HARVARD-MIT HEALTH SCIENCES AND TECHNOLOGY PROGRAM

Founded in 1970, the Harvard-MIT Health Sciences and Technology (HST) Program is one of the oldest and largest biomedical engineering and physician-scientist training programs in the United States and the longest-standing collaboration between Harvard and MIT. Since 2012, HST has been housed in the Institute for Medical Engineering and Science (IMES) (http://catalog.mit.edu/mit/research/institute-medical-engineering-science).

HST’s unique interdisciplinary educational program brings engineering as well as the physical and biological sciences from the scientist’s bench to the patient’s bedside. Conversely, it brings clinical insight from the patient’s bedside to the laboratory bench. In this way, HST students are trained to have deep understanding of engineering, physical sciences, and the biological sciences, complemented with hands-on experience in the clinic or in industry; and they become conversant with the underlying quantitative and molecular aspects of medicine and biomedical science. Within HST, approximately 300 graduate students work with eminent faculty and affiliated faculty members from the MIT and Harvard communities.

In addition to its outstanding record of accomplishment for research in human health care, HST educational programs are distinguished by three key elements:

• A strong quantitative orientation
• Required hands-on experience in a clinical setting
• A focused interdisciplinary research project

HST currently offers degrees in three multidisciplinary areas of graduate study:

• Medical Sciences MD Program
• Medical Engineering and Medical Physics Doctoral Program
• Speech and Hearing Bioscience and Technology Doctoral Program

Graduate Study

Doctoral Programs

Medical Sciences

HST’s Medical Sciences Program leads to the MD degree from Harvard Medical School. It is oriented toward students with a strong interest and background in quantitative science, especially in the biological, physical, engineering, and chemical sciences. The subjects in human biology developed for this curriculum represent the joint efforts of life scientists, physicians, physical scientists, and engineers from the faculties of Harvard and MIT.

The programs of study are designed to meet the interests and needs of the individual student. The student is encouraged to pursue advanced study in areas of interest that may complement the subjects offered in HST. Such study may be undertaken as part of the MD degree requirements or may be pursued in a program that combines the MD with a master’s or doctoral degree. Like all Harvard Medical School students, HST MD students complete two years of clinical training in local hospitals.

Because HST is committed to educating physicians who have a deep understanding of the scientific basis of medicine and who are well equipped for an interdisciplinary research career, HST encourages students in the MD curriculum to devote time to research and requires a thesis for completion of the degree. Many MD students desire even more research training than is possible during the standard four-year MD curriculum. For such students, one option is to pursue a formal PhD program in addition to an MD program. Another option expands the MD program to five or more years in order to include a major research training component.

Further details on the Medical Sciences Program and application forms may be obtained from:

Office of Admissions
Harvard Medical School
25 Shattuck Street
Boston, MA 02115

Applications must be submitted by October 15 of the year before desired matriculation. For further information, candidates can contact HST’s medical sciences admissions coordinator (hst-md-admissions@mit.edu).

Medical Engineering and Medical Physics

The Medical Engineering and Medical Physics (MEMP) Program is a five-to-seven-year program that leads to the PhD in Medical Engineering and Medical Physics awarded by MIT or by the Harvard Faculty of Arts and Sciences. The program trains students as engineers or physical scientists who also have extensive knowledge of the medical sciences. By understanding engineering and physical science applications, as well as their clinical implications, graduates of this program are well positioned to define new questions and formulate novel approaches in biomedical research.

The MEMP program is founded on a philosophy of openness and collaboration, characteristics that encourage innovative and independent thinking and creativity. This philosophy is fostered by the unique environment in which MEMP students study. While each MEMP student has depth in one classical discipline of engineering or physical science, the collective community has students in all disciplines. MEMP students also have peers with diverse career paths in medicine, science, engineering, business, and government. This community promotes an open exchange of ideas and exposes students to different perspectives on the health sciences. Moreover, MEMP students have access to research opportunities in labs at
Harvard, MIT, and the Harvard teaching hospitals. Students can do research with faculty at any of these institutions and have many opportunities through classes, events, and projects to interact with faculty from all of these institutions.

The program’s academic curriculum includes multiple components that prepare students to be medical innovators who will advance human health. First, HST provides MEMP students with a thorough graduate education in a classical discipline of engineering or physical science. Each student selects a concentration area, such as mechanical engineering, chemistry and chemical engineering, materials science, electrical engineering, computer science, physics, aeronautics and astronautics, brain and cognitive science, or nuclear engineering, and completes substantial coursework in this discipline.

Students then become conversant in the biological sciences through preclinical coursework followed by a series of 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 firsthand 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 is able to defend that research proposal in an oral presentation.

Finally, MEMP students investigate important problems at the interfaces of science, technology, and clinical medicine through individualized research projects that prepare them to undertake independent research. MEMP students have the opportunity to perform thesis research in laboratories at MIT, Harvard, and the Harvard affiliated teaching hospitals.

Neuroimaging and bioastronautics are areas of specialization within MEMP for which HST offers specially designed training programs. MEMP candidates may choose to apply through MIT, Harvard, or both. Those applying to MEMP through MIT should submit a single application. Those applying to MEMP through Harvard must also apply to the School of Engineering and Applied Sciences or the Biophysics Program. Additional information about applying to MEMP is available on the MEMP website (http://hst.mit.edu/academics/memp/admissions).

Speech and Hearing Bioscience and Technology

HST’s doctoral program in Speech and Hearing Bioscience and Technology (SHBT), formerly Speech and Hearing Sciences, prepares students with an undergraduate background in science or engineering to have a broad acquaintance with the field of speech and hearing, and to develop specialized knowledge that focuses on a particular approach in research. The only program of its type in the country—and the only doctoral training program funded in this area by the National Institutes of Health—SHBT is designed to develop research scientists who can apply the concepts and methods of the physical and biological sciences to basic and clinical problems in speech and hearing using innovative research. No other research training program provides the multidisciplinary depth and breadth offered by SHBT. The five-to-seven–year program leads to a PhD in speech and hearing bioscience and technology from MIT. SHBT’s more than 50 participating faculty members represent 10 academic departments from Harvard and MIT, with research facilities at MIT, Harvard University, Harvard Medical School and affiliated teaching hospitals, and the Massachusetts Eye and Ear Infirmary (MEEI). The small class size of this unique program ensures personalized and high-quality training by a diverse and dedicated faculty from the two institutions.

SHBT’s curriculum provides an effective method of training researchers by introducing the physical and biological bases of speech and hearing mechanisms involved in the communications process. While SHBT seeks to develop research scientists rather than clinical practitioners, there is a strong emphasis on providing students with exposure to clinical problems, approaches, and techniques. Graduates are thoroughly prepared for successful careers in basic and applied research in industry, universities, or government laboratories involved with biological and synthetic communication systems.

Typically, a student’s first two years in the program are devoted to coursework, which is supplemented by significant exposure to various research projects. Courses in the first year assume familiarity with calculus and differential equations, college-level physics, probability and statistics, and biology. The core curriculum covers the anatomical, acoustical, physiological, perceptual, and cognitive basics, as well as the clinical approaches to speech and hearing problems. The early introduction of important concepts in acoustics, anatomy, and physiology provides a solid base from which to pursue individual research interests. Early in the curriculum, students are introduced to various research laboratories that use different approaches to solving speech and hearing problems. This involvement in research provides an immediate application of classroom subjects. Students work with research advisors to develop a thorough understanding of basic concepts and tools in their fields of concentration. Later, students participate in subjects that require them to apply basic concepts to clinical problems and scientific research. Throughout the curriculum, special attention is devoted to developing personal integrity, scientific values, and scholarly practice. With faculty guidance, each student plans a concentration tailored to the student’s particular interest.

By the end of their second year, students identify an area of professional interest and choose a research project that forms the basis for their doctoral thesis. SHBT research in the speech
and hearing sciences focuses on the biological and physical mechanisms underlying human communication by spoken language. The processes addressed by these sciences include the physical acoustics of sound and the perceptual neurophysiological bases of hearing, as well as the linguistic, cognitive, and motor levels of processing by talkers and listeners.

The SHBT training program is offered through HST to students who enrolled in fall 2011 and earlier. The program is formally transitioning and is now administered through Harvard Medical School’s Division of Medical Sciences (DMS). Interested candidates should apply via DMS, not through HST. Please see the DMS website (http://www.hms.harvard.edu/dms/shbt) for more information.

Inquiries

Additional information on degree programs, admissions, and financial aid can be obtained from HST’s Academic Office, Room E25-518, 617-253-7470.

Emery N. Brown, MD, PhD
Edward Hood Taplin Professor of Medical Engineering
Professor of Computational Neuroscience
Member, Institute for Data, Systems, and Society
Core Faculty, Institute for Medical Engineering and Science
Warren M. Zapol Professor of Anaesthesia, MGH
Co-Director, Health Sciences and Technology Program

David E. Cohen, MD, PhD
Ebert Professor of Medicine and Health Sciences and Technology, HMS
Co-Director, Health Sciences and Technology Program

Faculty and Teaching Staff

Professors
Elfar Adalsteinsson, PhD
Professor of Electrical Engineering and Computer Science
Core Faculty, Institute for Medical Engineering and Science

Bonnie Berger, PhD
Professor of Applied Mathematics
Professor of Computer Science
Member, Health Sciences and Technology Faculty

Sangeeta N. Bhatia, MD, PhD
John and Dorothy Wilson Professor of Biochemistry
Professor of Electrical Engineering
Core Faculty, Institute for Medical Engineering and Science

Louis D. Braida, PhD
Henry Ellis Warren (1894) Professor
Professor of Electrical Engineering
Member, Health Sciences and Technology Faculty

Arup K. Chakraborty, PhD
Robert T. Haslam (1915) Professor
Director, Institute for Medical Engineering and Science
Robert T. Haslam Professor of Chemical Engineering
Professor of Biological Engineering
Professor of Chemistry
Professor of Physics

Richard J. Cohen, MD, PhD
Whitaker Professor In Biomedical Engineering
Core Faculty, Institute for Medical Engineering and Science

James J. Collins, PhD
Termeer Professor of Medical Engineering and Science
Professor of Biological Engineering
Core Faculty, Institute for Medical Engineering and Science

Elazer R. Edelman, MD, PhD
Thomas D. and Virginia W. Cabot Professor
Core Faculty, Institute for Medical Engineering and Science
Professor of Medicine, HMS

Dennis M. Freeman, PhD
Dean for Undergraduate Education
Professor of Electrical Engineering
Member, Health Sciences and Technology Faculty

John D. E. Gabrieli, PhD
Grover M. Hermann Professor
Professor of Cognitive Neuroscience
Core Faculty, Institute for Medical Engineering and Science

Lee Gehrke, PhD
Hermann L. F. von Helmholtz Professor
Core Faculty, Institute for Medical Engineering and Science

Martha L. Gray, PhD
J.W. Kieckhefer Professor
Professor of Medical and Electrical Engineering
Core Faculty, Institute for Medical Engineering and Science

David E. Housman, PhD
Virginia and Daniel K. Ludwig Professor for Cancer Research
Member, Health Sciences and Technology Faculty

Robert Langer, ScD
David H. Koch (1962) Institute Professor
Professor of Chemical Engineering
Professor of Mechanical Engineering
Professor of Biological Engineering
Member, Health Sciences and Technology Faculty
Roger Greenwood Mark, MD, PhD
Distinguished Professor in Health Sciences and Technology
Core Faculty, Institute for Medical Engineering and Science
Professor of Electrical Engineering and Computer Science

Leonid A. Mirny, PhD
Core Faculty, Institute for Medical Engineering and Science
Professor of Physics

Dava Newman, PhD
Apollo Program Professor
Professor of Aeronautics and Astronautics
Member, Institute for Data, Systems, and Society
Member, Health Sciences and Technology Faculty
(On leave)

David C. Page, MD
Professor of Biology
Member, Health Sciences and Technology Faculty

Phillip A. Sharp, PhD
Institute Professor
Professor of Biology
Member, Health Sciences and Technology Faculty

Collin M. Stultz, MD, PhD
Professor of Electrical Engineering and Computer Science
Core Faculty, Institute for Medical Engineering and Science

Peter Szolovits, PhD
Professor of Computer Science and Engineering
Member, Health Sciences and Technology Faculty

Ioannis V. Yannas, PhD
Professor of Mechanical Engineering and Polymer Science
Professor of Biological Engineering
Member, Health Sciences and Technology Faculty

Alex K. Shalek, PhD
Hermann L. F. von Helmholtz Career Development Professor
Assistant Professor of Chemistry
Core Faculty, Institute for Medical Engineering and Science

Senior Lecturers
Julie E. Greenberg, PhD
Senior Lecturer in Health Sciences and Technology

Instructors
José F. Gómez-Márquez
Instructor of Health Sciences and Technology

Visiting Lecturers
Grace Sock Leng Teo, PhD
Visiting Lecturer in Health Sciences and Technology

HST Affiliated Faculty
R. Rox Anderson, MD
Professor of Dermatology, MGH
Rebecca A. Betensky, PhD
Professor of Biostatistics, HSPH
Joseph V. Bonventre, MD, PhD
Samuel A. Levine Professor
Professor of Medicine, BWH
Brett Bouma, PhD
Professor of Dermatology, MGH
Mary L. Bouxsein, PhD
Associate Professor of Orthopedic Surgery, BIDMC
Thomas N. Byrne, MD
Professor of Neurology and Health Sciences and Technology, MGH
Alexandra V. Chabrerie, MD
Instructor in Medicine, MAH
Elliot L. Chaikof, MD, PhD
Johnson and Johnson Professor
Professor of Surgery, BIDMC
George M. Church, PhD
Robert Winthrop Professor
Professor of Genetics, HMS
Cecil H. Coggins, MD
Associate Professor of Medicine, MGH
George Daley, MD, PhD
Professor of Biological Chemistry and Molecular Pharmacology, CHB
Professor of Pediatrics, CHB
Bertrand Delgutte, PhD
Professor of Otology and Laryngology, MEEI
Jeffrey M. Drazen, MD
Parker B. Francis Distinguished Professor
Professor of Medicine, BWH
Professor in the Department of Environmental Health, HSPH
Stan N. Finkelstein, MD
Associate Professor of Medicine, BIDMC
Bruce R. Fischl, PhD
Professor of Radiology, MGH
Stuart A. Forman, MD, PhD
Associate Professor of Anaesthesia, MGH
Matthew P. Frosch, MD, PhD
Lawrence J. Henderson Associate Professor
Associate Professor of Pathology and Health Sciences and Technology, HMS
Randy L. Gollub, MD, PhD
Associate Professor of Psychiatry, MGH
John J. Guinan Jr, PhD
Professor of Otology and Laryngology, MEEI
Matti S. Hamalainen, PhD
Associate Professor of Radiology, MGH
Tayyaba Hasan, PhD
Professor of Dermatology, MGH
Miguel Hernan, MD, DrPH
Professor of Epidemiology, HSPH
Robert E. Hillman, PhD
Professor of Surgery, MGH
Paul L. Huang, MD, PhD
Professor of Medicine, MGH
Donald E. Ingber, MD, PhD
Judah Folkman Professor
Professor of Vascular Biology in the Department of Pathology, CHB
Rakesh K. Jain, PhD
A. Werk Cook Professor
Professor of Radiation Oncology (Tumor Biology), MGH
Jeffrey M. Karp, PhD
Associate Professor of Medicine and Health Sciences and Technology, BWH
Alireza Khademhosseini, PhD
Professor of Medicine, BWH
Isaac S. Kohane, MD, PhD
Lawrence J. Henderson Professor
Professor of Pediatrics, CHB
M. Charles Liberman, PhD
Professor of Otology and Laryngology, MEEI
Daniel M. Merfeld, PhD
Professor of Otology and Laryngology, MEEI
Richard N. Mitchell, MD, PhD
Lawrence J. Henderson Professor
Professor of Pathology and Health Sciences and Technology, HMS
Robert Padera, MD, PhD
Assistant Professor of Pathology, BWH
Timothy P. Padera, PhD
Assistant Professor of Radiation Oncology, MGH
Shiv S. Pillai, MD, PhD
Professor of Medicine, MGH
Bruce R. Rosen, MD, PhD
Professor of Radiology, MGH
Carl M. Rosow, MD, PhD
Professor of Anaesthesia, MGH
John J. Rosowski, PhD
Professor of Otology and Laryngology, MEEI
Frederick J. Schoen, MD, PhD
Professor of Pathology, BWH
Shiladitya Sengupta, PhD
Assistant Professor of Medicine, MGH
Jagesh V. Shah, PhD
Associate Professor of Systems Biology and Medicine, BWH
Christopher A. Shera, PhD
Professor of Otology and Laryngology, MEEI
Harvey B. Simon, MD
Associate Professor of Medicine, MGH
Priscilla J. Slanetz, MD
Associate Professor of Radiology, BIDMC
David Sosnovik, MD
Associate Professor of Medicine, MGH
Myron Spector, PhD
Professor of Orthopedic Surgery (Biomaterials), BWH/VAMC-Boston
Steven M. Stufflebeam, MD
Assistant Professor of Radiology, MGH
Guillermo J. Tearney, MD, PhD
Professor of Pathology, MGH
IMPORTANT NOTES regarding preclinical subjects (HST.011-HST.176 and HST.191):
Non-HST students are limited to one HST preclinical subject and must provide justification to the director and Associate Master of HST and Harvard in order to enroll. These subjects are scheduled according to the Harvard Medical School academic calendar, which differs from the MIT calendar. Students whose graduation depends upon completing one or more of these subjects should take particular care regarding the schedule.

HST.011 Human Functional Anatomy
Subject meets with HST.010
Prereq: Permission of instructor
G (Fall)
3-11-10 units
Lectures, detailed laboratory dissections, and prosections provide a thorough exploration of the gross structure and function of the human body. Fundamental principles of bioengineering are employed to promote analytical approaches to understanding the body's design. The embryology of major organ systems is presented, together with certain references to phylogenetic development, as a basis for comprehending anatomical complexity. Correlation clinics stress both normal and abnormal functions of the body and present evolving knowledge of genes responsible for normal and abnormal anatomy. Lecturers focus on current problems in organ system research. Only HST students may register under HST.010, graded P/D/F. Lab fee. 
L. Gehrke

HST.015 MATLAB for Medicine
Prereq: None
G (Summer)
2-0-4 units
Practical introduction to use of quantitative methods in medicine and health research. Each session covers a different topic in quantitative techniques, provides an application to medicine, and includes a modeling activity using MATLAB. Students also complete problem sets. 
M. Frosch

HST.021 Musculoskeletal Pathophysiology
Subject meets with HST.020
Prereq: Permission of Instructor
G (IAP)
3-0-3 units
Growth and development of normal bone and joints, the process of mineralization, the biophysics of bone and response to stress and fracture, calcium and phosphate homeostasis and regulation by parathyroid hormone and vitamin D, and the pathogenesis of metabolic bone diseases and disease of connective tissue, joints, and muscles, with consideration of possible mechanisms and underlying metabolic derangements. Only HST students may register under HST.020, graded P/D/F. 
M. Bouxsein, M. Seton
HST.031 Human Pathology
Subject meets with HST.030
Prereq: Biology (GIR), Physics I (GIR), permission of instructor
G (Fall)
4-3-8 units
Credit cannot also be received for HST.034, HST.035

Introduction to the functional structure of normal cells and tissues, pathologic principles of cellular adaptation and injury, inflammation, circulatory disorders, immunologic injury, infection, genetic disorders, and neoplasia in humans. Lectures, conferences emphasizing clinical correlations and contemporary experimental biology. Laboratories with examination of microscopic and gross specimens, and autopsy case studies emphasizing modern pathology practice. Only HST students may register under HST.030, graded P/D/F. Lab fee.
R. N. Mitchell, R. Padera

HST.035 Principles and Practice of Human Pathology
Subject meets with HST.034
Prereq: 7.05; or permission of instructor
G (Spring)
4-2-10 units
Credit cannot also be received for HST.030, HST.031

Provides a comprehensive overview of human pathology with emphasis on mechanisms of disease and modern diagnostic technologies. Topics include general mechanisms of disease (inflammation, infection, immune injury, transplantation, genetic disorders and neoplasia); pathology of lipids, enzymes, and molecular transporters; pathology of major organ systems; and review of diagnostic tools from surgical pathology to non-invasive techniques such as spectroscopy, imaging, and molecular markers of disease. The objectives of this subject are achieved by a set of integrated lectures and laboratories, as well as a student-driven term project leading to a formal presentation on a medical, socioeconomic, or technological issue in human pathology. Only HST students enrolled in specific degree programs may register under HST.034, graded P/D/F. Credit cannot also be received for HST.030 or HST.031.
S. Lovitch

HST.041 Mechanisms of Microbial Pathogenesis
Subject meets with HST.040
Prereq: Biology (GIR), 7.05, permission of instructor
G (Fall)
3-3-6 units

Deals with the mechanisms of pathogenesis of bacteria, viruses, and other microorganisms. Approach spans mechanisms from molecular to clinical aspects of disease. Topics selected for intrinsic interest and cover the demonstrated spectrum of pathophysiologic mechanisms. Only HST students may register under HST.040, graded P/D/F. Lab fee.
C. Crumpacker II, H. Simon

HST.061 Endocrinology
Subject meets with HST.060
Prereq: Biology (GIR), 7.05, permission of instructor
G (Spring)
3-0-6 units

Physiology and pathophysiology of the human endocrine system. Three hours of lecture and section each week concern individual parts of the endocrine system. Topics include assay techniques, physiological integration, etc. At frequent clinic sessions, patients are presented who demonstrate clinical problems considered in the didactic lectures. Only HST students may register under HST.060, graded P/D/F.
W. Kettyle, D. Breault

HST.071 Human Reproductive Biology
Subject meets with HST.070
Prereq: 7.05, permission of instructor
G (Fall; first half of term)
4-0-2 units

Lectures and clinical case discussions designed to provide the student with a clear understanding of the physiology, endocrinology, and pathology of human reproduction. Emphasis is on the role of technology in reproductive science. Suggestions for future research contributions in the field are probed. Students become involved in the wider aspects of reproduction, such as prenatal diagnosis, in vitro fertilization, abortion, menopause, contraception and ethics relation to reproductive science. Only HST students may register under HST.070, graded P/D/F.
A. Koniaris, O. Pourquie
HST.081 Hematology
Subject meets with HST.080
Prereq: 7.05, permission of instructor
G (Spring; second half of term)
2-1-3 units

Intensive survey of the biology, physiology and pathophysiology of blood with systematic consideration of hematopoiesis, white blood cells, red blood cells, platelets, coagulation, plasma proteins, and hematologic malignancies. Emphasis given equally to didactic discussion and analysis of clinical problems.
H. F. Bunn, N. Berliner

HST.091 Cardiovascular Pathophysiology
Subject meets with HST.090
Prereq: HST.030 or HST.031; permission of instructor
G (Spring)
4-3-8 units

Normal and pathologic physiology of the heart and vascular system. Emphasis includes hemodynamics, electrophysiology, gross pathology, and clinical correlates of cardiovascular function in normal and in a variety of disease states. Special attention given to congenital, rheumatic, valvular heart disease and cardiomyopathy. Only HST students may register under HST.090, graded P/D/F.
E. Edelman

HST.101 Respiratory Pathophysiology
Subject meets with HST.100
Prereq: Physics I (GIR), 7.05, permission of instructor
G (Spring)
4-0-8 units

Lectures, seminars, and laboratories cover the histology, cell biology, and physiological function of the lung with multiple examples related to common diseases of the lung. A quantitative approach to the physics of gases, respiratory mechanics, and gas exchange is provided to explain pathophysiological mechanisms. Use of medical ventilators is discussed in lecture and in laboratory experiences. For MD candidates and other students with background in science. Only HST students may register under HST.100, graded P/D/F.
J. Drazen, S. Loring

HST.111 Renal Pathophysiology
Subject meets with HST.110
Prereq: 7.05, permission of instructor
G (Spring)
4-0-8 units

Considers the normal physiology of the kidney and the pathophysiology of renal disease. Renal regulation of sodium, potassium, acid, and water balance are emphasized as are the mechanism and consequences of renal failure. Included also are the pathology and pathophysiology of clinical renal disorders such as acute and chronic glomerulonephritis, pyelonephritis, and vascular disease. New molecular insights into transporter mutations and renal disease are discussed. Only HST students may register under HST.110, graded P/D/F.
J. Seifton, A. Lam

HST.121 Gastroenterology
Subject meets with HST.120
Prereq: Biology (GIR), 7.05, Physics I (GIR), permission of instructor
G (Fall; second half of term)
3-1-2 units

Presents the anatomy, physiology, biochemistry, biophysics, and bioengineering of the gastrointestinal tract and associated pancreatic, liver, and biliary systems. Emphasis on the molecular and pathophysiological basis of disease where known. Covers gross and microscopic pathology and clinical aspects. Formal lectures given by core faculty, with some guest lectures by local experts. Selected seminars conducted by students with supervision of faculty. Only HST students may register under HST.120, graded P/D/F.
A. Rutherford, S. Flier

HST.131 Neuroscience
Subject meets with HST.130
Prereq: Permission of instructor
G (Fall)
6-3-6 units

Comprehensive study of neuroscience where students explore the brain on levels ranging from molecules and cells through neural systems, perception, memory, and behavior. Includes some aspects of clinical neuroscience, within neuropharmacology, pathophysiology, and neurology. Lectures supplemented by conferences and labs. Labs review neuroanatomy at the gross and microscopic levels. Only HST students may register under HST.130, graded P/D/F.
J. Assad, M. Frosch
HST.141 Molecular Medicine
Subject meets with HST.140
Prereq: 7.05
G (Fall)
2-0-4 units

Conducted as a seminar to study a variety of human diseases and the underlying molecular, genetic, and biochemical basis for the pathogenesis and pathophysiology of the disorders. Lectures by faculty and seminars conducted by students, with tutorials and supervision by faculty. Patients presented when feasible. Appropriate for students who have had a course in biochemistry and/or molecular biology.


HST.151 Principles of Pharmacology
Subject meets with HST.150
Prereq: Biology (GIR), 7.05, Physics I (GIR)
G (IAP, Spring; partial term)
6-0-6 units

An introduction to pharmacology. Topics include mechanisms of drug action, dose-response relations, pharmacokinetics, drug delivery systems, drug metabolism, toxicity of pharmacological agents, drug interactions, and substance abuse. Selected agents and classes of agents examined in detail. Course follows HMS calendar.

C. Rosow

HST.161 Biochemistry and Molecular Genetics in Modern Medicine
Subject meets with HST.160
Prereq: 7.05
G (Fall)
6-0-6 units

Foundation for understanding the relationship between biochemistry, molecular biology, genetics, and medicine. Intensive treatment of human biochemistry and physiological chemistry that focuses on intermediary metabolism and structures of key intermediates and enzymes important in human disease. Principles of human genetics reviewed. Translation of clinical understanding into analysis at the level of the gene, chromosome, and molecule; the concepts and techniques of molecular biology and genomics; and the strategies and methods of genetic analysis. The clinical relevance of these areas is underscored with patient presentations.


HST.165 Diagnostic Methods of Medicine
Subject meets with HST.164
Prereq: Permission of instructor
G (IAP)
2-0-6 units

Introduces modern diagnostic methods in medicine using imaging and molecular techniques. Discusses principles of major diagnostic modalities, including magnetic resonance, ultrasound, computed tomography, and high-throughput nucleic acid sequencing, as well as relevant computational and quantitative techniques. Laboratories provide experience with imaging technologies and bioinformatics tools. Case conferences emphasize clinical correlations and integration of information from multiple diagnostic modalities. Harvard subject HT.005 required; HST.015 and HST.191 recommended. Only HST students may register under HST.164, P/D/F.

G. Gerber, S. Huang, L. Li, D. Sosnovik

HST.176 Cellular and Molecular Immunology
Subject meets with HST.175
Prereq: 7.05
G (Fall)
5-0-7 units

Covers cells and tissues of the immune system, lymphocyte development, the structure and function of antigen receptors, the cell biology of antigen processing and presentation including molecular structure and assembly of MHC molecules, lymphocyte activation, the biology of cytokines, leukocyte-endothelial interactions, and the pathogenesis of immunologically mediated diseases. Consists of lectures and tutorials in which clinical cases are discussed with faculty tutors. Details of each case covering a number of immunological issues in the context of disease are posted on a student website. Only HST students may register under HST.175, graded P/D/F.

S. Pillai, B. Cherayil

HST.191 Introduction to Biostatistics
Subject meets with HST.190
Prereq: Calculus II (GIR)
G (Summer)
3-0-3 units

Provides training on how to comprehend, critique and communicate findings from biomedical literature. Considers how to assess the importance of chance in the interpretation of experimental data. Topics include probability theory, chi-squared and t-tests, ANOVA, linear and logistic regression, survival analysis, and statistical analysis using MATLAB. Includes critical reading of studies published in medical literature. Only HST students may register under HST.190, graded P/D/F.

R. Betensky
HST.192 Medical Decision Analysis and Probabilistic Medical Inference
Prereq: Permission of instructor
G (IAP)
2-0-2 units
Teaches the essentials of quantitative diagnostic reasoning and medical decision analysis. Guides participants through the process of choosing an appropriate contemporary medical problem in which risk-benefit tradeoffs play a prominent role, conducting a decision analysis, and ultimately publishing the results in a medical journal. Topics include decision trees, influence diagrams, Markov decision models and Monte Carlo simulation, methods for quantifying patient values, Bayesian inference, decision thresholds, and the cognitive science of medical decision making. HST.191 recommended.
M. B. Westover, M. Bianchi

HST.196 Teaching Health Sciences and Technology
Prereq: None
G (Fall, IAP, Spring, Summer)
Units arranged [P/D/F]
Can be repeated for credit.
For teaching assistants in HST where the teaching assignment is approved for academic credit by the department.
Staff

HST.198 Independent Study in Health Sciences and Technology
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Units arranged
Can be repeated for credit.
Opportunity for independent study of health sciences and technology under regular supervision by an HST faculty member. Projects require prior approval, as well as a substantive paper. Minimum 12 units required.
Consult HST Faculty

HST.199 Research in Health Sciences and Technology
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Units arranged [P/D/F]
Can be repeated for credit.
For research assistants in HST where the assigned research is approved for academic credit by the department. Hours are arranged with research supervisor.
S. S. Pillai, R. L. Maas, S. P. Balk, M. L. Bulyk, A. Rosenzweig

HST.200 Introduction to Clinical Medicine
Prereq: Permission of instructor
G (IAP, Spring; partial term)
9-19-12 units
Intensive preparation for clinical clerkships that introduces the basic skills involved in examination of the patient in addition to history taking and the patient interview. Provides exposure to clinical problems in medicine, surgery, and pediatrics. Students report their findings through history taking and oral presentations.
W. Goessling

HST.201 Introduction to Clinical Medicine and Medical Engineering I
Prereq: Permission of instructor
G (Summer)
0-20-0 units
Develop skills in patient interviewing and physical examination; become proficient at organizing and communicating clinical information in both written and oral forms; begin integrating history, physical, and laboratory data with pathophysiologic principles; and become familiar with the clinical decision-making process and broad economic, ethical, and sociological issues involved in patient care. There are two sections: one at Mount Auburn Hospital during IAP, and one at West Roxbury VA Hospital beginning in summer.
R. G. Mark, A. Chabrerie, J. Strymish

HST.202 Introduction to Clinical Medicine and Medical Engineering II
Prereq: HST.201
G (Fall, IAP, Spring, Summer)
0-20-0 units
Strengthens the skills developed in HST.201 through a six-week clerkship in medicine at a Harvard-affiliated teaching hospital. Students serve as full-time members of a ward team and participate in longitudinal patient care. In addition, students participate in regularly scheduled teaching conferences focused on principles of patient management.
R. G. Mark, A. Chabrerie, J. Strymish
HST.203 Clinical Experience in Medical Engineering and Medical Physics
Prereq: HST.201, HST.202
G (Fall, IAP, Spring, Summer)
0-12-0 units
An individually arranged full-time one-month directed study in a clinical environment where active medical engineering/medical physics investigation is in progress. Students engage in patient care, particularly those aspects that interface closely with technology. Students also focus on in-depth exploration of the technical and research area. A project proposal is required at time of registration. Term paper required.
HST Faculty

HST.211 Biomedical Inventions: Clinical Introduction
Prereq: Permission of instructor
G (IAP)
3-0-3 units
Provides students with an understanding of modern biomedicine. Explores the clinical areas where medical practice and biomedical enterprise intersect. Hear and interact with academic physicians engaged in care and treatment of patients, in the wards, ICUs, ORs and outpatient areas, and develop the knowledge base needed to obtain elective clinical experiences. Learn to interact with patients and clinicians. Focus is on the various needs of medical specialties, both device, IT and pharma to better treat common medical diseases.
W. Zapol, R. Anderson

HST.212 Biomedical Inventions: Clinical Experience and Selected Success Analysis
Prereq: HST.211
G (Spring)
3-0-3 units
Provides students with a survey of key biomedical research needs by lecture-discussions and facilitating interaction with academic-clinicians and scientists active in medical care/research. Both drug and technology development in the various medical and surgical specialties are examined. Students develop the knowledge base needed to obtain elective clinical experiences. Unsolved clinical problems are sought by each student in a biomedical area of their interest and presented to the class. Interactions with academic physicians who have successfully developed technologies and drugs that are approved by the FDA and in widespread clinical use. How, where, when and why biomedical enterprise and medical practice can successfully intersect is explored. Students can interact with academic physicians engaged in the development of novel technology and drugs, analyze successes and autopsy failed biomedical enterprises.
W. Zapol, R. Anderson

HST.220 Introduction to the Care of Patients
Prereq: Permission of instructor
G (IAP, Spring)
1-0-2 units
Elective subject for HST/MD candidates only. Provides an introduction to the care of patients through opportunities to observe and participate in doctor-patient interaction in an outpatient, office-based environment, and through patient-oriented seminars. Students are exposed to some of the practical realities of providing patient care. Topics include basic interviewing, issues of ethics and confidentiality, and other aspects of the doctor-patient relationship. Requirements include regular attendance, and a short paper on patient care.
H. Heller, MIT Medical Department Staff

HST.240 Translational Medicine Preceptorship
Prereq: HST.035
G (Fall, Spring)
0-12-0 units
Individually designed preceptorship joins together scientific research and clinical medicine. Students devote approximately half of their time to clinical experiences, and the remaining part to scholarly work in basic or clinical science. The two might run concomitantly or in series. Follow a clinical preceptor’s daily activity, including aspects of patient care, attending rounds, conferences, and seminars. Research involves formal investigation of a focused and directed issue related to selected clinical area. Final paper required.
E. Edelman

HST.299 Research in Health Sciences and Technology
Prereq: Permission of instructor
G (Fall, Spring, Summer)
Units arranged [P/D/F]
For research assistants in HST where the assigned research is approved for academic credit by the department. Hours are arranged with research supervisor.
HST Staff
HST.410[J] Projects in Microscale Engineering for the Life Sciences
Same subject as 6.07[J]
Prereq: None
U (Spring)
Not offered regularly; consult department
2-4-3 units
A project-based introduction to manipulating and characterizing cells and biological molecules using microfabricated tools. In the first half of the term, students perform laboratory exercises designed to introduce the design, manufacture, and use of microfluidic channels; techniques for sorting and manipulating cells and biomolecules; and making quantitative measurements using optical detection and fluorescent labeling. In the second half of the term, students work in small groups to design and test a microfluidic device to solve a real-world problem of their choosing. Includes exercises in written and oral communication and team building.
D. Freeman, M. Gray

HST.420[J] Principles and Practice of Assistive Technology
Same subject as 6.811[J]
Prereq: Permission of instructor
U (Fall)
2-4-6 units
See description under subject 6.811[J].
R. C. Miller, J. E. Greenberg, J. J. Leonard

HST.426 Maker Lab: Creating Technologies to Re-invent Health Care
Prereq: None
U (Spring)
1-2-9 units
Students work in teams to design do-it-yourself medical technologies, creative biosensors, and health construction kits to create accessible, patient-centered solutions. Covers affordable prototyping and design strategies for application in the American healthcare system and in low-resource settings. Explores the diverse possibilities that result from patient-designed solutions. Labs address paper diagnostics, microcontroller applications, wearable sensors, mobile health application design, and health kit architectures.
L. Gehrke, J. Gomez-Marquez, G. Teo, A. Young

HST.431[J] Infections and Inequalities: Interdisciplinary Perspectives on Global Health
Same subject as 7.331[J], 21A.331[J]
Prereq: None
U (Spring)
3-0-9 units. HASS-S
See description under subject 21A.331[J].
E. James, D. Kim, A. Chakraborty

HST.450[J] Biological Physics
Same subject as 8.593[J]
Prereq: 8.044 recommended but not necessary
Acad Year 2016-2017: G (Spring)
Acad Year 2017-2018: Not offered
4-0-8 units
See description under subject 8.593[J].
G. Benedek

HST.452[J] Statistical Physics in Biology
Same subject as 8.592[J]
Prereq: 8.333 or permission of instructor
Acad Year 2016-2017: G (Spring)
Acad Year 2017-2018: Not offered
3-0-9 units
M. Kardar

HST.460[J] Statistics for Neuroscience Research
Same subject as 9.073[J]
Prereq: Permission of instructor
Acad Year 2016-2017: G (Spring)
Acad Year 2017-2018: Not offered
3-0-9 units
See description under subject 9.073[J].
E. N. Brown
HST.500 Frontiers in (Bio)Medical Engineering and Physics
Prereq: None
G (Spring)
3-0-9 units
Provides a framework for mapping research topics at the intersection of medicine and engineering/physics in the Harvard-MIT community and covers the different research areas in MEMP (for example, regenerative biomedical technologies, biomedical imaging and biooptics). Lectures provide fundamental concepts and consider what's hot, and why, in each area. Training in scientific proposal writing (thesis proposals, fellowship applications, or research grant applications) through writing workshops. Topics include how to structure a novel research project, how to position research within the scientific community, how to present preliminary data effectively, and how to give and respond to peer reviews.
S. Bhatia, C. Stultz, S. Jhaveri

HST.506[J] Computational Systems Biology
Same subject as 6.874[J]
Subject meets with 6.802[J], 7.36[J], 7.91[J], 20.390[J], 20.490[J]
Prereq: Biology (GIR); 18.600 or 6.041
G (Spring)
3-0-9 units
See description under subject 6.874[J].
D. K. Gifford

HST.507[J] Advanced Computational Biology: Genomes, Networks, Evolution
Same subject as 6.878[J]
Subject meets with 6.047
Prereq: 6.006, 6.041, Biology (GIR); or permission of instructor
G (Fall)
4-0-8 units
See description under subject 6.878[J].
M. Kellis

HST.508 Quantitative Genomics
Prereq: Permission of instructor
G (Fall)
3-0-9 units
Provides in-depth quantitative understanding of evolutionary and population genetics, comparative and clinical genomics. Each module consists of a series of lectures, a journal club discussion of high impact publications, and lectures that provide clinical correlates. Homework assignments and final projects aim to develop understanding of genomic data from evolutionary principles.
L. Mirny, G. Kryukov, S. Sunyaev

HST.514[J] Sensory-Neural Systems: Spatial Orientation from End Organs to Behavior and Adaptation
Same subject as 16.430[J]
Prereq: Permission of instructor
G (Spring)
3-0-9 units
Introduces sensory systems, and multi-sensory fusion using the vestibular and spatial orientation systems as a model. Topics range from end organ dynamics to neural responses, to sensory integration, to behavior, and adaptation, with particular application to balance, posture and locomotion under normal gravity and space conditions. Depending upon the background and interests of the students, advanced term project topics might include motion sickness, astronaut adaptation, artificial gravity, lunar surface locomotion, vestibulo-cardiovascular responses, vestibular neural prostheses, or other topics of interest. Background in neuroscience or systems engineering preferred.
D. Merfeld, F. Karmali

HST.515[J] Aerospace Biomedical and Life Support Engineering
Same subject as 16.423[J], ESD.65[J]
Prereq: 16.400, 16.06, or permission of instructor
Acad Year 2016-2017: G (Spring)
Acad Year 2017-2018: Not offered
3-1-8 units
See description under subject 16.423[J].
D. J. Newman

HST.516 Circadian Biology: From Cellular Oscillations to Sleep Regulation
Prereq: Biological sciences
G (Fall)
4-0-8 units
Properties, mechanisms, and functional roles of circadian rhythms in organisms ranging from unicells to mammals. Cellular and molecular components, regulation of gene expression and physiological functions, genetic and biochemical analyses of circadian rhythms, and neurobiology of the mammalian circadian pacemaker. Mathematics and modeling of oscillatory systems and applications to circadian rhythms. Experimental studies of human rhythms, including the sleep-wake cycle and hormone rhythms, with applications to sleep disorders. Follows Harvard FAS calendar.
C. A. Czeisler
HST.518[J] Human Systems Engineering
Same subject as 16.453[J], ESD.773[J]
Subject meets with 16.400
Prereq: 6.041, 16.09, or permission of instructor
G (Fall)
3-1-8 units
See description under subject 16.453[J].
L. A. Stirling

HST.522[J] Biomaterials: Tissue Interactions
Same subject as 2.79[J], 3.96[J], 20.441[J]
Prereq: Chemistry (GIR), Biology (GIR), Physics I (GIR); or permission of instructor
G (Fall)
3-0-9 units
See description under subject 20.441[J].
I. V. Yannas, M. Spector

HST.523[J] Cell-Matrix Mechanics
Same subject as 2.785[J], 3.97[J], 20.411[J]
Prereq: 2.001, or 2.01 and 2.02A; Chemistry (GIR), Biology (GIR); or permission of instructor
G (Fall)
3-0-9 units
See description under subject 2.785[J].
I. V. Yannas, M. Spector

HST.524[J] Design of Medical Devices and Implants
Same subject as 2.782[J], 3.961[J], 20.451[J]
Prereq: Chemistry (GIR), Biology (GIR), Physics I (GIR); or permission of instructor
G (Spring)
3-0-9 units
See description under subject 2.782[J].
I. V. Yannas, M. Spector

Same subject as 10.548[J]
Prereq: 18.03; 10.301
Acad Year 2016-2017: Not offered
Acad Year 2017-2018: G (Fall)
2-0-4 units
Tumor pathophysiology plays a central role in the growth, invasion, metastasis and treatment of solid tumors. Principles of transport phenomena are applied to develop a systems level, quantitative understanding of angiogenesis, blood flow and microcirculation, metabolism and microenvironment, transport and binding of small and large molecules, movement of cancer and immune cells, metastatic process, and treatment response.
R. K. Jain

HST.526[J] Future Medicine: Drug Delivery, Therapeutics, and Diagnostics
Same subject as 10.643[J]
Subject meets with 10.443
Prereq: 5.12 or permission of instructor
G (Spring)
3-0-6 units
See description under subject 10.643[J].
D. G. Anderson

HST.531 Medical Physics of Proton Radiation Therapy
Prereq: None
Acad Year 2016-2017: Not offered
Acad Year 2017-2018: G (Spring)
2-0-4 units
Acceleration of protons for radiation therapy; introduction into advanced techniques such as laser acceleration and dielectric wall acceleration. Topics include the interactions of protons with the patient, Monte Carlo simulation, and dose calculation methods; biological aspects of proton therapy, relative biological effectiveness (RBE), and the role of contaminating neutrons; treatment planning and treatment optimization methods, and intensity-modulated proton therapy (IMPT); the effect of organ motion and its compensation by use of image-guided treatment techniques; general dosimetry and advanced in-vivo dosimetry methods, including PET/CT and prompt gamma measurements. Outlook into therapy with heavier ions. Includes practical demonstrations at the Proton Therapy Center of the Massachusetts General Hospital.
J. Unkelback, J. Schuermann
HST.533 Optimization Problems in Radiation Therapy and Medical Imaging
Prereq: 18.06
Acad Year 2016-2017: G (Spring)
Acad Year 2017-2018: Not offered
2-0-4 units
Discusses mathematical problems that arise in radiation therapy planning, from imaging to treatment. Provides an introduction to treatment plan optimization, image reconstruction, and selected topics in image processing. Goes on to lead students towards cutting edge research topics in the field.
J. Unkelbach, G. Sharp, Y. Wang, T. Bortfeld

HST.535 Principles and Practice of Tissue Engineering
Prereq: None
G (Spring)
2-0-6 units
Leaders in the field present the principles and practice of tissue engineering (and regenerative medicine). Topics include the principles underlying strategies for employing select exogenous cells, biomaterial scaffolds, soluble regulators or their genes, and mechanical loading for the regeneration of tissues and organs in vitro and in vivo. Differentiated cell types and stem cells are compared and contrasted for this application, as are natural and synthetic scaffolds. Covers the rationale for employing selected growth factors and examines the methods for incorporating their genes into the scaffolds. Discusses the influence of environmental factors, including mechanical loading and culture conditions. Presents methods for fabricating tissue-engineered products and devices for implantation. Addresses the federal regulatory status of tissue-engineered products, as well as strategies for introducing such products into the clinic. Examples of procedures currently employed clinically are analyzed as case studies. All sessions are webcast to the world and archived for open access review at any time.
M. Spector

HST.537[J] Fluid Dynamics and Disease
Same subject as 1.631[J]
Prereq: None
G (Spring)
3-0-9 units
See description under subject 1.631[J].
L. Bourouiba

HST.539[J] Frontiers of Interdisciplinary Science in Human Health and Disease
Same subject as 5.64[J]
Prereq: 5.13, 5.60; 5.07[J] or 7.05
G (Spring)
3-0-9 units
See description under subject 5.64[J].
A. Shalek

HST.540[J] Human Physiology
Same subject as 7.20[J]
Prereq: 7.05
U (Fall)
5-0-7 units
See description under subject 7.20[J].
M. Krieger, D. Sabatini

HST.541[J] Cellular Biophysics
Same subject as 2.794[J], 6.521[J], 20.470[J]
Subject meets with 2.792[J], 6.021[J], 20.370[J]
Prereq: Physics II (GIR); 18.03; 2.005, 6.002, 6.003, 6.071[J], 10.301, 20.110[J], or permission of instructor
G (Fall)
5-2-5 units
Meets with undergraduate subject 6.021[J]. Requires the completion of more advanced home problems and/or an additional project.
J. Han, T. Heldt, J. Voldman

HST.542[J] Quantitative Systems Physiology
Same subject as 2.792[J], 6.022[J], 20.371[J]
Subject meets with 2.796[J], 6.522[J], 20.471[J]
Prereq: Physics II (GIR), 18.03, or permission of instructor
U (Spring)
4-2-6 units
See description under subject 6.022[J].
T. Heldt, R. G. Mark, C. M. Stultz
HST.545 Physiological Systems Analysis
Prereq: 18.03, 18.06
U (Fall)
3-3-6 units
K. Parker

HST.560[J] Radiation Biophysics
Same subject as 22.55[J]
Subject meets with 22.055
Prereq: Permission of instructor
Acad Year 2016-2017: Not offered
Acad Year 2017-2018: G (Spring)
3-0-9 units
See description under subject 22.55[J].
Staff

HST.561[J] Noninvasive Imaging in Biology and Medicine
Same subject as 9.173[J], 20.483[J], 22.56[J]
Prereq: 18.03, 8.03, or permission of instructor
Acad Year 2016-2017: Not offered
Acad Year 2017-2018: G (Spring)
3-0-9 units
See description under subject 22.56[J].
A. Jasanoff

HST.562[J] Imaging and Sample Processing in Biology and Medicine
Same subject as 10.562[J]
Prereq: Biology (GIR), 5.12; or permission of instructor
G (Spring)
3-1-8 units
Discusses basic principles and concepts of bioimaging and sample processing. Topics include optical imaging modalities; optical/physical/chemical properties of a broad range of biological samples, including clinical tissues and sample handling/processing technologies; underlying engineering principles; and basic image analysis. Provides experience with optical microscopy and tissue processing technique (CLARITY).
K. Chung

HST.563 Imaging Biophysics and Clinical Applications
Prereq: 18.03, 8.03; or permission of instructor
Acad Year 2016-2017: G (Spring)
Acad Year 2017-2018: Not offered
2-1-9 units
Introduction to the connections and distinctions among various imaging modalities (x-ray, optical, ultrasound, MRI, PET, SPECT, EEG), common goals of biomedical imaging, broadly defined target of biomedical imaging, and the current practical and economic landscape of biomedical imaging research. Emphasis on applications of imaging research. Final project consists of student groups writing mock grant applications for biomedical imaging research project, modeled after an exploratory National Institutes of Health (NIH) grant application.
C. Catana, A. Kumar

HST.565 Medical Imaging Sciences and Applications
Prereq: None
G (Fall)
3-0-9 units
Covers the biophysical, mathematical and instrumentation basics of positron emission tomography (PET), x-ray and computed tomography (CT), magnetic resonance imaging (MRI), and single photon emission tomography (SPECT). Topics include particles and photon interactions, nuclear counting statistics, gamma cameras, and computed tomography as it pertains to SPECT and PET (including PET-CT, PET-MR, and time-of-flight PET). Discusses the clinical applications of PET in molecular imaging of the brain, the heart, and cancer. Includes a practical demonstration of SPECT and PET-CT imaging at the Massachusetts General Hospital. Considers the ways in which these imaging techniques are rooted in physics, engineering, and mathematics as well as their respective role in anatomic and physiologic/molecular imaging.
G. El Fakhri, M. Normandin

HST.576[J] Topics in Neural Signal Processing
Same subject as 9.272[J]
Prereq: Permission of instructor
G (Spring)
3-0-9 units
See description under subject 9.272[J].
E. N. Brown
HST.580[J] Data Acquisition and Image Reconstruction in MRI
Same subject as 6.556[J]
Prereq: 6.011
G (Fall)
3-0-9 units
See description under subject 6.556[J].
E. Adalsteinsson

HST.582[J] Biomedical Signal and Image Processing
Same subject as 6.555[J], 16.456[J]
Prereq: 6.003, 2.004, 16.004, or 18.085
G (Spring)
3-4-5 units
Fundamentals of digital signal processing with particular emphasis on problems in biomedical research and clinical medicine. Basic principles and algorithms for data acquisition, imaging, filtering, and feature extraction. Laboratory projects provide practical experience in processing physiological data, with examples from cardiology, speech processing, and medical imaging.
J. Greenberg, E. Adalsteinsson, W. Wells

HST.583[J] Functional Magnetic Resonance Imaging: Data Acquisition and Analysis
Same subject as 9.583[J]
Prereq: 18.05; 18.06 or permission of instructor
Acad Year 2016-2017: Not offered
Acad Year 2017-2018: G (Fall)
2-3-7 units
Provides background necessary for designing, conducting, and interpreting fMRI studies in the human brain. Covers in depth the physics of image encoding, mechanisms of anatomical and functional contrasts, the physiological basis of fMRI signals, cerebral hemodynamics, and neurovascular coupling. Also covers design methods for stimulus-, task-driven and resting-state experiments, as well as workflows for model-based and data-driven analysis methods for data. Instruction in brain structure analysis and surface- and region-based analyses. Laboratory sessions include data acquisition sessions at the 3 Tesla MRI scanner at MIT and the Connectom and 7 Tesla scanners at the MGH/HST Martinos Center, as well as hands-on data analysis workshops. Introductory or college-level neurobiology, physics, and signal processing are helpful.
S. Whitfield-Gabrieli, J. Polimeni, A. Yendiki

HST.584[J] Magnetic Resonance Analytic, Biochemical, and Imaging Techniques
Same subject as 22.561[J]
Prereq: Permission of instructor
Acad Year 2016-2017: Not offered
Acad Year 2017-2018: G (Spring)
3-0-12 units
Introduction to basic NMR theory. Examples of biochemical data obtained using NMR summarized along with other related experiments. Detailed study of NMR imaging techniques includes discussions of basic cross-sectional image reconstruction, image contrast, flow and real-time imaging, and hardware design considerations. Exposure to laboratory NMR spectroscopic and imaging equipment included.
L. Wald, K. Setsompop

HST.590 Biomedical Engineering Seminar Series
Prereq: None
G (Fall, IAP, Spring)
1-0-0 units
Can be repeated for credit.
Seminars focused on the development of professional skills. Each term focuses on a different topic, resulting in a repeating cycle that covers medical ethics, responsible conduct of research, written and oral technical communication, and translational issues. Includes guest lectures, case studies, interactive small group discussions, and role-playing simulations.
HST Faculty

HST.598 Research in Health Sciences and Technology
Prereq: None
U (Fall, IAP, Spring, Summer)
Units arranged
Can be repeated for credit.
For undergraduates desiring to carry on substantial projects of their own choosing in biomedical sciences or engineering. Work may be of experimental, theoretical, or design nature. A project proposal is required at time of registration.
Consult HST Faculty

HST.599 Research in Health Sciences and Technology
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Units arranged [P/D/F]
Can be repeated for credit.
For students conducting research in HST, in cases where the assigned research is approved for academic credit by the department. Hours arranged with research supervisor.
Consult HST Faculty
HST.710[J] Speech Communication
Same subject as 6.541[J], 24.968[J]
Prereq: Permission of instructor
G (Spring)
3-1-8 units
See description under subject 6.541[J].
L. D. Braida, S. S. Ghosh, R. E. Hillman, S. Shattuck-Hufnagel

HST.712[J] Laboratory on the Physiology, Acoustics, and Perception of Speech
Same subject as 6.542[J], 24.966[J]
Prereq: Permission of instructor
G (Fall)
2-2-8 units
See description under subject 6.542[J].
L. D. Braida, S. Shattuck-Hufnagel

HST.714[J] Acoustics of Speech and Hearing
Same subject as 6.551[J]
Prereq: 8.03, 6.003; or permission of instructor
G (Fall)
4-1-7 units
See description under subject 6.551[J].

HST.716[J] Signal Processing by the Auditory System: Perception
Same subject as 6.552[J]
Prereq: 6.003; 6.041 or 6.431; or permission of instructor
Acad Year 2016-2017: G (Fall)
Acad Year 2017-2018: Not offered
3-0-9 units
See description under subject 6.552[J].
L. D. Braida

HST.718 Anatomy of Speech and Hearing
Prereq: Biology (GIR), permission of instructor
G (IAP)
2-2-2 units
Studies the anatomy of the human head and neck, focusing on structures involved in speech and hearing. Covers general organization of the nervous system and control of the peripheral structures. Involves dissection of a human cadaver, examination of brain specimens, and analysis of cross-sectional radiographic images.
B. C. Fullerton

HST.720 Physiology of the Ear
Prereq: Permission of instructor
Acad Year 2016-2017: Not offered
Acad Year 2017-2018: G (Fall)
4-0-8 units
Physical and physiological mechanisms underlying the transduction and analysis of acoustic signals in the auditory periphery. Topics include the acoustics, mechanics, and hydrodynamics of sound transmission; the biophysical basis for cochlear amplification; the production of otoacoustic emissions; the physiology of hair-cell transduction and synaptic transmission; efferent feedback control; the analysis and coding of simple and complex sounds by the inner ear; and the physiological bases for hearing disorders. Based primarily on reading and discussions of original research literature.
J. J. Guinan, J. J. Rosowski, C. A. Shera

HST.721 The Biology of the Inner Ear
Prereq: Permission of instructor
G (Fall)
3-1-8 units
Reviews the normal biology, biophysics, physiology and morphology of the inner ear and auditory nerve, as well as the mechanisms underlying sensorineural hearing loss.
M. C. Liberman, S. F. Maison

HST.723[J] Neural Coding and Perception of Sound
Same subject as 9.285[J]
Prereq: Permission of instructor
G (Spring)
3-1-8 units
Neural structures and mechanisms mediating the detection, localization, and recognition of sounds. Discussion of how acoustic signals are coded by auditory neurons, the impact of these codes on behavioral performance, and the circuitry and cellular mechanisms underlying signal transformations. Topics include temporal coding, neural maps and feature detectors, learning and plasticity, and feedback control. General principles are conveyed by theme discussions of auditory masking, sound localization, musical pitch, cochlear implants, and auditory scene analysis. Follows Harvard FAS calendar.
HARVARD-MIT HEALTH SCIENCES AND TECHNOLOGY PROGRAM

HST.724 Clinical Aspects of Speech and Hearing
Prereq: HST.718 or permission of instructor
G (Spring)
5-5-2 units
Clinical approach to speech and hearing disorders as practiced by physicians, audiologists, speech clinicians, rehabilitation specialists, pathologists, and bioengineers. Includes observation of patient care in the clinic and operating room; laboratory experience in audiology, voice and speech evaluation, evaluation of balance disorders; lectures and discussion groups. Prior completion of HST.714[J] and HST.721 is recommended.
K. Stankovic

HST.725 Music Perception and Cognition
Prereq: HST.723[J] or permission of instructor
G (Spring)
Not offered regularly; consult department
4-0-8 units
Survey of perceptual and cognitive aspects of the psychology of music, with special emphasis on underlying neurocomputational representations and mechanisms. Systematically explores basic dimensions of hearing (pitch, timbre, consonance, loudness) and the time sense (duration, temporal pattern) that form our perception of tonal quality, melody, harmony, meter, and rhythm in music. Examines mechanisms responsible for separation of multiple voices/instruments (polyphony), and for melodic and rhythmic grouping of events (musical phrase structure). Special topics include comparative, evolutionary, and developmental psychology of music; biological vs. cultural influences; Gestaltist, associationist, and schema-based theories; music vs. speech perception; music vs. language cognition; music and cortical function, music therapy, and neural basis of music performance.
P. Cariani

HST.728[J] Automatic Speech Recognition
Same subject as 6.345[J]
Prereq: 6.003, 6.041, or permission of instructor
G (Spring)
3-1-8 units
See description under subject 6.345[J].
V. W. Zue, J. R. Glass

HST.730 Molecular Biology of the Auditory System
Prereq: Biology (GIR)
G (Fall)
3-0-9 units
Focuses on molecular approaches to cochlear development and function, based on readings and discussion of research literature. Lectures by course director and local experts in the field. Includes discussion of gene expression, cell fate determination, deafness mutations, stem cells and regeneration of the cochlea.
A. Edge

HST.750 Modeling Issues in Hearing and Speech
Prereq: HST.714[J], HST.721
G (Spring)
Not offered regularly; consult department
3-0-9 units
Explores the theory and practice of scientific modeling in the context of auditory and speech biophysics. Based on seminar-style discussions of the research literature, subject draws on examples from hearing and speech (cochlear and vocal-fold mechanics) and explores general, meta-theoretical issues that transcend the particular subject matter. Examples include: What is a model? What is the process of model building? What are the different approaches to modeling? What is the relationship between theory and experiment? How are models tested? What constitutes a good model?
C. A. Shera, J. R. Melcher

HST.780 Independent Study in Speech and Hearing Sciences
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Units arranged
Can be repeated for credit.
Opportunity for independent study of speech and hearing sciences under regular supervision by an SHBT faculty member. Projects require prior approval, as well as a substantive paper. Minimum 12 units required.
Consult L. D. Braida
HST.905 Introduction to Health Care Management
Prereq: None
G (Spring)
2.0-4 units
Introduction to the academic disciplines of business management with illustration from examples in various medical care settings. Topics include economics of health care; evolving role of physicians and other medical professionals; ethics of business decisions in a clinical context; underlying concepts in financial, marketing, and operations management in health institutions; and the management of risk in health-related enterprise. Presentations by carefully selected multidisciplinary faculty group from the Harvard and MIT communities. Student projects address current issues occasioned by the rapidly changing health care environment. Meets at Harvard Medical School.
S. Finkelstein, P. L. Slavin

HST.914[J] Frontiers in Therapeutics and Drug Delivery
Same subject as 10.644[J]
Prereq: 7.05 or permission of instructor
G (Fall)
Not offered regularly; consult department
3.0-6 units
See description under subject 10.644[J].
D. G. Anderson

HST.916[J] Case Studies and Strategies in Drug Discovery and Development
Same subject as 7.549[J], 15.137[J], 20.486[J]
Prereq: None
G (Spring)
2.0-4 units
See description under subject 20.486[J].
S. R. Tannenbaum, A. J. Sinskey, A. W. Wood

HST.918[J] Economics of the Health Care Industries
Same subject as 15.141[J]
Prereq: Permission of instructor
G (Spring)
3.0-6 units
See description under subject 15.141[J].
E. R. Berndt, J. J. Doyle

HST.920[J] Principles and Practice of Drug Development
Same subject as 7.547[J], 10.547[J], 15.136[J], ESD.691[J]
Prereq: Permission of instructor
G (Fall)
3.0-6 units
See description under subject 15.136[J].
T. J. Allen, C. L. Cooney, S. N. Finkelstein, A. J. Sinskey, G. K. Raju

HST.922 Enabling Technology Innovation in Healthcare and the Life Sciences
Subject meets with HST.921
Prereq: None
G (Spring)
2.0-7 units
Innovative, trans-faculty subject teaches how information technologies are reshaping and redefining the health care marketplace through improved economies of scale, greater technical efficiencies in the delivery of care to patients, advanced tools for patient education and self-care, network integrated decision support tools for clinicians, and the emergence of e-commerce in health care. Students ordinarily also register for HST.923 or HST.924, the lab component of this subject. Undergraduates require permission of instructor. Only HST students may register under HST.921, graded P/D/F.
M. Bagur

HST.924 Enabling Technology Innovation in Healthcare and the Life Sciences
Subject meets with HST.923
Prereq: None
G (Spring)
0.3-0 units
Student tutorial provides an opportunity for interactive discussion covering emerging information technologies (IT) used in healthcare. Practicum: HMS and MIT graduate students in medicine, business, law, education, engineering, computer science, public health, and government collaborate in interdisciplinary teams to design an innovative IT application. Student projects presented during the final class. Students ordinarily also register for HST.921 or HST.922, the lecture component of the subject. Undergraduates require permission of instructor. Only HST students may register under HST.923, graded P/D/F.
M. Bagur
HST.926[J] Seminar on Health Care Systems Innovation
Same subject as ESD.69[J]
Prereq: Permission of instructor
G (Fall)
2-0-7 units
See description under subject ESD.69[J].
S. Finkelstein, J. Moses, J. Coughlin

HST.928[J] Engineering Health: Understanding and Designing Affordable Health Diagnostics
Same subject as MAS.534[J]
Prereq: None
G (Fall)
3-1-8 units
See description under subject MAS.534[J].
R. Raskar

HST.929[J] Engineering Health: Designing and Deploying Affordable Health Diagnostics and Therapeutics
Same subject as MAS.535[J]
Prereq: None
G (Spring)
6-0-0 units
See description under subject MAS.535[J].
R. Raskar

HST.934[J] Introduction to Global Medicine: Bioscience, Technologies, Disparities, Strategies
Same subject as STS.449[J]
Prereq: None
G (Spring)
2-0-1 units
Exploration of basic themes in social medicine via a specific examination of issues in global medicine. The course takes as its challenge to understand new paradigms for global health that focus on providing complex medical services to treat complicated health conditions (e.g. multi-drug resistant TB, HIV/AIDS, and mental health problems) in low resource settings. Special attention given to the development of new technologies or adapting existing technologies in ways that enable new solutions to global health problems, as well as overcoming barriers to translation of medical technologies for use in settings of great need. Addresses classic themes of social inequalities and health disparities, and issues such as patenting and the development and delivery of pharmaceuticals or other biotechnologies in international context. Presentations by Harvard faculty involved in global health, basic or clinical research with a global reach, or medical humanitarian activities, in addition to class discussion.
M. Fischer, E. James, M. J. Good

HST.936 Global Health Informatics to Improve Quality of Care
Subject meets with HST.937, HST.938
Prereq: None
G (Spring)
2-0-1 units
Addresses issues related to how health information systems can improve the quality of care in resource poor settings. Discusses key challenges and real problems; design paradigms and approaches; and system evaluation and the challenges of measuring impact. Weekly lectures led by internationally recognized experts in the field. Students taking HST.936, HST.937 and HST.938 attend common lectures; assignments and laboratory time differ. HST.936 has no laboratory.
L. G. Celi, H. S. Fraser, V. Nikore, K. Paik, M. Somai

HST.937 Global Health Informatics to Improve Quality of Care
Subject meets with HST.936, HST.938
Prereq: None
G (Spring)
2-2-2 units
Addresses issues related to how health information systems can improve the quality of care in resource poor settings. Discusses key challenges and real problems; design paradigms and approaches; and system evaluation and the challenges of measuring impact. Weekly lectures led by internationally recognized experts in the field. Students taking HST.936, HST.937 and HST.938 attend common lectures; assignments and laboratory time differ. HST.936 has no laboratory.
L. G. Celi, H. S. Fraser, V. Nikore, K. Paik, M. Somai

HST.938 Global Health Informatics to Improve Quality of Care
Subject meets with HST.936, HST.937
Prereq: None
G (Spring)
2-2-8 units
Addresses issues related to how health information systems can improve the quality of care in resource poor settings. Discusses key challenges and real problems; design paradigms and approaches; and system evaluation and the challenges of measuring impact. Weekly lectures led by internationally recognized experts in the field. Students taking HST.936, HST.937 and HST.938 attend common lectures; assignments and laboratory time differ. HST.936 has no laboratory.
L. G. Celi, H. S. Fraser, V. Nikore, K. Paik, M. Somai
HST.940[J] Bioinformatics: Principles, Methods and Applications
Same subject as 10.555[J]
Prereq: Permission of instructor
G (Spring)
3-0-9 units
See description under subject 10.555[J].
Gr. Stephanopoulos, I. Rigoutsos

HST.950[J] Biomedical Computing
Same subject as 6.872[J]
Prereq: 6.034
G (Fall)
3-0-9 units
See description under subject 6.872[J].
G. Alterovitz, P. Szolovits

HST.971[J] Strategic Decision Making in the Life Sciences
Same subject as 15.363[J]
Prereq: None
G (Spring)
3-0-6 units
See description under subject 15.363[J].
J. Fleming, A. Zarur

HST.972[J] Medicine for Managers and Entrepreneurs Proseminar
Same subject as 15.132[J]
Prereq: None
G (Spring)
3-0-6 units
See description under subject 15.132[J].
R. J. Cohen

HST.973[J] Evaluating a Biomedical Business Concept
Same subject as 15.124[J]
Prereq: None
G (Fall)
3-0-6 units
Involves critical analysis of new biomedical business ideas. Inventors or principals of early stage companies present their ideas and provide background material including scientific papers and patents. Student teams interact with the companies, potential customers, other stakeholders and experts to develop a series of analyses concerning the critical issues. Company and student presentations supplemented by topic-specific lectures and presentations by biomedical entrepreneurs.
R. J. Cohen

HST.977[J] Critical Reading and Technical Assessment of Biomedical Information
Same subject as 15.122[J]
Prereq: SB degree in Biological Science or permission of instructor
G (Spring; first half of term)
1-0-2 units
Gain experience in critical reading of scientific literature, including patents, journal articles and FDA labels, with an emphasis on analyzing clinical controversies and emerging technologies in subject areas that have been or could become sources of entrepreneurial activity. Students required to analyze a variety of topics in the scientific literature, including screening for and cost-effectiveness of early detection of cancer, therapeutic opportunities in oncology, evaluation of immunotoxins and antibody therapies, and new prospects for the treatment of autoimmune disorders. To support the discussion of these topics, outside experts may be invited to participate as facilitators.
S. Lapidus, J. Karp

HST.978[J] Healthcare Ventures
Same subject as 15.367[J]
Prereq: 15.910; 15.390 or 10.391[J] or 10.579[J]
G (Fall)
3-0-9 units
Focuses on entrepreneurship, with emphasis on startups bridging digital health and high-tech. Explores US and global macro trends and case studies. Features lectures by leading healthcare entrepreneurs and venture investors, and provides practical experience in networking through team projects. Evaluation based on team participation and assignments, including two team presentations. Video conference facilities provided to facilitate remote participation by Executive MBA and traveling students. Enrollment by application only.
M. Gray, Z. Chu

HST.THG Graduate Thesis
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Units arranged
Can be repeated for credit.
Program of research leading to the writing of a PhD or ScD thesis or an HST SM thesis; to be arranged by the student and an appropriate MIT faculty advisor.
HST Faculty
HST.UR Undergraduate Research in Health Sciences and Technology
Prereq: None
U (Fall, IAP, Spring, Summer)
Units arranged [P/D/F]
Can be repeated for credit.

HST.URG Undergraduate Research in Health Sciences and Technology
Prereq: None
U (Fall, IAP, Spring, Summer)
Units arranged
Can be repeated for credit.

Extended participation in the work of a faculty member or research group. Research is arranged by mutual agreement between the student and a member of the faculty of the Harvard-MIT Division of Health Sciences and Technology, and may continue over several terms. Registration requires submission of a written proposal, signed by the faculty supervisor. A summary report must be submitted at the end of each term.

J. Greenberg

HST.S14-HST.S15 Special Subject: Health Sciences and Technology
Prereq: None
G (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged
Can be repeated for credit.

HST.S16-HST.S17 Special Subject: Health Sciences and Technology
Prereq: None
G (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged
Can be repeated for credit.

HST.S18-HST.S19 Special Subject: Health Sciences and Technology
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged
Can be repeated for credit.

Opportunity for group study of advanced subjects related to health sciences and technology not otherwise included in the curriculum. Offerings are initiated by HST faculty on an ad hoc basis subject to program approval. Prerequisites may vary by topic; consult faculty at time of offering.

HST Faculty

HST.S46-HST.S47 Special Subject: Health Sciences and Technology
Prereq: None
U (IAP)
Units arranged [P/D/F]
Can be repeated for credit.

HST.S48-HST.S49 Special Subject: Health Sciences and Technology
Prereq: None
U (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged
Can be repeated for credit.

Group study of subjects related to health sciences and technology not otherwise included in the curriculum. Prerequisites may vary by topic; consult faculty at time of offering.

HST Faculty

HST.S52 Special Subject: Medical Engineering and Medical Physics
Prereq: Permission of instructor
G (Fall)
Units arranged
Can be repeated for credit.

Opportunity for group study of advanced subjects related to the Medical Engineering and Medical Physics Program not otherwise included in the curriculum. Offerings are initiated by MEMP faculty on an ad hoc basis subject to program approval. Prerequisites may vary by topic; consult faculty at time of offering.

HST Faculty

HST.S53 Special Subject: Medical Engineering and Medical Physics
Prereq: None
G (Fall, IAP, Spring)
Not offered regularly; consult department
Units arranged
Can be repeated for credit.

Opportunity for group study of advanced subjects related to the Medical Engineering and Medical Physics Program not otherwise included in the curriculum. Offerings are initiated by MEMP faculty on an ad hoc basis subject to program approval. Prerequisites may vary by topic; consult faculty at time of offering.

HST Faculty
HST.S54 Special Subject: Medical Engineering and Medical Physics
Prereq: None
G (Fall, IAP, Spring)
Not offered regularly; consult department
Units arranged [P/D/F]
Can be repeated for credit.

Opportunity for group study of advanced subjects related to the Medical Engineering and Medical Physics Program not otherwise included in the curriculum. Offerings are initiated by MEMP faculty on an ad hoc basis subject to program approval. Prerequisites may vary by topic; consult faculty at time of offering.

HST Faculty

HST.S55 Special Subject: Medical Engineering and Medical Physics
Prereq: None
G (Fall, IAP, Spring)
Not offered regularly; consult department
Units arranged [P/D/F]
Can be repeated for credit.

Opportunity for group study of advanced subjects related to the Medical Engineering and Medical Physics Program not otherwise included in the curriculum. Offerings are initiated by MEMP faculty on an ad hoc basis subject to program approval. Prerequisites may vary by topic; consult faculty at time of offering.

HST Faculty

HST.S56-HST.S57 Special Subject: Medical Engineering and Medical Physics
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged [P/D/F]
Can be repeated for credit.

Opportunity for group study of advanced subjects related to the Medical Engineering and Medical Physics Program not otherwise included in the curriculum. Offerings are initiated by MEMP faculty on an ad hoc basis subject to program approval. Prerequisites may vary by topic; consult faculty at time of offering.

HST Faculty

HST.S58-HST.S59 Special Subject: Medical Engineering and Medical Physics
Prereq: Permission of instructor
G (Spring)
Units arranged
Can be repeated for credit.

Opportunity for group study of advanced subjects related to the Medical Engineering and Medical Physics Program not otherwise included in the curriculum. Offerings are initiated by MEMP faculty on an ad hoc basis subject to program approval. Prerequisites may vary by topic; consult faculty at time of offering.

HST Faculty

HST.S76-HST.S77 Special Subject: Speech and Hearing Sciences
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Units arranged [P/D/F]
Can be repeated for credit.

Opportunity for group study of advanced subjects related to the Speech and Hearing Sciences not otherwise included in the curriculum. Offerings initiated by members of the SHBT faculty on an ad hoc basis subject to program approval. Prerequisites may vary by topic; consult faculty at time of offering.

SHBT Faculty

HST.S78-HST.S79 Special Subject: Speech and Hearing Sciences
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged
Can be repeated for credit.

Opportunity for group study of advanced subjects related to the Speech and Hearing Sciences not otherwise included in the curriculum. Offerings initiated by members of the SHBT faculty on an ad hoc basis subject to program approval. Prerequisites may vary by topic; consult faculty at time of offering.

SHBT Faculty

HST.S96-HST.S97 Special Subject: Biomedical Enterprise
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged [P/D/F]
Can be repeated for credit.

Opportunity for group study of advanced subjects relating to biomedical enterprise not otherwise included in the curriculum. Offerings are initiated by HST faculty on an ad hoc basis subject to program approval. Prerequisites may vary by topic. Consult faculty at time of offering.

HST Faculty

HST.S98-HST.S99 Special Subject: Biomedical Enterprise
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged
Can be repeated for credit.

Opportunity for group study of advanced subjects relating to biomedical enterprise not otherwise included in the curriculum. Offerings are initiated by HST faculty on an ad hoc basis subject to program approval. Prerequisites may vary by topic. Consult faculty at time of offering.

HST Faculty