Harvard-MIT Program in Health Sciences and Technology

MEMP PhD Degree Requirements 2024-2025

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HST Credo of Professionalism

The primary objectives of HST are to educate leaders in medicine and the biomedical sciences and to develop and conduct research programs that integrate engineering, science, and medicine toward the betterment of human health.

Consistent with professional roles, HST students, faculty, and staff will:

- **Commit to the highest standards of excellence** in the practice of medicine and research, fulfill responsibilities, and be accountable for actions.
- **Maintain impeccable integrity and ethics** both in laboratory and clinical endeavors.
- **Treat patients with respect and honesty**. Be altruistic, empathetic, and compassionate in their treatment. Honor their right to confidentiality.
- **Treat colleagues, teachers, staff and students with respect and honesty.** Communicate opinions in a constructive manner and encourage free discourse.

IMES Diversity, Equality, and Justice Statement

The Institute for Medical Engineering and Science (IMES) values and is committed to an educational, research, and professional environment that is diverse, equitable, and inclusive.

As a community, we actively hold ourselves and colleagues responsible for practicing the following expected behaviors:

- Proactive and thoughtful recruitment of talented individuals with an emphasis on diversity and inclusion
- Respect, fairness, and transparency
- Recognition of each individual for their ideas and contributions
- Active listening, curiosity, and empathy
- Self-education and reflection
- Identifying, rejecting, and addressing discriminatory actions, stereotypes, and structures
- Allyship, including centering, uplifting, and celebrating marginalized voices and the communities they represent
- Accountability to ourselves, each other, and our communities

We recognize that systemic inequities have prevented, and continue to prevent, the equitable participation and success of individuals from underrepresented groups in science, engineering, medicine, and beyond. We are determined to address inequality and acknowledge that this requires active processes. Our goal is to intellectually, emotionally, and physically support each member of our community so they can achieve their personal, scientific, and professional best, such that we and IMES are enriched by their collective brilliance and capabilities.

PhD Qualifying & Research Milestones

YEAR ONE

February
- Submit TQE Contract: by Spring Registration Deadline

Summer
- Register for thesis research: HST.ThG *(you should register for thesis research credits in each term you actively working on research*)

YEAR TWO

Fall
- OQE Scheduling form due if taking January OQE (November 1)
- If taking the January OQE: meet with Qualifying Exam Chair, to discuss expectations and preparations for the exam.
- Submit Semi-Annual Progress Review **

January
- Option to take Oral Qualifying Exam, see HST calendar for exact dates

Spring
- Scheduling form due if taking Spring OQE (March 1)
- If taking the Spring OQE: meet with Qualifying Exam Chair, to discuss expectations and preparations for the exam.
- Option to take Oral Qualifying Exam, see HST calendar for exact dates
- **Letter of Intent 1** (due April 30)

YEAR THREE

Fall
- Scheduling form due if taking January OQE (November 1)
- If taking the January OQE: meet with Qualifying Exam Chair, to discuss expectations and preparations for the exam.

January
- Option to take Oral Qualifying Exam, see HST calendar for exact dates

Spring
- Scheduling form due for Spring OQE if not yet qualified (March 1)
- If taking the Spring OQE: meet with Qualifying Exam Chair, to discuss expectations and
  preparations for the exam.
- FINAL opportunity to take Oral Qualifying Exam, see HST calendar for exact dates
- **Letter of Intent 2 (due April 30)**

YEAR FOUR

Fall

- Meet with thesis committee
- Option to defend thesis proposal

Spring

- Defend Thesis Proposal, if not done in fall
- **Thesis Proposal (due April 30)**

YEAR FIVE and BEYOND

Each Semester

- Register for HST.ThG
- Meet with thesis committee (min. once per term)
- Submit Semi-Annual Progress Review **

Final Semester

- Defend and Submit Final Thesis

** *Semi-Annual Progress Review: Required each regular term (fall/spring) you are registered for HST.ThG, not required for summer.*

Academic Progress

In order to remain a student good standing, HST MEMP PhD students must meet the following criteria for satisfactory academic performance:

- Maintain a GPA of 3.5
- Pass the Technical Qualifying Exam (TQE) within five regular terms of registration or have an approved extension
- Make satisfactory progress towards completion of the biomedical sciences and clinical curriculum
- Identify and join a research lab, with reasonable prospects of a funded project, by the start of the third regular term of registration or have an approved extension
- Meet thesis milestones (Letter of Intent 1, Letter of Intent 2, and thesis proposal) by the published deadlines in April of the second, third and fourth years of enrollment or have an approved extension
- Pass the Oral Qualifying Exam (OQE) within six regular terms of registration or have an approved extension
- Earn satisfactory grades for each term of registration in HST.ThG

Guaranteed Transitional Support Program

In accordance with MIT policy regarding Guaranteed Transitional Support, HST is committed to supporting graduate students who wish to change research supervisors or research groups. Students considering such a change should contact Henrike Besche HST's Transitional Support Coordinator. Students are also welcome to contact Suraiya Baluch, Associate Dean for Graduate Advising, who serves as the Transitional Support Coordinator in MIT's Office of Graduate Education and provides an option for students who want to discuss their transition with someone outside of HST.

MEMP General Description

Is this program a good fit for me?

HST's Medical Engineering and Medical Physics (MEMP) PhD program offers a unique curriculum for engineers and scientists who want to impact patient care by developing innovations to prevent, diagnose, and treat disease. We're committed to welcoming qualified applicants from a wide range of communities, backgrounds, and experiences.

How is HST's MEMP PhD program different from other PhD programs?

As a MEMP student, you'll choose one of 11 technical concentrations and design an individualized curriculum to ground yourself in the foundations of that discipline. You'll study medical sciences alongside MD students and become fluent in the language and culture of medicine through structured clinical experiences. You'll select a research project from among laboratories at MIT, Harvard, affiliated hospitals and research institutes, then tackle important questions through the multiple lenses of your technical discipline and your medical training. As a result, you will learn how to ask better questions, identify promising research areas, and translate research findings into real-world medical practice.

What degree will I earn?

You'll earn a PhD awarded by MIT or by the Harvard Faculty of Arts and Sciences.

What can I do with this degree?

Lead pioneering efforts that translate technical work into innovations that improve human health and shape the future of medicine.

How long will it take me to earn a PhD in HST's MEMP program?

Similar to other PhD programs in MIT's School of Engineering, the average time-to-degree for MEMP PhD students is less than six years.

What can I expect?

You'll begin by choosing a concentration in a classical discipline of engineering or physical science. During your first two years in HST, you'll complete a series of courses to learn the fundamentals of your chosen area.

In parallel, you'll become conversant in the biomedical sciences through preclinical coursework in pathology and pathophysiology, learning side-by-side with HST MD students.

With that foundation, you'll engage in truly immersive clinical experiences, gaining a hands-on understanding of clinical care, medical decision-making, and the role of technology in medical practice. These experiences will help you become fluent in the language and culture of medicine and gain a first-hand understanding of the opportunities for — and constraints on — applying scientific and technological innovations in health care.

You'll also take part in two seminar classes that help you to integrate science and engineering with medicine, while developing your professional skills. Then you'll design an individualized professional perspectives experience that allows you to explore career paths in an area of your choice: academia, medicine, industry, entrepreneurship, or the public sector.

A two-stage qualifying examination tests your proficiency in your concentration area, your skill at integrating information from diverse sources into a coherent research proposal, and your ability to defend that research proposal in an oral presentation.

Finally, as the culmination of your training, you'll investigate an important problem at the intersection of science, technology, and medicine through an individualized thesis research project, with opportunities to be mentored by faculty in laboratories at MIT, Harvard, and affiliated teaching hospitals.

MEMP Degree Requirements

ENGINEERING AND PHYSICAL SCIENCES

MEMP students receive a thorough graduate education in a classical discipline of engineering or physical science. MEMP students earning a degree through MIT, selects a concentration area in consultation with their academic advisor and completes a selection of four advanced technical courses in the selected discipline. MEMP offers eleven areas (with the name of the faculty member serving as concentration area chair) listed below:

- Aeronautics and Astronautics (Lonnie Petersen)
- Biological Engineering (James J. Collins)
- Brain and Cognitive Sciences (Emery Brown)
- Mechanical Engineering (Mehmet Toner)
- Chemical Engineering (Kwanghun Chung)
- Chemistry (Alex Shalek)
- Computer Science (Peter Szolovits)
- Electrical Engineering (Roger Mark)
- Materials Science and Engineering (Sangeeta Bhatia)
- Nuclear Engineering (Sangeeta Bhatia)
- Physics (Collin Stultz)

MEMP students earning their degree through Harvard must meet the PhD coursework requirements of either the Biophysics Program or the School of Engineering and Applied Science (SEAS).

BIOMEDICAL SCIENCES AND CLINICAL COURSEWORK

All MEMP students must complete:

- Biomedical Sciences Core Requirements
- Biomedical Sciences Restricted Electives
- Clinical Coursework Requirements

Biomedical Sciences Core Requirements

- Human Pathology (HST030/031 or HST034/035)
- Molecular Genetics in Modern Medicine (HST160/161)
- Cardiovascular Pathophysiology (HST090/091)

Biomedical Sciences Restricted Electives

Restricted Electives - two full courses required*

- HST010: Human Functional Anatomy
- HST020: Musculoskeletal Pathophysiology*
- HST100: Respiratory Pathophysiology**
- HST110: Renal Pathophysiology**
- HST130: Introduction to Neuroscience
- HST162: Molecular Diagnostics and Bioinformatics*
- HST164: Principles of Biomedical Imaging*
- HST175: Cellular & Molecular Immunology

* May combine two half-term courses to count as one full course
**Must choose at least one of HST100, HST110

Clinical Coursework Requirements

All MEMP students must complete the clinical core requirement with one of the following options:

Option 1, two-part series:

- HST201: Introduction to Clinical Medicine and Medical Engineering I
- HST202: Introduction to Clinical Medicine and Medical Engineering II

HST201W and HST202W are offered at the West Roxbury Veteran's Administration Hospital. HST201M and HST202M are offered at Mt. Auburn Hospital. Students selecting Option 1 must complete both HST201 and HST202 at a single location.

Option 2:

- HST207: Introduction to Clinical Medicine and Medical Engineering

HST207 is offered at Massachusetts General Hospital followed by sessions at MIT.

ATTENDANCE AND PARTICIPATION EXPECTATIONS

The HST program is cognizant of completing demands on a student's time. Students need to be aware of the culture and expectations that differ between institutions. When MEMP students are enrolled in classes at HMS, there is an expectation that they will be present, on time, and prepared for class. It is explicitly noted that if a student must miss any session, they will exercise good judgment in that decision and will notify the faculty member in charge in advance of the absence. This is not to request permission, rather to acknowledge that as a close-knit community, such notification is the responsible, courteous, and collegial thing to do

GRADING FOR BIOMEDICAL SCIENCES CLASSES

Biomedical Sciences Core Requirements and Restricted Electives are graded with an internal grade and a narrative evaluation. The internal grades are then translated to the MIT transcript as described below.

Internal Grades

E: Excellent; **S**: Satisfactory; **M**: Marginal Pass; **U**: Unsatisfactory

- **E** & **S**: are recorded as a "P" (Pass) on the MIT transcript.
- **M**: is recorded as a "P" (Pass) on the MIT transcript and and flagged for review of academic progress.
- **U**: is recorded as a "F" (Fail) on the MIT transcript and flagged for review of academic progress.

Narrative Evaluations

Narrative evaluations are available for students to pick up in the IMES/HST Academic Office, typically six weeks after the end of the term. These evaluations are also distributed to Academic Advisors in their registration materials for the subsequent term.

PROFESSIONAL SKILLS DEVELOPMENT

Students take two seminar classes that help them integrate engineering, science and clinical perspectives while also developing professional skills that prepare them to become independent investigators at the interface of technology and medicine. The seminars introduce students to the breadth of research areas in biomedical engineering and sciences and also cover technical communication skills, responsible conduct of research and other professional development topics.

HST500: Introduction To (Bio) Medical Engineering And Medical Physics

All MEMP students are required to take HST500 during the spring semester of their first year. In the unusual case where a student is approved to defer HST.500, it must be taken in the second year and prior to the oral qualifying exam.

HST590: Biomedical Engineering Seminar Series

All MEMP students must complete four semesters of HST590, including one semester focused on responsible conduct of research. Other semesters typically include topics such as global health and mini MBA.

HST Professional Perspectives Requirement

Alumni of HST's MEMP PhD program pursue a wide range of career paths in academia, medicine, industry, entrepreneurship, and the public sector. Graduate students are eager to understand career options that may be available to them, either in areas well aligned to their specific research or in areas that differ from their focused graduate research engagement. To meet this need, HST has established a Professional Perspectives Requirement.

To fulfill the Professional Perspective Requirement, students must complete one of the activities listed below. Note that items 1-7 require registration for one unit of *HST.999: Practical Experience in Health Sciences and Technology*. To receive credit, students must submit a short report to the HST Academic Office summarizing the knowledge gained from the experience.

1. **Industry Colloquia:** Students attend three colloquia or seminars of their choice, focused on a topic under investigation by an industrial entity.
2. **Medical Colloquia:** Student attend three colloquia, seminars, HST fall Frontiers Lecture Series ("Pizza + Pizzaz") or grand rounds of their choice, focused on a topic related to a clearly defined area of biomedical research and patient care.
3. **Industry/Government Internship*:** During the summer, or over the Independent Activities Period (IAP), students engage in an internship with a company or government laboratory. Summer registration has tuition implications. [1] Students considering internships should also review the HST policy on outside employment.
4. **Academic Internship*:** Students are away from MIT for a period of time to engage in an academic internship at a peer institution. Summer registration has tuition implications.[1]
5. **Medical Clerkship*:** Students engage in a medical clerkship of at least two weeks beyond the MEMP requirements for HST.201 and HST.202. Summer registration has tuition implications.[1]
6. **Industry Invitation*:** Students are invited to share their research results by a visit to a company and by delivering research seminars to disseminate

research contributions. Visits to the company will involve discussions with industry scientists and technical staff.

7. **Medical Invitation*:** Students are invited to share their research results by a visit to an academic medical center and by delivering research seminars to disseminate research contributions. Visits to the academic medical center will involve discussions with medical researchers and clinicians.
8. **Professional Skills - Programs:** Students successfully complete a recognized MIT or Harvard program for career development, teaching, mentoring, or innovation. Current examples include MIT's Kaufman Teaching Certificate Program, MIT-Gordon Graduate Certificate in Technical Leadership, The Path to the Professorship, IDEA2 Global, IMPACT, and Catalyst. Students may petition to have other programs added to this list.
9. **Professional Skills - Classes:** Student register for and successfully complete an MIT or Harvard class focused on professional skills such as negotiation, business development, etc.

***For International Students:** When HST.999 is used to fulfill the Professional Perspectives Requirement and is directly related to the students' field of study, international graduate students are eligible to apply for Curricular Practical Training (CPT for F-1 visa holders) or Academic Training (AT for J-1 visa holders) from the International Students Office. Students enrolling in HST.999 who have already fulfilled the Professional Perspectives requirement may be advised by MIT's International Students Office to apply for Optional Practical Training (F-1 visa holders) or Academic Training (J-1 visa holders).

[1] Summer tuition per unit of credit will be charged for paid internships at rates published on the MIT Registrar's Office Website. For unpaid activities, the student may petition for a summer tuition waiver. For more detailed information regarding the cost of attendance, including specific costs for tuition and fees, books and supplies, housing and food as well as transportation, please visit the MIT Student Financial Services website.

Implementation of the HST Professional Perspectives Requirement:

All HST PhD students who matriculate in fall 2020 or later **must** complete the Professional Perspective Requirement to earn their degree. HST PhD students who enrolled prior to fall 2020 may petition to complete the requirement.

A student may petition to waive the HST Professional Perspectives Requirement. Waivers can be submitted at any time. Waivers will be granted for students who demonstrate significant engagement with industry, government, or academic medicine prior to matriculation into the PhD program.

A student may petition to repeat HST.999 for additional units of Professional Perspectives credit.

Students completing a Professional Perspectives activity that requires enrollment in HST.999 as noted above should enroll in HST.999 during the semester in which they engage in the corresponding activity.

Students who have not received a waiver or completed HST.999 will be asked for documentation of their Professional Perspectives activity (e.g. certificate of completion for a professional skills program) as part of their final degree audit during the semester before graduation.

QUALIFYING EXAMS

Each MEMP student earning a degree through MIT must complete a two-stage qualifying process. In the first stage, students demonstrate their technical qualification based on their performance in classes selected for their concentration area and in Human Pathology, which is part of the core biomedical science requirement. Students who successfully complete their technical qualification take the oral portion of the doctoral qualifying exam. Students typically complete their qualifying exams at the end of their 4th semester, and must do so no later than the end of their 6th semester.

MEMP students earning their degrees at Harvard must pass the doctoral qualifying exams offered by Harvard's Biophysics Program or SEAS.
Successful completion of the qualifying exam is a prerequisite for enrolling in the clinical coursework and for scheduling a thesis proposal defense.

Please see the Qualifying Exam section of this handbook for more details.

DOCTORAL THESIS

Each MEMP student must complete and defend a doctoral thesis to complete their degree. More information about doctoral thesis requirements is in the HST PhD Thesis Guide. Students earning their degrees at Harvard follow departmental thesis procedures defined by Biophysics or SEAS whenever the procedures differ from the HST guidelines.

For more information about the MEMP curriculum, contact:
Dr. Henrike Besche
Director of Education
MIT Room E25-518
77 Massachusetts Avenue Cambridge, MA 02139
hbesche@mit.edu

Please see the PhD Thesis Guide later in this handbook for more details.

MEMP Curriculum Map

updated 7.02.2024

Science / Engineering[1]

Choose one of the established concentration areas and select four courses from the approved list for the chosen area.

Current MEMP concentration areas are:

- Aeronautics & Astronautics
- Biological Engineering
- Brain & Cognitive Sciences
- Chemical Engineering
- Chemistry
- Computer Science
- Electrical Engineering
- Materials Science & Engineering
- Mechanical Engineering
- Nuclear Engineering
- Physics

Biomedical Sciences & Clinical[2]

Biomedical Sciences Core

- HST030 or HST034: Human Pathology
- HST160: Genetics in Modern Medicine
- HST090: Cardiovascular Pathophysiology

Restricted Electives - two full courses required*

- HST010: Human Anatomy
- HST020: Musculoskeletal Pathophysiology*
- HST100: Respiratory Pathophysiology**
- HST110: Renal Pathophysiology**
- HST130: Introduction to Neuroscience
- HST175: Cellular & Molecular Immunology
- HST162: Molecular Diagnostics and Bioinformatics*
- HST164: Principles of Biomedical Imaging*

** May combine two half-term courses to count as one full course*
***Must choose at least one of HST100, HST110*

Clinical Core

- HST201: Intro. to Clinical Med I + HST202: Intro. to Clinical Med II

OR

- HST207: Intro. to Clinical Medicine

Research/PhD Thesis[3]

Letter of Intent #1: Thesis Research Advisor and topic.
Due by April 30 of 2nd year.

Letter of Intent #2: Propose thesis committee and project.
Due by April 30 of 3rd year.

Thesis proposal: Defended before thesis committee.
Due by April 30 of 4th year.

Final Thesis:
Public defense and submission of final thesis document.

Qualifying Exam[1]

TQE: Technical qualification based on performance in four concentration area courses and Pathology

OQE : Oral examination to evaluate ability to integrate information from diverse sources into a coherent research proposal and to defend that proposal

Professional Skills[2,4]

HST500: Frontiers in (Bio)Medical Engineering and Physics
Required spring of first year

HST590: Biomedical Engineering Seminar
Required fall semester of first year. Minimum of four semesters required; one on responsible conduct of research and three electives. Topics rotate.

Professional Perspectives Requirement
required once during PhD enrollment

1. Harvard MEMPs fulfull Basic Science/Engineering and Qualifying Exam through their collaborating departments
2. Required for ALL MEMP PhDs
3. Harvard MEMPs must publicize final thesis defense and submit an electronic copy to the HST Academic Office (including signed cover).
4. Harvard MEMP Biophysics students may substitute MedSci 300 for HST590 term on responsible conduct of research.

MEMP Qualifying Examination

The qualifying exam requires that students' progress through a two-step process:

Technical Qualifying Exam (TQE): Students demonstrate technical competence based on coursework. The TQE is typically completed in the first three or four regular semesters of registration.

Oral Qualifying Exam (OQE): After successful completion of the TQE, students take an oral qualifying exam. It is desirable to complete the OQE by the end of the fourth regular semester of registration. Students must successfully complete the OQE by the end of the sixth regular semester of registration; explicit permission from the QuEHST committee is required to continue in the program beyond six semesters without passing the OQE.

Technical Qualifying Examination (TQE) Class Requirement
During their first year, students choose a technical concentration area in which to develop a focused engineering/physics skill set. Students must select a set of advanced technical subjects --- minimum of 4 classes and 42 units --- from a single concentration area. All students must also take **Human Pathology** (HST030/031 or HST034/035) and **HST500: Introduction to (Bio)Medical Engineering and Medical Physics** as part of their TQE.

Each student, with the assistance of his/her academic advisor, should construct a plan for satisfying the TQE course requirement. In constructing their TQE plans, students should consider the following:

- A thorough grounding in a classical engineering or physical sciences discipline is one of the fundamental underpinnings of the MEMP program. Many MEMP students have undergraduate backgrounds that were not structured this way, but we believe that such training is an important part of the preparation for interdisciplinary research. Selecting a technical concentration area provides students with the opportunity to focus their general technical interests and acquire a solid technical foundation in a specific discipline.
- It is often useful to enroll in undergraduate classes in preparation for some of the advanced technical subjects.

Students must register their plans by submitting a signed Contract for TQE form to Traci Anderson in E25-518, by Spring term Registration Day of their first year in the program. Changing the TQE concentration area at a later time requires a written petition to the QuEHST committee.

Changing TQE classes. Students may "shop" classes at the start of each term and make changes to TQE class selections – via an email to Traci Anderson with cc to the academic advisor – until **Add Date** of the term in which they are enrolled in the class being added. Please make sure that the email is clear with respect to which class(es) are being added to the TQE plan and which class(es) are being removed. Under no circumstances will students be permitted to add a class to the TQE plan after earning a grade in the class.

Students pass the TQE portion of the qualifying exam by demonstrating competence in the chosen concentration area and by earning a grade of 'satisfactory' or better in pathology. Competence in the chosen technical concentration area is demonstrated by:

- Earning at least three A grades and one B grade in the four selected TQE classes.
- Earning two A grades and two B grades in the four selected TQE classes, and subsequently earning an A grade in an alternate, fifth TQE class.
- *When five classes are required to meet the 42-unit minimum*: Earning at least 30 units of A and no more than 12 units of B in the five selected TQE classes.
- *Applies only to Biological Engineering, Chemical Engineering, and Material Science and Engineering TQE areas:* Earning at least two A grades and two B grades in the four selected TQE classes.

When a student does not initially meet the criteria above, the QuEHST committee will review the student's academic performance and decide on a remediation plan individualized to the circumstances. The student is welcome to submit a written statement explaining any circumstances impacting their performance and proposing a specific remediation. Remediation plans could potentially include:

- Taking (or retaking) one or more specific classes to achieve mastery of the material.
- After suitable preparation, retaking the final exam and earning a grade (specified by instructor) that is indicative of a firm grasp of the subject matter.
- After suitable preparation, taking an oral exam with a pass/fail outcome in a specific topic area.
- Communication between HST and the instructor(s) of those class(s) in which students received a B to determine the class rank of the candidate and the minimum rank indicating mastery of the subject material according to the instructor. (This approach is necessary because of the uneven grading policies - percent A's - in graduate subjects across different departments.) Under no circumstances should students approach instructors directly to discuss remediation.

Successful completion of the TQE is a prerequisite for taking the OQE.

MEMP TQE FAQ

What is the purpose of the TQE concentration area requirement?
One key element of the MEMP curriculum is to provide students with in-depth, advanced technical expertise in a classical engineering or physical sciences discipline. This is accomplished through rigorous graduate-level courses in a single concentration area to develop depth; this approach is deliberately different from many undergraduate programs in biomedical engineering that are designed to provide breadth. Successfully completing a MEMP concentration area provides you with the knowledge base necessary to interact on equal footing and communicate effectively with technical experts in your specific concentration area.

Many MEMP students have undergraduate backgrounds that were not structured this way, but we believe that thorough grounding in a classical discipline is an important part of the preparation for interdisciplinary research. Selecting a TQE concentration area give you an opportunity to focus your general technical interests and acquire a solid technical foundation in a specific discipline.

Can I define my own TQE concentration area?
MEMP students are required to select one of the eleven established concentration areas. That affords you a wide range of options, considerably broader and more diverse than the requirements for most other MIT PhD programs.

How does HST's TQE system compare to qualifying processes used by other MIT PhD programs?
Almost all MIT PhD programs have a two-part qualifying process. For the first portion, some departments require students to pass a set of written exams in specific topic areas, while other departments use systems based on grades in a particular set of classes. HST's grade-based system is similar to that used by EECS; this approach provides a flexible alternative to written exams that require all students in the program to qualify in a limited number of topic areas. The second portion of the qualifying process always consists of an oral exam, with each department specifying the relative balance of coursework and research covered in the oral exam.

How is the list of concentration areas determined?
Prior to establishment of the current TQE system, HST partnered with a number of MIT departments to admit and qualify MEMP PhD students. The initial set of concentration areas reflected the disciplines represented by those departments. Over time, the Qualifying Exam in HST (QuEHST) Committee has added new TQE tracks in response to student interest and evolution of the field.

How do I decide which TQE concentration area to choose?
There are multiple factors to consider in choosing your concentration area:

- *Your long-term career goals* – Throughout your career, you will find yourself in situations where you are expected to excel based on your past experience in a particular realm. Selecting your TQE concentration area at the start of graduate study is one of the rare opportunities that you'll have to switch your focus and chart a new course.

- *Your general research interests* -– Your TQE concentration area should

support your general research interests. For example, if you're interested in medical imaging, you might choose any of these concentration areas: EE, CS, NSE, BCS. It's ok to be choosing your TQE concentration area before deciding on a research lab, since the concentration area should support your general research interests, not the specific project that you ultimately choose for your PhD thesis.

- *Your undergraduate background* – Depending on your research interests and career goals, it might make sense to stay in your comfort zone and select the TQE concentration area most closely aligned with your undergraduate background. In other cases – due to your goals or because your undergraduate major is not represented in the established areas – you may decide to develop competency in a new field.

Is it common for MEMP students to choose a concentration area that's different from their undergraduate majors?
Yes, over half of MEMP students choose an area of study that's different than their previous degrees. If you wish to switch your focus, entering a new degree program is an excellent time to do so.

Will it be more difficult to pass the TQE in a new field of study?
It may require some additional effort. If it supports your long term career goals, then the extra effort required to gain expertise in a new area will be a worthwhile investment. Students choosing a concentration area different from their prior training are encouraged to take undergraduate classes to build a strong foundation before entering graduate classes.

Will taking undergrad classes slow down my progress?
Students who take the time to develop a strong foundation almost always report that it was a very good investment. It is far preferable to make the investment up front and take undergraduate classes first rather than performing poorly in graduate-level classes, then taking undergraduate classes followed by retaking the graduate classes.

I'm still not sure what to do - how can I get more information and advice about choosing a TQE concentration area?
There are lots of resources to help you with this decision. As in most cases, you should start with your academic advisor. In addition, you are encouraged to seek advice from Henrike Besche IMES/HST Director of Education. You can also consult with the faculty members who serve as concentration area chairs for the areas that you are considering. Finally, it's a good idea to talk to more senior MEMP students; ask your big buddy or any member of the Joint Council to introduce you to their classmates in concentration areas that you are considering. Also, note that the TQE process is set up to give you time to decide. During your first semester, you can take classes to explore a concentration area and see if it's a good fit for you.

If I have an undergraduate background in biomedical engineering (BME), should I choose biological engineering (BE) as my TQE concentration area?
It's a good idea to take a close look at the classes in a given concentration area to make sure that they fit your expectations. Biomedical engineering (BME) is a relatively new field, with individual undergraduate programs having wide variation in focus and content. If you have a BME background and are considering the BE TQE track, please be aware that the biological engineering curriculum at MIT is focused on the analysis and synthesis of molecular and cellular biological mechanisms. To succeed in the BE TQE concentration area, you'll need strong familiarity with the material covered in General Biochemistry (7.05) and Cell Biology (7.06)

When do I need to decide on my TQE concentration area? What if I want to switch later?
You should declare your concentration area on the TQE contract form, which is due by Spring term Reg Day of your first year in the program. If you want to request a change after that date, you can submit a written petition to the QuEHST Committee explaining the rationale for the change along with a revised TQE contract signed by your academic advisor. You can submit your petition to Traci Anderson via email. Such petitions are relatively rare, but experience has shown that QuEHST is likely to approve changes motivated by clear and defensible educational goals.

When do I need to decide on my TQE classes? What if I want to change them later?
Initially, you will submit your best guess of TQE classes on the TQE contract form due by Spring term Reg Day of your first year in the program. You can "shop" classes at the start of each term and make changes to your TQE class selections until Add Date of the term in which you are enrolled in the class being added to your TQE – just send an email to Traci Anderson with cc to your academic advisor before the deadline. Please make sure that the email is clear with respect to which class(es) you are adding to your TQE plan and which class(es) you are removing. Under no circumstances will you be permitted to add a class to your TQE contract after earning a grade in the class.

How can I increase my chance of success in TQE classes?
The classes on the TQE lists are rigorous graduate subjects. Depending on your background with the specific subject matter, many students find it helpful to take undergraduate classes in preparation for some of the advanced graduate classes.

I want to take a class for my TQE that isn't on the approved list, or that is on the list in another concentration area. Can I do that?
You may submit a petition requesting permission to count a class that's not on the approved list for your TQE concentration area. The petition should include a copy of a recent syllabus, if possible. Please lsut the courses taken/proposed for your TQE (include semester and grade if taken). Such petitions are more likely to be approved when:

- the class is sufficiently rigorous - usually this means problem sets and quizzes rather than entirely project based;

- the content is well aligned with topics covered in the approved classes in that concentration area.

You can submit your petition to Traci Anderson via email. Petitions may be submitted at any time, but please allow sufficient time if you wish to receive an answer before the start of classes: August 15 for fall; January 15 for spring.

Why pick from a pre-specified list of classes, rather than just taking whatever courses I want in my chosen concentration area? How are the lists of classes in each TQE concentration areas determined?
The lists of classes in each TQE concentration area are developed based on the requirements of the corresponding PhD program; this insures that MEMP students get the same rigorous training in foundational subjects as their peers in those disciplines. Beyond the basic departmental requirements, the lists are customized to allow MEMP students some flexibility to select from classes with a focus on human health and to achieve some measure of uniformity across the different TQE areas within MEMP. Each area has a concentration area chair, a faculty member knowledgeable in the discipline who oversees the TQE concentration area. The lists are updated annually based on curricular changes in the associated departments and degree programs.

Why is it recommended to include an alternate class on the TQE contract?
This is for planning purpose – the idea is to identify a class to be taken if it becomes necessary for any reason, including scheduling conflicts or a class not being offered. You won't be required to take the alternate (usually fifth) class if you meet the requirements of your TQE track based on the initial set (usually four) classes taken. Students whose TQE contract includes a class in which they earned a *B* in a fall term **must** list an alternate class.

Do my TQE courses affect what to expect during my oral qualifying exam (OQE)?
The purpose of the OQE is to evaluate whether you can integrate information from diverse sources into a well thought out and coherent research proposal, defend your proposal during an oral presentation, and think on your feet. While the OQE is not designed to explicitly cover material covered in TQE classes, material covered in TQE classes is considered 'fair game' during the OQE if it relates to your research project. (An additional area assessed by the OQE is the student's ability to explain the relevance of their proposed research to clinical medicine. Material covered in the pathology course requirement is likely to be relevant in that context.)

Why do some concentration areas have different criteria for passing the TQE?
Grading standards and policies differ among the various graduate programs represented by the TQE concentration areas. Based on discussions with faculty members in other MIT departments and years of experience with MEMP students taking these classes, we have developed criteria (new in 2016) that reflect the variations in grade distribution for core classes in different departments.

What happens if I don't get the required number of A's?
In most circumstances, you automatically have the option of taking one additional TQE class to meet the criteria. In a few cases (for example, if you receive three or more B grades in your initial set of TQE classes), the QuEHST committee determines the specific remediation plan that you'll follow. In this case, you are welcome to submit a written statement proposing a specific remediation and/or explaining any circumstances impacting your performance.

How common is it for students to take an additional TQE class?
15-20% of MEMP students take an additional class in order to meet the criteria for passing the TQE.

Oral Qualifying Examination (OQE) Requirement

Students should identify a research project during the first year, and should conduct full-time research during their first summer. This research experience is essential as part of the preparation for the oral qualifying exam, but need not be the basis of the doctoral thesis.

The purpose of the OQE is to evaluate whether the student can integrate information from diverse sources into a well thought out and coherent research proposal - a skill essential for successful scholarship. The ability to defend this proposal during an oral presentation is a central part of the qualifying process. The qualifying exam explores students' ability to formulate coherent research questions and to explain the relevance of their proposed research to clinical medicine. In addition, students should be prepared to demonstrate how they think on their feet. It is not possible to anticipate every question that might be asked during the OQE, but students should be prepared to show how they approach technical questions even when they do not immediately know the answer.

Each OQE is administered by an OQE committee composed of the student's Qualifying Exam (QE) chair and two additional faculty members. The student's research supervisor may not be a member of the OQE committee. A member of the QuEHST committee will be assigned as a QE chair upon successful completion of the TQE (or in those cases where a student has all As in the TQE subjects with one only remaining subject and thus eligible to schedule the OQE in the term of the final TQE subject registration.)

The OQE is offered twice each year, in January and Spring (May/June). Students indicate their intent to take the exam by submitting an OQE Scheduling form to Traci Anderson in the IMES/HST Academic Office by November 1 for January exams or by March 1 for Spring exams. The student and their QE chair must both sign the OQE scheduling form. Students may not submit the OQE scheduling form until they have successfully completed the TQE, with the following exceptions:

1) Students may submit the OQE scheduling form during the term in which they are taking Human Pathology and/or HST.500

2) When three A's and one B are required, students who have received A's in three TQE courses may submit the OQE scheduling form during the term in which they are taking their fourth TQE course.

3) When two A’s and two B's are required, students who have received A's in two TQE courses and a B in one TQE course may submit the OQE scheduling form during the term in which they are taking their fourth TQE course.

4) When five classes are required to meet the 42-unit minimum, students who have received A’s in TQE courses totaling at least 30 units may submit the OQE scheduling form during the term in which they are taking their remaining TQE course(s).

Three weeks prior to the exam date, the student must ensure that the the following items have been submitted to Traci Anderson in the IMES/HST Academic Office:

1. A recommendation letter from the research supervisor. The letter should address the student's potential for conducting independent research and their progress in the laboratory to date. It is the student's responsibility to ensure that the research advisor's letter is received in a timely fashion.

2. A research proposal (maximum 10 pages, single spaced, Arial 11pt font) based on research conducted under the guidance of the research supervisor. The format of the research proposal is similar to that submitted to a granting agency or foundation, as discussed in HST500. The required sections are:
   - Abstract
   - Overall Goals and Specific Aims
   - Background and Significance
   - Preliminary Data (As in HST500, students may use their own preliminary data or data from the literature or sponsoring laboratory supporting the feasibility of the proposed work.)
   - Research Design and Methods
   - References (not included in 10 page limit)

The OQE normally consists of a 30-minute oral presentation by the student, followed by questions from the OQE committee. However, the precise format of the exam is determined by the QE chair and therefore questions/interruptions may be allowed during the student's presentation. Two hours are allotted for the OQE.

While the written research proposal should be at a detailed scientific level, expectations for the oral presentation differ. Committee members will judge the oral presentation based on the student’s ability to present their research to a broad scientific audience, for example, readers of *Scientific American*. Students should avoid jargon and should not assume that the committee members possess detailed knowledge about their field of specialization. In preparing their oral presentation, students are encouraged to seek help and advice from their research supervisor, lab mates, fellow MEMP students, and other knowledgeable parties.

At the conclusion of the exam, the OQE committee makes a recommendation to the QuEHST committee. This recommendation is based on the student's performance on the oral exam, the written research proposal, and the research advisor's recommendation letter. The QuEHST committee determines the final outcome, which is one of the following:

Qualified: No further testing/evaluation is required. The student is qualified to proceed with thesis research.

Not Yet Qualified: Additional tasks are required to pass the OQE. This may include additional coursework and/or a repeat oral exam. Each student is permitted a maximum of two attempts at the oral exam.

Not Qualified: The student is not qualified to continue his/her pursuit of a degree in Medical Engineering and Medical Physics.

Petitions
Petitions to the QuEHST Committee requesting exceptions to any of these policies may be submitted to Traci Anderson (tanderso@MIT.EDU) in the IMES/HST Academic Office, E25-518.

QuEHST Committee

The doctoral qualifying examination is administered by the Qualifying Exam in HST (QuEHST) Committee, comprised of HST Faculty Members:

- Sangeeta Bhatia, chair
- Elfar Adalsteinsson
- Kwanghun Chung
- Martha Gray
- Roger Mark
- Ellen Roche
- Alex Shalek
- Mehmet Toner

SAMPLE FORMS: Qualifying Exams

Please see Appendix 1 for the following MEMP Qualifying Exam forms.

- Sample MEMP Schedules (TQE)
- Technical Qualifying Exam Form
- Oral Qualifying Exam Scheduling Form

Neuroimaging Training Program Requirements

The Neuroimaging Training Program (NTP), funded by a grant from the National Institute of Biomedical Imaging and Bioengineering, provides a cohesive curriculum and topic-specific mentorship for PhD students focused on neuroscience and biomedical imaging.

Technological advances in biomedical imaging have the potential to advance knowledge about the underlying etiology of brain disorders, mechanisms of treatment, and predictors of response. The NTP prepares students for careers in which they will further these advances into clinically relevant commercial products and services.

Students in this program have opportunities for research in many settings, including the Athinoula A. Martinos Center for Biomedical Imaging at Massachusetts General Hospital, the Surgical Planning Laboratory at Brigham & Women's Hospital, the Wellman Center for Photomedicine at Massachusetts General Hospital, and the McGovern Institute for Brain Research at MIT. Students do research under the supervision of faculty members who lead major research programs in the areas of cognitive and systems neuroscience, neurodegeneration, CNS oncology, cerebrovascular pathophysiology, psychiatric diagnosis, and image-guided therapy.

PhD students wishing to be formally affiliated with the Neuroimaging Training Program (NTP) must complete the following requirements in addition to the requirements of their primary PhD program. It is recommended that students select courses that can simultaneously fulfill other degree requirements whenever possible.

NTP students are required to take the following courses:

- HST 130: Neuroscience
- HST 582J: Biomedical Signal and Image Processing

NTP students must also take two imaging electives such as the ones on the list below. One course is selected to provide depth of understanding in the imaging modality or medical image analysis methods most closely related to the student's research, while the other should be chosen for breadth of biomedical imaging knowledge outside of the research area.

- HST 531: Medical Physics of Proton Radiation Therapy
- HST 533: Optimization Problems in Radiation Therapy and Medical Imaging
- HST 563: Imaging Biophysics and Clinical Applications
- HST 565: Molecular Imaging using SPECT and PET-CT
- HST 576: Topics in Neural Signal Processing
- HST 580: Data Acquisition and Image Reconstruction in MRI
- HST 583: Functional Magnetic Resonance Imaging: Data Acquisition and Analysis
- HST 584: Magnetic Resonance Analytic, Biochemical, and Imaging

Techniques
- 2.715: Optical Microscopy and Spectroscopy for Biology and Medicine
- 6.344: Digital Image Processing
- 6.631: Optics and Photonics

For more information on the Neuroimaging Training Program, contact the Co-Directors:

Dr. Bruce Rosen
Director, Martinos Center for Biomedical Imaging
617-726-5122
bruce@nmr.mgh.harvard.edu

Dr. Randy Gollub
Associate Director, Division of Psychiatric Neuroimaging, MGH
617-724-9602
rgollub@partners.org

Bioastronautics Training Program Requirements

Bioastronautics—at the interface of biology, medicine, engineering and space research—challenges the state of the art in human protection and integrative physiology.

An astronaut who travels for long periods far from earth is affected by weightlessness, space radiation, and psychological stress, and is utterly dependent on artificial life support. Bones and muscles, cardiovascular regulation, and sensory-motor control depend on gravity on earth and require protection during space flight. The challenge of bioastronautics is to protect the astronaut during and following long flights and to provide air, water, food, and telemedicine while dealing with the scientific issues of gravitational biology.

The MEMP PhD Program at HST can include a Bioastronautics specialization that equips graduate students with skills in space life sciences, aerospace engineering, and space medicine, opening up a broad range of possible career opportunities. The program provides its students with a combination of science and engineering coursework, clinical experiences, space-related research apprenticeships, and thesis research options at MIT, Harvard, and associated hospitals.

MEMP students interested in the bioastronautics program may enroll in the following courses. With careful selection, many of these can also fulfill requirements of the MEMP curriculum.

- 16.422 Human Supervisory Control of Automated Systems
- 16.432J Aerospace Biomedical and Life Support Engineering
- 16.453 Human Factors Engineering
- 16.851 Introduction to Satellite Engineering
- 16.853 Advanced Satellite Engineering
- 16.89J Space Systems Engineering
- 16.893 Engineering the Space Shuttle
- 16.895 Engineering Apollo: The Moon Project as a Complex System
- HST.542J Quantitative and Clinical Physiology
- HST.560J Radiation Biophysics
- HST.971J Strategic Decision Making in Biomedical Enterprise
- HST.020 Musculoskeletal Pathophysiology
- 2.183J Biomechanics and Neural Control of Movement

Students may optionally complete a summer internship at a NASA Center or industry partner. MEMP students specializing in bioastronautics also have the option (space permitting) to use either the Aerospace Medicine Clerkship at Johnson Space Center or the Space Medicine Short Course at University of Texas Medical Branch to fulfill the elective portion of the Introduction to Clinical Medicine and Medical Engineering (HST202).

HST PhD Thesis Guide

DEADLINES & REQUIREMENTS

Students should register for HST.ThG during any term in which they are conducting research towards their thesis. Regardless of their year in the program, students registered for HST.ThG in a regular term (fall or spring) must meet with their research advisor and complete the Semi-Annual PhD Student Progress Review Form to receive credit.

Years 1 - 2

- Students participating in lab rotations during year 1, may use the optional MEMP Rotation Registration Form, to formalize the arrangement and can earn academic credit by enrolling in HST.599.
- A first letter of intent (LOI-1) proposing a general area of thesis research and research advisor is required by **April 30th of the second year of registration.**

Year 3

- A second letter of intent (LOI-2) proposing a thesis committee membership and providing a more detailed description of the thesis research is required by **April 30th of the third year of registration** for approval by the HST-IMES Committee on Academic Programs (HICAP).

Year 4

- Beginning in year 4, (or after the LOI-2 is approved) the student must meet with their thesis committee at least once per semester.
- Students must formally defend their proposal before the approved thesis committee, and submit their committee approved proposal to HICAP by **April 30 of the fourth year of registration.**

Year 5+

- Meetings with the thesis committee must be held at least once per semester.

HST has developed these policies to help keep students on track as they progress through their PhD program. Experience shows that students make more rapid progress towards graduation when they interact regularly with a faculty committee and complete their thesis proposal by the deadline.

Entered HST PhD	Letter of Intent 1	Letter of Intent 2	Thesis Proposal
September 2024	April 30, 2026	April 30, 2027	April 30, 2028
September 2023	April 30, 2025	April 30, 2026	April 30, 2027
September 2022	April 30, 2024	April 30, 2025	April 30, 2026
September 2021	April 30, 2023	April 30, 2024	April 30, 2025

THE THESIS COMMITTEE - ROLES AND RESPONSIBILITIES

Students perform doctoral thesis work under the guidance of a thesis committee consisting of at least three faculty members from Harvard and MIT (including a chair and a research supervisor) who will help guide the research. Students are encouraged to form their thesis committee early in the course of the research and in any case by the end of the third year of registration. The HST IMES Committee on Academic Programs (HICAP) approves the composition of the thesis committee via the letter of intent and the thesis proposal (described below).

Research Supervisor

The research advisor is responsible for overseeing the student's thesis project. The research advisor is expected to:

- Oversee the research and mentor the student
- Provide a supportive research environment, facilities, and financial support
- Discuss expectations, progress, and milestones with the student and complete the Semi-Annual PhD Student Progress Review Form each semester
- Assist the student to prepare for the oral qualifying exam
- Guide the student in selecting the other members of the thesis committee
- Help the student prepare for, and attend, meetings of the full thesis committee, to be held at least once per semester
- Help the student prepare for, and attend, the thesis defense
- Evaluate the final thesis document

The research supervisor is chosen by the student and must be a faculty member of MIT* or Harvard University and needs no further approval. HICAP may approve other individuals as research advisors on a student-by-student basis. Students are advised to request approval of non-faculty research supervisors as soon as possible. In order to avoid conflicts of interest, the research advisor may not also be the student's academic advisor. In the event that an academic advisor becomes the research advisor, a new academic advisor will be assigned.

The student and their research advisor must complete the Semi-Annual PhD Student Progress Review during each regular term in order to receive academic credit for research. *See Appendix 2 for the form.*

*MIT Senior Research Staff are considered equivalent to faculty members for the purposes of research advising. No additional approval is required.

Thesis Committee Chair

Each HST PhD thesis committee is headed administratively by a chair, chosen by the student in consultation with the research advisor. The thesis committee chair is expected to:

- Provide advice and guidance concerning the thesis research
- Oversee meetings of the full thesis committee, to be held at least once per semester
- Preside at the thesis defense
- Review and evaluate the final thesis document

The thesis committee chair must be well acquainted with the academic policies and procedures of the institution granting the student's degree and be familiar with the student's area of research. The research advisor may not simultaneously serve as thesis committee chair.

For HST PhD students earning degrees through MIT, the thesis committee chair must be an MIT faculty member. A select group of HST program faculty without primary appointments at MIT have been pre-approved by HICAP to chair PhD theses awarded by HST at MIT in cases where the MIT supervisor is an MIT faculty member.**

HST PhD students earning their degree through Harvard follow thesis committee requirements set by the unit granting their degree - either the Biophysics Program or the School of Engineering and Applied Sciences (SEAS).

**List of non-MIT faculty approved to chair MIT thesis proposals when the research advisor is an MIT faculty member

Readers

In addition to the research advisor and the thesis committee chair, the thesis committee must include one or more readers. Readers are expected to:

- Provide advice and guidance concerning the thesis research
- Attend meetings of the full thesis committee, to be held at least once per semester
- Attend the thesis defense
- Review and evaluate the final thesis document

Faculty members with relevant expertise from outside of Harvard/MIT may serve as readers, but they may only be counted toward the required three if approved by HICAP.

The members of the thesis committee should have complementary expertise that collectively covers the areas needed to advise a student's thesis research. The committee should also be diverse, so that members are able to offer different perspectives on the student's research. When forming a thesis committee, it is helpful to consider the following questions:

1. Do the individuals on the committee collectively have the appropriate expertise for the project?
2. Does the committee include at least one individual who can offer different perspectives on the student's research? The committee should include at least one person who is not closely affiliated with the student's primary lab. Frequent collaborators are acceptable in this capacity if their work exhibits intellectual independence from the research advisor.
3. If the research has a near-term clinical application, does the committee include someone who can add a translational or clinical perspective?
4. Does the committee conform to HST policies in terms of number, academic appointments, and affiliations of the committee members, research advisor, and thesis committee chair as described elsewhere on this page?

[Friendly advice: Although there is no maximum committee size, three or four is considered optimal. Committees of five members are possible, but more than five is unwieldy.]

THESIS COMMITTEE MEETINGS
Students must meet with their thesis committee at least once each semester beginning in the fourth year of registration. It is the student's responsibility to schedule these meetings; students who encounter difficulties in arranging regular committee meetings can contact Henrike Besche at hbesche@mit.edu.

The format of the thesis committee meeting is at the discretion of the thesis committee chair. In some cases, the following sequence may be helpful:

- The thesis committee chair, research advisor, and readers meet briefly without the student in the room
- The thesis committee chair and readers meet briefly with the student, without the advisor in the room
- The student presents their research progress, answers questions, and seeks guidance from the members of the thesis committee

Please note that thesis committee meetings provide an important opportunity for students to present their research and respond to questions. Therefore, it is in the student's best interest for the research advisor to refrain from defending the research in this setting.

LETTERS OF INTENT (Not the same as the thesis proposal)
Students must submit two letters of intent (LOI-1 and LOI-2) with applicable signatures. *See Appendix 2 for both forms*.

In LOI-1, students identify a research advisor and a general area of thesis research, described in 100 words or less. It should include the area of expertise of the research advisor and indicate whether IRB approval (Institutional Review Board; for research involving human subjects) and/or IACUC approval (Institutional Animal Care and Use Committee; for research involving vertebrate animals) will be required and, if so, from which institutions. *LOI-1 is due by April 30 of the second year of registration and and should be submitted to HICAP, c/o Traci Anderson in E25-518.*

In LOI-2, students provide a description of the thesis research, describing the Background and Significance of the research and making a preliminary statement of Specific Aims (up to 400 words total). In LOI-2, a student also proposes the membership of their thesis committee. In addition to the research advisor, the proposed thesis committee must include a chair and one or more readers, all selected to meet the specified criteria. *LOI-2 is due by April 30th of the third year of registration and should be submitted to HICAP, c/o Traci Anderson in E25-518.*

LOI-2 is reviewed by the HST-IMES Committee on Academic Programs (HICAP) to determine if the proposed committee meets the specified criteria and if the committee members collectively have the complementary expertise needed to

advise the student in executing the proposed research. If HICAP requests any changes to the proposed committee, the student must submit a revised LOI-2 for HICAP review by September 30th of the fourth year of registration. HICAP must approve LOI-2 before the student can proceed to presenting and submitting their thesis proposal**. Any changes to the thesis committee membership following HICAP approval of LOI-2 and prior to defense of the thesis proposal must be reported by submitting a revised LOI-2 form to HICAP, c/o Traci Anderson.** After final HICAP approval of LOI-2, which confirms the thesis committee membership, the student may proceed to present their thesis proposal to the approved thesis committee, as described in the next section.

Students are strongly encouraged to identify tentative thesis committee members and begin meeting with them as early as possible to inform the direction of their research. Following submission of LOI-2, students are required to hold at least one thesis committee meeting per semester. Students must document these meetings via the Semi-Annual PhD Student Progress Review form in order to receive a grade reflecting satisfactory progress in HST.ThG.

THESIS PROPOSAL AND PROPOSAL PRESENTATION

For MEMP students receiving their degrees through MIT, successful completion of the Oral Qualifying Exam is a prerequisite for the thesis proposal presentation. For MEMP students receiving their degrees through Harvard, the oral qualifying exam satisfies the proposal presentation requirement.

Proposal Document

Each student must present a thesis proposal to a thesis committee that has been approved by HICAP via the LOI-2 and then submit a full proposal package to HICAP by April 30th of the fourth year of registration. The only exception is for students who substantially change their research focus after the fall term of their third year; in those cases the thesis proposal must be submitted within three semesters of joining a new lab. Students registering for thesis research (HST.THG) who have not met this deadline may be administratively assigned a grade of "U" (unsatisfactory) and receive an academic warning.

The written proposal should be no longer than 4500 words, excluding references. This is intended to help students develop their proposal-writing skills by gaining experience composing a practical proposal; the length is comparable to that required for proposals to the NIH R03 Small Research Grant Program. The proposal should clearly define the research problem, describe the proposed research plan, and defend the significance of the work. Preliminary results are not required. If the proposal consists of multiple aims, with the accomplishment of later aims based on the success of earlier ones, then the proposal should describe a contingency plan in case the early results are not as expected.

Proposal Presentation

The student must formally defend the thesis proposal before the full thesis committee that has been approved by HICAP.

Students should schedule the meeting and reserve a conference room and any audio visual equipment they may require for their presentation. To book a conference room in E25, please contact Catherine Hayes (clhayes9@mit.edu).

Following the proposal presentation, students should make any requested modifications to the proposal for the committee members to review. Once the committee approves the proposal, the student should obtain the signatures of the committee members on the forms described below as part of the proposal submission package.

[Friendly advice: As a professional courtesy, be sure your committee members have a complete version of your thesis proposal at least one week in advance of the proposal presentation.]

Submission Of Proposal Package

When the thesis committee has approved the proposal, the student submits the proposal package to HICAP, c/o Traci Anderson in E25-518, for final approval. HICAP may reject a thesis proposal if it has been defended before a committee that was not previously approved via the LOI-2.

The proposal package includes the following:

- The proposal document
- A properly formatted title page, including an abstract, the student's signature, IRB and/or IACUC approval numbers, institutions and dates if applicable. The abstract has a maximum length of 500 words and serves as a concise description of the proposed work that *can be read independently of the full proposal*. HICAP will use the abstract when reviewing the proposal for final approval. The abstract should be comprehensible to a general scientific audience, yet contain sufficient information for evaluation of the project. It should not include references. The components of the abstract are:
  a. a brief description of the project background and significance that explains why the work is important
  b. the specific aims of the proposal, including a contingency plan if needed
  c. an indication of the methods to be used to accomplish the specific aims.
- Signed research advisor agreement form
- Signed chair agreement form (which confirms a successful proposal defense)
- Signed reader agreement form(s)

See Appendix 2 for copies and samples of the aforementioned forms in the proposal package

THESIS DEFENSE AND FINAL THESIS DOCUMENT

When the thesis is substantially complete and fully acceptable to the thesis committee, a public thesis defense is scheduled for the student to present their work to the thesis committee and other members of the community. The thesis defense is the last formal examination required for receipt of a doctoral degree. To be considered "public", a defense must be announced to the community at least five working days in advance. At the defense, the thesis committee determines if the research presented is sufficient for granting a doctoral degree. Following a satisfactory thesis defense, the student submits the final

thesis document, approved by the research advisor, to Traci Anderson via email (see instructions below).

[Friendly advice: Contact Joseph Stein at least two weeks before your scheduled date to arrange for advertising via email and posters. A defense can be canceled for insufficient public notice.]

Before The Thesis Defense

Committee Approves Student to Defend: The thesis committee, working with the student and reviewing thesis drafts, concludes that the doctoral work is complete. The student should discuss the structure of the defense (general guidelines below) with the thesis committee chair and the research advisor.

Schedule the Defense: The student schedules a defense at a time when all members of the thesis committee will be physical present. Any exceptions must be approved in advance by the IMES/HST Academic Office.

Reserve Room: It is the student's responsibility to reserve a room and any necessary equipment. Please contact IMES Reservation (imes-reservation@mit.edu) to reserve rooms E25-140, E25-141, E25-119/121, E25-521.

Final Draft: A complete draft of the thesis document is due to the thesis committee two weeks prior to the thesis defense to allow time for review. The thesis should be written as a single cohesive document; it may include content from published papers (see libraries website on "Use of Previously Published Material in a Thesis") but it may not be a simple compilation of previously published materials.

Publicize the Defense: The IMES/HST Academic Office invites the community to attend the defense via email and a notice on the HST website. This requires that the student email a thesis abstract and supplemental information to Joseph Stein two weeks prior to the thesis defense. The following information should be included: Date and time, Location (Zoom invitation with password if offering a hybrid option), Thesis Title, Names of committee members, with academic and professional titles and institutional affiliations. The abstract is limited to 250 words for the poster, but students may optionally submit a second, longer abstract for the email announcement.

Thesis Defense Guidelines

Public Defense: The student should prepare a presentation of 45-60 minutes in length, to be followed by a public question and answer period of 15–30 minutes at discretion of the chair.

Committee Discussion: Immediately following the public thesis presentation, the student meets privately with the thesis committee and any other faculty members present to explore additional questions at the discretion of the faculty. Then the thesis committee meets in an executive session and determines whether the thesis defense was satisfactory. The committee may suggest additions or editorial

changes to the thesis document at this point.

Chair Confirms Pass: After the defense, the thesis committee chair should inform Traci Anderson of the outcome via email to tanderso@mit.edu.

Submitting The Final Thesis Document
The student submits the signed thesis document to Traci Anderson in E25-518.

Please refer to the thesis formatting guidelines at:
http://libraries.mit.edu/archives/thesis-specs/

Title page notes.
Sample title page from the MIT Libraries.

Program Line should read, "Submitted to the Harvard-MIT Program in Health Sciences and Technology, in partial fulfillment of the the requirements for the degree of ... "

Copyright: Starting with the June 2023 degree period and as reflected in the MIT Thesis Specifications, all students retain the copyright of their thesis. Please review this section for how to list on your title page.

Signature Page: On the "signed" version, only the student and research advisor should sign. Thesis committee members are not required to sign. On the "Accepted by" line, please list: ***Collin M. Stultz, MD, PhD/Director, Harvard-MIT Program in Health Sciences and Technology/*Nina T. and Robert H. Rubin Professor in Medical Engineering and Science/Professor of Electrical Engineering and Computer Science.**

The Academic Office will obtain Professor Stultz's signature.

Sample of an HST PhD thesis title page (signed and unsigned)

Thesis Submission Components.
As of 4/2021, the MIT libraries have changed their thesis submissions guidelines and are no longer accepting hard copy theses submissions. For most recent guidance from the libraries: https://libguides.mit.edu/mit-thesis-faq/instructions

Submit to the Academic Office, via email (tanderso@mit.edu)

- Pdf/A-1 of the final thesis should include an UNSIGNED title page
- A separate file with a SIGNED title page by the student and advisor, the Academic Office will get Dr. Collin Stultz's signature.

For the MIT Library thesis processing, fill out the "Thesis Information" here: https://thesis-submit.mit.edu/

File Naming Information: https://libguides.mit.edu/

Survey of Earned Doctorates.
The University Provost's Office will contact all doctoral candidates via email with instructions for completing this survey.

SAMPLE FORMS: Thesis Forms

Please see Appendix 2 for:

- MEMP Rotation Form (optional)
- Letter of Intent 1
- Letter of Intent 2
- Semi-Annual Progress Review Form
- Thesis Proposal Title Page
- Research Advisor Agreement Form
- Chair Agreement Form
- Reader Agreement Form
- Final Thesis Cover Sheet

APPENDIX 1

Sample Forms: MEMP Qualifying Exams

The forms appended here are also available for download on the HST Website.

- Sample MEMP Schedules
- Technical Qualifying Form
- Oral Exam Scheduling Form

MEMP sample schedules for assorted TQE concentration areas

These sample schedules include two courses (not counting seminars) per semester, assuming that students are also engaged in substantial research efforts. Many students take two TQE classes *plus Pathology* in the first term. It is also possible to take three courses during the spring term of the first year. In later years, students funded by research assistantships are expected to manage course workload and research.

These sample schedules are provided as examples; students are encouraged to develop their own schedule, tailored to their individual interests, in conjunction with their academic advisor.

Courses counting toward TQE concentration area requirements are indicated in the tables below in *italics.*

Aeronautics and Astronautics – OQE in Spring of 2nd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring
16.453: Human Systems Engineering	*16.423 Aerospace Biomedical and Life Support Engineering*	HST.ThG: Thesis	*2.080: Structural Mechanics*	other courses as desired
16.851: Intro to Satellite Engineering (1s half)	HST500: Frontiers in (Bio)Medical Engineering & Physics		HST.030: Human Pathology	prepare for OQE in May |June
HST.590: Seminar Series	HST.590: Seminar Series		HST.590: Seminar Series	HST.590: Seminar Series
HST.599 Research	HST.599 Research		HST.ThG: Thesis	HST.ThG: Thesis

Biological Engineering – OQE in Spring of 2nd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring
20.420 Principles of Molecular Bioengineering	*20.440 Analysis of Biological Networks*	HST.ThG: Thesis	*20.405 Principles of Synthetic Biology*	other courses as desired
20.430 Fields, Forces, and Flows in Biological Systems	HST500: Frontiers in (Bio)Medical Engineering & Physics		HST.030: Human Pathology	prepare for OQE in May | June
HST.590: Seminar Series	HST.590: Seminar Series		HST.590: Seminar Series	HST.590: Seminar Series
HST.599 Research	HST.599 Research		HST.ThG: Thesis	HST.ThG: Thesis

Biological Engineering – Undergraduate Subjects for preparation, OQE in January of 3rd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring	Year 3 Fall
7.06 Cell Biology	7.05 General Biochemistry	HST.ThG: Thesis	*20.420 Principles of Molecular Bioengineering*	*20.440 Analysis of Biological Networks*	other courses as desired
HST.030: Human Pathology	HST500: Frontiers in (bio)Medical Engineering & Physics		*20.430 Fields, Forces, and Flows in Biological Systems*	*20.405 Principles of Synthetic Biology*	Prepare for OQE in January
HST.590: Seminar Series	HST.590: Seminar Series		HST.590: Seminar Series	HST.590: Seminar Series	
HST.599 Research	HST.599 Research		HST.ThG: Thesis	HST.ThG: Thesis	HST.ThG: Thesis

Brain & Cognitive Sciences – OQE in Spring of 2nd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring
9.014: Quantitative Methods and Computational Models in Neurosciences	*9.073: Statistics for Neuroscience Research*	HST.ThG: Thesis	*HST.580: Data Acquisition and Image Reconstruction in MRI*	other courses as desired
HST.030: Human Pathology	HST500: Frontiers in (Bio)Medical Engineering & Physics		*HST.131: Neuroscience*	prepare for OQE in May | June
HST.590: Seminar Series	HST.590: Seminar Series		HST.590: Seminar Series	HST.590: Seminar Series
HST.599 Research	HST.599 Research		HST.ThG: Thesis	HST.ThG: Thesis

Chemical Engineering – OQE in Spring of 2nd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring
10.40: Chemical Engineering Thermodynamics	*10.50: Analysis of Transport Phenomena*	HST.ThG: Thesis	*10.539: Fields, Forces, and Flows in Biological Systems*	other courses as desired
10.569: Synthesis of Polymers	HST500: Frontiers in (Bio)Medical Engineering & Physics		HST.030: Human Pathology	prepare for OQE in May | June
HST.590: Seminar Series	HST.590: Seminar Series		HST.590: Seminar Series	HST.590: Seminar Series
HST.599 Research	HST.599 Research		HST.ThG: Thesis	HST.ThG: Thesis

Chemical Engineering – Undergraduate Subjects for preparation, OQE in January of 3rd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring	Year 3 Fall
10.302: Transport Processes	10.213: Chemical and Biological Engineering Thermodynamics	HST.ThG: Thesis	*10.40: Chemical Engineering Thermodynamics*	*10.50: Analysis of Transport Phenomena*	other courses as desired
HST.030: Human Pathology	HST500: Frontiers in (Bio)Medical Engineering & Physics		*10.569: Synthesis of Polymers*	*10.542: Biochemical Engineering & Biomanufacturing Principles*	Prepare for OQE in January
HST.590: Seminar Series	HST.590: Seminar Series		HST.590: Seminar Series	HST.590: Seminar Series	
HST.599 Research	HST.599 Research		HST.ThG: Thesis	HST.ThG: Thesis	HST.ThG: Thesis

Chemistry - OQE in Spring of 2nd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring
5.52: Tutorial in Chemical Biology	*5.64: Advances in Interdisciplinary Science in Human Health and Disease*	HST.ThG: Thesis	*5.062 Principles of Bioinorganic Chemistry*	other courses as desired
HST.030: Human Pathology	HST500: Frontiers in (Bio)Medical Engineering & Physics		*5.70 Statistical Thermodynamics*	prepare for OQE in May | June
HST.590: Seminar Series	HST.590: Seminar Series		HST.590: Seminar Series	HST.590: Seminar Series
HST.599 Research	HST.599 Research		HST.ThG: Thesis	HST.ThG: Thesis

Computer Science – OQE in Spring of 2nd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring
6.7300 Introduction to Modeling and Simulation	*6.7310: Introduction to Numerical Methods*	HST.ThG: Thesis	*6.7900: Machine Learning*	other courses as desired
HST.030: Human Pathology	HST500: Frontiers in (Bio)Medical Engineering & Physics		*6.7960: Deep Learning*	prepare for OQE in May |June
HST.590: Seminar Series	HST.590: Seminar Series		HST.590: Seminar Series	HST.590: Seminar Series
HST.599 Research	HST.599 Research		HST.ThG: Thesis	HST.ThG: Thesis

Computer Science – Undergraduate Subjects for preparation, OQE in January of 3rd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring	Year 3 Fall
6.3700 Introduction to Probability	6.1210 Introduction to Algorithms	HST.ThG: Thesis	*6.7900: Machine Learning*	*6.7310 Introduction to Numerical Methods*	other courses as desired
HST.030: Human Pathology	HST500: Frontiers in (Bio)Medical Engineering & Physics		*6.7960: Deep Learning*	*6.8710: Computational Systems Biology: Deep Learning in the Life Sciences*	Prepare for OQE in January
HST.590: Seminar Series	HST.590: Seminar Series		HST.590: Seminar Series	HST.590: Seminar Series	
HST.599 Research	HST.599 Research		HST.ThG: Thesis	HST.ThG: Thesis	HST.ThG: Thesis

Electrical Engineering – OQE in Spring of 2nd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring
6.4832: Fields, Forces, and Flows in Biological Systems	*6.8300 Advances in Computer Vision*	HST.ThG: Thesis	*6.7000: Discrete-Time Signal Processing*	other courses as desired
6.6300: Electromagnetics	HST500: Frontiers in (Bio)Medical Engineering & Physics		HST.030: Human Pathology	prepare for OQE in May
HST.590: Seminar Series	HST.590: Seminar Series		HST.590: Seminar Series	HST.590: Seminar Series
HST.599 Research	HST.599 Research		HST.ThG: Thesis	HST.ThG: Thesis

Electrical Engineering – Undergraduate Subjects for preparation, OQE in January of 3rd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring	Year 3 Fall
6.3700 Introduction to Probability	6.2300 Electromagnetics Waves and Applications	HST.ThG: Thesis	*6.6310: Optics and Photonics*	*6.8800 Biomedical Signal and Image Processing*	other courses as desired
HST.030: Human Pathology	HST500: Frontiers in (Bio)Medical Engineering & Physics		*6.7700: Fundamentals of Probability*	*6.6340: Nonlinear Optics*	Prepare for OQE in January
HST.590: Seminar Series	HST.590: Seminar Series		HST.590: Seminar Series	HST.590: Seminar Series	
HST.599 Research	HST.599 Research		HST.ThG: Thesis	HST.ThG: Thesis	HST.ThG: Thesis

Materials Science and Engineering – OQE in Spring of 2nd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring
3.20: Materials at Equilibrium	*3.21: Kinetic Processes in Materials*	HST.ThG: Thesis	*3.22 Structure and Mechanics of Materials*	other courses as desired
HST.030: Human Pathology	HST500: Frontiers in (Bio)Medical Engineering & Physics		*3.46 Photonic Materials and Devices*	prepare for OQE in May | June
HST.590: Seminar Series	HST.590: Seminar Series		HST.590: Seminar Series	HST.590: Seminar Series
HST.599 Research	HST.599 Research		HST.ThG: Thesis	HST.ThG: Thesis

Mechanical Engineering – OQE in Spring of 2nd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring
2.795: Fields, Forces, ad Flows in Biological Systems	*2.140: Analysis and Design of Feedback Control Systems*	HST.ThG: Thesis	*2.25: Fluid Mechanics*	other courses as desired
HST.030: Human Pathology	HST500: Frontiers in (Bio)Medical Engineering & Physics		*2.42 General Thermodynamics*	prepare for OQE in May | June
HST.590: Seminar Series	HST.590: Seminar Series		HST.590: Seminar Series	HST.590: Seminar Series
HST.599 Research	HST.599 Research		HST.ThG: Thesis	HST.ThG: Thesis

Mechanical Engineering – Undergraduate Subjects for preparation, OQE in January of 3rd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring	Year 3 Fall
2.004: Dynamics and Control II	2.006: Thermal-Fluids Engineering II	HST.ThG: Thesis	*2.25: Fluid Mechanics*	*2.140: Analysis and Design of Feedback Control Systems*	other courses as desired
HST.030: Human Pathology	HST500: Frontiers in (Bio)Medical Engineering & Physics		*2.798: Molecular, Cellular, and Tissue Biomechanics*	*2.37 Fundamentals of Nanoengineering*	prepare for OQE in January
HST.590: Seminar Series	HST.590: Seminar Series		HST.590: Seminar Series	HST.590: Seminar Series	
HST.599 Research	HST.599 Research		HST.ThG: Thesis	HST.ThG: Thesis	HST.ThG: Thesis

Nuclear Science and Engineering - OQE in Spring of 2nd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring
22.11 Applied Nuclear Physics (1st half)	22.51: Quantum Technology and Devices	HST.ThG: Thesis	22.55: Radiation Biophysics	other courses as desired
22.12 Radiation Interactions, Control, and Measurement *(2nd half)*	22.15 Essential Numerical Methods *(1st half)*			
HST.030: Human Pathology	HST500: Frontiers in (Bio)Medical Engineering & Physics		other courses as desired	prepare for OQE in May | June
HST.590: Seminar Series	HST.590: Seminar Series		HST.590: Seminar Series	HST.590: Seminar Series
HST.599 Research	HST.599 Research		HST.ThG: Thesis	HST.ThG: Thesis

Physics – OQE in Spring of 2nd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring
8.333 Statistical Mechanics I	*8.311 Electromagnetic Theory I*	HST.ThG: Thesis	*8.591 Systems Biology*	other courses as desired
HST.030: Human Pathology	HST500: Frontiers in (Bio)Medical Engineering & Physics		*8.701 Introduction to Nuclear and Particle Physics*	prepare for OQE in May
HST.590: Seminar Series	HST.590: Seminar Series		HST.590: Seminar Series	HST.590: Seminar Series
HST.599 Research	HST.599 Research		HST.ThG: Thesis	HST.ThG: Thesis

Harvard-MIT Health Sciences and Technology

Contract for Technical Qualifying Exam (TQE)

Name: _____ **Email:** _____

Advisor: _____ **Research Advisor** (if known)**:**_____

I. Concentration Area (check one):

☐ Aeronautics & Astronautics
☐ Biological Engineering
☐ Brain & Cognitive Sciences
☐ Chemical Engineering
☐ Chemistry
☐ Computer Science
☐ Electrical Engineering
☐ Materials Science & Engineering
☐ Mechanical Engineering
☐ Nuclear Science & Engineering
☐ Physics

NOTE: Students wishing to change their TQE concentration area after submission of this form must submit a written petition to the QuEHST committee.

II. Concentration Subject Selection

List a plan below which fulfills the requirements of your concentration area; a summary subject grid can be found on the back of this form and detailed information about each concentration area is available on the HST website: http://hst.mit.edu/academics/memp/concentration-areas

Alternate Subject: We recommend all students designate an additional subject on their plan as an alternate, for planning purposes. Any student listing a TQE subject in which they have already earned a "B" during their 1st semester MUST include an alternate subject.

NOTE: Students may make changes to their TQE class selections until ADD date of the term in which they are enrolled in the class being added to their TQE. Under no circumstances will students be permitted to add a class to their TQE after earning a grade in the class. To make a change, email Traci Anderson in the HST Academic Office with a cc. to your academic advisor by ADD date.

Subject number	**Subject Title**	**Units***	**Term/Year** *(eg. Spring 2017)*
			[ALTERNATE]

* 42 units required, may require 5 subjects in certain concentration areas.

III. Other TQE Subject Requirements

All students must also take **Human Pathology** (HST030/031 or HST034/035) and
Introduction to (Bio)Medical Engineering and Medical Physics (HST500) as part of their TQE.

_____ _____

Student Signature/Date Academic Advisor Signature/Date

<table>
<tr><th>Aeronautics and Astronautics</th><th>Biological Engineering</th><th>Brain and Cognitive Sciences</th><th>Chemical Engineering</th></tr>
<tr><td rowspan="3">Choose Two Core Classes:
16.422; 16.423; 16.453

Select remaining requirements from Core Classes or Additional Classes:
16.470; 16.456J; 2.183J; 16.413; 16.89; 16.895; 22.55J</td><td>choose BOTH
20.420J and 20.440</td><td>choose ONE
9.011 or HST.131</td><td>choose at least TWO
10.40; 10.50; 10.65</td></tr>
<tr><td>choose at least ONE
[20.C51J + 6.C51], 20.201; 20.405J; 20.410J; 20.415; 20.430J; 20.463J; 20.490</td><td>choose at least ONE
9.012; 9.013J; 9.014; 9.015J; 9.017</td><td>10.34; 10.531J; 10.537J; 10.538J; 10.539J; 10.542; 10.545; 10.546J; 10.55; 10.562J; 10.566; 10.568;10.569; 10.643J; 10.668J</td></tr>
<tr><td>20.203J; 20.215; 20.409; 20.446J; 20.452J; 20.465; 20.470J; 20.475; HST.507J; HST.522J; HST.523J, HST.537J; HST.538J</td><td>9.021J; 9.073J; 9.123J; 9.181J; 9.285J; 9.301J; 9.422J; 9.520J; 9.611J; 9.660; HST.562J; HST.580J; HST.582J</td><td>Electrical Engineering</td></tr>
<tr><td rowspan="2">Chemistry</td><td colspan="2" rowspan="2">Computer Science</td><td rowspan="3">choose TWO from one group and ONE from each of two additional groups.
<u>System Science and Control Eng.</u>
6.C67; 6.3010; (6.7000 or 6.7010 or 6.8800J); (6.7100J or 6.7940);(6.C57J or 6.7210J); 6.8810J; HST.584J
<u>Circuits and Electronic Systems</u>
6.4861J; 6.6000; 6.6010; 6.6220
<u>Information Science and Communication</u>
6.7700J; 6.7710; (6.7800 or 6.7810); 6.7900; 6.8300
<u>Electromagnetics</u>
6.4832J; 6.6280; 6.6300; (6.6310 or 2.710); 6.6340J
<u>Physical Science and Engineering:</u>
6.4812J; 6.6400; 6.6500J; 6.6510
<u>Other</u>
(6.7300J or 6.7330J)</td></tr>
<tr><td>42 UNITS required, may need 5 subjects</td></tr>
<tr><td>5.05; 5.061; 5.062; 5.068; 5.44 5.45; 5.46; 5.511; 5.512; 5.52; 5.53; 5.54J; 5.56; 5.64J; 5.68J; 5.698J; 5.70J; 5.72; 5.73; 5.74; 5.78; 5.83; 7.51; 10.569; [20.C51J + 6.C51]; 20.201; 20.420J; 20.463J; 20.465; BCMP 250 (HU); CHEM 170 (HU)</td><td colspan="2">choose TWO from one group and ONE from each of the other groups

<u>Algorithms</u>
6.1220J; 6.5210J; 6.5220J; 6.5250J; 6.7310J; 6.7320J
<u>Probability/Statistics</u>
6.7300J; 6.7700J; 6.7800; 6.7810; 6.7900; 6.7960; 9.520J; 15.077J; 16.391; HST.460J; STAT 211 (HU)

<u>Applications</u>
2.740, 6.4812J; 6.7920[J]; 6.8200; 6.8210; 6.8300; 6.8420; (6.8610J or 6.8620J or 6.8630J); 6.8700J; 6.8710J; 6.8800J; 6.8810J; 8.591J; 18.417; HST.538J; HST.956J; BioPhys 205 (HU)</td></tr>
<tr><td rowspan="2">Materials Science and Engineering</td><td colspan="2" rowspan="2">Mechanical Engineering</td><td rowspan="2">Nuclear Science and Engineering</td><td>Physics</td></tr>
<tr><td>No more than TWO from the first group</td></tr>
<tr><td rowspan="2">Choose BOTH
3.20 and 3.21

3.22; 3.23; 3.40J; 3.46; 3.941J; 3.942; (3.963J or 3.971J)</td><td colspan="2">choose at least TWO from the first group; if you choose more you may include from sets marked with *</td><td rowspan="2">42 UNITS required, may need 5 subjects

22.11; 22.12; 22.13; 22.14; 22.15; 22.51J; 22.55J</td><td>8.591J; 8.592J; 8.593J</td></tr>
<tr><td colspan="2">2.032; 2.066; (2.071 or 2.072 or 2.080J)*; (2.097J or 2.29)*; (2.140 or 2.151 or 2.153)*; 2.25; 2.37; 2.42; 2.55; 2.675, (2.710 or 6.6310); 2.75J; (2.720 or 2.77); (2.794J; 2.795J or 2.798J)*; 2.810

2.174; 2.183J; 2.341J; 2.740, (2.782J or 2.785J or 2.79J or 3.963J); 3.23; HST.537J; HST.582J</td><td>8.311; 8.321; 8.322; 8.333; 8.334; 8.351J; 8.421; 8.422; 8.511; 8.512; 8.613J; 8.701</td></tr>
</table>

Harvard-MIT Health Sciences and Technology

Request to Schedule MEMP Oral Qualifying Exam (OQE)

Eligibility: Must have passed the TQE or met the exceptions as outlined on the HST website.

Purpose: The purpose of the OQE is to evaluate whether the student can integrate information from diverse sources into a well thought out and coherent research proposal - a skill essential for successful scholarship. The ability to defend this proposal during an oral presentation is a central part of the qualifying process. The qualifying exam explores students' ability to formulate coherent research questions and to explain the relevance of their proposed research to clinical medicine. In addition, students should be prepared to demonstrate how they think on their feet.

Instructions:

- Review guidelines/deadlines for research proposal and supervisor letter as described on HST website
- Meet with QE Chair to discuss format and expectations for the exam
- Submit signed scheduling form to the HST Academic Office (E25-518 or tanderso@mit.edu) by **March 1** (for May exams) or **November 1** (for January exams).

Name:_____ **Email:**_____

Academic Advisor: _____

Research Supervisor: _____

OQE Month (check one)**:** ❑ January ❑ May **Year:** _____

TQE Status (check one): ❑ TQE Passed ❑ Remaining Requirement this term
(check eligibility rules on HST website)

Have you taken the OQE before? ❑ NO ❑ YES, if so when _____

Tentative Title of Research Proposal:

_____
Student Signature Date

_____
Qualifying Exam Chair Signature Date

Office Use

_____ TQE Complete
_____ Copy of Proposal
_____ Letter from Research Supervisor

Exam Committee: _____

Exam Date/Time: _____

APPENDIX 2

Sample Thesis Forms

The forms appended here are also available for download on the HST Website.

- Rotation Form (optional)
- Letter of Intent 1
- Letter of Intent 2
- Semi-Annual Progress Review Form
- Thesis Proposal Title Page
- Research Advisor Agreement Form
- Chair Agreement Form
- Reader Agreement Form
- Final Thesis Cover Sheet

Health Sciences and Technology (HST)
Medical Engineering/Medical Physics (MEMP)

Rotation Registration Form

Student: _____ Year Entered MEMP: _____

Email: _____ Phone: _____

Faculty/PI: _____ Email: _____

Direct Supervisor: _____ Email: _____
(*if different*)

Lab Location: _____

Rotation Start Date: _____ Rotation End Date: _____
(*tentative*)

Expected Hours Per Week: _____

Brief Description of rotation activities (*eg. lab meetings, shadowing, learning technique, small project.)*

Will you be registering for academic credit (HST.599)? *YES* *NO*
If yes, please include deliverable/grading criteria in description above.

MEMP students are typically funded by departmental fellowship for their first year only. **Faculty signature below indicates that the PI is aware of the cost of future student support, as posted on the HST website, should this rotation become a thesis project.**
https://hst.mit.edu/academics/financial-support/research-assistantships/ra-costs

_____ _____
Student Signature --- Date Faculty Supervisor/PI --- Date

-- Submit to HST Academic Office , E25-518 --

Letter of Intent 1
HST PhD Candidates

The purpose of LOI-1 is to identify your research supervisor(s) and general thesis research area. The LOI-1 is due by April 30 of the second year of registration and should be submitted to HICAP, c/o Traci Anderson in E25-518.

Name: _____

Signature | Date: _____

My signature above indicates that I understand the thesis committee policies, including roles, eligibility and responsibilities of the thesis committee members posted online in the HST PhD Thesis Guide.

Research Advisor: _____

Academic Title | Primary Institution: _____

Area of Expertise: _____

Signature | Date: _____

Research co-Advisor *(optional)*: _____

Academic Title | Primary Institution: _____

Area of Expertise: _____

Signature | Date: _____

Project Title: _____

General Area of Thesis Research *(max. 100 words.)*
Description should be informative, for a lay audience and should not include jargon.

Letter of Intent 2

HST PhD Candidates

The purpose of this form is to provide the HST-IMES Committee on Academic Programs (HICAP) with sufficient information to determine if the membership of your proposed committee is appropriate to mentor and evaluate your thesis research.

Full criteria for thesis committee composition is posted online in the HST PhD Thesis Guide.

Name:

Signature | Date:
My signature above indicates that I understand the thesis committee policies, including roles, eligibility and responsibilities of the thesis committee members as posted online in the HST PhD Thesis Guide.

Section I: Thesis Committee

Friendly advice: Although there is no maximum committee size, three or four is considered optimal. Committees of five members are possible, but more than five is unwieldy

Research Advisor

Academic Title | Institution

Describe the specific areas of
expertise relevant to your project.

Signature | Date

Co-Advisor *(optional)*

Academic Title | Institution

Describe the specific areas of
expertise relevant to your project.

Signature | Date

Chair *(may not also be an advisor)*

Academic Title | Institution

Describe the specific areas of
expertise relevant to your project.

Signature | Date

Section I, continued

Reader

Academic Title | Institution

Describe the specific areas of
expertise relevant to your project.

Signature | Date

Reader

Academic Title | Institution

Describe the specific areas of
expertise relevant to your project.

Signature | Date

Reader

Academic Title | Institution

Describe the specific areas of
expertise relevant to your project.

Signature | Date

Outside Perspective. *A thesis committee should include at least one person who is not closely affiliated with the student's primary lab. Frequent collaborators are acceptable in this capacity if their work exhibits intellectual independence from the research supervisor. Identify the committee member(s)who can offer an outside perspective:* _____

Clinical Perspective. *If the research has a near-term clinical application, identify the committee member(s) who can add a translational or clinical perspective:* _____

Section II: Research Description

Project Title _____

Instructions: In the two sections below, explain the significance of your proposed research (why this work is important) and describe your aims/key goals (as best you can at this stage of your project). Maximum combined word count is **400**.

Significance of Proposed Research

Specific Aims

Methods

While you are not required to include a formal write up of your research methods at this time, please provide some indication of the methods to be used in this research:

☐ **Human Subject Data** ☐ **Animal Model (specify the type)**

☐ **Clinical Records Data** ☐ **Other**

HST SEMI-ANNUAL PhD STUDENT PROGRESS REVIEW

PAGE 1: INSTRUCTIONS

The purpose of this progress review is to ensure that PhD students and their research advisors are communicating regularly regarding the student's progress on thesis research and the student's overall professional development. Completion of the review during each regular term (fall and spring) is mandatory for all PhD students beginning in the third year of registration. **Students conducting thesis research must submit page 4 of this form in order to receive academic credit for HST.ThG.**

Please note that except for the last page, only the student and their research advisor will see the completed forms.

Please provide a copy of the form for your supervisor to complete independently. One copy is to be filled out by the student, the other by the research advisor. Feel free to use additional pages if you need more space. After both are completed, the student and the research advisor should meet to compare and discuss the results. This is the opportunity for both parties to get a better sense of progress on the project, of the student's development, and of the student/supervisor working relationship, as well as to plan for future progress.

The research advisor will assigns a grade of satisfactory or unsatisfactory for thesis research, directly on the review form. ***The student and the research advisor each sign the review and send page 4 to Traci Anderson in E25-518 by the last day of classes at MIT.*** The student should retain copies of the two review forms while the research advisor may wish to as well.

The review covers the following topics:

Questions 1:	Review of Past Progress
Questions 2 and 3:	Setting of Future Goals
Question 4:	Rate of Progress
Question 5:	Student's Professional Development
Question 6:	Frequency of Interaction
Question 7:	Funding Status
Page 4:	Deadlines and Requirements and Grading

HST SEMI-ANNUAL PhD STUDENT PROGRESS REVIEW

PAGES 2-3: CONFIDENTIAL, FOR DISCUSSION BETWEEN STUDENT AND RESEARCH ADVISOR

Student's Name:

Title and/or brief description of thesis project:

1. Describe your {your student's} accomplishments from the previous semester.

2. Describe the aspects of faculty advising that were helpful in the previous semester, as well as those that could be improved.

3. What goals would you like {your student} to accomplish during the next semester?

4. What technical, scientific, and administrative challenges will you {your student} face in pursuing these goals? Circle all that apply.

need additional training in lab skills

access to equipment

need more communication with research advisor

not enough time to do all that is required

need to acquire additional scientific knowledge

access to other resources

need more communication with other lab personnel

other: _____

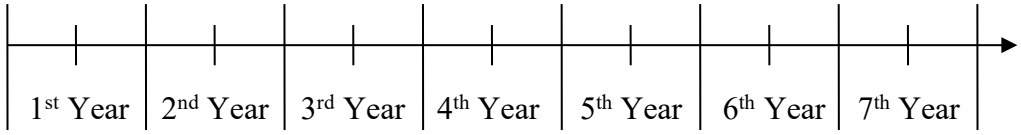
5. What resources would help you {your student} overcome the challenges circled above and accomplish the goals described in your answer to question #3.

HST SEMI-ANNUAL PhD STUDENT PROGRESS REVIEW

6. Indicate your level of satisfaction with the rate of progress of your {your student's} thesis project. Discuss your selection.

Very Satisfied Adequate Not Satisfied

On the timeline below, indicate how long you {your student} have been in the HST PhD program. Next, indicate when you expect to achieve the next milestone (i.e., thesis proposal or graduation).



7. Discuss your {student's} prospects for conference presentations and journal article submissions in the coming year.

8. How often do you meet with your research advisor {your student}? Do you feel that this is frequent enough?

9. Is funding for research and stipend stable over the upcoming semester? Are you aware of any potential uncertainties in your funding?

HST SEMI-ANNUAL PhD STUDENT PROGRESS REVIEW
PAGE 4: SUBMIT TO HST ACADEMIC OFFICE

Student Name: _____

Research Advisor Name: _____

Year in Program: _____ Term/Year of Review (ie. fall 2022):_____

1. **Thesis Milestones.** Please indicate which of the following milestones have been completed.

Deadline*	PhD Thesis Milestone	Completed? (yes/no)
April 30 – **Year 2**	**Letter of Intent 1**: *Identify a research advisor and general area of research*	
April 30 – **Year 3**	**Letter of Intent 2:** *Propose Thesis Committee and outline project*	
April 30 – **Year 4**	**Thesis Proposal:** *Submit a successfully defended thesis proposal to the HST-IMES Committee on Academic Programs*	

**Students who change labs or have a delay in the qualifying exams may request a one-semester extension; please contact the HST Academic Office.*

2. **Thesis Committee meeting.** (Required each term beginning in the fourth year of registration)

   Date of Meeting:
   If no meeting was held this term, please explain why.

   Names of committee members who attended:

   Brief description of the outcome:

3. **Expected Graduation Date** (Month + Year): _____.
   Optional for students in year 1-3. This is not a binding date but a general target based on committee meeting discussion.

4. **Grade for HST.ThG. (**check one**):** ❑ Satisfactory ❑ Unsatisfactory progress
   Please note that even if the research advisor assigns a Satisfactory, HST may administratively assign a grade of Unsatisfactory if the thesis proposal deadline has not been met.

_____ _____
(student's signature) *(research advisor's signature)*

This page must be signed by both the student and research advisor and returned to Joe Stein in E25-518 by the last day of classes at MIT in order for the student to receive a grade for thesis research.

SAMPLE TITLE PAGE FOR THESIS PROPOSAL

Health Sciences and Technology
Medical Engineering and Medical Physics Program

Proposal for Thesis Research in Partial Fulfillment of the Requirements for the Degree of
Doctor of Philosophy in Medical Engineering and Medical Physics
Massachusetts Institute of Technology

Title:	Effects of Barbiturate Intake on Somnambulism in Large Eurasian Rodents
Submitted by:	Ivanna Degri 11 Einstein Way Cambridge, MA 02139 Idegri123@mit.edu
Signature:	
Date of Submission:	April 15, 2014
Expected Date of Completion:	May 2016
Thesis Supervisor:	Heinrich Eisenhhamster, DVM, MD PhD
Location of Research:	Department of Veterinary Psychology Harvard University
IACUC/IRB approval:	IACUC #12345-6, MIT, 1/15/12
Abstract Word Count:	492 (Maximum length 500 words)

Abstract (Please include the three subheadings below in the body of your abstract.)

Background and Significance:
Specific Aims:
Methods:

PhD THESIS RESEARCH ADVISOR AGREEMENT
Harvard-MIT Health Sciences and Technology

This form is to be submitted with the final defended and approved doctoral thesis proposal to the HST-IMES Committee on Academic Programs (HICAP).

Section I: to be completed by the student

Student Name:

Thesis Proposal Title:

DATE of Thesis Proposal Presentation to Committee:

Name of Research Advisor:

Section II: to be reviewed and signed by faculty research advisor.

I agree that the proposal presented to the thesis committee and outlined in the thesis proposal is adequate for a doctoral thesis.

I agree to serve as the student's research advisor and have reviewed the roles and responsibilities of the research advisor as defined in the HST PhD Thesis Guide (and listed below).

The research advisor is responsible for overseeing the student's thesis project. The research advisor is expected to:

- supervise the research and mentor the student;
- provide a supportive research environment, facilities, and financial support;
- discuss expectations, progress, and milestones with the student and complete the Semi-Annual PhD Student Progress Review Form each semester;
- assist the student to prepare for the oral qualifying exam;
- guide the student in selecting the other members of the thesis committee;
- help the student prepare for, and attend, meetings of the full thesis committee, to be held at least once per semester;
- help the student prepare for, and attend, the thesis defense;
- evaluate the final thesis document.

Research Advisor Signature | Date:

Research Advisor Email:

Comments (optional):

THESIS CHAIR AGREEMENT

Harvard-MIT Health Sciences and Technology

This form is to be submitted with the final defended and approved doctoral thesis proposal to the HST-IMES Committee on Academic Programs (HICAP).

Section I: to be completed by the student

Student Name:

Thesis Proposal Title:

DATE of Thesis Proposal Presentation to Committee:

Name of Thesis Committee Chair:

Section II: to be reviewed and signed by the Thesis Committee Chair.

I confirm that the student successfully defended the thesis proposal to the full thesis committee on the date listed above.

I agree that the proposal presented to the thesis committee and outlined in the thesis proposal is adequate for a doctoral thesis.

I agree to serve as the student's PhD thesis committee chair and have reviewed the roles and responsibilities of the chair as defined in the HST PhD Thesis Guide (and listed below).

> Each HST PhD thesis committee is headed administratively by a chair, chosen by the student in consultation with the research supervisor. The thesis committee chair is expected to:
>
> - provide advice and guidance concerning the thesis research;
> - oversee meetings of the full thesis committee, to be held at least once per semester;
> - preside at the thesis defense;
> - review and evaluate the final thesis document.
>
> The thesis committee chair must be well acquainted with the academic policies and procedures of the institution granting the student's degree and be familiar with the student's area of research. The research supervisor may not simultaneously serve as thesis committee chair.

Chair Signature | Date:

Chair Email:

Comments (optional):

THESIS READER AGREEMENT

Harvard-MIT Health Sciences and Technology

This form is to be submitted with the final defended and approved doctoral thesis proposal to the HST-IMES Committee on Academic Programs (HICAP).

Section I: to be completed by the student

Student Name:

Thesis Proposal Title:

DATE of Thesis Proposal Presentation to Committee:

Name of Thesis Reader:

Section II: to be reviewed and signed by the faculty thesis reader.

I agree that the proposal presented to the thesis committee and outlined in the thesis proposal is adequate for a doctoral thesis

I agree to serve on the thesis committee as a reader and have reviewed the roles and responsibilities of a PhD thesis reader as defined in the HST PhD Thesis Guide (and listed below).

> In addition to the research supervisor and the thesis committee chair, the thesis committee must include one or more readers.
>
> Readers are expected to:
> - provide advice and guidance concerning the thesis research;
> - attend meetings of the full thesis committee, to be held at least once per semester;
> - attend the thesis defense;
> - review and evaluate the final thesis document.

Thesis Reader Signature | Date:

Thesis Reader Email:

Comments (optional):

PhD, CC License

This is a Thesis Title

By

John A. Silva

B.Bm.E.
Example University, 2015

M.Eng
Example University, 2019

Submitted to the Department of Biological Engineering
in Partial Fulfillment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY IN BIOLOGICAL ENGINEERING

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

FEBRUARY 2023

Authored by: John A. Silva
Department of Biological Engineering
December 29, 2022

Certified by: Beatrice J. Jansen
Professor of Biological Engineering, Thesis Supervisor

Accepted by: Claudia Smith
Department of Biological Engineering Chair