Harvard-MIT Program in Health Sciences and Technology

PhD Degree Requirements

2015-2016

Table of Contents

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, and students with respect and honesty.
- Communicate opinions in a constructive manner and encourage free discourse.

2015-16 Academic Calendar

Also available at: http://hst.mit.edu/academics/academic-calendar

2015

August

10	Mon	HMS MD 1st Year Orientation Begins
27	Thu	Harvard GSAS Registration Deadline (GSAS students only)
31	Mon	MIT On-Line Registration Opens

September

1	Tue	HST Thesis due for September MIT degree
2	Wed	Harvard GSAS Classes Begin
3	Thu	HST New Student Orientation
4	Fri	LAST DAY to submit Fall RA, TA and Fellowship Applications
7	Mon	Holiday - Labor Day - No Classes
8	Tue	HST MD 1st & 2nd Year Classes Begin
8	Tue	MIT Registration Day (ALL HST Students)
9	Wed	MIT Classes Begin
10	Thu	HST PhD Student Orientation, part 2
11	Fri	MIT February Degree Application Deadline
11	Fri	MIT Fall Registration Deadline
15	Tue	LAST DAY to sign up for MIT Family Health Insurance OR to waive individual coverage
24	Thu	Faculty Poster Session

October

2	Fri	MD Intent to Apply for Honors
9	Fri	MIT Cross-Registration DEADLINE
9	Fri	ADD Deadline (MIT classes)
12	Mon	Holiday - Columbus Day - No Classes
13	Tue	MIT follows Monday Schedule of Classes
15	Thu	MD Admissions Deadline
23-24	Fr/Sa	MIT Family Weekend

November

11	Wed	Holiday - Veterans Day - No Classes
18	Wed	DROP Deadline (MIT Courses)
26-27	Th/Fr	Holiday - Thanksgiving Recess - No Classes

December

1	Tue	MIT Spring Term On-Line Pre-Registration Opens
1	Tue	MEMP PhD Admissions - through Biophysics
3	Thu	Harvard GSAS Classes End
10	Thu	MIT Classes End
11	Fri	HST/HMS Classes End
11-21	Fri	Harvard GSAS Final Exam Period
14-18	Mon	HST/HMS AND MIT Final Exam Period

December continued		
15	Tue	HST PhD Admissions Application Deadline (MIT & SEAS)
19	Sat	Winter Recess Begins: MIT & HMS
22	Tue	Winter Recess Begins: GSAS
30	Wed	Deadline to Initiate MIT Spring Pre-Registration

2016

January		
4	Mon	HST/HMS Winter Session Classes AND MIT Independent Activities Period (IAP) Begins
12	Tue	Soma Weiss Student Research Day
15	Fri	FINAL Spring pre-registration deadline
15	Fri	TQE Contract Due (MEMP 1st year)
18	Mon	Holiday - Martin Luther King, Jr. Day - No Classes
25	Mon	Harvard GSAS Spring Term Classes Begin
25-26	M-T	MEMP Oral Qualifying Exam
25	Mon	MIT On-Line Registration Opens (ALL Students)
29	Fri	HST/HMS Winter Classes and MIT IAP period Ends
February		
1	Mon	MIT Registration Day (ALL HST students)
1	Mon	HST/HMS Spring Classes Begin
1	Mon	HST PhD Thesis Due for the February MIT Degree
2	Tue	MIT Spring Classes Begin
5	Fri	LAST DAY to submit Spring RA, TA and Fellowship Applications
5	Fri	MIT June Degree Application Deadline
5	Fri	Last Day to Complete MIT Registration
15	Mon	Holiday - President's Day - No Classes
15	Mon	Last Day to Sign-up for MIT Family Health
16	Tue	MIT follows Monday Schedule of Classes
March		
4	Fri	Last day to ADD MIT Subjects
14-18	M-F	Harvard GSAS Spring Vacation (MIT & HMS/HST classes meet)
21-25	M-F	MIT & Year 1 HST/HMS Spring Vacation (HMS Year 2 and GSAS classes meet)
April		
14	Thu	HST Forum
18-19	M/T	Holiday - Patriot's Day (HST/HMS & GSAS classes meet) - No Classes
21	Thu	MIT Deadline to DROP Spring Classes
27	Wed	Harvard GSAS Spring Term Classes End

May

2	Mon	MIT Summer and Fall Pre-Registration Opens
5-14	Th-Sa	Harvard GSAS Final Exam Period
12	Thu	MIT Classes End
13	Fri	HST MD Courses End
16-20	M-F	HST/HMS AND MIT Final Exam Period
16	Mon	PhD Thesis Due for June MIT Degree
23-24	M/T	MEMP Oral Qualifying Exam
26	Thu	Harvard Commencement
27	Fri	HST Graduation Celebration
30	Mon	Holiday - Memorial Day - No Classes
31	Tue	Deadline to Initiate MIT Summer Pre-Registration

June

3	Fri	MIT Commencement
3	Fri	Last day to submit Summer RA, TA and Fellowship Applications
10	Fri	MIT September Degree Application Deadline
10	Fri	MIT Summer Registration Deadline
13	Mon	Deadline to Initiate MIT Fall Pre-Registration

PhD Qualifying & Research Milestones

http://hst.mit.edu/academics/memp/degree-requirements/phd-thesis-guide#Milestones

YEAR ONE

January

- Submit TQE Contract: January 15

Summer

- Register for research. HST.599 *(you should register for research credits ANY term you are doing research prior to submitting the thesis proposal)*

YEAR TWO

Fall

- Meet with Qualifying Exam Chair, to discuss progress towards completing TQE and summer research.
- Scheduling form due if taking January OQE (November 1)

January

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

Spring

- Scheduling form due if taking Spring OQE (March 1)
- Option to take Oral Qualifying Exam, see HST calendar for exact dates
- Letter of Intent 1 (due April 30)

YEAR THREE

Fall

- Semi-Annual Progress Review **
- Scheduling form due if taking January OQE (November 1)

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)
- FINAL opportunity to take Oral Qualifying Exam, see HST calendar for exact dates
- Semi-Annual Progress Review **
- Letter of Intent 2 (due April 30)

YEAR FOUR

Fall

- Semi-Annual Progress Review **
- Option to defend thesis proposal

Spring

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

YEAR FIVE and BEYOND

Each Semester

- Register for HST.ThG (after thesis proposal submitted, do not need to register for HST.599)
- Semi-Annual Progress Review **

Final Semester

- Defend and Submit Final Thesis

*** Semi-Annual Progress Review: Also required in Year 1 & 2 if registered for HST.599*

MEMP Academic Program

General Description

The MEMP curriculum includes multiple components that prepare students to be medical innovators who will advance human health:

- Students receive a thorough graduate education in a classical discipline of engineering or physical science. Each student selects a concentration area and completes a series of courses where they learn the fundamentals of their chosen discipline.

- Students become conversant in the biomedical sciences through preclinical coursework and clinical experiences. Courses such as pathology and pathophysiology are taken together with HST MD students. Then students engage in immersive clinical experiences where they acquire a hands-on understanding of clinical care, medical decision-making, and the role of technology in medical practice. Through these experiences, students 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.

- Two seminar classes help students integrate science and engineering with medicine and develop professional skills.

- A two-stage qualifying examination ensures that each student is proficient in his or her chosen concentration area, can integrate information from diverse sources into a coherent research proposal, and able to defend that research proposal in an oral presentation.

- Students investigate important problems at the interfaces of science, technology, and clinical medicine through individualized thesis research projects mentored by faculty in laboratories at MIT, Harvard, and affiliated teaching hospitals.

Neuroimaging and Bioastronautics are two areas of specialization within MEMP for which HST offers specially designed training programs.

MEMP Degree Requirements

Engineering and Physical Sciences

MEMP students earning a degree through MIT complete a program of study in their chosen engineering or physical science concentration area consisting of four advanced technical classes approved by their academic advisor.

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 gain a firm grounding in the fundamentals of medical science through a sequence of preclinical courses followed by immersive clinical experiences.

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)
- Biochemistry and Molecular Genetics in Modern Medicine (HST160/161)
- Cardiovascular Pathophysiology (HST090/091)

Biomedical Sciences Restricted Electives

All MEMP students must select two of the following:

- Human Functional Anatomy (HST010/011)
- Respiratory Pathophysiology (HST100/101)*
- Renal Pathophysiology (HST110/111)*
- Neuroscience (HST130/131)
- Cellular and Molecular Immunology (HST175/176)

* Must choose at least one of HST100, HST110

Clinical Coursework Requirements

Students complete a six-week course where they learn to do a complete medical history and physical exam, followed by a six-week clerkship in medicine where they serve as full-time members of a ward team and participate in longitudinal patient care. Through these experiences students become familiar with the clinical decision-making process and broad economic, ethical, and sociological issues involved in patient care.

All MEMP students must complete two clinical courses:

1. HST201: Introduction to Clinical Medicine and Medical Engineering I
2. 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 must complete both HST201 and HST202 at a single location.

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 enroll in HST500 during the spring semester of their first year.

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.

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.

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

Doctoral Thesis

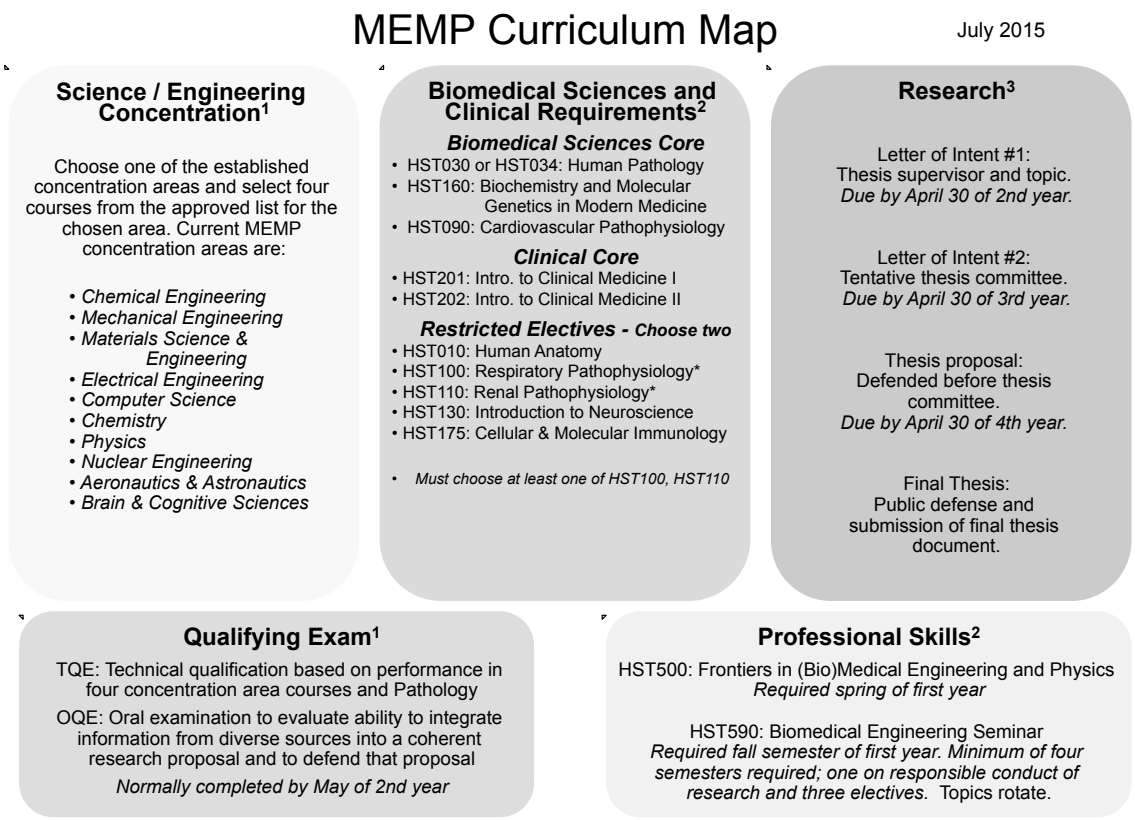
Each MEMP student must complete and defend a doctoral thesis to complete their degree. More information about doctoral thesis requirements is in the HST PhD Thesis Guide.

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. Julie Greenberg
Director of Education
MIT Room E25-518
77 Massachusetts Avenue Cambridge, MA 02139
617-258-6086
jgreenbe@mit.edu

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

MEMP Curriculum Map



1. Harvard MEMPs fulfill Basic Science/Engineering Concentration and Qualifying Exam through their collaborating department (SEAS or Biophysics).
2. Required for all MEMP students. (Biophysics students may substitute *MedSci 300* for HST590 term on responsible conduct of research.)
3. Harvard MEMPs must submit LOI-1 and LOI-2. In addition, they must submit a copy of the Harvard department approved thesis proposal and an electronic copy of the final thesis. Harvard MEMPs should not register for HST.ThG.

MEMP Qualifying Examination

The doctoral qualifying examination is administered by the Qualifying Exam Committee in HST (QuEHST). The qualifying exam requires that students progress through a two-step process:

- Demonstrate technical competence based on coursework
- After successful completion of part 1, pass an oral qualifying exam

Technical Qualifying Examination (TQE) Course Requirement

During the fall semester of their first year admitted students must choose a technical concentration area in which to develop a focused engineering/physics skill set. Students must choose **four advanced technical subjects** from a single area listed on the Contract for Technical Qualifying Exam. A concentration area chair, also listed on the form, maintains the list of approved classes. 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.

Students should identify a **research project** during the first graduate 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 dissertation.

Each student, with the assistance of his/her academic advisor, should construct a plan for satisfying the TQE course requirement.

In constructing their TQE plan, 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 new set of skills.

- It is often useful to enroll in undergraduate courses in preparation for some of the advanced technical subjects.

Students must register their plan by submitting a signed Contract for TQE form to Traci Anderson in the HST Academic Office, E25-518, by January 15 of their first year in the program. The student and his/her academic advisor must both sign the Contract for TQE form. Students should complete the courses during the first three semesters of graduate study if possible, and in any case no later than the fourth semester. Changes to the contract after it is filed require explicit permission from the qualifying exam committee chair subsequently assigned to the student.

A qualifying exam (QE) committee chair is assigned to the student in the spring semester of the student's first year in the program and is available to provide advice regarding the qualifying exam process. Students should meet with their assigned QE chair *at the beginning of their third semester* to review the TQE contract, performance in coursework to date, and research experience. If necessary, the QE chair may prescribe remedies for unsatisfactory coursework to date.

The most efficient way to pass the TQE portion of the qualifying exam is to demonstrate competence in the chosen area by earning at least 3 A's and a B in the four TQE subjects, and a grade of 'satisfactory' or better in pathology.

Those students not meeting the above criteria may be assigned a remedy at the discretion of their QE chair. Example remedies include:

1. Communication between the QE committee chair and the instructor(s) of those subject(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 of the subject. (This approach is necessary because of the uneven grading policies - percent A's - in graduate subjects across different departments.)

2. Retake the course(s) that have not yet been mastered.

3. After suitable preparation, retake the final exam and earn a grade indicative of a firm grasp of the subject matter (specified by instructor).

4. After suitable preparation, take an oral exam conducted by the faculty member who taught the course(s) (with a P/F outcome).

5. In some cases, earn an 'A' in a more advanced subject.

6. If the course follows directly from an undergraduate course, serve as a teaching assistant for the undergraduate course.

During the student's fourth semester, the assigned QE chair reviews the student's performance on the TQE. Continued registration after four semesters of study requires successful completion of the TQE or explicit permission from the QuEHST committee.

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

Oral Qualifying Examination (OQE) Requirement

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.

The OQE is offered twice each year, in January and May. Students indicate their intent to take the exam by submitting an OQE Scheduling form to Traci Anderson in the HST Academic Office, E25-518, by November 1 for January exams or by March 1 for May 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;

2) 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.

The OQE should normally be completed by the end of the fourth regular semester of registration but no later than the end of the sixth semester. Continued registration after six semesters of study normally requires successful completion of the OQE; students who have not passed the OQE by the end of the sixth semester must receive explicit permission from the QuEHST committee to continue registration.

The QuEHST committee, in consultation with the QE chair, assigns an OQE committee composed of the QE chair and two additional faculty members. The student's research supervisor may not be a member of the OQE committee.

Three weeks prior to the exam date, the student must ensure that the the following items have been submitted to Traci Anderson in the HST Academic Office, E25-518:

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 proposal 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)*

In general, the OQE consists of a 30-minute oral presentation by the student, complete with PowerPoint slides, 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.

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 supervisor'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.

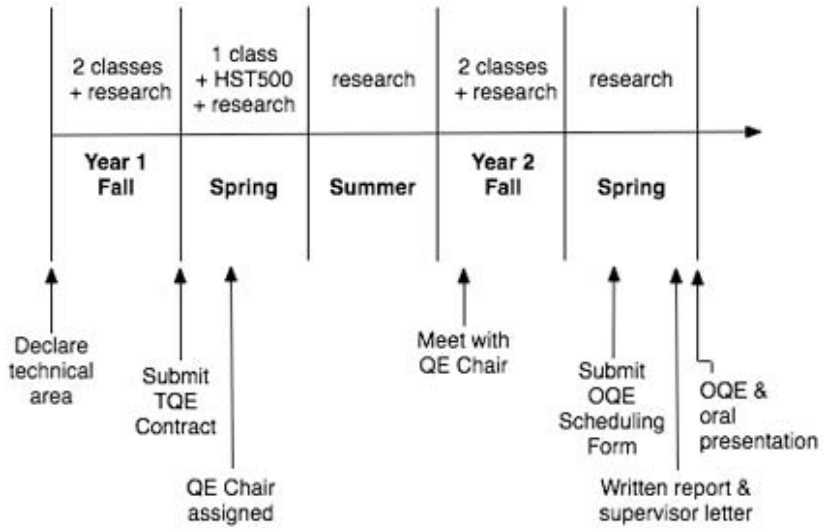
Not Yet Qualified: Additional tasks are required to pass the OQE. This may include additional coursework and/or a repeat oral exam. Each student is permitted a maximum of two attempts at the oral exam.

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 HST Academic Office, E25-518.

Oral Qualifying Exam Timeline



Sample MEMP Forms

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

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

Neuroimaging Training Program Requirements

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 561J: Noninvasive Imaging in Biology and Medicine
- 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 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
- 22.562: Spatial Aspects of Nuclear Magnetic Resonance Spectroscopy

For more information on the Neuroimaging Training Program, contact:

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

MEMP students who are funded by the National Space Biomedical Research Institute Training Grant in Bioastronautics and others who wish to be formally affiliated with the program must complete the following requirements in addition to the regular MEMP curriculum.

- HST 515J Aerospace Biomedical Engineering
- 16.453 Human Factors Engineering
- 16.89J Space Systems Engineering OR 16.851 Satellite Engineering
- 16.459 Bioengineering Journal Article Seminar (registration required for three semesters; continued attendance recommended after three semesters of registration)

And at least one subject from the following list:

- HST 560J: Radiation Biophysics
- HST 971J: Strategic Decision Making in Biomedical Enterprise
- 16.895J: Engineering Apollo: The Moon Project as a Complex System
- HST 921/923: Information Technology in the Health Care System of the Future
- HST 514J: Sensory-Neural Systems
- HST 020: Musculoskeletal Pathophysiology

Students in the program are required to complete a summer apprenticeship at a NASA Center, typically during their first year in the program. They 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). In addition, students in the program have the option of completing a clinical preceptorship (HST203) at a NASA Center.

For more information about the Bioastronautics curriculum, please contact:

Professor Laurence R. Young
Apollo Program Professor of Astronautics and HST
lry@mit.edu

HST PhD Thesis Guide

Important Deadlines & Requirements

YEARS 1 - 2

- Students conducting research, prior to submitting a thesis proposal, must register for pre-thesis research (HST.599). Students conducting research in a regular term (fall or spring) must also meet with supervisor and complete HST Semi-Annual PhD Student Progress Review to earn credit.

- A first letter of intent (LOI-1) proposing a general area of thesis research and research supervisor is required **by April 30th of year two.**

YEAR 3

- Beginning in year 3, student and research supervisor complete HST Semi-Annual PhD Student Progress Review for each regular term (fall and spring).

- A second letter of intent (LOI-2) proposing a tentative thesis committee is required April 30th of the third year of registration. The letter should indicate the research supervisor and general thesis area since these may have changed since the first LOI.

YEAR 4

- Beginning in year 4, the student must meet with their tentative thesis committee at least once per semester until the formal thesis committee is formed.

- Students must finalize their thesis committee, formally defend their proposal before the committee, and submit their proposal to the HST Graduate Committee **by April 30 of the forth year of registration.**

YEAR 5

- Following submission of the thesis proposal, 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 sooner rather than later.

Entered HST PhD	Letter of Intent 1	Letter of Intent 2	Thesis Proposal
September 2015	April 30, 2017	April 30, 2018	April 30, 2019
September 2014	April 30, 2016	April 30, 2017	April 30, 2018
September 2013	April 30, 2015	April 30, 2016	April 30, 2017
September 2012	April 30, 2014	April 30, 2015	April 30, 2016

Beginning Thesis Research

Students may choose their doctoral thesis topic in virtually any research area at the interface of physical science/engineering and the biomedical sciences. Students are encouraged to begin research activities early in their graduate program; research work towards the thesis may be done at MIT, Harvard, or affiliated hospitals. HST encourages students to explore areas that are relevant to clinical medicine. The candidate pursues the thesis under the direction of a research supervisor and is guided by a thesis committee.

[Friendly advice: If you are having trouble selecting a research area and/or advisor, invite several faculty who you know best to join you in a brainstorming session.]

The Thesis Committee

COMMITTEE COMPOSITION AND FUNCTION

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 and act as readers of the thesis. Faculty members with relevant expertise from outside of Harvard/MIT may serve as thesis committee members, but they may only be counted toward the required three if approved by the HST IMES Committee on Academic Programs.

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 approves the composition of the thesis committee via the letter of intent and the thesis proposal (see below). In order to avoid conflicts of interest, a student's research supervisor cannot simultaneously be either the academic advisor or thesis committee chair. In the event that an academic advisor becomes the research supervisor, a new academic advisor will be found.

In addition to covering all the areas of expertise needed to do your thesis research, your committee should also be diverse. It should include people from various departments and labs. It is often very helpful to include at least one person who is likely to view your problem from a very different perspective than you and your supervisor. When formatting your committee, it may be helpful to ask the following questions:

- Do the individuals on the committee collectively have the appropriate expertise for the project?
- Does the committee include at least one individual who can take an external view of the work?
- Does the committee include someone who can add a translational or clinical perspective?

- Does the committee conform to HST policies in terms of number, academic appointments, and affiliations of the committee members, research supervisor, 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. If you find that you are having trouble getting your committee members to meet, contact Julie Greenberg at jgreenbe@mit.edu.

[Friendly advice: Begin meeting with your proposed committee even before this. Group discussions can be very effective for generating new ideas and developing a clear research plan.]

RESEARCH SUPERVISOR

The research supervisor is responsible for overseeing the student's research thesis project, providing a supportive research environment, and mentoring the student. The research supervisor is chosen by the student and must be a faculty member of MIT* or Harvard University, but needs no further approval of the HST IMES Committee on Academic Programs. The HST IMES Committee on Academic Programs may approve other individuals as research supervisors on a student-by-student basis. The student must request approval of non-faculty research supervisors as soon as possible.

The student and their research supervisor must complete the HST Semi-Annual PhD Student Progress Review during each regular term in order to receive academic credit for research.

THESIS COMMITTEE CHAIR

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 responsible for overseeing the committee meetings that are convened at least once each semester to review research progress; conducting the thesis defense; and, with the committee, reviewing the thesis. For HST PhD students earning degrees through MIT, the thesis committee chair must be an MIT faculty member.* Under limited circumstances, members of the HST faculty without primary appointments at MIT are eligible to chair thesis committees for students earning MIT degrees; please check with the Academic Office if you wish to explore this option. 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). In any case, 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.

*MIT Senior Research Staff are considered equivalent to faculty members for the purposes of supervising research and chairing thesis committees. No additional approval is required.

The Letter of Intent (Not the same as the thesis proposal)

Students must submit two letters of intent (LOI-1 and LOI-2).

LOI-1 should propose a general area of thesis research and a research supervisor. It must be submitted to the HST IMES Committee on Academic Programs by April 30 of the second year of registration. LOI-1 should include the area of expertise of the supervisor. It should also 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. The research description should be no longer than 100 words. The student and research supervisor must sign the letter of intent.

LOI-2 should address the same issues as LOI-1 and also specify at least two people who, in addition to the thesis supervisor, will tentatively serve on the thesis committee. At least one member of the tentative thesis committee must be eligible to serve as thesis committee chair (see below). LOI-2 should also specify the research supervisor and general area of thesis research since these may have changed since LOI-1. LOI-2 must be signed by the student, research supervisor and tentative committee members. It must be submitted to the HST IMES Committee on Academic Programs by April 30th of the third year of registration.

Students are strongly encouraged to identify tentative thesis committee members and begin meeting with them as early as possible. Following submission of LOI-2, students are required to hold at least one meeting per semester with their tentative thesis committee. The role of the tentative committee is to offer advice in formulating the research. In many cases, the tentative committee members may ultimately serve on the final thesis committee, although they are under no obligation to do so. Students not meeting the LOI submission deadlines will have their financial support withheld until the overdue LOI has been submitted.

The LOIs are understood to provide only a tentative thesis plan, and it is recognized that the research direction may change in the process of developing a formal thesis proposal. The research topic and thesis committee are only considered final after the thesis proposal (see below) has been approved. LOIs should be submitted to the HST IMES Committee on Academic Programs, c/o Traci Anderson in E25-518.

[Friendly advice: Be sure to take responsibility for obtaining the necessary signatures and submitting the letter to HST's Academic Office. This is the best way to ensure the letter doesn't languish on someone's desk.]

Thesis Proposal and Proposal Presentation

PROPOSAL DOCUMENT

Each student must present a thesis proposal to their thesis committee and submit an approved proposal to the HST IMES Committee on Academic Programs by April 30th of the fourth year of registration. The only exception is for students who substantially change their research focus after submitting their original letter of intent; in those cases the thesis proposal must be submitted within three semesters of joining a new lab. Students registering for research credit (HST.THG, HST599) who have not met this deadline will be administratively assigned a grade of "U" (unsatisfactory) or "F". One "U" or "F" grade will result in a Dean's Warning. If a grade of "U" or "F" is received two semesters in a row, further registration may be denied.

The 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.

PROPOSAL PRESENTATION

The student must formally present the written thesis proposal before the full thesis committee. For MEMP students receiving their degrees through Harvard, the oral qualifying exam satisfies the proposal presentation requirement.

Students should reserve a conference room and any audio visual equipment they may require for their presentation as far in advance as reasonably possible. To book a conference room and/or an LCD projector, please contact Joseph Stein (jrstein@mit.edu).

The student must correct any deficiencies in the proposal identified by the committee, and the committee then reviews the amended proposal. 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 a week in advance of the proposal presentation.]

[Friendly advice: Be sure to take responsibility for obtaining the necessary signatures and submitting the proposal to HST. The proposal serves as a contract between you and your committee, but not until it is approved by the HST IMES Committee on Academic Programs.]

SUBMISSION OF PROPOSAL PACKAGE

When the thesis committee deems the proposal acceptable, the student submits the proposal package to the HST IMES Committee on Academic Programs, c/o Traci Anderson in E25-518, for final approval. The HST IMES Committee Academic Programs has responsibility for final approval of both the proposal and the composition of the thesis committee.

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*. The HST IMES Committee on Academic Programs 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, and
    c. an indication of the methods to be used to accomplish the specific aims.
- a supervision agreement signed by the thesis supervisor;
- an agreement signed by the chair of the committee;
- signed agreements from each reader;
- a cover letter signed by the chairman of the committee documenting the time and place of the thesis proposal presentation, the names and areas of expertise of the thesis committee members and the committee's assessment of the proposal.

Thesis Document and Thesis Defense

When the thesis document is substantially complete and fully acceptable to the thesis committee, a public thesis defense is scheduled for the student to present his/her 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 through email and posters at least five working days in advance. Through the defense, the thesis committee judges the adequacy of the thesis research. Once the thesis is satisfactorily defended and the final thesis document (signed by the thesis supervisor) is submitted to Traci Anderson in E25-518, the student's thesis requirement will have been fulfilled.

[Friendly advice: Contact Joseph Stein far enough in advance to ensure that your defense will be advertised at least five working days before the scheduled date. A defense can be canceled if insufficient public notice is given.]

THESIS DEFENSE PROCEDURES

- The thesis committee, working with the student and reviewing thesis drafts, concludes that the doctoral work is complete.

- A complete final draft of the thesis document is due to the thesis committee approximately two weeks prior to the thesis defense to allow the committee time to review.

- The HST Academic Office sends out an email announcement, posts flyers, and advertises the defense on the HST website. For this to happen, the student emails a thesis abstract and important supplemental information to Joseph Stein approximately ten days prior to the thesis defense in order to publicize the defense. The following information is needed: Date and time, Location, Thesis Title, Committee members (with their academic and professional titles and institutional affiliations), Abstract - the abstract can be any length for the email announcement, but we can only fit around 250 words on the poster. You can either send a single abstract that will fit on the poster or send two versions.

- A thesis defense is held to which the public is invited.

- The entire thesis committee should be present at the defense. In extreme circumstances, one reader may be absent as long as at least three other committee members are present. Any exceptions must be approved in advance by the HST Academic Office.

- Students should reserve a room and any necessary equipment for their thesis defense. Please email Joseph Stein in the HST Academic Office to reserve rooms E25-101, E25-119/121, E25-521 and/or an LCD projector.

In a discussion immediately following the public thesis presentation, involving the student and all faculty members present, additional questions can be explored at the discretion of the faculty. The thesis committee meets in executive session to decide whether the thesis defense was satisfactory. Additions or editorial changes to the thesis document may be suggested to the student by the committee at this point.

The chair of the thesis committee should inform Traci Anderson that the student has successfully defended the PhD thesis 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/

1. *Cover/Title page.* On the "Accepted by" line, please list: Emery N. Brown, MD, PhD/Director, Harvard-MIT Program in Health Sciences and Technology/Professor of Computational Neuroscience and Health Sciences and Technology

Sign your cover/title page and have your thesis supervisor(s) sign. The Academic Office will obtain Dr. Brown's signature. You do not need the signatures of your thesis committee members.

2. *UMI Form.* Print out and complete the UMI form http://libraries.mit.edu/archives/thesis-specs/images/umi-proquest-form.pdf Prepare an additional copy of your cover/title page and abstract, staple them to the UMI form, and submit this together with the three copies of your thesis.

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

4. *Thesis Submission*. HST requires that you submit **three copies of your thesis, two hard copies and one .pdf version**. The two hard copies must meet the MIT Libraries paper standards, which can be found by clicking on the "Paper" tab of the Libraries webpage. The third electronic copy is for HST and may be emailed to Traci Anderson tanderso@mit.edu.

Sample Thesis Forms

Please see Appendix 2 for:

- Letter of Intent Form
- Semi-Annual Progress Review Form
- Thesis Proposal Cover Sheet
- Sample Title page
- Committee Agreement Forms

APPENDIX 1

Sample MEMP Qualifying Exam Forms

The forms appended here are also available for download on the HST Website, under the header ”Qualifying Exam Policies and Forms” at:
http://hst.mit.edu/academics/policies-and-forms

- 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 limited to two courses (plus seminars) per term.
- 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 below in *italics.*

Mechanical Engineering – all grad courses, OQE in May of 2nd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring
2.795J: Fields, Forces, ad Flows in Biological Systems	*2.372J Design and Fabrication of Microelectromechanical Systems*	Research	*2.798J Molecular, Cellular, and Tissue Biomechanics*	other courses as desired
HST030: Human Pathology	HST500: Frontiers in (bio)Medical Engineering & Physics		*2.25: Fluid Mechanics*	prepare for OQE in May
HST590: Seminar Series	HST590: Seminar Series		HST590: Seminar Series	HST590: Seminar Series
Research	Research		Research	Research

Mechanical Engineering – some undergrad courses 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	Research	*2.25: Fluid Mechanics*	*2.710: Optics*	other courses as desired
HST030: Human Pathology	HST500: Frontiers in (bio)Medical Engineering & Physics		*2.798J Molecular, Cellular, and Tissue Biomechanics*	*2.372J Design and Fabrication of Microelectromechanical Systems*	prepare for OQE in January
HST590: Seminar Series	HST590: Seminar Series		HST590: Seminar Series	HST590: Seminar Series	
Research	Research		Research	Research	Research

Chemical Engineering – all grad courses, OQE in May of 2nd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring
10.40: Chemical Engineering Thermodynamics	*10.569: Synthesis of Polymers*	Research	*10.539: Fields, Forces, and Flows in Biological Systems*	other courses as desired
10.50: Analysis of Transport Phenomena	HST500: Frontiers in (bio)Medical Engineering & Physics		HST030: Human Pathology	prepare for OQE in May
HST590: Seminar Series	HST590: Seminar Series		HST590: Seminar Series	HST590: Seminar Series
Research	Research		Research	Research

Chemical Engineering – some undergrad courses 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	Research	*10.40: Chemical Engineering Thermodynamics*	*10.569: Synthesis of Polymers*	other courses as desired
HST030: Human Pathology	HST500: Frontiers in (bio)Medical Engineering & Physics		*10.50: Chemical and Biological Engineering Thermodynamics*	*10.543J Protein Folding and Human Disease*	Prepare for OQE in January
HST590: Seminar Series	HST590: Seminar Series		HST590: Seminar Series	HST590: Seminar Series	
Research	Research		Research	Research	Research

Electrical Engineering – all grad courses, OQE in May of 2nd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring
6.561 Fields, Forces, and Flows in Biological Systems	*6.555 Biomedical Signal and Image Processing*	Research	*6.336 Introduction to Numerical Simulation*	other courses as desired
HST030: Human Pathology	HST500: Frontiers in (bio)Medical Engineering & Physics		*6.777 Design and Fabrication of Microelectromechanical Systems*	prepare for OQE in May
HST590: Seminar Series	HST590: Seminar Series		HST590: Seminar Series	HST590: Seminar Series
Research	Research		Research	Research

Electrical Engineering – some undergrad courses for preparation, OQE in January of 3rd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring	Year 3 Fall
6.003 Signals and Systems	6.013 Electromagnetics and Applications	Research	*6.561 Fields, Forces, and Flows in Biological Systems*	*6.555 Biomedical Signal and Image Processing*	other courses as desired
HST030: Human Pathology	HST500: Frontiers in (bio)Medical Engineering & Physics		*6.777 Design and Fabrication of Microelectromechanical Systems*	*6.011 Introduction to Communication, Control, and Signal Processing*	Prepare for OQE in January
HST590: Seminar Series	HST590: Seminar Series		HST590: Seminar Series	HST590: Seminar Series	
Research	Research		Research	Research	Research

Materials Science and Engineering– OQE in May 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*	Research	*3.96: Biomaterials: Tissue Interactions*	other courses as desired
3.23: Electrical, optical, and magnetic properties of materials	HST500: Frontiers in (bio)Medical Engineering & Physics		HST030: Human Pathology	prepare for OQE in May
HST590: Seminar Series	HST590: Seminar Series		HST590: Seminar Series	HST590: Seminar Series
Research	Research		Research	Research

Computer Science – OQE in May of 2nd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring
6.338 Parallel Computing	*6.437 Inference and Information*	Research	*6.337 Introduction to Numerical Methods*	other courses as desired
HST030: Human Pathology	HST500: Frontiers in (bio)Medical Engineering & Physics		*HST.508 Quantitative Genomics*	prepare for OQE in May
HST590: Seminar Series	HST590: Seminar Series		HST590: Seminar Series	HST590: Seminar Series
Research	Research		Research	Research

Aeronautics and Astronautics – OQE in May of 2nd year

Year 1 Fall	Year 1 Spring	Summer	Year 2 Fall	Year 2 Spring
16.453: Human Factors Engineering	*16.423J Aerospace Biomedical and Life Support Engineering*	Research	*16.851 Satellite Engineering*	other courses as desired
HST030: Human Pathology	HST500: Frontiers in (bio)Medical Engineering & Physics		*16.910: Introduction to Numerical Simulation*	prepare for OQE in May
HST590: Seminar Series	HST590: Seminar Series		HST590: Seminar Series	HST590: Seminar Series
Research	Research		Research	Research

Harvard-MIT Health Sciences and Technology
Contract for Technical Qualifying Exam (TQE)

Revised July 2015

Name:_____ **Email: _____**

Academic Advisor: _____ **Year entered MEMP: _____**

Research Supervisor (if known): _____

Concentration Area (circle one)*:

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

Classes To Be Taken for TQE Requirement **Select four classes from the list corresponding to the concentration area circled above**		
Subject number	**Subject name**	**Term**

I understand that the four classes listed above plus Human Pathology constitutes the basis of my technical qualification exam and that no revisions are permitted without explicit approval of the assigned Qualifying Exam Chairperson.

Student Signature Date

Academic Advisor Signature Date

QE Chair Signature (required only for revised TQE class plans) Date

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

Mechanical Engineering	Chemical Engineering	Materials Science & Engineering	Electrical Engineering	Computer Science	Physics	Chemistry	Nuclear Science & Engineering	Aeronautics & Astronautics	Brain & Cognitive Sciences
2.032 2.071 2.072 2.080J 2.094 2.131 2.140 2.151 2.153 2.25 2.37 2.372J 2.42 2.55 2.56 2.710 **or** 6.631 2.75J 2.782J* 2.785J* 2.79J* 2.795J 2.798J 2.799 2.810 3.963J* ES 211 ** You may not choose more than one of these*	10.34 10.40* 10.50* 10.65 * 10.537J 10.538J 10.539J 10.542 10.546J 10.55 10.568 10.569 10.668J ** You must choose at least two of:* *10.40* *10.50* *10.65*	3.20* 3.21* 3.22 3.23 3.40J 3.46 3.54J 3.941J 3.96J** 3.961J** 3.963J** 3.97J** 3.971J** ** You must choose both 3.20 and 3.21* *** You may not choose more than one of these*	*Select two courses from one group and one from each of two additional groups:* 6.011 6.231 6.241J 6.251J **or** 6.255J 6.341 **or** 6.344 **or** 6.555J 6.556J 6.334 6.374 6.376 6.525J 6.775 6.262 6.436J 6.437 **or** 6.438 6.450 6.453 6.867 6.630 **or** 6.632 6.631 **or** 2.710 6.634J 6.561J **or** 6.641 **or** 6.685 6.720J 6.728 6.730 6.774 6.777J 6.336J **or** 6.339J	*Select two courses from one group and one from each of the other groups:* 6.046J 6.337J 6.338J 6.852J 6.854J 6.856J 6.434J 6.436J 6.437 6.438 6.867 15.077J HST.460J STAT211 6.555J 6.872J 6.874J 6.878J 8.591J 18.417 HST.508 HST.509 6.345J* 6.863J* 6.864* 6.866** 6.869** 6.831*** 6.832 6.839***	8.311 8.321 8.322 8.333 8.334 8.351J 8.421 8.422 8.511 8.512 8.591J* 8.592J* 8.593J* 8.613J 8.701 **You may not choose more than two of these*	5.062 5.511 5.52 5.53 5.64 5.68J 5.70J 5.72 5.73 5.74 5.78 ** Your TQE course selections must total at least 42 units, so it may be necessary to take 5 classes instead of the usual 4*	22.107 22.11 22.12 22.13 22.14 22.15 22.51 22.55J 22.56J ** Your TQE course selections must total at least 42 units, so it may be necessary to take 5 classes instead of the usual 4*	2.080J 6.231* 6.241J** 16.31** 16.323* 16.423J 16.453J 16.470J 16.851*** 16.89J *** 16.910J**** 16.920J**** 22.55J HST.582J ** You may not choose both 6.231 and 16.323* *** You may not choose both 6.241 and 16.31* **** You may not choose both 16.851 and 16.89* **** You may not choose both 16.910 and 16.920*	9.011* HST.131* 9.012** 9.013J** 9.015J** 9.073J 9.173J 9.181J 9.285J 9.301J 9.322J 9.422J 9.472J 9.520 9.601J 9.611J 9.660 HST.580J HST.582J HST.721 ** You must choose 9.011 or HST.131, but not both* *** You must choose at least one of 9.012, 9.013, 9.015*

Concentration Area Chairs:
Mechanical Engineering: Mehmet Toner, mehmet_toner@hms.harvard.edu
Chemical Engineering: Elfar Adalsteinsson, elfar@mit.edu
Materials Science and Engineering: Sangeeta Bhatia, sbhatia@mit.edu
Electrical Engineering: Roger Mark, rgmark@mit.edu
Computer Science: Peter Szolovits, psz@mit.edu
Physics: Collin Stultz, cmstultz@csail.mit.edu
Chemistry: Collin Stultz, cmstultz@csail.mit.edu
Nuclear Science and Engineering: Julie Greenberg, jgreenbe@mit.edu
Aeronautics and Astronautics: Larry Young, lry@mit.edu
Brain and Cognitive Sciences: Emery Brown, enbrown1@mit.edu

Mechanical Engineering

2.032 Dynamics, 2.071 Mechanics of Solid Materials, 2.072 Mechanics of Continuous Media, 2.080J Structural Mechanics, 2.094 Finite Element Analysis of Solids and Fluids II, 2.131 Advanced Instrumentation and Measurement, 2.140 Analysis and Design of Feedback Control Systems 2.151 Advanced System Dynamics and Control, 2.153 Adaptive Control, 2.25 Fluid Mechanics, 2.37 Fundamentals of Nanoengineering, 2.372J Design and Fabrication of MEMS, 2.42 General Thermodynamics, 2.55 Advanced Heat and Mass Transfer, 2.56 Conduction and Change of Phase Heat Transfer, 2.710 Optics **or** 6.631 Optics and Photonics, 2.75J Medical Device Design, 2.782J* Design of Medical Devices and Implants, 2.785J* Cell-Matrix Mechanics, 2.79J* Biomaterials -- Tissue Interactions, 2.795J Fields, Forces, and Flows in Biological Systems, 2.798J Molecular, Cellular, and Tissue Biomechanics, 2.799 The Cell as a Machine, 2.810 Manufacturing Processes and Systems, 3.963J* Biomaterials Science and Engineering, ES211 Microphysiological Systems (Harvard)

*You may not choose more than one class of the following: 2.782J, 2.785J, 2.79J, 3.963J

Chemical Engineering

10.34 Numerical Methods Applied to Chemical Engineering, 10.40* Chemical Engineering Thermodynamics, 10.50* Analysis of Transport Phenomena, 10.65* Chemical Reactor Engineering, 10.537J Molecular, Cellular, and Tissue Biomechanics, 10.538J Biomolecular Kinetics and Cellular Dynamics, 10.539J Fields, Forces, and Flows in Biological Systems, 10.542 Biochemical Engineering, 10.546J Statistical Thermodynamics, 10.55 Colloid and Surfactant Science, 10.568 Physical Chemistry of Polymers, 10.569 Synthesis of Polymers, 10.668J Statistical Mechanics of Polymers

* You must choose at least two of the following three courses: 10.40, 10.50, 10.65

Materials Science and Engineering

3.20* Materials at Equilibrium, 3.21* Kinetic Processes in Materials, 3.22 Mechanical Behavior of Materials, 3.23 Electrical, Optical, and Magnetic Properties of Materials, 3.40J Modern Physical Metallurgy, 3.46 Photonic Materials and Devices, 3.54J Corrosion: The Environmental Degradation of Materials, 3.941J Statistical Mechanics of Polymers, 3.96J** Biomaterials: Tissue Interactions, 3.961J** Design of Medical Devices and Implants, 3.963J** Biomaterials Science and Engineering, 3.97J** Cell-Matrix Mechanics, 3.971J** Molecular, Cellular, and Tissue Biomechanics

* You must choose both 3.20 and 3.21
**You may not choose more than one class of the following: 3.96J, 3.961J, 3.963J, 3.97J, 3.971J

Electrical Engineering
Select two courses from one group and one from each of two additional groups.

System Science and Control Engineering:
6.011 Signals, Systems and Inference
6.231 Dynamic Programming and Stochastic Control
6.241J Dynamic Systems and Control
6.251J Introduction to Mathematical Programming **or** 6.255J Optimization Methods
6.341 Discrete-time Signal Processing **or** 6.344 Digital Image Processing **or** 6.555J Biomedical Signal and Image Processing
6.556J Data Acquisition and Image Reconstruction in MRI

Circuits and Electronic Systems
6.334 Power Electronics
6.374 Analysis and Design of Digital Integrated Circuits
6.376 Bioelectronics
6.525J Medical Device Design
6.775 CMOS Analog and Mixed-Signal Circuit Design

Information Science and Communication
6.262 Discrete Stochastic Processes
6.436J Fundamentals of Probability
6.437 Inference and Information **or** 6.438 Algorithms for Inference
6.450 Principles of Digital Communication
6.453 Quantum Optical Communication
6.867 Machine Learning

Electromagnetics
6.630 Electromagnetics **or** 6.632 Electromagnetic Wave Theory
6.631 Optics and Photonics **or** 2.710 Optics
6.634J Nonlinear Optics
6.561J Fields, Forces, and Flows in Biological Systems **or** 6.641 Electromagnetic Fields, Forces, and Motion **or** 6.685 Electric Machines

Physical Science and Engineering
6.720J Integrated Microelectronic Devices
6.728 Applied Quantum and Statistical Physics
6.730 Physics for Solid-State Applications
6.774 Physics of Microfabrication: Front End Processing
6.777J Design and Fabrication of MEMS

Other
6.336J Introduction to Numerical Simulation **or** 6.339J Numerical Methods for Partial Differential Equations

Computer Science
Select two courses from one group and one from each of the other groups.

Algorithms
6.046J Design and Analysis of Algorithms
6.337J Introduction to Numerical Methods
6.338J Parallel Computing
6.852J Distributed Algorithms
6.854J Advanced Algorithms
6.856J Randomized Algorithms

Probability and/or Statistics
6.434J Statistics for Engineers and Scientists
6.436J Fundamentals of Probability
6.437 Inference and Information
6.438 Algorithms for Inference
6.867 Machine Learning
15.077J Statistical Learning and Data Mining
HST460J Statistics for Neuroscience Research
STAT211 Statistical Inference (Harvard)
[Students without a strong background in probability are encouraged to take 6.431 Applied Probability or 18.440 Probability and Random Variables before attempting one of the TQE classes listed above.]

Applications
6.555J Biomedical Signal and Image Processing
6.872J Biomedical Computing
6.874J Computational Systems Biology
6.878J Advanced Computational Biology: Genomes, Networks, Evolution
8.591J Systems Biology
18.417 Introduction to Computational Molecular Biology
HST508 Quantitative Genomics
HST509 Computational and Functional Genomics
6.345J Automatic Speech Recognition*
6.863J Natural Language and the Computer Representation of Knowledge*
6.864 Advanced Natural Language Processing*
6.866 Machine Vision**
6.869 Advances in Computer Vision**
6.831 User Interface Design and Implementation***
6.832 Underactuated Robotics
6.839 Advanced Computer Graphics ***
[Students with no background in computational biology may wish to take 7.91J Foundations of Computational and Systems Biology before attempting some of the TQE classes listed above.]

* You may not choose more than one class of the following: 6.345J, 6.863J, 6.864
** You may not choose both 6.866 and 6.869
*** You may not choose both 6.831 and 6.839

Physics
8.311 Electromagnetic Theory I, 8.321 Quantum Theory I, 8.322 Quantum Theory II, 8.333 Statistical Mechanics I, 8.334 Statistical Mechanics II, 8.351J Classical Mechanics: A Computational Approach, 8.421 Atomic and Optical Physics I, 8.422 Atomic and Optical Physics II, 8.511 Theory of Solids I, 8.512 Theory of Solids II, 8.591J Systems Biology*, 8.592J Statistical Physics in Biology*, 8.593J Biological Physics*, 8.613J Introduction to Plasma Physics I, 8.701 Introduction to Nuclear and Particle Physics

* You may not choose more than two of the following: 8.591J, 8.592J, 8.593J

Chemistry
Your TQE course selections must total at least 42 units, so it may be necessary to take five classes instead of the usual four.

5.062 Principles of Bioinorganic Chemistry, 5.511 Synthetic Organic Chemistry I, 5.52 Advanced Biological Chemistry, 5.53 Molecular Structure and Reactivity, 5.64 Biophysical Chemistry, 5.68J Kinetics of Chemical Reactions, 5.70J Statistical Thermodynamics, 5.72 Statistical Mechanics, 5.73 Introductory Quantum Mechanics I, 5.74 Introductory Quantum Mechanics II, 5.78 Biophysical Chemistry Techniques

Nuclear Science and Engineering
Your TQE course selections must total at least 42 units, so it may be necessary to take five classes instead of the usual four.

22.107 Computational Nuclear Science and Engineering, 22.11 Applied Nuclear Physics, 22.12 Radiation Interactions, Control, and Measurement, 22.13 Nuclear Energy Systems, 22.14 Materials in Nuclear Engineering, 22.15 Essential Numerical Methods, 22.51 Quantum Theory of Radiation Interactions, 22.55J Radiation Biophysics, 22.56J Noninvasive Imaging in Biology and Medicine

Aeronautics and Astronautics
2.080J Structural Mechanics**;** 6.231* Dynamic Programming and Stochastic Control **or** 16.323* Principles of Optimal Control; 6.241J** Dynamic Systems & Control **or** 16.31** Feedback Control Systems; 16.423J Aerospace Biomedical and Life Support Engineering; 16.453J Human Factors Engineering; 16.470J Statistical Methods in Experimental Design; 16.851*** Satellite Engineering **or** 16.89J*** Space Systems Engineering; 16.910J**** Introduction to Numerical Simulation **or** 16.920J**** Numerical Methods for Partial Differential Equations; 22.55J Radiation Biophysics; HST.582J Biomedical Signal and Image Processing

Brain and Cognitive Sciences
9.011* Systems Neuroscience **or** HST.131* Neuroscience; 9.012** Cognitive Science; 9.013J** Molecular and Cellular Neuroscience Core II; 9.015J** Molecular and Cellular Neuroscience Core I; 9.073J Statistics for Neuroscience Research; 9.173J Noninvasive Imaging in Biology and Medicine; 9.181J Developmental Neurobiology; 9.285J Neural Coding and Perception of Sound; 9.301J Neural Plasticity in Learning and Memory; 9.322J Genetic Methods in Neurobiology; 9.422J Principles of Neuroengineering; 9.472J Neuroimaging Cells and Circuits; 9.520 Statistical Learning Theory and Applications; 9.601J Language Acquisition I; 9.611J Natural Language and the Computer Representation of

Knowledge; 9.660 Computational Cognitive Science; HST.580J Data Acquisition and Image Reconstruction in MRI, HST.582J Biomedical Signal and Image Processing; HST.721 The Biology of the Inner Ear

* You must choose either 9.011 or HST131; you may *not* choose them both
** You must choose at least one of 9.012, 9.013, 9.015

Harvard-MIT Health Sciences and Technology

Request to Schedule MEMP Oral Qualifying Exam (OQE)

Name:_____ **Email: _____**

Academic Advisor: _____ **Year entered MEMP: _____**

Desired OQE Month: January May (circle one) **Year: _____**

Research Supervisor: _____

Tentative Title of Research Proposal:

_____

Student Signature Date

_____

Qualifying Exam Chair Signature Date

Please submit signed form to the HST Academic Office (E25-518) by March 1 (for May exams) or by November 1 (for January exams).

Office Use

_____ TQE Complete
_____ Copy of Proposal Received
_____ Letter from Research Supervisor Received Exam Date: _____

APPENDIX 2

Sample Thesis Forms

The forms appended here are also available for download on the HST Website, under the header ”Thesis” at: http://hst.mit.edu/academics/policies-and-forms

- Letter of Intent Form
- Semi Annual Progress Review Form
- Thesis Proposal Cover Sheets
- Sample Thesis Title Page
- Committee Agreement Forms

Letter of Intent
HST PhD Candidates

Check One

❑ **Letter of Intent 1 (LOI-1)**, due April 30, Year 2 ❑ **Letter of Intent 2 (LOI-2)**, due April 30, Year 3

** Note, i*f you are making progress more quickly than the suggested guidelines, you may submit LOI-2, in lieu of LOI-1. Similarly, if you defend and submit a thesis proposal early, you do not need to submit LOI-2.*

Name: _____

Signature/Date: _____

My signature above indicates that I understand the thesis committee policies on reverse of form, including eligibility requirements for thesis committee chair.

Research Supervisor: _____

Supervisor's area of expertise: _____

Supervisor's Signature: _____

Research involves human subjects: ❑**Yes** ❑**No** **If yes, project requires IRB approval from MIT.**
Research involves vertebrate animals: ❑**Yes** ❑**No** **If yes, project requires IACUC approval from MIT.**
Other institutions involved: _____
If you answered *yes* to either of the above questions, list any other institutions whose IRB or IACUC approval is required.

Project Title: _____

General area of thesis research (max. 100 words. Description should be informative, for a lay audience and should not include jargon. Area of Research text will be reviewed by HST-IMES Committee on Academic Programs, HICAP):

----------(Required for LOI-2, only)----------

One of your proposed readers should meet eligibility requirements to be chair of committee, see reverse of form for policy.

Tentative Thesis Reader: _____ **Tentative Thesis Reader**: _____

Reader's area of expertise: _____ **Reader's area of expertise**: _____

_____ _____

Reader's signature: _____ **Reader's signature**: _____

LOI and Thesis Committee policies on page 2

Letters of Intent

Tentative thesis committee
Students are strongly encouraged to identify tentative thesis committee members and begin meeting with them as early as possible. Following submission of LOI-2, students are required to hold at least one meeting per semester with their tentative thesis committee. The role of the tentative committee is to offer advice in formulating the research. In many cases, the tentative committee members may ultimately serve on the final thesis committee, although they are under no obligation to do so.

Thesis Proposal

Final Thesis Committee
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 chairman and a research supervisor) who will help guide the research and act as readers of the thesis. Faculty members with relevant expertise from outside of Harvard/MIT may serve as thesis committee members, but they may only be counted toward the required three if approved by the HST-IMES Committee on Academic Programs.

Research Supervisor. The research supervisor is responsible for overseeing the student's research thesis project, providing a supportive research environment, and mentoring the student. **The research supervisor is chosen by the student and must be a faculty member of MIT* or Harvard University, but needs no further approval of the HST IMES Committee on Academic Programs (HICAP)**. HICAP may approve other individuals as research supervisors on a student-by-student basis. The student must request approval of non-faculty research supervisors as soon as possible.

Thesis Committee Chair. 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 responsible for overseeing the committee meetings that are convened at least once each semester to review research progress; conducting the thesis defense; and, with the committee, reviewing the thesis. 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 (check the HST PhD Guide on the HST Website for a current list). 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). In any case, 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.

*MIT Senior Research Staff are considered equivalent to faculty members for the purposes of supervising research and chairing thesis committees. No additional approval is required.

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 supervisors 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 research (HST.599, HST.77X, or HST ThG.)**

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

Please print out two copies for the review. One copy is to be filled out by the student, the other by the research supervisor. The copies should be completed independently. Feel free to use additional pages if you need more space. After both are completed, the student and the research supervisor 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 supervisor will assigns a grade of satisfactory or unsatisfactory for thesis research, directly on the review form. ***The student and the research supervisor 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 the original copies of the two review forms while the research supervisor may wish to retain photocopies.

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 SUPERVISOR

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 — need to acquire additional scientific knowledge

access to equipment — access to other resources

need more communication with research supervisor — need more communication with other lab personnel

not enough time to do all that is required — other: _____

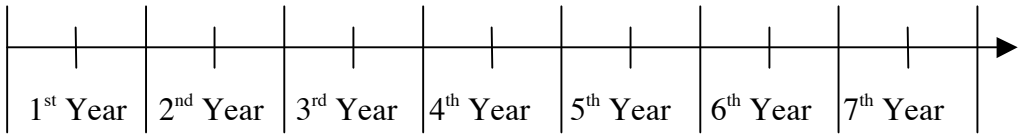
5. What resources would help you {your student} overcome the challenges circled above and accomplish the goals described in your answer to question #3.

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 supervisor {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 Supervisor Name: _____

Year in Program: _____ Term/Year of Review (ie. fall 2014):_____

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 supervisor and general area of research*	
April 30 – **Year 3**	**Letter of Intent 2**: *Propose tentative thesis committee, and update area of research / research supervisor, if necessary*	
April 30 – **Year 4**	**Thesis Proposal:** *Submit a successfully defended thesis proposal to the HST Committee on Academic Programs, including listing of the final thesis committee.*	

**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:

Names of committee members who attended:

Brief description of the outcome:

** If a committee meeting was not held this semester, please explain why.

3. **Grade for student's thesis research. (check one)**

❑ Satisfactory ❑ Unsatisfactory progress

**Please note that even if the research supervisor assigns a Satisfactory, HST may administratively assign a grade of Unsatisfactory if the thesis proposal deadline has not been met.*

_____ _____

(student's signature) *(research supervisor's signature)*

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

SAMPLE COVER LETTER FOR THESIS PROPOSAL

HST IMES Committee on Academic Programs
c/o Academic Office, E25-518

Dear Academic Programs Committee Chair:

Ivana Degri presented her PhD thesis proposal on January 27, 2014, in Room 6-220 at MIT to the following committee:

Chair: Professor I.B. Smart (MIT). Professor of Biology. Whose area of expertise is …

Supervisor: Dr. Heinrich Eisenhamster (HU) Associate Professor of Psychology. Whose area of expertise is…

Reader: Dr. Boris Badenov (MIT) Senior Research Scientist, HST. Whose area of expertise is…

Reader: Prof. Natasha Fatale (MIT) Professor of Chemistry. Whose area of expertise is …

The attached proposal, was favorably received by the Committee and we approve the scientific content and proposed work as being suitable for a PhD thesis.

All of the above members of the Committee have agreed to serve on the Thesis Committee.

Sincerely,

I. B. Smart

Prof. I.B. Smart
Thesis Committee Chair

Heinrich Eisenhamster

Prof. Heinrich Eisenhamster
Thesis Supervisor

Enc.
Thesis Proposal
Supervisor Agreement
Reader Agreements

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:

THESIS SUPERVISOR AGREEMENT

Harvard-MIT Health Sciences and Technology

To: HST IMES Academic Programs Committee

From: Thesis Supervisor _____

The program outlined in the proposal,

Title: _____

_____

Author: _____

Date: _____

is adequate for a doctoral thesis. I believe the following readers are appropriate for the thesis:

Reader 1: _____

Reader 2: _____

Reader 3: _____

Reader 4: _____

Facilities and support for the research outlined in the proposal are available. I am willing to supervise the research and evaluate the thesis report. I further agree to hold a thesis committee meeting at least once per semester to review and guide the student's research.

Signed: _____

Title: _____

Date: _____

Comments:

THESIS CHAIR AGREEMENT

Harvard-MIT Health Sciences and Technology

To: HST IMES Committee on Academic Programs

From: Thesis Chair _____

The Program outlined in the proposal:

Title: _____

_____

Author: _____

Date: _____

Supervisor: _____

Readers: _____

_____

_____

is adequate for a doctoral thesis. I am willing to aid in guiding the research and in evaluating the thesis report as the thesis committee chair. Specifically, I agree to oversee a thesis committee meeting at least once each semester, to convene the thesis defense and to review and guide the student's research.

Signed: _____

Title: _____

Date: _____

Comments:

THESIS READER AGREEMENT

Harvard-MIT Health Sciences and Technology

To: HST IMES Committee on Academic Programs

From: Thesis Reader _____

The Program outlined in the proposal:

Title: _____

_____

Author: _____

Date: _____

Supervisor: _____

Readers: _____

_____

_____

is adequate for a doctoral thesis. I am willing to aid in guiding the research and in evaluating the thesis report as a reader. Specifically, I agree to participate in a thesis committee meeting at least once each semester, to review and guide the student's research.

Signed: _____

Title: _____

Date: _____

Comments: