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## Department of Biomedical Engineering (BME)

### Graduate Student Handbook

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**School of Science and Engineering Website** for fillable forms, information and additional resources: <https://www.slu.edu/science-and-engineering/academics/graduate-programs/index.php>

**Saint Louis University** Policies can be found at <https://catalog.slu.edu/academic-policies/academic-policies-procedures/graduation-requirements/>

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## 1. Application for Admission to the Graduate Program

The program's admission requirements and procedures correspond to the requirements set forth by the School of Science and Engineering (SSE) Graduate Programs (<https://www.slu.edu/apply.php>). Students who do not have an undergraduate degree in biomedical engineering, but in a related field in science or engineering, may apply for admission to the program. In consultation with their advisors and the BME Graduate Coordinator, these students may be required to take certain undergraduate-level biomedical engineering courses to supplement their background.

## 2. General Policies

### 2.1. Selection of Guidance Committee

All students in the BME graduate program need to establish a guidance committee within their first semester in the program. Students in the M.S. program need to establish a committee of 3 graduate faculty members, at least 2 of which must have appointments in the BME program. Students in the PhD program need to establish a committee of at least 5 graduate faculty members, at least 3 of whom must have appointments in the BME program and 1 of whom must be an outside member (outside of the BME program; e.g. faculty from a different Department, Institution or an Industry representative). The guidance committee will be identified on the Program of Study form and should meet regularly while the student remains in the program. Outside committee members must be approved by using the SSE Request for Approval of External Committee Member form available at <https://www.slu.edu/science-and-engineering/student-resources/graduate-resources/index.php>.

### 2.2. Program of Study Form

Once a guidance committee has been established, each student should complete a Program of Study form listing the courses they plan to take to complete the requirements for their program. Fillable forms for M.S. and Ph.D. degrees can be found at <https://www.slu.edu/science-and-engineering/student-resources/graduate-resources/index.php>. The form needs to be completed and filed with the SSE Graduate Office by the end of the student's first semester in the program and can be updated annually as needed. The form also needs to list all Guidance Committee members.

### 2.3. Annual Student Review Form

Each year, all students in the Ph.D. and M.S. degree programs will fill out a student progress self-assessment form and will give these completed forms to their Guidance Committee Chair (their advisor). For new students, the Guidance Committee Chair must complete his or her evaluation by January 15. For continuing students, the process must be completed by June 15. The overall objective of this process is to make sure students are on track for finishing their degree in a timely manner. The link to the fillable Annual Student Review Form can be found at <https://www.slu.edu/science-and-engineering/student-resources/graduate-resources/index.php>.

### 2.4. Required Seminar Course (Biomedical Engineering 5000)

The Biomedical Engineering Department offers a Graduate/Research seminar course each fall and spring semester, which meets most weeks on Wednesdays at 3:30 PM. Graduate students are required to register for and attend this zero-credit seminar course (BME 5000) for both the fall and spring

semesters of their first year at SLU for M.S. students or for both semesters of each of their first two years at SLU for Ph.D. students. Students are permitted to miss at most two seminar sessions each semester or they will fail the seminar course.

### *2.5. Good Standing Status*

Students are considered to be in academic good standing with the SLU Graduate Office if they maintain a grade point average (GPA) of 3.0 or higher. A student with a GPA below 3.0 will be placed on academic probation and must, in consultation with the BME Graduate Program Coordinator, agree to a time frame and procedure to re-establish good standing status. Students will not be eligible to graduate or to be advanced to doctoral candidacy while not in good academic standing.

### *2.6. Time Off for Graduate Students Receiving Financial Support*

Graduate students (BS-MS, M.S. and Ph.D) receiving financial support are expected to commit themselves fully to their studies and research. During times when classes are not in session, graduate students are expected to devote themselves full-time to their research. Students on full support are permitted to take off a maximum of two weeks during the calendar year for vacation, interview trips, etc. Additional time off can be arranged in discussion with the research advisor, but it may result in a reduction of the student's stipend or a delayed graduation. Vacation or personal time off for research assistants must be scheduled so as not to impede the progress of an ongoing research project and should be approved by the research advisor. Full-time summer appointments do not include paid vacation. An appointment may be prepared for periods of less than three months in the summer to allow for planned vacations.

## **3. Master of Science Degree Requirements**

### *3.1. General Course Requirements*

A total of 30 credit hours work (primarily at the 5000-6000 level) in technical areas is required for the Master of Science degree. The candidate for the Master of Science degree has the choice of following a plan of study either with or without a thesis. A third choice is a project M.S. degree, which could be considered in consultation with the research advisor and BME Graduate Program Coordinator in certain circumstances.

#### *3.1.1. Thesis M.S. Course Requirements*

Under the Master of Science Thesis Option, students must take 6 credits (both maximum and minimum) of Thesis Research (BME 5990) toward their degree. There are 3 required courses for Thesis M.S. students: BME 5000 Seminars (0 credits – to be taken the first two semesters of degree), BME 5010 Research Analysis (2 credits – to be taken the first fall semester of degree) and BME 5040 Technical Communication (1 credit – to be taken the last semester). In addition, a maximum of 6 credits of 4000-level courses may count towards the course requirements. However, students must confirm with the BME Graduate Program Coordinator that a specific 4000-level course can be applied to their graduate program before they take that course for credit. Lastly, no more than 6 of the required credits can be devoted to Research Topics (BME 5970) or Graduate Reading Courses (BME 5980).

### *3.1.2. Non-thesis MS Course Requirements*

For non-thesis M.S., only the BME 5000 Seminars (0 credits – to be taken the first two semesters of degree) is a required course. In addition, a maximum of 6 credits of 4000-level courses may count towards the course requirements. However, students must confirm with the BME Graduate Program Coordinator that a specific 4000-level course can be applied to their graduate program before they take that course for credit. Lastly, no more than 6 of the required credits can be devoted to Research Topics (BME 5970) or Graduate Reading Courses (BME 5980).

### *3.1.3. Project M.S. Course Requirements*

Under the Master of Science Project Option, students must take 3 credits (both maximum and minimum) of Independent Research (BME 5990) toward their degree. For project M.S., only the BME 5000 Seminars (0 credits – to be taken the first two semesters of degree) is a required course. In addition, a maximum of 6 credits of 4000-level courses may count towards the course requirements. However, students must confirm with the BME Graduate Program Coordinator that a specific 4000-level course can be applied to their graduate program before they take that course for credit. No more than 6 of the required credits can be devoted to Research Topics (BME 5970) or Graduate Reading Courses (BME 5980).

## *3.2. Transfer of Credit*

Per University policy, students can transfer a maximum of 20% coursework required for the degree program. As an example, the masters program allows for up to 6 credit hours of transfer credit and the remaining 80% must be completed at Saint Louis University. Link to a fillable petition form can be found here [https://www.slu.edu/academics/graduate/pdfs/ge\\_transfer\\_of\\_credit\\_fillable.pdf](https://www.slu.edu/academics/graduate/pdfs/ge_transfer_of_credit_fillable.pdf). Students should consult with their advisor before completing this because students should also complete the following form [https://www.slu.edu/registrar/pdfs/grad\\_off\\_campus\\_enrollment.pdf](https://www.slu.edu/registrar/pdfs/grad_off_campus_enrollment.pdf). The BME Graduate Program Coordinator and the SSE Associate Dean of Graduate Education must agree that the specific courses are acceptable. No credit transfer will be allowed for any courses that have been used in fulfillment of the requirements of any other degree. Due to academic and procedural differences between U.S. and foreign institutions, credit from foreign universities is not normally acceptable for transfer.

### *3.3. Work and Productivity Expectations for M.S. Thesis Option Students*

Students pursuing the Master of Science Thesis Option will be expected to work on their research projects for at least 20 hours per week during the academic year, and full-time during breaks and over the summer. During their time in the M.S. program, students will be expected to produce at least one complete journal manuscript, which could be submitted or ready for submission.

### *3.4. M.S. Thesis Proposal*

Candidates for the Master of Science Research Thesis Option are required to pass an oral thesis proposal, which consists of both an oral presentation and a written proposal document. The written proposal must be submitted to the candidate's Guidance Committee at least two weeks

prior to the oral proposal date. The written proposal should be a brief document including background and introduction, methods, preliminary data, proposed studies, and a timeline. The document should be maximum of 10 pages, including references and figures. The oral thesis proposal includes a 20-40-minute seminar style presentation of the proposal to the candidate's guidance committee. Once completed, the Master's Thesis Proposal form (see <https://www.slu.edu/science-and-engineering/student-resources/graduate-resources/index.php> for the form) is submitted to SSE Graduate Office at SSEgrad@slu.edu. Students should complete the form in consultation with their research advisor and submit it to the SSE Grad Office 2 weeks before the proposal date. The oral thesis proposal should be completed within 12 months after beginning the program and at least one complete semester before the expected graduation date. A 2-hour block should be reserved for the proposal defense.

### *3.5. M.S. Thesis Defense*

Upon completion of the research, the student prepares a written thesis related to his or her research and must pass a final oral thesis defense, which includes a public seminar style 30-45-minute presentation on the research project. The time and location of the presentation must be publicized at least two weeks in advance so that it can be attended by all interested persons. Students should email SSEgrad@slu.edu at least two weeks before the defense date so that the SSE grad team can make a public announcement. The M.S. thesis is expected to be defended within 12 months after passing the oral thesis proposal.

### *3.6. Timeline for Completion of the Master of Science Degree*

Full-time students who are pursuing a master's degree (either thesis or course-only option) are expected to complete their MS degrees after 2-2.5 calendar years in residence as a graduate student. Students who do not meet these time guidelines should discuss their situation with the BME Graduate Program Coordinator so that they can determine how to finish their course of study in a timely manner.

### *3.7. Continuing after an MS Degree toward a Doctoral Degree.*

Students who have completed the M.S. degree within the past three years may petition to be allowed to continue for a PhD degree by completing the [Petition for Admission into Doctoral Program form \(https://www.slu.edu/academics/graduate/pdfs/phd\\_admit\\_petition\\_fillable.pdf\)](https://www.slu.edu/academics/graduate/pdfs/phd_admit_petition_fillable.pdf). Petitioning to be allowed to continue for a PhD is essentially equivalent to applying for readmission to the program. As such, the student must have demonstrated excellent progress during their MS work, as evidenced by timely progress through the degree and publications and/or presentations that demonstrate the quality, quantity and creativity of the student's work. Simply passing the MS thesis defense is not by itself sufficient evidence that a student will be allowed to continue for a Ph.D. degree. This petition does not apply to graduate students who had two failed attempts to pass either the doctoral qualifying exam or the doctoral oral dissertation proposal and subsequently changed to the M.S. program.

Students who have completed an M.S. degree at SLU or at another institution can petition to transfer up to 24 credit hours of eligible coursework (excluding thesis credits) towards the Ph.D. degree.

### *3.8. Changing from the M.S. to the Ph.D. program*

Students who were accepted into the M.S. program but have decided, in consultation with their graduate advisor, to forego completion of the M.S. degree and change over to the Ph.D. program will need to complete the Petition to Amend the Graduate Program form (fillable form at [https://www.slu.edu/academics/graduate/pdfs/petition\\_to\\_amend\\_grad\\_program\\_form.pdf](https://www.slu.edu/academics/graduate/pdfs/petition_to_amend_grad_program_form.pdf)). To be considered for such a change, students must have completed 1 full year in the M.S. program and be in good standing as evidenced by their GPA (>3.0) and research accomplishments.

## **4. Accelerated BS-MS Program**

### *4.1. Program Purpose and Expectations*

The Accelerated BS-MS Program in Engineering is a discrete accelerated program that allows high achieving students to complete both B.S. and M.S. degrees in a total of 5 years. The BS degree is in biomedical engineering and the M.S. degree is in engineering with emphasis in BME. The master's degree provides additional technical depth and specialization that can lead to expanded career opportunities and responsibilities, as well as preparation for doctoral (Ph.D.) studies.

This program is designed to provide selected, high-achieving, undergraduate students with the opportunity to combine advanced undergraduate coursework with graduate coursework to accelerate graduate degree completion. Students may apply up to 15 credits of graduate coursework (5000 level and above) taken during their fourth academic year toward both their bachelor's and master's degree. Taking more than 15 credits of graduate coursework during the fourth year will count towards their master's degree.

Students entering the Accelerated BS-MS Program are subject to all current undergraduate and graduate admissions and degree requirement policies of the School of Science and Engineering and Saint Louis University, unless stated otherwise below. A BS-MS degree information sheet is available at <https://www.slu.edu/science-and-engineering/student-resources/graduate-resources/index.php>.

### *4.2. Application Process*

Undergraduate students in the BME program who have an overall cumulative grade point average of at least 3.25 after completing the fifth semester of study or 75 credit hours of coursework may apply for admission to the accelerated BS-MS degree program. Applicants should also have research experience, which could include BME 3850/5850 Design of BME Lab Experiments or BME 4970/4980 Independent Research. Applicants should first seek approval from the tentative MS advisor before submitting the application to the Director of the School of Engineering by March 25 before they are submitted to the graduate office for final approval (room 1002 of McDonnell Douglas Hall) by April 1.

Students should normally apply to the Program for pre-admission to the accelerated BS-MS program in the spring semester of their junior year by filling out and submitting the Accelerated BS-MS Program in BME Application for Admission form (available at <https://www.slu.edu/science-and-engineering/student-resources/graduate-resources/index.php>). This application includes a plan for integrating the Senior Project with the Thesis project, along with a Statement of Purpose and a Program of Study. Students are encouraged to discuss their plans related to the accelerated BS-MS program with

the Graduate Program Coordinator or their chosen research advisor before they apply to the program to make sure they are informed of all the necessary procedures related to the program. In their senior year, accelerated BS-MS students will register for BME 5955 Capstone Projects I and BME 5965 Capstone Projects II rather than the standard Senior Project courses.

#### *4.3. Thesis, Project, and Non-Thesis M.S. Degree Options*

Students in the accelerated BS-MS program in BME are typically expected to complete a thesis, but a non-thesis or a project option are also available. Students in the accelerated BS-MS program should select a research advisor (for thesis or a project) or a graduate mentor (for non-thesis) during the junior year. Students who choose the thesis option should begin their research no later than the summer between the junior and senior years. A delay in starting the thesis research may result in a corresponding delay in finishing the M.S. portion of the accelerated BS-MS degree program. Students who choose the project option should begin their research no later than the first semester of their master's year.

#### *4.4. Course Requirements*

Students must satisfy the B.S. and M.S. degree requirements separately with the exception that a maximum of 15 credit hours of qualifying coursework (5000-level) taken to satisfy B.S. requirements can also be used to fulfill 15 credit hours of M.S. degree requirements. Up to 9 additional credits of qualifying coursework (4000- or 5000-level) completed while a senior but that are not required for earning the B.S. degree can be used towards the M.S. degree. Thesis BS-MS students should take BME 5010 Research Analysis (2 credits) during the fall semester of their senior year and BME 5040 Technical Communication (1 credit) during the spring semester of their M.S. year. Both thesis and non-thesis BS-MS students should take 5000 Seminars (0 credits) both semesters of their M.S. year. Admission to the BS-MS program does not require completion of the bachelor's degree; however, admission to the M.S. degree will require completion of the bachelor's degree.

#### *4.5. Admittance into the Graduate Program*

At the end of the senior year, progress of students in the accelerated BS-MS program will be evaluated by the BME Graduate Committee. Upon successful fourth year review and completion of the B.S. degree requirements, accelerated BS-MS students will automatically be switched to graduate student status. Students applying to the accelerated BS-MS program are not required to take the GRE examination (or TOEFL for international students).

#### *4.6. Work and Productivity Expectations for Accelerated BS-MS Students*

As an accelerated program, the work expectations for students in the BS-MS program are higher than those for students in the regular M.S. Thesis option. Students will be expected to perform at least 20 hours of research per week during their fourth year in the undergraduate program in addition to their other commitments. Students in the accelerated program are also required to work on their research during the summer and during breaks and should produce at least one journal manuscript ready for submission prior to completing the M.S. degree.

#### *4.7. Timeline for Completion of the Accelerated Master of Science Degree*



Students in the accelerated BS-MS program are expected to complete their M.S. degree after no more than three semesters plus a summer in residence as a graduate student. For the thesis option, the oral thesis proposal should be taken within 6 months of completion of BME 5965 (Capstone Projects II) and at least one full semester before the thesis defense. See section 3.4 for additional information regarding the M.S. thesis proposal. The M.S. thesis is expected to be defended within 12 months after passing the oral thesis proposal. See section 3.5 for additional information regarding the M.S. thesis defense.

## **5. Doctor of Philosophy Requirements.**

### *5.1. General Policies*

The requirements for the Doctor of Philosophy degree for students in BME are summarized below. Additional requirements are imposed by the SLU Graduate Programs Office and are documented in the Graduate Catalog. It is the responsibility of the student to ensure that all SLU Graduate Programs and the School of Science and Engineering Graduate Programs requirements are met. Questions regarding the requirements may be directed to the BME Graduate Program Coordinator. The Doctor of Philosophy Degree is awarded only upon sufficient evidence of high attainment in scholarship and the ability to engage in independent research in the field of Biomedical Engineering. It is not awarded for the completion of course and seminar requirements, no matter how successfully completed.

### *5.2. Course Requirements*

A minimum of 60 credit hours of approved courses (primarily at the 5000-6000 level) beyond the bachelor's degree are required. A total of 12 credits must be satisfactorily completed in BME 6990 Dissertation Research. A maximum of 6 credits of 4000-level courses may be applied towards the course requirements. However, students must confirm with the BME Graduate Program Coordinator that a specific 4000-level course can be applied to their graduate program before they take that course for credit. No more than 6 of the required coursework credits can be devoted to Research Topics (BME 6970) or Graduate Reading Courses (BME 6980). For all Ph.D. students, excluding those who have completed M.S. degree at Parks, three of the required courses are the BME 5000 Seminars (0 credits - to be taken the first 4 semesters), BME 5010 Research Analysis (2 credits – to be taken the first fall semester of degree) and BME 5040 Technical Communication (1 credit – to be taken when a student is ready to write their first research paper).

### *5.3. Transfer of Credit*

A maximum of 24 semester hours of graduate course work taken while earning a Master of Science degree at SLU or other institutions may be applied toward the Master's degree. The BME Graduate Program Coordinator and the SSE Graduate Office must agree that the specific courses are acceptable. Thesis credit hours completed as part of the M.S. degree may not be applied. No credit transfer will be allowed for any courses that have been used in fulfillment of the requirements of any other degree. Due to academic and procedural differences between U.S. and foreign institutions, credit from foreign universities is not normally acceptable for transfer.

### *5.4. Work and Productivity Expectations for Ph.D. Students*

Students pursuing the Doctoral Program will be expected to work on their research projects for at

least 20 hours per week during the academic year while taking classes and full time (40 hours per week) after all coursework has been completed as well as during breaks and over the summer. Students with teaching assistant (TA) duties will have a scaled back work requirement based on their TA workload. Lower number of hours per week may result in delayed graduation. During their time in the Ph.D. program, students will be expected to produce at least three complete journal manuscripts and bring at least one new technique to the lab. Students are also expected to have presented their work at national and local conferences and symposiums several times.

### *5.5. Requirements for Achieving Doctor of Philosophy Candidacy Status.*

#### *5.5.1. The Qualifying Examination.*

The qualifying examination is intended to test the student's fundamental knowledge in biomedical engineering and may be taken no more than twice. This examination is usually taken during the student's first or second year. There are both written and oral qualifying exam options as described in **Appendix A**. Both written and oral qualifiers need to be taken in a single day. In extenuating circumstances, the written qualifier could be extended to two consecutive days. There are two windows for taking the qualifying exam – early summer (June) and winter break (January). Students are responsible for scheduling their qualifying exam in consultation with their advisor. In the case of failure for the first attempt of this examination, written feedback will be provided that can be used by the student as guidance in their second attempt at this examination. Additional important BME-specific information on the qualifying exam is given in **Appendix B**. All forms can be found at <https://www.slu.edu/science-and-engineering/student-resources/graduate-resources/index.php>.

#### *5.5.2. Consequences of Not Passing the Qualifying Examination.*

Students are given two chances to pass the qualifying examination. If a student is not able to pass this examination after exhausting all of the allowed chances, they could be transferred to the MS degree program or choose to leave the graduate program.

#### *5.5.3. The Dissertation Proposal.*

The examining committee for the proposal examination consists of the student's Guidance Committee members. As part of the proposal, students are required to submit a written document that describes the research project. The document should be submitted 2 weeks prior to the proposal defense. The document should contain enough introductory material to inform the proposal examination committee about the underlying background of the project. The document should also contain additional logically arranged sections, such as sections on objectives, experimental and theoretical methods, results, conclusions, and timelines for finishing the dissertation. Important information regarding the written and oral dissertation proposal form is given in **Appendix C**.

The Dissertation Proposal will be presented orally in a seminar lasting 20 to 40 minutes. Following the seminar, the Guidance Committee conducts an oral examination of the student within the area of the proposed research. Students should take this examination after passing the oral qualifying examination and after all coursework has been completed (typically after 3 years in the program). If a student does not pass the proposal examination on their first attempt, a

second and final attempt shall occur within one additional semester.

Students who pass the qualifying and dissertation proposal examinations become Ph.D. candidates. A student must be admitted to candidacy at least two full sequential semesters before the date on which the doctorate degree will be conferred.

#### *5.6. Final Oral Defense of the Ph. D. Dissertation.*

The oral defense is conducted by the student's Guidance Committee. In the event that not all of the members who served on the proposal examination are available to serve on the dissertation defense committee, substitutions may be made. However, the final makeup of the dissertation defense committee must in all cases consist of at least 3 faculty members from the BME program (as defined in point 2.1. above) and at least 1 person from outside the program. The minimum members required is 5.

The Dissertation Defense will be presented orally in a public seminar lasting 30 to 45 minutes. The open forum is followed by a closed-door session, where the Guidance Committee conducts an oral examination of the student within the area of the conducted research. A 2-hour block should be reserved for the defense. The time and location of defense must be publicized two weeks in advance so that the defense can be attended by all interested persons.

At least two weeks before the public defense, students must complete the notification of readiness form. Following signature by the Dissertation Committee Chair, the form should be submitted to [SSEgrad@slu.edu](mailto:SSEgrad@slu.edu) to receive the Dean's signature and to be submitted for additional processing by the Grad. Affairs office. Link to form: [ge\\_readiness\\_fillable.pdf \(slu.edu\)](#)

The candidate may only take the final oral defense twice, and students who are not able to pass the defense in two attempts will not be awarded a doctoral degree. Students must complete their entire program of study for the degree, including the dissertation and final oral examination, within four years after admission to candidacy. Requests for postponement of the Ph.D. thesis defense beyond the 4-years' time limit must be made in a written petition to the BME Graduate Program Coordinator. The form should clearly state the reason for the delay and be signed by both the student and his or her research advisor. The petition will be considered by the BME Graduate Committee and there is no guarantee for approval.

#### *5.7. Timeline for Completion of the Doctoral Degree*

It is expected that students will complete the doctoral degree within 5-6 years of admission starting from a B.S. degree and 3-5 years starting from a M.S. degree. Important dates are also established by SLU's Office of Graduate Education. Students should review the dates as early as possible to ensure the defense is scheduled according to the University's established deadlines. By not adhering to the provided deadlines, degree conferral may be delayed. Link to these: [Information for Current Students: SLU](#).

## Appendix A

### Qualification through Three Topic Exam Style

With regard to three topic qualification examination, this appendix describes exam format and timeline, selection of examiners, administration of the exam, and exam outcomes.

#### Forms

All forms can be found at <https://www.slu.edu/science-and-engineering/student-resources/graduate-resources/index.php>

#### Timeline

##### **When to take the qualifying exam?**

Students are advised to pursue this qualifying examination before the end of their first academic year in the PhD program. Please consult individual programs for specific deadlines, examination dates, and other recommendations.

##### **When to schedule the qualifying exam?**

Students should submit the completed PhD Qualifying Exam Petition Form to the Office of Graduate Education & Research at least 30 days prior to date of examination.

##### **When will the grade be given?**

Students will be notified in writing of the outcome of the PhD qualifying examination no later than two weeks of the exam date, and within two weeks of the submission of additional required work (if required).

#### General Description

The intent of the three topic examination format is to allow doctoral students to qualify for pursuit of doctoral studies by demonstrating their PhD-level knowledge in three topics related to their research. The students in consultation with their PhD Advisor will identify three topics from the examination topics list provided by their home program or department. Students may choose topics drawn from outside their home program with the approval of their advisor. The faculty evaluator for each topic is suggested by the PhD Advisor and should be approved by the program. Upon identification of faculty evaluators, students should complete the qualifying examination petition form by following the steps outlined in Ph.D. Qualifying Exam Policy. This includes determining time, date, and location of examination.

#### Format of Exam

The test will be given in three, two-hour blocks of time, one topic during each two-hour block. The student home program in consultation with the faculty evaluators will provide more information on each topical exam. This information should include list of topics or syllabus for each exam block, format of each block (e.g. open book, closed book), and list of suggested references for each topic. This information should be provided to students 30 days prior to date of examination.

### Exam Day

A proctor is appointed by the program to administer the qualification examination. Faculty evaluators provide the exam questions to the proctor at least one day prior to examination day. The proctor will return the student answers to the faculty evaluators for grading in 24 hours after completion of the exam.

### Exam grading

Students are expected to provide the faculty evaluators with the PhD Qualifying Exam Results Form. The steps for completing this form are explained in the Ph.D. Qualifying Exam Policy. The faculty evaluators will grade the exam in no later than two weeks and will forward the exam results to the student's PhD Advisor. The PhD advisor will notify the student the outcome of the PhD qualifying examination in writing within two weeks of the examination. The outcome for each examination topic will be reported as follows:

- Pass: indicating the student passed in the three topical area(s) selected.
- Conditional Pass: indicating the student did not pass in the selected topical area(s). The faculty evaluator in consultation with the PhD Advisor will determine the additional work that should be completed by student to pass the topical exam.
- Fail: indicating the student failed one or more of the topical areas. In this case, based on the discretion of the student's PhD advisor, the examination committee, Associate Dean of Parks graduate programs and the program, the student might be instructed to re-take the topic(s) or could be given a chance to proceed with a lower degree such as Master's.

If students receive conditional pass in any of the examination topics, they will be given an opportunity to mitigate the conditional pass by completing additional work determined by the faculty evaluator and the student's PhD advisor. Additional required work due to a Conditional Pass will be documented through a conditional pass contract, which will include details of the additional work expected of the student, and an expected completion date. The faculty evaluator will review the additional work and will issue a pass or fail grade. In the case of fail grade the student should contact the Associate Dean and department chair/director. The steps for mitigating conditional pass grades are outlined in the Ph.D. Qualifying Exam Policy.

Students must pass all the three topics in order to qualify for pursuit of their doctoral studies. Students who cannot pass the qualifying examination might be given an option for the award of lower degrees, such as MS, which may require additional work following the guidelines for these degrees.

## Qualification through Research Writing(s) and oral examination

With regard to this "Research Writing(s)" type of examination format, this appendix describes administration of the exam, selection of examiners, expectations regarding work submitted by the student, required oral examination, exam outcomes, and notification time frame.

### Timeline

#### **When to take the qualifying exam?**

Students are advised to pursue this Qualifying examination style after the end of their first summer in the program (to allow time for laboratory research) and before their PhD proposal examination. Please, consult individual programs for program specific deadlines or recommendations.

#### **When to schedule the qualifying exam?**

The research writing(s) that a student submits for consideration by the qualifying examination committee must be submitted together with the Qualifying Exam Request Form at least 30 days prior to the requested oral examination date.

#### **When will the grade be given?**

Students will be notified in writing of the outcome of the PhD qualifying examination no later than two weeks of the oral examination, and within two weeks of the submission of additional required work (if required).

### General Description

The intent of the "Research Writing(s)" examination format is to allow a doctoral student to qualify for pursuit of doctoral studies through evaluation of their research writing(s), and evaluation of their responses during a single oral exam conducted after review of the writing(s). To successfully qualify, students must demonstrate PhD-level knowledge in three identified topical area(s). Each topical area(s) selected by the student for consideration in this examination format must be related to the content of the research writing(s) submitted by the student. A list of approved topics is provided by each program. Students may request the addition of different disciplines to their oral exam related to their research area.

### **The Research Writing**

The research writing(s) submitted by the student should represent significant potential for scholarly research at the doctoral level.

### Acceptable research writings

- One or more peer-reviewed journal articles that are related to the student's intended research focus. Such articles may be published, in-press, accepted, submitted, or in-preparation. Students should be cautioned, however, that a single article in-preparation, listing the student as a secondary author, would likely not present a strong case for PhD program qualification; and conversely, that one or more published journal articles, listing the student as primary author, are not a guarantee of qualification.
- A written pre-proposal report with one or more aims that are related to the student's research

focus. The written pre-proposal report should be very similar to a peer-reviewed article in preparation, except that it may consist predominantly of preliminary data and detailed future work plans. The report should include the following sections: Background and Introduction, Materials and Methods, Preliminary Data and Data Analysis, Future Work, and Conclusions for one or more aims. To be considered for the Qualifying examination, the report should adhere to strict guidelines for technical writing and should give sufficient information to guide the examiners in determining what is the scope and feasibility of the project.

NOTE: A project that is too narrow in scope (i.e. detailing research at the Master's level – e.g. simple Page 5 of 14 screening of several parameters) or too broad (i.e. without a well-defined end-point – e.g. development of cancer cure) would not be appropriate.

This written research report is meant as an avenue for a graduate student establishing a new project where research related to project feasibility and procedure development is needed before data collection could begin. Graduate students joining well-established projects could also choose to do this qualifying examination style; however, a larger amount of preliminary data would be expected.

#### The Examination Committee

The qualifying examination committee shall consist of three individuals, with at least one individual from the respective program(s) housing each selected exam topic. Examination committee members are suggested by the PhD advisor in consultation with the program. One examination committee member will ordinarily be the student's PhD advisor. In such cases wherein the student has not yet selected an advisor, another faculty member from the student's home program will be selected based on that program's recommendation.

#### Petition requirements

The research writing(s) that a student submits for consideration by the qualifying examination committee must be submitted together with the Qualifying Exam Request Form to the examination committee. Prior to submitting the Qualifying Exam Request Form and research writing(s), students are strongly encouraged to consult with their research advisor, their home program, and/or the Associate Dean to ensure that the submitted research writings are reasonable and commensurate with the general expectations for this type of qualifying examination.

#### Assessment

Qualification will be assessed by the examination committee's overall evaluation of the student's PhD level knowledge in the three topical areas selected. This will be accomplished through 1) evaluation of the quality and significance of the submitted research writing(s); 2) evaluation of how well the student responds to questions on fundamentals in three topical areas, where in all cases the questions will stem from concepts presented in the research paper(s); 3) evaluation of how well the submitted research writing(s) represent the PhD research topic to be pursued by the student; and 4) the student's ability to demonstrate both depth and breadth of knowledge in the topical areas in relation to the submitted research writing(s). The foregoing will be assessed by the examination committee through both a review of the submitted research writing(s) and a subsequent, required oral examination that is not to exceed 90 minutes in length.

### Exam grading

The outcome for a PhD qualifying examination is determined by majority vote of the qualifying examination committee members, and leads to one of the following results:

- Pass: indicating the student passed in the three topical area(s) selected.
- Conditional Pass: indicating the student did not pass in the selected topical area(s). The student will receive a pass grade after successfully completing the additional work determined by the examination committee in consultation with the PhD advisor.
- Fail: indicating the student failed. The student will be directed to meet with the Associate Dean and PhD Advisor to discuss future options, such as the award of lower degrees (e.g. MS). If this path is chosen, additional work might be required following the guidelines for these degrees.

Additional required work due to a "conditional pass" will be documented through a conditional pass, which will include details of the additional work expected of the student, and an expected completion date. The resulting additional work will be evaluated by the original examination committee.



## Appendix B

### Summary of BME Program-Specific Requirements for Ph.D. Qualifying Exam

The Qualifying Exam is intended to test the student's foundational knowledge in biomedical engineering and may be taken no more than twice. This examination is typically taken during the student's first or second year, minimally after completion of the courses to be examined. The student is responsible for setting their Qualifying Exam in consultation with their graduate advisor. In the case of failure for the first attempt of this examination, written feedback will be provided that can be used by the student as guidance in their second and final attempt.

The provided list of approved courses (see page 2) pertains to both the written and oral (research writing) forms of the Qualifying Exam. Each student will choose 3 courses from the list for their qualifying exam. At least one of the selected topics must be from the list of core BME courses. In exceptional cases, if the student needs to be examined on a course outside of the approved list, such request must be approved by the BME Program Graduate Committee (consisting of 3 BME faculty members). Only one course can be outside of the approved list. A petition form for approval of a course outside of the provided list (see page 3) must be submitted no later than 2 weeks before the exam date. Approval of the request is not guaranteed.

The faculty conducting the Qualifying Exam will consist of the instructors of the selected courses. In the event that course instructors have changed, a student will have the option of nominating either the current or past course instructor to provide the examination (subject to approval by the BME Program Graduate Committee). Three examiners must be selected for each Qualifying exam – one per course topic. For the research writing exam format, if two courses taught by the same instructor are chosen for the exam, the instructor of those courses must nominate (subject to approval by the BME Program Graduate Committee) an alternate instructor to provide the exam for one of the courses. If the student's graduate advisor is not an instructor for any of the selected courses, the advisor can be present at the oral exam, but will not be an evaluator.

#### List of approved courses:

##### Core BME courses

BME 4600/5600: Quantitative Physiology I  
BME 4400: Biomaterials  
BME 4130/5130: Medical Imaging  
BME 4200: Biomechanics  
BME 4100: Biomedical Signals

BME 4430/5430: Regenerative Engineering  
BME 5400: Tissue-Material Interfaces  
BME 4210/5210: Human Movement  
Biomechanics  
BME 5930: Biomedical Robotics

##### Other approved BME courses

BME 4410/5410: Tissue Engineering  
BME 4650/5650: Quantitative Physiology II  
BME 4320/5320: Drug Delivery  
BME 4300: Biotransport  
BME 4930/5930: Biofluids  
BME 4150/5150: Brain-Computer Interface

## Appendix C

### Dissertation Proposal Guidelines

*These guidelines have been adapted from the National Science Foundation proposal guide. You can find the original document at: [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=gpg](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg)*

#### 1. Written Report Maximum Length and Pagination Instructions

The Dissertation Proposal written report should be no more than 15 pages in length and each page must be numbered. Do not number the Title Page if included and begin numbering your pages with 1. Appendices are not allowed. Students should only use a standard, single-column format for the text. While line spacing (single-spaced, double-spaced, etc.) is at the discretion of the student, established page limits must be followed.

#### 2. Written Report Margin and Spacing Requirements

The written report must be clear, readily legible, and conform to the following requirements:

One of the following typefaces identified below must be used:

- Arial, Courier New, or Palatino Linotype at a font size of 10 points or larger
- Times New Roman at a font size of 11 points or larger
- Computer Modern family of fonts at a font size of 11 points or larger

A font size of less than 10 points may be used for mathematical formulas or equations, figure, table or diagram captions and when using a symbol font to insert Greek letters or special characters. Students are cautioned, however, that the text must still be readable, no more than 6 lines of text can be within a vertical space of 1 inch, and margins must be at least 0.7 inches in all directions.

#### 3. Content

To help you think about your document here are some ideas of the topics you should include. You do not need to follow the exact sequence of topics or include all of them. This is just a list of ideas that you might consider when putting your paper together.

- I. Aim/Hypothesis/Objective of study: What are you going to do?
- II. Background: What has already been done? Place your work/ideas in context of the field of study.
- III. Materials & Methods: What did you do? What are you planning to do?
- IV. Experimental design and expected outcomes: Experiments/Modeling you planned but might not have done yet? What do you expect the results to look like (if they have not taken place)? What equations/measurements you propose to use?
- V. Preliminary Work/Results to date: What data have you gathered, what equipment/s have you learned to use? What programs have you written?
- VI. Discussion/Conclusions: What does it all mean? If you have results that are unexpected, can you explain them? Can you make any conclusions of the work you put together in context of the advancement of your field.
- VII. Future Work: Ideas you want to pursue next?

## VIII. References

Tip for document: Make sure each section of document has a title, include an index and title page (will not count as part of the fifteen pages). The more explicit you make your titles the easier it is for the person reading your document to think about what they are reading.

Tip for references: if you have not used a reference software such as EndNote we recommend you start as soon as possible.

### **4. References Cited**

Reference information is required. Each reference must include the names of all authors (in the same sequence in which they appear in the publication), the article and journal title, book title, volume number, page numbers, and year of publication. If the document is available electronically, the Pubmed ID and website address should be identified. Students must be especially careful to follow accepted scholarly practices in providing citations for source materials relied upon when preparing any section of the proposal. There is no established limitation for the number of references, the reference section must fit within the 15-page limit.

### **5. Oral Presentation**

Oral presentations do not have a required format, and students may use any software of their choice to create the visual aids for their presentation. The maximum time limit for the oral presentation is 45 minutes. Questions from the Guidance Committee will follow the oral presentation.

### **6. Delivery of Written Document**

The written document is due to the Guidance Committee Members two weeks before the scheduled exam date. The document may be delivered in PDF format or in hard copy.