Exam. A copy of the certificate of completion of the training will need to be included in the Candidacy Exam Evaluation form.

### **TA Evaluations**

All students serving as Teaching Assistants will be evaluated each semester. These evaluations are based upon feedback collected from the undergraduate students who were in a class where the student served as the TA as well as the course instructor for this class. Additionally, the graduate student is asked to provide feedback on their assignment and asked to report how many hours per week was spent on the TA assignment as the department seeks to evenly distribute the load of the TA assignments among the students serving as TA.

### **Vacation Policy**

The faculty in the department understand the need for a work-life balance of their graduate students. As such, research groups generally have a vacation policy that is tailored to balancing this need for work-life balance with making satisfactory progress towards the graduate degree. More specifically, students working on degrees involving research components (PhD, MS) should follow a group's vacation policy and meet the expectations for attending to lab duties by their research groups, regardless if they are supported by RA or TAs. The reason for this is that students may be supported by a TA one semester and by an RA other semesters, yet the expectation of satisfactory progress towards their degree is not dependent upon the type of financial support received.

Also, spending time in the lab is not equivalent as making progress on research. Some people make great progress in short periods of time while others take longer. It is next to impossible to have general rules that determine how many hours of work a week results in adequate research progress and instead it is up to the advisor of the student to decide if there has been good progress in the student's research. Questions should be brought to the attention of the advisor or, if needed, to the Graduate Program Director (see the section about **Chain of Command** above).



## **GRADUATE DEGREES OFFERED BY THE DEPARTMENT**

### **Degree Requirements**

The general Rensselaer Polytechnic Institute requirements for various graduate degrees appear in the Rensselaer Catalog, which also provides an excellent summary of the major steps needed to fulfill the requirements for each degree. You should read the online Rensselaer Catalog and become familiar with the requirements for your degree. The Department of Biomedical Engineering requirements, which are in addition to those of the Institute, appear in this handbook.

The primary graduate degrees administered by the Department of Biomedical Engineering are the Doctor of Philosophy, the Master of Science, and the Master of Engineering. The following sections describe the requirements for each of these degrees in more detail. A Plan of Study, which specifies formally the exact courses and research credits required, is prepared by the student, in consultation with the advisor. An Advisory Committee, either a Masters' Thesis Committee for a M.S. degree or a Doctoral Thesis Committee for a Ph.D., is formed by the student in consultation with the advisor for degree plans involving a thesis. The student's Research Advisor serves as head of this committee which has the responsibility to guide the student's research. In this Graduate Student Handbook, a "term" is defined as a semester (e.g. fall or spring term) or a full summer.

For all of the degree plans listed below, students must maintain minimum scholarship standards to remain in the graduate program. Students must maintain a 3.0 GPA or better to meet the Institute's minimum academic requirements. Additionally, graduate students admitted to the doctoral program must maintain a GPA of 3.3 to Advance to Doctoral Status.

### **Doctor of Philosophy (Ph.D.) Degree**

Matriculation into the doctoral program is based upon prior demonstration of a high level of academic achievement in graduate and/or undergraduate work. Advanced study and research are conducted under the guidance of a faculty member of the Department of Biomedical Engineering and an interdisciplinary committee. A total of 72 credits (21 course work credits minimum and the remainder research credits) satisfy both the Department's and the Institutes' residency and thesis requirements. A maximum of 8 credits at the 4000-level, i.e., a maximum of two courses, may be applied to the 21 coursework requirement, with the remainder of the courses at the 6000-level. These requirements are formalized in a Plan of Study that is prepared in consultation with the student's research advisor.

Students must maintain a 3.0 GPA or better to meet the Institute's minimum academic requirements. Additionally, Advancement to Doctoral Status requires a 3.3 GPA at the time of the advancement.

Please note that students entering with a B.S. have no more than seven years to complete their Ph.D. Students who entered the program with a Masters have no more than five years to complete their Ph.D.

**The minimum course work requirements are as follows:**

	<b>Credit hours</b>	
Advanced Mathematics/Statistics	3-4	(1 course)
Advanced Life Science	3-4	(1 course)
Technical Depth Courses*	13-15	(4-5 courses)

*(\* minimum of 3 courses should have the prefix BMED and be at the 6000-level; the remainder needs to be engineering or science courses)*

	<b>SUBTOTAL</b>	<b>21</b>
Dissertation		51
	<b>TOTAL</b>	<b>72</b>

**Plan of Study (1<sup>st</sup> or 2<sup>nd</sup> term)**

All graduate students pursuing the Ph.D. should create a Plan of Study in consultation with the Research Advisor and submit it to the graduate curriculum committee before the end of the student's second full-time semester at RPI. Note that the summer counts as a semester for this purpose, i.e., students starting in the fall need to have the Plan of Study on file by the end of the spring, students starting in the spring need to have the Plan of Study on file by the end of the summer, and students starting in the summer need to have the Plan of Study on file by the end of the fall semester. Forms for the Plan of Study and Planner worksheet can be found on the BME web site.

Each student who has filed a Plan of Study should register in the usual manner and in accordance with the plan. If there are any changes, a revised Plan of Study must be submitted for approval. An accurate Plan of Study, matching the student's transcript is required for key checkpoints and is checked by the graduate school (e.g. Annual Review, Advancement, Formation of Doctoral Committee, Candidacy and Thesis Completion). An approved plan of study is an Institute requirement for all graduate students by the end of their second semester in the program and failure to do so will negatively impact your Satisfactory Academic Progress (eligibility for both students currently and those who plan in the future to receive federal financial aid).

**Literature Review (Before the beginning of the 2<sup>nd</sup> year (3<sup>rd</sup> term))**

The graduate committee suggests that all graduate students prepare a literature review of their thesis area before beginning their third semester. A thorough knowledge of your research area is necessary to understand how your project fits within the field at large. All or portions of this review can be used for your literature review/background for both your candidacy and/or thesis. Focused literature reviews can be submitted with your advisors approval for publication as well.

### **Advancing into Doctoral Status (3<sup>rd</sup> term or before the end of the 4<sup>th</sup> term)**

Students in the PhD program should advance to Doctoral Status between the 3<sup>rd</sup> and 4<sup>th</sup> semesters in the program. In order to advance to doctoral status, graduate students in BME must satisfy the following requirements:

- (a) Take a minimum of 9 credits which include classes to satisfy the Advanced Mathematics/Statistics or the Advanced Life Science criterion (or both).
- (b) Have an approved and accurate Plan of Study on file.
- (c) Maintain a grade point average of 3.3 or better.
- (d) Choose a thesis advisor and identify a doctoral thesis topic.
- (e) Write a short (three-page maximum) preliminary research proposal which needs to be signed by the research advisor.
- (f) Must have a published or submitted conference abstract, manuscript, or invention disclosure in the relevant research area.

A dossier containing supporting material satisfying the above requirements is to be submitted by the student to the BME graduate committee via Ms. Mary Foti ([fotim@rpi.edu](mailto:fotim@rpi.edu)).

If a student is not able submit the required information before the end of the 4<sup>th</sup> semester, they are required to petition the graduate committee for an extension for a maximum of one more semester. This petition should include a plan for completion of advancement and need for the extension. Such a request must be accompanied by a letter of support from their Research Advisor.

See the BME website for Advancement format.

### **Doctoral Thesis Committee (3<sup>rd</sup> or 4<sup>th</sup> term)**

Once students have advanced to Doctoral Status, they should form a Doctoral Thesis Committee in consultation with their Research Advisor. This can be done immediately following advancement but before the end of their 4<sup>th</sup> semester. The Research Advisor serves as the chair of the student's Doctoral Thesis Committee. The Committee for a Ph.D. should consist of at least four members, with three members from the BME department (primary or joint faculty members). The fourth member can be from RPI, as long as the member does not hold a joint appointment in BME, or they can be external to RPI. It is possible to have more than four members in the committee, where no restrictions on the affiliation apply to the additional members.

Student can obtain the Doctoral Thesis Committee nomination form from the OGE website. Once signatures are obtained, it needs to be submitted to the department for approval by the Department Head. The Department Head sends the nomination to the graduate school for approval.

If the proposed Doctoral Thesis committee includes members outside of Rensselaer, students should submit their Doctoral Thesis Form, CVs' of external members (required) and a brief statement on external members' expertise. Based on this information, the GPD will send a memo supporting the external members' inclusion to the committee. The completed nomination form and required materials will be sent to the OGE for consideration by the Dean of the Graduate School. Students will receive confirmation of their thesis committee from the OGE.

### **Candidacy and Candidacy Exam (Before the beginning of the 5<sup>th</sup> term)**

There is no set format for candidacy in the department and can be presented as a 12 pg. R01, 15 pg. NSF grants or can be significantly longer including a complete literature review, please consult your advisor for his/her preference. All candidacies should contain background/significance of the work, preliminary studies, research plan and time line to completion. Students should discuss candidacy format and content with their research advisor. This document should be given to your committee 2 weeks prior to your candidacy exam. If you are unable to distribute 2 weeks prior, you must ask permission of the committee to distribute late or reschedule the examination.

The Candidacy exam should be scheduled before the 5<sup>th</sup> semester and after the student's thesis committee has been approved by the OGE. The Candidacy Exam is open to the department and general public and should include: relevant background, scope of problem being addressed by this work, significance, research results to date and a detailed research plan for the remainder of the Ph.D with a timeline to completion. Please note that the Candidacy Exam is not meant as a test run for the Public Thesis Defense, but instead is intended to obtain feedback from the Doctoral Thesis Committee on proposed doctoral research. Students should have an approved and accurate Plan of Study on file that correlates to courses taken. Once a date for candidacy has been established, the PhD student should notify the department so the exam can be advertised to faculty and students within BMED.

Students unable to complete this requirement before their third year, must submit a plan to complete this requirement to the GPD before the beginning of their third year (5<sup>th</sup> Semester). This request must provide a rationale for the extension and plan to complete this requirement and must be accompanied by a letter of support from the student's advisor. Completion of Candidacy before the beginning of the third year is a requirement of Satisfactory Academic Progress by the Institute and will impact your eligibility for both students currently and those who plan in the future to receive federal financial aid.

Completion of the Candidacy also requires a certificate of the CITI Responsible Conduct of Research training which needs to be submitted together with the signed Completion of Candidacy form.

### **Committee Progress Meeting and Submission of a Manuscript (3<sup>rd</sup> year – 5<sup>th</sup> or 6<sup>th</sup> terms)**

Students should prepare a first author manuscript before the end of their 3<sup>rd</sup> year and this paper should be submitted before the end of the 3<sup>rd</sup> year. It is an expectation that all doctoral students submit and publish prior to graduation.

In addition, the student should make an appointment to update their thesis committee individually or as a whole where possible (please discuss with your research advisor as to his/her preference). Ideally this should be done at the end of the third year, after submitting the manuscript and midway between your candidacy and thesis defense.

### **Doctoral Dissertation**

“The doctoral dissertation demonstrates the doctoral candidate’s capacity for independent work. It embodies the results of an original investigation in the doctoral candidate’s principal field of study on a subject approved by the student’s doctoral committee. Only work meeting the highest standards of integrity will be accepted for degree requirements at Rensselaer. Academic integrity is a requirement of continued good academic standing and for the awarding of a graduate degree. A manual, Thesis Writing, containing required format specifications, is available from the department, the Office of Graduate Education, or on the Web on the Office of Graduate Education’s home page at <http://www.rpi.edu/dept/grad/docs/ThesisGuide/manual.pdf>. Before preparing your final manuscript, please check the Office of Graduate Education Web site for the most recent formatting and submission guidelines.” \*\*taken directly from the 2012-13 Course Catalog

Per Institute guidelines, the thesis should be given to the advisor 1 month prior to the thesis defense and customarily is distributed to the Advisory Committee with two weeks notice but no later than one week before the Thesis Defense to allow the Advisory Committee time to read the thesis and provide comments. Any deviation from this policy must have prior and written approval from all members of the committee or the defense should be rescheduled.

### **Public Doctoral Dissertation Defense**

A student will schedule the Public Dissertation Defense once they have (1) an accurate and approved Plan of Study on file with all the required coursework proposed in the Plan of Study fulfilled, (2) the thesis research should be completed and (3) a thesis draft has been written.

Once the thesis date is set, the student is required to inform the BME department so that faculty and graduate students can be notified. When possible students should make every effort to schedule defenses that do not conflict with core faculty's teaching schedules to avoid scheduling conflicts. The Doctoral Dissertation Defense is a public presentation followed by a closed door examination by the committee. The candidate is required to bring a form for the committee to sign to indicate the outcome of the examination to the OGE.

Details and deadlines about the Dissertation examination can be found in the Rensselaer Catalog or the OGE website.

### **PhD Dissertation Submission**

After passing the Dissertation, the final and complete dissertation must be submitted on-line to the OGE. Please see the OGE website for detailed descriptions. You must be a registered student in the term you are earning your degree. Please see the OGE for thesis submission deadlines for the May, August and December degrees.

### **Steps for Completing a Ph.D. Degree in Biomedical Engineering**

Students must follow these steps for completing a Ph.D. Degree:

1. Find a Research Advisor.
2. Complete a Plan of Study before the end of the second semester in the program.
3. Prepare a literature review on thesis area (recommended)
4. Complete the requirements for Advancing into Doctoral Status by the end of the 4<sup>th</sup> semester.
5. Form a Doctoral Thesis Committee (4 full-time tenured/tenure-track faculty members, 3 of whom must be from the BME department (primary or joint faculty members) and 1 from outside the department) by the end of the 4<sup>th</sup> semester.
6. Prepare your Candidacy document, Schedule and pass Candidacy Exam no later than end of the 2<sup>nd</sup> year, before you start your third year.
7. Submit a manuscript before the end of your third year.
8. Progress Meeting with your Committee
9. Successfully complete research and write a dissertation.
10. Submit thesis to Advisory Committee (due advisor 1 month prior to exam, due to committee at least 1 week prior to defense – no exceptions).

11. Successfully complete the Public Dissertation Defense as judged by the Doctoral Committee.
12. Review and complete the graduation checklist for the Ph.D.
13. Submit completed Doctoral Dissertation to the Graduate School.

## Recommended course distribution Planner (Example)

<u>Academic Year I</u>		<u>Submit Plan of Study</u>	
<b>Fall</b>	<b>Credit hours</b>	<b>Spring</b>	<b>Credit hours</b>
Advanced Mathematics/Statistics	3-4	Advanced Life Science	3-4
Technical Depth Course I	3-4	Technical Depth Course II	3-4
Discussions in Graduate Research	0	Discussions in Graduate Research	0
Dissertation	7-9	Dissertation	7-9
<b>Total: 15</b>		<b>Total: 15</b>	

*\*This presumes that the student is a T.A. in year 1 and plans on completing four years of full time study.*

### Summer I

Research and Prepare Literature Review

## Academic Year II      Submit Advancement, Form a Doctoral committee and Candidacy during the 2<sup>nd</sup> Academic Year

<b>Fall</b>	<b>Credit hours</b>	<b>Spring</b>	<b>Credit hours</b>
Technical Depth Course III	3-4	Technical Depth Course V	3-4
Technical Depth Course IV	3-4	Discussions in Graduate Research	0
Discussions in Graduate Research	0	Dissertation	11-12
Dissertation	7-9		
<b>Total: 15</b>		<b>Total: 15</b>	

*\*Students should submit their advancement paperwork at the beginning of the 4<sup>th</sup> semester and immediately form a Dissertation committee in consultation with their advisor. Candidacy should be completed before the beginning of the 3<sup>rd</sup> year.*

### Summer II

Research

## Academic Year III      Submit a manuscript and have a progress meeting with Committee during the 3<sup>rd</sup> Academic Year

<b>Fall</b>	<b>Credit hours</b>	<b>Spring</b>	<b>Credit hours</b>
Discussions in Graduate Research	0	Discussions in Graduate Research	0
Dissertation	15	Dissertation	15
<b>Total: 15</b>		<b>Total: 15</b>	

*\* Submit a first-authored manuscript during the 3<sup>rd</sup> year and have a progress update meeting with your Committee, half way between your candidacy and dissertation completion (end of 3<sup>rd</sup> year, beginning of 4<sup>th</sup> year)*

### Summer III

Research

## Academic Year IV/V      Submit PhD Thesis during the 4<sup>th</sup> Academic Year & Graduate

<b>Fall</b>	<b>Credit hours</b>	<b>Spring</b>	<b>Credit hours</b>
Discussions in Graduate Research	0	Discussions in Graduate Research	0
Dissertation	15	Dissertation - Doctoral Thesis completion	15
<b>Total: 15</b>		<b>Total: 15</b>	

*\*Students should defend their thesis in the Spring.*



### **Completing a M.S. en route to a Ph.D. Degree**

Student can earn a M.S. degree while they are studying towards their doctoral degree without delaying their progress towards the Ph.D. Once all your PhD course work requirements have been met, you have successfully passed your candidacy and submitted a manuscript, you will be eligible to earn your M.S. degree.

Students who want to pursue a M.S. along the way to their Ph.D. should file two degree plans: one for the Ph.D. and one for the M.S. A degree will be awarded once all requirements for the degree have been met.

### **Students Entering the PhD Program with a M.S. Degree from Another Institution**

Graduate students admitted to the PhD program may sometimes be eligible to waive part of their course work requirements. Up to 12 credits of graduate courses where students received a B or better may be used to fulfill coursework requirements, i.e., students will need to take a minimum of 9 credits at Rensselaer. If students received a MS in Biomedical Engineering, then a minimum of 6 credits need to have the BMED prefix at the 6000 level, and the remaining 3 credits need to be in math, science or engineering at the 6000 level. If students received a MS in engineering or the sciences, but not in BME, they would need to take a minimum of 9 credits in Biomedical Engineering with the 6000 level BMED prefix.

To waive requirements in technical depth, advanced mathematics/statistics and advanced life science, students need to attach (unofficial) transcripts and syllabi for courses they are requesting for consideration. Final approval will lie with the graduate committee and additional coursework beyond the 9 credits may be required to fulfill PhD coursework requirements at Rensselaer.

For students granted a waiver for 12 credits, the 9 credits will comprise their GPA for advancement; failure to maintain a 3.3 GPA will require a student to take additional coursework.

## **Master Degrees**

The Biomedical Engineering Department offers two different routes for Master degrees: (1) The Master of Science (M.S.) is a Master degree that requires a thesis and (2) the Master of Engineering (M.Eng) is a coursework-only Master. The M.Eng. is generally recommended for students who do not plan further graduate studies. Pursuing a M.S. is advised for students who plan to obtain a higher graduate degree or have a strong interest in research. The Master's thesis should contribute new knowledge to the field of study and is reviewed by the Masters' committee and submitted to the OGE for review.

Students pursuing a Master degree must complete a minimum of 30 credit hours. The minimum number of credits for coursework for a M.S. is 21 and 30 for a M.Eng. At least 3 BME classes at the 6000-level are required for the coursework and no more than 2 classes at the 4000-level can be included. Additionally, one course in the life sciences (biology or physiology) and one course in advanced mathematics/statistics are required. In consultation with their advisor, students must develop a Plan of Study that satisfactorily meets Institute requirements and Departmental requirements.

### **M.S. Coursework Requirements:**

The minimum course work requirements for a M.S. degree are as follows:

	<b>Credit hours</b>	
Advanced Mathematics/Statistics	3-4	(1 course)
Advanced Life Science	3-4	(1 course)
Technical Depth Courses*	13-15	(4-5 courses)

*(\*minimum of 3 courses should have the prefix BMED and be at the 6000-level; remainder needs to be engineering or science courses)*

	<b>SUBTOTAL</b>	<b>21</b>
Master's Thesis	9	
	<b>TOTAL</b>	<b>30</b>

### **M.S. Thesis Committee**

The Research Advisor serves as the chair of the student's Thesis Committee. Thesis Committees for students seeking a M.S. degree with thesis consist of three members, who must be

primary or joint tenure or tenure-track faculty in BME. It is possible to have more than three members in the committee, where no restrictions on the affiliation apply to the additional members.

If a committee member is not a faculty member at RPI, the student must submit a CV and rationale why their participation is beneficial to the MS student to the GPD. The GPD will prepare request that this member of the scientific community be considered to serve on the student's committee. Students should fill out a M.S. committee nomination form (see OGE website), obtain all necessary signatures and submit to the Biomedical Engineering Department for the Department Head's approval. This form is forwarded to the OGE for consideration and the student will receive confirmation of the committee from the OGE.

### **M.S. Thesis and Defense**

The M.S. thesis is expected to be original work contributing to the scientific community at large. There is a specified format and students should see the OGE website for information detailing M.S. thesis format. However, the thesis should include a literature review, research plan and research findings. This should be submitted to the committee at least 2 weeks prior to the defense.

The M.S. defense should be advertised within the department and is a public presentation with a closed door examination in front of the thesis committee. Deadlines for defense and thesis submission are posted on the OGE website.

Students must be registered during the term that they will receive their degree and complete all requirements of the degree checklist to obtain their degree.

### **Steps for Completing a M.S. Degree in Biomedical Engineering**

Students must follow these steps for completing an M.S. degree:

1. Find a Research Advisor
2. Complete a Plan of Study before the end of the second semester in the program.
3. Form a M.S. Thesis Committee (3 full-time tenured/tenure-track faculty members, all of whom must be from the BME department) with approval from the OGE (before the end of the second term).
4. Successfully complete research and write a thesis.
5. Submit thesis to Advisory Committee (due to committee at least 2 week prior to de-

fense).

6. Successfully complete the M.S. Thesis Defense as judged by the Advisory Committee.
7. Submit completed thesis to Graduate School for final approval
8. Complete all required coursework on Plan of Study
9. Complete M.S. degree checklist.

### **M.Eng. Coursework Requirements:**

The minimum course work requirements for a **M.Eng. degree** are as follows:

	<b>Credit hours</b>	
Advanced Mathematics/Statistics	3-4	(1 course)
Advanced Life Science	3-4	(1 course)
Technical Depth Courses*	13-15	(4-5 courses)

*(\* minimum of 3 courses should have the prefix BMED and be at the 6000-level; remainder needs to be engineering or science courses)*

**SUBTOTAL 21**

Additional coursework\* 9

*(\* can include up to 3 credit hours of directed studies; courses should be relevant to the degree  
→ work with your advisor on the selection of appropriate courses)*

**TOTAL 30**

### **Steps for Completing a M.Eng. Degree in Biomedical Engineering**

Students must follow these steps for completing a **M.Eng. degree**:

1. Complete a Plan of Study before the end of the second semester in the program.
2. Complete all required coursework on Plan of Study
3. Complete M.Eng. Degree checklist.

### **Continuation into the Ph.D. Program from the M.S./M.Eng. Program**

M.S. or M.Eng. students who want to continue in the Ph.D. program need to re-apply to the Biomedical Engineering Program. Note that students need to have a GPA exceeding 3.3 for the classes of their Plan of Study as these classes will be used to evaluate the GPA for Advancement to Doctoral Status. In addition, it is highly recommended that the student's M.S./M.Eng. advisor write one of the reference letters for the student's application. The application will be reviewed by the Graduate Committee and decisions will be made on a case by case basis.

## **List of Recommended Courses (chosen in consultation with research/academic advisor)**

### **Advanced Mathematics/Statistics**

Each graduate degree offered by the BME department requires one course in Advanced Mathematics/Statistics. Courses can be selected from the list below or petitioned to the graduate committee for **prior** approval with the support of your advisor. The committee will only consider course petitions prior to taking the course and not after the Add Deadline.

<b><u>Course #</u></b>	<b><u>Credit</u></b>	<b><u>Course Title</u></b>
BIOL-4200	4	BIOSTATISTICS
BMED-6470	3	BIOSTATISTICS FOR LIFE SCIENCE APPLICATIONS
BMED-6480	4	BIOMEDICAL DATA SCIENCE
CHME-6610	3	MATH METHODS IN CHEM ENGR I
ISYE-4140	4	STATISTICAL ANALYSIS
ISYE-6020	3	DESIGN OF EXPERIMENTS
MANE-4240	3	INTRO TO FINITE ELEMENTS
MANE-6660	3	FUNDAMENTALS OF FINITE ELEMENT
MATH-4600	4	ADVANCED CALCULUS
MATH-4700	4	FOUNDATIONS OF APPLIED MATH
MATH-4720	4	MATH IN MEDICINE & BIOL
MATH-4800	4	NUMERICAL COMPUTING
MATH-6860	4	FINITE ELEMENT ANALYSIS
MATH-6800	4	COMPUTATIONAL LIN ALGEBRA
MATH-6600	4	METHODS OF APPLIED MATHEMATICS
MATH-6500	4	PARTIAL DIFFERENTIAL EQUATIONS
MATP-4600	4	PROB THEORY & APPLICATIONS
MATP-4620	4	MATHEMATICAL STATISTICS
MATP-6610	4	COMPUTATIONAL OPTIMIZATION

## **Advanced Life Science**

Each graduate degree offered by the BME department requires one course in Advanced Life Science (biology or physiology). Courses can be selected from the list below or submitted to the graduate committee for approval with the support of your advisor.

<b><u>Course #</u></b>	<b><u>Credit</u></b>	<b><u>Course Title</u></b>
BIOL-4620	4	MOLECULAR BIOLOGY
BIOL-4630	4	MOLECULAR BIOLOGY II
BIOL-4760	4	MOLECULAR BIOCHEM I
BIOL-4770	4	MOLECULAR BIOCHEM II
BIOL-6100	4	FROM NEURON TO BEHAVIOR
BIOL-6260	4	ADVANCED CELL BIOLOGY
BIOL-6410	4	SEQUENCE ANALYSIS
BIOL-6640	3	PROTEOMICS
BIOL-6690	3	ADV MOLECULAR BIOLOGY
BMED-4500	4	ADV SYSTEMS PHYSIOLOGY

## Technical Depth

All graduate degrees require 13-15 credit hours of Technical Depth. This will typically be satisfied by four to five courses. At least three of those courses must be in Biomedical Engineering and these three courses must be at the 6000-level. The remaining Technical Depth courses have to be in engineering or science. Examples include, but are not limited to, BMED 6280: Biomechanics of Soft Tissue, BMED 6410: BioMEMS, BMED 6420: Clinical Orthopedic and Contemporary Research, BMED 6440: Biophotonics, BMED 6450: Drug and Gene Delivery, BMED 6460: Biological Imaging Analysis, BMED 6470: Biostatistics for Life Science Applications, BMED 6480: Biomedical Data Science, BMED 6510: Mechanobiology, BMED 6550: Cell Biomechanics, BMED 6580: Biomedical Fluid Mechanics, BMED 6590: Medical Imaging, BMED 6650: Introduction to Cell and Tissue Engineering, and BMED 6660: Muscle Mechanics & Modeling.

Please note that the final approval of what classes can be included for Technical Depth in a Plan of Study lies with the BME Graduate Committee. The committee will individually evaluate each Plan of Study as a whole to make decisions on a case-by-case basis.



## Faculty Research Areas of the Biomedical Engineering Department

	Biofabrication and Biomanufacturing	Biomedical Imaging and Image Analytics	Biomolecular Science and Engineering	Musculoskeletal Biomechanics and Mechanobiology	Systems Biology and Healthcare Analytics	Tissue Engineering and Regenerative Medicine
<b>Primary Faculty</b>						
Deva Chan		√	√	√		
David Corr	√			√		√
Ryan Gilbert	√					√
Juergen Hahn	√		√		√	
Mariah Hahn			√	√		√
Xavier Intes		√				
Eric Ledet				√		
Deanna Thompson			√			√
Deepak Vashishth	√		√	√	√	√
Leo Wan	√		√	√		√
Ge Wang		√				
Pingkun Yan		√			√	
<b>Joint Faculty</b>						
Steven Cramer			√			
Suvranu De					√	
Jonathan Dordick	√		√			√
Richard Gross			√			
Robert Linhardt			√			
Douglas Swank			√	√		
George Xu		√				
Birsen Yazici		√				

## **Transfer Credits**

If a course is listed as a transfer, the transfer credits must be approved by the Registrar's Office before they can be applied toward the degree. You should verify that the Transfer Credit Approval Form and an official transcript showing the completion of the course are on file with the Registrar's Office. Because the residence requirement for the master's degree is 24 credit hours, not more than six credits may be transferred toward the master's degree. A student may not transfer more than 12 credit hours toward a 72 credit hour doctoral degree. Additionally, only courses completed with a grade of B or better can be transferred and the credits to be transferred have to meet the requirements for the degree pursued as outlined in this handbook.

## **Financial Assistance**

Financial assistance to graduate students within the Department of Biomedical Engineering falls into two principal categories: fellowships and assistantships. Assistantships are either graduate research assistantships or graduate teaching assistantships. Payments for assistantships are usually processed twice a month, while fellowship payments follow a payment schedule determined by the individual fellowship. The research advisors and the department are making every effort to provide support for the PhD students of the program and almost all of them receive full financial support.

## **Duration of Financial Assistance**

Students who receive financial aid normally are supported continuously, either on a 9-month basis or on a 12-month basis as long as they demonstrate satisfactory progress in a degree program. Continued financial aid is contingent upon the availability of sufficient funds to provide the stipend and satisfactory academic/research performance.

Please note that support via teaching assistantships is limited to two years of support by Institute rules. Additional support will have to be in the form of graduate research assistantships or fellowships.

## **Satisfactory Academic Progress:**

To remain eligible for current and future federal financial loan programs, students must be in good academic standing.

- 1) Must maintain a GPA 3.0 or greater
- 2) Must receive a S in Research (thesis or project credits)
- 3) Must have an approved Plan of Study on file by the end of their 1<sup>st</sup> year.

- 4) Must complete their candidacy examination by the end of their 2<sup>nd</sup> year

### **Housing**

Most graduate students live off campus and arrange housing for themselves. However, the University also has a limited number of openings for graduate student housing.

### **The Rensselaer Graduate Community at City Station**

The Rensselaer Graduate Community at City Station is a new housing development built exclusively for Rensselaer graduate students and graduate level affiliates. Developed to make locating and entering housing at Rensselaer a hassle-free process, it is within walking distance of the campus, enjoys Rensselaer services such as the Rensselaer Shuttle and Rensselaer Public Safety, and is, at the same time, an off-campus private community in itself.

City Station West and City Station East offer two, three, and four bedroom furnished suites for single students and City Station South houses married couples and families. City Station South suites are unfurnished. At each location, utilities and internet are included in the rent, and each suite includes air conditioning, dishwasher, washer and dryer, and 24-hour security monitoring. All residents are provided off-street parking at no cost and access to an on-site exercise facility. Various retail outlets, including a coffee shop, sandwich shop, full service restaurant, and a hair salon are located on the first floors of West and East.

If you are interested in applying for residence at the Rensselaer Graduate Community at City Station, please go to the City Station website. Applications may be mailed to Dennis Gornic in the Rensselaer Office of Graduate Education (1516 Peoples Avenue, Troy, NY 12180) or emailed to: [dgornic@rpi.edu](mailto:dgornic@rpi.edu). Rooms are assigned on a first-come, first-serve basis until capacity is reached.

## **Co-Terminal Program and the Master Degree**

Students interested in pursuing a co-terminal Master degree (M.Eng.) in Biomedical Engineering are required to submit the application materials mentioned below to the Biomedical Engineering Department for consideration. Upon review and approval by the Biomedical Engineering Graduate Committee, application materials are sent for final evaluation at the Graduate School where admission decisions are finalized and communicated to the students. Additional information can be found on the Department's web site.

*Students must apply before the end of the first semester in their senior year (by October 30 for expected May graduation and by April 15 for expected December graduation) and must have a GPA > 3.3 for consideration to the co-terminal program. Co-terminal Master's applications should be submitted to the BME departmental office (JEC 7049) in hard copy form (no emails/soft copies). Applications will be reviewed once a month during the academic year.*

### **Instructions for Students Pursuing a M.Eng.:**

BME undergraduate students pursuing a M.Eng. should complete a graduate plan of study with the approval of their BME undergraduate academic advisor satisfying the M.Eng. requirements described earlier in this handbook.

Non BME undergraduates should submit application with a self-determined plan of study satisfying the BME M.Eng. degree requirements and the Graduate Program Director will assign a BME faculty as an academic advisor for the completion of their application and a M.Eng. degree.

### **Application Materials for Co-terminal Program:**

1. Application
2. Graduate Plan of Study in compliance with BME department's criteria
3. CAPP report
4. Unofficial transcript
5. M.Eng. planner

## **Co-Terminal FAQ's**

### **Admission**

1. When do I apply?

Co-terminal applications must be submitted before the end of the first semester of the applicants' senior year (by October 30 for expected May graduation and by April 15 for expected December graduation). Applicants must have 90 credits (in progress or earned) of coursework towards their undergraduate degree.

2. Where do I find the Plan of Study form?

The Plan of Study is available on-line at the Office of Graduate Education website.

3. What if the courses I list on the Plan of Study change?

If the courses listed change, an updated plan must be submitted to BME Graduate Committee for consideration with final approval by the Office of Graduate Education.

### **Financial Aid, Tuition and Fees**

1. Can I receive Undergraduate Financial Aid?

You can no longer be considered for federal Undergraduate Financial Aid as you will have received a B.S. degree prior to starting the co-terminal year. However, you will be eligible for a graduate level Federal Direct student loan. The form and requirements are the same for federal undergraduate/graduate financial aid. Also, you will remain eligible for the RPI financial aid during the two semesters of graduate coursework.

2. Can I be considered for a TA or RA?

Co-terminal students are not eligible for a TA or RA.

### **Academic**

1. When/how does a student get assigned a graduate adviser?

Co-terminal students will continue to be advised by their undergraduate advisor.

2. How many credits will I be eligible to register for?

While you can register for 21 hours per semester before you receive your B.S. degree, the maximum number of credits for the graduate portion of your study is 15 credits per semester.

3. Can I become a part-time student in the Co-terminal Program?

Co-terminal student must remain as full time students and cannot shift to part-time status.

4. When do I receive my B.S. degree? I was supposed to graduate but I will complete 2 more semesters to receive my Master degree under the co-terminal program.  
You will receive your B.S. degree after completing the B.S. requirements, i.e., after 8 semesters. The MS degree will be awarded at the end of your 10th semester. You should file a degree application with the Office of the Registrar for each degree at the beginning of the semester in which you will actually graduate. See the academic calendar for deadline information.
5. Can I use a course for both my undergraduate and graduate degree?  
No - credits applied toward satisfying requirements of the undergraduate degree cannot be used to satisfy the requirements for the Master degree.
6. Can I still designate courses as Pass/No Credit?  
Co-terminal students are subject to graduate degree program guidelines after they have earned the 128 credits required for their bachelor's degree. Any courses taken after a student has reached the minimum, will be subject to graduate level policies, and graduate policies prohibit designating a graduate course as Pass/No Credit.
7. Can I participate in the Commencement ceremony with my class?  
Yes, as you will receive your BS degree together with the rest of your class.

I, \_\_\_\_\_ have read and understand the rules and regulations of the Biomedical Engineering Graduate Program.

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Signature

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Date

**\*Due at the end of your first term in the Biomedical Engineering Graduate Program.**